Monday, 8:00am - 9:30am

■ MA01

Hilton- Golden Gate 6

Advances in Military Healthcare Operations Research

Sponsor: Military Applications Society

Sponsored Session

Chair: Nathaniel Bastian, PhD Student & NSF Graduate Research Fellow, Pennsylvania State University, 355 Leonhard Building, University Park, 16802, United States of America, ndbastian@psu.edu

1 - Optimizing U.S. Army Medical Department Workforce Planning Decisions using Goal Programming

Nathaniel Bastian, PhD Student & NSF Graduate Research Fellow, Pennsylvania State University, 355 Leonhard Building, University Park, 16802, United States of America, ndbastian@psu.edu, Lawrence Fulton, Pat McMurry, Paul Griffin

The U.S. Army Medical Department manages its officers over 30 years, so determining the appropriate number of hires and promotions for each medical specialty is complex. We proffer mixed-integer linear weighted goal programming models to optimize workforce planning, using simulation to verify and validate the results. Our models allow for better transparency of personnel for senior decision-makers and human resource planners, while effectively projecting the required manpower structure.

2 - Fuzzy Resource Allocation in Health Systems

Tahir Ekin, Assistant Professor, Texas State University, 601 University Dr. McCoy 411, San Marcos, TX, 78666, United States of America, tahirekin@gmail.com, Paul Griffin, Ozan Kocadagli, Nathaniel Bastian, Lawrence Fulton

The efficient use of system resources in health systems is crucial due to increasing demand despite increasing costs. Large health systems generally have fixed inputs to be allocated to branches that have particular target output levels. We propose a fuzzy resource allocation optimization model and illustrate it using real-world data from an U.S. Army hospital network. We discuss the implications of using a fuzzy decision making model that can deal with various risk preferences.

3 - Dispatching and Locating Military Aeromedical Evacuation Assets with Security Escort Assets

Benjamin Grannan, Virginia Commonwealth University, 1015 Floyd Ave, Richmond, VA, 23225, United States of America, grannanbc@mymail.vcu.edu, Laura McLay

In military medical systems, some aeromedical evacuation assets are weaponized and capable of flying solo. Other evacuation assets must fly in tandem with a security escort asset. Unavailable assets translate into delay of medical treatment for casualties. This paper introduces a MIP model that examines the locating and dispatching decisions for two types of aeromedical evacuation assets and security escort assets. The objective is to minimize the service time of the most urgent casualties

4 - The Future of Small Navy Ship Sickbays and Army Aeromedical Evacuation Aircraft

Nolan Roggenkamp, Captain / Student, U.S. Army, 11005 Moran Road, Monterey, CA, 93940, United States of America, ndroggen@nps.edu, Temi Ayeni

The purpose of this study is to explore the current configuration of Sickbays on small Navy surface combatant ships and the Army's Aeromedical Evacuation Aircraft. We will conduct a current capability based analysis that qualitatively identifies the employment of medical technology, equipment, and consumables on these two respective platforms. The results will be used as a baseline to determine the most effective means of utilizing advanced medical technologies in the future.

■ MA02

Hilton- Golden Gate 7

Growth Oriented Innovation in Entrepreneurial and Ecosystem Settings

Sponsor: Technology, Innovation Management and Entrepreneurship

Sponsored Session

Chair: Sinan Erzurumlu, Associate Professor, Babson College, 231 Forest St, Babson Park, MA, 02457, United States of America, serzurumlu@babson.edu

1 - Governance Structure and Growth of High-Technology Startup

Jizhen Li, Associate Professor, Tsinghua University, School of Economics and Management, Room 541, Weilun Building, Beijing, 100084, China, lijizhen@gmail.com, Yueheng Wang, Can Huang

The governance structure of high-technology startups would influence their early-stage growth. In particular, whether the owner of technology is a majority shareholder or holds a high-level management position may affect the firm's performance. Our research finds that the high-technology startups with technologist-dominant governance structure grow slower than the capitalist-dominant ventures.

2 - Relationships under Stress: The Effects of Business Cycles on Industry-university Systems

Julio Pertuze, Assistant Professor, Pontificia Universidad Catolica de Chile, Av. Vicuña Mackenna 4860, Macul, Santiago, RM, 7660259, Chile, jpertuze@ing.puc.cl

While universities have been portrayed as "engines of growth," little attention has been given to their role in periods of economic downturn. This paper analyzes the coevolution of industry-university relationships in the forest products sector. We found that universities act as "knowledge buffers" for cyclical industries, helping firms to regain lost capabilities and allowing corporate technologies time to mature despite changes in firm strategy. Policy and managerial implications are discussed

3 - The Role of Network Structure in Entrepreneurial Action

Sunny S. Yang, Senior Lecturer, University of Essex, Essex Business School, Essex, United Kingdom, sunnyy@essex.ac.uk, Emma Y. Liu, Yanto Chandra

We study the spread of entrepreneurial actions in a dynamic, networked system where each individual embedded decides to act entrepreneurially in each period. We develop a graph-theoretic model and simulate it to characterize system behaviors by investigating the combined impact of network structures and other contextual factors including external shock. Our analysis suggests that the change in network structures significantly impacts the number of individuals taking entrepreneurial actions.

4 - Innovation and Risk in Product Development: Empirical Testing of 3D Printers on KickStarter.com

Chao-Yang Song, Post-Doctoral Research Fellow, Singapore University of Technology and Design, 20 Dover Dr, Singapore, 138682, Singapore, chaoyang_song@sutd.edu.sg, Kevin Otto, Jianxi Luo, Katja Holtta-Otto

A new method is explored to explain market adoption of new products from innovation and risk perspectives. Based on the Real-Win-Worth framework, 26 questionnaires are developed to assess the all 3D printer projects to date from KickStarter.com. Key innovation or risk indicators and their correlations that explain crowd-funding success are identified via a PLS regression analysis. The results provide implications to crowd-funding strategy and risk management of early-stage innovation projects.

5 - Product Innovation and Platform Strategy: Technological Evolution in the Smartphone Industry

Hyunwoo Park, Georgia Institute of Technology, 85 5th St NW, Atlanta, GA, 30308, United States of America, hwpark@gatech.edu, Rahul Basole

Our study is based on the technological evolution of smartphones including physical characteristics, performance characteristics, and features over the past decade. Our longitudinal analysis of a dataset consisting of 1,169 smartphones by 79 device manufacturers and 12 different platforms highlights the significant transformational changes that have occurred. We propose an index to measure innovativeness of a smartphone upon which we test hypotheses on product family and platform strategy.

■ MA03

Hilton- Golden Gate 7

Social Networks, Personal Information, and Open Innovation

Sponsor: eBusiness

Sponsored Session

Chair: Idris Adjerid, University of Notre Dame, 358 Mendoza College of Business, Notre Dame, United States of America, iadjerid@nd.edu

1 - LIKE Economy: An Empirical Estimation

Rajiv Garg, McCombs School of Business, University of Texas, Austin, TX, United States of America, RajivGarg@mccombs.utexas.edu

Monetization of social interactions and influence is one of the key challenges facing researchers and practitioners alike. Users are often given incentives to "like" products and vendors on social media sites under the assumption that likes are valuable, the crux of the matter lies in the question: How much is a "like" worth to a seller? We address this question by empirically estimating the economic value of Facebook LIKE.

2 - Visceral Targeting - using Personal Information for ÚHidden Persuasion

Sonam Samat, Carnegie Mellon University, 5530 Howe Street, Apt 2, Pittsburgh, PA, 15232, United States of America, sonamsamat@gmail.com, Alessandro Acquisti, Eyal Pe'er, Ralph Gross

Online behavioral advertising has helped marketers target products to individuals based on their personal information. Marketers are constantly looking for ways to collect more information about customers. We investigate whether morphing individuals' facial images, which are collected from their social network profiles, making them unrecognizable yet subconsciously familiar, and using the resulting face composite to solicit personal information, can influence disclosure behavior.

3 - Baring Out with Iron Hands: Can Disclosing Make Us Harsher?

Laura Brandimarte, Carnegie Mellon University, Hamburg Hall 2107E, 4800 Forbes Avenue, Pittsburgh, United States of America, lbrandim@andrew.cmu.edu, Alessandro Acquisti, Francesca Gino

Two studies investigate how the act of disclosing sensitive information affects individuals' judgments of others who made similar disclosures. Study 1 uses information from social networks and finds that participants who shared online information about their questionable behaviors judged others who did the same more harshly, as compared to participants who did not share such information. Study 2 uses an online experiment to test for the causal role of disclosure, and confirms the result.

4 - Innovative or Practical? An Empirical Study of Idea Selection in an Open Innovation Funnel

Ajit Sharma, Ross School of Business, 701 Tappan Street, Ann Arbor, United States of America, asharmaz@umich.edu, Yan Huang

The digitization of innovation is increasingly manifest in a wide variety of open innovation archetypes. Arguably, the critical skill in open innovation is selection rather than generation of ideas. We empirically investigate idea-screening choices at the stage gates of an open innovation funnel for a large private bank. We find support for a desire to be radical in the early stage gates which is superseded by concerns of feasibility and execution in later stages closer to implementation.

■ MA04

Hilton- Continental 1

Empirical Research in Operations / Supply Chain

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Anupam Agrawal, UIUC, 363 Wohlers Hall, Champaign, Il, 61821-6255, United States of America, anupam@illinois.edu

1 - Organization Structure, Sourcing Quality, and Spillover

Anupam Agrawal, UIUC, 363 Wohlers Hall, Champaign, Il, 61821-6255, United States of America, anupam@illinois.edu

We detail a very interesting real life experiment, wherein a firm had two different organization structures in its two plants, and these different structures enabled differential improvement in the quality of sourced components. We also study spillover between these two plants.

2 - Differential Risks of Innovation Failures: New Products vs. New Versions of Existing Products

Kingshuk Sinha, Professor, Mosaic Company Professor of Corporate Responsibility, Carlson School of Management, University of Minnesota, Minneapolis, MN, United States of America, ksinha@umn.edu, Ujjal Mukherjee

We investigate the underpinnings of two types of failures of technological innovation-in-use: (i) new products and (ii) new versions of existing products. The empirical context of the study is medical device recalls. We analyze two types of recalls: PMA and 510K. The results suggest differential risk of failure for a medical device firm across the two types of recalls. Implications of the study results are discussed.

3 - Competencies for Contingent Talent Supply Chain Intermediaries

Sriram Narayanan, Associate Professor, Michigan State University, N357 College of Business Building, 632 Bouge Street, East Lansing, Mi, 48824, United States of America, narayanan@broad.msu.edu, Hakan Yildiz, David Closs

Contingent talent supply chain management (CT-SCM) is a proactive approach to effectively meeting changing workforce needs of companies. Our research focuses on identifying key competencies of a managed service provider in orchestrating a CT-SCM. We use case based approach and substantiate our analysis with archival data where applicable.

4 - Firm and Regulator Timeliness in the Medical Device Product Recall Process

Rachna Shah, Associate Professor, UMN, United States of America, shahx024@umn.edu, George Ball

We investigate the attributes of medical device recalls that impact firm and regulator recall timeliness. Utilizing a unique dataset containing multiple time-stamps for ten years of medical device recalls, we find that more serious recalls lead to slower response times from both firms and regulators. Contrary to our expectations, we then discover that taking more time to open and close a recall may create more opportunities for learning and prevent future quality problems which lead to recalls.

■ MA05

Hilton- Continental 2

Session

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Alp Muharremoglu, Associate Professor, University of Texas at Dallas, Richardson, TX, United States of America, alp@utdallas.edu

1 - Optimality of (s,S) Policies in EOQ Models with General Cost Structures

Sandun Perera, PhD Candidate, Naveen Jindal School of Management, The University of Texas at Dallas, 800 West Campbell Rd., Richardson, TX, 75080, United States of America, sandun.perera@utdallas.edu, Ganesh Janakiraman, Shun-Chen Niu

The EOQ model is at the heart of supply chain optimization. We prove the existence of an optimal policy of the (s,S) type in the EOQ model under minimal assumptions on the ordering/procurement and holding/backorder costs. This result holds whenever an optimal solution exists for the problem of minimizing the long-run average cost within the class of (s,S) policies. Our proof is constructive and elementary, i.e., it is based on first principles that do not rely on advanced mathematical machinery.

2 - Optimal Storage Profile in a Semi-automated Order Fulfillment System

Rong Yuan, PhD Candidate, MIT, 235 Albany St, Cambridge, MA, 02139, United States of America, rongyuan@mit.edu, Stephen Graves

In this paper we examine the operation of a semi-automated fulfillment center, in which the storage pods do the traveling rather than the operators. The primary decision we consider is on what pod to store each unit of inventory. The objective is to minimize the expected number of pods required to satisfy a set of randomly-generated orders. We model this problem as a mixed-integer problem with non-linear objective function.

3 - Generalized Price-Only Contracts

Lifei Sheng, University of British Columbia, 2053 Main Mall, Vancouver, BC, Canada, Fay.Sheng@sauder.ubc.ca, Mahesh Nagarajan, Tim Huh

We consider a two-stage decentralized supply chain using a generalized price-only contract, wherein a supplier sequentially and dynamically offers a retailer n different wholesale prices. We show structural properties of how the profits of the supplier and the retailer change as n becomes large. Our analysis has some important implications for the role of strategic inventory and Coase's conjecture.

■ MA06

Hilton- Continental 3

Information in Supply-Chains

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Noam Shamir, Tel Aviv University, Tel Aviv, Israel, nshamir@post.tau.ac.il

1 - Information Sharing in a Supply Chain with a Trade Association under a Wholesale Price Contract

Hyoduk Shin, University of California-San Diego, 9500 Gilman Drive, La Jolla, CA, United States of America, hshin@rady.ucsd.edu, Noam Shamir

Studying the incentives of a group of retailers, organized as a trade association, to exchange forecast information, we compare between two industry policies: exclusionary and non-exclusionary information sharing. Although non-exclusionary policy has been advocated to promote information sharing, we show the opposite can happen and explain the reason.

2 - Cartel Formation through Strategic Information Leakage in a Distribution Channel
Noam Shamir, Tel Aviv University, Tel Aviv, Israel, nshamir@post.tau.ac.il

A group of retailers attempt to establish a cartel. In order to reduce the risk of the cartel's exposure, the retailers coordinate their strategies by sharing information with their manufacturer. Although the manufacturer is not part of the cartel, he is willing to assist the retailers in such a scheme.

3 - Bargaining in Supply Chains with a Single Pivotal Agent
Dror Hermel, Ariel University, Ariel University, Ariel, Israel, drorhe@ariel.ac.il, Daniel Granot, Mahesh Nagarajan

We study a setting where a single pivotal player negotiates with several non-pivotal players. We provide a bargaining framework to derive allocations of profit, using Nash bargaining principles. We identify inherent outside options, and use these to generate an endogenous disagreement outcome. When the non-pivotal players are not allowed to communicate, our solution coincides with the Nash-Nash solution, and it coincides with the Shapley value, when the non-pivotal players can communicate.

4 - The Third Party Logistics Coordinator Mechanism for Transshipments in Decentralized Systems
Yale T. Herer, Technion - Israel Institute of Technology, Faculty of Industrial Engineering, Haifa, 32000, Israel, yale@technion.ac.il, Avinoam Tzimerman

We investigate a multi-retailer single period stochastic lotsizing problem. In our decentralized system the retailers are independent, doing what is in their own best interest. We add transshipments to this constellation by introducing a third party whom we call 3PLC, which stands for Third Party Logistics Coordinator. We develop a coordination mechanism involving 3PLC with without the retailers disclosing their private information (costs and demand parameters) to the other retailers.

■ MA07

Hilton- Continental 4

From OR to OM: Observations on the Emergence of a Discipline

Cluster: Tutorials

Invited Session

Chair: John Buzacott, York University, Schulich School of Business, Toronto, ON, Canada, jbuzacott@schulich.yorku.ca

1 - From OR to OM: Observations on the Emergence of a Discipline
John Buzacott, York University, Schulich School of Business, Toronto, ON, Canada, jbuzacott@schulich.yorku.ca

This tutorial is based on the author's experience 50 years ago in applying OR in industry. It describes some of the problems and issues encountered, almost all of which were then new. There were no textbooks about how to use OR to understand production and inventory control. However, as awareness of the problems increased, approaches were developed using OR that industry found helpful. Eventually consultants, software developers and academics working with managers created a body of knowledge which was the basis of a new discipline, Operations Management.

■ MA08

Hilton- Continental 5

Applications of Little's Law

Cluster: Applications of Little's Law

Invited Session

Chair: John Little, MIT Sloan School, E62-534, 100 Main St., Cambridge, MA, 02142, United States of America, jlittle@mit.edu

1 - Generalized Little's Law-Asset Picking System to Model an Investment Portfolio: a Working Prototype
ML Ceprini, MIT Sloan School, E62-534; 100 Main St, Cambridge, MA, 02142, mceprini@mit.edu, John Little

Decision rules create an Asset Picking System (APS) structure that, combined with Little's Law (LL), Generalized Little's Law (GLL) and its corollaries, generates the GLL-APS model, a financial engineering tool bridging operations research and finance. The model selects type and number of shares for each investment. Changes can be accepted/rejected by the customer. GLL-APS customizes portfolios for clients. Now it is a working prototype, later, an assessed and calibrated model.

2 - Formula for Profit Increase Based on Little's Law
Michael George, 3605 Beverly Drive, Dallas, TX, 75205, mike@entropy2718.com, Dinesh Rajan

We derive a formula that will allow an executive to predict the profit increase created by an investment in Operations Management methods such as Lean and Six Sigma. The decomposition of Little's Law results in the Entropy and waste in a manufacturing process, which is then minimized. The accuracy of the resulting Formula for Profit Increase is confirmed by case studies. Shannon's Information Theory thus becomes a new approach to optimization in OM applications.

3 - Use of Little's Law For the Diagnosis and Realization of Hidden Profits and Undiscovered Risks
John F. Carrier, MIT, 247 Gray Street, Arlington, MA, 02476, United States of America, jfcarrie@mit.edu

We demonstrate how Little's Law may be used to detect and quantify the "hidden factories" within any system. We show its application to a large logistics project (deepwater O&G), and how it "cut through the Big Data problem" to find $20M/yr in savings. We also show how a mid-sized US manufacturer used its principles to survive the economic downturn of 2008-9, and how a start-up company used it to develop a system to serve its key customers while remaining loyal to its sustainability goals.

4 - Analysis of Biological Aging
John Little, MIT Sloan School, E62-534, 100 Main St., Cambridge, MA, 02142, United States of America, jlittle@mit.edu

Mitnitski, Song and Rockwood (2013) in an article on biological aging apply Little's Law in the following form: (the average number of biological deficits present in an individual) equals (the rate of environmental stresses) times (the average recovery time). Average deficits accumulate with age and average environmental stresses stay relatively constant. So Little's Law tells us that average recovery time increases with age. The usefulness of this simple formula is demonstrated with data.

■ MA09

Hilton- Continental 6

Healthcare Operations

Sponsor: Manufacturing & Service Operations Management/Healthcare Operations

Sponsored Session

Chair: Robert Batt, Asst. Professor, UW-Madison, 975 University Ave., Madison, WI, 53706, United States of America, rbatt@bus.wisc.edu

1 - Planning Regional Hospital Bed Capacity to Ensure Appropriate Access to Inpatient Care
Thomas Best, Doctoral Candidate, The University of Chicago Booth School of Business, 5807 S Woodlawn Ave, Chicago, IL, 60637, United States of America, tbest@chicagobooth.edu, Burhaneddin Sandikci, Donald Eisenstein, Varun Gupta

We consider a public board that oversees hospital bed capacities across a geographic region. The board aims to avoid excess bed capacities and also to reduce delays of inpatient admissions. To achieve its mission, the board sets bed capacity targets and evaluates proposed capacity changes against these targets. We develop a model to predict the delays from proposed bed capacities. We apply our model to regional inpatient data, and discuss its predictions and their implications for the board.

2 - using Matching to Examine Early Warning Systems for ICU Admissions
Wenqi Hu, Columbia University Business School, 3022 Broadway, Uris 4V, New York, NY, 10027, United States of America, whu17@gsb.columbia.edu, Jose Zubizarreta, Carri Chan

Unplanned transfers of patients from the ward to the Intensive Care Unit (ICU) occur due to rapid deterioration and can increase patients' mortality. This work is an empirical study of the potential benefits of preventive ICU admission based on a new warning system. In estimating the effect of endogenous admission decisions, we use a near-far matching method to improve the strength of the instrumental variable and find that preventative admission can potentially improve patient outcomes.

3 - SURGE: Smoothing Usage of Resources is Good for Emergencies
Alex Mills, Indiana University, Operations & Decision Technologies Dept, Kelley School of Business, Bloomington, IN, 47405, United States of America, millsaf@indiana.edu, Jonathan Helm, Yu Wang

Following a mass-casualty incident (MCI), a hospital faces a surge in demand. We study management tools to create surge capacity to meet this demand. We show that a hospital's best strategy to improve its surge response is not through immediate actions after the MCI, but through proactive long-term demand planning. In particular, discharging patients early sacrifices long-term recovery for short-term responsiveness, while workload smoothing improves the response in both short and long-term.

4 - The Disposition Decision: Handoffs and End-of-Shift Effects in an Emergency Department

Robert Batt, Asst. Professor, UW-Madison, 975 University Ave., Madison, WI, 53706, United States of America, rbatt@bus.wisc.edu, Diwas KC, Brian Patterson, Bradley Staats

We examine what factors impact the probability of a patient being handed-off to a new doctor at the end of a shift versus being dispositioned by the current doctor. We also look at the effect of hand-offs on operational variables such as length of stay and revisit rate.

■ MA10

Hilton- Continental 7

Stochastic Models for Service Operations

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Vasiliki Kostami, London Business School, Regent's Park, London, NW1 4SA, United Kingdom, vkostami@london.edu

1 - Design and Operations of Service Systems with Unknown Customer Types

Mihalis Markakis, Assistant Professor, Universitat Pompeu Fabra, Ramon Trias Fargas, 25-27, Barcelona, Spain, mihalis.markakis@upf.edu, Kostas Bimpikis

Motivated by call centers and healthcare facilities, we consider a queueing system with two customer types and two server pools, where only a probabilistic prior for the types of customers is known upon their arrival. For given staffing levels we determine the stability region of the system and propose a simple threshold scheduling policy that is maximally stable, evaluating its delay performance through simulations. Finally, we look into the problem of optimally staffing the system.

2 - Prioritization of Customers with Hidden Types in a Service System

Zhankun Sun, Statistics and Operations Research UNC at Chapel Hill Hanes Hall, CB, szk@unc.edu, Nilay Argon, Serhan Ziya

We consider a service system with a single server and two types of customers. Each customer incurs a linear holding cost that depends on its type. The server can choose to investigate and classify a customer, serve one of the already classified customers, or serve one of the unclassified customers without investigation. We provide a characterization for the server's optimal actions.

3 - Competition and the Operational Performance of Hospitals: The Role of the Hospitals' Objective

Dimitrios Andritsos, HEC Paris, 1 Rue de la Liberation, Jouy-en-Josas, France, andritsos@hec.fr, Sam Aflaki

We examine the effect of a hospital's objective (i.e., non profit vs. for profit) in hospital markets for elective care. Using queueing models and game-theoretic analysis we compare the equilibrium behavior of three market structures: i) no competition ii) competition between non-profit hospitals and iii) competition between non-profit and for-profit hospitals.

4 - Managing the Customer Mix and Crowding via Pricing and Capacity Allocation

Vasiliki Kostami, London Business School, Regent's Park, London, NW1 4SA, United Kingdom, vkostami@london.edu, Dimitris Kostamis, Serhan Ziya

We study the pricing and capacity allocation problem of a service provider who serves two distinct customer classes with utilities that depend on how many customers are in the system as well as who these customers are. We study the system when the provider can price discriminate and when she is restricted by a single price. We extend our analysis to the case where class interaction is prevented by allocating capacity segments to the two customer classes.

■ MA11

Hilton- Continental 8

Pricing and Contracts in Supply Chains

Sponsor: Manufacturing & Service Operations Management/Supply Chain

Sponsored Session

Chair: Fernando Bernstein, Professor, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, fernando.bernstein@duke.edu

1 - Sell Directly or Indirectly? Channel Structure and Dynamic Pricing with Strategic Customers

Sean Zhou, The Chinese University of Hong Kong, Shatin, N.T., Hong Kong, Hong Kong - PRC, zhoux@baf.cuhk.edu.hk, Jiye Xue, Qianbo Yin

We consider a dual-channel supply chain where a manufacturer sells a seasonal product to strategic consumers through both an independent retailer and its direct channel over a finite selling season. During each period, the manufacturer and the retailer sequentially set the wholesale and retail prices. We derive the unique sub-game perfect Nash equilibrium of this dynamic game and study how channel structure affects dynamic pricing strategies.

2 - Optimal Long-Term Supply Contracts with Asymmetric Demand Information

Ilan Lobel, Assistant Professor, NYU Stern School of Business, 44 W 4th St, New York, NY, 10012-1126, United States of America, ilobel@stern.nyu.edu, Wenqiang Xiao

We study the design of optimal dynamic long-term supply contracts between a manufacturer and a retailer. We show the simple structure of optimal long-term contracts both for the case of backlogging and the case of lost sales.

3 - Chasing Demand: Learning and Earning in a Changing Environment

Bora Keskin, The University of Chicago Booth School of Business, 5807 S. Woodlawn Avenue, Chicago, IL, 60637, United States of America, bora.keskin@chicagobooth.edu, Assaf Zeevi

We consider a price-setting firm facing an unknown demand model that can change over time. We show that the firm can achieve a substantially better revenue performance in demand environments that change in "bursts" than it would in a demand environment that changes "smoothly." We also extend our analysis to the case of rapidly changing demand settings, and obtain a range of results that quantify the net effect of the volatility in the demand environment on the revenue performance.

4 - A Simple Heuristic for Joint Inventory and Pricing Problems with Lead Time

Yang Li, California State University, Sacramento, CA, United States of America, yang.li@csus.edu, Fernando Bernstein, Kevin Shang

We study a joint inventory and pricing problem in a single-stage system with positive lead time. This problem is, in general, intractable due to its computational complexity. We develop a simple heuristic that resolves this issue. The heuristic first generates a pricing policy which depends on the initial inventory level. We then transform the joint problem into a standard inventory problem. This heuristic enables us to explore the impact of lead time on the joint decision.

■ MA12

Hilton- Continental 9

Pricing and Regulation Issues in Sustainable Operations

Sponsor: Manufacturing & Service Operations Management/Sustainable Operations

Sponsored Session

Chair: Gal Raz, Associate Professor, University of Virginia, Darden School of Business, Charlottesville, VA, United States of America, razg@darden.virginia.edu

1 - Optimal Pricing for New and Remanufactured Products

James Abbey, Texas A&M University, 4217, College Station, TX, 77843, United States of America, jabbey@mays.tamu.edu, Joe Blackburn, Dan Guide

When considering remanufactured products, do consumers follow the typical principle of 'cheaper is better' or do other rules apply? Additionally, do consumer markets for remanufactured products demonstrate homogeneous, price-taking behavior? This research provides insights into these and other questions through triangulation of empirical investigations and tightly coupled economic modeling.

2 - The Economical and Environmental Impact of Take Back Legislations in presence of Secondary Markets

Shumail Mazahir, PhD Candidate, HEC, Jouy en Josas, 78350, France, shumail.mazahir@hec.edu

We analyze the economical and environmental impact of various take back schemes in presence of secondary markets. We look at the cases (a) secondary market with remanufactured product (b) new and remanufactured products for both markets.We analyze the environmental and economical impacts on primary and secondary markets in presence of various combination of take back laws and provide conditions where one scheme can outperform the other.

3 - Economic and Environmental Assessment of Remanufacturing in a Competitive Setting

Gal Raz, Associate Professor, University of Virginia, Darden School of Business, Charlottesville, VA, United States of America, razg@darden.virginia.edu, Anton Ovchinnikov, Vered Blass

This paper provides data-driven assessment of economic and environmental aspects of remanufacturing under competition. We study a product-line competition where one firm is selling new products and the other new and refurbished products. We use analytical and behavioral models to examine the impact of remanufacturing on the firms' competition.

4 - Competing on Toxicity: The Impact of Supplier Prices & Reg on Mfgs Substance Replacement Strategies

Tim Kraft, Assistant Professor, University of Virginia, Darden School of Business, Charlottesville, VA, United States of America, KraftT@darden.virginia.edu, Gal Raz

We examine how competition impacts manufacturers' decisions to replace a substance of concern. We find that if manufacturers face a cost tradeoff between the substance's expected regulatory risk and the supplier price for the replacement substance, then a high-end manufacturer can use his brand to control the market. Conversely, opportunities may exist for manufacturers to collaborate to replace a substance, even when the shared cost to replace is greater than the sum of their individual costs.

■ MA14

Imperial B

Air Traffic Control: Safe and Sound?

Sponsor: Aviation Applications

Sponsored Session

Chair: David Chin, FAAFederal Aviation Administration, 800 Independence Avenue, SW, Washington, DC, 20591, United States of America, david.chin@faa.gov

1 - Computer Simulation Model to Study Current and Future Oceanic Operations

Antonio Trani, Virginia Tech, Blacksburg, VA, United States of America, vuela@vt.edu, Tao Li, Aswin Gunnam

This presentation describes the development of a North Atlantic Simulation Model (NATSAM III) to investigate the effects of changes to operational policies and strategies in oceanic airspace. We discuss the methodology, different components of the model, validation and a case study of the benefits of North Atlantic Data Link Mandates.

2 - Reducing Scheduled Block Times through Departure Sequencing

Mark Hansen, University of California, Berkeley, 114 McLaughlin Hall, Berkeley, CA, 94720, United States of America, mhansen@ce.berkeley.edu, Lu Hao

In previous work we have found a relationship between scheduled block times and the distribution of realized times, by phase of flight. Here, we consider how departure sequencing might be used to change the taxi-out time distribution and therefore reduce scheduled block times.

3 - World Airline Safety: Better than Ever?

Arnold Barnett, Professor, MIT, E62-568, MIT, Cambridge, MA, 02139, United States of America, abarnett@mit.edu

Moving beyond the (often ghastly) headlines about plane crashes and disappearances, we investigate statistically both the absolute mortality risks that air travelers face and cross-national disparities in risk levels. The answer to the titled question is: yes and no.

4 - Is There a Business Case for North Atlantic Data Link Mandate?

Aswin Gunnam, Research Analyst, GRA Incorporated, 1250 Maryland Avenue SW, Washington, DC, 20024, United States of America, aswin.ctr.gunnam@faa.gov, Arnold Barnett, Thea Graham

ICAO is has introduced GPS & satellite based Data Link technology over the North Atlantic oceanic airspace which would reduce the safety risks, but also would require huge investments. We present a cost-benefit analysis by estimating the risk levels with and without the Data Link and translating the resultant reduction in risk in NAT into economic consequences.

■ MA15

Hilton- Exec. Boardroom

Applications in Electricity Networks and Natural Disasters

Cluster: Data Envelopment Analysis

Invited Session

Chair: Jaap Bos, Maastricht University, Maastricht,The Netherlands, j.bos@maastrichtuniversity.nl

1 - Institutions and the Impact of Natural Disasters

Jaap Bos, j.bos@maastrichtuniversity.nl, Mark Sanders, Martien Lamers

We investigate the impact of natural disasters events using stochastic frontier analysis, separating efficient government responses to disasters from inefficient ones that have high human and economic costs. We find that the inefficiencies are not related to variables such as disaster intensity and regional geography, but instead have to turn to indicators of institutional quality and economic activity to explain them.

2 - StoNED Versus Two-stage DEA for Regulation of Electricity Networks

Mette Bjørndal, Norwegian School of Economics, NHH, Helleveien 30, Bergen, Norway, Mette.Bjorndal@nhh.no, Endre Bjørndal

We compare StoNED to the present method used by the Norwegian regulator. We see that the estimation of distributional parameters under StoNED has a strong effect on the best-practice frontier, while the average-practice frontier is more robust to noise in the data. The efficiency scores are calibrated by the regulator in order to ensure that companies with average efficiency earn the regulatory rate of return, and we discuss how this calibration can be related to the average-practice frontier.

3 - Compensating for Exogenous Cost Drivers in the Regulation of Electricity Networks

Endre Bjørndal, Norwegian School of Economics, NHH, Helleveien 30, Bergen, Norway, Endre.Bjorndal@nhh.no, Mette Bjørndal, Astrid Cullmann, Maria Nieswand

The present yardstick model used by the Norwegian regulator compensates, via two-stage DEA efficiency analysis, for a number of environmental factors. These factors are correlated with measured efficiency and company size. We compare conditional nonpararametric methods to current benchmarking model, and we discuss whether the choice of method affects the revenue caps of companies in a systematic manner.

4 - Stepwise DEA in Benchmarking of the Brazilian Distribution Electricity Companies

Ana Lúcia Lopes, Professor, Universidade Federal de Minas Gerais, Rua Rio de Janeiro, 2754 apto. 601, Belo Horizonte, MG, 30160042, Brazil, analopes.ufmg@gmail.com, Marcelo Azevedo, Sergio Fiuza

Data Envelopment Analysis(DEA) has been used by regulators to measure the efficient operational costs in transmission and distribution energy sector. This paper explores the Stepwise DEA methodology to identify variables that should be used in the evaluation of the Brazilian distribution energy companies. The results points out to the inclusion of number of transformers, rural and urban network as outputs in a model that uses OPEX as input and energy, consumers and network length as outputs.

■ MA16

Hilton- Franciscan A

Operations and Finance

Sponsor: M&SOM/ iForm (Interface of Finance, Operations, and Risk Management)

Sponsored Session

Chair: Arun Chockalingam, Assistant Professor, Eindhoven University of Technology, Den Dolech 2, Eindhoven, Netherlands, A.Chockalingam@tue.nl

1 - Managing Inventory for Entrepreneurial Firms with Trade Credit and Payment Defaults

Kevin Shang, Associate Professor, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, kevin.shang@duke.edu, Wei Luo

This paper considers an entrepreneurial firm that periodically orders inventory to satisfy non-decreasing demand in a finite horizon. The firm provides trade credit to its customer while receiving it from its supplier. A default penalty cost is incurred for unfulfilled payments. We prove the optimal and near-optimal policies under different trade credit periods and assess the value of considering financial flows when making the inventory decision.

2 - The Financial Holding Cost of Inventory
Lei Xie, Associate professor, Shanghai University of Finance and Economics, Yangpu district, Guoding Road 777, Shanghai, China, xie.lei@mail.shufe.edu.cn, S. Alex Yang, Fehmi Tanrisever, Xiaoying Liang

We study a joint financing and inventory management model that characterizes firms' inventory policy under certain financial market imperfections and relate this model to the traditional inventory models.

3 - The Entrepreneurial Newsvendor: Managing Market Frictions through Process Investment
Fehmi Tanrisever, Bilkent University, Main Campus MA Building, Ankara, Turkey, tanrisever@bilkent.edu.tr, Sinan Erzurumlu, Nitin Joglekar, Moren Levesque

We show that the preemptive investment decision can be employed as an operational hedge to mitigate capital market frictions and create value by enhancing the firm's financing options and production volume. The fiscal value created by mitigating frictions is in addition to the traditional benefits of process investment. We derive conditions when such a preemptive investment is the optimal for the entrepreneur in the presence of capital market frictions.

4 - Short-term Financing with Reverse Factoring
Arun Chockalingam, Assistant Professor, Eindhoven University of Technology, Den Dolech 2, Eindhoven, Netherlands, A.Chockalingam@tue.nl, Matthew Reindorp, Fehmi Tanrisever

According to pecking order theory, firms resort to external sources to finance their operations when internal funds are limited. Firms may obtain short-term loans directly from banks or they may receive loans in the form of reverse factoring through the aid of other supply chain partners. We examine the trade-off between dynamically switching between traditional bank loans and reverse factoring as the risk-free rate of interest and customer demand fluctuate over time.

■ MA17

Hilton- Franciscan B

Empirical Research in Service Operations

Sponsor: Manufacturing & Service Operations Management/Service Operations

Sponsored Session

Chair: Jose Guajardo, University of California Berkeley, 545 Student Services Bldg #1900, Berkeley, CA, United States of America, jguajardo@haas.berkeley.edu

1 - Impact of Delay Announcements in Call Centers: An Empirical Approach
Seyed Emadi, Assistant Pofessor, Kenan-Flagler Business School, 300 Kenan Drive, Chapel Hill, NC, 27599, United States of America, Seyed_Emadi@kenan-flagler.unc.edu, Baris Ata, Che-Lin Su, Zeynep Aksin

We undertake an empirical study of the impact of delay announcements on callers' abandonment behavior and the performance of a call center with two priority classes. We develop a methodological framework to find the new system equilibrium and analyze the impact on the system performance when there is a change in the call center operations, e.g. a new delay announcement rule or a new service discipline is introduced.

2 - Profitability Implications of Selling the Right Set of Information
Chris Parker, Penn State University, Business building, State College, PA, 16802, United States of America, chris.parker@psu.edu, Kamalini Ramdas, Nicos Savva

Farmers in India can receive daily price information via a text message subscription service in their choice of up to three markets out of a large selection of markets. We model the farmers' decision process and use structural estimation to understand these dynamics. We use counterfactual analysis to determine the impact of different managerial decisions on service penetration and profitability as well as farmer profitability.

3 - The Impact of Team Presence on Worker Productivity
Tom Tan, Cox Business School, Southern Methodist University, 6212 Bishop Blvd, Dallas, United States of America, ttan@mail.cox.smu.edu, Serguei Netessine

We examine how the presence of other coworkers affects individual workers' performance. Our study offers an approach for capturing the experience in a fluid team and highlights the need to understand the external impact of heterogeneous skills on other coworkers. In addition, our findings provide insights into how team composition can optimize worker productivity to achieve higher sales.

4 - Disentangling Production Smoothing from the Bullwhip Effect
Robert Bray, Assistant Professor, Kellogg School of Management, 830 Hinman Ave., 2S, Evanston, IL, 60202, United States of America, robertlbray@gmail.com, Haim Mendelson

Historically, production smoothing and the bullwhip effect have shared a common measure: the difference between production variability and demand variability. This metric confounds the two effects, however, suggesting that firms that exhibit the bullwhip effect cannot smooth production. We develop new production smoothing measures that are robust to the bullwhip effect. We derive these measures from a structural econometric production scheduling model, based on demand signal processing.

■ MA18

Hilton- Franciscan C

Choice Models in Revenue Management and Pricing V

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Huseyin Topaloglu, Cornell University, 223 Rhodes Hall, Cornell University, Ithaca, NY, 14853, United States of America, ht88@cornell.edu

1 - A Market Discovery Algorithm to Estimate a General Class of Non-parametric Choice Models
Gustavo Vulcano, New York University, 44 West Fourth St, Suite 8-76, New York, NY, 10012, United States of America, gvulcano@stern.nyu.edu, Garrett van Ryzin

We develop a column generation algorithm to estimate rank-based customer preferences for a set of substitutable products using only sales transactions and product availability data. The problem we address is how to jointly estimate the arrival rate of consumers and the pmf of the rank-based choice model under a maximum likelihood criterion. Numerical experiments confirm the potential of our proposal.

2 - A Dynamic Model of Shopping and Consumption
John Semple, SMU, Cox School, Dallas, United States of America, jsemple@mail.cox.smu.edu, Edward Fox, Laura Norman

We combine standard random utility theory with dynamic programming to determine how one should consume a set of products in order to maximize the utility of the entire set. Both the optimal policy and the optimal expected value function are closed-form and intuitively appealing. Our model can be used to design the optimal set of any size for a particular consumer based solely on their marginal preferences for products in a larger assortment.

3 - Solving Large-Scale Network Revenue Problems: An Aggregation Perspective
Thomas Vossen, University of Colorado Boulder, Leeds School of Business, UCB0419, Boulder, CO, 80309, United States of America, Vossen@Colorado.edu

Using compact approximate linear programs (ALPs) resulting from functional approximations to the network revenue management problem as a starting point, we propose aggregation schemes to solve the resulting problems. Computational results illustrate the potential of our approach.

4 - Revenue Upper Bound under Mixture of Logits
Huseyin Topaloglu, Cornell University, 223 Rhodes Hall, Cornell University, Ithaca, NY, 14853, United States of America, ht88@cornell.edu, Jacob Feldman

We consider assortment optimization problems when customers choose according to a mixture of multinomial logit models. The problem of finding the revenue-maximizing assortment is NP-hard. We develop an efficient approach to obtain good upper bounds on the optimal expected revenue.

■ MA19

Hilton- Franciscan D

Operations and Marketing Interface

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Ming Hu, Assistant Professor, Rotman School of Management, University of Toronto, 105 St George Street, Toronto, ON, Canada, Ming.Hu@rotman.utoronto.ca

1 - Risk-aversion and Contracting in Managed Print Services

Jie Ning, Case Western Reserve University, 11119 Bellflower Rd, Cleveland, Oh, 44106, United States of America, jxn174@case.edu, John Handley, Volodymyr Babich, Jussi Keppo

Managed print service is an IT infrastructural service that provides comprehensive management over institutional customers' printer fleets. We develop a model on the service provider's optimal contracts under asymmetric information. Applying our model to a proprietary data set from Xerox, we estimate the structural parameters and report that the service provider is better modeled to be risk-averse rather than risk-neutral. We show that this result is robust to different model specifications.

2 - Newsvendor Mergers

Xin Wang, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, xinwang1@andrew.cmu.edu, Soo-Haeng Cho

We examine the effects of a merger between two price-setting newsvendors on the firms' prices, inventories and expected profits in an oligopolistic market. Existing literature studies mergers under deterministic demand, and predicts that cost savings always cause prices to drop. However, we find that under uncertain demand, cost savings from inventory pooling always cause prices to rise, and that marginal cost reduction induces firms to lower their prices only when it is substantial.

3 - Dynamic Pricing with Reference Price Effects under Heterogeneous Customer Arrivals

Zizhuo Wang, University of Minnesota, 111 Church St SE, Minneapolis, United States of America, zwang@umn.edu

We consider a seller facing heterogeneous arriving customers with reference price effect. We illustrate a new form of price discrimination opportunity, where the seller's optimal pricing strategy is cyclic even when customers are loss-neutral and have identical demand functions. This result differs from those in prior studies where the optimal price paths are shown to be asymptotically constant and is unique due to the interaction between heterogeneous arrivals and reference price effects.

4 - Less for More: Product Line Design under Social Influence

Jiahua Wu, Jiahua.Wu09@Rotman.Utoronto.Ca, Ming Hu

We consider a monopolistic firm selling multiple substitutable products to a stream of sequential arrivals whose purchase decisions can be influenced by earlier purchases. The products are horizontally differentiated on a Hotelling circle. We show that social influence increases product substitutability. In anticipation of this, the firm would reduce product variety in its product line.

■ MA20

Hilton – Yosemite A

Pricing & Revenue Management Convergence

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Hai Chu, Director, Decision Science, Walt Disney Parks & Resorts, 1375 E Buena Vista Dr., Lake Buena Vista FL 32836, United States of America, Hai.D.Chu@disney.com

Co- Chair: Cara Dienes,Walt Disney Parks & Resorts U.S., P.O. Box 10000, Lake Buena Vista FL 32830-9600, United States of America, Cara.J.Dienes@disney.com

1 - Optimization Challenges with a Customer Choice Model

Matt Maxwell, SAS Institute Inc., 500 SAS Campus Dr, Cary NC 27513, United States of America, Matt.Maxwell@sas.com

Traditional revenue management techniques centered on an independent demand model (IDM) where each demand is only interested in a single product. Recent market changes have weakened the legitimacy of the IDM model and prompted increased interest in customer choice models (CCM) where potential customers select from all available products based upon their preferences. We highlight some challenges that arise when using a CCM as compared to an IDM in revenue optimization.

2 - The Evolution of Revenue Management Systems

Frederick Zahrn, Walt Disney Parks & Resorts U.S., P.O. Box 10000, Lake Buena Vista FL 32830-9600, United States of America, Frederick.C.Zahrn@disney.com, Cara Dienes

Revenue Management (RM) systems in the travel industry have focused on availability control rather than dynamic pricing functionality, and they have tended to pay limited attention to customer choice behavior such as buy-down. This presentation explores a framework for understanding current and future RM systems that incorporate choice models or dynamic pricing functionality. While we focus on resort hotel applications, the framework is intended to be relevant beyond this context.

3 - Upgrades and Upsells: Hilton vs Hert

Guillermo Gallego, The Liu Family Professor, Columbia University, New York NY 10027, United States of America, gmg2@columbia.edu

We consider a revenue management problem with two popular upsell models that resemble the practice by Hilton and Hertz. Under the Hilton model, customers may be offered a conditional discount for an upgrade at booking. Under the Hertz model, customers may be offered an upgrade at a discounted price if profitable to Hertz. We compare the profitability of these models and against other variants.

4 - Lower Bounds on the Effectiveness of Dynamic Pricing under Limited Learning

Wang Chi Cheung, Graduate Student, Massachusetts Institute of Technology, 77 Massachusetts Ave, E40-149, Cambridge MA 02139, United States of America, wangchi@mit.edu, David Simchi-Levi

Motivated by flash-sales in the online retail environment, we consider an online dynamic pricing problem with limited price experimentation, when the underlying demand curve is unknown. We provide a tight lower bound on the seller's regret, which matches the regret upper bound by Simchi-Levi et al. (2013). Through the analysis, we identify the structure of an optimal pricing strategy, and illustrate a learning-earning trade-off by quantifying the loss in revenue under insufficient learning.

■ MA21

Hilton- Union Sq 1

Transportation and Routing under Uncertainty II

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Leila Hajibabai, University of Illinois at Urbana–Champaign, Urbana, IL, United States of America, hajibab1@illinois.edu

1 - Approximate Dynamic Programming for Last Mile Problem with Stochastic Demand

Shih-Fen Cheng, sfcheng@smu.edu.sg, Lucas Agussurja, Hoong Chuin Lau

We look at the problem of arranging rides for stochastically arriving passengers from a hub to their final destinations with limited number of vehicles. We propose a two-level approach: at the upper level, the strategic decision of assignment and dispatch in each period is made, and it is formulated as a MDP. The value function of this MDP is evaluated at the lower level by running Monte Carlo simulation. The effectiveness of our approach is demonstrated using a real-world dataset.

2 - Reliable Facility Location Design under Service Disruption, En-Route Congestion and In-Facility Waiting

Weijun Xie, Georgia Institute of Technology, Atlanta, GA, United States of America, xieweijun06@gmail.com, Na Cui, Yanfeng Ouyang, Yun Bai, Shi An, Mingliu Chen

The quality of service systems highly depends on the accessibility, efficiency and reliability of service facilities. This paper presents a scenario-based stochastic program that integrates service disruption uncertainty, en-route traffic congestion and in-facility delay into a reliable service facility location problem. Numerical bounds and a tractable MINLP approximation model are derived and solved by a customized solution approach based on Lagrangian relaxation and conic quadratic program.

3 - Algebraic Approaches for the Stochastic Shortest Path Problem in General Networks

Katherine Hastings, West Liberty University, 208 University Drive, CUB 165, West Liberty, WV, 26074, United States of America, katherine.hastings@westliberty.edu, Douglas Shier

We present an algebraic approach for computing the distribution of the length of a shortest s-t path in general (possibly cyclic) networks, in which arc lengths are modeled with probability distributions. Fixed-point iteration techniques along with concepts from min-plus algebra are used to develop algorithms for the exact distribution as well as lower bounding distributions. We also obtain bounds on the expected length of a shortest path. Results are presented for example networks.

4 - Dynamic Snow Plow Fleet Management under Uncertain Demand and Service Disruption

Leila Hajibabai, University of Illinois at Urbana–Champaign, Urbana, IL, United States of America, hajibab1@illinois.edu, Yanfeng Ouyang

A set of models and methodologies are developed for dynamic snow plow fleet management in a demand-responsive decision-making process (e.g., under service disruptions or uncertain maintenance demand). The numerical results show that the proposed algorithm can solve the problem effectively.

■ MA22

Hilton- Union Sq 2

Post-Disaster Relief and Response

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Nilay Noyan, Associate Professor, Sabanci University, Istanbul, 34956, Turkey, nnoyan@sabanciuniv.edu

1 - Modeling Public-Private Inventory Management Partnership Policies for Regional Catastrophic Planning

Unsal Ozdogru, Clinical Assistant Professor, University of Illinois at Chicago, 601 South Morgan Street , MC 294, Chicago, IL, 60607, United States of America, uozdogru@uic.edu, Matthew Liotine

Preparedness for disasters such as hurricanes, etc. has been a challenging task to plan for, but is critical to reducing losses in human life, improving economic welfare and limiting environmental damage. We developed analytical models to evaluate tradeoffs between various public and private sourcing arrangements to make necessary items such as water available in the affected regions in order to reduce the impact of disasters. Recommendations are made regarding the efficacy of the policies.

2 - Strategic Planning for Disabled and Elderly Populations in Natural Disasters

Jacqueline Griffin, Northeastern University, 334 Snell Engineering Center, 360 Huntington Avenue, Boston, MA, 02115, United States of America, ja.griffin@neu.edu, Rana Azghandi

New York City received criticism for how it served the disabled in its response to Superstorm Sandy. In order to address disaster response for the mobility challenged, we develop a MIP model to aid in the evacuation of these individuals accounting for real-time location information, availability of limited resources, and time constraints. The evacuation planning problem is complicated by the heterogeneous nature of evacuee's needs, shelter-in-place options, and reusable transportation resources.

3 - G-network Models for Relief Centers at Disaster Sites

Merve Ozen, PhD Student, University of Wisconsin Madison, 1513 University Avenue, Madison, Wi, 53706, United States of America, mozen@wisc.edu, Ananth Krishnamurthy

We use a generalized queuing network (G-network) to model relief centers that distribute aid to victims at a disaster site. We analyze the effects of batch routing and crowd congestion on sojourn times in the network and explore impacts of stock-outs and staffing decisions.

4 - Stochastic Optimization Models for Designing Last Mile Relief Networks

Nilay Noyan, Associate Professor, Sabanci University, Istanbul, 34956, Turkey, nnoyan@sabanciuniv.edu, Burcu Balcik, Semih Atakan

We introduce a last mile relief network design problem under demand- and network-related uncertainties. We focus on providing accessible and equitable services to beneficiaries, and develop two-stage stochastic programming models. We implement an exact branch-and-cut algorithm based on Benders decomposition, and conduct numerical analysis to evaluate the proposed alternative models. We discuss the practical implications of our results on a case study based on the 2011 Turkey earthquake.

■ MA23

Hilton- Union Sq 3

Uncertainty in Transportation Models I

Sponsor: TSL/Freight Transportation & Logistics

Sponsored Session

Chair: Maria Elbek, Aarhus University, Fuglesangs Allee 4, Aarhus V, 8210, Denmark, meandersen@econ.au.dk

1 - Effective Truckload Dispatch Decision Method with Incomplete Advance Load Information

Hossein Zolfagharinia, PhD Candidate, Wilfrid Laurier University, 75 University Avenue west, Waterloo, ON, Canada, hzolfagharinia@wlu.ca, Michael Haughton

One source of improved profitability for truckload freight carriers is advanced knowledge of detailed client demand. We quantify the profit improvement by using mixed integer programming (MIP) to model dynamic truckload transportation operations. The MIP model, along with an effective approach to handle incomplete knowledge are the study's major contributions.

2 - Robust Optimization of Truckload Relay Networks under Demand Uncertainty

Zahra Mokhtari, Graduate Research Assistant, Oregon State University, 204 Rogers Hall, Corvallis, OR, 97321, United States of America, mokhtarz@onid.oregonstate.edu, Hector A. Vergara

This study addresses the problem of strategic relay network design for truckload transportation under demand uncertainty. We try to find suitable robust solutions under any possible realization of demand instead of optimizing the relay network design using most likely values. Budgeted uncertainty is applied in defining the demand uncertainty set. Thus, a trade-off between conservatism and optimality determines the quality of the solutions. A robust optimization formulation is presented along with results obtained for several problem instances of this problem.

3 - Shipment Consolidation with Generalized Arrival Processes and Non-linear Customer Disutility Functions

Qishu Cai, University of Waterloo, Waterloo, ON, Canada qcai@uwaterloo.ca, Qi-Ming He, James Bookbinder

We model the process of combining multiple small orders into a larger load, for shipment together to gain economies of scale. Markovian arrival processes of orders with different quantities and priorities, and disutility functions that increase in a customer-order's waiting time, are considered. An optimal dispatch policy is found.

4 - A Stochastic Solution Approach for Multi-period Collection of Recyclable Materials in a Multi-compartment Vehicle

Maria Elbek, Aarhus University, Fuglesangs Allé 4, Aarhus V, 8210, Denmark, meandersen@econ.au.dk, Teodor Gabriel Crainic, Walter Rei

We consider an approach for scheduling the multi-period collection of recyclable materials. To establish a high service level for the citizens, cubes for collection may not be overfilled. Inspired by theory on the Inventory Routing Problem (IRP), we present a two-stage stochastic model and solution method for scheduling the collection in order to minimize the cost.

■ MA24

Hilton- Union Sq 4

Active Traffic Control Strategies for Real-Time Management

Sponsor: TSL/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Ketan Savla, Assistant Professor, University of Southern California, 3620 South Vermont Avenue KAP 254A, Los Angeles, CA, 90089, United States of America, ksavla@usc.edu

1 - A Processor Sharing Perspective on Horizontal Traffic Queues

Ketan Savla, Assistant Professor, University of Southern California, 3620 South Vermont Avenue KAP 254A, Los Angeles, CA 90089, United States of America, ksavla@usc.edu, Mohammad Motie

Motivated by emerging ITS technologies, we consider a horizontal traffic queue, where vehicles arrive on a road with finite length according to a spatio-temporal Poisson process, and depart after traveling to a common destination at the end of the road. Vehicle speed is dynamically determined by relative distance with respect to neighbors, and a constant speed limit. We make connection with processor sharing queues to derive fluid limit of proposed system, and use it to study maximum throughput.

2 - Information-based Network Traffic Control using Hybrid Route Guidance Strategy under Vehicle-to-vehicle Communications

Yong Hoon Kim, Purdue University, West Lafayette, IN, United States of America, kim523@purdue.edu, Srinivas Peeta

We address information-based network control using a hybrid route guidance strategy under vehicle-to-vehicle (V2V) communications. It seeks to improve guidance quality by balancing the ability of the centralized layer to generate a predictive guidance with the ability of the decentralized V2V layer to respond rapidly to random incidents. Numerical experiments are illustrated to demonstrate the efficiency of the proposed approach.

3 - Data-driven Linear Decision Rule Approach for Distributionally Robust real-time Signal Control

Tao Yao, Penn State University College of Engineering Electronic and Computer Services, University Park, PA, United States of America, tyy1@engr.psu.edu, H. Liu, K. Han, Terry Friesz

We propose a two-stage linear-decision-rule approach for optimizing traffic signal based on both historical and real-time information. In the offline stage a distributionally robust optimization problem is solved based on historical data whiling accounting for daily variations (uncertainties). The online stage employs a practical linear decision rule that provides the best traffic signal response to real-time data. This methodology is implemented in a realistic network setting.

4 - A Three Level Location-inventory Problem with Correlated Demand

Mehrdad Shahabi, West Virginia University, Morgantown, West Virginia, United States of America, mshahabi@mix.wvu.edu, Avinash Unnikrishnan, Stephen Boyles

A model for three level location-inventory problem correlated demand has been presented. A solution approach based on a customized outer approximation strategy is applied and the algorithmic benefits of such framework are discussed. The results from numerical experiments show that the proposed solution procedure clearly outperforms state-of-the-art commercial solvers.

5 - Dynamic Pricing and Learning in Network Equilibrium Models

Tarun Rambha, tarun.1988@gmail.com, Stephen Boyles

Route choice dynamics of boundedly rational travelers in traffic networks seldom converge to equilibria. Under general assumptions of the learning behavior of travelers, we propose a Markov decision process framework that dynamically prices the network to maximize the probability of reaching a particular equilibrium or system optimal state.

■ MA25

Hilton- Union Sq 5

Infrastructure Investment and Management

Sponsor: TSL/Urban Transportation

Sponsored Session

Chair: Harry van der Weijde, Vrije Universiteit Amsterdam, Department of Spatial Economics, De Boelelaan 1105, Amsterdam, 1081HV, Netherlands, h.vanderweijde@gmail.com

1 - Regulating the Formation of Transport Networks when Capacity Investment is Discrete

Harry van der Weijde, Vrije Universiteit Amsterdam, Department of Spatial Economics, De Boelelaan 1105, Amsterdam, 1081HV, Netherlands, h.vanderweijde@gmail.com, V. A. C van den Berg, E. T. Verhoef

We examine the effects of different policies that regulate the formation of transport networks by private operators. To do so, we construct a small network in which it is possible to build congestible links with discrete capacities between each pair of nodes. We examine several multi-stage games in which one or more operators choose which links to construct and operate. We find that capacity subsidisation and price regulation are not always sufficient to achieve the first-best welfare maximum. We also discuss when second-best network regulation is better than price regulation.

2 - Analytical Model for Evaluating the Long-Term Benefits of Internal Curing

Yuntao Guo, Purdue University, West Lafayette, IN, United States of America, guo187@purdue.edu, Jason Weiss, Srinivas Peeta, Xiaozheng He

This study seeks to quantify the long-term benefits of internally cured concrete mixtures in terms of cost reduction, sustainability, and congestion mitigation. A nonlinear programming model is developed to maximize the long-term benefits of internal curing by identifying the optimal infrastructure renewal plan. The model can help planners in designing effective and sustainable repair mechanisms in high traffic areas to reduce the impacts of the associated traffic disruptions.

3 - Pavement Rehabilitation Planning using a Mechanistic-empirical Approach

Yun Bai, University of Illinois at Urbana-Champaign, Urbana, IL, United States of America, yunbai1@illinois.edu, Yanfeng Ouyang, Jaime Alberto Hernandez-Urrea, Osman Erman Gungor, Imad L. Al-Qadi

This research develops an optimization framework for design and rehabilitation of a single pavement integrating Mechanistic-Empirical roughness transfer models. A mixed integer nonlinear program and a dynamic programming subroutine are developed to determine the optimal rehabilitation timing and asphalt concrete design thickness addressing the trade-off between agency and user costs.

4 - Utilization Optimization of Tolled Freeways

Shokoufeh Mirzaei, California State Polytechnic University,pomona, Industrial and Manufacturing Engineering, 3801 W Temple Ave, Pomona, CA, 91768, United States of America, smirzaei@csupomona.edu, Gabriela Abanto, Santiago Galvis Correa, Alberto Rosa, Sesar Salasar

In this paper a set of parameters that has a significant impact on the traffic intensity of tolled freeway lanes are identified. The impacts of significant parameters are then quantified and their optimal values are obtained so that the utilization level of tolled lanes is maximized while the system constraints (e.g. minimum speed) are met. Finally, a set of he control actions are defined to maintain the traffic flow as optimum as possible.

■ MA26

Hilton- Union Sq 6

Urban Operations Research

Sponsor: Location Analysis

Sponsored Session

Chair: Mihiro Sasaki, Professor, Nanzan University, 27 Seirei, Seto, Japan, mihiro@nanzan-u.ac.jp

1 - A Business Model on the EV Support Infrastructure Focusing on the Number of Stations and Charge Fee

Yudai Honma, Assistant Professor, The University of Tokyo, Komaba 4-6-1, Meguro-ku, Tokyo, 153-8505, Japan, yudai@iis.u-tokyo.ac.jp

Electric vehicles (EV) have attracted an increasing amount of attention. However, the continuous cruising distance of an EV is limited to around 160 km, which is insufficient for everyday use. To promote the diffusion of EV, EV support infrastructure such as EV station is essential and it must become profitable. In this research, we propose a business model on the EV support infrastructure with respect to the number of EV stations and charging fee.

2 - Solving Large-scale Multi-target Tracking Problem to Identify Massive People Flow in Urban Area

Shunji Umetani, Dr., Osaka University, 2-1 Yamadaoka, Suita, Osaka, Japan, umetani@ist.osaka-u.ac.jp, Akira Kumano, Takashi Hasuike, Yuma Konishi

Analysis of spatiotemporal people flow in urban area has become increasingly important in many applications including marketing and public services. Although we can partially monitor people flow by tracking various devices such as mobile phones and IC tickets, it is quite incomplete because some privacy and integration issues still remain. To identify massive people flow from fragmentary observed data, we solve multi-target tracking problem by integer linear programming approach.

3 - Special Considerations in Transit Route Optimization

Richard Church, Professor, University of California, Santa Barbara, 1832 Ellison Hall, Santa Barbara, CA, 93106-4060, United States of America, rick.church@ucsb.edu, Timothy Niblett

There are several fundamental models that have been used as the basis for transit route optimization including the shortest covering path model and the maximal covering shortest path model. We show that special issues arise in the use of these two models which may actually prevent optimal routes from being identified.

4 - A Scheduling Problem for Locating EV Battery Charging Stations

Mihiro Sasaki, Professor, Nanzan University, 27 Seirei, Seto, Japan, mihiro@nanzan-u.ac.jp, Kazuya Matsui, Ken-ichi Tanaka

In this paper, we consider a scheduling problem of locating EV battery charging stations where the location of all stations is given. Due to budgetary limitation, it might be generally difficult to locate all stations at a time. In such a case, the stations would be located in order according to a pre-determined schedule. We show how the schedule difference give an impact on user convenience, and propose heuristics to find good schedules.

■ MA27

Hilton- Union Sq 7

Railroad OR Models

Sponsor: Railway Applications

Sponsored Session

Chair: Clark Cheng, Director Operations Research, Norfolk Southern Railway, 1200 Peactree St NE, Atlanta, GA, 30309, United States of America, Clark.Cheng@nscorp.com

1 - Railway Crew Scheduling with Train Departure Delay

Yutian Yang, University of Texas at Austin, 204 East Dean Keeton Street, Austin, TX, 78712, United States of America, yutian_peter@utexas.edu, Brian Roth, Anant Balakrishnan

In this talk, we study a freight railway crew assignment problem in which train departure time can be postponed. We propose a deterministic optimization model which integrates trip scheduling and crew assignment. We provide model improvements and present computational results using real-life data from a major North American railway company.

2 - Developing a Real-time Train Movement Planning System

Ravindra Ahuja, President & CEO, Optym, 2153 SE Hawthorne Road, Gainesville, Fl, 32641, United States of America, ravindra.ahuja@optym.com, Amit Agarwal

We are developing a real-time train movement planning system for a railroad. In this presentation, we will give an overview of the system: our approach and our development methodology. We will also give a demonstration of the system share the lessons learnt in this interesting and educative project.

3 - Scheduling Geometry Cars in Norfolk Southern Rail Network

Andy Yoon, Manager Operations Research, Norfolk Southern Corporation, 1200 Peachtree Street NE, Atlanta, GA, 30309, United States of America, andy.yoon@nscorp.com, Yudi Pranoto, Clark Cheng, Gaohao Luo

We present a scheduling model that minimizes deadhead miles of geometry cars while considering track inspection time interval requirements. A solution procedure was developed to assist decision making in scheduling geometry cars inspecting Norfolk Southern rail network.

4 - Locomotive Shop Routing using Approximation Dynamic Programming

Clark Cheng, Director Operations Research, Norfolk Southern Railway, 1200 Peactree St NE, Atlanta, GA, 30309, United States of America, Clark.Cheng@nscorp.com, Coleman Lawrence, Maurice Cheung, Ricardo Fiorillo

We will present the locomotive shop routing system at Norfolk Southern Railway. The system is built based on the approximation dynamic programming (ADP).

■ MA28

Hilton- Union Sq 8

Airline Network Planning and Schedule Development

Sponsor: Aviation Applications

Sponsored Session

Chair: Ahmed Abdelghany, Associate Professor, Embry-Riddle Aeronautical University, 600 S. Clyde Morris Blvd., Daytona Beach, FL, United States of America, abdel776@erau.edu

1 - Airline Schedule Optimization Model with Efficient Aircraft and Crew Rotations

Ahmed Abdelghany, Associate Professor, Embry-Riddle Aeronautical University, 600 S. Clyde Morris Blvd., Daytona Beach, FL, United States of America, abdel776@erau.edu, Khaled Abdelghany

This research contributes to the clean-sheet flight scheduling problem by presenting a modeling framework that incorporates aircraft and crew rotations in flight scheduling models. Given the desired service frequency in the different city pairs, the framework generates an operational flight timetable that maximizes the airline's revenue, while generating efficient rotations for aircraft and crew. We present the application of the framework using a real-world data of a major US airline.

2 - An Approach to Analyze Consumer Welfare Impacts of U.S. Airline Mergers

Laurie Garrow, Georgia Institute of Technology, School of Civil Engineering, Atlanta, GA, 30332, United States of America, laurie.garrow@ce.gatech.edu, Matthew Higgins, Jeff Newman

The U.S. airline industry has experienced significant consolidation. Economists often use a BLP approach to quantify consumer welfare impacts associated with mergers. Within aviation, the full potential of the BLP approach has yet to be realized, due to limited publicly-available fare information. We discuss a dataset we are using to overcome this limitation, outline our research approach, and discuss and potential benefits for airline itinerary choice modeling applications.

3 - Bank Structure Model

Gizem Keysan, Manager, United Airlines, 233 S Wacker Dr, Chicago, IL, 60606, United States of America, gizem.keysan@united.com

Banks are periods where most flights arrive/depart around the same time. They create more connection possibilities while providing efficiency with opportunities to swap aircraft. In order to build the best bank structure, it is crucial to consider several factors such as valuable connections, manpower availability and gating feasibility. We present an optimization model that recommends bank start and end times to maximize connection revenue while adhering to the operational constraints.

4 - Considering Uncertain Capacity Changes in Airline Revenue Management

Daniel Kadatz, Freie Universität Berlin, Garystr. 21, Raum 201, Berlin, 14195, Germany, daniel.kadatz@fu-berlin.de, Catherine Cleophas, Christina Büsing

We demonstrate a model integrating non-optimal mandatory capacity changes in airline revenue management. Such changes frequently occur in the booking horizon in practice, but theoretical approaches almost entirely neglect them so far. We outline a new approach incorporating uncertain capacity changes, present a set of designs for simulation experiments as well as first numerical results.

■ MA29

Hilton- Union Sq 9

Joint Session Wagner/CPMS: Daniel H. Wagner Prize for Excellence in Operations Research Practice

Cluster: Daniel H. Wagner Prize for Excellence in Operations Research Practice & CPMS, The Practice Section

Invited Session

Chair: C. Allen Butler, President, Daniel H. Wagner, Associates, Inc., Hampton, VA, United States of America, Allen.Butler@va.wagner.com

1 - Daniel H. Wagner Prize

C. Allen Butler, President, Daniel H. Wagner, Associates, Inc., Hampton, VA, United States of America, Allen.Butler@va.wagner.com

The competition for the 2014 Daniel H. Wagner Prize for Excellence in Operations Research Practice resulted in six finalists, who submitted papers to the judging committee and who will present their results in three sessions. In this keynote, the winner of the competition will be announced and the authors will give a reprise of the winning presentation.

2 - Project Portfolio Planning at Intel Corporation

Siddhartha Sampath, Intel Corporation, Decision Engineering Group, 5000 W. Chandler Blvd., Chandler, AZ, 85226, United States of America, siddhartha.sampath@intel.com, Karl Kempf

We address the problem of deciding between project funding opportunities under budget constraints. Projects interactions make selection difficult but senior managers have business intuitions that inform the decisions. We use modeling, simulation and optimization methods to find the best project portfolios including tools for decision makers to apply their insights in making the final selection. Interplay of analytics and intuition produces better solutions faster than was previously achieved.

3 - Airline Crew Augmentation, Decades of Improvements from Sabre

Shahram Shahinpour, Senior of Operations Research, Sabre Holdings, Inc, 3150 Sabre Dr., Southlake, TX, 76092, United States of America, Shahram.Shahinpour@sabre.com, Tina Shaw, Yogesh Dashora

The airline crew pairing problem is to generate optimized legal anonymous pairings that cover the flight complement requirements. The exact crew composition needed on a flight often varies depending on of the pairings that cover it. Different from the conventional approaches, Sabre Long Haul Pairing Optimizer models this dependency explicitly and uses sophisticated Branch and Price techniques. We use real airline examples to show our solution brings considerable savings to the airline industry.

■ MA30

Hilton- Union Sq 10

Stochastic Scheduling and Supply Chains

Cluster: Scheduling and Project Management

Invited Session

Chair: Xiaoqiang Cai, Professor, The Chinese University of Hong Kong, Dept of Systems Engineering, Shatin, NT, Hong Kong, Hong Kong - PRC, xqcai@se.cuhk.edu.hk

1 - Production Planning and Pricing Policy in a Make-to-stock System Subject to Machine Breakdowns

Houcai Shen, Professor, Nanjin University, 22 Hankou Road, Nanjing, Jiangsu, Nanjing, China, hcshen@nju.edu.cn, Ting Wu, Xiutian Shi

We consider a make-to-stock system served by an unreliable machine that produces one type of product. The system manager must determine the production level and selling price at each decision point. We first show that the optimal production and pricing policy is a threshold control. We then establish the structural relationships among the three threshold parameters. Finally we provide some numerical examples to illustrate the analytical results and gain additional insights.

2 - Production Costs, High Worth Players, and Tails in Subcontracting

George Vairaktarakis, Professor, Case Western Reserve University, 10900 Euclid Ave, 323 PBL, Cleveland, Oh, 44106, United States of America, gxv5@case.edu, Vernon Hsu, Ke Fu

We consider multiple manufacturers subcontracting part of their workload at a third-party (3P) production facility with the rest of the work processed in-house. Production costs are customer-specific, both at their own facility as well as at 3P. We explore production plans and cooperative strategies that incentivize optimal behavior.

3 - Carbon Emission Reduction in the Presence of Production Mix Selection

Xiaolin Xu, Professor, Nanjing University, Nanjing, China, xuxl@nju.edu.cn, Jian chen, yongbo xiao, Xiaoqiang Cai

This paper investigates the question of how should the government impose a suitable incentive to induce firms to emit carbons to the level that optimizes the social welfare. We consider a producer that manufactures a product either by an old or new technology, or by a mix of the two technologies. Two carbon emission reduction policies, i.e., taxing on the high-carbon products and subsiding on the low-carbon products, are studied on the side of the government.

4 - Risk Sharing by Delay-in-Supply for a Dual-Channel Supply Chain

Weili Xue, Southeast University, School of Economics and Management, Nanjing, China, wlxue1981@gmail.com, Chen Zhiyuan, Xiaogan Jiang

We study a dual-channel supply chain where the supplier can delay his supply to the retailer. The supplier can satisfy his realized demand of the direct channel by the retailer's order. We find that delay-in-supply can be used to sharing the supplier's demand risk, and benefits the retailer at the same time, to improve the whole supply chain. We also study the delay-in-supply affects' on selling prices and the wholesale price, show the effect of demand variability on the obtained results.

■ MA31

Hilton- Union Sq 11

Service Operations and Marketing Inter-Related Issues

Sponsor: Service Science

Sponsored Session

Chair: Rohit Verma, Singapore Tourism Board Distinguished Professor, Cornell University, School of Hotel Administration, 338 Statler Hall, Ithaca, NY, 14850, United States of America, rv54@cornell.edu

1 - Primary Task Utilization and Secondary Task Compliance: A Behavioral Investigation

Brett Massimino, Cornell University, School of Hotel Administration, Ithaca, NY, 14850, United States of America, massimino.3@fisher.osu.edu, John Gray, James Hill

We use a laboratory experiment to examine human performance behaviors in a multitasking environment. We examine how the level of utilization on a primary, individual-oriented task and noncompliance penalties for a secondary, organization-oriented task interact in affecting one's propensity to perform the secondary task. We frame our study in the realm of non-IS workers complying with Information Security processes, yet offer implications for many other manufacturing and service settings.

2 - Incorporating Customer Feedback in Service Operations with Text Analytics

Shawn Mankad, Assistant Professor, University of Maryland, 4316 Van Munching Hall, College Park, MD, 20742, United States of America, smankad@rhsmith.umd.edu, Rohit Verma, Spring Han, Nagesh Gavirneni

There is a large literature showing that online reviews have a direct impact on decision making and product sales. Yet, most extant works utilize only the numerical "star" rating or at most the valence of the review text for modelling. In this work, we apply modern text analytics to a corpus of reviews for hotels in a major city from a leading review website to identify key areas of service operations that depend on hotel type and quality.

3 - The Influence of Surprise and Anticipation on Peak and End Effects in Service Operations

Mike Dixon, Assistant Professor, Naval Postgraduate School, 555 Dyer Road, IN-234, Monterey, 93943, United States of America, mjdixon@nps.edu, Rohit Verma, Liana Victorino

In many service designs there is a high point — a peak portion that often defines the entire experience. We investigate how anticipation and surprise influences these peak segments. We test the influence of anticipation and surprise of peaks and their placements using an online survey-based experiment.

4 - Service Design, Customer Reviews and Preferences: Insights from Hospitality Industry

Rohit Verma, Singapore Tourism Board Distinguished Professor, Cornell University, School of Hotel Administration, 338 Statler Hall, Ithaca, NY, 14850, United States of America, rv54@cornell.edu, Rachna Shah, Kanika Thakran

This paper presents the results of customer preferences and reviews for service design features in the hospitality industry.

■ MA32

Hilton- Union Sq 12

Frontiers in Service Science

Sponsor: Service Science

Sponsored Session

Chair: Changrui Ren, IBM Research - China, Building 19, Zhongguancun Software Park, Beijing, China, rencr@cn.ibm.com

1 - Process Monitoring and Automation to Enable Service Delivery Excellence

Sai Zeng, Research Scientist, IBM T. J. Watson Research Center, 1101 Kitchawan Rd, Yorktown Heights, United States of America, saizeng@us.ibm.com, Miao He, Changrui Ren

Process Automation is critical to reduce the need for human work in the production of goods and services to make the processes uniform and efficient. In this talk, we present an evidence based analytical approach to identify top opportunities for process automation, and provide objective assessment of benefit to enable process leaders to take informed decisions. A case study in Finance and Administration Process Delivery Services is used to illustrate the core idea of our analytical approach.

2 - Practice in Data-Driven Target Marketing Activities in O2O Commerce

Bing Shao, Staff Researcher, IBM, Building 19, Zhongguancun Software Park, 8 Dongbeiwang West Road, Haidian Distric, Beijing, China, shaobing@cn.ibm.com, Changrui Ren, Miao He, Jinfeng Li, Hao Ji

The essence of online-to-offline (O2O) commerce is closed loop processing of transactions from online consumer decision making through payment to local service. We present a piece of practice to transform big data into actionable insights and guidance using decision analysis and optimization, which may help the O2O merchants optimize its marketing strategy including providing real time, relevant, and personalized product or service promotions, obtaining the early customers.

■ MA33

Hilton- Union Sq 13

Incentives for Innovation/Innovative Projects

Cluster: New Product Development

Invited Session

Chair: Morvarid Rahmani, Assistant Professor, Georgia Tech, 800 West Peachtree Street, N.W., Atlanta, GA, 30308, United States of America, Morvarid.Rahmani@scheller.gatech.edu

Co-Chair: Karthik Ramachandran, Associate Professor, Georgia Institute of Technology, Scheller College of Business, 800 West Peachtree NW, Atlanta, GA, 30308, United States of America, Karthik.Ramachandran@scheller.gatech.edu

1 - Incentive Alignment and Coordination of Project-Based Supply Chains with Schedule Based Contracts

Shi Chen, Assistant Professor, University of Washington, Foster School of Business, Foster School of Business, ISOM Department, Box 353226, Seattle, WA, 98195, United States of America, shichen@uw.edu, Hau Lee

Consider a project-based supply chain which involves multiple activities each requiring a concentrated use of certain key materials. We derive the optimal material delivery schedule and payment scheme so that a delivery-schedule-based contract coordinates the channel. We show that the manufacturer's profit is not affected by the average supply lead time but is affected by the variance of the lead time. We also show that delivery reliability is the most important factor for channel coordination.

2 - Selling a New Product to Uncertain Customers with Learning Externality

Yufei Huang, PhD Student, University College London, Gower Street, London, United Kingdom, yufei.huang.10@ucl.ac.uk, Onesun Steve Yoo, Bilal Gokpinar

We study a seller's optimal pricing strategy and capacity decision when selling a new/innovative product to risk-averse customers who are uncertain about their valuations. Customers may deliberately delay their purchase for more information from other customers to reduce their valuation uncertainty. We then analyse the effect of learning externality on the market equilibrium, the seller's pricing strategy and capacity decision.

3 - Economics of Co-design: The Role of Product Lines

Sreekumar Bhaskaran, Associate Professor, Southern Methodist University, 6212 Bishop Blvd., Dallas, TX, 75275, United States of America, sbhaskar@mail.cox.smu.edu, Amit Basu

Inputs from final customers can be very helpful in creating effective customized products, but this "co-design" process requires customers who participate in it to commit significant time and effort. In this paper, we illustrate the role of product lines to engage the customer in the design process.

■ MA34

Hilton- Union Sq 14

Modeling the Education System

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Donna C Llewellyn, Associate Vice Provost for Learning Excellence, Georgia Tech, CETL Clough 457, 266 4th St. NW, Atlanta, GA, 30332-0383, United States of America, donna.llewellyn@cetl.gatech.edu

1 - The U.S. STEM Undergraduate Model: Applying System Dynamics to Undergraduate STEM Student Persistence

Debbie Hughes, Director of Higher Education & Workforce, The Business-Higher Education Forum, 2025 M St NW Suite 800, Washington DC, 20036, United States of America, debbie.hughes@bhef.com

BHEF's U.S. STEM Undergraduate Model, a first-of-its-kind system dynamics model focused on undergraduate STEM education, contextualizes President Obama's call for 1M additional STEM graduates, and provides an evidence-based approach to the high-impact practices needed to change STEM student persistence at scale. Through its National Higher Education and Workforce Initiative BHEF embeds the Model findings into strategic regional workforce projects in emerging high-skill high-demand fields.

2 - Modeling the Knowledge Economy: Exploring Productivity, Inequality, and Creative Destruction

Dan Sturtevant, CEO, Silverthread, Inc., 12 Lill Ave, Newton, MA, 02465, United States of America, dan@silverthreadinc.com, Merrilea Mayo, Jeanne Contardo

We present the "Aligned Workforce Model," a computer simulation used to explore the misalignment between education production and workforce needs. This agent- and network-based model contains simulated people, firms, and a representation of the ever-changing constellation of human knowledge. Using this model, we can explore the impact of policy choices on unemployment, skills across the workforce, economic productivity, inequality, and the strength of the middle class.

3 - Modeling Market-Based Reforms in Education

Spiro Maroulis, Assistant Professor, Arizona State University, School of Public Affairs, 411 N. Central Ave, Phoenix, AZ, 85004, United States of America, Spiro.Maroulis@asu.edu

In this talk, I will discuss applying the ideas and tools of complexity science to educational policy and management problems. In particular, I will present a computational, agent-based model that captures the dynamic processes involved in moving from a non-market to choice-based system. I will also present an example of applying network analysis to better understand competition within school districts.

4 - Analyzing K-12 Education System Interventions

Pratik Mital, PhD Candidate, Georgia Institute of Technology, North Ave NW, Atlanta, GA, 30332, United States of America, pratik_mital@gatech.edu, Roxanne Moore, Donna C Llewellyn

Schools and school districts are complex, dynamic systems affected by numerous factors. In this work, a framework is developed that can be used to analyze interventions in the K-12 education system in US. Techniques like agent-based modeling and social network analysis are used that allow the user to analyze the barriers and enablers to school change and reform. The framework is applied to model and analyze various case studies of school interventions.

■ MA35

Hilton- Union Sq 15

Public Health II

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Chaitra Gopalappa, Assistant Professor, University of Massachusetts, 160 Governors Drive, Amherst, United States of America, chaitrag@umass.edu

1 - Understanding the Crisis in Somali IDPs

James Cochran, University of Alabama, Culverhouse College of Commerce and Bus, 347 Alston Hall, Tuscaloosa, AL, 35487, United States of America, jcochran@cba.ua.edu, Alaa Zeid

1.5 million Somalis have been internally displaced; many live in overcrowded settlements with limited access to water, sanitation, food, and shelter. Not surprisingly, mortality rates for children under 5 and women in these settlements are alarmingly high. We describe our WHO–supported efforts to collect data in these settlements and apply negative binomial regression to determine the conditions most strongly associated with these high mortality rates and provide guidance for relief efforts.

2 - Estimation of Global Impacts and Costs of Cancer Screening

Chaitra Gopalappa, Assistant Professor, University of Massachusetts, 160 Governors Drive, Amherst, United States of America, chaitrag@umass.edu, Carel Pretorius, Jeremy Lauer, Melanie Bertram, Rachel Sanders

Estimates of health impacts and costs of screening for different types of cancers can guide development of public health policies on screening strategies. We present our ongoing work with WHO in developing simulation models of national populations for estimation of impacts and costs of alternate screening strategies and Markov models for estimation of onset and progression rates for simulating the natural history of cancer.

3 - Modeling the Complex Interaction between Comorbidities: Breast Cancer and Diabetes

Julie Ivy, North Carolina State University, 111 Lampe Drive, Campus Box 7906, Raleigh, NC, United States of America, jsivy@ncsu.edu, Jennifer Mason, Shadi Hassani Goodarzi, Kendall McKenzie, Nisha Nataraj, Maria Mayorga, Jeremy Tejada

In 2010, over 200,000 women were diagnosed with invasive breast cancer, and 12.6 million women were affected by diabetes in the US, according to the Centers for Disease Control and Prevention. While we know much about these prevalent diseases individually, little has been studied about the interaction between them. Here, we build a modeling framework that explores this complex relationship so as to assess the prognosis for women who are diagnosed with diabetes given their breast cancer risk.

4 - Potential Impact of H7N9 Influenza Virus Pandemic Outbreak in the U.S.

Walter Silva Sotillo, PhD Student, University of South Florida, 4202 E. Fowler Ave, Tampa, FL, 33620, United States of America, silvasotillo@mail.usf.edu, Tapas Das

Until April 8, 2014, WHO reported 409 confirmed cases (with fatality around 30%) of H7N9 virus in China. Current concerns are that H7N9 might become human-to-human transmittable and spread internationally. We use data from recent reports and a simulation model to predict the potential impact of H7N9 pandemic in the U.S.

■ MA36

Hilton- Union Sq 16

Network Design

Sponsor: Telecommunications

Sponsored Session

Chair: Bernard Fortz, Professor, Université Libre de Bruxelles, GOM CP212, Bld du Triomphe, Brussels, 1050, Belgium, bernard.fortz@ulb.ac.be

Co-Chair: Dimitri Papadimitriou, Pr.Eng.Research, Bell Labs, Copernicuslaan 50, Antwerp, 2018, Belgium, dimitri.papadimitriou@alcatel-lucent.com

1 - Robust Optimization Approaches to Virtual Network Embedding

Martin Tieves, RWTH Aachen University, Lehrstuhl II für Mathematik, Wüllnerstrafle 5b, Aachen, 52056, Germany, tieves@math2.rwth-aachen.de, Arie Koster, Stefano Coniglio

Network virtualization is a key technology of modern telecommunications, allowing to decouple management aspects of the physical network from service provisioning. We consider the virtual network embedding problem (VNE) of selecting which virtual networks to embed onto the physical network to maximize profits. We present and investigate extensions of Mixed Integer Programming formulations for VNE handling data uncertainty by adopting both the Hose and the Gamma Robustness uncertainty models.

2 - Virtual Network Embedding with Network Design Elements: Reservation of Physical Resources

Stefano Coniglio, RWTH Aachen University, Lehrstuhl II für Mathematik, Wüllnerstrafle 5b, Aachen, 52056, Germany, stefano.coniglio@gmail.com, Martin Tieves, Arie Koster

Virtualization techniques allow for the coexistence of many virtual networks jointly sharing the resources of an underlying physical network. Unlike previous work, we focus on the service provider's point of view of deciding not only which virtual network requests to accept, but also which quantity of resources to reserve from the physical network owner so to maximize the revenue. We present Mixed-Integer Linear Programming formulations for the problem and investigate them computationally.

3 - Models for Traffic Engineering in Ethernet Networks Implementing the Multiple Spanning Tree Protocol

Bernard Fortz, Professor, Université Libre de Bruxelles, GOM CP212, Bld du Triomphe, Brussels, 1050, Belgium, bernard.fortz@ulb.ac.be, Luis Gouveia, Martim Moniz

The Multiple Spanning Tree Protocol (MTSP) maintains a set of spanning trees that are used for routing the demands in the network. Each spanning tree is allocated to a pre-defined set of demands. We present MIP models for the problem of optimally designing a network implementing MTSP, such that link utilization is minimized and propose a binary-search algorithm that efficiently produces near-optimal solutions for the problem.

4 - The Two-Level Diameter Constrained Spanning Tree Problem

Luis Gouveia, Professor, Univ of Lisbon, Centro de Investigacao Operacional, Bloco C6 - Piso 4- Campo Grande, Lisbon, 1749-016, Portugal, legouveia@fc.ul.pt, Ivana Ljubic, Markus Leitner

In this work, we introduce the Two-Level Diameter Constrained Spanning Tree Problem (2-DMSTP). We first observe that any feasible solution to the 2-DMSTP can be viewed as a DMST that contains a diameter constrained Steiner tree. This observation allows us to prove graph theoretical properties related to the centers of each tree which are then exploited to develop mixed integer programming formulations, valid inequalities, and symmetry breaking constraints.

■ MA37

Hilton- Union Sq 17

Predictive Analytics for Social Media

Sponsor: Artificial Intelligence

Sponsored Session

Chair: Hyun-Woo Kim, PhD Candidate / Graduate Teaching Fellow, Pennsylvania State University, 324 IST Building, University Park, PA, 16802, United States of America, hxk263@ist.psu.edu

1 - Predictive Analytics for Presidential Elections

Hyun-Woo Kim, PhD Candidate / Graduate Teaching Fellow, Pennsylvania State University, 324 IST Building, University Park, PA, 16802, United States of America, hxk263@ist.psu.edu

There are a great amount of non-random signals and opinionated conversations related to presidential election campaigns coming out of social media. This work will demonstrate that understanding social dynamics associated with user affects, influence and information diffusion would help voters, political parties, election candidates and public administrations accurately capture the common understanding of the general public.

2 - 8-K Filings, Twitter Activities and Stock Market Reactions

Tawei Wang, University of Hawaii at Manoa, 2404 Maile Way, BUSAD E602C, Honolulu, HI, 96822, United States of America, twwang@hawaii.edu, Asheq Rahman, Roger Debreceny

This paper investigates Twitter activities around 8-K filing dates and the association between such activities and stock market reactions to 8-K filings. Using a sample of S&P 1500 companies' 8-K filings in 2012, we show the number of tweets, impression, sentiment, and influential tweeters directly affect the stock market reactions.

3 - Geolocation of Twitter Users through NLP, Machine Learning and Social Networking Algorithms

Ryan McKeown, Booz Allen Hamilton, 9800 Gable Ridge Terrace, Rockville, MD, 20850, United States of America, mckeown_ryan@bah.com, Curie Chang, Ryan Corbett

There are many problems that would benefit from Twitter data if geolocation was available. Less than two percent of Twitter users have geolocation enabled. We have developed an approach that combines NLP, machine learning and social networking algorithms to automatically detect a user's residence location at state level.

4 - CRM in Social Media: Predicting Increases in Facebook Usage Frequency

Michel Ballings, Professor, University of Tennessee, Knoxville, Knoxville, United States of America, Michel.Ballings@Gmail.com, Dirk Van den Poel

The purpose of this study is to (1) assess the feasibility of predicting increases in Facebook usage frequency, (2) evaluate which algorithms perform best, (3) and determine which predictors are most important. The results indicate that it is feasible to create models with high predictive performance. The top performing algorithm was Stochastic AdaBoost with a cross-validated AUC of 0.66 and accuracy of 0.74. This study is the first to assess the prediction of usage frequency in a social network

5 - Evaluating Social Media Data Appropriateness for Travel Demand Analysis: A Time Geography Approach

Mohsen Parsafard, Mississippi State University, 319 N Jackson St, Apt 2A, Starkville, MS, 39759, United States of America, mp1273@msstate.edu, Guangqing Chi, Xiaopeng Li

Social media data (e.g., twitter) hold a large amount of geo-tagged records of individuals that can be potentially used to reconstruct their activity trajectories. Based on time geography, this study proposes a set of measures that specify a continuous temporal-spatial bound of an individual's possible activity range with a discrete set of sampled time-location tags of this individual. We apply these measures to show the suitability of the tested twitter data for individual activity studies.

■ MA38

Hilton- Union Sq 18

Exploring Strategies for Innovation and Learning

Cluster: Strategy Science

Invited Session

Chair: Hart Posen, Associate Professor, University of Wisconsin-Madison, 975 University Avenue, Madison, WI, 53706, United States of America, hposen@bus.wisc.edu

1 - Technological Change and Incumbent Search in Music and Movies

Mary Benner, University of Minnesota, 3-365 Carlson School of MGMT, 321-19th Avenue South, Minneapolis, MN, 55455, United States of America, mbenner@umn.edu, Joel Waldfogel

Digital technology has spurred important changes in the music and movie industries, challenging the advantages of incumbents and creating innovative ways to conduct industry activities. Using extensive data on music and movie product releases, we examine how the search strategies of incumbents changed in the wake of the technological changes. We explore their approaches for discovering and selecting new talent and products, and the outcomes of these strategies.

2 - Does Strategic Management Need Neurosciences?

Stefano Brusoni, ETH Zurich, Weinbergstrasse 56/58, Zurich, 8092, Switzerland, sbrusoni@ethz.ch, Maurizio Zollo, Daniella Laureiro-Martinez, Vinod Venkatraman, Stefano Cappa

Neuroscientific methods enable management scholars to observe constructs nowadays central to strategy, e.g. cognition, ambidexterity. Yet, these methods (e.g. fMRI) are not 'general purpose technologies': They are good at solving specific classes of problems, but not all problems. We identify these classes of problems, with specific focus on three areas: attention control, routine emergence, and emotions. We discuss the ethical issues and the managerial implications.

3 - The Roles of the Giant Cluster in Knowledge Diffusion and Recombination

Jeho Lee, Associate Professor, Seoul National University, 599 Gwanangno, Gwanak-gu, Seoul, 151-916, Korea, Republic of, jeho0405@gmail.com, Jaeyong Song, Sungyong Chang

We examine the roles of a giant cluster in fostering knowledge diffusion and recombination. Our numerical analysis shows that the giant cluster acts as a knowledge integrator by facilitating knowledge diffusion between previously unconnected clusters. But, not all giant clusters are equally effective in fostering knowledge recombination. We find that only giant clusters with a modest fraction of bridges with no hubs are conducive to enhancing knowledge recombination.

4 - Performance Responses To Competition Across Skill-Levels In Rank Order Tournaments

Karim Lakhani, Harvard Business School, k@hbs.edu, Kevin Boudreau, Michael Menietti

Tournaments are widely used in the economy to organize production & innovation. We study individual contestant-level data on 2796 contestants in 774 software design contests. We find that performance response to added contestants varies non-monotonically across contestants of different abilities; most respond negatively to competition; highest-skilled contestants respond positively. In counterfactual simulations, we interpret a number of tournament design policies.

■ MA39

Hilton- Union Sq 19

Hospital-based Challenges

Sponsor: Health Applications

Sponsored Session

Chair: Vedat Verter, Professor, McGill University, 1001 Sherbrooke Street West, Montreal, QC, H3A 1G5, Canada, vedat.verter@mcgill.ca

1 - Integrated Surgical Bed Management

Mohammad Mehdi Ghotboddini, McGill University, 1001 Sherbrooke St, Montreal, QC, Canada, mehdi_ghotboddini@yahoo.com, Vedat Verter, Lawrence Rosenberg, Valerie Vandal

In collaboration with Montreal Jewish General Hospital Surgical Unit, we systematically approach surgical block scheduling problem to achieve cost containment by controlling over surgical case cancellation due to downstream bed shortage. We develop a stochastic model and apply a modified sample average approximation method to solve it.

2 - Operating Room Simulation Model Helps Hospitals Quantify their Challenges

Michael Carter, Professor, University of Toronto, Mech & Ind Engineering, 5 King's College Rd., Toronto, ON, M5S 3G8, Canada, mike.carter@utoronto.ca, Carolyn Busby, Daphne Sniekers

Over the past six years, we have developed a generic perioperative simulation model that has so far been implemented in eight Ontario hospitals. Initially, we developed the model to help OR planners optimize the surgical schedule and case mix. However, we discovered that the very act of validating the model provided hospitals with quantitative evidence highlighting flaws in their practices and exactly how to correct them. We will discuss several examples.

3 - Patient Flow Smoothing

Hamidreza Eslami, Canada, hamidreza.eslami@mail.mcgill.ca, Vedat Verter

Observing the current flow of colorectal surgery patients at Montreal General Hospital (MGH) reveals a significant gap between reality and the care pathway designed collectively by the care providers. This study addresses this issue in three phases, care process analysis, simulation, and mathematical modeling.

4 - Design of Financial Incentives for Avoiding Unnecessary C-Sections

Beste Kucukyazici, McGill University, 1001 Sherbrooke Street West, Montreal, QC, H3A 1G5, Canada, beste.kucukyazici@mcgill.ca, Cheng Zhu

Rates of C-section, which exposes potential harms on mothers and newborns as well as heavy economic burden, have been increasing constantly and this growth raises some concerns for the policy makers. This research focuses on optimizing the financial incentives, i.e. choosing best payment scheme and optimizing how to reimburse obstetricians under this scheme, in order to reduce the C-section rates without sacrificing birth quality while alleviating economic burden for overall health care system.

■ MA40

Hilton- Union Sq 20

Monitoring and Prevention of Hospital Acquired Infections

Sponsor: Health Applications

Sponsored Session

Chair: Eduardo Perez, Assistant Professor, Texas State University, 601 University Drive Ingram School of En, San Marcos, TX, 78666, United States of America, eduardopr@txstate.edu

1 - Agent-Based Mediation Modeling of a Controlled Trial to Reduce MDRO Transmission

Sean Barnes, Assistant Professor, University of Maryland, 4352 Van Munching Hall, University of Maryland, College Park, MD, 20742, United States of America, sbarnes@rhsmith.umd.edu, Anthony Harris, Lisa Pineles, Daniel Morgan

In 2012-2013, the University of Maryland led a 20-site randomized controlled trial to assess the benefits of universal gloves and gowns to reduce the transmission of multidrug-resistant organisms (MDROs) in acute-care hospitals. We develop an agent-based model to estimate the reduction in MDRO transmission directly due to this intervention.

2 - Further Empirical Evidence for Hand-Hygiene as a Habitual Citizenship Behavior

Reidar Hagtvedt, Assistant Professor, University of Alberta, 2-43 Business Building, Edmonton, Al, T6G2C7, Canada, hagtvedt@ualberta.ca, Sarah Forgie, Ken Schultz

Hand-hygiene is a habitual behavior often neglected, occasionally leading to nosocomial infections, which can be devastating to patients. Health-care workers typically claim to understand the importance of hand-hygiene, yet compliance is routinely low. We propose a theory for the phenomenon of hand-hygiene, based on an expansion of the Theory of Planned Behavior, and test it using observations gathered over four years at a major teaching hospital, as well as surveys.

3 - Reducing Surgical Site Infections

Eva Lee, Professor & Director, Georgia Institute of Technology, Ctr for OR in Medicine & Healthcare, Atlanta, GA, 30332, United States of America, eva.lee@gatech.edu

This project is joint with Grady Memorial Hospital. Surgical-site infections (SSI) are a national problem, occurring in an estimated 2.8% of all procedures (for some, it is up to 30%). It causes complication, prolong length and stay and unnecessary burden on patients, hospitals and 3-party payers. We describe our recent successes in reducing SSI for coronary artery bypass graft through systems modeling and process optimization.

4 - Analyzing CAUTI Prevention Strategies: A Discrete-Event Simulation Study

Eduardo Perez, Assistant Professor, Texas State University, 601 University Drive Ingram School of En, San Marcos, TX, 78666, United States of America, eduardopr@txstate.edu, Berkcan Uyan

Healthcare associated infections are a significant problem for the U.S. healthcare industry, with 1.8 million patients affected each year. Catheter-associated urinary tract infections (CAUTIs) are the second most common type of HAI. Beyond the obvious patient care implications, Medicare has discontinued paying hospitals for care related to CAUTIs. In this work we utilize systems modeling and simulation methods to reduce the incidence of CAUTIs at a real hospital located in central Texas.

■ MA41

Hilton- Union Sq 21

Online Decision Making in Healthcare

Sponsor: Health Applications

Sponsored Session

Chair: Diana Negoescu, University of Minnesota, Minneapolis, MN, United States of America, dianegoescu@gmail.com

1 - Approximation Methods for Determining Optimal Allocations in Response Adaptive Clinical Trials

Vishal Ahuja, University of Chicago, Chicago, IL, 60615, United States of America, vahuja@chicagobooth.edu, John Birge, Chris Ryan

Response-adaptive clinical trials, where patient assignment to treatments evolves dynamically, offer potential for efficiency gains over traditional designs, and typically modeled as Bayesian adaptive MDP. A consequence of this setup is the increase in problem size, often exponentially, with trial size & complexity. We propose grid-based approximation as a way to reduce the problem dimensionality and the associated computationally burden, thus widening the scope of implementing adaptive designs.

2 - Active Postmarketing Drug Surveillance for Multiple Adverse Events

Joel Goh, Stanford, Palo Alto, CA, United States of America joelgoh@stanford.edu, Margrét Bjarnadöttir, Mohsen Bayati, Stefanos Zenios

Existing methods for drug surveillance do not capture multiple adverse events and their interactions. We propose a new method to do this based on a queueing network. We apply asymptotic analysis to design a sequential hypothesis test that assesses the effect of a drug on multiple adverse events, by continuously monitoring the times of drug treatment and adverse event occurrences in a patient population. We validate our method on (a) simulated data and (b) actual health insurance claims data.

3 - Dynamic Kidney Exchange: The Effect of Batching and Pooling Across Programs

Vahideh Manshadi, Yale University, New Haven, United States of America, manshadi@mit.edu, Itai Ashlagi, Maximilien Burq, Patrick Jaillet

In kidney exchange, incompatible patient-donor pairs arrive over time; they usually register at one of the exchange programs, and wait to be matched. Because of the abundance of hard-to-match patients, the average waiting time is currently long. Using theoretical analysis and computational experiments, we show that the waiting time can be reduced using certain batching policies, or matching schemes that incentivize programs to share their easy-to-match pairs with other programs.

4 - Dynamic Learning of Patient Response Types

Diana Negoescu, University of Minnesota, Minneapolis, MN, United States of America, dianegoescu@gmail.com, Kostas Bimpikis, Dan Iancu, Margaret Brandeau

We optimize treatment policies for a class of chronic diseases where measurements of treatment effectiveness are noisy and where negative health events occur with frequencies that depend on patient response type. We find analytic expressions for adaptive treatment policies and illustrate the performance of such a policy in a case study on multiple sclerosis.

■ MA43

Hilton- Union Sq 23

Computational Optimization

Sponsor: Computing Society

Sponsored Session

Chair: Matthew Saltzman, Associate Professor, Clemson University, Dept. of Mathematical Sciences, Martin Hall, Box 340975, Clemson, SC, 29634-0975, United States of America, mjs@clemson.edu

1 - Dual-guided Pivot Rules for Linear Programming

Jaques Desrosiers, Professor, HEC Montréal & GERAD, 3000, Ch Cote-Sainte-Catherine, Montréal, Qc, H3T2A7, Canada, jacques.desrosiers@gerad.ca, Jean Bertrand Gauthier, Marco Luebbecke

We describe a generic algorithm for LPs guided by dual feasibility considerations. The resolution process moves according to a direction and a step size. The core component is obtained via the smallest reduced cost upon dividing the dual variables in two subsets: one fixed, the other optimized. The Primal Simplex, the Minimum Mean Cycle-Canceling for network problems, and the Improved Primal Simplex are special cases. We show how to identify directions yielding non-degenerate pivots.

2 - Decomposition Algorithms for Mean-CVaR Multistage Stochastic Linear Programs

Hamed Rahimian, PhD Student, The Ohio State University, 1971 Neil Ave., Columbus, OH, 43210, United States of America, rahimian.1@osu.edu, Güzin Bayraksan, Weini Zhang

We study a risk-averse approach in the multistage stochastic linear programming, where a convex combination of the expected cost and its associated conditional value-at-risk represents the objective function. Due to the coherency of the CVaR, five decomposition schemes are considered in the general framework of Nested L-shaped method to solve the model. We present the computational performance of the single-cut and multi-cut versions of the algorithms for a multistage water allocation problem.

3 - Computational Experience with the MAS Algorithm for Derivative-free Optimization

Hua Zheng, Carnegie Mellon University, Department of Chemical Engineering, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, huazheng@andrew.cmu.edu, Luis Miguel Rios, Nick Sahinidis

The derivative-free optimization algorithm Model-and-Search (MAS) is a local optimization algorithm designed to improve the objective of the best known point by using models fitted by information from nearby evaluated points. The algorithm relies on global optimization of algebraic models to guide the search and identify improving points. The main purpose of this paper is to present extensive computational experience with this algorithm and comparisons with existing implementations.

■ MA44

Hilton- Union Sq 24

Information Systems and the Digital Society

Sponsor: Information Systems

Sponsored Session

Chair: Jie Zhang, University of Texas at Arlington, 701 S West St. #19437, Arlington, TX, 76019, United States of America, jiezhang@uta.edu

1 - Playing God: Role of Intermediary in Matching Markets

Rajiv Mukherjee, Assistant Professor, Southern Methodist University, 6212 Bishop Blvd., Dallas, TX, 75275, United States of America, rmukherjee@mail.smu.edu, Amit Basu, Sreekumar Bhaskaran

We examine the role of an intermediary in matching markets like marriage and labor. In this context, an online intermediary's optimal positioning and pricing strategy is developed. The role of competition and social norms is also considered.

2 - Selecting Tasks in Crowdsourcing Platforms

Jiahui Mo, Assistant Professor, Nanyang Technological University, jiahui.mo@utdallas.edu, Sumit Sarkar, Syam Menon

Crowdsourcing platforms are increasing in popularity, and consequently the number of tasks posted by seekers is also increasing – this makes it difficult for solvers to evaluate all the tasks before making a participation decision. We develop a system that provides recommendations to solvers when they log on to the platform.

3 - Firm's Strategic use of Recommendation System
James Zhang, UC Irvine, Paul Merage School of Business, Irvine, United States of America, zhez1@uci.edu, Vidyanand Choudhary

We examine the impact of the use of recommender systems by an online retailer on his profit and consumers' surplus. The retailer employs both recommender system and search engine to help consumers search for products. We develop an analytical model to examine the firm's strategy when products offer heterogeneous margins to the retailer.

4 - Community Involvement in Online Crowdsourcing Communities
Indika Dissanayake, Doctoral Student, University of Texas at Arlington, Box 19437, 701 S West Street, Arlington, TX, 76019, United States of America, indika.dissanayake@mavs.uta.edu, Jingguo Wang, Jie Zhang

Recent advances in information technology bring significant changes to the nature of social interactions and information exchange. Physical face-to-face communications are slowly replaced by online virtual communities. Motivated by this phenomenon, this research investigates how the voluntary community involvement impact peer-recognition and performance in virtual crowdsourcing communities.

■ MA45

Hilton- Union Sq 25

Behavioral Research on Inventory and Pricing

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Elena Katok, Ashbel Smith Professor, University of Texas at Dallas, 800 W. Campbell Drive, Dallas, TX, 75080, United States of America, ekatok@utdallas.edu

1 - Learning with Censored Information: An Application to Inventory Management
Kyle Hyndman, University of Texas at Dallas, 800 W Campbell Rd (SM31), Richardson, TX, 75080, United States of America, tdp062000@utdallas.edu, Canan Ulu, Dorothee Honhon

We conduct an experiment in which a retailer must learn about the unknown demand of two related products. Customers may substitute in case of a stock-out. Subjects over-estimate demand of the low-demand product and underestimate demand of the high-demand product.

2 - Decision Making Under Service Level Contracts
Tobias Stangl, University of Cologne, Albertus-Magnus-Platz, Koeln, 50923, Germany, tobias.stangl@uni-koeln.de, Gary Bolton, Ulrich Thonemann

Service level contracts are common in practice. By measuring service levels and enforcing penalty payments service level contracts can feature a sharpened expected profit function which makes the economic consequences of deviations from the normative benchmark more severe. In a set of laboratory experiments we show that service level contracts can significantly reduce the pull-to-center effect and ensure high supply chain efficiency.

3 - Pure Reciprocity under Alternative Procurement Mechanisms
Jason Shachat, Professor, Durham University, Millhill Ln., Durham, DH1 3LB, United Kingdom, jason.shachat@gmail.com

Almost all procurement contracts fail to specify standards for all possible supplier performance dimensions, making moral hazard a ubiquitous presence in supply chain relationships. We argue that gift exchange and reciprocity is an alternative force that supports this phenomenon. We test for this presence and relative strength of this gift exchange hypothesis in a stylized procurement setting under alternative auction mechanisms.

4 - Markdown or Everyday-Low-Price? The Role of Behavioral Motives
Karen Zheng, Massachusestts Institute of Technology, Sloan School of Management, Cambridge, MA, 02142, United States of America, yanchong@mit.edu, Özalp Özer

We study a seller's optimal pricing (markdown vs. everyday-low-price) and inventory strategies when consumers are affected by two salient behavioral motives: anticipated regret and misperception of product availability. We determine and quantify the operational and profit implications of these motives. We contrast the roles of consumers' strategic (pecuniary) versus behavioral (non-pecuniary) motives in affecting purchase, pricing, and inventory decisions.

■ MA46

Hilton- Lombard

Convexification Techniques in MIP & MINLP

Sponsor: Optimization/Integer and Discrete Optimization

Sponsored Session

Chair: Jean-Philippe P Richard, University of Florida, 303 Weil Hall P.O. Box 116595, Gainesville, FL, 32611, United States of America, richard@ise.ufl.edu

1 - Disjunctive Cuts for the Second-Order Cone and its Cross-Sections
Sercan Yildiz, Carnegie Mellon University, Pittsburgh, PA, United States of America, syildiz@andrew.cmu.edu, Fatma Kilinc-Karzan, Gerard Cornuejols

Several recent papers have attempted to extend the disjunctive cut framework from mixed-integer linear to mixed-integer conic programs. In this work we study sets obtained via a two-term disjunction on the second-order cone or its cross-sections. We develop a methodology to derive a family of convex valid inequalities for such sets. We also show that a single inequality is sufficient to describe the convex hull of the disjunction and can be represented in second-order conic form in many cases.

2 - Supermodular Inequalities for Bounded Products of Continuous and 0/1 Variables
Akshay Gupte, Assistant Professor, Clemson University, Martin O-321, Dept. of Math Sciences, Clemson, SC, United States of America, agupte@clemson.edu, Shabbir Ahmed, Santanu Dey

We study the convex hull of the lower-level set of a function defined by the product of a single bounded continuous variable x and a nonnegative monotone submodular function that is zero-valued at some points. This set arises in mixed integer bilinear programs, hyperbolic functions etc. We exploit the supermodular structure in this set and use disjunctive programming to obtain extended formulations. When the upper bound on x is "large enough", the convex hull is described explicitly. The valid inequalities are strengthened under specific generalizations of the level set.

3 - On Cutting Planes for Cardinality Constrained Optimization Problems (CCOP)
Jinhak Kim, Purdue University, 403 W. State Street, Room 532, West Lafayette, IN, 47906, United States of America, kim598@purdue.edu, Jean-Philippe P Richard, Mohit Tawarmalani

We separate the optimal point of an LP relaxation of CCOP from the intersection of a cardinality constraint with a relaxation of the optimal tableau. The separation problem is recast as a network optimization problem on a network formed using the coefficients of the tableau constraints. Our procedure generalizes the equate-and-relax procedure recently developed for complementarity problems.

4 - On Sublinear Inequalities for Mixed-integer Conic Programs
Dan Steffy, Oakland University, Dept. of Mathematics and Statistics, 2200 N. Squirrel Road., Rochester, MI, 48309, United States of America, steffy@oakland.edu, Fatma Kilinc-Karzan

First, without making any assumptions, we show that sublinear inequalities, together with the conic constraint, are sufficient to describe the closed convex hull of the feasible region for MICPs. Second, we show that for Lorentz cone, the description of sublinear inequalities can be significantly simplified.

■ MA47

Hilton- Mason A

Stochastic/Robust Optimization in Energy Systems

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Yuping Huang, Ph.D Candidate, University of Central Florida, 12800 Pegasus Dr. RM 320, Orlando, FL, 32816, United States of America, yuping.huang@knights.ucf.edu

1 - Power Generation Expansion Planning: Benders Decomposition with Efficient Cut Calculation
Timo Lohmann, Colorado School of Mines, Division of Economics and Business, Golden, CO, United States of America, tlohmann@mines.edu, Steffen Rebennack

We present a long-term power generation expansion planning model with short-term demand response, i.e., load depends on the electricity market price, in its general form, and introduce a Benders Decomposition approach in GAMS' .net environment to solve the large scale (convex) MINLP. We discuss special cases of the model which allow us to efficiently calculate the Benders optimality cuts. Solving linearized NLP subproblems becomes obsolete which leads to a highly efficient algorithm.

2 - Capacity Expansion of Distributed Generation using Bilevel Mixed Integer Program

Jasper Quach, University of South Florida, 4202 E Fowler Ave, Tampa, Fl, 33620, United States of America, jasper@mail.usf.edu, Bo Zeng

We consider using bilevel mixed integer program to study capacity expansion problem of distributed generation within an electricity market environment. Numerical study on a typical distributed system will be presented, along with detailed discussions and management insights.

3 - A Multistage and Multiscale Stochastic Programming Approach to Electricity Infrastructure Investment

Zhouchun Huang, University of Central Florida, 4000 Central Florida Blvd., University of Central Florida, Orlando, FL, 32816, United States of America, zhouchun.huang@knights.ucf.edu, Qipeng Zheng

To study the infrastructure needs of an electricity grid, we propose a stochastic programming model that integrates long-term investment planning and short-term unit commitment models, both of which are multistage decision problems in nature but have different time scales. The infrastructure expansions are planned several years ahead and the time scales for unit commitment decisions are in hours to meet real-time demand. A nested column generation approach is adopted for solving the problem.

4 - Stochastic Multistage Expansion Planning for an Integrated Energy System

Yuping Huang, Ph.D Candidate, University of Central Florida, 12800 Pegasus Dr. RM 320, Orlando, FL, 32816, United States of America, yuping.huang@knights.ucf.edu

A stochastic multistage expansion planning model is proposed for the integrated natural gas and power generation system. Under uncertainties from energy supply and NG price, the objective is to minimize the expected gas-electricity investment and O&M costs with risk aversion. This model is solved by a modified Benders' decomposition.

■ MA48

Hilton- Mason B

Decomposition Algorithms for Stochastic (Integer) Programs

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Merve Bodur, PhD Student, University of Wisconsin-Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, mbodur@wisc.edu

1 - Dual Decomposition Algorithms for Solving Chance-Constrained Binary Programs

Yan Deng, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, yandeng@umich.edu, Jon Lee, Siqian Shen

Based on the standard mixed-integer programming reformulation of a chance-constrained binary program, we assign multipliers to constraints that involve variables across scenarios and formulate a Lagrangian relaxation that is decomposable into scenario subproblems. The subproblems are mutually independent and free of big-M constants. The algorithm follows an objective bounding process, and exploits inequalities particularly strong for 0-1 polytopes to shrink feasible regions and improve bounds.

2 - Decomposition Algorithms for Two-Stage Chance-Constrained Programs

Xiao Liu, Ohio State University, 1971 Neil Ave., Columbus, OH, 43210, United States of America, liu.2738@osu.edu, Simge Kucukyavuz, James Luedtke

We study a class of chance-constrained two-stage stochastic optimization problems where second-stage feasible recourse decisions incur additional cost. We propose a new model where recovery decisions are made for the infeasible scenarios to obtain feasible solutions to a relaxed second-stage problem. We develop decomposition algorithms with specialized optimality and feasibility cuts to solve this class of problems. Computational results indicate that our algorithms are highly effective.

3 - Spatial Detection to Minimize Abandonment Rate

David Morton, Professor, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60208, United States of America, mortondp@gmail.com, Fang Lu, John Hasenbein

We consider a spatial detection problem in which we seek to protect an offshore oil drilling platform in the Arctic Ocean from sea ice (ice floes) by locating docking stations and allocating autonomous underwater vehicles to those docking stations. We formulate and approximate a multi-stage stochastic integer program for this purpose. The model differs from a typical stochastic facility location model in that service times depend on how long a customer (ice floe) waits for service.

4 - Strengthened Benders Cuts for Stochastic Integer Programs with Continuous Recourse

Merve Bodur, PhD Student, University of Wisconsin-Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, mbodur@wisc.edu, Sanjeeb Dash, Oktay Gunluk, James Luedtke

With stochastic integer programming as the motivating application, we investigate techniques to use integrality information to obtain improved cuts within a Benders decomposition algorithm. We analyze the use of split cuts in the extended and projected spaces. We demonstrate that although the two approaches yield equivalent relaxations when considering a single split disjunction, applying multiple splits in the extended space generally yields significantly stronger relaxations.

■ MA49

Hilton- Powell A

Network Analysis Methods and Applications

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Sergiy Butenko, Texas A&M University, 4037 ETB, TAMU-3131, College Station, TX, 77843, United States of America, butenko@tamu.edu

1 - On S-plex and S-defective Clique Numbers of a Graph

Oleg Shirokikh, Frontline Systems Inc., 1575 Delucchi Ln, Suite 112, Reno, NV, United States of America, oleg@solver.com, Austin Buchanan, Vladimir Boginski, Sergiy Butenko

We consider degree-based clique relaxations – s-plex and s-defective clique – which have appeared in social network analysis and bioinformatics. We investigate theoretical properties, provide analytical and computational bounds for the related optimization problems. We provide exact solutions for both problems and show polynomial solvability for special graphs. We propose new scale reduction techniques and attempt to find optimal solutions for both problems on extremely large sparse networks.

2 - Large Cohesive Subgroups with High Clustering Coefficient

Zeynep Ertem, Texas A&M, 3131 University Dr, College Station, 77840, United States of America, zeynep84@tamu.edu, Sergiy Butenko

Cohesive subgroups often correspond to significant community structures. Clique finding methods can detect such groups, however, such groups usually have missing edges (i.e., not perfectly connected). We propose a clustering coefficient based relaxation, called α-cluster, which calculates a subgraph whose nodes satisfy at least α level of clustering coefficient. We introduce a clustering algorithm based on α-cluster.

3 - On Lifted Facet-defining Inequalities for Connected Subgraph Polytope

Yiming Wang, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, kkelvin@neo.tamu.edu, Austin Buchanan

We study the facet-defining inequalities for connected subgraph polytope. We mainly focused on the inequalities via lifting. We develop an algorithm to generate facet-defining inequalities in linear time if the graph is a forest and show in general graphs generating such an inequality is NP-hard. We also find a class of inequalities that are valid and discuss when these inequalities can be facet-defining.

4 - Applying a Hybrid Metaheuristic to the Routing on Multicast Problem

Carlos Oliveira, F-Squared Inc, Princeton, NJ, United States of America, oliveira@ufl.edu

Multicast routing systems are used to simultaneously transfer data to multiple destinations. We consider the delay constrained multicast routing problem (DCMRP), which is of great interest for telecommunication engineers. We propose a hybrid metaheuristic approach for the DCMRP, where a GRASP is used along with VNS algorithm. Experiments show that the proposed technique provides superior solution quality, while it is also efficient in terms of the use of computational resources.

■ MA50

Hilton- Powell B

Network Design with Hubs II

Cluster: Network Design

Invited Session

Chair: Hans-Jurgen Sebastian, Professor, RWTH Aachen University, Kackertstrafle 7B, Aachen, NR, D-52062, Germany, sebastian@or.rwth-aachen.de

1 - Solution Approaches for the Dynamic Hub Location Problem

Astrid Dettenbach, RWTH Aachen University, Aachen, Germany, hoerhammer@or.rwth-aachen.de

We consider a dynamic hub location problem with single allocation and multiple capacity levels. We contribute by developing a model that incorporates changes in cost and demand structure over time. Which locations serve as hubs, the capacity of these hubs and the allocation of non-hub locations to hub locations are the key decision variables in each period. We develop and evaluate heuristics to solve large problems.

2 - Continuous Facility Location with Backbone Network Costs

John Gunnar Carlsson, University of Minnesota, Minneapolis, MN, United States of America, jgc@isye.umn.edu

We consider a continuous facility location problem in which our objective is to minimize the weighted sum of three costs: fixed costs from installing the facilities, backbone network costs incurred from connecting the facilities to each other, and coverage costs incurred from providing services from the facilities to the service region. We derive two optimal facility configurations: one of these is the well-studied honeycomb heuristic, while the other is an Archimedean spiral.

3 - The Design of Capacitated Intermodal Hub Networks with Different Vehicle Types

Sibel Alumur, Assistant Professor, University of Waterloo, 200 University Avenue West, Waterloo, ON, N2L 3G1, Canada, sibel.alumur@uwaterloo.ca, Elif Zeynep Serper

We propose a mixed-integer programming formulation of this hub network design problem. The aim of the model is to minimize total costs while determining the location of hubs, the allocation of non-hub nodes to hubs, which hub links to establish, and how many vehicles to operate on each hub link to route the demand between given origin-destination pairs. We propose a local search heuristic and present computational analysis on the CAB and Turkish network data sets.

■ MA51

Hilton- Sutter A

Optimization of Energy Systems

Sponsor: Optimization/Nonlinear Optimization

Sponsored Session

Chair: Naiyuan Chiang, Argonne National Laboratory, 9700 S Cass Ave, Bldg 240, Lemont, IL, 60439, United States of America, nychiang@mcs.anl.gov

1 - A Multi-scale Optimization Approach to Dynamic Optimal Power Flow Problems

Fu Lin, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL, 60439, United States of America, fulin@mcs.anl.gov, Sven Leyffer, Todd Munson

We study dynamic optimal power flow problems with temporal constraints. These constraints couple variables over different time periods, and they arise in modeling dynamical aspects of power generation and storage. We develop a multi-scale approach that exploits the multi-period structure. Our column-generation-based algorithm solves a sequence of problems from coarsest to finest time scales. This approach strikes a balance between solution quality and computational complexity in large problems.

2 - Advanced Vehicle Routing Based on Powertrain Type, Battery State of Charge and Traffic Conditions

Orkun Karabasoglu, Assistant Professor in ECE, SYSU-CMU, Joint Institute of Engineering, 5000 Forbes Ave, pittsburgh, PA, 15213, United States of America, karabasoglu@cmu.edu, Zhiqian Qiao

Most navigation systems use data from satellites to provide drivers with the shortest-distance, least-time or highway-preferred paths. We propose a novel navigation strategy where vehicle powertrain type, battery state of charge and traffic conditions are used in addition to the traditional parameters. It is found that optimal paths might change significantly for different vehicle types and different initial battery state of charge.

3 - Development of Control-Oriented Models for Model Predictive Control in Buildings

OíNeill Zheng, University of Alabama, Dept. of Mechanical Engineering, Box870276, Tuscaloosa, AL, 35487, United States of America, zoneill@eng.ua.edu

Model Predictive Control (MPC) has gained attention in recent years for application to building controls because of significant potential for energy savings. MPC utilizes dynamic models and input forecasts to estimate future energy usage and employs optimization to determine control inputs that minimize an integrated cost function or a specified prediction horizon. This talk will present the development of control-oriented models in buildings.

4 - Scalable Strategies for Large-scale Structured Nonlinear Optimization

Naiyuan Chiang, Argonne National Laboratory, 9700 S Cass Ave, Bldg.240, Lemont, IL, 60439, United States of America, sorakid507@gmail.com, Victor Zavala

A robust and efficient solver is alway a challenge for large-scale stochastic NLP problems. We discuss the details of our implementation PIPS-NLP, a parallel nonlinear interior-point solver. PIPS-NLP is designed to exploit different types of the problem structure. It adopts a filter-based line search method and applies a curvature test instead of the inertia test. We present the global convergence analysis and also some numerical results based on CUTEr test problems and real energy applications.

■ MA52

Hilton- Sutter B

Stochastic Methods and Machine Learning in Optimization

Sponsor: Optimization/ Linear and Conic Optimization

Sponsored Session

Chair: Katya Scheinberg, Lehigh University, 200 West Packer ave,, Bethelehem, PA, 18015, United States of America, katyas@lehigh.edu

1 - Distributed Coordinate Descent Method for Learning with Big Data

Martin Takac, Lehigh University, 27 Memorial Drive West, Bethlehem, United States of America, martin.taki@gmail.com, Peter Richtarik

We initially partition the coordinates (features) and assign each partition to a different node of a cluster. At every iteration, each node picks a random subset of the coordinates from those it owns, independently from the other computers, and in parallel computes and applies updates to the selected coordinates based on a simple closed-form formula. We give bounds on the number of iterations sufficient to approximately solve the problem with high probability.

2 - Stochastic Approximation Schemes for Stochastic Optimization with Imperfect Information

Uday Shanbhag, Pennsylvania State University, 310 Leonhard Building, University Park, PA, 16803, United States of America, udaybag@engr.psu.edu, Hao Jiang

We consider the solution of a stochastic convex optimization problem complicated by a parametric misspecification. We assume that this misspecification may be resolved by the solution of a suitable defined convex learning problem. To resolve the absence of convergent efficient schemes, we present a coupled stochastic approximation scheme (with rate estimates) which simultaneously solves the computational and the learning problems.

3 - A Dynamic Penalty Parameter Updating Strategy for Matrix-free SQO Methods

Hao Wang, Lehigh University, H.S. Mohler Laboratory, 200 West Packer Avenue, bethlehem, pa, 18015, United States of America, haw309@lehigh.edu, James V. Burke, Frank E. Curtis, Jiashan Wang

A penalty parameter updating strategy is proposed within a penalty-SQO algorithm for solving nonlinear optimization problems. Our strategy dynamically updates the penalty parameter during the solution process for each subproblem, producing a search direction that simultaneously predicts progress towards feasibility and optimality. We prove that our strategy yields reasonable (not excessively small) values of the penalty parameter and illustrate the behavior of our strategy via numerical test.

4 - Non-linear Label Ranking for Large-scale Prediction of Long-Term User Interests

Mihajlo Grbovic, Yahoo Labs, 701 First Avenue, Sunnyvale, CA, 94089, United States of America, mihajlo@yahoo-inc.com, Vladan Radosavljevic, Nemanja Djuric, Narayan Bhamidipati

We consider the problem of personalization of online services from the viewpoint of ad targeting. We propose to address this problem as a task of ranking the ad categories depending on a user's preference, and introduce a novel label ranking approach capable of efficiently learning non-linear, highly accurate models in large-scale settings. Experiments on real-world advertising data set with more than 3.2 million users show that the proposed algorithm outperforms the existing solutions.

■ MA53

Hilton- Taylor A

Portfolio Planning

Cluster: Optimization in Finance

Invited Session

Chair: John Birge, Jerry W. and Carol Lee Levin Professor of Operations Management, University of Chicago Booth School of Business, 5807 S Woodlawn Ave, Chicago, IL, 60637, United States of America, john.birge@chicagobooth.edu

1 - Comparing Front-end Load and Balance Fees in Individual Account Pension Systems

Luis Chavez-Bedoya, Research Professor, Esan Graduate School of Business, Alonso de Molina 1652, Surco, Lima, Peru, l.chavezbedoya@gmail.com

We study the effect of risk aversion and density of contribution on the comparison of proportional charges on flow (contributions) and balance (assets) during the accumulation phase of a defined contribution pension under the system of individual accounts. Theoretical results are shown when the comparison is done through expected utility of terminal wealth, expected terminal wealth and the inverse of its coefficient of variation.

2 - Expected Utility Maximization in Large-scale Portfolio Optimization

Gerd Infanger, Department of Management Science and Engineering, Stanford University, Stanford, CA, 94305, infanger@stanford.edu

We discuss a new approach of expected utility maximization for large-scale portfolio optimization when asset returns are represented via a factor model (fundamental, economic and/or statistical). We show how to obtain equilibrium returns and discuss active management based on factor exposures. Expected utility maximization is more general than mean-variance optimization and can better consider fat tails in asset return distributions. Numerical results are discussed.

3 - Heuristic Algorithms for Financial Model Calibration

Amber Zhang, IBM, 185 Spadina Ave, Toronto, Canada, Amber.Zhang@ca.ibm.com, Asif Lakhany, Helmut Mausser

Estimating the parameters of a financial model is an important part of any pricing framework. Calibration tries to find the parameter values that minimize the discrepancy between model and market prices. Heuristic search methods, which can escape from local minima, are an effective alternative to commonly-used gradient-based methods. We develop heuristic algorithms to calibrate the parameters of a two factor Hull-White interest rate model.

■ MA54

Hilton- Taylor B

Stochastic Control and Optimal Stopping in Finance

Sponsor: Financial Services Section

Sponsored Session

Chair: Hongzhong Zhang, Assistant Professor, Columbia University, 1255 Amsterdam Ave, New York, NY, 10027, United States of America, hz2244@columbia.edu

Co-Chair: Xuedong He, Assistant Professor, Columbia University, 316 Mudd, 500 W. 120th street, New York, NY, 10027, United States of America, xh2140@columbia.edu

1 - Optimal Stopping Problems in Diffusion-type Models with Running Maxima and Drawdowns

Neofytos Rodosthenous, Lecturer Financial Mathematics, Queen Mary, University of London, Mile End Rd, London, E1 4NS, United Kingdom, N.Rodosthenous@qmul.ac.uk, Pavel Gapeev

We study optimal stopping problems related to the pricing of perpetual American options. We consider a risky asset with dividend and volatility rates depending on its maximum and maximum drawdown processes. We obtain closed-form solutions to the equivalent free-boundary problems for the value functions in the state space of the resulting 3-dimensional Markov process. The 2-dimensional optimal stopping boundary functions are characterized by 1st-order nonlinear ordinary differential equations.

2 - A Super-solution Based Iterative Approach for Stochastic Dynamic Programming

Nan Chen, The Chinese University of Hong Kong, 609 William Mong Engineering Building, Hong Kong, Hong Kong - PRC, wyu@se.cuhk.edu.hk, Nan Chen

We use the information relaxation technique to develop a value-and-policy iterative method to solve stochastic control problems. In each iteration, an upper bound for the true value function and a suboptimal policy with its corresponding value (a lower bound) are obtained so that we can use the gap between the bounds to measure the quality of the policy. Our iterative approach also points to a systematic way to improve heuristic policies widely used in large-scaled control problems.

3 - Realization Utility with Adaptive Reference Points

Linan Yang, Columbia University, United States of America, ly2220@columbia.edu

We consider a dynamic stock liquidation problem in which an investor decides when to sell a stock to maximize her realization utility with reference points adaptive to prior gains and losses. We study both theoretically and numerically the trading strategies and asset pricing implications of three types of investors: those who don't realize the reference point adaptation, those who realize but fail to adjust their strategies for the adaptation, and those who are able to do the adjustment.

4 - Optimal Multiple Stopping with Negative Discount Rate and Random Refraction Times under Levy Models

Hongzhong Zhang, Assistant Professor, Columbia University, 1255 Amsterdam Ave, New York, NY, 10027, United States of America, hz2244@columbia.edu, Tim Leung, Kazutoshi Yamazaki

We study an optimal multiple stopping problem driven by Levy processes. Our model allows for a negative effective discount rate, which arises in a number of financial applications such as stock loans and real options. Moreover, successive exercise opportunities are separated by i.i.d. random refraction times. Under a wide class of Levy models, we rigorously show that the optimal strategy to exercise successive call options is uniquely characterized by a sequence of up-crossing times.

■ MA55

Hilton- Van Ness

Expediting Global Optimization Algorithms via Special Mathematical Structure

Sponsor: Optimization/Global Optimization & MINLP

Sponsored Session

Chair: Ruth Misener, Royal Academy of Engineering Research Fellow, Imperial College London, South Kensington Campus, London, United Kingdom, r.misener@imperial.ac.uk

1 - Undercover: A Primal MINLP Heuristic Exploring a Largest Sub-MIP

Timo Berthold, Fair Isaac Europe Ltd, Takustr. 7, Berlin, 10551, Germany, timoberthold@fico.com, Ambros Gleixner

We present Undercover, a primal heuristic for nonconvex MINLP that explores a linear sub-MIP of a given MINLP. Therefore, we identify a smallest set of variables to fix, a so-called cover, such that each constraint is linearized. It turns out that many instances allow for small covers. Although general in nature, we show that the heuristic is most successful on MIQCPs.

2 - A Second Order Multilevel Algorithm for Nonconvex Optimization

Chin Pang Ho, Imperial College London, South Kensington Campus, London, SW7 2AZ, United Kingdom, c.ho12@imperial.ac.uk

Using classical methods, it does not seem possible to overcome the well known curse of dimensionality in nonconvex optimization. However, high-dimensional systems often behave as if governed by a model with only few degrees of freedom. In this talk we discuss how to make systematic use of low dimensional models to speed up the computations in second order optimisation algorithms such as Newton method. We discuss the convergence rate and its application to problem of exploring energy landscapes.

3 - A New Relaxation Technique for Nonconvex Stochastic Programs with Continuous Random Variables

Joseph Scott, Assistant Professor, Clemson University, 206 S. Palmetto Blvd, 207B Earle Hall, Clemson, SC, 29634, United States of America, jks9@clemson.edu

We consider the global solution of nonconvex stochastic optimization problems with expected-value objectives, continuous and compactly supported random variables, and no recourse decisions. This problem is common in engineering design applications including power generation from renewable resources. We present a method for computing underestimating programs that are convex, rigorously account for sampling error, and are convergent, enabling the use of branch-and-bound optimization algorithms.

■ MA56

Hilton - Green Room

Software Demonstrations

Cluster: Software Demonstrations

Invited Session

1 - AnyLogic North America - AnyLogic Demonstration

Nikolay Churko, Head of Department, AnyLogic, 53 Frontage Road, Hampton, NJ, 08827, United States of America, nikolay@anylogic.com

AnyLogic is a System Dynamics, a Discrete Event and an Agent Based tool at the same time. This gives you a great advantage as you can tailor the modeling approach to best fit your challenge. On the other hand, with AnyLogic you are frequently facing the choice of the right techniques and methodologies. Our AnyLogic demonstration serves two goals: first, to give you a tour through AnyLogic modeling language, second, to teach you how to select the right approach and abstraction level.

2 - ExtendSim Simulation Software

David Krahl, Imagine That, Inc., 6830 Via Del Oro, Suite 230, San Jose, CA, 95119, United States of America, davek@extendsim.com

ExtendSim is a multi-domain simulation environment in which you can dynamically model continuous, discrete event, discrete rate, agent-based, and mixed-mode systems. The authoring environment facilitates the building of front ends that simplify model interaction and enhance communication. Core features such as hierarchy, built-in relational database, evolutionary optimization, and interactive modeling make ExtendSim models more engaging and easier to experiment with. Use ExtendSim to achieve your modeling objectives rapidly and be assured success.

■ MA64

Parc- Cyril Magnin I

Matching in Markets

Sponsor: Applied Probability Society

Sponsored Session

Chair: Ciamac Moallemi, Barbara and Meyer Feldberg Associate Professor of Business, Columbia Business School, 3022 Broadway, Uris 416, New York, NY, 10027, United States of America, ciamac@gsb.columbia.edu

Co-Chair: Costis Maglaras, Columbia Business School, New York, NY, United States of America, cm479@columbia.edu

1 - Dynamic Matching Markets with an Application in Residential Real Estate

Hua Zheng, Columbia Business School, 3022 Broadway, Uris 4S, New York, NY, 10027, United States of America, hzheng14@gsb.columbia.edu, Ciamac Moallemi, Costis Maglaras

We study a dynamic microstructure model of a dynamic market where buyers and sellers arrive stochastically over time, and are heterogeneous with respect to their product characteristics and preferences and their idiosyncratic financial information. We analyze its dynamics, market depth, and buyer/seller bidding strategies. The motivating application stems from residential real estate.

2 - Optimal Allocation without Money: An Engineering Approach

Itai Ashlagi, MIT, 100 Main st., Cambridge, MA, United States of America, iashlagi@mit.edu, Peng Shi

We study the allocation of heterogeneous services to agents without monetary transfers under incomplete information. The social planner's goal is to maximize a possibly complex public objective. We take an ``engineering" approach, in which we solve a large market approximation, and convert the solution into a feasible finite market mechanism that still yields good results. We apply this framework to real data from Boston to design a mechanism that assigns students to public schools.

3 - Managing Congestion in Dynamic Matching Markets

Nick Arnosti, Stanford University, Stanford, CA, United States of America, narnosti@stanford.edu, Yash Kanoria, Ramesh Johari

It is often costly for agents in matching markets to determine whether potential partners are interested in forming a match. This creates friction in the marketplace, lowering welfare for all participants. We use a dynamic model to quantitatively study this effect. We demonstrate that by reducing visibility, the market operator may benefit both sides of the market. Somewhat counter-intuitively, benefits of showing fewer sellers to each buyer are greatest when there is a shortage of sellers.

■ MA65

Parc- Cyril Magnin II

Diffusion Models for Queues

Sponsor: Applied Probability Society

Sponsored Session

Chair: Shuangchi He, National University of Singapore, 1 Engineering Drive 2, Singapore, 117576, Singapore, heshuangchi@nus.edu.sg

Co-Chair: Jim Dai, Cornell University, 226 Rhodes Hall, Cornell University, 136 Hoy Road, Ithaca, NY, 14853, United States of America, jd694@cornell.edu

1 - Further Reflections on Reflected Brownian Motion in the Octant

John Hasenbein, University of Texas at Austin, Grad Program in OR/IE, Austin, United States of America, jhas@mail.utexas.edu, Ziyu Liang

This work is an extension of earlier work on optimal paths in large deviations for rotationally symmetric RBM in the octant. In particular, for the Harrison-Reiman case, we show that only gradual paths can be optimal. Furthermore, we show that, unlike the general case, spiral optimal paths are not optimal in this case. This conforms with the intuition that approximations of single-class queueing networks are more well-behaved than those for multiclass networks.

2 - SRBM, Geometric Views, and Optimal Paths

Jim Dai, Cornell University, 226 Rhodes Hall, Cornell University, 136 Hoy Road, Ithaca, NY, 14853, United States of America, jd694@cornell.edu, Masakiyo Miyazawa

For a multidimensional semimartingale reflecting Brownian motion (SRBM), I will first describe a geometric condition for the existence of product-form stationary distribution (Dai, Miyazawa and Wu 2014). I will then discuss a connection between this condition and the "entrance velocity" of the optimal path for the associated variational problem. Examples and conjectures will be presented.

3 - Hazard Rate Scaling for the G/M/1+G Processor Sharing Queue

Josh Reed, New York University, 44 W 4th St, New York, NY, 10012, United States of America, jreed@stern.nyu.edu, Guodong Pang, Bert Zwart

We study the G/M/1+G processor sharing queue. In our first result, under the assumption of Poisson arrivals and exponential abandonment distributions, we provide a partial differential equation satisfied by the Laplace transform of the sojourn time distribution of an infinitely patient customer arriving to the system and requesting service. In our second set of results, we obtain diffusion approximations to several performance measures of the system.

4 - A Diffusion Model for Efficiency-Driven Queues

Shuangchi He, National University of Singapore, 1 Engineering Drive 2, Singapore, 117576, Singapore, heshuangchi@nus.edu.sg

We propose a one-dimensional diffusion model for GI/GI/n+GI queues in an overloaded regime. Using this model, we obtain performance formulas, including the distributions of the steady-state queue length and virtual waiting time, for service level estimation in efficiency-driven call centers. The proposed diffusion model and performance formulas are justified by limit theorems. We prove the convergence of queue length and virtual waiting time processes when they are scaled in both space and time.

■ MA66

Parc- Cyril Magnin III

QSR Best Student Paper Competition

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Hui Yang, Assistant Professor, University of South Florida, 4202 East Fowler Avenue, ENB 118, Tampa, FL, 33620, United States of America, huiyang@usf.edu

1 - Reliability of Systems with Spatially Distributed Units

Dingguo Hua, Graduate Student, Rutgers University, Department of Industrial and Systems Eng, Rutgers University, Piscataway, NJ, 08854, United States of America, hua.dingguo@gmail.com, Elsayed Elsayed

The reliability of systems with spatially distributed units has emerged as an important topic in aerospace and military industries. In this paper, we investigate spatially distributed k-out-of-n pairs:G balanced systems with different requirements. Reliability and other metrics such as time to a specified failure are estimated.

2 - Optimal Supersaturated Design via Lasso

Dadi Xing, Purdue University, 210 Airport Rd, Apt 4, West Lafayette, IN, 47906, United States of America, dxing@purdue.edu, Michael Yu Zhu, Hong Wan

In the supersaturated design(SSD)study, most existing criteria for constructing optimal SSD are motivated and further justified from the estimation perspective. We will propose a number of optimality criteria for the construction of SSD from the perspective of penalized variable selection methods. The properties of these criteria will be discussed. A computing algorithm will be used to construct such optimal SSD, examples of simulation and an application of the algorithm will also be presented.

3 - Heterogeneous Time-to-event Data Modeling and Inference with an Unknown Number of Sub-populations

Mingyang Li, University of Arizona, 1127 James E. Rogers Way, Tucson, AZ, 85721, United States of America, mingyangli@email.arizona.edu

A Bayesian non-parametric model is proposed to model heterogeneous time-to-event data by assuming an unknown number of sub-populations and quantifying influence of covariates. An inference algorithm is further proposed to achieve joint model estimation and selection and to deal with non-conjugate priors.

4 - Non-crossing Quantile Regression Processes Based on Monotone B-splines

Yuan Yuan, Student, University of Wisconsin-Madison, 1513 University Ave, room 3255, Madison, WI, 53706, United States of America, yyuan4@wisc.edu, Nan Chen, Shiyu Zhou

In this paper, we solve the well-known problem, i.e. crossing of multiple quantile curves, by developing a model based on monotone B-splines. We have also developed a procedure to adaptively select variables and reduce model complexity. Numerical studies illustrate its effectiveness well. The proposed model is also applied to study how wind characteristics affects the wind power generation.

■ MA67

Parc- Balboa

Reliability Analysis and Fault Management for Complex Engineering Systems

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Qingyu Yang, Assistant Professor, Wayne State University, 4815 fourth street, Detroit, United States of America, qyang@wayne.edu

1 - Maintenance Policies for Complex Systems with Stochastic and Economic Dependent Components

Linkan Bin, Assistant Professor, Mississippi State University, lb1425@msstate.edu, Nagi Gabraeel

Methods that study the maintenance of complex systems focus on policies based on independent components. We develop a dynamic maintenance policy that accounts for both economic dependence due to shared set-up costs and stochastic dependence resulting from the interactions among the degradation processes by grouping maintenance activities. We show in the numerical studies that the total maintenance cost of the system is significantly reduced by incorporating both types of component dependence.

2 - Optimal Maintenance and Parts Reordering for a One-unit System with a Deteriorating Spare Part

Hongwei Luo, Research Assistant, University of Arizona, 1127 E. James E. Rogers Way Room 111, P.O. Box 210020, Tucson, AZ, 85721, United States of America, harveyluo@email.arizona.edu, Haitao Liao

In this research, we consider an operating system with one-unit operating component and a deteriorating on-site spare part. The goal of this study is to derive the long-run average cost during the maintenance cycle by introducing related costs and also determine the optimal spare part replacement and reordering policy to minimize the cost. Numerical examples are provided to illustrate the use of the model in practice.

3 - Reliability Assessment during a Product's Early Design Stage using Bayesian Networks

Petek Yontay, Arizona State University, 699 S Mill Ave, Tempe, AZ, 85281, United States of America, pyontay@mainex1.asu.edu, Luis Mejia, Rong Pan

In this research, we propose a Bayesian Network model for reliability prediction of a new product at its conceptual design stage. We focus on the concept of integrating functional analysis with the product failure information derived from multiple sources such as historical data from parent products and expert opinions. We will demonstrate our methodology with an industrial example.

4 - A Physical-Statistical Model of Overload Retardation in Crack Propagation under Cyclic Loading

Wujun Si, Wayne State University, 4815 fourth street, Detroit, MI, 48202, United States of America, wujun.si@wayne.edu, Qingyu Yang

Reliability analysis for units subjected to cyclic stress loading has been intensively studied under the assumption that the loading stress is ideally periodic. In reality, however, many factors such as overloads during cyclic loading will have a remarkable effect on unit life prediction. In this paper, a physical-statistical model is proposed to capture the overload retardation effect in crack propagation. An experiment is designed and conducted to verify the developed model.

■ MA68

Parc- Davidson

Recent Advances in Simulation-Based Optimization

Sponsor: Simulation

Sponsored Session

Chair: Jie Xu, Assistant Professor, George Mason University, 4400 University Dr., MS 4A6, Fairfax, VA, 22030, United States of America, jxu13@gmu.edu

1 - Multi-objective Particle Swarm Optimization

Loo Hay Lee, Associate Professor, National University of Singapore, 10 Kent Ridge Crescent, Singapore, Singapore, iseleelh@nus.edu.sg, Ek Peng Chew, Haobin Li

Particle Swarm Optimization (PSO) is a popular search method for single objective problem. In this talk, we will demonstrate how the PSO can be extended to tackle the multi-objective problems. Through the numerical runs, we will show the promising performance of this algorithm. We will also discuss how the approach can be extended for stochastic problem.

2 - Stochastically Constrained Simulation Optimization on Integer Lattices

Raghu Pasupathy, Associate Professor, Purdue University, Dept. of Statistics, West Lafayette, United States of America, pasupath@vt.edu, Kalyani Nagaraj

We present theoretical and implementation details of a random-restarts solver for solving constrained simulation optimization problems on integer lattices. Our theory and implementation is particularly sensitive to the difficult context where the stochastic constraints are binding. We will discuss choice of constraint relaxation, relationship between restarts and sample size, and consistency/efficiency.

3 - Gradient-based Adaptive Stochastic Search for Simulation Optimization over Continuous Space

Enlu Zhou, Georgia Institute of technology, 755 Ferst Drive, NW, Atlanta, GA, 30319, United States of America, enlu.zhou@isye.gatech.edu, Shalabh Bhatnagar

We extend the idea of model-based algorithms for deterministic optimization to simulation optimization over continuous space. Our idea starts with reformulating the original simulation optimization problem into another optimization problem over the parameter space of the sampling distribution, and thus we can use a direct gradient search on the parameter space to update the sampling distribution. To improve the computational efficiency, we further develop a two-timescale updating scheme.

4 - Developing an Agent-based Model for Cardiovascular Health
Yan Li, Purdue University, West Lafayette, IN, 47907, United States of America, li528@purdue.edu, Jose Pagan, Mark Lawley, Nan Kong

Cardiovascular disease (CVD) is the leading cause of death in the U.S. We develop an agent-based model to capture individual health progression and social influencing on health behaviors, as well as study emergent CVD-related population health outcomes (e.g., diabetes, MI, stroke, death). The numerical results demonstrate predictive validity of the model and show how it can be used in practice by assessing the impact of various hypothetical lifestyle interventions on CVD-related outcomes.

■ MA69

Parc- Fillmore

Applications of OR in Bioenergy

Sponsor: Energy Natural Resources and the Environment/ Sustainability and Environment

Sponsored Session

Chair: Sandra D. Eksioglu, Associate Professor, Department of Industrial Engineering, Clemson University, 134 Freeman Hall, Clemson, SC, 29634, United States of America, seksiog@clemson.edu

1 - Designing a Reliable and Dynamic Intermodal Hub and Spoke Supply Chain for Biomass
Mohammad Marufuzzaman, Mississippi State University, Industrial & Systems Engineering, PO Box 9542, Starkville, MS, 39762, United States of America, maruf237@gmail.com, Sandra D. Eksioglu

The objective of this paper is to design cost-efficient and reliable supply chain networks for biomass delivery to biofuel plants. We propose a dynamic, mixed integer nonlinear programming model that is solved using a Benders based rolling horizon algorithm. Numerical experiments show that the proposed algorithm can solve large scale problem instances to a near optimal solution in a reasonable time.

2 - A Hub-and-Spoke Supply Chain Design with Multi-objective Analysis for Cellulosic Biofuel
Md Roni, Computational Energy Analyst, Idaho National Laboratory, PO BOX 1625, Idaho Falls, Id, 83401, United States of America, mohammad.roni@inl.gov, Jacob Jacobson, Hadi Karimi, Kara Cafferty

We propose a multi-objective, hub-and-spoke model to design the supply chain for biofuels. The multi-objective optimization model captures the trade-offs that exist between costs, environmental and social impacts of delivering biofuels. The multi-objective, mixed-integer, linear programming model is solved using an augmented ?-constraint method. In order to perform the multi-objective analysis, we develop a case study using data from the Midwest region of the USA.

3 - Models for Analyzing the Impact of Production Tax Credit on Renewable Electricity Production
Sandra D. Eksioglu, Associate Professor, Department of Industrial Engineering, Clemson University, 134 Freeman Hall, Clemson, SC, 29634, United States of America, seksiog@clemson.edu

This work is focused on using biomass for co-firing in coal-fired power plants. We develop models to capture the impact of the production tax credit (PTC) on renewable electricity production. The existing PTC is a flat tax credit that is not affected by the amount of renewable electricity produced, plant capacity, etc. We develop a case study and use numerical analysis to compare renewable electricity production through the existing PTC scheme and all-units, and incremental discount schemes.

4 - Stochastic Biomass Logistics Network Design under Price-based Supply
Gokhan Memisoglu, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, gmemis@tamu.edu, Halit Uster

We present a two-stage stochastic program to construct biomass logistics networks under price dependent biomass supply at farms and yield uncertainty. An efficient solution approach based on Sample Average Approximation (SAA) and an analysis of the relationship between price and the network structure decisions are presented.

■ MA70

Parc- Hearst

Natural Hazard Management

Sponsor: Energy Natural Resources and the Environment/ Natural Resources

Sponsored Session

Chair: Steffen Rebennack, Colorado School of Mines, 1500 Illinois Street, Golden, 80401, United States of America

Co-Chair: Vitaliy Krasko, Colorado School of Mines, United States of America

1 - Optimal Treatment Strategies for Invasive Species Control under Dispersal Uncertainty
Eyyüb Kibis, Research Assistant, Wichita State University, 1845 Fairmount St., Wichita, KS, 67260, United States of America, eyyubyunus@gmail.com, Esra Büyüktahtakin

In this study, we present a mixed integer linear programming method for invasive species control. The study integrates the biological characteristics of invasive species into a complex spatially explicit model which stimulates the stochastic seed dispersal behavior of an invasive weed in Kansas.

2 - A Stochastic Dynamic Programming Model of Large Wildfire Management
Matthew Thompson, Research Forester, Rocky Mountain Research Station, US Forest Service, Missoula, MT, 59802, United States of America, mpthompson02@fs.fed.us

Previous research has shown that the dynamics of large wildfire incidents can be represented as a Markov chain, capturing the effects of environmental variation and partial control on incident management decisions through time. Here that work is expanded to consider a stochastic dynamic programming formulation to help fire managers determine the optimal organizational capacity as a function of current incident complexity, suppression cost, and density of at-risk resources and assets.

4 - Some Thoughts on Human Resources Analytics
Hila Chalutz, Tel Aviv Afeka College of Engineering, Tel Aviv, Israel, Hilab@afeka.ac.il, Gonen Singer

The paper examines predictive capabilities of service organizations in regards to client success measures based on human resources data. The precision framework of human factors is of paramount importance when predicting client success. The paper provides evidence that predicting client's human resources variables play a vital role on service success in the long run. This approach may assist practitioners to invest the appropriate resources throughout the service delivery process. The paper also provides evidence that service organizations can be selective in regards to their clients based on predetermined criteria.

3 - Natural Hazard Management for Post-Wildfire Debris Flows
Vitaliy Krasko, Colorado School of Mines, Division of Economics and Business, Golden, CO, United States of America, vkrasko@mines.edu, Paul Santi, Kevin McCoy, Timo Lohmann, Steffen Rebennack, Daniel Kaffine

The focus of this talk is a natural-social science optimization model that provides guidance for allocating mitigation funds towards reducing the economic impacts of post-wildfire debris flows. The model minimizes expected damages by optimally allocating funds into mitigation treatments across individual drainage basins that decrease the probability of an event and/or reduce the volume conditional on occurrence. Several case studies are presented.

4 - An Agent-based Modeling of a Multimodal Near-field Tsunami Evacuation: Decision-Making and Life Safe
Haizhong Wang, Assistant Professor, Oregon State University, 101 Kearney Hall, Corvallis, OR, 97331, United States of America, Haizhong.Wang@oregonstate.edu, Dan Cox, Lori Cramer

The goal of this research is to investigate the impacts of different evacuee decision-making time on the estimation of casualties in a multi-modal tsunami evacuation. We are using NetLogo to simulate the evacuee decision-making process in a near-field tsunami evacuation scenario. The simulation results would provide the coastal community an effective evacuation decision making guidelines for a tsunami event, minimizing the loss of life in the limited warning time.

5 - Estimating the Burn Probability of the Forest Reserve of Bogota, Colombia
Ridley S. Morales, Universidad de los Andes, Cra 1 Este No 19A - 40, Bogota, DC, 0000, Colombia, rs.morales64@uniandes.edu.co, Gilberto Morales, Carlos Felipe Valencia, Raha Akhavan Tabatab

Forest fires are time evolving disasters that consume environmental and financial resources, endangering the rescue units that try to mitigate them. In this study, we use simulation integrated with Geographic Information Systems (GIS) to map the burn probability of the forest reserve of Bogot·. This study is conducted in collaboration with Bogota's Fire Department, with the goal of providing a tool for long-term planning in fire prevention activities.

■ MA71

Parc - Lombard

Auctions for Procurement

Cluster: Auctions

Invited Session

Chair: Sasa Pekec, Duke University, Durham, NC, United States of America, pekec@duke.edu

1 - Budget Constrained Procurement

Giuseppe Lopomo, giuseppe.lopomo@duke.edu, Alexandre Belloni, Roberto Steri, Leslie Marx

We characterize optimal mechanisms for a financially constrained buyer facing multiple suppliers with privately known costs. We first establish the optimality of a simple direct mechanism, using basic duality, within the class of all mechanisms with a dominant strategy equilibrium. We then provide a dynamic implementation, and calibrate the parameters of our model to data and show numerically that our mechanism outperforms auctions formats currently used by the Brazilian government and the FCC.

2 - Split-Award Procurement Auctions – Can Bayesian Equilibrium Strategies Predict Bidding Behavior?

Martin Bichler, mar.bichler@gmail.com, Kemal Guler, Stefan Mayer

We analyze to which extent Bayes Nash equilibrium predictions can explain human bidding behavior in sealed-bid split-award auctions with ex ante split decisions. There was no significant difference to the risk-neutral Bayes Nash equilibrium bid function in computerized experiments in the lab where bid functions are reused, however, there was underbidding in human subject experiments. The experiments suggest that strategic complexity does not serve as an explanation for underbidding.

3 - Split Award Auctions: Insights from Theory and Experiments

Damian Beil, Associate Professor, Stephen M. Ross School of Business, University of Michigan, 701 Tappan St, Ann Arbor, MI, 48109, United States of America, dbeil@umich.edu, Aadhaar Chaturvedi, Elena Katok

We consider two (sealed and open) split-award auction formats where the buyer announces the award splits before the auction. We show revenue equivalence between the two formats and find that for non-regular cost distributions more multi-sourcing might actually reduce the buyer's overall expected payment. Lab experiments indicate that revenue equivalence fails, and the buyer's expected payment in a sealed-bid auction may decrease with more multi-sourcing even with regular distributions.

■ MA72

Parc- Stockton

Study of Reliability and Security in Power Systems

Sponsor: Energy, Natural Res & the Environment/ Energy

Sponsored Session

Chair: Bo Zeng, Assistant Professor, University of South Florida, 4202 E Fowler Ave, Tampa, FL, 33620, United States of America, Bzeng@usf.edu

1 - Demand Response Portfolio Management via Robust Optimization

Andy Sun, Assistant Professor, Georgia Institute of Technology, 765 Ferst Drive NW, Atlanta, GA, 30332, United States of America, andy.sun@isye.gatech.edu

We consider the demand response (DR) portfolio management problem faced by demand response service providers, where the portfolios are composed of a large number of commercial and industrial organizations. We construct new mixed-integer optimization models to describe the specific dynamics of such DR resources. Then we propose a robust optimization model with a new type of uncertainty sets to model the realization uncertainty of DR. We will discuss solution methods and preliminary test results.

2 - The Value of a Spare Transformer Inventory to an Electric Power Grid's Security against Attack

Wood Kevin, Professor, Naval Postgraduate School, Operations Research Dept., Glasgow Hall, Monterey, CA, 93943, United States of America, kwood@nps.edu, Javier Salmeron

We develop an attacker-defender model for an electric power grid in which certain high-voltage transformers (HVTs) damaged by an attacker can be replaced quickly with inventoried spares. The model can help guide a utility company's inventory strategy for HVTs. Global Benders decomposition solves the model, which includes a mixed-integer subproblem that extends a DC power flow model. A new enumerative solution of the master problem shows great promise for improving efficiency.

3 - Detect Unobservable Attacks with Phasor Measurement Units

Feng Pan, Los Alamos National Laboratory, M.S. C933, Los Alamos, NM, 87545, United States of America, fpan@lanl.gov, Annarita Giani, Russell Bent, Kameshwar Pooll

There've been increasing concerns about cyber-attack to power grids, partly due to the reliance on remote sensing. We first discuss unobservable attacks and introduce a bilevel program to model such attacks. Under sparse attacks, we show that enumerating upper-level extreme point is sufficient to get an optimal solution and is more efficient than KKT based approaches. We then introduce a model for placing phasor measurement units to detect unobservable attacks and present our empirical studies.

4 - Investment of Wind Power with Dynamic Topology in a Market Environment

Yifan Wang, University of South Florida/Northeastern University, China, 3707 Jefferson Commons DR., apt 202, Tampa, FL, 33613, United States of America, yifanw@mail.usf.edu, Bo Zeng, Shixin Liu

We consider wind plant installation within an existing grid operated within an electricity market. A bi-level model is formulated with the consideration of intentional transmission line switching off. A novel algorithm is implemented to solve the problem in an efficient way.

■ MA73

Parc- Mission I

Investment in Renewables & CCS Technology and Cost of Renewables

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Nur Sunar, University of North Carolina at Chapel Hill, Nur_Sunar@kenan-flagler.unc.edu

1 - Incentives for Early Adoption of Carbon Capture Technology

Stephen Comello, Stanford Graduate School of Business, 655 Knight Way, Stanford, CA, 94305, United States of America, scomello@stanford.edu, Stefan Reichelstein

We analyze a policy proposal for regulating future electricity power plants in the U.S. The cornerstone of this regulation is an emission standard of 80 kg CO2/MWh, beginning in 2027 for all plants that come into operation after 2017. Initial compliance costs are high, yet learning effects reduce this cost by 2027, provided all plants adopt carbon capture in the intervening years. We identify a set of tax credits that provide the required incentive to comply with the standard before the mandate.

2 - Cost- and Price Dynamics of Solar PV Modules

Anshuman Sahoo, PhD Candidate, Stanford University, 473 Via Ortega, Stanford, CA, 94305, United States of America, asahoo@stanford.edu, Stefan Reichelstein

Recent solar module price declines have exceeded those predicted by an 80% learning curve that has characterized prices. We develop a dynamic model of a competitive module industry; the equilibrium price, which we call the economically sustainable price (ESP), equals the long-run marginal cost. Comparing ESPs to selling prices, we find that the dramatic price reductions were due to excess capacity. We extrapolate a trajectory of future costs to which equilibrium prices should converge over time.

3 - A Decision Support Tool for Assessing the Installation Logistics of an Offshore Wind Farm

Euan Barlow, Department of Management Science, University of Strathclyde, Glasgow, United Kingdom, euan.barlow@strath.ac.uk, Diclehan Tezcaner Ozturk, Evangelos Boulougouris, Kerem Akartunali, Sandy Day, Matthew Revie

This study describes a simulation tool designed to support decision makers during the planning and bidding phase of an offshore wind farm (OWF) installation. Duration and costs of an installation scenario subject to uncertain weather conditions are modelled, and different installation scenarios compared. A case study of an OWF installation explores the impact of key logistical decisions, such as installation fleet composition and vessel scheduling. Recommendations on good practice are proposed.

4 - Diffusion Networks of Residential Solar Panels

Sebasti·n Souyris, Ph.D. Candidate, The University of Texas at Austin, 1652 W 6th St Apt P, Austin, TX, 78703, United States of America, sebastian.souyris@utexas.edu, Varun Rai

We investigate the diffusion of residential solar panels in Texas using a novel point process approach. We collect a unique data set at disaggregate household level that allows us to understand how the demographic and economic characteristics influence the adoption decision. We project the dynamics of the market; thereby, giving insights about where the developers should focus their customer acquisition efforts and what type of policies are more efficient to incentivize the adoption.

■ MA74

Parc- Mission II

Design and Control of Energy Systems

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Jay Rosenberger, Associate Professor, University of Texas Arlington, P.O. Box 19017, Arlington, TX, 76019, United States of America, jrosenbe@uta.edu

1 - Sustainable Design of Plug-in Hybrid Electric Vehicle Charging Stations Considering Service Level

Amirhossein Khosrojerdi, University of Oklahoma, 1021 East Brooks St Apt F, Norman, Ok, 73071, United States of America, akhosrojerdi@ou.edu, Janet Allen, Farrokh Mistree, Alexander Rodriguez

We propose a method for considering trade-offs among economic, social and environmental aspects of sustainability when designing a plug in hybrid electric vehicle (PHEV) charging station. Our approach is based on simulations of charging demand of PHEV users and then projecting the charging service level using Multi-Variant Adaptive Regression Splines (MARS) for different design alternatives. We also discuss the impact of various charging scenarios on promoting PHEV adoption.

2 - Hybrid SVM for Market Price Forecasting for the Adaptive Design of PHEV Charging Stations

Piampoom Sarikprueck, The University of Texas at Arlington, 1020 W.Abram St.,, Apt.146, Arlington, TX, 76013, United States of America, piampoom.sarikprueck@mavs.uta.edu, Wei-Jen Lee, Asama Kulvanitchaiyanunt, Victoria Chen, Jay Rosenberger

PHEV charging stations utilized with renewable energy sources and storage device can participate to a deregulated market. The accurate predictions of availability and/or prices of energy sources are essential to minimize the forecast uncertainty for optimal dynamic control. For electric price prediction, hybrid SVM with data clustering techniques is proposed to particularly improve spike price estimation. Future research will analyze forecasting results by Martingale Model Forecast Evolution.

3 - Two-Stage Approach for Controlling a System of Plug-In Hybrid Electric Vehicle Charging Stations

Jay Rosenberger, Associate Professor, University of Texas Arlington, P.O. Box 19017, Arlington, TX, 76019, United States of America, jrosenbe@uta.edu, Wei-Jen Lee, Asama Kulvanitchaiyanunt, Victoria Chen, Piampoom Sarikprueck

This research uses a Design and Analysis of Computer Experiment (DACE) approach to build a metamodel representing the expected value function of a second-stage dynamic control problem in a two-stage framework for plug-in hybrid electric vehicle (PHEV) charging stations. The control problem is formulated and initially solved by the mean value problem using linear programming. The metamodel is developed based on an experimental design over possible solutions from the first stage design problem.

4 - Designing a System of PHEV Electric Charging Stations Considering Market Penetration

Janet Allen, University of Oklahoma, University of Oklahoma, Norman, Ok, 73071, United States of America, janet.allen@ou.edu, Farrokh Mistree, Amirhossein Khosrojerdi

A method is proposed for designing a system of plug-in hybrid electric vehicle charging stations. The rate of the PHEV penetration is projected using a Bass diffusion model, and a simulation model is developed to determine PHEV charging service level of the system for various design scenarios. Finally, a mixed-integer mathematical model is developed to consider the control stage and to design both charging stations (node level decision) and a network of charging stations (network level decision)

■ MA75

Parc- Mission III

Simulation and Optimization I

Contributed Session

Chair: Ingmar Vierhaus, Zuse Institute Berlni, Takustrafle 7, Berlin, 14195, Germany, vierhaus@zib.de

1 - Design and Management of Mobility-on-Demand Systems (MoD) under Uncertainty

Yinghan Deng, National University of Singapore, Blk E1 07-17, 1 Engineering Drive 2, Singapore, Singapore, yinghandeng@nus.edu.sg, Michel Cardin, Amedeo Odoni

This is a first effort to demonstrate the complex interactions between strategic and operational decisions in MoD systems, and provide an effective approach to addressing them. An agent-based simulation model was developed to evaluate the performance of a generic MoD system. A simulation-based optimization approach is then applied to determine the strategy for deploying the system's resources in a way that minimizes both set-up cost and the operating cost associated with load rebalancing.

2 - A Prediction Interval Estimator for the Original Response when using Box-Cox Transformations

Michael Walker, The University of Alabama, 305 Alston Hall, 361 Stadium Dr., Tuscaloosa, AL, United States of America, mlwalker3@crimson.ua.edu, Marcus Perry

Motivated by electron microscopy experiments, we develop an approximate prediction interval on the original response variable Y, where a normal-theory linear model is fit using a transformation on Y from the Box-Cox family. In simulation we assess the performance of our estimators for the mean and variance of Y as well as our proposed interval. We then apply our method to two experimental data sets, one with a standard design, and the other with a split-plot error structure.

3 - Patient and Impatient Pedestrians in a Spatial Game for Egress Congestion

Harri Ehtamo, Professor, AALTO University, Otakaari 1, Espoo, Finland, harri.ehtamo@aalto.fi, Simo Heliövaara

In this study, we present a spatial game theoretic model for pedestrian behavior in situations of exit congestion. The behavioral game model is coupled with a popular social-force egress simulation model. The simulation results to optimize the pedestrian motion are discussed.

4 - Re-Engineering Tree Ensemble Algorithms to Capture Individual-Level Effects for Agent-Based Models

Michael Egner, Senior Vice President, Ipsos, 10567 Jefferson Blvd., Culver City, CA, 90232, United States of America, megner@gmail.com

Tree ensembles are powerful and well-known machine learning classification methods. In this research, we re-engineer these ensembles to split on the magnitude of bivariate or multivariate relationships, in order to transform the trees from classifiers into estimators of individual-level model impacts (e.g., an individual-level estimate of the effect of price on purchase). A real-world business case study applying this method to an agent-based market forecasting model will be discussed.

5 - Layers of Experiments with Adaptive Combined Design

Sungil Kim, Samsung SDS, 512, Samseongro, Gangnamgu, Seoul, Korea, Seoul, Korea, Republic of, sungil.kim@outlook.com

In the field of nanofabrication, where engineers often work with resource-limited experimental budgets, it is essential to involve methodology regarding the selection of experimental regions over batches of experiments. This article proposes such a methodology for sequential design of experiments for batches of experimental runs, termed Layers of Experiments with Adaptive Combined Design (LoE/ACD).

■ MA76

Parc- Embarcadero

Predictive Analytics for Structured and Unstructured Data

Sponsor: The Practice Track

Sponsored Session

Chair: Simon Sheather, Texas A&M University, Department of Statistics, College Station, TX, 99843, United States of America, sheather@stat.tamu.edu

1 - Text Analytics - Today and Tomorrow

Edward Jones, Exec. Vice President, Texas A&M Statistical Services, LP, 4285 Hollowstone Dr., College Station, TX, 77845, United States of America, Edward.Jones@TAMStatServices.com

Applications of text analytics increase daily as analysts develop and explore new techniques for analyzing unstructured data. Integrating text analytics with traditional structured data analysis is an area of increasing interest and opportunity. Analysts are now able to explore not only what people say, but also what they think and feel using text analytics. This paper describes these techniques and presents examples of their use in quality assurance, marketing and politics.

2 - High Performance Statistical Procedures

Mike Speed, Analytical Consultant, SAS Institute, 9312 Lake Forest Ct, S, College Station, TX, 77845, United States of America, mike.speed@sas.com

The SAS high-performance analytics infrastructure forms the backbone of your ongoing analytic endeavors – no matter how big your big data demands get, nor how complex your analysis needs become. While, these procedures are great when you have big data and the infrastructure to do the analyses, these procedures are still very important for those who have a typical desktop and/or laptop. This talk will explore those features.

3 - Predictive Analytics for Structured Data using SAS and JMP

Simon Sheather, Texas A&M University, Department of Statistics, College Station, TX, 99843, United States of America, sheather@stat.tamu.edu

We shall focus on the challenges and issues associated with applying regression methods to big data problems in business. In particular, we will consider the pros and cons of subset selection versus shrinkage methods approach (including lasso and elastic net) to model selection. We will also discuss the use of multiple adaptive regression splines (MARS). Real examples to be discussed include average airline ticket prices and fan interest in NFL games.

■ MA77

Parc- Market Street

Joint Session Analytics/CPMS: Predictive Analytics Applicatons

Sponsor: Analytics & CPMS, The Practice Section

Sponsored Session

Chair: Hila Chalutz Ben-Gal, Dr., Afeka College of Engineering, Industrial Engineering, Tel Aviv, Israel, hilab@afeka.ac.il

1 - Predicting Future Trends by Social Excitement Patterns

Irad Ben-Gal, Professor, Tel Aviv University, Faculty of Engineering, Tel Aviv, Israel, bengal@tau.ac.il, Roi Libman, Hila Chalutz Ben-Gal, Alon Sela

The spread of new ideas has much in common with the spread of viral infections. We will present two works that have used these "Social Hypes Finger Print" in order to predict new hypes. The first work is the "Hot Trends Detector". It predicted the growth of new trends with a success of 80%. The second is the Tweet Advice project that confronted the complex prediction of "hot" stock by analyzing tweets sentiment in combination with the Social Hypes Finger Print.

2 - Project Management Analytics

Hila Chalutz Ben-Gal, Dr., Afeka College of Engineering, Industrial Engineering, Tel Aviv, Israel, hilab@afeka.ac.il

We propose a method to monitor and analyze large-scale projects in order to reduce the uncertainty regarding the project completion time. We show that there are optimal control/observation points for the above purpose. Examples will be given.

3 - Multiclass Classification Based on Random Subspaces, Bagging and Bayesian Inference

Marcelo Bacher, PhD Student, Tel Aviv University, Tel Aviv University, Ramat Aviv, Israel, Tel Aviv, Israel, mgbacher@post.tau.ac.il, Hila Chalutz Ben-Gal

We propose a classification method combining Random Subspace with Bagging and Bayesian inference. We investigated our method on multiclass data containing categorical, numerical and missing values. Moreover, we assume data clusters might overlap, the independence among its features can be violated and the assumption that the data is Gaussian-like distributed does not necessarily hold. Preliminary results show that the proposed method has good potential to cope with the above-mentioned scenarios.

4 - Some Thoughts on Human Resources Analytics

Hila Chalutz,Tel Aviv Afeka College of Engineering, Tel Aviv, Israel, Hilab@afeka.ac.il, Gonen Singer

The paper examines predictive capabilities of service organizations in regards to client success measures based on human resources data. The precision framework of human factors is of paramount importance when predicting client success. The paper provides evidence that predicting client's human resources variables play a vital role on service success in the long run. This approach may assist practitioners to invest the appropriate resources throughout the service delivery process. The paper also provides evidence that service organizations can be selective in regards to their clients based on predetermined criteria.

■ MA78

Parc- Mason

JIPE and IJOR Special Session on Analytics

Sponsor: Analytics

Sponsored Session

Chair: Kuo-Hao Chang, Dep. of Industrial Engineering and Engineering Management, National Tsing Hua University, Taiwan - ROC, chang@mx.nthu.edu.tw

1 - The Ship Routing and Freight Assignment Problem for Daily Frequency Operation of Liner Shipping

Dung-Ying Lin, National Cheng Kung University, 1 University Road, Transportation Management, Tainan City, Ch, 70101, Taiwan - ROC, dylin@mail.ncku.edu.tw

To cope with excess capacity and improve service quality, liner carriers have recently adopted a new operational model known as daily frequency. In this new model, carriers provide daily pickup and delivery service to customers at major ports along the Pacific Rim. We investigate the problem for daily frequency operation of liner shipping and find that Shanghai, Hong Kong and Singapore are ports that are ideal for carriers in establishing daily frequency operations along the Pacific Rim.

2 - Computing the Waiting Time in a Security Check System

Hsing Luh, Professor, Dep. of Mathematical Sciences, National Chengchi University, Taiwan - ROC, orlab63@gmail.com

The objective of this presentation is to introduce a queueing model to assist the Transportation Security Office understand how to design and manage the security wait environment with customers' satisfaction, for example the normal wait time is no more than 30 minutes. To meet the security conditions in practice, such as checks in various security stages, we use a queueing model with service time of semi-Coxian distributions. The semi-Coxian distribution in fact complicates the computation but reflects relatively better estimation than a traditional model. Thus, it is useful both to maintain the security level and to release the tense in the security check points in airports, or international borders.

3 - On Scheduling Recovery Teams for Reaching Shelters in Minimum Time in Disaster Management

I-Lin Wang, Professor, Department of Industrial and Information Management, National Cheng Kung University, Tainan 70101, Taiwan - ROC, ilinwang@mail.ncku.edu.tw

How to rescue people from dangerous regions affected by a disaster in minimum time is usually a top-priority task in humanitarian logistics. We consider a network restoration problem where the time and resources for restoring broken roads (arcs) have been estimated. We aim to schedule the recovery teams of different capabilities to restore roads such that all shelters (nodes) can be reached with minimum time. Efficient algorithms for special cases of our problem will be analyzed and discussed.

4 - Optimal Power Storage Strategy of Hybrid Renewable Energy Systems in Uncertain Environments

Kuo-Hao Chang, Dep. of Industrial Engineering and Engineering Management, National Tsing Hua University, Taiwan - ROC, chang@mx.nthu.edu.tw, Grace Lin

In this paper, we consider the optimal power storage strategy of Hybrid Renewable Energy Systems (HRES) in uncertain environments. The goal is to achieve minimum expected total cost over a finite time horizon, while satisfying the power demand of each area. We propose a simulation model to characterize the operation of HRES and develop a metamodel-based solution method to solve the problem. An extensive computational study shows that the solution method can solve the proposed model of realistic size efficiently, facilitating the decision process in practice.

■ MA79

Parc- Powell I

Panel Discussion: Early DA Applications — What Would We Do Differently Today? A Panel of Early DA Pioneers will Review Their The Classic Applications and Share what they Would do Differently Today

Sponsor: Decision Analysis

Sponsored Session

Chair: Carl Spetzler, Chairman and CEO, SDG, 745 Emerson Street, Palo Alto, CA, 94301, United States of America, cspetzler@sdg.com

1 - A Panel of Early DA Pioneers will Review Their The Classic Applications and Share what they Would do Differently Today

Moderator: Carl Spetzler, Chairman and CEO, SDG, 745 Emerson Street, Palo Alto, CA, 94301, United States of America, cspetzler@sdg.com, Panelists: Jim Matheson, Edward Cazalet, Warner North, Ralph Keeney, Ronald Howard

What would we do differently today? A panel of early DA pioneers will review their classic applications and share what they would do differently today.

2 - My Lessons from Early DA Applications

Warner North, President and Principal Scientist, NorthWorks, Inc., 1715 Taylor Street, San Francisco, CA, 94133, United States of America, northworks@mindspring.com

Among my early DA applications were projects with Mexico on planning the future of this country's electric power system, the US Department of Commerce on cloud seeding for hurricanes, NASA on planetary contamination of Mars by terrestrial microbes, and the US Forest Service on managing wildland fires. Lessons include problem formulation, understanding history and stakeholder concerns, iterating from a pilot version of the analysis, and sensitivity analysis.

■ MA80

Parc- Powell II

Evaluating Forecasts

Sponsor: Decision Analysis

Sponsored Session

Chair: Victor Richmond Jose, Georgetown University, McDonough School of Business, 544 Hariri Building, Washington, DC, 20057, United States of America, vrj2@georgetown.edu

1 - Evaluating Forecasts Reported at Different Points in Time

Edgar Merkle, University of Missouri, 28A McAlester Hall, Columbia, MO, 65211, United States of America, merklee@missouri.edu, Barbara Mellers, Philip Tetlock, Mark Steyvers

We consider situations where forecasts associated with the same question are reported at different times. Question difficulty often decreases over time, so forecasts made earlier in time should receive a better score than equivalent forecasts made later in time. To address these issues, we tailor models from item response theory to handle probabilistic forecasts and to estimate change in question difficulty over time. We apply the models to geopolitical forecasts from a recent tournament.

2 - Scoring Rules for Sequences of Probabilistic Forecasts

Eva Regnier, Associate Professor, Naval Postgraduate School, 699 Dyer Road, Monterey, CA, 93943, United States of America, eregnier@nps.edu

There are more and more forecasting systems that generate a sequence of probability forecasts for the same event, such as sporting, political, and weather events. Based on a non-improvability axiom, we propose properties of a "good" forecasting system and offer scoring functions for evaluating the performance of a forecasting system and a sample of probability sequences.

3 - On Proper Scoring Rules and Cumulative Prospect Theory

Arthur Carvalho, University of Waterloo, 200 University Avenue West, School of Computer Science, Waterloo, On, N2L 3G1, Canada, a3carval@uwaterloo.ca, Stanko Dimitrov, Kate Larson

We discuss how to adapt proper scoring rules to cumulative prospect theory, and why comonotonicity is a sufficient condition for proper scoring rules to be indeed proper under cumulative prospect theory. We also show how to construct a comonotonic proper scoring rule from any proper scoring rule. Finally, we propose a new approach that uses non-deterministic payments based on proper scoring rules to elicit an agent's true belief when his value function and weighting functions are unknown.

4 - Percentage Error, Relative Error, and the Combination of Forecasts

Victor Richmond Jose, Georgetown University, McDonough School of Business, 544 Hariri Building, Washington, DC, 20057, United States of America, vrj2@georgetown.edu

We present properties of two families of scale-free forecast accuracy measures, which generalize the percentage and relative error measures, and discuss how these families provide incentives toward either over- or under-reporting of forecasts. We illustrate these properties in a forecast combination setting.

■ MA81

Parc- Divisadero

Data Analytics & Optimization with its Applications

Sponsor: Data Mining

Sponsored Session

Chair: Chun-An Chou, SUNY Binghamton, 4400 Vestal Pkwy, Binghamton, NY, United States of America, cachou@binghamton.edu

Co-Chair: Fatma Gumus, PhD Student, SUNY Binghamton, 4400 Vestal Pkwy, Binghamton, NY, United States of America, fgumus1@binghamton.edu

1 - Modeling Recovery Curves with Application to Prostatectomy

Fulton Wang, MIT, 5 Cambridge Center, Office 792, Cambridge, MA, 02139, United States of America, fultonw@mit.edu, Cynthia Rudin, John Gore, Tyler McCormick

We propose a Bayesian model that predicts recovery curves based on information available before the disruptive event. A recovery curve of interest is the quantified sexual function of prostate cancer patients after prostatectomy surgery. We illustrate the utility of our model as a pre-treatment medical decision aid, producing predictions that are both interpretable and accurate, and uncover covariate relationships that agree with and supplement past prostatectomy studies

2 - Spatiotemporal Analytics of Heart Diseases

Chen Kan, Graduate Student, University of South Florida, Tampa, FL, United States of America, chenkan@mail.usf.edu, Hui Yang

Cardiovascular diseases are the leading cause of death in the world. This paper presents a novel spatiotemporal warping approach to quantify the dissimilarity of disease-altered cardiac electrical activity. Furthermore, we optimize the embedding of each functional recording as a node in a high-dimensional complex network. This, in turn, significantly improves the recognition of disease patterns and advances the smart management of heart health.

3 - Network Optimization Formulation for Multi-voxel Pattern Analysis of Brain Functional Connectivity

Fatma Gumus, PhD Student, SUNY Binghamton, 4400 Vestal Pkwy, Binghamton, NY, United States of America, fgumus1@binghamton.edu, Chun-An Chou

We propose a network optimization method for multi-voxel pattern analysis of brain functional connectivity. The overall objective is to determine informative brain voxels that are functionally similar to each other. The selected voxels for benchmark fMRI datasets are tested with several machine learning techniques, and the experimental results shows comparable classification accuracy compared to previous approaches.

■ MA82

Parc- Haight

Multi-Criteria Analysis for Supply Chain and Logistics

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Hugo Yoshizaki., Associate Professor, University of Sao Paulo, Av. Professor Almeida Prado, Trav. 2, 128, Cidade Universitaria, Sao Paulo, SP, 05508-900, Brazil, hugo@usp.br

1 - Facilitated Modelling for Logistic Decisions: A Case Study on Ethanol Distribution in S.Paulo/Brazil

Claudio Barbieri da Cunha, Associate Professor, University of Sao Paulo, Department of Transportation Engineering, Escola Politecnica, Sao Paulo, SP, 05508-900, Brazil, cbcunha@usp.br, Rachel Silva

Decision-making techniques usually focus on the alternative comparison, rather than studying the values and preferences of the decision-makers. This research aims to demonstrate how individual stakeholders' criteria can be extracted and incorporated using the "Facilitated modeling mode" in order to consider the greenhouse gas emissions from different transport modes in view of the environmental prerequisites for ethanol exports.

2 - Multi-attribute Value Theory Applied to Last-mile Delivery of Disaster Relief Items

Luìsa Cavalcanti, Researcher, University of Sao Paulo, Logistic Systems Program - POLI/USP, Cidade Universitaria, Sao Paulo, SP, 05508-900, Brazil, luba0587@gmail.com, Andre Mendes

After a disaster strikes, decisions regarding cargo transportation have a high impact on the vulnerable victims waiting for help. The multiplicity of objectives, especially when demand outsources capacity, suggests the applicability of the Multi-Attribute Value Theory (MAVT) approach. In this research, the method was applied to a Logistics Cluster training scenario, and the results encourage using MAVT as a tool for humanitarian decision makers.

3 - Multi-criteria in Location Decisions for Pre-positioning Relief Supplies in Brazil

Irineu Brito Jr, Professor, Fatec Jessen Vidal SJ dos Campos, Rua Helena Davi Neme, 94 ap 41, Sao Jose dos Campos, SP, 12245310, Brazil, ibritojr@yahoo.com.br, Adriana Leiras, Hugo Yoshizaki.

This paper proposes a methodology to define locations for pre-positioning disaster relief supplies through a two-stage stochastic optimization model with multi-criteria decision analysis considerations. An application in Brazil illustrates the effectiveness of the proposed approach. Results show that stochastic models promote more reliable outcomes than deterministic ones; and multi-criteria methods help in the modeling process by considering variables often treated exogenously to the problem.

■ MA83

Parc- Sutro

Statistical Approaches for Medical Engineering

Sponsor: Data Mining

Sponsored Session

Chair: Daehan Won, ph.d. student, University of Washington, Industrial & Systems Engineering, University of Washington, Box 352650, Seattle, WA, 98105, United States of America, wondae@uw.edu

1 - Feature Selection and Classification of Visual Evoked Responses in Idiopathic Generalized Epilepsy

Daehan Won, PhD Student, University of Washington, Industrial & Systems Engineering, University of Washington, Box 352650, Seattle, WA, 98105, United States of America, wondae@uw.edu, Jeffrey Tsai, Cao (Danica) Xiao, W. Art Chaovalitwongse

Our goal of this study is to determine whether steady-state visual evoked potentials (SSVEPs) can facilitate diagnosis of Epilepsy. SSVEPS were recorded using a 128-channel EEG to a foveal Gabor pattern whose contrast was modulated. By stepwise incrementing the contrast, we obtained a contrast versus response function (CRF) yielding parameters that characterized the shape of the CRF. Features selections are applied to determine channel importance for classifying individuals.

2 - An Integrated Feature Ranking and Selection Framework for ADHD Diagnosis

Cao (Danica) Xiao, PhD Student, University of Washington, Seattle, 3900 Northeast Stevens Way, Mechanical Engineering Building, room G6, Seattle, WA, 98195, United States of America, danicaxiao@gmail.com, W. Art Chaovalitwongse, Jesse Bledsoe, Margaret Semrud-Clikema, Thomas Grabowski, Sonya Mehta

We propose an Integrated Feature Ranking and Selection Framework that utilizes normalized brain cortical thickness extracted from MRI data to help diagnose ADHD in an early age with objective measures and promising accuracy.

3 - using Physiological Signals to Assess Mental Workload on Human-Computer Interaction Tasks

Shouyi Wang, Assistant Professor, University of Texas at Arlington, 500 West First Street, 420H Woolf Hall, UT Arlington, Arlington, TX, 76019, United States of America, shouyiw@uta.edu

Degraded state of cognitive functioning due to high cognitive workload can lead to errors and overall suboptimal performance. In this work, we made a comprehensive signal features analysis and classification study to investigate the feasibility of wireless physiological signals for mental workload assessment in real-life. Our study shows the affordable wireless acquisition systems may have a great potential to facilitate the development of Brain-Computer-Interfaces (BCI) technologies.

4 - An Algorithm for Non-convex Structural Regularization

Minh Pham, ptuanminh@gmail.com, Xiaodong Lin, Andrzej Ruszczynski

Structural L1 penalties have many applications in machine learning, biology, cancer research, medical imaging...The non-convex counterpart of L1 penalties such as SCAD and MCP are shown to have less bias than L1 penalties. A few algorithms have been proposed to solve the case when the structural matrix is identity. We propose an algorithm based on alternating linearization for the general structural matrix.

5 - A Center-based Community Detection Method

Dohyun Kim, Myongji University, Dept. of Industrial & Management Eng., 116 Myongji-ro, Cheoin-gu, Yongin, Gyeonggi-do, 449-728, Korea, Republic of, norman.kim@gmail.com, June Young Lee, Sejung Ahn

Community detection problem is one of the main topics in network analysis. One of the most popular method is the modularity maximization, which optimizes the strength of the communities. However, the modularity maximization often fails to detect communities smaller than some scale. To avoid the problem, the proposed approach finds centers considering the node density and distance and then explores center-based communities. We demonstrate the proposed method on real-world networks.

Monday, 11:00am - 12:30pm

■ MB01

Hilton- Golden Gate 6

Analytics for New Efficiencies: Quality and Lifecycle Management in the DoD

Sponsor: Military Applications Society

Sponsored Session

Chair: Aaron Burciaga, Senior Manager, North America Inventory Analytics Lead, Accenture, 4305 Majestic Lane, Fairfax, VA, 22033, United States of America, adburciaga@gmail.com

1 - Product Segmentation and Lifecycle Methodologies for Target Service Levels

Rodrigo Hernandez, Analyst, Accenture, 1841 W. Evergreen, Apt 1R, Chicago, IL, 60622, United States of America, rodrigo.hernandez@accenture.com

Service Levels are critical components for managing inventory levels and expected rewards, namely revenue in business or readiness in the DoD and National Security. Our methodology weighs product lifecycle, value, demand and variability in order to maximize reward. Security issues share similar volatility with retail products, as characterized by conflict intensity and phase of operations. We demonstrate advanced algorithms that handle volatile demand in order to right-size inventories.

2 - A Quality Assessment Approach to Army Unit Readiness

Natalie Scala, Assistant Professor, Towson University, Dept. of e-Business and Technology Manag, 8000 York Road, Towson, MD, 21252, United States of America, nscala@towson.edu, Paul Goethals

This research examines the current U.S. Army readiness reporting method and proposes a system based on desirability functions from quality theory. We present case studies contrasting current and proposed systems and function weight guidelines. Under this methodology, readiness assessment becomes dynamic, increases in accuracy, and transforms to a holistic metric.

3 - Rethinking Military Applications of Modern Principles in Data Strategy across Military Organizations

Harpreet Toor, Big Data and Cloud Strategist, Booz Allen Hamilton, 360 H St. NE, Apt. #431, Washington, DC, 20002, United States of America, toor_harpreet@bah.com

Military applications of data strategies, specifically analysis capabilities that result from deploying "big data" methodologies for data management, are too often linearly focused on intelligence and logistics functions and not on application across the enterprise. This paper will explore how the application of modern principles in data strategy across military organizations to create an analysis-first approach to decision-making will result in better execution of military strategy.

■ MB02

Hilton- Golden Gate 7

Best Dissertation Award Finalists – Technology, Innovation Management and Entrepreneurship Section

Sponsor: Technology, Innovation Management and Entrepreneurship

Sponsored Session

Chair: Sinan Erzurumlu, Associate Professor, Babson College, 231 Forest St, Babson Park, MA, 02457, United States of America, serzurumlu@babson.edu

1 - Organizational Ambidexterity and Networks in Successful Technology Commercialization

Andrew Earle, Assistant Professor, University of New Hampshire, Paul College of Business and Economics, 10 Garrison Ave., Durham, NH, 03824, United States of America, Andrew.Earle@unh.edu

This dissertation relieves tension between organizational ambidexterity and network perspectives by developing a contingent model of exploration and exploitation. I hypothesize firms benefit by configuring their inter-organizational networks to gather novel information when discovering new technologies but gather redundant information when bringing these to market. I test these hypotheses with panel data on firms active in commercializing technologies in the field of green chemistry.

2 - Identity and Institutional Change in a Mature Field: The Re-Emergence of the Swiss Watch Industry

Ryan Raffaelli, Assistant Professor of Business Administration, Harvard Business School, Morgan Hall, Boston, MA, 02163, United States of America, rraffaelli@hbs.edu

I examine the decline and re-emergence of the Swiss mechanical watch industry from 1970-2008, exploring how, when, and why market demand for legacy technologies resurrect and reshape a field. I focus on mechanisms of identity and institutional change, and how leaders reframe values associated with a legacy technology. I demonstrate how the reclamation of identity can reposition an industry, and how incumbent firms re-define their identity after a technology threatens their market position.

3 - Synchronizing Exploration and Exploitation: Knowledge Creation Challenges in Innovation

Jennifer Bailey, Babson College, Technology and Operations Management, Babson Park, MA, United States of America, jbailey@babson.edu

This research considers the challenges of simultaneously pursuing exploration and exploitation within an innovation project. An important theme across all three papers is the path-dependent nature of the knowledge creation process. Collectively, they consider issues related to the dynamic generation and resolution of uncertainty during the innovation process, managing short-term versus long-term performance tradeoffs, learning from innovation experience and knowledge-sharing under competition.

4 - Understanding Breakthrough Emergence through Missed Opportunities

Sen Chai, Harvard University, 1050 Mass Ave, Cambridge, MA, 02138, United States of America, chais@nber.org

Who misses breakthroughs? Why are some scientists more successful than others? I take a counterfactual perspective and explore the mechanism by which breakthroughs fail in the form of misses and delays. Instead of sampling on rare successes, I conceptualize breakthroughs as marked by multiple failures before eventual success. My findings suggest that the seminal discovery was missed several times due to difficulties in solving a particular problem and identifying breakthrough opportunities.

■ MB03

Hilton- Golden Gate 7

Economics of Information

Sponsor: eBusiness

Sponsored Session

Chair: Rajiv Garg, McCombs School of Business, University of Texas, Austin, TX, United States of America, Rajiv.Garg@mccombs.utexas.edu

1 - The Effect of Store Transportation Costs on Customers' Multichannel Purchase Behavior

Amit Mehra, Professor, Indian School of Business, AC 6124, Gachibowli, Hyderbad, AP, 500032, India, amit_mehra@isb.edu, Anuj Kumar, Subodha Kumar

We examine the causal effect of changing customers' store access costs on their store and online purchase behavior. We use new store opening data for a large fashion retailers in the US and employ propensity score matching estimates to show that when store openings reduce customers' store transportation costs, it results in increase in their store and online purchases. But when store openings do not reduce customers' store transportation costs, their purchase behavior remains unchanged.

2 - The Spillover Effects of Health IT Investments on Regional Health Care Costs

Hilal Atasoy, Assistant Professor, Temple University, 455 Alter Hall, Philadelphia, PA, 19102, United States of America, hilal.atasoy@temple.edu, Pei-yu Chen, Kartik Ganju

Health IT investments are presumed to decrease health care costs, however the empirical evidence is mixed. Effects of health IT can go beyond hospitals due to patient mobility and information sharing. We find that, although EMR adoption increases the costs for the adopting hospitals, it has significant spillover effects by reducing the health care costs of the other hospitals in the same region. Higher software integration among adopting hospitals further strengthens the spillover effects.

3 - Impact of Location on Knowledge Sharing within Enterprise

Yingda Lu, Assistant Professor, Rensselaer Polytechnic Institute, 110 8th street, Troy, NY, 12180, United States of America, luy6@rpi.edu, Baohong Sun, Sunder Kekre

In this study, we propose a Hierarchical Bayes model to capture how employees from different markets have different contribution patterns on social media platform. We find that employees from emerging markets are mainly active whenever they have questions to answer, and immediately drop out of the community when all their questions are answered. On the other hand, employees from developed markets are more consistent over time on their contribution level on the platform.

4 - Knowledge Transfer and Depreciation in Online Medical Consultation: Study of eVisit Operation

Changmi Jung, changmi@andrew.cmu.edu, Linda Argote, Rema Padman, Ateev Mehrotra

Online medical consultation (eVisit), a digital innovation in healthcare, raises concerns among healthcare organizations due to challenges in incorporating the new service, we need to understand how the operational efficiency is linked to organizational experience in the care delivery environment and the effect of knowledge transfer among intra-practice offices. However, knowledge accumulated through experience may depreciate as the task of assigning and triaging eVisits is knowledge intensive.

5 - Jack of All, Master of Some: The Interaction Effect of Knowledge Breadth and Depth on Innovation

Elina Hwang, Carnegie Mellon University, Tepper School of Business, 5000 Forbes Avenue, Pittsburgh, PA, 15215, United States of America, elinah@cmu.edu, Param Singh, Linda Argote

To be innovative, individuals should possess both broad and deep knowledge. Although the value of knowledge breadth has been recognized, the role of deep knowledge in innovation has been overlooked. Our findings suggest that knowledge breadth feeds into novelty, but its effect on usefulness and innovativeness of ideas is contingent on the presence of deep knowledge. Consequently, breakthrough ideas were more likely to be spawned by innovators who possess both diverse and deep knowledge.

■ MB04

Hilton- Continental 1

Information, Incentives and Behavioral Decision Making in Operations Management

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Guangwen Kong, Assistant Professor, University of Minnesota, 111Church Street SE, Minneapolis, MN, 55455, United States of America, gkong@umn.edu

1 - How do Delay Announcements Shape Customer Behavior? An Empirical Study

Gad Allon, Northwestern University - Kellogg, 2001 Sheridan Rd., Evanston, IL, United States of America, g-allon@kellogg.northwestern.edu, Qiuping Yu, Achal Bassamboo

We explore the impact of delay announcements by studying the data from a medium sized call center, where customers are provided with anticipated delay. Our key insights show that delay announcements not only impact customers' beliefs about the system, but also directly impact customers' per unit waiting cost. Specifically, customers' per unit waiting cost decreases with the offered waiting times associated with the announcements.

2 - All You Need is Trust? An Examination of Interorganizational Supply Chain Projects

Gökçe Sargut, Assistant Professor, College of Business and Public Adm., Governors State University, 1 University Parkway, University Park, IL, 60484, United States of America, gsargut@govst.edu, Andreas Brinkhoff, Özalp Özer

We examine the effects of relationship-level (trust and asymmetric dependence) and project-level factors (between-firm communication and within-firm commitment) on the success of inter-firm supply chain projects (e.g. VMI, 3PL, and EDI implementation). In order to further probe our surprising findings, we introduce a categorical scheme that differentiates supply chain projects based on decision rights configuration. We discuss how firms can effectively manage supply chain projects and alliances.

3 - The Impact of Competition for Common Customer Base on Agent's Compensation Plan

Elnaz Jalilipour Alishah, PhD Student, University of Washington, Michael G. Foster School of Business, ISOM Department, Seattle, WA, 98195, United States of America, jalilipo@uw.edu, Hamed Mamani, Yong-Pin Zhou

We study effect of agent's competition for common customer base on incentive efficiency of compensation packages. We model an environment where customers make the final decision based on perceived service quality, while incurring disutility from waiting. We show that some well-known contracts in the literature are unable to coordinate. Therefore we suggest contracts and operational tools to coordinate and analyze their flexibility and implication for practical implementation.

4 - Farmers' Information Management in Developing Countries – A Highly Asymmetric Information Structure

Chen-Nan Liao, Department of Industrial Engineering and Operations Research, 4141 Etcheverry Hall, University of California Berkeley, Berkeley, CA, 94720, United States of America, chennanliao@gmail.com, Ying-Ju Chen

In developing countries, information is usually transmitted through local networks, and, thus, farmers may have very different information channels. We establish a general framework that accommodates highly asymmetric information structures to study farmers' information management and utilization problems. We find the unique Bayesian Nash equilibrium, show that asymmetric information structures can lead to various novel results, and conduct a comprehensive study in the weak signal limit.

■ MB05

Hilton- Continental 2

Empirical Research and Quality Risk

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Aleda Roth, Professor, Clemson University, 100 Sirrine Hall, Clemson, SC, United States of America, aroth@clemson.edu

1 - The Impact of Supply Chains on Firm-Level Productivity

Juan Serpa, Ph.D Candidate, University of British Columbia, 2053 Main Mall, Henry Angus 391, Vancouver, BC, V6T1Z4, Canada, juan.serpa@sauder.ubc.ca, Harish Krishnan

By collecting data on supply chain relationships, we explore the channels through which productivity can spill over across firms. We consider two key types of channels: endogenous and exogenous. The endogenous channel measures the extent to which a firm's productivity is influenced by the productivity of its supply chain partners; the exogenous channels measure how productivity is influenced by the partners' characteristics (e.g. inventory turnover, financial leverage).

2 - The Decision to Recall: A Behavioral Experiment in the Medical Device Industry

George Ball, University of Minnesota, 321 19th Ave, Minneapolis, MN, United States of America, ball0197@umn.edu, Rachna Shah

We present results of a behavioral experiment investigating biases in the product recall decision making process in the medical device industry. Using industry expert subjects, this experiment identifies opportunities for firms to improve the objectivity of the product recall decision.

3 - Recall Strategies and Supply Chain Capabilities: Time to Recall in the FDA-Regulated Food Industry

Aleda Roth, Professor, Clemson University, 100 Sirrine Hall, Clemson, SC, United States of America, aroth@clemson.edu, Tracy Johnson-Hall, Manpreet Hora

We examine the effects of recall strategies and supply chain capabilities on time to recall. Using survival analysis on data related to food recalls of FDA-regulated products from 2004-2010, we demonstrate the importance of supply chain capabilities in shortening time to recall, and discuss implications for firms and policy-makers.

■ MB06

Hilton- Continental 3

Contract Design in Various Operations

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Zhixi Wan, Assistant Professor, University of Illinois at Urbana-Champaign, 1206 S Six Street, Champaign, 61820, United States of America, wanzhixi@illinois.edu

1 - Impact of Downstream Competition for an Innovative Supplier in a Supply Chain

Hyoduk Shin, University of California-San Diego, 9500 Gilman Drive, La Jolla, CA, United States of America, hshin@rady.ucsd.edu, Jingqi Wang

We study a supply chain with a supplier who invests in innovation, which increases the value of products, and downstream manufacturers who sell to users. Analyzing a bargaining model, we find that the supplier's optimal innovation level is higher under downstream competition than under downstream monopoly if innovation cost is relatively high, and lower if it is relatively low. Interestingly, we find that under certain conditions, the downstream competition negatively impacts the supplier.

2 - Coordinate Semi-Centralized Production Network through Fix Cost Sharing under Incomplete Information

Fang Liu, Nanyang Technological University, 50 Nanyang Drive, Singapore, Singapore, Liu_Fang@ntu.edu.sg, Jing-Sheng Song

A typical semi-centralized network comprises the headquarters (HQ), a home plant (H), and a foreign branch (B). H supplies a key component to B with guaranteed service. B incurs a high fix cost, which causes high expediting costs at H. We propose to have H share a portion of B's fix cost and find: 1) HQ-initiated contract can lead to the first-best solution, but H may be worse off. 2) H-initiated contract under full information and 3) asymmetric information can lead to near optimal performance.

3 - using Procurement Service Providers in Supplier Screening

Zhixi Wan, Assistant Professor, University of Illinois at Urbana-Champaign, 1206 S Six Street, Champaign, 61820, United States of America, wanzhixi@illinois.edu, Sripad Devalkar

We consider a buyer who hires a procurement service provider to conduct preliminary screening and recommend suppliers from a supplier pool for final screening. We study the contract design problem and characterize the optimal number of suppliers the buyer should ask the provider to recommend.

4 - Bundle Payments vs. Fee-for-Service: Impact of Payment Scheme on Performance

Shima Nassiri, University of Washington, Foster School of Business, Seattle, WA, United States of America, shiman@uw.edu, Hamed Mamani, Elodie Adida

Healthcare payments in the US have been based on a fee-for-service scheme, which provides incentives for high volume of care. The new healthcare legislation tests Bundle Payments that remove such incentives. We consider a population of patients that wish to undergo treatment. Treatments may result in failure, where unforeseen complications can occur. We analyze effects of different payment schemes on the extent of patient selection, treatment intensity, payer costs, and the total social welfare.

■ MB07

Hilton- Continental 4

Clearing the Jungle of Stochastic Optimization

Cluster: Tutorials

Invited Session

Chair: Warren Powell, Professor, Princeton University, Sherrerd Hall, Charlton St, Princeton, NJ, 08544, United States of America, powell@princeton.edu

1 - Clearing the Jungle of Stochastic Optimization

Warren Powell, Professor, Princeton University, Sherrerd Hall, Charlton St, Princeton, NJ, 08544, United States of America, powell@princeton.edu

Stochastic optimization is a highly fragmented field, reflecting the diversity of applications and computational challenges. We bring the competing approaches for sequential decision problems under a common umbrella. We first suggest a five-element modeling framework which replaces the challenge of finding decisions to one of finding policies. We then describe four fundamental classes of policies that integrate stochastic programming, dynamic programming with other communities.

■ MB08

Hilton- Continental 5

Celebrating the Contributions of George Dantzig: Applications and Software

Cluster: Celebrating George B. Dantzig's 100th Birthday and His Influence on MS/OR

Invited Session

Chair: Mukund Thapa, Stanford Business Software, Inc, CA, United States of America, Mukund.Thapa@sbsinc.net

1 - Applications of Stochastic Optimal Power Flow

Robert Entriken, Principal Technical Leader, EPRI, 3420 Hillview Avenue, Palo Alto, CA, 94304, United States of America, rentrike@epri.com, Taiyou Yong

Stochastic optimal power flow techniques have been used in formulating a reserve determination problem to address the issue of the increasing penetration of intermittent generation in the U.S. electric power system. Two immediate applications, market reserve validation and post-contingency rapid redispatch, are described to illustrate value that can be derived from using the reserve determination model. Utility system operations and planning personnel can use these applications to mitigate system uncertainty and improve system reliability.

2 - The Origins of a Practical Simplex Method

Robert Fourer, President, AMPL Optimization Inc, 2521 Asbury Ave, Evanston, IL, 60201, United States of America, 4er@ampl.com

Although the modern simplex method is traced to George Dantzig's "Programming of Interdependent Activities" of 1949, the algorithm described there has never been practical. It was rather Dantzig's later work with William Orchard-Hays at RAND that provided a template for a simplex method that could be implemented on early computers and steadily refined thereafter. This talk describes how the "revised" simplex method has made today's powerful linear (and integer) programming solvers possible.

3 - On Probabilistic Bounds in Two-stage Stochastic Programming

Gerd Infanger, Department of Management Science and Engineering, Stanford University, Stanford, CA, 94305, infanger@stanford.edu

George B. Dantzig, a great pioneer of stochastic programming, suggested very early on that sampling could be used to approximate expected values of second-stage cost and gradients. By now, sampling-based approximations have emerged as powerful techniques for solving practical stochastic problems. Based on joint work and recent results, this presentation will review confidence bounds on the optimal objective of two-stage stochastic programs.

4 - On Applied Mathematics

Richard Van Slyke, Department of Computer Science, NYU Polytechnic School of Engineering, Brooklyn, NY, 11201, rvslyke@poly.edu

This talk will cover what I learned from George Dantzig, during the years that he was at the RAND Corporation, U.C. Berkeley, and Stanford. As a result of our interactions I imagined myself an "applied mathematician". George was certainly a superb model, but intimidating to follow. I will illustrate some of the approaches I ultimately followed. To specify an applied mathematician one needs to specify the applications and the mathematics. I will emphasize applications to telecommunications and finance. The mathematical methods include a variety of optimization techniques.

■ MB09

Hilton- Continental 6

Empirical Studies on Hospital Operations

Sponsor: Manufacturing & Service Operations Management/Healthcare Operations

Sponsored Session

Chair: Stefan Scholtes, University of Cambridge, UK, ss248@cam.ac.uk

Co-Chair: Nicos Savva, London Business School, Regentís Park, London, NW1 4SA, United Kingdom, nsavva@london.edu

1 - Do Mandatory Overtime Laws Improve Quality? Staffing and Operational Flexibility in Nursing Homes

Susan Lu, Assistant Professor, Purdue University, Krannert School of Business, West Lafayette, IN, 47907, United States of America, lu428@purdue.edu, Lauren Lu

During the 2000s, a number of states passed laws that restrict the use of mandatory overtime and cap the maximum work hours for nurses. Using U.S. nursing homes data from 2004 to 2012, we find that the passage of mandatory overtime laws reduces the overall quality in nursing homes.

2 - An Empirical Analysis on the Effect of Nursing Team Characteristics on Patient Outcomes

Stefan Scholtes, Judge Business School, University of Cambridge, Cambridge, CB2 1AG, United Kingdom, s.scholtes@jbs.cam.ac.uk, Sandra Suelz

We match a sample of 40,025 patients across 19 wards of a major hospital over a 5-year period with nursing shift data to assess the impact of nursing team characteristics, specifically team familiarity and diversity, on patient outcomes.

3 - Managing Variety in Professional Service Firms: A Study of Service Platforms in Hospitals

Sandra Suelz, Faculty of Management, Economics and Social Science, University of Cologne, Albertus-Magnus-Platz, Cologne, 50923, Germany, suelz@wiso.uni-koeln.de, Stefan Scholtes, Ludwig Kuntz

This paper presents an empirical study of the quality implications of service platforms in the hospital industry. We show that for related services, platform-based delivery is associated with higher quality; that the beneficial effect of departmental focus on quality is reduced if the service is part of a service platform; and that quality deteriorates if merged service bundles are relatively unrelated. We outline the implications with a counterfactual departmental redesigns based on our sample.

■ MB10

Hilton- Continental 7

Learning in Queues

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Costis Maglaras, cm479@columbia.edu

1 - Observation-Based Abandonment in Queues

John Yao, Columbia University, New York, NY, United States of America, jyao14@gsb.columbia.edu, Costis Maglaras, Assaf Zeevi

We present a queueing model in which customers use their experience in line to infer system parameters, estimate waiting times, and make strategic abandonment decisions. The key feature is that customers do not know the service capacity when they join the queue, and instead observe their progress through the line - their queue position and estimated speed – to decide whether to abandon. We show how the large-scale system dynamics under our model differs from traditional abandonment models.

2 - A Model of Rational Retrials in Queues

Shiliang Cui, Georgetown University, McDOnough School of Business, Washingrton, DC, 20057, United States of America, shiliang.cui@georgetown.edu, Senthil Veeraraghavan, Xuanming Su

Consumers suffer disutility in waiting for a service. When they can self-organize the timing of their service visits, they may avoid long queues and choose to retry later. We study an observable queue in which consumers make rational join, balk and costly "retry" decisions upon their arrival. Retrial attempts could be costly due to factors such as transportation costs, retrial hassle and visit fees. We characterize the equilibrium under such retrial behavior, and study its welfare effects.

3 - First Ranked First to Serve: A Tournament Approach to Call Centers

Konstantinos Stouras, PhD Candidate, INSEAD, Bd. de Constance, Fontainebleau, 77305, France, Konstantinos.STOURAS@insead.edu, Serguei Netessine, Karan Girotra

We develop a stylized model of a virtual call center that pays its agents on-demand, by committing to a (relative) performance ranking prioritization scheme. We characterize the optimal design of such a "service contest" under different objectives of the firm, as well as different models of agents' performance. We show that using less information, or deploying coarser priority classes, can paradoxically create higher incentives for agents to most efficiently deliver service to its customers.

4 - How to Charge and Prioritize Time-sensitive Customers with Heterogeneous Demand Rates

Ricky Roet-Green, Postdoctoral Fellow, Rotman School of Management, University of Toronto, 105 St.George Street, Toronto, On, Canada, rgricky@gmail.com, Philipp AfËche, Opher Baron, Joseph Milner

Providers often face time-sensitive customers that differ in their demand rates. However, the pricing literature for queues typically assumes unit demand for all customers. We study a revenue-maximizing provider that designs a price/lead-time menu for customers with heterogeneous demand rates and private information on their preferences. We show under what conditions it is optimal to prioritize customers based on their demand rates and transaction values, even if all are equally time-sensitive.

■ MB11

Hilton- Continental 8

Empirical Research in Supply Chain Management

Sponsor: Manufacturing & Service Operations Management/Supply Chain

Sponsored Session

Chair: Vishal Gaur, Cornell University, Johnson School, Ithaca, NY, United States of America, vg77@cornell.edu

1 - Inventories and the Bullwhip: A Chicken and Egg Situation
Maximilliano Udenio, Doctoral Student, Eindhoven University of Technology, Den Dolech 2, Eindhoven, Netherlands, M.Udenio@tue.nl, Vishal Gaur, Jan C. Fransoo

We explore the role of inventories in the bullwhip effect. Through an empirical study of firm-level data, we investigate whether inventory-related decisions exacerbate or smoothen the distortions commonly associated with the bullwhip effect.

2 - The Impact of Supplier Inventory Service Level on Retailer Demand
Nathan Craig, Ohio State University, 2100 Neil Avenue, Columbus, OH, 43210, United States of America, craig.186@osu.edu, Ananth Raman, Nicole DeHoratius

While the effects of inventory service level changes have been studied empirically at the end consumer level, relatively little is known about the interaction between a retailer and a supplier. Using data from an apparel supplier, we show increases in service level to be associated with substantial increases in retailer orders. Retailers that order frequently exhibit a larger reaction to service level changes, an outcome consistent with retailers learning about and reacting to such changes.

3 - Driving Open Innovation in Supply Networks
Marcus Bellamy, Georgia Institute of Technology, 800 West Peachtree NW, Atlanta, GA, 30308, United States of America, marcus.bellamy@scheller.gatech.edu, Soumen Ghosh, Manpreet Hora

We investigate how firms can benefit from open innovation in supply networks. This is particularly interesting since supply networks are primarily created to drive operational efficiency in the supply process, but can also be leveraged to drive open innovation. Using secondary empirical supply chain data on customer and supplier relationships, we show that certain structural characteristics and relationship strength can drive open innovation and impact firm performance.

■ MB12

Hilton- Continental 9

Environmental Sustainability in Service Operations

Sponsor: Manufacturing & Service Operations Management/Sustainable Operations

Sponsored Session

Chair: Nagesh Gavirneni, Cornell University, Johnson Graduate School of Management, Ithaca, NY, 14853, United States of America

1 - Servicizing and Other Models for Reduced Consumption: A Literature Review and Call for Research
Sandra Rothenberg, Professor, Rochester Institute of Technology, 108 Lomb memorial drive, Rochester, Ny, 14623, United States of America, srothenberg@saunders.rit.edu, Anne Sherman, Jonathan Eppolito

In this paper, we first review the role of services in reduced consumption, and discuss the means by which a company can make more by selling less. We then take a broad look at the business models that move the economy toward lower levels of consumption. Our review suggests that there is a critical gap in our understanding of more collaborative consumption models. Implications for scholars, business and policy makers are discussed.

2 - Sustainability Practices in Convention Centers
Spring Han, Assistant Professor, Faculty of Management, Higher School of Economics, Moscow, Russia, hjh56@cornell.edu, Rohit Verma

The environmental impacts of meetings, incentives, conventions, and exhibitions (MICE) industry are as far reaching as its economic reach. Research on sustainability in the MICE sector, however, is scarce. This study explores the most prevalent practices that the industry employs in European countries and the US and, relative importance of sustainability to convention consumers.

3 - Positively Deviant: A Behavior Science Approach to Promoting Sustainability
Emily Leeming, University of Nevada Reno, Psychology Department MS/296, Reno, NV, 89557, United States of America, emilyleeming@yahoo.com, Daniel Reimer, Chelsea Wilhite

The concept of deviance often possesses negative connotations. However when societies face pervasive problems, deviant responses can be seen as valuable. Sustainability provides examples of positive deviance. This paper will provide case examples of behavior change within sustainability and human services. Contemporary behavior science is presented to discuss principles in these positively deviant successes. An in-depth evaluation of a Lake Tahoe resort's sustainability program is highlighted.

4 - An Investigation into the Association between Sustainability and Patient Satisfaction in US Hospitals
Tanya Boone, Associate Professor, College of William and Mary, 705 College Terrace, Williamsburg, VA, 23185, United States of America, Tonya.Boone@mason.wm.edu

Hospitals have significant environmental and social impacts yet lag in adoption of sustainability. This paper examines the association between successful sustainability programs and patient satisfaction in US hospitals. We match a set of hospitals that have demonstrated improvement in environmental performance with a set of comparable hospitals that have not. We find significant differences for some measures with sustainable hospitals viewed more favorably by patients.

■ MB14

Imperial B

Airport/Airline Operations Management

Sponsor: Aviation Applications

Sponsored Session

Chair: Farbod Farhadi, University of Massachusetts Amherst, 121 Presidents Drive 230, Amherst, MA, 01003, United States of America, ffarhadi@som.umass.edu

1 - An Effective Branch-and-Price Algorithm for Runway Scheduling Problems
Mohammad Reihaneh, University of Massachusetts Amherst, Isenberg School of Management, 121 Presidents Drive 230, Amherst, MA, 01002, United States of America, mreihaneh@som.umass.edu, Ahmed Ghoniem, Farbod Farhadi

This paper presents a branch-and-price algorithm for multiple-runway aircraft sequencing problems. The subproblem of column generation is solved as an elementary shortest path problem with resource constraints using an enhanced dynamic programming procedure. This approach greatly improves the tractability of the problem when compared with solving a classical 0-1 MIP model over a set of computationally challenging instances.

2 - Mergers and Service: Investigating the Merger-customer Service Relationship in the Airline industry
Amirhossein Alamdar Yazdi, Isenberg School of Management, 24 Rolling Green Dr., Amherst, MA, 01002, United States of America, aalamdaryazd@som.umass.edu, Adams Steven

We analyze the effect of the recent airline mergers on customer service and satisfaction both at carrier and route levels. Both service and satisfaction levels affect performance and it is therefore surprising why mergers are understudied from service level perspective. Our study extends the existing merger literature by incorporating service level into capacity and pricing effects of the consequent concentration of service providers.

3 - A Model for Airline Operations Recovery
Peng Duan, Lead Operations Research Analyst, Sabre Holdings, Inc, 1008 Zhongshan Road #1008, Shanghai, China, peng.duan@sabre.com, Xiaodong Luo, Shahram Shahinpour

Over the course of airline operations, disruptions can be caused by different factors which could lead to the cancellation and/or delay of flights. We presents a model that developed by Sabre Airline Solutions which will identify the disruptions and create options to help the operations controller to recover disruptions and bring operations back to normal. The model considers a variety of recovery options and takes into account of the impact to crew operation and passenger connections.

4 - On the Impact of Jet-fuel Price on the Size of Airlines
Soheil Sibdari, UMass Dartmouth, 248 Old Westport Rd, Dartmouth, MA, 02135, United States of America, ssibdari@umassd.edu, Iman Mohammadian

We address an interesting phenomenon in the US domestic airline market during 2003-2013 that despite higher load factors and inflated airfares most airlines were experiencing profit losses. We explore the operations of seven US major airlines and observe that this profit instability can be partly due to the fuel cost fluctuations in that period.

■ MB15

Hilton- Exec. Boardroom

Efficiency Analysis Applications

Cluster: Data Envelopment Analysis

Invited Session

Chair: Nataliya Plesha, University of Connecticut, Storrs, CT, 06269, United States of America, nataliya.plesha@uconn.edu

1 - Capial Misallocation and Firm Innovation: A Structural Analysis
Lihong Yang, Assistant Professor, Renmin University of China, School of Business, Zhongguancun 59 Street, Beijing, 100872, China, lihong.yang@ruc.edu.cn

In this paper we examine micro-level channels of how capital misallocation can affect a firm's innovation activities. In particular, we investigate theoretically and empirically how the misallocation of capital assets across firms inhibits a firm's incentive for product innovation and process innovation. Theoretical predictions are tested using unique firm level data which provides direct measures for innovation and firm-specific capital misallocation.

2 - Total Factor Productivity Growth in the U.S. Agricultural Sector: Interstate Analysis
Nataliya Plesha, University of Connecticut, Storrs, CT, 06269, United States of America, nataliya.plesha@uconn.edu, Subhash Ray

Growing concern toward global environmental and public health problems, the burden placed by agricultural activities on environmental quality have encouraged scientists to use models of productivity analysis to assess joint production of "goods" and "bads". We use directional distance function to measure TFP growth accounting for use of by-product assumption.

3 - Measuring Environmentally Sensitive Efficiency and Productivity Growth in the Urban Water Sector
Jayanath Ananda, Senior Lecturer, La Trobe University, School of Economics, Albury-Wodonga Campus, Wodonga Vi 3690, Australia, j.ananda@latrobe.edu.au, Benjamin Hampf

Using the global Malmquist-Luenberger index approach, this paper analyses the efficiency and productivity growth trends in the Australian urban water sector whilst incorporating an undesirable output – greenhouse gas emissions. Results indicate that the productivity growth of the sector has declined when greenhouse gas emissions are included. The findings call for a greater understanding of energy intensity of various water supply options and sewerage operations.

■ MB16

Hilton- Franciscan A

Managing Financial Flows in Supply Chain

Sponsor: M&SOM/ iForm (Interface of Finance, Operations, and Risk Management)

Sponsored Session

Chair: Lingxiu Dong, Associate Professor, Olin Business School, Washington University in St. Louis, One Brookings Drive, St. Louis, MO, 63130, United States of America, dong@wustl.edu

1 - Franchise Contracting with Dynamic Franchisee Response, Debt Financing, and Bankruptcy Risk
Volodymyr Babich, Georgetown University, McDonough School of Business, Washington D.C., United States of America, vob2@georgetown.edu, Chris Tang

In a sequential moves game the franchisor chooses values of franchise fee and a royalty rate, the franchisee solves an optimal stopping problem, deciding when to sign the contract and open a store, and banks offer competitive loan rates (accounting for bankruptcy risk). We explain the existence of royalty rates in contracts due to dynamics in the model, recommend that the franchisor assumes greater share of store operating costs, and quantify ramifications of ignoring financing considerations.

2 - The Strategic Role of Business Insurance in Managing Supply Chain Risk
Harish Krishnan, University of British Columbia, Sauder School of Business, Vancouver, BC, V6T 1Z2, Canada, krishnan@sauder.ubc.ca, Juan Serpa

Supply chain risk management involves coordinating the unobservable efforts of multiple firms. This can be done through contracts, which transfer risk to firms best positioned to mitigate it. Firms can also manage risk by purchasing insurance. Unlike contractual incentives, which allocate risk within a supply chain, insurance externalizes this risk and decreases effort incentives. We show, however, that firms may strategically use insurance to prevent excessive free riding in a supply chain.

3 - Softening Competition through Trade Credit
S. Alex Yang, Assistant Professor, London Business School, Regent's Park, London, NW1 4SA, United Kingdom, sayang@london.edu, Heikki Peura

We analyze the role trade credit plays in softening horizontal competition and show this role of trade credit induces higher capacity investment, benefiting customers and improving social welfare.

4 - Push, Pull, and Trade Credit Contracts in Competitive Markets
Xiaomeng Guo, Phd Candidate, Washington University in St. L, 605 Leland Ave, Apt 605, Saint Louis, MO, 63130, United States of America, xiaomeng.guo@wustl.edu, Lingxiu Dong, Danko Turcic

Supply chain contracts vary by the inventory responsibility imposed on supply chain members and the timing of payment. We consider three basic wholesale price contracts that are different from each other in one or both of the dimensions, push, pull, and trade credit. The research focuses on understanding the implications of product offerings and downstream retail competition for the equilibrium contract offering in the supply chain.

■ MB17

Hilton- Franciscan B

Queuing Models for Service Management

Sponsor: Manufacturing & Service Operations Management/Service Operations

Sponsored Session

Chair: Laurens Debo, Associate Professor, University of Chicago, 5807 S Woodlawn Ave, Chicago, IL, 60637, United States of America, laurens.debo@chicagobooth.edu

1 - Characterizing the Steady State Distribution of a Call Center with Forward-Looking Callers
Xiaoshan Peng, PhD Student, Booth School of Business, University of Chicago, 5807 S Woodlawn Ave, Chicago, IL, 60637, United States of America, x-peng@chicagobooth.edu, Baris Ata, Peter Glynn

We analyze a queue system with endogenous abandonment. The customers waiting in the queue in the call center decide either leave the system or keep waiting in the queue dynamically. On the other hand, the system evolution and thus the waiting time distribution are determined by customers' dynamic decisions. We characterize the equilibrium of the system.

2 - Optimal Pricing in Tandem Queueing Systems with Finite Buffers
Hayriye Ayhan, Professor, Georgia Institute of Technology, School of ISyE, Atlanta, GA, 30332, United States of America, hayhan@isye.gatech.edu, Sigrun Andradottir, Xinchang Wang

We study pricing in a two-station tandem queue with finite buffers. Our goal is to determine the pricing policies that maximize the long-run average profit. We show that the optimal dynamic policy exhibits a monotone structure in which the quoted prices have greater dependency on the queue length at station 1 than at station 2. We also show that the optimal static pricing policy performs as well as the optimal dynamic policy when the buffer size before station 1 becomes large.

3 - An Analytical Throughput Approximation for Closed Fork/Join Networks
Erkut Sonmez, Assistant Professor, Boston College, Carroll School of Management, 140 Commonwealth Ave, Chestnut Hill, MA, 02467, United States of America, erkut.sonmez@bc.edu, Alan Scheller-Wolf, Nicola Secomandi

Fork/Join stations are used to model synchronization between entities, and fork/join queueing networks are natural models for a variety of service, communication and manufacturing systems. In this paper, we present a new and simple analytical approximation to estimate the throughput of a closed queueing network that features a single fork/join station receiving inputs from general subnetworks.

4 - Optimization of Industrial-Scale Assemble-to-Order Systems
Alan Scheller-Wolf, Professor, Carnegie Mellon University, Tepper School of Business, Carnegie Mellon University, Pittsburgh, PA, 15213, United States of America, awolf@andrew.cmu.edu, Willem van Jaarsveld

We provide insights and algorithms for inventory control in industrial-sized Assemble-to-Order systems. Our initial focus is first-come first-serve (FCFS) allocation of components to products. By developing a novel stochastic programming formulation, we compute solutions that are within one percent of the lower bound for realistically sized systems. We then answer the following questions: How do common heuristics used in practice compare to our performance, and how costly is the FCFS assumption?

■ MB18

Hilton- Franciscan C

RM & Pricing Topics

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Wei Wang, Scientist, PROS Inc, 3100 Main St, #900, Houston, TX, 77002, United States of America, weiwang@pros.com

1 - Integrating Price Optimization Modeling with Marketing Initiatives

Yanqi Xu, Director of Applied Technology, Princess Cruises, 24305 Town Center Road, Valencia, CA, 91355, United States of America, yanqi6@yahoo.com

The session will focus on: 1. an algorithm that we used in the accurate estimation of price elasticity, and 2. a model that integrates price optimization with other key marketing objectives. We will present an example to illustrate an approach that jointly optimizes both company strategic objectives and short term profits. We will also discuss the influence of big data technology on the analytics applications in the travel industry.

2 - Channel and Competitor Based Pricing and Distribution Optimization for Rental Car Industry

Mohit Mahajan, Senior Manager, Science and Research, PROS, 3100 Main St, Suite 900, Houston, TX, 77002, United States of America, mmahajan@pros.com, Ezgi Eren, Nikhil Kumar

Pricing and distribution optimization solution for car rental industry jointly optimizes pricing and yielding decisions, and fleet movement recommendations. It incorporates demand forecast relative to competitor prices and differentiates pricing across booking channels and through booking horizon. The number of decision variables and constraints considered in the optimization problem leads to computational challenges which are addressed by decomposing the problem into three step optimization.

3 - Demand Learning in Dynamic Auctions

Fatemeh Saberian, University of Washington, Industrial & Systems Engineering, University of Washington, Box 352650, Seattle, WA, 98105, United States of America, negar.saberian@gmail.com, Archis Ghate

We will present a Bayesian framework for learning bidder demand in dynamic auctions while minimizing the minimum bids. We will first present a complete structural analysis of the clairvoyant model and then discuss computational procedures to approximately solve the optimal learning problem.

4 - Revenue vs. Load Factor in Dynamic Revenue Management

Darius Walczak, Principal Research Scientist, PROS Inc., Science and Research, 3100 Main Street, Houston, TX, United States of America, dwalczak@pros.com, Wei Wang

Revenue and load factor are two basic metrics in revenue management. The trade-off between these metrics can be effectively analyzed by means of an efficient frontier. We explore practical ways to generate it in a dynamic, single-resource context including optimization with a mixed objective as well as using heuristics.

■ MB19

Hilton- Franciscan D

Demand Response Pricing in Data Centers and Grids

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Parijat Dube, IBM, 1101 Kitchawan Road, Yorktown Heights, NY, 10598, United States of America, pdube@us.ibm.com

1 - Market Design for Data Center Demand Response

Zhenhua Liu, California Institute of Technology, Pasadena, United States of America, zhenhua@caltech.edu, Adam Wierman, Steven Low

Energy and sustainability have become one of the most critical issues of our generation. Demand response is considered crucial for the renewable energy incorporation. In this talk, we focus on a particularly promising industry for demand response: data centers. We use simulations to show that data centers can provide as much flexibility as large-scale storage if given the proper incentives. Then we discuss the challenges and our recent progress in the market design to improve social welfare.

2 - Equilibrium Analysis of the LMP Mechanism for Economic Dispatch

Rahul Jain, Associate Professor, University of Southern California, Electrical Engineering Department, Los Angeles, CA, 90089, United States of America, rahul.jain@usc.edu, Wenyuan Tang

Locational marginal pricing (LMP) is widely employed for pricing in the wholesale electricity market. Although it's known that the LMP mechanism is vulnerable to market manipulation, there is little systematic analysis. We show via counterexamples a Nash equilibrium may not exist in the LMP mechanism. And when it exists, the price of anarchy may be arbitrarily large. We then provide two sufficient conditions under either of which an efficient Nash equilibria exists.

3 - Transactive Energy Management (TEM) with Economic Value-based Signals

Mark Yao, Research Scientist, IBM Research, 1101 Kitchawan Rd, Ossining, NY, 10598, United States of America, markyao@us.ibm.com

TEM is a method of managing electricity system locally and globally. At its core an electricity system managed by TEM uses economic value-based signals as the primary control signal in a network of Transactive Control Nodes on the grid. Such economic value-based signals are computed by the TCNs along the electricity supply path based on local objectives and constraint. In response to these economic signals are feedback signals based on current and forecasted electrical loads.

4 - Optimal Battery Pricing under Undetermined Demand Response Programs

Yanyi He, Postdoctoral Researcher, NEC Lab America, 10080 North Wolfe Road, SW3-Suite 305, Cupertino, CA, 95014, United States of America, heyanyi@nec-labs.com, Ratnesh Sharma

The Goal of the study is to find the optimal battery selling pricing based on the benefits of participating on various demand response programs. The expected multi-objective benefits of representative customers are calculated under different load scenarios and demand response programs. The aggregated demand-price curve along with the cost curve is used to derive for the optimal battery prices under different market structures.

■ MB20

Hilton- Yosemite A

Pierskalla Award

Sponsor: Health Applications

Sponsored Session

Chair: Dimitris Bertsimas, Professor of Operations Research and Statistics, Massachusetts Institute of Technology, Massachusetts Institute of Technology, Sloan School of Management, E40-147, Cambridge, MA, 02139, United States of America, dbertsim@mit.edu

1 - Pierskalla Award

Dimitris Bertsimas, Professor of Operations Research and Statistics, Massachusetts Institute of Technology, Massachusetts Institute of Technology, Sloan School of Management, E40-147, Cambridge MA 02139, United States of America, dbertsim@mit.edu

The Health Applications Society of INFORMS sponsors an annual competition for the Pierskalla Award, which recognizes research excellence in the field of health care management science. The award includes a honorarium for the best paper presented in a Health Applications Society sponsored session at the annual INFORMS conference. The award is named after Dr. William Pierskalla to recognize his contribution and dedication to improving health services delivery through operations research. The Pierskalla award information can be found on the website at: https://www.informs.org/Community/HAS/Pierskalla-Award.

■ MB21

Hilton- Union Sq 1

Novel Techniques for Vehicle Routing

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Burcu Keskin, Associate Professor, University of Alabama, 300 Alston Hall, Tuscaloosa, Al, 35487, United States of America, bkeskin@cba.ua.edu

Co-Chair: Ibrahim Capar, Graduate Research Assistant, ISM Dept. 300 Alston Hall, 361 Stadium Drive, Tuscaloosa, Al, 35487-0226, United States of America, icapar@cba.ua.edu

1 - The Split Delivery Min-Max Multi-Depot Vehicle Routing Problem with Minimum Delivery Amounts

Xingyin Wang, University of Maryland, Mathematics department, University of Maryland, College Park, MD, 20742, United States of America, wang_xingyin@yahoo.com, Bruce Golden, Edward Wasil

The split delivery min-max multi-depot vehicle routing problem with minimum delivery amounts is a variant of the standard multi-depot VRP. The objective is to minimize the total time of the most costly route taking into account the travel times and the customer service times. The service time of a customer can be split among the vehicles, provided that each visit serves a minimum fraction of the total service required. We develop a heuristic that produces high-quality results.

2 - The Split Delivery Vehicle Routing Problem

Gizem Ozbaygin, Ph.D. Candidate, Bilkent University, Industrial Engineering Department, Ankara, Turkey, ozbaygin@bilkent.edu.tr, Hande Yaman Paternotte, Oya Karasan, Barbaros Tansel

The split delivery VRP is a relaxation of the capacitated VRP where multiple vehicles can visit and serve the demand of a customer. We try to solve this problem with a formulation using two indexed flow variables. This formulation may have solutions where several vehicles exchange loads at some customers. We cut-off such solutions using a) cutting planes, b) extending the formulation locally with vehicle indexed variables, and c) node splitting. We report some preliminary computational results.

3 - Online and Open Vehicle Routing Problem with Split Delivery

Ibrahim Capar, Graduate Research Assistant, ISM Dept. 300 Alston Hall, 361 Stadium Drive, Tuscaloosa, Al, 35487-0226, United States of America, icapar@cba.ua.edu, Burcu Keskin

We consider an online, nomadic vehicle routing problem with split deliveries. This type of problem is common for shippers that use common carriers with TL, LTL, or container services. We develop an integer programming based online optimization model to minimize long run total transportation cost.

■ MB22

Hilton- Union Sq 2

Disaster Planning

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Yingyan Lou, Assistant Professor, Arizona State University, P.O. Box 873005, Tempe, AZ, 85287-3005, United States of America, yingyan.lou@asu.edu

1 - Pre-disaster Investment Decisions for Strengthening the Chinese Railway System to Earthquakes

Liu Hong, Huazhong University of Science and Technology, 1037#, Luoyu Road, Wuhan, 430074, China, liu.hong@hust.edu.cn, Xiaozheng He, Srinivas Peeta, Yongze Yan, Min Ouyang

We propose an analytical model for a pre-disaster investment problem that seeks to select and prioritize links in China Railway Network (CRN) to strengthen under a limited budget with the objective of minimizing the post-earthquake loss of the CRN, which is represented in terms of the functionality deterioration of railway system service. A heuristic is used to solve the problem. Numerical experiments using real-world data illustrate the tractability and effectiveness of the proposed method.

2 - Designing Service Coverage and Measuring Accessibility and Serviceability

EunSu Lee, Associate Research Fellow, Upper Great Plains Transportation Institute, 1616 12th Ave. N #210E, Fargo, ND, 58102, United States of America, eunsu.lee@ndsu.edu

This study proposes a novel approach to analyze potential accessibility to ambulance services by combining the demand-covered-ratio and potential serviceability with the ambulance-covering-ratio.

3 - A Bilevel Model and GPU Computing Solution Strategy for Evacuation Route Planning

David Prentiss, University of Maryland, 1173 Glenn Martin Hall, College Park, MD, 20742, United States of America, dprentiss@gmail.com, Elise Miller-Hooks

We propose a bilevel evacuation and shelter design problem with a space-based risk exposure objective that minimizes the maximum risk exposure of evacuees under stochastic, heterogeneous hazard scenarios. A solution strategy is developed that exploits a fast, low-memory, equilibrium-finding algorithm as well as parallel implementation on graphics processing units.

■ MB23

Hilton- Union Sq 3

Uncertainty in Transportation Models II

Sponsor: TSL/Freight Transportation & Logistics

Sponsored Session

Chair: Nico Dellaert, Associate Professor, Eindhoven University of Technology, Den Dolech 2, Eindhoven, 5612AZ, Netherlands, n.p.dellaert@tue.nl

1 - Real-time Recovery in Berth Allocation with Stochastic Arrival and Handling Times

Nitish Umang, École Polytechnique Fédérale de Lausanne, Switzerland, nitish.umang@epfl.ch

In this research we study the berth allocation problem (BAP) in real time as disruptions occur. In practice, the actual arrival times and handling times of the vessels deviate from their expected or estimated values, which can disrupt the original berthing plan and potentially make it infeasible. We consider a given baseline berthing schedule, and solve the BAP on a rolling planning horizon with the objective to minimize the total realized costs of the updated berthing schedule as the actual arrival and handling time data is revealed in real time. The uncertainty in the data is modeled by making appropriate assumptions about the probability distributions of the uncertain parameters based on past data. We present an optimization based recovery algorithm based on set partitioning method and a smart greedy algorithm to reassign the vessels in the events of disruption. A simulation study is carried out to assess the solution performance and efficiency of the proposed algorithms, in which the baseline schedule is chosen as the solution of the deterministic berth allocation problem without accounting for any uncertainty. Our research problem derives from the real world issues faced by the SAQR port, Ras Al Khaimah, UAE, where the berthing plans are regularly disrupted owing to a high degree of uncertainty in information. Results indicate that the proposed algorithms can significantly reduce the total realized costs of the berthing schedule as compared to the ongoing practice of reassigning vessels at the port.

2 - A Constructive Heuristic for Stochastic Time-dependent Service Network Design

Stein W. Wallace, Professor of Operational Research, Norwegian School of Economics, Department of Business and Management Sc, Norwegian School of Economics, Bergen, NO-5045, Norway, Stein.Wallace@nhh.no, Teodor Gabriel Crainic, Xin Wang

This research looks at a stochastic, time-dependent, capacitated, multi-commodity service network design problem in which periodic, cyclic schedules are built. We find and illustrate the underlying structures of stochastic solutions by studying the optimal solutions to the stochastic network design problem and comparing them with deterministic counterparts. To achieve this, the following issues are addressed: Why does the solution select one particular route rather than others? What drives the solution to add/drop a service? Structural properties that characterize the stochastic solutions are found when addressing these issues and are then used to develop a constructive heuristic.

3 - Influence of Spillback Effect on the Dynamic Shortest Path Problem with Network Disruptions

Nico Dellaert, Associate Professor, Eindhoven University of Technology, Den Dolech 2, Eindhoven, 5612AZ, Netherlands, n.p.dellaert@tue.nl, Derya Sever, Tom Van Woensel

Due to the limited capacity of roads, we observe that when a particular road is disrupted because of accident or traffic jam, the traffic queue propagates backwards. We consider this so-called spillback effect in a dynamic shortest path problem, with network disruptions following a stochastic process. We model this problem as a Markov Decision Process, and consider several options to come to good solutions, using only a fraction of the available knowledge on the traffic situation.

■ MB24

Hilton- Union Sq 4

Advances in Network Modeling

Sponsor: TSL/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Nan Jiang, University of Texas, Austin TX, United States of America, jiang@utexas.edu

1 - Modeling Mixed Equilibrium Behaviors in Transportation Networks with Link Flow Constraints

Xia Yang, University of Texas, Austin, TX, United States of America yangxiacsu.shiny@gmail.com, Xuegang (Jeff) Ban

We model mixed equilibrium behaviors with user equilibrium (UE), system optimum (SO) and Cournot-Nash (CN) players as a generalized Nash equilibrium problem (GNEP). Link flow constraints are considered and numerical results are presented to illustrate the model.

2 - Parallel Implementation of Agent-based and Kinematic Wave Model-based Dynamic Traffic Simulation

Jeff Taylor, The University of Utah, Salt Lake City, UT, United States of America, jeff.d.taylor@utah.edu, Xuesong Zhou

This talk will present a computationally efficient implementation of a simplified kinematic wave model based dynamic network simulator. To enable flexible parallel computing on a multi-core shared memory architecture, we discuss how to (1) how to embed an event-based simulation logic; (2) how to decompose simulation steps to reduce communications overheads in parallel execution; (3) how to automate the partition and map computation tasks. The algorithms are implemented in an open-source dynamic traffic assignment package.

3 - A Simulation-based Optimization Algorithm for Dynamic Transportation Problems

Carolina Osorio, MIT, Cambridge, MA, United States of America osorioc@mit.edu, Linsen Chong

This work proposes a simulation-based optimization algorithm for continuous generally constrained dynamic urban transportation problems with stochastic simulation-based objective functions. The algorithm combines ideas from metamodel simulation-based optimization, transient queueing theory, traffic flow theory and stochastic microscopic traffic simulation. We benchmark and evaluate the performance of the algorithm with a large-scale traffic signal control problem.

4 - System Optimal Dynamic Traffic Assignment with Schedule Delay on Two-terminal Networks

Hong Zheng, Purdue University, West Lafayette, IN, United States of America, zheng225@purdue.edu, Srinivas Peeta

We analyze system optimal dynamic traffic assignment with schedule delay on a single-origin single-destination network. We show the problem is equivalent to the earliest arrival latest departure flow. A numerical example is illustrated.

■ MB25

Hilton- Union Sq 5

New Methods for Leveraging Open Data in Public Transit Analysis and Modeling

Sponsor: TSL/Urban Transportation

Sponsored Session

Chair: Nicholas Lownes, University of Connecticut, 261 Glenbrook Rd, U-3037, Storrs, CT, 06269, United States of America, nlownes@engr.uconn.edu

1 - Clustering in Metric Space for Transit Route Stop Set Identification

Kelly Bertolaccini, Graduate Assistant, University of Connecticut, 260 Glenbrook Rd, Storrs, CT, 06269, United States of America, klb06003@engr.uconn.edu, Nicholas Lownes

Identifying sets of stops to group into routes is an important component of transit network design. This research presents a clustering model formulated in a metric space defined by the ratio of the LEHD trajectories between stop pairs to the shortest path distance between them with the objective of maximizing the metric space covered by the stop sets.

2 - A Bus Dispatching Policy to Minimize Headway Variance

Simon Berrebi, Georgia Tech, 790 Atlantic Drive, Atlanta, GA, 30332-0355, United States of America, sberrebi3@gatech.edu, Kari Watkins

On high frequency bus routes, passenger-waiting time increases with headway variance. In this research, the bus-dispatching problem was addressed as a continuous-time stochastic decision process, with time-dependent transition probabilities. A policy to minimize headway variance was derived analytically by backward induction and compared to methods used in practice through simulation. The policy yielded lower passenger waiting time and was more resilient to perturbation.

3 - Incorporating Travel Time Reliability in Schedule-based Transit Assignment

Alireza Khani, Postdoctoral Fellow, University of Texas at Austin, 1616 Guadalupe St, Suite 4.202, Austin, TX, 78701, United States of America, akhani@utexas.edu, Tyler Beduhn, Mark Hickman

A hyperpath model is proposed for modeling the effect of service reliability on user behavior in a schedule-based transit network. The reliability of the transit service is modeled through stochastic arrival and departure times at the stops, and a logit route choice model is proposed to assign passengers to the reliable paths.

4 - Schedule-based Transit Assignment with Capacities and Priority: A Multicommodity Flow Application

Mark Hickman, University of Queensland, St Lucia, 4072, Queensland, Australia, m.hickman1@uq.edu.au, Alireza Khani

We consider the problem of a user equilibrium in a schedule-based transit assignment. When fixed capacity constraints and boarding priority are applied, the assignment can be modelled as a multicommodity flow problem with side constraints. We show how this might be solved using a combination of dual prices and column generation. We implement this solution procedure in an agent-based passenger assignment and simulation for a network of a mid-sized city.

■ MB26

Hilton- Union Sq 6

Location Modeling & Applications

Sponsor: Location Analysis

Sponsored Session

Chair: Richard Church, Professor, University of California, Santa Barbara, 1832 Ellison Hall, Santa Barbara, CA, 93106-4060, United States of America, rick.church@ucsb.edu

1 - Solving Location Problems by a Trajectory Approach

Zvi Drezner, California State University, 800 N. State College, Fullerton, CA, 92834, United States of America, zdrezner@fullerton.edu, Tammy Drezner

We solve location problems by following a trajectory from a solution point to a related problem to the desired solution location.

2 - Geospatial Analysis on Somali Piracy

Daisuke Watanabe, Tokyo University of Marine, Tokyo, Japan daisuke@kaiyodai.ac.jp, Shigeki Toriumi

Recently, piracy attacks occurred off the coast of Somalia and threaten the ships and vessels navigating on the sea lane between Asia and Europe. The purpose of this study is to determine geographical characteristics of the areas where Somali piracy has occurred. To achieve this purpose, we plotted the piracy incidents from 2005 to 2013 on a map and analysis using spatial analysis method including kernel density method and optimal location model.

3 - A Simple Framework for Parallel Multi-Objective Optimization using Java

F. Antonio Medrano, UC Santa Barbara, 1832 Ellison Hall, Santa Barbara, CA, 93106, United States of America, medrano@geog.ucsb.edu, Richard Church

Solving multi-objective combinatorial optimization (MOCO) problems can quickly become intractable when applied to big data. Top MIP solvers have built-in parallelism, but specialized algorithms are typically coded serially. Java provides a new concurrency API that allows for simple conversion of a serial method to parallel that is well suited to approaches for finding the supported Pareto set of a MOCO problem. These methods are discussed, along with extensions for finding unsupported solutions.

4 - Comparing Anti-Covering Location Problem New Heuristic Solutions and Times to Optimal Ones

Matthew Niblett, University of California, Santa Barbara, 1832 Ellison Hall, UC Santa Barbara, Santa Barbara, CA, 93106-4060, United States of America, mniblett@geog.ucsb.edu, Richard Church

The Anti-Covering Location Problem (ACLP) involves maximizing the number of facilities located within a region such that each is separated by a minimum separation standard. For small problems optimal solutions are obtained quickly, while larger problems require much more time. A new heuristic solution approach, Marching Army, has been developed. The heuristic solution performance is compared to optimal ones.

■ MB27

Hilton- Union Sq 7

Railway Analytics

Sponsor: Railway Applications

Sponsored Session

Chair: Qing He, University at Buffalo (SUNY), 225 Ketter Hall, Buffalo, NY, 14260, United States of America, qinghe@buffalo.edu

1 - Multivariate Deterioration Model using Railway Track Geometric Data

Zhiguo Li, IBM T J Watson Research Center, 1101 Kitchawan Road, Route 134, Yorktown Heights, 10598, United States of America, zhiguo.li.wisc@gmail.com, Qing He

Track geometric data play an important role in ensuring a safe, reliable and comfortable railway service. For optimization of track maintenance and renewal works, the track geometry deterioration model can be developed to represent a geometric parameter's behavior and predict its future trend. While the previous studies focused on the models for single parameters, we develop a multivariate model for multiple measurements. Its effectiveness is validated by using real track irregularity data.

2 - Risk Analysis of Petroleum Crude Oil Transportation by Rail

Xiang Liu, Assistant Professor, Rutgers, The State University of New Jersey, CoRE 606, 96 Frelinghuysen Road, Piscataway, NJ, 08854-8018, United States of America, xiang.liu@rutgers.edu, Christopher PL Barkan, Mohd Rapik Saat

Managing the risk of rail transport of petroleum crude oil receives growing national attention. In this research, a model is developed to estimate the probability of large, multiple-tank-car release indents accounting for a variety of track and train characteristics. The model is used to evaluate the safety effectiveness of various tank car designs.

3 - Rail Network Simulation System for Mining Industry

Alexey Sorokin, Senior Systems Engineer, Optym, LLC, 2153 SE Hawthorne Road, Gainesville, Fl, 32641, United States of America, alexey.sorokin@optym.com, Krishna Jha, Amit Agarwal, Ravindra Ahuja

We developed a simulation system designed to realistically simulate rail operations of mining companies and to perform a variety of what-if case studies regarding capital expansion and operational changes. This is a sophisticated discrete-event simulation system with many interdependent decision modules designed to handle all important aspects of rail operations. The system helps in effective capital expansion plans for a rail network in terms of throughput and maintenance operations.

4 - Identification of Asymmetric Wheel Profile Wear and Its Benefit Analysis

Qing He, University at Buffalo (SUNY), 225 Ketter Hall, Buffalo, NY, 14260, United States of America, qinghe@buffalo.edu, Zhiguo Li

Compared to normal wheel profile wear, asymmetric wheel profile wear accelerates the degradation process and cause much more consequential damages to the wheels, rails, turnouts and bogie components. This study develops a statistical method to identical the asymmetric wheel profile wear for a wheel set based on wayside detector data. Further, we conduct benefit analysis to classify the railcars with asymmetric wheel profile wear based on maintenance records.

■ MB28

Hilton- Union Sq 8

Air Cargo and Aviation Operational Performance

Sponsor: Aviation Applications

Sponsored Session

Chair: Bo Zou, University of Illinois at Chicago, 2073 Engineering Research Facility, 842 West Taylor Street, Chicago, IL, 60607, United States of America, bzou@uic.edu

1 - Identifying Arrival and Departure Demand Metrics for an Empirical Runway Capacity Model

Amy Kim, Assistant Professor, University of Alberta, 3-007 NREF, Civ & Env Eng., University of Alberta, Edmonton, AB, T6G2W2, Canada, amy.kim@ualberta.ca, Yi Liu

Precisely identifying the number of flights that wish to both arrive to and depart at an airport is required to effectively assess its runway capacity. We extract this information by combining several existing and readily available data sources. We develop an empirical runway capacity model, and assess how data regarding arrival and departure demands should be represented in this model. The developed methodology was applied to case studies of several major commercial airports in the U.S.

2 - Optimization of Arrival Patterns for Time-dependent Queueing Models

Raik Stolletz, Professor, University of Mannheim, Schloss, Mannheim, 68131, Germany, stolletz@bwl.uni-mannheim.de, Axel Franz

We consider a time-dependent queueing system of truck handling operations at an air cargo terminal. Our optimization approach is based on the stationary backlog-carryover approach. The time-dependent arrival rates serve as decision variables, i.e., changes in the original demand pattern are allowed and intentional. The objective of this non-linear optimization model is to minimize total expected waiting times while limiting the change in the arrival pattern.

3 - Modeling Delay Propagation: A Joint Analytical-Statistical Approach

Bo Zou, University of Illinois at Chicago, 2073 Engineering Research Facility, 842 West Taylor Street, Chicago, IL, 60607, United States of America, bzou@uic.edu, Nabin Kafle

An analytical tool is developed to compute propagated flight delay in the US. The results are used to empirically model the impact on delay propagation of various influencing factors. Spatial and temporal analysis and assessment of the propagated delay are performed which is useful for airline scheduling and airport planning and performance benchmarking purposes. In particular, the delay multipliers are quantified for major carriers and airports in the system.

4 - The Air Cargo Scheduling Problem

Yavuz Durdak, Phd. Student, Middle East Technical University Operations Research Department, ODT Universiteler Caddesi, Dumlupinar Bulvari No:1, Ankara, 06800, Turkey, yavuz.durdak@metu.edu.tr, Haldun Süral, Sinan Gürel

In this study, we consider the Air Cargo Scheduling Problem based on real life application. The aim is to move cargo and passengers that have different priorities and delivery time windows, from a number of origin airports to destinations by a transportation system. The system has predefined routes and a heterogeneous fleet of aircraft. The problem is formulated as a heterogeneous vehicle, multicommodity, pick-up, and delivery network flow problem with a large set of system specific constraints.

■ MB29

Hilton- Union Sq 9

Joint Session Wagner/CPMS: Daniel H. Wagner Prize for Excellence in Operations Research Practice

Cluster: Daniel H. Wagner Prize for Excellence in Operations Research Practice & CPMS, The Practice Section

Invited Session

Chair: C. Allen Butler, President, Daniel H. Wagner, Associates, Inc., Hampton, VA, United States of America, Allen.Butler@va.wagner.com

1 - Daniel H. Wagner Prize

C. Allen Butler, President, Daniel H. Wagner, Associates, Inc., Hampton, VA, United States of America, Allen.Butler@va.wagner.com

The competition for the 2014 Daniel H. Wagner Prize for Excellence in Operations Research Practice resulted in six finalists, who submitted papers to the judging committee and who will present their results in three sessions. In this keynote, the winner of the competition will be announced and the authors will give a reprise of the winning presentation.

2 - Vaccine Prioritization for Effective Pandemic Response

Eva Lee, Professor & Director, Georgia Institute of Technology, Ctr for OR in Medicine & Healthcare, Atlanta, GA, 30332, United States of America, eva.lee@gatech.edu

When vaccine availability is limited, prioritized vaccination is considered the best strategy to contain a (flu) pandemic. We derive a mathematical decision framework to track the effectiveness of prioritized vaccination through the course of a pandemic. Our approach couples a disease propagation model with both a vaccine queuing model and optimization engine to determine the optimal prioritized coverage in a mixed vaccination strategy. This approach demonstrably minimizes infection and mortality. This work is joint with the Centers for Disease Control and Prevention.

3 - Identifying Risks and Mitigating Disruptions in the Automotive Supply Chain

Don Zhang, Technical Expert, Research & Advanced Engineering, Ford Motor Company, Dearborn MI, United States of America, xzhang35@ford.com, Yao Ge, Oleg Gusikhin, Michael Sanders, Keith Combs, William Schmidt, David Simchi-Levi, Yehua Wei, Peter Y. Zhang

Firms are exposed to a variety of low probability / high impact risks which may disrupt their operations and supply chains. These risks are difficult to predict and quantify, and therefore difficult to manage. As a result, managers may deploy countermeasures sub-optimally, leaving their firms exposed to some risks while wasting resources to mitigate other risks that would not cause significant damage. In a three-year research engagement with Ford Motor Company, we address this practical need by developing a novel risk exposure model that assesses the impact of a disruption originating anywhere in the firm's supply chain. Our approach defers the need to estimate the probability associated with any specific disruption risk until after the company learns how the realization of such a disruption will impair its operations. As a result, the company can make more informed decisions about where to focus its limited risk management resources. We demonstrate how Ford has applied this model to identify previously unrecognized risk exposures, evaluate pre-disruption risk mitigation actions, and develop optimal post-disruption contingency plans, including circumstances in which the duration of the disruption is unknown.

■ MB30

Hilton- Union Sq 10

Scheduling in Practice

Cluster: Scheduling and Project Management

Invited Session

Chair: Emrah Cimren, Sr. Analytics Lead, Nike, One Bowerman Drive, Beaverton, OR, 97005, United States of America, Emrah.Cimren@nike.com

1 - University of California Increases Procurement Efficiency with Optimal eCommerce Scheduling

Andrew Clark, Director, Strategic Sourcing, UCSF, 1855 Folsom St, San Francisco, Ca, 94141, United States of America, andrew.clark@ucsf.edu, Susan Cholette, Ozgur Ozluk

This paper documents the creation of a scheduling tool to find an optimal schedule for loading suppliers into the eCommerce systems at UC San Francisco and UC Berkeley. Automating supplier enablement decisions for these two campuses alone has led to a clear work plan with a clear understanding of the potential benefit; $15 Million over the next 5 years. Further, we formulated the model to permit expansion to all 10 UC campuses and explored various operational models.

2 - An Integration of Fatigue Risk Management into Crew Scheduling

Gulsah Hancerliogullari, Assistant Professor, Istanbul Bilgi University, Eski Silahtaraga Elektrik Santrali Kazim, Karabekir Cad. No: 2/13 34060 Eyüp, Istanbul, 34060, Turkey, gulsah.hancerli@bilgi.edu.tr, Emrah Koksalmis

The feasibility of a Crew Scheduling Problem (CSP) depends on many rules and regulations imposed by government, international organizations, labor unions and airline companies themselves. In this study, we compare the Fatigue Risk Management Systems (FRMS) enforced by civil aviation authorities such as Federal Aviation Authority (FAA), Directorate General of Civil Aviation (Turkey), and develop a mathematical model, in which these rules and regulations are included as constraints.

3 - Integrated Scheduling of Jobs and Maintenance Activities

Dirk Briskorn, University of Wuppertal, Rainer-Gruenter-Str. 21, Wuppertal, Germany, briskorn@wiwi.uni-wuppertal.de

We consider a problem to integratedly schedule jobs and maintenance activities. Maintenance levels of machines are lowered by jobs and must be increased by maintenance activities once in a while. We analyze approximability and provide heuristics with excellent avergage case performance.

■ MB31

Hilton- Union Sq 11

Stochastic Methods in Cloud Computing Services

Sponsor: Service Science

Sponsored Session

Chair: Cathy Xia, Associate Professor, Ohio State University, Columbus, OH, United States of America, xia.52@osu.edu

1 - Cloud Provider Selection – An Expedia View

Ilyas Iyoob, Director, Advanced Analytics, Gravitant, 11940 Jollyville Rd, Ste 325-N, Austin, TX, 78759, United States of America, iyoob@utexas.edu, Aaron Yan

Wouldn't it be nice if we could pick and choose cloud providers like we do flights on Expedia? Consumers today are faced with a very large number of options, and a big part of the confusion is knowing which provider, offering, and location combination to pick for each of their IT environments such that their requirements are best satisfied. Using consumer requirements data from our cloud brokerage business, we model this as a vendor selection problem in the Cloud IT Supply Chain.

2 - Stochastic Optimal Control for Dynamic Resource Allocation in the Clouds

Mark Squillante, IBM T.J. Watson Research Center, 1101 Kitchawan Rd, Yorktown Heights, United States of America, mss@us.ibm.com, Xuefeng Gao, Yingdong Lu, Mayank Sharma, Joost Bosman

We consider a general class of dynamic resource allocation problems that arises in many cloud environments, with the goal of dynamically allocating capacity for every resource type to serve uncertain/variable demand and maximize expected net-benefit over a given time horizon. We derive the optimal control policy and efficient algorithms for governing adjustments to resource allocation capacities over time. Numerical experiments investigate various issues of theoretical and practical interest.

3 - Performance Modeling and Approximations for Heterogeneous Servers

Natarajan Gautam, Associate Professor, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, gautam@tamu.edu

We consider multiple parallel heterogeneous servers which are typical in cloud computing services. The servers use processor sharing for cloud computing jobs. In addition, the server speeds change over time. Exact analysis of such a system is typically intractable. However, it is crucial that the servers provide probabilistic performance guarantees. To that end, we develop a few approximations based on fluid queues, large deviations and matrix analytic methods.

4 - Resource Provisioning for Cloud Computing Services via Poisson Approximation

Yue Tan, PhD Candidate, The Ohio State University, 1971 Neil Ave, Columbus, OH, 43210, United States of America, tan.268@osu.edu, Yingdong Lu, Cathy Xia

This talk presents a stochastic modeling approach to guide the resource-provisioning task for future service clouds with large-scale demands. By replacing commonly used normal approximation with Poisson approximation, then based on Stein-Chen methods, we show that the asymptotic provisioning methodology provides better provisioning solutions.

■ MB32

Hilton- Union Sq 12

Service Science Best Paper Award

Sponsor: Service Science

Sponsored Session

Chair: P K Kannan, University of Maryland, Smith School of Business, College Park, MD, United States of America, PKannan@rhsmith.umd.edu

1 - Truthful Mechanisms for Resource Allocation and Pricing in Clouds

Mahyar Movahed Nejad, Wayne State University, 4815 Fourth St., Rm. 2033, Detroit, MI, 48202, United States of America, mahyar@wayne.edu, Daniel Grosu, Lena Mashayekhy

Cloud computing systems provide a large pool of virtualized and dynamically scalable resources as Infrastructure as a Service (IaaS), and offer them to users in the form of virtual machine (VM) instances. We design truthful greedy and optimal mechanisms for the problem of VM provisioning, allocation, and pricing. We prove that our proposed mechanisms are truthful, that is, the users do not have incentives to manipulate the system.

2 - A Unified, Operational View of Service, Service Systems, and Service Science

Steven Alter, Professor of Information Systems, University of San Francisco, alter@usfca.edu

To be taken seriously, service science should use concepts and frameworks that are easy to apply to real situations. I propose: 1) a broadly applicable definition of service 2) a conceptual model linking the definition to work systems that produce services 3) a related conceptual model linking work system resources to value for customers 4) use of those conceptual models to create operational meanings of co-production, value co-creation, value proposition, user experience, and other concepts

3 - Service Systems Engineering: A Field for Future Information Systems Research

Tilo Boehmann, Professor, University of Hamburg, Department of Informatics, Vogt-Koelln-Str. 30, Hamburg, 22527, Germany, Tilo.Boehmann@uni-hamburg.de, Jan Marco Leimeister, Kathrin Möslein

Service systems are complex socio-technical systems that enable value co-creation. Service systems engineering (SSE) calls to advance evidence-based design knowledge for such systems with regard to the architecture, the interactions, and the resource base of service systems, helping value creation to become better adapted to the context of need.Information systems research is ideally positioned to contribute through (action) design research or the piloting of IT-enabled innovation.

4 - Growing the Service Brand

Ming-Hui Huang, Professor, National Taiwan University, 1, Sec. 4, Roosevelt Rd., Taipei, 10617, Taiwan - ROC, huangmh@ntu.edu.tw, Chekitan Dev

Given the unique characteristics of service, it is important to have a better understanding about service branding. Analyzing a proprietary panel data set with a two-step system GMM panel model we observe the growth and decline of the service brand, identify core-value and value-added drivers for growing the service brand, and uncover the best service-driver combinations. Our findings provide important theoretical and managerial implications for growing the service brand.

■ MB33

Hilton- Union Sq 13

New Research Topics on Innovation

Cluster: New Product Development

Invited Session

Chair: Manuel Sosa, Associate Professor of Technology and Operations Management, INSEAD, 1 Ayer Rajah Ave., Singapore, Singapore, manuel.sosa@insead.edu

1 - The Evolution of Product Form: Identifying and Analyzing Styles in Design Patents

Tian Chan, PhD, INSEAD, 1 Ayer Rajah Avenue, Singapore, Singapore, TianHeong.CHAN@insead.edu, Jurgen Mihm, Manuel Sosa

We introduce an approach to identify styles (categories of product designs similar in form) among 400,000 US design patents. We combine state-of-the-art clustering techniques with experimental validation to create, for the first time, a dataset of styles. Building on this platform, we find that i) the level of turbulence (unpredictability of changes) in product form follows a U-shaped pattern to the level of turbulence in product function, and ii) product form turbulence is increasing over time.

2 - Search Behavior in Innovation Communities and Contests

Karim Lakhani, Harvard Business School, k@hbs.edu, Kevin Boudreau

Crowds can be organized in the forms of communities and contests. Both of these approaches have within them different assumptions about incentives, intellectual property and the underlying innovative search process. We compare and contrast the assumptions and provide field experimental data to show the salience of the differences.

3 - Creativity in Contests

Sanjiv Erat, UCSD, Gilman Dr, La Jolla, CA, United States of America, sanjiv_erat@isb.edu

We investigate through an experiment whether contest incentives improve creativity. Our main finding is that while incentives can help improve creativity, the type of incentives matter. Specifically, while rewarding creativity through piece-rate enhances creativity, competition incentives are ineffective.

■ MB34

Hilton- Union Sq 14

Joint Session SPPSN/MIF: Disaster Relief and Humanitarian Logistics

Sponsor: Public Programs, Service and Needs & Minority Issues Forum

Sponsored Session

Chair: Christopher Zobel, Professor, Virginia Tech, Dept. of Business Information Technology, 1007 Pamplin Hall, Blacksburg, VA, 24061-0235, United States of America, czobel@vt.edu

1 - Volunteer Assignment Policies Following a Large-scale Disaster

Emmett Lodree, University of Alabama, 361 Stadium Drive, Tuscaloosa, AL, United States of America, ejlodree@cba.ua.edu, Lauren Davis

After a disaster event, volunteers sporadically emerge to perform relief tasks at various sites within the affected area. This paper investigates optimal policies for assigning volunteers to relief sites such that the expected work remaining at the end of a finite planning horizon is minimized. We introduce a nested Markov decision problem to address this situation, and discuss various solution approaches.

2 - Shortest Path Problem with Arc Failure Scenarios

Preethi Issac, University Of Iowa, S243 John Pappajohn Bus Bldg, Iowa City, 52242, United States of America, preethi-issac@uiowa.edu, Ann M. Campbell

We consider a shortest path problem from source to destination over a set of arc failure scenarios. Our aim is to create a primary path and a set of alternative paths that provide the driver an option when an impassable road is encountered after a disaster. We provide an integer programming model and an exact algorithm that can be used to solve instances derived from real road networks.

3 - Improving Disaster Relief Supply Pre-positioning in the Rocky Mountain Region

Andrew Arnette, Assistant Professor, University of Wyoming, aarnette@uwyo.edu, Christopher Zobel

This research is being conducted with the American Red Cross in Colorado and Wyoming to examine the effectiveness of pre-positioning decisions for relief supplies to help improve the accessibility and location of distribution centers and shelters, as well as the scheduling and delivery of materials needed in the relief efforts. Combining GIS functionality and mathematical modeling with real-world data, the effort seeks to develop a model to make future disaster response efforts more effective.

4 - Managing Bottlenecks in Port and Overland Transport Networks for Food Aid

Mallory Soldner, PhD Candidate, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, msoldner@gatech.edu, Ozlem Ergun, Jarrod Goentzel, Julie Swann

Delays in transportation in humanitarian supply chains prevent life-saving aid from reaching beneficiaries when needed. These delays are often driven by reliability issues (e.g., at congested ports) and can change greatly depending on the quantities arriving. We describe a queuing model with breakdowns to model delays, and include our congestion-based delay characterization into a convex cost network flow model that determines optimal routing when several port and corridor options are available.

■ MB35

Hilton- Union Sq 15

Decisions in a Nonprofit Supply Chain II

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Gemma Berenguer, Purdue University, 403 W. State St., West Lafayette, IN, 47906, United States of America, gemmabf@purdue.edu

1 - A Framework to Support Direct-Marketing Strategies in Non-Profit Fundraising

Elizabeth Durango-Cohen, Associate Professor of, Illinois Institute of Technology, 565 W. Adams Street, Chicago, IL, United States of America, durango-cohen@iit.edu, Pablo Durango-Cohen

In this talk, we present an integrated framework to support nonprofit fundraising. The proposed models enable fundraisers to exploit the wealth of data now available to nonprofit organizations, and support the implementation of policies that discriminate based on both observed and unobserved characteristics that contribute to systemic differences between individuals.

2 - Resources for Results: Optimal Endowment Allocation for a Resource-constrained Early-stage NPO

Pryiank Arora, PhD Student, Georgia Institute of Technology, 800 W Peachtree St NW, Atlanta, GA, 30308, United States of America, Priyank.Arora@scheller.gatech.edu, Milind Sohoni, Sripad Devalkar

We study a novel `results-based' approach, to raise donations for projects, by an early-stage, resource-constrained, non-profit organization (NPO) that implements projects for public benefit. The NPO uses its endowment to implement initial phases, securitizes results as certificates, and invites donors to purchase them. We characterize the optimal endowment required to maximize benefit and compare it with `traditional' fund-raising approaches.

3 - Market Practices and Costs for Food Commodities in Darfur

Jarrod Goentzel, Massachusetts Institute of Technology, 77 Massachusetts Ave, Cambridge, MA, United States of America, goentzel@mit.edu, Tim Russell, Yasmin Abdel Gadir

Humanitarian organizations that increasingly complement aid distribution with cash or vouchers need to assess the supply of commodities in local markets. In 2013, the authors led a supply assessment of food commodities in markets across the Darfur region of Sudan. This paper uses the results of 145 trader surveys, 16 transporter surveys, and four focus groups to characterize practices and costs for sourcing, transporting, and managing key commodities in these markets.

4 - Supply Chains and Food Vouchers in Darfur

Michael Veatch, Gordon College, 255 Grapevine Rd, Wenham, MA, 01923, United States of America, Mike.Veatch@gordon.edu, Austin Drukker, Jarrod Goentzel

The U.N. World Food Program has tested food vouchers in the Darfur region of Sudan as an alternative to food aid. Because of high transport costs and other constraints, it is not clear that the market can meet the demand for food. We develop a simple food availability model, using optimization rather than market equilibrium, to support voucher planning.

■ MB36

Hilton- Union Sq 16

Reliable Sensor Cover and Network Design

Sponsor: Telecommunications

Sponsored Session

Chair: Richard Li-Yang Chen, Principal Member of Technical Staff, Sandia National Laboratories, 7011 East Ave, Livermore, CA, 94550, United States of America, rlchen@sandia.gov

1 - Algorithms for a Robust Sensor Cover and Communication Problem

Andrew Romich, Sandia National Laboratories, 7011 East Avenue, MS 9154, Livermore, CA, United States of America, aromich@sandia.gov, George Lan, J. Cole Smith

We consider sensor placement to cover a set of targets in a region, in a manner that allows sensors to communicate with one another. Communication effectiveness for each sensor pair is determined by a concave function of distance between the sensors. Also, final sensor placement is stochastic, as caused by drifting. We maximize a communication effectiveness metric, and require all targets to be covered by some sensor, where sensor drift occurs according to a robust (worst-case) mechanism.

2 - Directed Edge-Failure Resilient Network Design

Deon Burchett, PhD Student, University of Florida, Weil Hall, Gainesville, Fl, 32611, United States of America, deonlb@hotmail.com, Cynthia Phillips, Richard Li-Yang Chen

We consider the directed edge-failure resilient network design problem (DRNDP). This problem entails the design of a directed multi-commodity flow network that is capable of fulfilling a specified percentage of demands in the event that any Γ arcs are destroyed, where Γ is a constant parameter. We provide a formulation of DRNDP and solve it in a branch-and-cut framework. We present computational results.

3 - LP Relaxations and a Branch-and-Cut Approach for the Resilient PMU Placement Problem

Robert Carr, Senior Member of Technical Staff, Sandia National Laboratories, 6350 Eubank #1517, Albuquerque, NM, 87111, United States of America, rdcarr@sandia.gov, Joseph Ruthruff, Richard Li-Yang Chen

Having a Phasor Measurement Unit (PMU) at a node of an electrical network helps detect a local electrical malfunction. The PMU placement problem seeks to place the minimum number of PMUs so as to detect all local malfunctions. In the resilient version, some small constant number of PMUs might fail. We give small non-trivial LP relaxations and describe a branch-and-cut approach to this problem.

4 - Reliable Network Design by Graph Algorithms and Integer Programming Approaches

Neng Fan, University of Arizona, Systems and Industrial Engineering, Tucson, AZ, United States of America, nfan@email.arizona.edu

In this talk, we use graph algorithms and integer programming approaches to solve reliable network design problems. The application cases include power grid design, water system planning, etc.

■ MB37

Hilton- Union Sq 17

Joint Session AI/QSR: Multidisciplinary Information Fusion for System Informatics

Sponsor: Artificial Intelligence & Quality, Statistics and Reliability

Sponsored Session

Chair: Changqing Cheng, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, ccheng@tamu.edu

Co-Chair: Hui Wang, Florida State University, 2525 Pottsdamer St., Tallahassee, FL, 32310, United States of America, hwang10@fsu.edu

1 - Surface Quality Monitoring in Ultra-precision Machining with Physical and Data-driven Model

Changqing Cheng, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, ccheng@tamu.edu, Satish Bukkapatnam

We investigated a delayed differential equation model to identify chatter-free process parameters in ultra-precision machining, based on which we developed a data-driven approach for real-time surface roughness monitoring with features extracted from in situ sensor signals. By combining physical and statistical models, we achieved R^2 over 0.8 for surface roughness estimation in a real-time sense.

2 - Local Calibration of Parameters in Poly (Vinyl Alcohol)-treated Buckypaper Fabrication

Arash Pourhabib, Assistant Professor, Oklahoma State University, 322 Engineering North, Stillwater, OK, 74078, United States of America, arash.pourhabib@okstate.edu, Yu Ding, Jianhua Huang, Chuck Zhang, Kan Wang

We propose a framework for the the local calibration of parameters when a simulation model is used to approximate a physical process. The proposed framework acknowledges the dependency of parameters on input variables. We present the model in terms of a regularized optimization and solve it using a representer theorem. We apply the method to calibrate a finite element (FE) simulation for predicting Young's moduli of PVA-treated CNT buckypaper.

3 - A Transfer Learning Approach to Surface Variation Modeling and Cost-effective Monitoring

Chenhui Shao, University of Michigan, Ann Arbor, 2350 Hayward St., Ann Arbor, MI, 48109, United States of America, chshao@umich.edu, S. Jack Hu, Judy Jin, Hui Wang

This talk presents a method for modeling and monitoring surface variations by exploiting similarities among manufacturing processes. A novel approach is developed to improve spatial data modeling in surface manufacturing by fusing multidisciplinary information from similar but not identical manufacturing processes. The method is able to improve modeling precision without increasing measurements while help cost-effectively establish monitoring baseline when launching a new manufacturing process.

4 - Collaborative Degradation Modeling by Fusing Data on a Networked Structure

Shuai Huang, Assistant Professor, University of Washington, Industrial and Systems Engineering, United States of America, shuaihuang@usf.edu, Kaibo Liu

Degradation signals are sometime expensive to collect in many healthcare and manufacturing applications. Such a lack of data has imposed great challenges for degradation modeling and prognostics. To tackle this problem, we propose a collaborative degradation modeling method that can effectively fuse degradation signals of multiple entities that collectively form a network.

■ MB38

Hilton- Union Sq 18

Cognition and Positioning

Cluster: Strategy Science

Invited Session

Chair: Dan Levinthal, University of Pennsylvania, Wharton School, Philadelphia, PA, United States of America, dlev@wharton.upenn.edu

1 - Cognition and the Resource-Based View of the Firm

Felipe Csaszar, Ross School of Business, U. of Michigan, 701 Tappan Ave #R4336, Ann Arbor, MI, 48104, United States of America, fcsaszar@umich.edu

This paper provides a psychological micro-foundation for the RBV by developing a behaviorally plausible model of how resources are assessed by managers and how, once acquired, resources affect firm production and value. The model sheds light on the question of under what conditions, strategies based on acquiring resources are more likely to create a sustainable competitive advantage. The model also helps to address some of the definitional problems of the RBV raised by Priem and Butler (2001).

2 - Strategic Foresight

Giovanni Gavetti, Dartmouth College, Tuck Business School, United States of America, Giovanni.Gavetti@tuck.dartmouth.edu

This presentation will focus on the concept of strategic foresight. It will use an intellectual historical perspective to interpret the current debate and shed some light on future avenues of research.

3 - Making Sense of Sound: The Technological and Cultural Evolution of Synthesizers

Mary Tripsas, Boston College, Carroll School of Management, Boston, MA, United States of America, tripsas@bc.edu

We leverage the historical case of sound synthesis technologies to explore whether technologies that are deeply embedded in cultural tastes may, in fact, exhibit atypical trajectories. Based upon both qualitative and quantitative analyses of more than 30 years of advertisements that appeared in the field's leading trade magazine, we analyze how changing cultural tastes can shape both the framing and the capabilities of emerging and abandoned technologies.

4 - The Effect of Abductive Reasoning on Early-Stage Innovation Decisions

Dan Lovallo, University of Sydney, Sydney, Australia, dan.lovallo@sydnedy.edu.au

This study examines the effect of the form of logical reasoning on accepting a potentially innovative design concept. An experiment was conducted to simulate an uncertain environment characterized by incomplete information with members of a committee called upon to decide whether or not to invest in innovation-oriented new product concepts. Under an abductive reasoning frame manipulation, a form of logical reasoning that introduces hypotheses and theories to explain given facts, individuals were more likely to accept concepts whereas under deductive reasoning they were more likely to reject concepts. We recommend that to increase the likelihood of product concepts being accepted during design concept selection, decision makers should not treat concept selection as a decision problem alone but also as a design problem. They should employ innovative abduction to think creatively about new ways to frame a proposed concept as something else than what is presented and new working principles underpinning the proposed concept.

■ MB39

Hilton- Union Sq 19

Joint Session HAS/Analytics: Learning from Healthcare Data

Sponsor: Health Applications & Analytics Section

Sponsored Session

Chair: Donald Lee, Yale School of Management, 165 Whitney Ave, New Haven, CT, 06520, United States of America, donald.lee@yale.edu

1 - Identifying Impactable High-Risk Diabetes Patients

Margrét Bjarnadottir, University of Maryland, 4324 Van Munching Hall, University of Maryland, College Park, MD, 20742, United States of America, margret@rhsmith.umd.edu, David Anderson

Case management has been suggested as an option in fighting rising health care costs through coordinated care that advocates quality and cost effectiveness, but the evidence on the cost effectiveness is mixed. A key for cost-effectiveness is to identify not only high-cost patients, but impactable patients, that is patients where case management will both help the patient and the bottom line. We utilize modern data mining methods and upper bound methodologies to explore this problem.

2 - A Robust Approach to Designing Prostate Cancer Screening Strategies

John Silberholz, PhD Candidate, MIT, 77 Massachusetts Ave. E40-149, Cambridge, MA, 02139, United States of America, josilber@mit.edu, Dimitris Bertsimas

Prostate cancer is the most common non-skin cancer in US men, and many published mathematical models evaluate the effectiveness of screening strategies for the disease. In some instances the most effective screening strategy according to one model is evaluated as worse than not screening at all under a different model. Using robust and stochastic optimization, we identify screening strategies that are effective across multiple models, which provides evidence of the quality of these strategies.

3 - Stronger Instrumental Variables via Integer Programming for Healthcare Research

Jose Zubizarreta, Columbia University Business School, 3022 Broadway, Uris 417, New York, NY, 10027, United States of America, jz2313@columbia.edu

Weak instrumental variables constitute an important problem for estimation because confidence intervals do not have adequate coverage and because estimates are highly sensitive to biases from unmeasured confounders. Typically, the strength of an instrument is thought as given, but we present a new method that augments the strength of an instrument by solving an integer program. We use this method to estimate the effect of hospital length stay on readmissions of late-preterm babies in California.

■ MB40

Hilton- Union Sq 20

Payment Innovations in Health Care

Sponsor: Health Applications

Sponsored Session

Chair: Christian Wernz, Virginia Tech, 205 Durham Hall, Blacksburg, VA 24061, United States of America, cwernz@vt.edu

Co-Chair: Hui Zhang, PhD Student, Virginia Tech, Blacksburg, VA, United States of America, corinnaz@vt.edu

1 - The Role of Provider Payment in the Primary and Secondary Prevention of Type 2 Diabetes

John Franklin, University of Southern California, 1136 1/2 N El Centro Ave #1, Los Angeles, CA, 90038, United States of America, jpfrankl@usc.edu

One way that alternative provider payment systems try to encourage higher quality and reduced costs in health care is through better facilitation of prevention-oriented programming at the clinic level. Yet to date there has been little analysis of the characteristics of these systems that actually encourage (or discourage) disease prevention. This paper uses a system dynamics model to examine the relationship between payment systems and prevention, using the example of type 2 diabetes.

2 - Impact of Pay for Performance Incentives on Primary Care Efficiency in the Military Health System

Lawrence Fulton, Rawls School of Business,, Texas Tech University, 703 Flint Ave, Lubbock, TX, 79410, United States of America, lf25@txstate.edu, Paul Griffin, Nathaniel Bastian

We determine the effectiveness of a pay-for-performance (P4P) incentive program at U.S. Army hospitals using DEA and regression models. We evaluate pre- (2001 to 2007) and post- (2007 to 2012) P4P program implementation on primary care efficiency. We also compare to the other branches of service not using P4P.

3 - Mitigating Specialty Provider Financial Risk in Prospective Bundled Payment Systems

Danny Hughes, Research Director, The Harvey L. Neiman Health Policy Institute, 1891 Preston White Drive, Reston, VA, 20191, United States of America, dhughes@neimanhpi.org, Nadia Bilal

Retrospective bundled payment models, which cover all medical services associated with an episode of care, are used with existing fee-for-service (FFS) payments and usually include stop loss provisions to manage financial risk. As payments shift beyond FFS to prospective bundled payments, the mechanisms and benchmarks for managing these stop loss provisions may no longer exist. Using simulation-based optimization models, we develop pricing strategies to mitigate provider risk.

4 - How Reimbursements and Incentives Affect Decisions in Radiology and Accountable Care Organizations

Hui Zhang, PhD Student, Virginia Tech, Blacksburg, United States of America, corinnaz@vt.edu, Christian Wernz, Danny Hughes, Anthony Slonim

The effect of new reimbursement structures and incentives on cost and quality of care are challenging to predict. To address this challenge, we apply multiscale decision theory to model the decisions of and the interdependencies between health care stakeholders, including payers, Accountable Care Organizations, physicians and radiologists, with a focus on imaging use and investment. We discuss the effect of incentives on agent decisions and the optimal distribution of incentives between agents.

■ MB41

Hilton- Union Sq 21

Patient-Centric Healthcare and Personalized Medicine

Sponsor: Health Applications

Sponsored Session

Chair: Abe Zeid, Northeastern University, 360 Huntington Ave, Boston, United States of America, zeid@coe.neu.edu

1 - Modeling, Analysis and Improvement of Lung Cancer Diagnostic Procedure

Shan Jiang, University of Wisconsin-Madison, 1513 University Avenue, Room 3235, Madison, WI, 53706, United States of America, sjiang44@wisc.edu, Nicholas Faris, Xinhua Yu, Feng Ju, Jingshan Li, Raymond Osarogiagbon

To improve the care delivery process of lung cancer, we developed both simulation and analytic models to study the diagnostic procedure for lung cancer care delivery. In addition to performance evaluation, such as mean care delivery time and its variability, bottleneck analysis method is proposed to identify the most critical steps that impede the whole care delivery process. Such methods provide a quantitative tool to improve care delivery process for lung cancer patients.

2 - Patient Relationship Management in Healthcare

Sanjeev Bordoloi, University of St Thomas, 1000 LaSalle Ave TMH 443, Minneapolis, United States of America, sbordoloi@stthomas.edu

Healthcare organizations are starting to place higher priority to patient satisfaction. Satisfaction is measured through patient surveys and understanding patient's perceptions. One area that hospitals have found challenging is their service offered over the phone. We observed the call center operations within a hospital with the goal to improve overall patient relationship.

3 - Theoretical Modeling and Empirical Analysis of Canadian Joint Replacement Surgery Waiting Time Data

Qu Qian, Assistant Professor, Shanghai University of Finance and Econo, School of International Business Adminis, 100 Wudong Road, Shanghai, China, qian.qu@mail.shufe.edu.cn, Anming Zhang, Hong Chen

We empirically analyze joint replacement surgery waiting time data of 9 Canadian provinces from 2005-2012. The empirical analysis reveals surgeon's management of patient waiting list. By comparing the waiting times before and after January 2008, we assess the effectiveness of the policy of setting a waiting time target for joint replacement surgeries. Based on these empirical results, we develop a theoretical model to further investigate patient's waiting time problem.

4 - Data-driven Healthcare Service Opportunities in Korea

Chie-Hyeon Lim, Postdoctoral researcher, Postech, Eng. Bldg. 4-316, 77 Cheongam-Ro, Nam-Gu, Pohang, Korea, Republic of, freechon@gmail.com, Ki-Hun Kim, Kwang-Jae Kim, Chi-Hyuck Jun, Sung-Hong Kang

The National Health Insurance Service (NHIS) of Korea has collected insurance and medical record data of nearly all the citizens since 2001. Development of a big-picture of healthcare service opportunities utilizing the NHIS database is of national interest. Such picture would serve as a map for the healthcare policy and service development. In this talk, we discuss how we identified 138 data-driven healthcare service opportunities and present the big-picture which encompasses the opportunities.

5 - Design and Operations for Online-Offline-Integrated Healthcare Networks Facilitators

Jiun-Yu Yu, Assistant Professor, National Tawain University, No. 1, Section 4, Roosevelt Road, Da-An, Taipei, Taiwan - ROC, jyyu@ntu.edu.tw

Healthcare Networks Facilitators (HNFs) are organizations or platforms that help their members, including patients, families, doctors, and nurses, actively interact with one another so that everyone involved in the process benefits. HNFs are expected to create innovative healthcare services that are unlikely to be delivered in the past. This study aims to investigate the design and operations for online-offline-integrated HNFs so that these expectations can be met.

■ MB42

Hilton- Union Sq 22

Using OR to Model Healthcare Policy

Sponsor: Health Applications

Sponsored Session

Chair: Michael Carter, Professor, University of Toronto, Mech & Ind Engineering, 5 King's College Rd., Toronto, ON, M5S 3G8, Canada, mike.carter@utoronto.ca

1 - Designing Optimal Policies for the Recruitment of Rural Health Professionals

Anna Graber, annagr26@gmail.com, Vedat Verter, Michael Carter

Rural areas worldwide experience shortages of health workforce. In Canada, government policies such as alternative models of care for rural areas, promotion of rural medicine programs, educational programs for future physicians and financial incentives were used in an attempt to improve the discrepancy in resources. We would like to determine which financial policies and education location alternatives are best in order to attract workforce to rural areas, considering professionals' preferences.

2 - Resource Allocation and Risk Analysis of Renal Dialysis Centres in Ontario

Mahsa Shateri, University of Toronto, 5 King's College Road, Toronto, ON, M5S 3G8, Canada, mahsa.shateri@gmail.com, Michael Carter

The number of facility-based hemodialysis patients increases about 3% every year in Ontario. Three alternative methodologies have been employed to develop a tool that enables these facilities to determine the nurse-to-patient ratio while considering the possible incidents requiring the dedication of a nurse's time to a patient due to treatment complications. This tool also takes into account different nurses and patients types.

3 - using Analytics to Manage and Improve Ontario's Chronic Care System

Ali Vahit Esensoy, Sr Manager, Strategic Analytics, Cancer Care Ontario, 505 University Avenue, Toronto, ON, M5G 1X3, Canada, AliVahit.Esensoy@cancercare.on.ca, Neal Kaw, Somayeh Sadat

We present highlights of the Strategic Analytics practice at Cancer Care Ontario, which assists the agency's programs in making planning decisions through analytic products that employ OR, statistics, and machine learning. After a summary of projects to date, we focus our work with the Ontario Renal Network in developing a 12-year dialysis capacity assessment model to inform planning considerations including dialysis station deployment and patient-based funding allocation.

■ MB43

Hilton- Union Sq 23

Quadratic Assignment Problems and Applications

Sponsor: Computing Society

Sponsored Session

Chair: Peter Hahn, 2127 Tryon Street, Philadelphia, PA, 19146, United States of America, hahn@seas.upenn.edu

1 - A Biased Random-key Genetic Algorithm for Facility Placement to Minimize Total Flow Cost

Mauricio Resende, AT&T Labs Research, 200 S. Laurel Avenue, Room A5-1F34, Middletown, NJ, 07748, United States of America, mgcr@research.att.com, José Goncalves

We seek to place N rectangular facilities with unequal area on a rectangular floor space of dimension L x W such that all facilities fit in the space with no overlap and the sum of pairwise products of given distances and flows between facilities is minimized. A biased random-key genetic algorithm is proposed for this problem.

2 - On Solving a Hard Quadratic 3-Dimensional Assignment Problem

Hans Mittelmann, Arizona State University, Box 871804, Tempe, United States of America, mittelma@asu.edu, Domenico Salvagnin

We address the exact solution of a very challenging (and previously unsolved) instance of the quadratic 3-dimensional assignment problem, arising in digital wireless communications. Using special cutting plane and orbital shrinking techniques we are able to solve the target instance with moderate computational effort (the equivalent of one week of computations on a standard PC).

3 - Solving QAP with the Reformulation and Linearization Technique on a Heterogenous Cluster

Alexandre Goncalves, IFRJ - Instituto Federal de Rio de Janeiro, Str Dr José Augusto P. dos Santos s/n, São Goncalo, 24425-004, Brazil, alexandre.domingues.2000@gmail.com, Lucia Drummond, Artur Pessoa

The application of the Reformulation Linearization Technique (RLT) to the QAP leads to a tight linear relaxation with huge dimensions. The level 3 RLT (RLT3) is prohibitive in conventional machines for large instances due to memory limitations. The RLT2 obtains bounds with lower quality then RLT3, but with lower memory. This work presents a proposal of a application to solve the QAP on a heterogeneous clusters composed by machines with CPUs and GPUs using a combined RL2/RL3 B&B algorithm

4 - Solvable QAP Instances via the Level-1 RLT

Lucas Waddell, Graduate Student, Clemson University, Martin Hall, Clemson, SC, 29634, United States of America, lwaddel@clemson.edu, Warren Adams

Due to the difficulty associated with solving the QAP, researchers have directed attention to identifying polynomially-solvable special cases. We show that the level-1 RLT form serves as a unifying entity for many such cases, in that the continuous relaxation yields an optimal binary solution. The key challenge is the identification of complementary primal and dual solutions for which the primal variables are binary. These results build upon our earlier contributions.

■ MB44

Hilton- Union Sq 24

Digital Content Distribution and Management

Sponsor: Information Systems

Sponsored Session

Chair: Hong Guo, University of Notre Dame, 356 Mendoza College of Business, Notre Dame, IN, 46556, United States of America, hguo@nd.edu

1 - PULL or PUSH? Website's Strategic Choice of Content Delivery Mechanism

Dan Ma, Singapore Management University, 80 Stamford Road, Singapore, Singapore, madan@smu.edu.sg

Websites can push online content to users through Really Simple Syndication feeds (RSS). I construct a model to study the impact of RSS use on users and websites and examine their adoption strategy. I find that RSS can increase or decrease website profit; in a competitive context, it can actually be a disadvantage. Moreover, in a sequential adoption setting, under certain conditions, a first-adopter disadvantage exists. Together, my findings suggest the complexity of RSS adoption strategy.

2 - Impact of Anti-piracy Effort on Software Firms' Competition and Profitability

Can Sun, School of Business, University of Alberta, Edmonton, Canada, can1@ualberta.ca, Yonghua Ji

Piracy is a big issue for software companies all over the world. We study a problem where high quality software faces competition from low quality one and also the one pirated from the high quality software. The use of pirated software can be reduced through anti-piracy measures which make the pirated version either less attractive or more costly to use. We find that different measures can have different (and sometimes surprising) implications on software firms' competition and profits.

3 - ISP Competition and Content Discrimination: Implications for Net Neutrality

Yu-Chen Yang, Assistant Professor, National Sun Yat-sen University, 70 Lienhai Rd.,, Kaohsiung, 80424, Taiwan - ROC, ycyang@mis.nsysu.edu.tw, Hong Guo, Arthur Lim, Subhajyoti Bandyopadhyay, Hsing Cheng

We investigate how competition between ISPs affects their ability to discriminate between content providers. We compare the potential packet discrimination outcomes under the duopoly versus monopoly ISP regimes within a game-theoretical framework, and find that the ISPs still have the incentive and ability to discriminate between content providers and extract payment from them for priority delivery. The findings have important implications for the ongoing net neutrality debate.

■ MB45

Hilton- Union Sq 25

Inspections and Improvement Initiatives in Supply Chains

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Enno Siemsen, UMN, Minneapolis, Minneapolis, United States of America, siems017@umn.edu

1 - The Quality Management Implications of Dormitory Housing in Chinese Manufacturing

Enno Siemsen, UMN, Minneapolis, Minneapolis, United States of America, siems017@umn.edu, Elliot Bendoly

Quality inspections at source sites are essential to make global supply chains work. The inspectors that perform such inspections in China are often housed in company dormitories. We use data from an electronics manufacturer in southern China to examine the implications such an arrangement has on quality levels in the plant. We further examine the influence of individual attributes and social rewards on inspector behavior.

2 - Monitoring the Monitors: How Social Factors Influence Supply Chain Auditors

Jodi Short, Professor, UC Hastings College of Law, 200 McAllister Street, San Francisco, CA, 94102, United States of America, shortj@uchastings.edu, Michael Toffel, Andrea Hugill

Supply chain auditors provide companies with strategic information about the practices of suppliers, yet little is known of what influences their ability to identify and report dangerous or illegal conduct at factories. We find that reporting practices are shaped auditors' experience, gender, and professional training; ongoing relationships between auditors and audited factories; and gender diversity on audit teams. Our study suggests strategies for designing more credible monitoring regimes.

3 - Promoting Change from the Outside: Implementation Delays in Environmental Improvement Projects

Suvrat Dhanorkar, PhD Candidate, University of Minnesota, 321 19th avenue south, minneapolis, MN, 55455, United States of America, dhano002@umn.edu, Enno Siemsen, Kevin Linderman

Although challenging, externally promoting change in firms is vital to operations, supply chains and public policy settings. Combining proprietary and public data from state-level environmental agencies, we examine the factors that affect implementation of environmental improvement projects. We examine how factors such as recommendation structure as well as ongoing external influences impact implementation delays.

4 - Learning and Forgetting in Supply Chains

Anupam Agrawal, UIUC, 363 Wohlers Hall, Champaign, Il, 61821-6255, United States of America, anupam@illinois.edu, Suresh Muthulingam

Using a primary longitudinal dataset, we investigate how the depreciation of organizational knowledge (organizational forgetting) affects vendor quality performance. We find that quality gains from process improvement initiatives depreciate while those from quality assurance initiatives do not, and this depreciation is lower for knowledge embedded in technology than for knowledge embedded in organizational routines or members.

■ MB46

Hilton- Lombard

Advances in Discrete Optimization

Sponsor: Optimization/Integer and Discrete Optimization

Sponsored Session

Chair: Santanu Dey, Georgia Tech, 765 Ferst Drive, NW, Atlanta, United States of America, santanu.dey@isye.gatech.edu

1 - GMI/Split Cuts using Lattice Information

Karen Aardal, Professor, Delft University of Technology, Delft Institute of Applied Mathematics, Mekelweg 4, Delft, 2628 CD, Netherlands, k.i.aardal@tudelft.nl, Andrea Lodi, Andrea Tramontani, Laurence Wolsey, Fred Von Heymann

We consider a heuristic separation procedure for generating split cuts. The procedure is based on a lattice reformulation of single-row integer programs.

2 - Computational Experiments with Split Cuts Induced by Lattice Reformulation

Andrea Tramontani, CPLEX Optimization, IBM Italy, Via Martin Luther King 38/2, Bologna, 40132, Italy, andrea.tramontani@it.ibm.com, Andrea Lodi, Karen Aardal, Fred Von Heymann, Laurence Wolsey

We report on computational experiments with split cuts induced by lattice reformulation of single-row integer programs.

3 - Almost Symmetries in Graphs

Bernard Knueven, University of Tennessee, 504 John D. Tickle Building, 851 Neyland Drive, Knoxville, TN, 37996-2315, United States of America, bknueven@utk.edu, Jim Ostrowski, Sebastian Pokutta

This work addresses the following question. Given an arbitrary graph, G, and a budget, k, find a subgraph of G formed by removing at most k edges that contains the most symmetry. If such a subgraph contains non-trivial symmetries, we call the symmetries "almost symmetries". We discuss how to find such symmetries and the affect that these have on solving combinatorial optimization problems.

■ MB47

Hilton- Mason A

Computational Methods for Stochastic Optimization and Variational Problems

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Farzad Yousefian, UIUC, Dept. of Industrial and System Eng, 104 S Mathews Ave, Urbana, IL, 61801, United States of America, yousefi1@illinois.edu

1 - Adaptive Sampling in Stochastic Recursions for Optimization and Root Finding

Raghu Pasupathy, Associate Professor, Purdue University, Dept. of Statistics, West Lafayette, United States of America, pasupath@vt.edu

There has recently been much interest in solving simulation optimization and stochastic root finding problems using recursions obtained by replacing derivatives in Newton-type methods with their sampled counterparts. We present a sequential sampling strategy that adaptively determines the sample size within such recursions by trading-off (estimated) structural and sampling errors. We analyze the resulting convergence rates.

2 - Stochastic Compositional Gradient: Optimizing Compositions of Stochastic Functions

Mengdi Wang, Assistant Professor, Princeton University, 6124 Kaitlyn Ct, West Windsor, NJ, 08550, China, mengdiw@princeton.edu, Ethan Fang, Han Liu

Classical stochastic gradient methods are well suited for minimizing expected values. However, they do not apply to the minimization of a nonlinear function involving expected values, i.e., $\min_x f(E_w[g_w(x)])$. We propose a stochastic compositional gradient descent (SCGD) method that updates using sample subgradients and a extrapolation step. For smooth problems, the SCGD converges at a rate of $O(k^{-2/7})$ in the general case and $O(k^{-4/5})$ in the strongly convex case.

3 - Algorithms for Derivative-free Stochastic Search for Learning of Noisy, Expensive Functions

Yingfei Wang, Princeton University, 35 Olden Street, Princeton, NJ, 08540, United States of America, yingfei@cs.princeton.edu, Warren Powell

We have developed a modular, optimal learning testing environment (MOLTE) for testing learning/stochastic optimization algorithms on a wide range of offline and online problems. We conduct a thorough series of comparisons of pre-coded competitive policies from different communities on pre-coded problems including standard test functions and real-world applications. We address the experimental issues that have been overlooked such as the difficulty of tuning and the construction of priors.

4 - Optimal Robust Smoothing Extragradient Algorithms for Stochastic Variational Inequality Problems

Farzad Yousefian, UIUC, Dept. of Industrial and System Eng, 104 S Mathews Ave, Urbana, IL, 61801, United States of America, yousefi1@illinois.edu, Angelia Nedich, Uday Shanbhag

We present two robust variants of extragradient algorithms for solving stochastic variational inequality problems. The first scheme employs an averaging technique. We show that using an appropriate choice for the weights, a suitably defined gap function attains the rate O(1/k^0.5). In the second scheme, under an assumption of weak-sharpness, we develop a recursive stepsize rule and we show almost-sure convergence and convergence in a mean-squared sense to the solution at the rate O(1/k).

■ MB48

Hilton- Mason B

Multistage Stochastic Optimization and Applications in Healthcare

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Oleg Shylo, Assistant Professor, University of Tennessee, 523 John D. Tickle Building, 851 Neyland Drive, Knoxville, TN, 37996, United States of America, oshylo@utk.edu

1 - Totally Unimodular Multistage Stochastic Programs

Ruichen Sun, PhD Student, University of Pittsburgh, 1048 Benedum Hall, 3700 O'Hara Street, Pittsburgh, PA, 15261, United States of America, rus19@pitt.edu, Oleg Shylo, Andrew Schaefer

We consider totally unimodular multistage stochastic programs, that is, multistage stochastic programs whose extensive-form constraint matrix is totally unimodular. Such stochastic programs may be solved as multistage stochastic linear programs, even if there are integrality restrictions. We establish several sufficient conditions to ensure a multistage stochastic program is totally unimodular, and provide examples that arise in practice.

2 - Integrating Proactive and Reactive Operating Room Management

Gabriel L. Zenarosa, PhD Student, University of Pittsburgh, 3700 O'Hara Street, 1048 Benedum Hall, Pittsburgh, PA, 15261, United States of America, glz5@pitt.edu, Andrew Schaefer, Oleg Prokopyev

The goal of this research is to provide approaches for the design of operating room (OR) schedules that are adaptable and flexible to unexpected events. We formulate, calibrate, and solve OR scheduling models under uncertainty. These models produce initial schedules that facilitate flexible reactions during the surgical day, including rescheduling. Outcomes include generalizable insights on the aspects of flexible OR schedules and applicable techniques for solving these difficult problems.

3 - Patient Scheduling under Uncertainty and Resource Constraint

Jeremy Castaing, University Of Michigan, Industrial and Operations Engineering, 1205 Beal Avenue, Ann Arbor, MI, 48109-2117, United States of America, jctg@umich.edu, Brian Denton, Amy Cohn

We develop a stochastic optimization that creates a patient appointment schedule aiming to reduce patient waiting times and total hours of operation of a Cancer Infusion Center. The resulting model is a large-scale integer programming model, intractable for large instances of the scheduling problem. We design an algorithm giving good approximations to the optimal solution and we validate the heuristic result using several bounds on the optimal objective.

■ MB49

Hilton- Powell A

Interdiction Models in Complex Networks

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Alexander Veremyev, University of Florida, 1350 N. Poquito Road, Shalimar, FL, 32579, United States of America, averemyev@ufl.edu

1 - Sequential Shortest Path Network Interdiction with Incomplete Information

Juan Borrero, University of Pittsburgh, 3700 O'Hara street, Pittsburgh, United States of America, jsb81@pitt.edu, Oleg Prokopyev, Denis Saure

We study sequential interdiction of evaders on a network when the interdictor has partial initial information about the network structure and costs. In each period, the interdictor removes up to k arcs from the network, after which an evader travels a shortest path. By observing the evaders' actions the interdictor learns about the network and adjusts its actions accordingly. We analyze a class of policies that remove a set of k-most vital arcs of the observed network, and assess its optimality.

2 - Stochastic Maximum Coverage Problem

Konstantin Pavlikov, Stochastic Maximum Coverage Problem, University of Florida, 303 Weil Hall, P.O. Box 116595, Gainesville, FL, 32611-6595, United States of America, kpavlikov@ufl.edu, Alexander Veremyev

The network maximum coverage problem under uncertainty is considered. In this problem, network vertices are assumed to cover their adjacent nodes with some probability, independently of each other. The emphasis is put on minimizing the risk of losing coverage in the presence of random failures of "covering" components. We formalize the stochastic coverage problem, formulate and further investigate the corresponding combinatorial optimization problems.

3 - On the Minimum Vertex Blocker Clique Problem

Foad Mahdavi Pajouh, University of Florida, 350 N Poquito Rd, Shalimar, Fl, 32579, United States of America, mahdavi@ufl.edu, Vladimir Boginski, Eduardo Pasiliao

Cliques are among the earliest concepts used to model cohesive clusters in graphs. A clique is a subset of vertices that induces a complete subgraph. Given an integer r>0, we consider the problem of removing a subset of vertices of minimum cardinality in a weighted undirected graph, such that the weight of any remaining clique is bounded above by r. A linear 0-1 programming formulation, polyhedral results, an exact algorithm for solving this problem, and its complexity will be presented.

■ MB50

Hilton- Powell B

Network Design in the Automotive Industry

Cluster: Network Design

Invited Session

Chair: Stefan Minner, Technische Universitat München, Arcisstr. 21, Munich, 80333, Germany, stefan.minner@tum.de

1 - Timing a Sequence of New Car Ramp-ups in Automotive Production Networks

Thomas Stäblein, TU München, Arcisstr. 21, München, 80333, Germany, thomas.staeblein@gmail.com, Annika Becker, Raik Stolletz

A quantitative model is developed to optimize the production technology installation and the ramp-up sequence for new cars. Additionally, phase-outs, platform development and the delivery to markets are considered. Based on real-world data from the premium car industry, we show first insights on the optimization of timing investments and ramp-ups with respect to cash-flows. We pay attention to decisions for multiple products with learning and technology know-how transfer among plants.

2 - Strategic Capacity Planning in Automotive Production Networks under Duties and Duty Drawbacks

Katharina Mariel, Daimler AG, HPC: E203, Stuttgart, 70546, Germany, katharina.mariel@daimler.com, Stefan Minner

High tariffs and complex customs procedures for automotive goods have a crucial impact on global production strategies. Motivated by real-world planning problems of an OEM, we develop a mixed-integer model that simultaneously considers strategic capacity adjustments and duties and drawbacks for multi-stage production processes. In a numerical case study the impact of duties and duty drawbacks on strategic capacity decisions is highlighted.

3 - Supply Network Design under Local Content and Exchange Rate Uncertainty

Stefan Minner, Technische Universität München, Arcisstr. 21, Munich, 80333, Germany, stefan.minner@tum.de

We present an analytical approach to design the optimal sourcing strategy and product configuration of an automotive supply chain under joint exchange rate and demand uncertainty. The model includes different legal constraints when determining the local content under different cost structures with fixed and variable costs.

■ MB51

Hilton- Sutter A

Optimization for Large-scale Data Analysis and Optimization

Sponsor: Optimization/Nonlinear Optimization

Sponsored Session

Chair: George Lan, Assistant Professor, University of Florida, 303 Weil Hall, Gainesville, FL, 32611, United States of America, glan@ise.ufl.edu

1 - Accelerated First-Order Method for Convex Composite Optimization and the Applications in Image Analysis

Yuyuan Ouyang, Postdoctoral associate, Department of Industrial and Systems Engineering, University of Florida, Gainesville, FL, United States of America, ouyang@ufl.edu

We present an accelerated scheme for solving a class of convex composite optimization problems and its application in image analysis. The proposed AL-ADMM method, namely accelerating linearized alternating direction method of multipliers, has accelerated rate of convergence in terms of its dependence on Lipschitz constant of the smooth component. A backtracking technique for searching Lipschitz constant is also proposed for practical performance.

2 - Optimal Randomized First-order Methods for Saddle Point Optimization

Cong Dang, University of Florida, 303 Weil Hall, P.O. Box 116595, Gainesville, FL, 32611, United States of America, congdd@ufl.edu, George Lan

We present novel randomized algorithms for solving saddle point problems whose dual feasible region is a direct product of many convex sets. Our algorithms can achieve the optimal O(1/N) rate of convergence by solving only one dual subproblem at each iteration. When applied to linearly constrained problems, they need to solve only one randomly selected subproblem per iteration instead of solving all as in the Alternating Direction Method of Multipliers.

3 - The Complexity and Optimal Algorithms for Convex Programming under Linear Optimization Oracle

Yi Zhou, Ph.D. Student, University of Florida, Industrial and Systems Engineering, Gainesville, United States of America, yizhou@ufl.edu, George Lan

We present new conditional gradient methods which possesses optimal complexity in terms of the number of call to the first-order oracle and linear optimization oracle.

4 - Extending the Scope of Uniformly Optimal Methods for General Nonlinear Programming

Saeed Ghadimi, University of Florida, 303 Weil Hall, P.O. Box 116595, Gainesville, FL, 32603, United States of America, sghadimi@ufl.edu, George Lan, Hongchao Zhang

We develop a generic framework to extend uniformly optimal convex programming algorithms to general nonlinear programming. Without requiring any problem parameters, these algorithms achieve the best known complexity for nonconvex problems, and the optimal complexity for convex ones. In particular, for the first time in the literature, we show that the level-type algorithms can be used for solving nonconvex problems uniformly.

■ MB52

Hilton- Sutter B

Recent Progresses on Solving Markov Decision Processes

Sponsor: Optimization/ Linear and Conic Optimization

Sponsored Session

Chair: Yinyu Ye, Professor, Stanford University, Huang 308, Stanford, CA, 94025, United States of America, yyye@stanford.edu

1 - Reduction of Average-cost Markov Decision Processes to Discounting under an Accessibility Condition

Eugene Feinberg, Distinguished Professor, Stony Brook University, Dept. of Applied Math. & Statistics, Stony Brook, NY, 11790, United States of America, eugene.feinberg@stonybrook.edu, Jefferson Huang

We present sufficient conditions under which an average-cost MDP with Borel state and action spaces can be reduced to a discounted problem. Our assumptions include the existence of a continuous solution to the optimality equation for an embedded stochastic longest-path problem. Our results have applications to the existence of stationary optimal policies for infinite-state MDPs and strongly polynomial bounds for policy iteration and linear programming algorithms for certain MDPs and games.

2 - A Linear Programming Approach to Constrained Nonstationary Markov Decision Processes

Ilbin Lee, PhD Student, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, ilbinlee@umich.edu, Marina Epelman, Edwin Romeijn, Robert L. Smith

We study infinite-horizon constrained nonstationary Markov decision processes with discounted cost criterion and finite state space. This problem can equivalently be formulated as a countably infinite linear program (CILP), a linear program with countably infinite number of variables and constraints. We provide a complete algebraic characterization of extreme points of the CILP formulation and illustrate the characterization for special cases. We also suggest ideas for a simplex-type algorithm.

3 - Algorithms for Fast-Mixing Markov Decision Processes

Ian Post, University of Waterloo, Department of Combinatorics and Optimiza, 200 University Ave West, Waterloo, ON, N2L 3G1, Canada, ipost@uwaterloo.ca

We give an algorithm for solving Markov decision processes that have the property that any policy converges in polynomial iterations to its stationary distribution, even if the discount factor is very close to 1.

4 - Dantzig's Pivoting Rule for Shortest Paths, Deterministic MDPs, and Minimum Cost-Time Ratio Cycles

Thomas Dueholm Hansen, Postdoc, Stanford University, 385 Curtner Avenue, Apt. N, Palo Alto, Ca, 94306, United States of America, tdh@cs.au.dk, Haim Kaplan, Uri Zwick

Post and Ye recently proved an upper bound on the number of iterations required by Dantzig's pivoting rule when solving deterministic Markov decision processes. We improve the bound by Post and Ye and a similar bound by Orlin for shortest paths. Furthermore, we show that as a consequence Dantzig's pivoting rule solves the minimum cost to time ratio cycle problem in strongly polynomial time.

■ MB53

Hilton- Taylor A

Mathematical and Statistical Analysis of High Frequency Tradings

Cluster: Optimization in Finance

Invited Session

Chair: Xin Guo, Coleman Fung Chair Professor, UC Berkeley, Dept of IEOR, berkeley, Ca, 94708, United States of America, xinguo@berkeley.edu

1 - Tools for Studying Relationship between Temperature Forecasts and Natural Gas Futures

John Wu, Lawrence Berkeley National Laboratory, 1 Cyclotron Road, Berkeley CA 94720, john kwu@lbl.gov

Natural gas is consumed by homes and businesses at a fairly steady rate, however the futures trading on natural gas is actually quite volatile. In this work, we employ a number of different tools to study the characteristics of the price fluctuation to understand its potential causes. In this process, we found two techniques to be particularly instructive: non-uniform fast Fourier transform (NUFFT) and co-integration. In this study, we find clear signature of automated trading. Furthermore, we find that the temperature forecast errors account for about half of the price variation. This observation underscores the importance of improving the accuracy of temperature forecast systems produced by earth system modeling efforts.

2 - Can Large Uninformed Selling Explain Oct. 1987 and 2010 Flash Crash?

Isaac(Yuan) Mao, Dept. IEOR, UC Berkeley, 4174 Etcheverry Hall, UC Berkeley, Berkeley, CA, United States of America, yuan.mao@berkeley.edu, Xin Guo, Terrence Hendershott

Our extension of Kyle's (1985) model predicts market-wide information effect have different impact on stocks. We can predict SP500 stock price change during the stock market crashes and recover the large uninformed selling empirically.

3 - Multi-stage Optimal Exposure Problem

Yuanyuan Chen, The Chinese University of Hong Kong, ERB 810A, CUHK, Shatin, N.T., Hong Kong, Hong Kong - PRC, yychen@se.cuhk.edu.hk, Duan Li, Xuefeng Gao

We study a multi-stage optimal exposure problem which a large buyer faces. The buyer needs to decide at each time t whether to submit limit order or hidden order, or both and how many for each. We identify certain market conditions under which the buyer would never use iceberg orders. We further present some findings on how the market parameters affect the choice made among limit, hidden and iceberg orders.

4 - High Frequency Limit Order Book Dynamics via Support Vector Machines

Alec Kercheval, Professor, Florida State University, 1017 Academic Way, Rm 208, Department of Mathematics, Tallahassee, FL, 3 2306-4510, United States of America, kercheva@math.fsu.edu, Yuan Zhang

To analyze high frequency electronic trading behavior, a machine learning framework using multi-class support vector machines is proposed to automate short term forecasting of order book events. Experiments with sample market data show the method can forecast mid-price movements and price spread crossings a short time into the future.

■ MB54

Hilton- Taylor B

Some Recent Topics in Financial Engineering

Sponsor: Financial Services Section

Sponsored Session

Chair: Tim Leung, Columbia University, 500 West 120th Street MC4704, New York, United States of America, tl2497@columbia.edu

1 - A Stochastic Model for Order Book and Price Dynamics

Xinyun Chen, Stony Brook University, Department of Applied Math and Stat, Stony Brook, NY, 11790, United States of America, xinyun.chen@stonybrook.edu, Jose Blanchet

We construct and study a continuous time model that incorporates the whole limit order book to inform the joint evolution of the spread and the price processes. The construction of the order book model is guided by empirical data. In particular, the model addresses the autocorrelation pattern of order flows. Under the multi-scale asymptotic regime suggested by empirical observations, we solve a jump-diffusion approximation for the spread-price process determined by the order book dynamics.

2 - Commodity Leveraged Exchange Traded Funds

Kevin Guo, Columbia University, 345 S.W. Mudd Building, 500 West 120th Street, New York, NY, 10027, United States of America, klg2138@columbia.edu, Tim Leung

We investigate the tracking errors of leveraged exchange traded funds (LETFs) based on commodity indices. We observe from empirical data the discrepancy of LETF and their reference indices returns. This leads us to define the tracking error associated with each LETF. We conclude that tracking errors can significantly deteriorate returns over the long run. Incorporating correlated tracking errors into LETF price dynamics, we examine the effectiveness of a some trading strategies.

3 - Static and Dynamic Trading Strategies for Leveraged ETF Portfolios

Zheng Wang, Columbia University, IEOR Department, Rm 315, SEAS, 500 West 120th Street, New York, NY, 10027, United States of America, zw2192@columbia.edu, Tim Leung

We discuss a number of ways to construct static and dynamic portfolios using liquidly traded leveraged ETFs. In order to model the portfolio value dynamics, it is crucial to account for the various leverage ratios, value erosion due to realized volatility, and expense fees. We examine the risk characteristics of these portfolio both analytically and empirically.

4 - Implied Volatility of Leveraged ETF Options: Consistency and Scaling

Tim Leung, Columbia University, 500 West 120th Street MC4704, New York, United States of America, tl2497@columbia.edu

The growth of the exchange-traded fund (ETF) industry has given rise to the trading of options written on ETFs and their leveraged counterparts (LETFs).We study the relationship between the ETF and LETF implied volatility surfaces under a general stochastic volatility framework. We derive analytic approximations for the implied volatilities and identify their dependence on the leverage ratio.

■ MB55

Hilton- Van Ness

Optimization for Dimension Reduction

Sponsor: Optimization/Global Optimization & MINLP

Sponsored Session

Chair: Genevera Allen, Rice University, 6100 Main St. MS - 138, Houston, TX, 77005, United States of America, gallen@rice.edu

1 - Sparse PCA via Fantope Projection and Selection

Vince Vu, Assistant Professor, Ohio State University, Department of Statistics, 1958 Neil Avenue, 404 Cockins Hall, Columbus, OH, 43210-1247, United States of America, vqv@stat.osu.edu

Sparse PCA is dimension reduction and variable selection technique for high-dimensional data. This talk will present a recently developed convex relaxation of sparse PCA based on the convex hull of rank-k projection matrices (the Fantope). The resulting semidefinite program (SDP) can be solved efficiently by alternating direction method of multipliers and has near-optimal statistical properties. Insight into sparsity and the structure of the SDP enable its application to massive datasets.

2 - Sparse and Smooth Principal Components Analysis

Genevera Allen, Rice University, 6100 Main St. MS - 138, Houston, TX, 77005, United States of America, gallen@rice.edu

We present an optimization framework to simultaneously achieve sparsity and smoothness in both the left and right singular vectors. This framework generalizes existing approaches to Sparse PCA and Functional PCA, providing a unified optimization framework for regularization in PCA. We also propose a scalable alternating algorithm, study its convergence guarantees, and demonstrate its effectiveness on simulated data and an EEG example.

3 - Exact Data Reduction for Big Data

Jieping Ye, Associate Professor, Arizona State University, Tempe, AZ, 85287, United States of America, jieping.ye@asu.edu

Recent technological innovations have enabled data collection of unprecedented size and complexity. As an emerging and powerful tool for analyzing massive collections of data, data reduction has attracted tremendous attentions in the past few years. In this talk, I will present some of our recent work on exact data reduction in that the final model constructed from the reduced data is identical to the original model constructed from the complete data.

■ MB56

Hilton - Green Room

Software Demonstrations

Cluster: Software Demonstrations

Invited Session

1 - Bringing Optimization to the Enterprise with AIMMS PRO

Deanne Zhang, Sr. AIMMS Optimization Specialist, AIMMS, Heidi.Fergerstrom@aimms.com

AIMMS PRO brings optimization to the enterprise. We will demonstrate how PRO, the web-based deployment platform, eliminates the IT and technical hurdles involved with deploying a solution throughout an organization so that companies can reap the benefits of optimization and analytics.

2 - Optimization Modeling Made Easy

Mark Wiley, VP Marketing, Lindo Systems Inc., 1415 North Dayton Street, Chicago, IL, 60642, United States of America, mwiley@lindo.com, Gautier Laude

Learn how easy it is to: • Build linear, nonlinear, quadratic, integer optimization models • Incorporate uncertainty, • Access data from Excel/databases • Embed a solver into your application. See a demonstration of the new releases of: • LINDO API - a callable solver engine • LINGO - an integrated modeling language and solvers • What's Best! - a large-scale solver for Excel.

■ MB64

Parc- Cyril Magnin I

Applied Probability for Smart Cities

Sponsor: Applied Probability Society

Sponsored Session

Chair: Robert Hampshire, Carnegie Mellon University, Heinz College, Carnegie Mellon University, Pittsburgh, PA, 15213, United States of America, hamp@andrew.cmu.edu

1 - Fork-join Queues in In-Network Function Computation

Samyukta Sethuraman, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, samyukta@tamu.edu, Natarajan Gautam

We consider a smart sensor network which measures data and transmits to a sink. The sink node is ultimately interested in a function of the measured values, e.g., the maximum, calculated in a distributed fashion. To efficiently perform this under stochastic conditions, we model the flow of information along predefined arborescences, as a fork-join queueing network. We obtain bounds on the performance under light and heavy traffic conditions, and thereby select the ideal set of arborescences.

2 - Congestion-Based Staffing Policy for Toll Booths

Katsunobu Sasanuma, PhD Candidate, Carnegie Mellon University, Heinz College, Carnegie Mellon University, Pittsburgh, PA, 15213, United States of America, katz@cmu.edu, Robert Hampshire, Alan Scheller-Wolf

We study a traffic management policy for facilities with toll booths, that efficiently utilizes limited resources by dynamically changing the staffing level depending on the queue length. Our objective is to know when we need to add more operators and when to withdraw extra operators. The policy of changing the number of operators depending on the queue size is discussed and analytical results of performance indicators are shown.

3 - Is the Curb 80% Full or 20% Empty? A Dynamic Parking Pricing Experiment in San Francisco

Robert Hampshire, Carnegie Mellon University, Heinz College, Carnegie Mellon University, Pittsburgh, PA, 15213, United States of America, hamp@andrew.cmu.edu

The city of San Francisco is undertaking a large-scale controlled parking pricing experiment. San Francisco has adopted a performance goal of 60-80% occupancy for its metered parking. The goal represents an heuristic performance measure intended to reduce double parking and cruising for parking, and improve the driver experience. We develop an empirical Erlang C formula, and evaluate the impacts of the first two years of the San Francisco program.

■ MB65

Parc- Cyril Magnin II

Fluid and Diffusion Approximations of Stochastic Systems

Sponsor: Applied Probability Society

Sponsored Session

Chair: John Hasenbein, University of Texas at Austin, Grad Program in OR/IE, Austin, United States of America, jhas@mail.utexas.edu

1 - Optimal Pricing and Capacity Sizing when Customers Abandon, Amy Ward, Chihoon Lee

We consider how to jointly set the price and capacity in order to maximize the steady-state expected profit in a GI/GI/1+GI queue with a high rate of prospective customer arrivals. We use the solution to an approximating diffusion control problem to provide a simple condition under which the optimal price and service rate are such that the system operates in heavy traffic. Then, we further use that solution to propose a price and service rate that we can prove is asymptotically optimal.

2 - Diffusion Approximations for Probabilistic Matching Systems

Hanyi Chen, PhD Candidate, The University of Edinburgh, School of Mathematics, JCMB King's Buildings, Edinburgh, EH9 3JZ, United Kingdom, H.Chen-29@sms.ed.ac.uk, Burak Buke

The internet portals which enable potential customers and suppliers to meet and match, e.g. employment and renting portals, dating and classified websites, have become increasingly popular in the last decade. In these systems, each supplier and customer pair matches probabilistically. We provide models for analyzing the user traffic in these systems. It can be shown that these systems are unstable if uncontrolled. We suggest fluid and diffusion limits to facilitate analysis of these systems.

3 - The Analysis of Provider Triage Systems in Emergency Rooms

Ozlem Yildiz, University of Rochester, Simon School of Business, 4-333 Simon Hall. Simon Graduate School, of Business, Universiy of Rochester, Rochester, NY, 14627, United States of America, ozlem.yildiz@Simon.Rochester.edu, Tolga Tezcan, Michael Kamali

We study when and how provider triage (PT) methods should be applied in an emergency room (ER) to maximize the economic contribution using multi-server fluid approximations. We show that PT should be applied when arrival rate to the ER must exceed a threshold, which is provided in closed-form. Testing the performance of our proposed solution using patient flow data from our partner ER via simulation, we show that it leads to near-optimal results.

4 - Dynamic Control of Collaborative Networks

Itai Gurvich, Kellogg School of Management, Northwestern University, 2001 Sheridan Road, Evanston, IL, 60201, United States of America, i-gurvich@kellogg.northwestern.edu

We study collaboration and resource sharing in processing networks. We first characterize sufficient conditions on the network's collaboration architecture that guarantee that the static planning problem truly captures the capacity of the process. We then proceed to study control of synchronization under non-preemption. We find that synchronization of collaborating resource under non-preemption introduces fundamental and non-trivial tradeoffs between throughput and controllability.

■ MB66

Parc- Cyril Magnin III

Simulation and Computer Experiments

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Matthew Plumlee, Georgia Institute of Technology, Atlanta, GA, United States of America, mplumlee@gatech.edu

1 - Joint Modeling of Point and Integral Responses in Computer Experiments

C. F. Jeff Wu, Coca-Cola Chair in Engineering Statistics and Professor, Georgia Institute of Technology, 755 Ferst Dr, atlanta, United States of America, jeffwu@isye.gatech.edu, Heng Su, Rui Tuo

In some computer experiments, the quantity of interest may be the average value of the responses over a specific region. One example is the diffuse solar irradiance on a building façade. We extend the standard Gaussian process framework so that it can handle both point and integral data. We find that a closed-form expression can be derived, and the predictions on new points and regions can be obtained with high accuracy. An illustration is made with real data from the irradiance study.

2 - A New Measure in Global Sensitivity Analysis: Shapley Values of Input Parameters

Eunhye Song, Northwestern University, 2145 Sheridan Road, Technological Institute, C210, Evanston, Il, 60208, United States of America, eunhyesong2016@u.northwestern.edu, Barry Nelson, Jeremy Staum

Global sensitivity analysis captures the variation in the model response over the range of the input parameters whose uncertainty is represented by probability distributions. We propose a new global sensitivity measure derived from the concept of Shapley value in cooperative game theory and compare its properties to other variance-based global sensitivity measures. Gaussian process modeling is used to facilitate efficient computation of the sensitivity measure for complex models.

3 - Local Gaussian Process Approximation for Large Computer Experiments

Robert B. Gramacy, Associate Professor, University of Chicago, 5807 S Woodlawn Ave, Chicago, IL, 60637, United States of America, rbgramacy@chicagobooth.edu, Daniel Apley, Jarad Niemi

By focusing expressly on desirable properties of the predictive equations, we derive a family of local sequential design schemes that dynamically define the support of a Gaussian process predictor based on a local subset of the data. Then we show how independent application of our local design strategy across the elements of a vast predictive grid facilitates a trivially parallel implementation.

4 - Sequential Algorithms for Generating Space-filling Designs with Unknown Constraints

Tirthankar Dasgupta, Associate Professor, Harvard University, 1 Oxford Street, 7th Floor, Harvard Statistics Department, Cambridge, MA, 02138, United States of America, dasgupta@stat.harvard.edu, Li Zhu, Robert B. Gramacy

We explore sequential strategies for obtaining a space-filling design within a feasible sub-region of the design space, where the feasibility constraints are unknown. Two criteria that are based on minimizing the prediction errors from Gaussian Process models are proposed for iteratively selecting new design points.

■ MB67

Parc- Balboa

Industrial Data Analytics

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Shiyu Zhou, Professor, University of Wisconsin-Madison, Department of Industrial Engineering, Madison, WI, 53706, United States of America, szhou@engr.wisc.edu

1 - Hierarchical Bayesian Kernel Models Applied to Event Data

Hiba Baroud, University of Oklahoma, 202 West Boyd St, Room 124, Norman, OK, 73019, United States of America, hbaroud@ou.edu, Kash Barker

We propose to use hierarchical Bayesian kernel methods to model count data and predict the number of occurrences of a particular event using historical data and component and event characteristics. The model is implemented using several data sets and compared to other count data models for validation purposes.

2 - Detecting Point Pattern of Multiple Line Segments using Hough Transformation

Yuhang Liu, Graduate Student, University of Wisconsin Madison, Department of Industrial Engineering, Madison, WI, 53711, United States of America, liu427@wisc.edu, Shiyu Zhou

Surface defects in manufacturing often exhibit particular spatial patterns. These patterns can help to identify the potential root causes. In this paper, we present a new method to detect the point patterns consisting of multiple line segments. The idea is to convert the point pattern detection problem into a simple point matching problem by using Hough Transformation. The proposed method is easy to implement and has a good performance. The algorithm and case studies are presented in the paper.

3 - Robust Parameter Design for Profile Quality Control

Lulu Bao, Tsinghua University, Department of Industrial Engineering, Tsinghua University, Beijing, 100084, China, baoll11@mails.tsinghua.edu.cn, Qiang Huang, Kaibo Wang

In certain manufacturing processes, product quality is characterized by spatial profiles. Such profiles are expected to meet specific shape requirements. This talk aims to improve profile quality using robust parameter design. A hierarchical model is built to reflect the spatial correlation the profile data has and linked with process variables. The performance of the proposed method is studied using a motivating example from nano-manufacturing.

4 - Reliability Optimization for Critical Components with Uncertain Component Reliability in the Design

Qianru Ge, Ph.D Candidate, Technology University of Eindhoven, Technology University of Eindhoven, Den, Eindhoven, 5612 AZ, Netherlands, q.ge@tue.nl, Geert-Jan Van Houtum, Ivo Adan, Hao Peng

We develop an optimization model to determine the reliability design of critical components in a system. Since the system is under a service contract, a penalty cost should be paid by the OEM when the total system down time exceeds a predetermined level, which complicates the evaluation of the life cycle costs. Furthermore, in the design phase for each critical component, all the possible designs are subject to uncertain component reliability. An efficient approximation method is proposed.

■ MB68

Parc- Davidson

Simulation Methodology Applications

Sponsor: Simulation

Sponsored Session

Chair: Seong-Hee Kim, Associate Professor, Georgia Institute of Technology, Atlanta, GA, 30332, United States of America, skim@isye.gatech.edu

1 - Sampling from Manifolds without Derivatives

Enlu Zhou, Georgia Institute of technology, 755 Ferst Drive, NW, Atlanta, GA, 30319, United States of America, enlu.zhou@isye.gatech.edu, Chang-han Rhee

We introduce an algorithm that generates samples from a manifold, based only on the ability to evaluate the mapping defined by the parametrization of the manifold. In particular, we do not assume the ability to evaluate the derivatives of the mapping. Our approach is useful when the manifold is analytically intractable and highly nonlinear—-for example, in studying complex regulatory networks in systems biology where the mapping is typically defined by the solution of a system of ODEs.

2 - A Simulation Based Optimization Model for Workforce Scheduling in Call Centers

Amr Eltawil, Acting chairperson, Industrial Engineering and Systems Management, Egypt-Japan University of Science and Technology, 179 New Borg El-Arab City,Alexandria,Egy, Alexandria, 21934, Egypt, eltawil@ejust.edu.eg, Aya Seada

One of the key metrics used in evaluating call centers performance is the service level (SL).The SL is the percentage of incoming calls an agent can answer within a specified time. In this paper, we present a case study of using discrete event simulation for workforce scheduling in the largest home appliances company in Egypt. The model considers many factors that cannot be handled by the current workforce planning process that relies on using Erlang-C method.

3 - Simulating High Speed and Rate-Based Systems

David Krahl, Imagine That, Inc., 6830 Via Del Oro, Suite 230, San Jose, CA, 95119, United States of America, davek@extendsim.com, Cecile Pieper

Systems that process material at high speed or continuously are common. These include pulp and paper, manufacturing, petrochemical, and mining. These kinds of systems typically pose unique challenges for simulation modelers. This session will discuss various simulation modeling technologies including discrete event, continuous, and discrete rate. Real-world examples will be presented to illustrate these concepts.

4 - Building Metamodels for Cycle Time Quantiles in Manufacturing Systems

Demet Batur, Assistant Professor, University of Nebraska, CBA 209, Lincoln, NE, United States of America, dbatur@unl.edu, Jennifer Bekki

We present a procedure for building metamodels from discrete-event simulation models of manufacturing systems. The performance measure of interest is the quantiles of the cycle time distribution while the independent variables are controllable aspects of the production system itself such as arrival rate, service time, setup time, loading/unloading time, etc. Experimental results will be presented on a prototype simulation model of a semiconductor manufacturing system.

5 - Impact of Sensor Measurement Errors in Sensor Positioning in Water Quality Monitoring Networks

Chuljin Park, Assistant Professor, Hangyang University, Engineering Center #706-2, 222 Wangsimni-ro Seongdong-gu, Seoul, 133-791, Korea, Republic of, parkcj@hanyang.ac.kr, Seong-Hee Kim, Jisu Park, Mustafa Aral, Yongsoon Eun

We study the impact of sensor measurement errors in the problem of determining sensor locations in water quality monitoring networks. We develop a probabilistic model for sensor measurement errors and find sensor locations that minimize the expected time until spill detection subject to the reliability of detecting a spill is greater than a pre-specified threshold. Randomness in a contaminant spill and rain events is considered with various levels of bias and variability in sensor measurements.

■ MB69

Parc- Fillmore

Models for Electric Vehicle Charging Infrastructure Network

Sponsor: Energy Natural Resources and the Environment/ Sustainability and Environment

Sponsored Session

Chair: Yongxi Huang, Assistant Professor, Clemson University, 314 Lowry Hall, Clemson University, Clemson, SC, United States of America, yxhuang@clemson.edu

1 - Optimal Electric Vehicle Charger Placement Problem: A Time-of-Day Parking Activity Based Approach

Jing Dong, Assistant Professor, Iowa State University, 350 Town Engineering Building, Ames, IA, 50011, United States of America, jingdong@iastate.edu, Changzheng Liu

This study optimizes the electric vehicle charger placement to minimize the unmet charging demand. The spatial and temporal distributed charging demands are derived from parking activities of GPS-tracked vehicles. A mixed integer programming approach is developed to solve the proposed problem.

2 - Concurrent Electric Vehicle Fleet Sizing and Charging Station Network Design

Scott Mason, Professor and Endowed Chair, Clemson University, 124 Freeman Hall, Clemson, SC, 29631, United States of America, mason@clemson.edu, Yongxi Huang, Navid Matin Moghaddam

We present a model for the capacitated electric vehicle routing problem that focuses on both fleet sizing and network design decisions simultaneously. We focus on determining the required routing for each electric vehicle, including required driving, waiting, and charging times, such that all customer demands are satisfied within required time windows. Any feasible solution must not violate vehicle capacity constraints, maximum range limitations, or customer-required delivery requirements.

3 - Life Cycle Analysis of Electric Vehicles using a Detailed Optimization Model of the Electricity Grid

Allison Weis, PhD Student, Carnegie Mellon, EPP Baker Hall 129, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, aeweis@andrew.cmu.edu, Paulina Jaramillo, Jeremy Michalek

The potential environmental benefit of electric vehicles over conventional vehicles depends heavily on the emissions resulting from charging the electric vehicles. In this work we use a MILP model of optimal power plant dispatch and unit commitment to characterize the criteria air pollutant and greenhouse gas emissions caused by charging. We combine these results with the emissions from other electric vehicle life cycle stages and compare them to life cycle emissions for conventional vehicles.

4 - A Dynamic Location Model for Electric Vehicle Charging Corridor

Shengyin Li, Graduate student, Clemson University, 139S Lowry Hall, Clemson University, Clemson, SC, 29634, United States of America, shengyl@clemson.edu, Yongxi Huang

We develop a dynamic flow-based location model for optimally deploying public electric vehicle charging stations on a transportation network to meet demand increases in a sequential manner. Mixed integer programming models were formulated to minimize the total system cost over planning horizon, considering realistic scenarios of relocations. We demonstrated the models using a South Carolina case study with probabilistic analysis based future demand changes on a geographic resolution.

■ MB70

Parc- Hearst

Using Optimization for Wildfire Preparation and Mitigation

Sponsor: Energy Natural Resources and the Environment/ Natural Resources

Sponsored Session

Chair: Hugh Medal, Assistant Professor, Mississippi State University, 260F McCain Hall, Mississippi State, MS, 39762, United States of America, hugh.medal@msstate.edu

1 - Analyzing the Vulnerability of Landscapes to Pyro-terror Attacks: A Network Interdiction Approach

Eghbal Rashidi, Mississippi State University, 340C McCain Hall, Starkville, MS, 39759, United States of America, er442@msstate.edu, Hugh Medal

We study the potential impact of a pyro-terrorism attack on a landscape. A mathematical programming model is developed from a terrorist's point-of-view to optimally locate ignition points and maximize the damage caused by the fire. Considering fuels treatment as a strategy to reduce the loss due to fire, we also model a Stackelberg game in which a fire manager finds optimal locations for fuel treatments, and terrorists locate ignition points to maximize the damage.

2 - Forest and Wild Land Fire Management Resource Sharing

David Martell, Professor, University of Toronto, 33 Willcocks Street, Toronto, ON, M5S 3B3, Canada, david.martell@utoronto.ca, Bernardo Pagnoncelli, Cameron Buttazzoni, Adriana Piazza

Each year forest fire managers must decide what resources (e.g., airtankers and fire fighters) to acquire subject to uncertainty concerning when and where the fires might occur. Many have developed inter-agency resource sharing agreements that enhance their ability to cope with elevated fire loads. We developed a simulated multi-agency fire management system and used it to explore how specific deterministic and stochastic resource sharing models would perform in such planning environments.

3 - Arson Wildfire Damage Reductions through Displacement and Deterrence

Jeffrey Prestemon, Research Forester, USDA Forest Service, Southern Research Station, Forestry Sciences Laboratory, PO Box 12254, RTP, NC, 27709, United States of America, jprestemon@fs.fed.us, David Butry, Douglas Thomas

Little is known about how law enforcement efforts reduce arson wildfire counts, although studies confirm its effectiveness. Using temporally autoregressive arson wildfire production functions estimated for tribal lands in the U.S., we examine how law enforcement might temporally displace arson fires, reducing their ignition success and fire spread potential, yielding positive net benefits for landowners or society.

■ MB71

Parc - Lombard

Procurement and Auction Markets

Cluster: Auctions

Invited Session

Chair: Gabriel Weintraub, Columbia Business School, gyw2105@columbia.edu

1 - Entrant Cost Uncertainty in Procurement Auctions: Theory and Experiments

Izak Duenyas, Professor, Stephen M. Ross School of Business, University of Michigan, 701 Tappan St, Ann Arbor, MI, 48109, United States of America, duenyas@umich.edu, Damian Beil, Brendan See, Stephen Leider

Although an incumbent supplier may know her cost to produce an item, an entrant supplier is usually less informed. We model this scenario and allow the entrant to learn additional information at a cost. The buyer can influence the learning cost. We study whether the entrant will learn prior to the auction or delay learning and make a less-informed bid. We derive theoretical results which we then test in the lab.

2 - Mechanism Design for Procurement with Differentiated Products Demand Systems

Daniela Saban, Columbia University, Uris Hall, 4I, New York, United States of America, dhs2131@columbia.edu, Gabriel Weintraub

We study the problem faced by a buyer who uses an auction to select an assortment and unit prices from a set of suppliers with private costs offering differentiated products. Once the assortment and prices are fixed, consumers can choose their most preferred product from this set. We use a mechanism design approach to optimize the trade-off between variety and price competition when maximizing consumer surplus. We use these results to analyze the performance of simple and practical mechanisms.

3 - Efficient Iterative Auctions for Multi-Featured Items: A Network Flow Approach

Sasa Pekec, Duke University, Durham, NC, United States of America pekec@duke.edu, Ozan Candogan

We focus on a setting in which every item is described by a given set of features. Bidders' values for bundles are the sum of individual feature valuation functions (with decreasing marginals). We determine (hypothetical) allocations of features, and link them to allocations of (actual) items via a network flow formulation. Using this formulation, we reveal a new class of valuations for which a Walrasian equilibrium exists, and construct an efficient iterative auction for multi-featured items.

4 - Optimizing Prices in Descending Clock Auctions

Tuomas Sandholm, Carnegie Mellon University, 5000 Forbes Ave., Pittsburgh, PA, 15213, United States of America, sandholm@cs.cmu.edu, Tri-Dung Nguyen

In a descending clock auction (DCA), bidder-specific prices are decremented during the auction. In each round, a bidder can accept or decline his offer. DCAs have been proposed for sourcing spectrum from incumbents in the FCC's imminent incentive auctions. We present the first techniques for determining the prices to offer the bidders in each round: a percentile-based approach and an optimization-based approach. We provide theory and experiments for homogeneous items and for incentive auctions.

■ MB72

Parc- Stockton

Assorted Topics in Distributed Energy Generation

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Alexandra M. Newman, Colorado School of Mines, 1500 Illinois St., Golden, CO, 80401, United States of America, anewman@mines.edu

1 - Generating Load Profiles to Reduce Power use in a Forward Operating Base

Gavin Goodall, PhD Student, Colorado School of Mines, 1500 Illinois St., Golden, CO, 80401, United States of America, ggoodall@mines.edu

We present the methodology behind creating power demand profiles for forward operating bases(FOBs) based on five input parameters: latitude, longitude, number of people, mission type and duration of operations, for use in the design and dispatch strategy of renewable energy technologies at FOBs. Additionally, we demonstrate how to reduce the power consumption of the FOB by improving the configuration of heating and cooling units, lighting, and other power draws within facilities on the base.

2 - Solution Quality and Jackknife Estimators in Large Scale Hydroelectric Scheduling

A. Rodrigo de Queiroz, Professor, Federal University of Itajuba, Av. BPS, 1303, bairro Pinheirinho, Itajuba, MG, 37500-903, Brazil, ar_queiroz@yahoo.com.br, David Morton

In stochastic programs the assessment of solution quality is vital, especially when the size of the problem is too large to be solved to optimality. We model a hydroelectric scheduling problem as a large-scale multi-stage stochastic linear program. We solve this problem via a sampling-based decomposition algorithm. We use jackknife estimators to reduce bias when estimating the optimal value of the stochastic program.

3 - Quantifying the Net Value of Electric Power Generation Technologies in a Capacity Expansion Model

Kelly Eurek, National Renewable Energy Lab, Golden, CO, 80401, United States of America, kelly.eurek@nrel.gov

The Regional Energy Deployment System (ReEDS) is a linear programming model designed to explore the evolution of the electric sector infrastructure under a variety of economic, technology, and policy assumptions. Using the ReEDS model, we develop a method for quantifying the net value that new generation capacity provides to the reliable balancing of supply and demand resources. The net value can be an alternative metric for technology competitiveness, more useful than the ever-present LCOE.

4 - Optimal Power Generation Expansion Planning with Learning Consideration

Soheil Shayegh, Georgia Institute of Technology, North Ave NW, Atlanta, GA, 30332, United States of America, soheilsh@gatech.edu, Valerie Thomas

We introduce a novel optimization approach to the global power generation expansion planning problem. It incorporates an endogenous learning mechanism to update the construction cost and emissions as a function of operating generation for each technology. We include an energy balance system to translate the emissions into the change in temperature. The optimization was performed with two objective functions with or without considering the learning effect and the optimal solutions were compared.

■ MB73

Parc- Mission I

Uncertainty in Climate Policy Modeling

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Robert Barron, University of Massacusetts, 160 Governor's Drive, Room 219, Amherst, MA, 01003, United States of America, barron@ecs.umass.edu

Co-Chair: Erin Baker, University of Massachussetts, Amherst, MA, edbaker@ecs.umass.edu

1 - Grid Integration Cost Assumptions and the Optimal Electricity Supply Technology R&D Portfolio

Robert Barron, University of Massacusetts, 160 Governor's Drive, Room 219, Amherst, MA, 01003, United States of America, barron@ecs.umass.edu, Erin Baker, Noubara Djimadoumbaye

Many low carbon energy technologies are non-dispatchable, which imposes additional costs when these technologies are connected to the grid. This work examines the impact of assumptions about grid integration costs on the optimal R&D portfolio for minimizing the cost of climate change. Absent a budget constraint the optimal R&D portfolio is affected by grid integration cost assumptions, but given a budget constraint grid integration cost assumptions have little impact.

2 - Optimal Climate Policy under Uncertainty: Modeling Catastrophes with Stochastic Control

Delavane Turner, PhD Candidate, Stanford University, Huang Engineering Center, Stanford, CA, 94305, United States of America, delavane@stanford.edu

Greenhouse gas policies balance the costs of reducing emissions and the benefits of avoided climate change. This paper explores climate impacts from sea level rise in the face of an uncertain and potentially irreversible catastrophe. A benchmark integrated assessment model is reformulated with stochastic control to investigate whether precautionary action to reduce the threat of polar ice-sheet collapse is warranted. This work provides insight into managing downside risks of climate change.

3 - Minimizing Water Requirements for Electricity Generation in Water Scarce Areas

Erica Stults, Worcester Polytechnic Institute, 100 Institute Rd, ME Department, Worcester, Ma, 01609, United States of America, estults@wpi.edu, John Bergendahl, Andrew Trapp, Isa Bar-On

Thermoelectric power generation uses approximately 50% of the water withdrawn in the US. We explore the replacement of existing power generation plants by alternative technologies, and its effect on water use. We show how the replacement of traditional thermoelectric generation with renewable solar and wind technologies can reduce future water demands for power generation. A case study replacing a large generation plant in Texas demonstrates a significant decrease in water requirements.

4 - Stochastic Modeling of Energy Technology Portfolios

Ekundayo Shittu, The George Washington University, 1776 G St. NW, Washington, DC, 20052, United States of America, eshittu@email.gwu.edu, Ilka Deluque

In the context of climate change, we present models of energy technology choices and capacity additions under sequential and multiple uncertainties. The investment decisions that firms make on their energy technology portfolios are shaped by uncertainties in demand, technological success or learning and regulatory policy. We unpack the impacts of these layers of uncertainties to indicate that the influence of uncertainty on a firm's spending has different, and sometimes intriguing, outcomes.

■ MB74

Parc- Mission II

Existing Challenges in Non-convex Electricity Markets

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Kory Hedman, Assistant Professor, Arizona State University, PO Box 875706, GWC 206 School of ECEE, Tempe, AZ, 85287-5706, United States of America, Kory.Hedman@asu.edu

1 - System Operator Modifications to Electricity Market Solutions

Mostafa Sahraei-Ardakani, Post Doctoral Scholar, Arizona State University, 519 ERC Building, Tempe, United States of America, mostafa@asu.edu, Kory Hedman

ISOs play the role of the invisible hand in electricity markets with the objective to maximize social welfare. Due to the size and complexities of these non-convex markets, ISOs make many approximations to obtain a solution within a reasonable timeframe. This presentation discusses ISO practices that involve adjustments to the market solution as well as the practice to choose market solutions that may have lower uplift payments, which may coincide with solutions that have less social welfare.

2 - Non-convexities in Electricity Markets: Theoretical and Practical Implications

Alex Papalexopoulos, Dr, President and CEO, ECCO International, Inc., 268 Bush Street, Suite 3633, San Francisco, CA, 94104, United States of America, alexp@eccointl.com, Panagiotis Andrianesis, George Liberopoulos

In centralized day-ahead electricity markets with marginal pricing, unit commitment costs and capacity constraints give rise to non-convexities which may result in losses to some of the participating generating units. We provide both theoretical and practical implications for several mechanisms developed to address the issue of non-convexities, and compare their performance and incentive compatibility.

3 - Challenges in Electricity Markets

Richard O'Neill, Federal Energy Regulatory Commission, 888 First Street NE, Washington, DC, United States of America, richard.oneill@ferc.gov

In ISOs, complexity and transparency can co-exist. The ISO markets contain the necessary complexity to solve the complex operations problems. Financial market exists for those who want simplicity. The presentation will address the challenges in electricity markets including pricing in non-convex markets, stochastic issues, ancillary service markets, uplift or multi-part pricing, and ramp products.

4 - Challenges for Balancing Area Coordination Considering High Wind Penetration

Robin Broder Hytowitz, PhD Student, Johns Hopkins University, 3400 North Charles Street, Ames Hall 313, Baltimore, MD, 21218, United States of America, hytowitz@jhu.edu, Ozge Ozdemir, Ben Hobbs

In order to manage variability in wind generation, balancing area consolidation has been proposed. With an increase in network size, challenges arise in incorporating complexities into system operations and solving to optimality, so the putative efficiency improvements might not be realized. These impacts are assessed with day-ahead and real-time models that consider variability as well as uncertainty through deterministic, stochastic, and trade models, with an example using the COMPETES model.

■ MB75

Parc- Mission III

Simulation and Optimization II

Contributed Session

Chair: Suzanne Marcotte, Associated professor, ESG-UQAM, Dept Management and technology, P.O. Box 8888, Downtown Station, Montreal, Qc, H3C3P8, Canada, Suzanne.Marcotte@cirrelt.ca

1 - Robustness of Capacity Markets – A Stochastic Capacity Expansion Model Applied to the GB Case

Daniel Hach, PhD Student in OR, WHU - Otto Beisheim School of Management, Burgplatz 2, Vallendar, 56179, Germany, daniel.hach@whu.edu, Stefan Spinler

Electricity capacity markets are currently discussed in several countries worldwide – e.g. the U.K. and Texas. We quantitatively assess the effect of different design options on the electricity market. Using a long term stochastic electricity capacity investment model we compare the impact of these design options regarding cost, supply adequacy, and sustainability. Our model includes stochastic conventional plant outages and a robustness framework to reflect uncertain policy changes.

2 - A Chance-Constrained Optimization Model of Urban Land-use Allocation under Seismic Hazard

Chih-Hao Wang, Assistant Professor, California State University Fresno, 4691 Barrington Club Dr, COLUMBUS, OH, 43220, United States of America, cwang@csufresno.edu, Jean-Michel Guldmann

Seismic damages result from interactions between seismic hazards (ground motion/failure) and urban vulnerabilities (land-use pattern). A seismic damage model is statistically estimated with simulated data for Taichung, Taiwan, and is next incorporated into a chance-constrained optimization model allocating future land uses to city districts. This model maximizes the total economic benefits of future land development subject to chance constraints for maximum seismic damages in each district.

3 - Simulating Late Order Management Policies for Proactive Order Consolidation

Suzanne Marcotte, Associated professor, ESG-UQAM, Dept Management and technology, P.O. Box 8888, Downtown Station, Montreal, Qc, H3C3P8, Canada, Suzanne.Marcotte@cirrelt.ca, Walter Rei, Olivier D. Gadoury, Teodor Gabriel Crainic

In the context of global sourcing, Proactive Order Consolidation (POC) is an efficient strategy to perform shipments. However, giving uncertainty in sourcing, one of the main challenges is the management of late orders. In this study, we propose series of operational policies to manage the order delays in the context of organizing shipments. To evaluate these policies, we develop a simulation framework that formulates the general global sourcing process.

4 - Improvement of Work Process Performance with Task Assignments and Mental Workload Balancing

Cansu Kandemir, Ph.D. Candidate, Old Dominion University, 5115 Hampton Blvd., Norfolk, VA, 23529, United States of America, ckandemi@odu.edu, Holly Handley

This research aims to propose a simulation optimization model to evaluate the potential improvements in organizations for performance of work processes. The model created for this study will serve as a test-bed to evaluate different hypotheses on the optimal method to assign employees to tasks based on credentials, while still maintaining a workload balance among employees. The outcome of the study will provide guidance on identifying the region where both goals can be met successfully.

5 - A Reliability Based Approach to Supplier Selection

Layek Abdel-Malek, New Jersey Institute of Technology, University Heights Newark, Newark, 07102, United States of America, layek.abdel-malek@njit.edu, Marta Rinaldi, Eleonora Bottani, Roberto Montanari

A comparison between two scenarios is presented where a company should choose between two policies. The first is to retain one supplier with limited reliability and suffers possible stock out and the second is to have a backup supplier to make up for shortages in case they occur. The comparison aims at assessing the economic profitability of the two scenarios based on the operating conditions. The results of this comparison should provide companies with a tool in design this supply chains

■ MB76

Parc- Embarcadero

Making Operations Research Deliver

Sponsor: The Practice Track

Sponsored Session

Chair: Jack Levis, Director of Process Management, UPS, JLevis@ups.com

1 - Forget the Drones: The Making of the UPS ORION Project

Jack Levis, Director of Process Management, UPS, JLevis@ups.com

To manage the ever increasing complexity of its delivery operations, UPS embarked on an ambitious mission in 1999 to streamline and automate its delivery route planning process. ORION (On-Road Integrated Optimization and Navigation) is the result of this decades long quest. Considered to be the largest operations research project in the world, ORION uses an array of technologies and advanced algorithms, to provide the UPS drivers with optimized routes.

■ MB77

Parc- Market Street

Joint Session Analytics/CPMS: The Whys Hows and Whats of Analytics Certification

Sponsor: Analytics & CPMS, The Practice Section

Sponsored Session

Chair: Polly Mitchell-Guthrie, Sr. Manager, Advanced Analytics Customer Liaison, SAS, SAS Campus Dr., Cary, NC, 27513, United States of America, Polly.Mitchell-Guthrie@sas.com

1 - Why Should you Become a Certified Analytics Professional?

Elizabeth Nielsen, Quintiles, 4820 Emperor Boulevard, Durham, NC, 27703, United States of America, Elizabeth.Nielsen@quintiles.com

Being a Certified Analytics Professional can positively impact your career since it is an independent assessment of knowledge and understanding of business analytics. It can be used as a marketing tool with your customers to show that you take analytics seriously. If you're looking for a new opportunity using analytics, the CAP designation gives your prospective employer an unbiased verification of your qualifications. CAP is the gold standard for the business analytics field.

2 - CAP Exam Prep Tips

Matthew Windham, Director of Analytics, NTELX Inc., 1945 Old Gallows Road, Suite 700, Vienna, VA, 22182, United States of America, mwindham@ntelx.com

How does one effectively prepare for the exam? While each individual is different, with their own learning styles, this session is meant to provide attendees with insights on preparation techniques taken by those who have already passed the exam. The variety of approaches discussed should provide the audience with ample options to consider for their own preparation efforts. Since this is a panel discuss event, audience participation is encouraged.

3 - Gaining the Analytics Advantage through Professional Certification of your Employees

Freeman Marvin, Executive Principal, Innovative Decisions, Inc., 8230 Old Courthouse Road, Suite 460, Vienna, VA, 22182, United States of America, ffmarvin@innovativedecisions.com

The INFORMS Certified Analytics Professional program has obvious benefits to the individual analysts who earn a certificate. What you may not realize are the many benefits to your company, agency, or organization of having employees who are CAP certified. Learn the five advantages that your CAP certified employees can give you over your competition or in the accomplishment if your mission.

4 - From OR Credentialing to Analytics Certification: A Five-Plus Year Journey

Scott Nestler, Chair, Analytics Certification Board, 8419 Riverside Rd, Alexandria, VA, 22308, United States of America, acb@informs.org

In 2008, at the Military Operations Research Society Symposium in New London, CT I heard a short talk about a proposed credentialing program for OR practitioners that caused me to ask, "how can I get involved?" Six years and hundreds of meetings later, I serve as the Chair of the Analytics Certification Board. This talk will provide historical anecdotes about the development of the Certified Analytics Professional (CAP) program, and my thoughts on why it is a worthy venture for INFORMS.

■ MB78

Parc- Mason

Big Data Industry Applications

Sponsor: Analytics

Sponsored Session

Chair: Grace Lin, VP & Director General, Advanced Research Institute, Institute for Information Industry, Taipei, Taiwan, gracelin.ny@gmail.com

Co-Chair: Ya-Hui Chan, Manager, Big Data Analytics, Advanced Research Institute (ARI), Institute for Information Industry (III), Taipei, Taiwan, yhchan@iii.org.tw

1 - Problems and Solutions to Throughput Modeling and Predictive Maintenance for Semi-conductor Packaging

Raymond Yu, Big Data Analytics, Advanced Research Institute (ARI), Institute for Information Industry (III), fishyu@iii.org.tw, Ming-Chen Shen, Grace Lin, Roger Gung, Paul Chou

This paper introduces two problems, solutions, and experimental results in semiconductor packaging: throughput modeling and predictive maintenance. Throughput modeling is about predicting throughput incorporating statistical models and/or data mining techniques by exploring vast amounts of historical data for product/tool specifications and their corresponding throughputs. Predictive maintenance is designed to incorporate throughput models and real-time performance measures that predict failures and performance degradations in order to optimize maintenance policies.

2 - Smart Tourism and Big Data Analytics

Grace Lin, VP & Director General, Advanced Research Institute, Institute for Information Industry, Taipei, Taiwan, gracelin.ny@gmail.com, Tim Lin, Jesse Shih, Ko-Yang Wang

In this talk, a Smart Tourism Initiative that was designed to provide tourists with high quality services, and deeper and more authentic experiences using big data analytics - before, during and after their trips will be presented. Key features include real-time, interactive, heterogeneous tourism information integration and Smart Matching, and O2O personalized SoLoMo-Based Services and Social media connectivity. Some pilot results and next steps will also be discussed.

3 - Analytics in the Cloud

Ko-Yang Wang, Executive Vice President, Institute for Information Industry, kyw@iii.org.tw

The emerging Information and big data analytics technologies are changing the way decisions are made everywhere. In this talk, Dr. Wang will discuss trends in IT, from Service-oriented Architecture, Business Process Management, Smart System Services and Cloud, to SoLoMo, APP and API Economy. The opportunities in leveraging emerging Information Technology for better decision-making will also be discussed.

■ MB79

Parc- Powell I

Decision Analysis in Organizations

Sponsor: Decision Analysis

Sponsored Session

Chair: Robert Bordley, Booz Allen Hamilton, 101 West Big Beaver, Troy, MI, 48085, United States of America

1 - Appreciating Decision Quality … Learning from our Mistakes

Vince Barabba, Chairman, Market Insight Corporation, 308 Cherry Ave, Capitola, Ca, 95010, United States of America, vbarabba@sbcglobal.net

The presentation will illustrate how General Motors improved its enterprise decision making by incorporating the thinking pricess underlying Ron Howard and Howard Raiffa's pioneering efforts. Although the decision process is no longer operating as an enterprise-wide process, some of the key components are still being used within the company. The presentation will focus on the successful impact of the fully integrated system on General Motors between 1985 and 2005.

2 - Which Came First? DA Practice or DA Research?

Jeffrey Keisler, Professor, Univ. of Massachusetts, Boston, 100 Morrissey Blvd, Boston, Ma, 02125, United States of America, jeff.keisler@umb.edu

In decision analysis, research has informed practice and practice has informed research, benefiting the field overall. Important examples from the literature demonstrate this. From reviewing these examples and reflecting on personal experience, I will suggest principles for how we can consciously manage research-practice interactions to continue to make progress.

3 - How to Dispose of California's Defunct Offshore Oil Platforms?

Max Henrion, CEO, Lumina Decision Systems, 26010 Highland Way, Los Gatos, Ca, 95033, United States of America, henrion@lumina.com, Brock Bernstein

The 27 oil platforms off California's coast are reaching the end of their productive lives. Should they be removed at great cost to the oil companies? Or should they be left their with their rich marine ecosystems? An interdisciplinary team created a decision analysis tool with Analytica to help the initially conflicted decision makers find a solution satisfying almost everyone.

4 - Session Summary

Robert Bordley, Booz Allen Hamilton, 525 Choice Court, Troy, MI, 48085, United States of America, rbordley@umich.edu

Decision analysis at General Motors took several forms: (1) the Dialogue Decision Process,(2) Cost Driver Analysis based on Henrion's sophisticated influence diagram software, and (3) Technology Portfolio Mgt —- for which Jeff Keisler, former President of this Society, has recently received a best publication award. Vince Barabba's leadership across these efforts during GM's Golden Age of Decision Analysis highlights DA's value in facilitating enriched cross-functional dialogues.

■ MB80

Parc- Powell II

Value of Information Analysis: Theory and Applications

Sponsor: Decision Analysis

Sponsored Session

Chair: Matthew Bates, Research Environmental Engineer, US Army Corps of Engineers, 696 Virginia Rd, Concord, MA, 01742, United States of America, Matthew.E.Bates@usace.army.mil

1 - Value of Sequential or Static Information in Models with Statistical Dependence

Jo Eidsvik, Professor, Department of Mathematical Sciences, Norwegian University of Science and Technology,, NTNU, NO-7491, Trondheim, Norway, joeid@math.ntnu.no, Gabriele Martinelli, Debarun Bhattacharjya

We describe static and sequential information gathering in multivariate and spatial decision making problems when there is statistical dependence. Value of information analysis is used to compare the static and sequential testing options for a Gaussian portfolio example and a Bayesian network model for petroleum prospects.

2 - Entropy Based Methodology for Valuation of Uncertainty Reduction

Adam Fleischhacker, Assistant Professor of Operations Management, University of Delaware, 222 Alfred Lerner Hall, Newark, DE, 19716, United States of America, ajf@udel.edu, Pak-Wing Fok

We propose a distribution-free entropy-based methodology to calculate the expected value of uncertainty reduction efforts without requiring sampled observations of demand or a priori assumptions regarding the underlying demand distribution. We leverage our results to answer an often overlooked question in demand management: "Is there value in further reducing my demand uncertainty or do I act on my currently available information?""

3 - Prioritizing of Research to Improve Environmental Remediation Decisions

Matthew Bates, Research Environmental Engineer, US Army Corps of Engineers, 696 Virginia Rd, Concord, MA, 01742, United States of America, Matthew.E.Bates@usace.army.mil, Magnus Sparrevik, Igor Linkov, Jeffrey Keisler

Environmental remediation projects are often characterized by high degrees of complexity and uncertainty that make selection of optimal management alternatives difficult, especially when tradeoffs are needed across multiple domains. We apply Value of Information analysis to selection of remediation alternatives for the contaminated sediments of the Grenland Fjord, Norway, based on tradeoffs across uncertain environmental impact, human health risk, societal benefit, and monetary cost objectives.

4 - Putting Qualitative Data to Work: The Other Half of the Data Puzzle
McCall Baldwin, Baldwin Advisory Services, United States of America, mbaldwin@baldwinadvisory.com

In order to further reduce uncertainty in the decision-making process, we need to incorporate both quantitative and qualitative aspects of data. This paper demonstrates methods of identifying, implementing and integrating both quantitative and qualitative aspects of data. The result is a comprehensive approach to data deployment that further reduces uncertainty surrounding the decision-making process. With a reduction in uncertainty comes an improvement in the value of decisions.

■ MB81

Parc- Divisadero

Joint Session Data/AI/HAS: Big Data Analytics and Smart Health I

Sponsor: Data Mining, Artificial Intelligence, & Healthcare

Sponsored Session

Chair: Sung Won Han, New York University, 650 First Avenue, New York, NY, United States of America, sungwonhan2@gmail.com

1 - Blood Donation Tailoring Problem to Improve Blood Supply Management
Guven Kaya, Ph.D. Student, Industrial Engineering-University of Houston, E222 Engineering Building 2, Houston, TX, 77204, United States of America, gkaya@central.uh.edu, Ali Ekici

Blood donation tailoring is to identify blood donation types and collect blood products. Donors perform donation types that provide blood products to patients, having collection/inventory/spoilage costs. We collect data about donation types with demand, cost, time, eligibility percentages, compatibility from blood banks. We develop MIP models to find collected/spoiled/carried blood product amount on single and multi-period settings. We provide results based on data from blood donation centers.

2 - Heterogeneous Postsurgical Data Analytics for Effective Healthcare Services
Hui Yang, Assistant Professor, University of South Florida, 4202 East Fowler Avenue, ENB 118, Tampa, FL, 33620, United States of America, huiyang@usf.edu

The rapid advancements of healthcare information technology, biomedical sensors, and computing power have resulted in data-rich environments in hospitals. With massive healthcare recordings readily available, it becomes a challenge for physicians to improve the prediction of postsurgical complications. This paper presents our recent efforts to develop new decision-support methods and tools of heterogeneous postsurgical informatics.

3 - Quantitative Approach for Surgical Task Recognition
Mahtab Jahanbani Fard, Wayne State University, Detroit, United States of America, mahtab.jahanbanifard@wayne.edu, R. Darin Ellis

Recognition of surgical procedure from different granularity level becomes one of the recent interests of researchers. Due to the stochastic description of the physical environment, modeling surgical assessment systems should incorporate with higher level modeling such as HMM which known to be more robust and accurate classifiers. In this study we review existing models and introduce a new model to recognize surgical task using HMM.

4 - Analyze Patient Flow of Appointment System with Blocking by Semi-Markov Model
Jie Song, Peking University/Department of Industrial and Management Engineering, Room512,Founder Building,No.298, Chengfu Road, Haidian, Beijing, HD, 100871, China, songjie@coe.pku.edu.cn, Yu Li, Yaqing Bai

This paper develops a novel method to manage patients' access to its appointment intervals and slots that explicitly takes into account the Key Resource Appointment System(KRAS) in China. A short-run booking window KRAS with blocking and batch transfer has been formulated as a semi-Markov model. Along with the parameters approximation and recursion, we get the close form that can quantitatively estimate the patient indirect waiting time and the system blockages.

■ MB82

Parc- Haight

Multiple Criteria Decision Making Applications

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Murat Köksalan, Middle East Technical University, IE Dept., METU, Ankara, Turkey, koksalan@metu.edu.tr

1 - Bi-Objective Energy and Environmental Policy Research
Sahan Yildiz, Research Assistant, Middle East Technical University, IE Dept. METU, ANKARA, 06530, ysahan@metu.edu.tr, Murat Köksalan, Ebru Voyvoda

We design a bi-objective decision support system for energy policy decisions. We consider maximizing total consumption and minimizing greenhouse gas emissions as objectives and explore the efficient frontier. We also investigate robust policies against external energy price changes.

2 - Finding Preferred Points for Multi-objective Integer Programs
Banu Lokman, Middle East Technical University, Department of Industrial Engineering, Ankara, Turkey, banulokman@gmail.com, Murat Köksalan

We approximate the nondominated set with a hypersurface and identify a preferred point interacting with the decision maker. We then define a small preferred region around the identified point and generate the nondominated points in that region. Computations show that preferred points are generated with little cognitive and computational effort.

3 - Generating Representative Subsets of Nondominated Solutions in Multi-objective Integer Programming
Gokhan Ceyhan, Middle East Technical University, Department of Industrial Engineering, Ankara, 06800, Turkey, gceyhan@metu.edu.tr, Murat Köksalan, Banu Lokman

Generating all nondominated solutions of a multi-objective integer program is neither practical nor useful. The computational burden could be prohibitive and the resulting set could be huge. We develop algorithms to generate a small representative subset of nondominated solutions and we present computational results.

4 - A Probabilistic Approach to Multiple Criteria Sorting
Sinem Mutlu, Middle East Technical University, Department of Industrial Engineering, Ankara, 06800, Turkey, sinemmutlu01@gmail.com, Murat Köksalan, Yasemin Serin

We address the problem of placing alternatives evaluated in multiple criteria into preference-ordered classes. Either the decision maker directly places an alternative or the approach places when the probability of misclassification is below a specified threshold. We demonstrate that the approach works well.

■ MB83

Parc- Sutro

Optimization Models in Data Mining

Sponsor: Data Mining

Sponsored Session

Chair: Petros Xanthopoulos, University of Central Florida, 12800 Pegasus Dr., Orlando, United States of America, petrosx@ucf.edu

1 - Data-driven Analytic Tools for Studying Brain Concussion During Sports
Ioannis Pappas, PhD Student, University of Florida, 3751 SW 20th Avenue, Apt 22, Gainesville, FL, 32607, United States of America, ioannis.p.pappas@ufl.edu, Panos Pardalos

We conduct analysis of EEG readings that were retrieved during a unique live recording of High School athletes playing football in practice. We identified excerpts of EEG before and after a concussion incident that took place during practice. We depict signal interdependencies by quantifying signal correlations using graph theory. We use linear and non linear measures in order to explain the causality of the differences between the EEG before and after the concussion.

2 - Sparse Mixed-Membership Matrix Factorization via Mixed-Integer Programming
Andrew Trapp, Worcester Polytechnic Institute, 100 Institute Rd., Worcester, MA, 01602, United States of America, atrapp@wpi.edu, Patrick Flaherty

We consider regularized mixed-membership matrix factorization, where one factor matrix can have a limited number of non-zero entries, and the other has simplex constraints. This provides a mixed-membership representation for each column of the original matrix with sparse mixing components. We transform the original and NP-hard biconvex optimization problem into a mixed-integer linear program, and show that reasonable-size problems can be solved via a sequential refinement approach.

3 - A Robust Consensus Unsupervised Framework for Time Series Clustering

Siavash Haghtalab, University of Central Florida, 1341-North Gate Circle, Apt 105B, Oviedo, Fl, 32765, United States of America, s.haghtalab@gmail.com

Network clustering is an important task for many Manufacturing tasks. Unfortunately different clustering algorithms might give different clustering results for the same data. In unsupervised learning since we do not have any prior information on the data, we do not have any information on how to choose a best fitted algorithm. In this work we will purpose a robust unsupervised framework to show how much the results and robustness of a clustering can be improved even by using bad clustering.

4 - Constraint Subspace Classification Algorithm for High Dimensional Datasets

Orestis Panagopoulos, Graduate Assistant, University of Central Florida, 2220 SW 34th Street, Apt.315, Gainesville, FL, 32608, United States of America, ore.pan@hotmail.com, Panos Pardalos, Vijay Pappu

In this work, we propose the extended binary classification method Constrained Subspace Classifier (CSC). CSC optimizes Local Subspace Classifier (LSC) by accounting for the relative angle between the subspaces and utilizing the projection metric. An efficient alternate optimization technique is also proposed. Simulations demonstrate that the method improves the accuracy of LSC, showing the significance of considering the relative angle between subspaces while approximating the classes.

Monday, 12:30pm – 2:30pm

Hilton Grand Ballroom A-B

Cluster: Interactive Session

Invited Session

Chair: Anna Nagurney, University of Massachusetts-Amherst, Amherst, MA, United States of America, nagurney@isenberg.umass.edu

1 - Operating Room Allocation for Overtime Control with Chance Constraints

Zheng Zhang, University of Michigan, 1205 Beal Ave, Ann Arbor, MI, United States of America, zhazheng@umich.edu, Brian Denton, Xiaolan Xie

This study considers operating room (OR) allocation problems with multiple ORs and random service time. We present a new stochastic programming formulation for surgery planning that guarantees a given proportion of ORs close punctually. We show this can reduce cost and achieve a more equitable balance of overtime for nursing staff. Decisions include a combination of surgery allocation decisions prior to the start of the day and dynamic reallocation decisions throughout the day.

2 - Online Robotic Parameter Optimization for High Precision Manufacturing via Analytic Hierarchy Process

Binbin Li, Texas State University, 1014 Sagewood Trail, San Marcos, TX, 78666, United States of America, b_l77@txstate.edu, Heping Chen, Tongdan Jin

High precision robots are widely used in automobile assembly, remote surgery, and aerospace industry. We propose a Gaussian Process Regression (GPR) model to establish the relation between process parameters and robotic performance including First Time Through and cycle time. Analytic hierarchy process is employed to search for the best covariance function. Experimental data show that GPR outperforms design-of-experiment and meta-heuristics in terms of global optimality and computational time.

3 - Risk Assessment and Mitigation for Food Supply Chains

Yanling Chang, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, changyanling@gmail.com, Brian Kues, Alan Erera, Chelsea White

We propose a dynamic risk analysis method to evaluate and mitigate the risks to food supply chains posed by intelligent and adaptive adversaries. We justify the value of our model by comparison to the traditional risk analysis approach. Finally, we determine the value of the defender's information about the attacker.

4 - Optimization, Discrete-event Simulation and Game Theory to Redesign Hazardous Materials' Logistics

Diana Ramirez, CSO, FCIMEC, Carrera 53 No.74-86 Of. 402, Barranquilla, Colombia, dramirez@fcimec.org, Luis Ramirez, Linda Bendavid, Nilson Herazo, Santiago Nieto, Miguel Jimenez, Lauren Castro, Jairo Montoya

This work integrates Game Theory, Meta-heuristic Optimization and Computer Simulation to solve a real-life location-routing problem found in bulk liquids and hazardous materials' transport. The models search for optimal transport network configuration in order to minimize environmental impacts while improving economic performance. A DSS is developed in which stochastic travel times are considered for daily truck operation.

5 - Equilibrium and Optimal Location of Retail Stores Competing with Mail Order Business

Masaaki Ozawa, Keio University, 5-29-4 Hiyoshi, Kohoku-ku, Yokohama, Japan, ozawa0130@gmail.com

We present a competitive location model in a one-dimensional city model with two competing retail stores and one mail order business. Consumers' choice of store is modeled by the production constraint spatial interaction models. We investigate the characteristics of the equilibrium and optimal location for two stores using different parameter settings: attraction and decay parameter. As the attraction of the mail order business increases, the two retail stores move to two separate locations.

6 - Optimal Inventory Mirroring via Linear Integer Programming

Zhiwei (Tony) Qin, Data Scientist, Walmart Labs, 850 Cherry Ave, San Bruno, CA, 94066, United States of America, tqin@walmartlabs.com, Jagtej Bewli, Mohan Akella

Inventory mirroring concerns with problem of deciding how many warehouses in the fulfillment network an SKU should be stocked. In the context of online retailing, strategic inventory mirroring allows the retailer to reduce overall delivery and fulfillment costs. In this poster, we propose a practical methodology to approximately solve the optimal inventory mirroring problem, by formulating the problem as a binary integer programming problem.

7 - Seasonal Transmission Switching to Reducing the Cost of Electricity

Masood Jabarnejad, Instructor and PhD Student, Auburn University, 333 East Magnolia Ave., Auburn, AL, 36830, United States of America, masood@auburn.edu, Jorge Valenzuela

Electricity generation infrastructure has a critical role in any country's economy and national security. The more efficient these infrastructures are, the cheaper service and better reliability they can offer to the society. We propose to use and integrate seasonal transmission switching with dynamic thermal rating system to reduce the electric generation costs, save money for the companies and offer cheaper service to the customers.

8 - Value-chain Optimization for Complex Chemical Production Processes

Patrick Briest, McKinsey & Co., Kennedydamm 24, Düsseldorf, 40476, Germany, patrick_briest@mckinsey.com, Isabelle Patouillaud, Valerio Dilda

We propose a novel production planning approach for the chemicals industry centered around an end-to-end optimization model covering the full length of the value chain, from procurement over production to sales. Our model incorporates cost/price curves for raw materials and finished goods and a MIP production model detailed enough to mimic physical plant behavior across all possible production scenarios. We present results based on a first real-life application with a global chemicals company.

9 - Integrating Uncertain Data in Disaster Relief Facility Location

Bin Li, University of Arkansas, Bell Engineering Building 4110, Fayetteville, AR, 72703, United States of America, binli@email.uark.edu, Ashlea Milburn

A multi-objective formulation of the minimax regret for the facility location problem that allows decision makers to open an efficient number of facilities when there is demand uncertainty. The problem is motivated by the recent need of integrating social data from multiple sources in order to make optimal decisions. CPLEX is used for solving three different optimization problems based on three different facility location strategies.

10 - Social Media Usage in Static Disaster Relief Routing Plans

Emre Kirac, PhD Candidate, University of Arkansas, 4207 Bell Engineering Center, Fayetteville, AR, 72701, United States of America, ekirac@uark.edu, Ashlea Milburn, Clarence Wardell III

Precise information about the affected people is required so as to perform a quick response in disaster relief. Traditionally, on-the-ground assessment teams collect this information, but it takes some time. Social media can provide additional information about needs in less time, but such needs are not verified. This research evaluates the tradeoff associated with considering unverified information in disaster relief planning. These approaches are compared across a variety of demand scenarios.

11 - Intellectual Map of Information Systems

Mohammadmahdi Moqri, University of Florida, Gainesville, FL, 32611 United States of America, moqri.mo@gmail.com

We improve and redefine the Invisible Networks of Knowledge models as a social network and use it to map the intellectual structure of the field of Management Information Systems. The results help us observe how the field has been evolving and identify the core and emerging areas of research.

12 - The Art of Revenue Management: Optimizing by the LoS in Airport Carparks

Andreas Papayiannis, University of Manchester, School of Mathematics, Manchester, United Kingdom, Andreas.Papayiannis@manchester.ac.uk, Paul Johnson

We investigate the revenue management (RM) problem encountered in airport carparks, where spaces are sold in advance online. Currently, most RM practices in this sector are simple adjustments of those developed for hotels, exploiting the strong similarities of the two industries. However, unlike in hotels where the day of the week strongly affects the price of a room, a distinct setting appears where the daily price of a parking space depends heavily on the length-of-stay (LoS) of the booking. A continuous-time formulation leads to a HJB-type PDE model; by optimizing over the LoS, the PDE is solved to generate the dynamic table of expected marginal values required for bid-price control.

13 - Exploring Scheduling Changes in Clinic Rotations of a Medical Residency Program

Akshit Agarwal, Rochester Institute of Technology, Rochester, NY, 14623, United States of America, aa9425@rit.edu, Ruben Proano

Resident rotational programs require residents to have a one week outpatient clinic assignment every month. We explore the implications of having two consecutive weeks of clinic rotation every two months. We use discrete optimization to generate rotational schedules, and we explore combined metrics to assess the quality of this policy change.

14 - Freeway Reliability Scenario Generation: A Hybrid Approach

SeyedBehzad Aghdashi, NC State University, 803 Essex Forest Dr, Cary, NC, 27518, United States of America, behzad_aghdashi@ncsu.edu

The main objective of the proposed Scenario Generation approach is to increase the quality of each scenario, making it more representative of the expected congestion patterns on the freeway. The proposed approach uses three core mathematical schemes: a) a deterministic mathematical model b) a Monte Carlo simulation, and c) an optimization.

15 - Assessment of Capacity and Stability in National Sustainable Transportation

Hamed Ahangari, PhD Candidate, University of Connecticut, 1 Northwood Rd, Storrs, CT, 06268, United States of America, hamed.ahangari@uconn.edu, Carol Atkinson-Palombo, Norman Garrick

In last three decades, transportation system was faced with sustainability concerns but few efforts have been made to develop national sustainable transportation index-NTSI. This research use a nested approach to estimate NTSI by 19 environmental, social, and economic indicators in 30 developed countries. We also suggest and measure two new dimensions to assess sustainable systems: capacity and stability. Results offer a three dimensions clustering model to classify different countries.

16 - A Multi-criteria Approach to Maritime Search and Rescue Location Analysis

Amin Akbari, PhD Student, Dalhousie University/ Industrial Engineering Department, 5269 Morris Street/ PO Box 15000, Room R1-203, Halifax, NS, B3H 4R2, Canada, amin.akbari@dal.ca, H.A Eiselt, Ronald Pelot

This study's aim is to analyze the optimal location-allocation of maritime search & rescue resources by applying customized versions of the maximal covering and p-median problems. The optimal solutions of these two models are compared in terms of three decision criteria: (1) coverage; (2) mean access time; and (3) service equity. The results show a significant increase in resource utilization based on coverage and response time criteria for the model solutions compared to the current situation.

17 - Tournament Scheduling for Recreational Leagues

Athena Alimirzaei, Clinical Assistant Professor, University of Texas at Dallas, 800 W Campbell Rd, Richardson, TX, 75080, United States of America, athena.alimirzaei@utdallas.edu

There are many thousands of recreational sports leagues worldwide for both youth and adults of all ages. The recreational league scheduling problem is to assign matches in a given league to the resources allocated to that league. This work is motivated by the scheduling problem faced by the local company AllPlayers.com. A goal programming model has been developed to generate sports schedules on-line with various goals and restrictions.

18 - A Novel, Simple Interpretation of Nesterov's Method as a Combination of Gradient and Mirror Descent

Zeyuan Allen-Zhu, MIT, 32 Vassar St, Rm 32-G636, Cambridge, MA, 02139, United States of America, zeyuan@csail.mit.edu, Lorenzo Orecchia

Almost all first-order methods rely on two types of algorithmic steps: gradient-descent and mirror-descent steps. We obtain a simple interpretation of Nesterov's accelerated gradient method by expressing it as a natural coupling of the two types of steps. This interpretation has facilitated some recent breakthroughs (of the same authors) in approximately solving packing and covering LPs in nearly-linear time.

19 - Admission Batches to Minimize Internal Shuffles in a Centralized or Decentralized Hospital

Bruno Alves Maciel, Rochester Institute of Technology, 979 Nathaniel Rochester Hall, Rochester, NY, United States of America, ba8641@rit.edu, Ruben Proano, Richard Latham

We analyze the impact of a batched bed assignment process on the number of internal movements in several hospital units. The process can be applied under a centralized or decentralized admission policy, varying the amount of time between batch admissions while trying to minimize the number of internal movements. Our preliminary results show that under a centralized policy the need for internal movements can be completely eliminated.

20 - Evaluating and Testing Contemporary Snow Removal Routing Models under Ongoing Weather Conditions

Nathan Arrowsmith, RIT, 298 Pennels Dr, Rochester, NY, 14626, United States of America, nea4305@rit,edu

Snow removal route scheduling is a major component of winter weather planning. Recent approaches have focused on plowing all streets as quickly as possible and have demonstrated notable reductions in deadheading. These approaches however have largely ignored the impact of ongoing snow accumulation in the decision making process. By considering weather and traffic behavior, these methods can be evaluated for their efficacy during snow events. An accumulation-aware model is also under evaluation.

21 - The Effect of Urban Form and Location in Consumer Satisfaction

Homa Atef Yekta, Sharif University of Technology, Azadi St., Tehran, Iran, homa.atefyekta@gmail.com, Hamed Ahangari

Determinant of consumer satisfaction includes series of endogenous and exogenous factors. This research hypothesizes that urban form and business location are exogenously contributing in consumer satisfaction. We use online rating as the proxy of satisfactions. For location and urban variables we consider parking number, walkability score, network scale, and network density. The findings show that there is a strong statistical relation between urban form and consumer satisfaction.

22 - Efficiency Initiatives in Catalyst Production Lines the Use of Simulation as a Tool to Support Energy

Alexandre Augusto Massote, Professor, FEI University, Campus of S„o Bernardo, S„o Bernardo do Campo, Brazil, massote@fei.edu.br

This work includes the energy efficiency variables within the context of manufacturing systems and the aims are: to emphasize the importance of planning the production including variables related to energy; to use the simulation for improving the efficiency of the energy into industries; to investigate the opportunities of saving energy.

23 - Analyzing Tweets to Inform a Model of Patient Choice, Arrival Rates and Wait in Emergency Rooms

Barry Barrios, Virginia Tech, 250 Durham Hall, Blacksburg, VA, 24061, United States of America, barriosb@vt.edu, Ekkehart Beck

Patients tweet about their experience in emergency departments (EDs). We show how these relate to observed arrival and waiting time patterns seen in US EDs. Using these data we develop a model to study the effect of patient tweets on patient choice of ED, arrival rates and waiting times.

24 - The Care Life Cycle: Linking Health and Social Care for an Ageing Population

Sally Brailsford, Professor of Management Science, University of Southampton, School of Management, Southampton, United Kingdom, s.c.brailsford@soton.ac.uk

The Care Life Cycle is a five-year multidisciplinary research program funded by the UK EPSRC. Its aim is to apply "complexity science" methods to study the links between supply and demand for health and social care in an ageing population. We have developed a suite of linked simulation models, including an agent-based model of family formation, a system dynamics model of social care provision, and a hybrid DES-SD-ABS model for the eye condition age-related macular degeneration.

25 - Managing Stakeholder Voices for the Development of a Novel Rehabilitation Device for Upper Limbs Rehabilitation

Aline Marian Callegaro, Universidade Federal do Rio Grande, Porto Alegre, 90035190, Brazil, nimacall@gmail.com, Amanda SÛria Buss, Carla Schwengbe ten Caten, M·rcia Elisa Soares Echeveste, Raffaela Leane Zenni Tanure

The development of new technologies for the health area must take into consideration customer requirements from different stakeholders of the product value chain. This study aims in managing requirements from different stakeholders to develop a novel rehabilitation device for upper limbs rehabilitation. The Customer Value Chain Analysis (CVCA) tool was used to identify stakeholders and the Quality Function Deployment (QFD) tool to analyze and prioritize the requirements. Study results are described according the engineering requirement process: elicitation, analysis, and documentation. The results of this new approach of managing requirements report technology inputs for the development process of new medical devices.

26 - Modeling and Assessing Health Care Services Utilization in Hospital Readmission for Cancer Patients

Hanqing Cao, Senior Scientist, Philips Research North America, 345 Scarborough Rd, Briarcliff Manor, NY, 10510, United States of America, hanqing.cao@philips.com, Usha Raghavan, Yugang Jia

Healthcare services utilization data have not been previously employed to assess the readmission risk for cancer patients, while both are at the high priority of US government aiming to cutting cost. We developed models to investigate the relationship between health care services utilizations with unplanned 30-day hospital readmission. A number of interesting insights were generated from healthcare services utilization and unplanned hospital readmissions for cancer patients.

27 - Literature Review of Mathematical and Simulation Models for School Closures in Pandemic Influenza

Yao-Hsuan Chen, CDC, 1600 Clifton Rd, Atlanta, GA, 30333, United States of America, xhj1@cdc.gov, Amra Uzicanin, Karen Wong, Hongjiang Gao

We reviewed assumptions, structures, parameters, and results of published models that evaluated effects of school closures implemented to mitigate impact of an influenza pandemic. Out of 1587 papers identified in the initial search in PubMed, 39 met inclusion criteria for further review. Despite great variety in model specifications, published models found school closures to be effective in mitigating a pandemic influenza outbreak when implemented quickly and for sufficient duration.

28 - Eliciting and Combining Expert Opinion ñ An Overview and Comparison of Methods

Mutsa Chinyamakobvu, Masters Student, Rhodes University, P.O. Box 94, Grahamstown, EC, 6140, South Africa, m.chinyamakobvu@ru.ac.za, Isabelle Garisch

This paper is an overview and comparison of the elicitation and combination methods available for Expert Judgement Analysis. These include the traditional committee method, the Delphi method, the paired comparisons method, the negative exponential model, the classical model, the histogram technique, using the Dirichlet distribution and the employment of overfitting. The supra Bayes approach, and combining the opinions of experts given as confidence levels, are also considered.

29 - Design of Fuel Supply Chain for Power Plants: A Hybrid Stochastic and Robust Optimization Approach

Anna Danandeh, University of South Florida, 4202 E Fowler Ave, Tampa, FL, United States of America, annadanandeh@mail.usf.edu, Bo Zeng

42 percent of the US electricity power is generated from burning coal, whose quality variations may cause violations of EPA regulations. In this project, we develop a stochastic-robust hybrid multi-stage and multi-generator optimization model in which the demand randomness is described by a set of scenarios and the concept of uncertainty set is adopted to bound quality variations.

30 - NP-Hardness Proof for the Maintenance Scheduling for Modular Systems Problem

Tamar Cohen, Technion Israeli Institute of Technology, 11 Hagalil St., Gival Ela, Israel, tamar.cg@gmail.com, Liron Yedidsion

The Maintenance Scheduling for Modular Systems problem consists of a tree of components with respective cycle limits. The cycle limit for each component specifies the time interval in which it must be repaired. In order to reach a component in the tree its predecessor module must also be disassembled. The goal is to find a periodic replacement policy that minimizes the cost associated with component maintenance and module disassembly. In this paper we provide a proof that the problem is NP-hard.

31 - A Scenario-based Approach to Inventory Routing Problem

Vinayak Dinesh, RIT, 6000 Reynolds Drive, Rochester, NY, 14623, United States of America, vxd9920@rit.edu, Scott Grasman

Inventory routing problems (IRPs) that integrate inventory & routing problems can be considered a shift towards centralized thinking, influenced by practices like VMIs. This research tries to solve an IRP using a scenario based approach, considering uncertain demands. Furthermore the number of scenarios has been reduced by grouping retail centers showing similar demands with techniques like K-means clustering. As per our knowledge this is the first attempt at solving IRPs using this approach.

32 - Optimal Sampling Times for a Partially-observable Growing Population

Ali Eshragh, Lecturer/Researcher in Statistics and Optimization, The University of Newcastle, School of Mathematical and Physical Science, Callaghan, NS, 2308, Australia, Ali.Eshragh@newcastle.edu.au

Our goal is to estimate the rate of growth of a population governed by a simple birth process. We may choose (n) time points at which to count the number of individuals present, but due to detection difficulties, we are able only to observe each individual with fixed probability (p). We discuss the optimal times at which to make our (n) observations in order to maximize the Fisher Information for the rate of growth and support our theoretical results by numerical experiments.

33 - Model-based Simulation Systems for Adaptive Training in Time-critical Decision Making

Kushal Abhyankar, Wright State University, Dayton, OH, United States of America, kushal.abhyankar@wright.edu, Subhashini Ganapathy

The main goal of education and training is to provide capabilities that can help humans improve performance and accelerate decision-making. Advances in mobile computing (e.g., sensor technology, context aware computing, and cloud computing) allow for the design of systems that goes beyond the traditional methods of simulation training to support adaptive learning. The focus of this paper will be to present a human performance model for disaster response through sensor-based information.

34 - Textbooks for Responsible Data Analysis in Excel

Nathan Garrett, Woodbury University, 7500 Glenoaks Blvd., Burbank, CA, 91510, United States of America, nathan.garrett@woodbury.edu

With 27 million users, Excel is the most common data analysis software. However, audits show that almost all complex spreadsheets have errors. This project examines textbooks to understand why; are we teaching responsible data analysis? These textbooks are compared against spreadsheet development best practices. The results show a wide range of approaches, and that none of the ten books fully covers both the features and methodologies needed to create well-rounded Excel data analysts.

35 - Scheduling Multiple Parallel Machines with Capacity Constraints

Lai Wei, University of Michigan, Ross School of Business, Ann Arbor, MI, United States of America, laiwi@umich.edu, Dongdong Ge, Simai He

This work studies the problem of scheduling n independent jobs on p identical machines, with a limit on the number of jobs (q) that can be assigned to each machine. The goal is to minimize the total weighted completion time of the jobs. We consider both its deterministic case and the 2-≠stage stochastic optimization model and provide constant approximation algorithms for both problems.

36 - Total Value-of-ownership Model for Analyzing the Economics of a Fleet of Electric Vehicles

Thomas Goerzen, PhD Student, University of Paderborn, Warburger Strafle 100, Paderborn, Germany, Thomas.Goerzen@wiwi.uni-paderborn.de

We present a total value of ownership model to analyze the economics of a commercial fleet of electric vehicles. In comparison to existing models, we consider a significantly larger number of different cost and value parameters. Thereby we provide a better insight into the economic potential of electrified car fleets.

37 - Maximizing Sandfly Mortality for Controlling Kala-Azar Transmission in India

Kaushik Gorahava, Senior Quality Engineer, Verotech Solutions, LLC, 6189 NW 72nd Way, Parkland, FL, 33067, United States of America, kgorahava@gmail.com

Leishmaniasis is a family of human infectious diseases spread by the bite of sandflies. The Indian state of Bihar has the highest Leishmaniasis mortality rate in the world. Currently in Bihar, DDT (for controlling Leishmaniasis) is distributed only according to human population size. Is this process of insecticide distribution optimal? In this research, we explore this question by using models which optimize sandfly mortality rate under limited budget scenario.

38 - Demand Substitution in a Dual Sourcing Problem

Mustafa Hekimoglu, PhD Student, Erasmus University, Postbus 1738, Rotterdam, 3000 DR, Netherlands, hekimoglu@ese.eur.nl, Alan Scheller-Wolf

We consider quality difference between products from two suppliers. A natural outcome of this quality difference is demand substitution between products from two suppliers. We prove that the cost function for this model is pseudoconvex, which indicates the optimality of dual index policy under a mild sufficient condition. Also, a heuristic policy is developed by exploiting the myopic cost function. Extensive numerical tests show the heuristic deviates 7% from the optimal cost.

39 - Optimized Surveillance for Mosquito-borne Infections in Louisiana

Alexander Gutfraind, University of Illinois at Chicago, 1603 W. Taylor Street Rm. 834, MC 923, Chicago, IL, 60612, United States of America, agutfraind.research@gmail.com, Justin Davis, Krishna Patel, Lauren Meyers

Mosquito-borne infections, such as the West Nile Virus, cause millions of infections every year around the globe and in the USA. Infection control requires monitoring of the mosquito vectors. Here we report on one of the first applications of OR methods to this problem. Based on multiple years of data from St. Tammany Parish, LA we developed a spatial statistical model for the surveillance network. Using the model we optimized the efficiency and sensitivity of the surveillance schedule.

40 - Failure at the Top: How Power Undermines Collaborative Performance

John Hildreth, UC Berkeley, 2220 Piedmont Avenue, Berkeley, CA, United States of America, angus@berkeley.edu, Cameron Anderson

How does leaders' power affect their ability to work with other leaders? Laboratory experiments and field studies of executives found that groups of high power individuals performed worse than other groups: High power individuals were less creative when working together in groups and less able to reach agreement on difficult negotiation tasks because these groups engaged in more status conflict, were less focused on their tasks, and shared task information less effectively with each other.

41 - Departure Process in Heavily-loaded Service Systems with General Service Times

Junfei Huang, Assistant Professor, The Chinese University of Hong Kong, No.12, Chak Cheung Street, Shatin, N.T., Hong Kong - PRC, junfeih@cuhk.edu.hk

We derive an approximation for departure process in heavily-loaded service systems with general service time distributions. The results is based on some comparison results between loss systems and systems with buffers.

42 - Impact of Operational Drivers on Repurchase Intention in E-fulfilment

Nikunj Jain, Indian Institute of Management Indore, Rau-Pithampur Road, Prabhand Shikhar, Indore, MP, 453331, India, f11nikunjk@iimidr.ac.in

This study empirically examines the relationship between repurchase intention of customers and order procurement, order fulfilment and reverse service exchanges processes in an online retail environment. After controlling for customers' preferential brands, partial least squares structural equation modelling(PLS-SEM)analysis shows that operational drivers(ease of return,product information,product availability and condition of product on arrival)significantly affect repurchase intention.

43 - Towards Zero-carbon Manufacturing Operation: An Advanced Analytics Decision

Tongdan Jin, Associate Professor, Texas State University, 601 university Drive, San Marcos, TX, 78666, United States of America, tj17@txstate.edu, Victor Santana-Viera, Binbin Li, Heping Chen, Jesus Jimenez

This research performs a feasibility analysis on operating large manufacturing facilities under one hundred renewables penetration. We integrate wind turbines and concentrated photovoltaics into large enterprise systems to achieve zero carbon emissions goal. Our numerical experiments show that 100% renewable energy penetration is virtually affordable to any manufacturing facility in the world.

44 - New Branching Rules for Integer Programming using Strong Branching and Sampling

Ezgi Karabulut, Georgia Institute of Technology, 755 Ferst Drive NW, Atlanta, GA, 30332, United States of America, ezgi.karabulut@gatech.edu, Pierre Le Bodic, George Nemhauser

In this research, we aim to utilize a sampling approach in branch-and-bound trees. For that purpose, we incorporate sampling and strong branching with multiple levels. The first round of experiments on multicommodity network flow problems with fixed charge yield promising results for optimality gap in fixed amount of time.

45 - Iterative Simulation-optimization Algorithm for the Ambulance Location Problem

Sun Hoon Kim, Yonsei University, Korea, Seoul, Korea, Republic of, misia789@hanmail.net, Kee Yong Shin, Hyuk Lee, Cheng Yu Hwang, Young Hoon Lee

This study suggests an iterative simulation optimization algorithm for an ambulance location problem to minimize the number of vehicles while achieving required reliability level. An optimization model in the suggested model provides information regarding location of ambulances, the simulation model is used to validate the solution and interaction parameters are updated based on the simulation results. The computational experiments show that the suggested model outperforms existing algorithms.

46 - A Gage R&R Study in a Healthcare Setting

Russell Krenek, Clemson University, 129 Freeman Hall, Clemson, SC, 29634-0920, United States of America, rkrenek@g.clemson.edu, Shannon Harris, George Helmrich, Joel Greenstein, Byung Rae Cho

Despite being paramount to healthcare quality improvement initiatives, Gage Repeatability and Reproducibility studies in a hospital setting are rarely studied in the literature. This poster discusses a Gage R&R experiment in a hospital setting by developing various aspects of the quality of measurement associated with medical devices and processes to identify what part of measurement variability is affected by repeatability and reproducibility. A strategy for collecting data is also presented.

47 - Demand Forecasting by Factorization Machines in Fashion Industry

Chongshou Li, Phd Candidate, Department of Management Sciences, City University of Hong Kong, To Yuen Building - 2802, Tat Chee Avenue, Kowloon,Hong Kong, Hong Kong - PRC, chongshli2-c@my.cityu.edu.hk, Andrew Lim, Brenda Cheang

Demand forecasting is a challenging problem because demands for fashion products are highly affected by season, region and short life cycle. Factorization Machines (FMs) have recently been proposed as generic predictors and solved such problems in many areas. In this study, a novel model based on FMs is proposed for fashion products demand forecasting based on sixteen months of sales data from a multinational fashion retailer. Experimental results show that our approach produces good results.

48 - Optimal Pairing of Single and Multi-occupancy Rooms in a Centralized or Decentralized Hospital

Richard Latham, RIT, 6000 Reynolds Dr., Box 509, Rochester, 14623, United States of America, rel5224@rit.edu, Ruben Proano, Bruno Alves Maciel

The study uses a response surface design with a Monte Carlo simulation experiment to determine the best room configuration for a hospital interested in reducing the number of internal shuffles. These shuffles result from the need to implement isolation requirements to control healthcare-acquired infections in multi-occupancy rooms. The model determines the optimal pairing of single and multi-occupancy rooms in each unit when using a decentralized or centralized scheduling methodology.

49 - A Multilevel Proximal Algorithm for Large Scale Composite Convex Optimization

Duy Luong, Dr, Imperial College London, South Kensington, London, SW7 2AZ, United Kingdom, vu.luong@imperial.ac.uk

Composite convex optimization models consist of the minimization of the sum of a smooth convex function and a non-smooth convex function. Such models arise in many applications where, in addition to the composite nature of the objective function, a hierarchy of models is readily available. We propose a novel method to take advantage of the hierarchy of models for computing the search directions. We establish the global convergence and compare with two popular algorithms (ISTA and FISTA).

50 - Improving Model Inference from FRAP Data – An Example from the Drosophila Wing Disc

Lin Lin, University of Minnesota, Twin Cities, 1618 Eustis St., Saint Paul, MN, 55108, United States of America, linlinbme2009@gmail.com

Fluorescence recovery after photobleaching (FRAP) is used to obtain quantitative information about diffusion and binding kinetics by fitting the experimental data to a mathematical model. However, when the system involves the complex interaction of transport and reaction steps, the question arises as to what level the system should be modeled and how one is to estimate the parameters. I will propose a theoretical approach to investigate these questions and to improve parameter estimation.

51 - Allocating Linear Rescheduling Cost with Machine Unavailability

Zhixin Liu, University of Michigan - Dearborn, 19000 Hubbard Dr, Dearborn, MI, 48126, United States of America, zhixin@umich.edu, Liang Lu, Xiangtong Qi

We study a rescheduling problem faced by multiple jobs owners, where jobs need to be rescheduled to minimize the total weighed completion time, when the machine becomes unavailable for a period of time and the initial optimal schedule becomes infeasible. We provide a simple closed form core allocation of the total cost saving for all the jobs, and also provide the Shapley value of the game in a computable form.

52 - Stochastic Modeling and Optimization of Biomanufacturing Operations

Tugce Martagan, University of Wisconsin-Madison, 4701 Sheboygan Ave Apt 302, Madison, WI, United States of America, martagan@wisc.edu, Ananth Krishnamurthy

We consider the manufacturing of custom-made proteins. We first develop reliability models and condition-based control policies for fermentation systems. Next, we investigate optimal protein purification strategies via dynamic programming to minimize costs. We collaborate with several local biomanufacturing companies to validate our models and implement our findings.

53 - Measuring Near Real-time Harm in the Hospital using Electronic Health Records (EHR)

Seyed Mani Marashi, PhD Student, Wayne State University, 4815 Fourth Street, Detroit, MI, 48202, United States of America, ez6964@wayne.edu, Jack Jordan, Kenneth Chelst

Harm occurs when a patient develops a new medical problem in a hospital. It is historically measured using billing data that lags the actual harm by weeks and also has accuracy issues. We used electronic health records to achieve better and faster measurement using cases of venous thromboembolism.

54 - Mathematical Analysis of Fireworks Displays with Respect to Solid Angles

Yohei Okimura, Keio University, 3-14-1 Hiyoshi, Kohoku-ku, Yokohama, 223-8522, Japan, youhei.o@a7.keio.jp, Yudai Honma, Takamori Ukai, Osamu Kurita

Fireworks displays are typical features of Japanese summer. We propose a mathematical model to evaluate the optimal viewing points for fireworks displays based on computational geometry algorithms. We calculate the solid angles of actual fireworks displays with respect to the shielding by millions of existing buildings in Tokyo metropolitan area.

55 - Evaluating Algorithms for Processing Nuclear Detection Sensor Data

Christie Nelson, Rutgers University, 23A Norwood Ct, Princeton, NJ, 08540, United States of America, christie.l.nelson.phd@gmail.com, William M. Pottenger, Fred Roberts, Paul Kantor

Many nuclear detection algorithms have been developed for scanning vehicles for threats and must be evaluated fairly. An approach is to conduct experiments with simulated data using sensor data as input, with a goal to find experimental configurations revealing meaningful differences between algorithms. Combinatorial Experimental Design provides a set of configurations which cover all levels and pairs of levels of important variables; these must be reviewed and valued by subject matter experts.

56 - Exact and Heuristic Anytime Algorithms for Solving the Knapsack Problem

Diego Mesquita, University of Alberta, 2-32 Athabasca Hall, Edmonton, AB, T6G2E8, Canada, parentep@ualberta.ca

In 1997, Richard E. Korf presented an approach for solving Combinatorial Optimization problems which has been successfully applied to problems such as Number Partitioning and Bin Packing. In this work we apply it to the Knapsack Problem and provide a critique of Korf's method.

57 - Group Buying: Retail Stores' Performance and Implications

Qijun Qiu, The University of Hong Kong, RM 723, 7/F, K.K. Leung Building, Pokfulam RD., Hong Kong, Hong Kong - PRC, angieq@connect.hku.hk, Benjamin Yen

We study a new promotion strategy, Group Buying (GB), in which consumers enjoy a price discount by forming a group. We build monopoly and competition models to examine if and how store offers GB in a sustainable manner. We find that store's decision depends on the market pattern and its regular pricing policy, while it still can manage to secure a reasonable profit. Further, store competition affects the equilibrium in a quite dramatic way. All these explain the prevalence of GB worldwide.

58 - Credit Card Holders Behavioral Modeling: Multistage Regression Approach

Denys Osipenko, Doctoral Researcher, University of Edinburgh Business School, 29 Buccleuch Place, Edinburgh, EH8 9JS, United Kingdom, denis.osipenko@gmail.com, Johnathan Crook

Because of the variety of the card holders' behaviour patterns and income sources each consumer account can move to different states. The key question is which approach gives more accurate results: multinomial logistic regression or multistage decision tree with binary logistic regressions. This paper investigates the approaches to credit cards profitability estimation at account level based on multistates conditional probability.

59 - AI-AFTER: Identifying the Right Goal of Forecast Combination

Craig Rolling, Assistant Professor, Lundquist College of Business, 1208 University of Oregon, Eugene, OR, 97403, United States of America, crolling@uoregon.edu

There are two potential goals of forecast combination: combining for adaptation or combining for improvement. It is important to know which goal is more appropriate for a given analysis so that a suitable combination method may be used. AI-AFTER first determines the appropriate goal of forecast combination, then combines the forecasts to achieve the proper goal. As a result of this approach, the combined forecasts from AI-AFTER perform well in both adaptation and improvement scenarios.

60 - Modeling Red and Yellow Alert Durations for Ambulance Systems as Partial Busy Periods

Amir Rastpour, University of Alberta, Edmonton, AB, Canada, rastpour@ualberta.ca

Ambulance system Red and Yellow alerts are time periods during which all or most ambulances are busy, respectively. Modeling such systems as Erlang loss systems, we obtain the first moment of alert period duration, and show that our results are consistent with empirical data from Calgary. We also obtain alert duration Laplace Transform and higher moments when the service time distribution is general. We study the impact on alert duration of increasing the number or service speed of ambulances.

61 - Development of Control Models for the Planning of Sustainable Transportation Systems

Alexander Paz, University of Nevada, PO BOX 454015, Las Vegas, NE, 89154, United States of America, apaz@unlv.edu, Pushkin Kachroo, Pankaj Maheshwari

The proposed research envisages how to incorporate sustainability considerations into the transportation planning process. A dynamic model for planning and development of sustainable transportation systems is presented. A system of three nonlinear differential equations is used to represent the dynamics of three states; namely Transportation, Activity, and Environmental systems. A policy scenario considering investment in energy efficient technologies and its effects is discussed.

62 - The Behavior of Government Subsidies to Low-carbon Products and Social Welfare Analysis

Jie Ren, University of Science and Technology of China, School of Management, 96 Jinzhai Road, Hefei, 230026, China, ahrj@mail.ustc.edu.cn

We study the effect of government subsidies to individual consumers, manufacturers or both subsidized by using three modes of game between government and enterprises. In order to provide a support for the government to make scientific subsidies decisions and for the manufacturers and consumers to make good decisions in the context of government subsidies, we analysis the impact of different government subsidies modes on the manufacturer's revenue, consumer surplus and social welfare.

63 - A Defender-Attacker-Defender Model for Railway Infrastructure

Hassan Sarhadi, PhD Student, Memorial University of Newfoundland, 57 Allandale Road, PO BOX 534, St.John's, NL, A1B 3S7, Canada, hassan.sarhadi@mun.ca, David Tulett, Manish Verma

Owners of railway facilities need to defend their assets, particularly railyards, against attack by terrorists. We use a Defender-Attacker-Defender framework to model this problem. The resulting mathematical formulation is very complex, but we are able to solve the problem optimally for a small number of protected/interdicted terminals.

64 - Buyer-supplier Relationship: The Impact of Service Logistics Level in Customer Satisfaction and Loyalty

Mauro Sampaio, FEI University, Campus of S„o Bernardo, S„o Bernardo do Campo, 09850-901, Brazil, msampaio@fei.edu.br

The objective of this research is to demonstrate the impact of logistics service on customer satisfaction and, consequently, on their loyalty. Empirical evidence is provided on the relationship between operational and relational performance, satisfaction, affective commitment, purchasing behavior and loyalty of buyers from the Brazilian industry.

65 - Using Big Data Analytic to Eliminate Empty Miles in Logistics

Haibo Wang, Texas A&M International University, 5201 University Blvd, Laredo, TX, 78041, United States of America, hwang@tamiu.edu, Wei Wang, Jun Huang, Wei Ning

This study presents a framework using information system based on big data analytic and cloud computing to eliminate empty miles to improve the efficiency of logistics. First, data and text mining tools are used to extract valuable information automatically for input, then a mathematical programming model is proposed to solve the problem of matching shipments with carriers in term of time and cost. The customer retention and dynamic pricing schedule are also implemented in the proposed system.

66 - Discounting over Subjective Time: One Step Towards a Unified Theory of Intertemporal Choice

Yitong Wang, Lecturer, University of Technology, Sydney, Cnr Quay Street and Ultimo Road, Haymarket NSW, NS, 2000, Australia, yitongwang@uts.edu.au, L. Robin Wang, Liangyan Wang

Discounted utility theory has been regarded as the normative theory when modelling inter-temporal choice. However, existing research suggests people in general don't obey discounted utility theory as their discount rates are context dependent. This paper incorporates decision makers' time perception into discounted utility model and finds relatively constant discount rates over subjective time. Our finding helps in developing a unified theory for inter-temporal decision making.

67 - Dynamic Optimal Inflow Control with Queues for Minimal Evacuation Time in a Tsunami Inundated Area

Junji Urata, The University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, 1138656, Japan, urata@bin.t.u-tokyo.ac.jp, Eiji Hato

The optimal control is needed to prevent a traffic congestion for evacuation in a tsunami inundated area. This paper proposes a dynamic inflow control model on intersections and aims to minimize the evacuation time. This model treats the flow conservation, the FIFO and the physical queues in a many-to-one network. The Pontryagin's maximum principle is applied to get the earliest evacuation time. The dynamic optimization is formulated by the constrained conditions of DTA.

68 - Operations Research for Functional Neuroimaging
Svetlana Soloveva, PhD Student, Rutgers University, 617 Bowser Road, Piscataway, NJ, 08854, United States of America, svetsolo@rutgers.edu, Dimitris Metaxas

Our goal is to identify disease related features and common features of a healthy brain through characterization of changes in connectivity of functional networks. Our neuroimaging data is recorded with MEG and MRI. We solve inverse electromagnetic problem for realistic head models to localize sources of activity in the brain. Measures of functional similarity are used for network analysis.

69 - WLC-based Process Plan Decision and its Heuristic Approaches
Boxuan Zhao, Xi'an Jiaotong University, Xi'an, China, zbx.1067@stu.xjtu.edu.cn, Kun Chen, Jianmin Gao

This paper investigates WLC-based process plan decision which is a real-time dynamic and closed loop decision-making method for process planning, and derives nine heuristic approaches. The simulation results in the general job shop show the strategies considering order features outperform those considering shop status. The processing-time-related strategies perform best and present a good robustness as the workload control is relaxed. The locations of focused stations affect their performances.

70 - Common Pitfalls in "Common Practice"
Channing (Chang) Yan, Senior Consultant, Decision Strategies, Inc., Houston, TX, 77042, United States of America, cyan@decisionstrategies.com

Traditionally drilling time and cost have always been estimated deterministically. A typical approach is to develop an approximate average and then add enough contingency until we feel comfortable with the number. Few people realize the danger of this practice, and most consider it to be "conservative"; hence it is all "good". This paper challenges the convention and demonstrates what has always been done in the past is not necessarily always right or a best practice. It points out several common pitfalls in our common practice as well as challenges in influencing people with a new way of thinking.

71 - Modeling Brand Correlation through Iterative Sparsity Search
Qiong Zhang, Virginia Commonwealth University, 1015 Floyd Avenue Richmond, VA 23284-308, Richmond, va, 23294, United States of America, zhangqiong1985@gmail.com

We propose a novel statistical approach to estimate the covariance structure of multiple brands in grocery stores. The method can also be used for predicting brand performances in unexplored markets.

72 - A Simulated-based Approach for ED Patient Throughput and Med/surg Unit Workforce Optimization
Jingyu Zhang, Philips Research North America, 345 Scarborough Rd, Briarcliff Manor, NY, 10510, United States of America, jingyu.zhang@philips.com, Xiang Zhong, Zhichao Shu, Therese Fitzpatrick

Many hospitals in the US face serious patient throughput problems especially in their emergency department (ED). While new patients wait long time for ED beds, ED beds are still occupied by those patients who should have moved to other general med/surg units. A root cause is the workforce utilization problem in those general units. We developed a simulation-based approach to improve ED patient throughput and optimize med/surg unit workforce simultaneously.

73 - Modified Cell Transmission Model for Traffic Signal Control Optimization
Hao Yu, Southeast University, 2 Sipailou, Nanjing, 210096, China, seudarwin@gmail.com

The traffic signal timing optimization problem is formulated based on a modified cell transmission model. The node model of the new CTM is enhanced to capture complex traffic signal control strategies. Detailed model structure is proposed, as well as some numerical studies. It shows that the new model is able to simulate different traffic signal control strategies, with quite low additional computation."

Monday, 1:30pm - 3:00pm

■ MC01

Hilton- Golden Gate 6

Sensors and Weapons

Sponsor: Military Applications Society

Sponsored Session

Chair: Michael Hirsch, President, ISEA TEK, 620 N. Wymore Road, Suite 260, Maitland, FL, 32751, United States of America, mhirsch@iseatek.com

1 - Optimizing Sensor Placement to Maintain Coverage and Connectivity Following Perturbations
Andrew Romich, Sandia National Laboratories, 7011 East Avenue, MS 9154, Livermore, CA, United States of America, aromich@sandia.gov, George Lan, J. Cole Smith

We consider a sensor placement problem in which the sensors must maintain coverage of a set of adversarial locations. Maximum intra-sensor communication, as determined by a function of distance between sensors, is desired. Complicating the sensor location problem are uncertainties related to final sensor positions due to unintended movement, e.g., due to air or water currents to which the sensors may be subjected.

2 - Optimal Positioning of Active Multistatic Sensors for Point Coverage Applications
Emily Craparo, Naval Postgraduate School, 1411 Cunningham Road, GL-238, Monterey, CA, 93943, United States of America, emcrapar@nps.edu, Mumtaz Karatas

We study the problem of optimally positioning active multistatic sonar sources for a point coverage application where all receivers and targets are stationary. We formulate exact and approximation algorithms for optimally placing sources under a various sensor models, and we extend these models to account for unreliable sensors.

3 - Approximate Dynamic Programming for the Dynamic Weapon Target Assignment Problem
Carl Parson, Air Force Institute of Technology, 2950 Hobson Way, Wright-Patterson AFB, OH, 45433, United States of America, carl.parson.ctr@afit.edu, Darryl Ahner

As the sophistication of air defense systems increases, traditional weapon's employment strategies no longer suffice. In many practical examples, weapon's effectiveness may not necessarily be independently multiplicative. This research formulates the dynamic weapon-target assignment problem with conditional weapons effectiveness and solves it using dynamic programming. A small example is solved exactly prior to presenting approximation methods to help mitigate the curse of dimensionality.

4 - Maritime Anomaly Detection
Cleber Almeida De Oliveira, Fundaç„o EZUTE, Rua do RÛcio, 313 - 11∫ andar, Sao Paulo, 04552-000, Brazil, oacleber@gmail.com

The challenge in this research is to determine the location of dependent sources for data collection in oil rig areas and to specify an effective information exploitation system for maritime situation awareness that reduces the operator's workload to detect maritime anomalies and allow a comprehensive association between anomalies and scenarios of interest so that follow-on decisions may be better rationalized.

■ MC02

Hilton- Golden Gate 7

Rx for Patent Fatigue in Innovation Research: New Data, New Causal Methods, and New Results

Sponsor: Technology, Innovation Management and Entrepreneurship

Sponsored Session

Chair: Lee Fleming, UC Berkeley, 330 Blum Hall, Berkeley, CA, 94720, United States of America, lfleming@berkeley.edu

1 - What Does the Patent Allowance Rate Tell us About Examination Standards?

Alan Marco, Acting Chief Economist, U.S. Patent and Trademark Office, 600 Dulany St. MDE 2D39, Alexandria, VA, 22314, United States of America, Alan.Marco@uspto.gov, Micharl Carley, Deepak Hegde

Patents play a key role in companies' innovation strategies: this study analyzes factors that affect patent examination outcomes at the US Patent & Trademark Office (PTO). Controlling for application characteristics and stocks of pending applications, we find little evidence to support claims of widely varying quality. Apart from offering implications for patent policy makers, our study also contributes a novel methodology to estimate the effect of covariates on patent allowance and abandonment.

2 - Do Inventors Value Secrecy in Patenting? Evidence from the American Inventor's Protection Act of 1999

Stuart J. H. Graham, Georgia Institute of Technology, Atlanta GA, United States of America, stuart.graham@scheller.gatech.edu, Deepak Hegde

This study examines the revealed preferences of inventors towards secrecy in patenting by analyzing their disclosure choices before and after the enactment of the American Inventor's Protection Act (AIPA) of 1999. We find that about 7.5% of U.S. patent applications use AIPA's provisions to keep their inventions secret before patent grant. Small U.S. inventors, in particular, are more likely than large corporations to prefer disclosure over secrecy for their most important inventions. Our findings question the conventional wisdom — which seems to have shaped important policy — that the disclosure of patent applications harms U.S. invention by increasing the risk of imitation for small inventors.

3 - Friendly Boards and Innovation

Lee Fleming, UC Berkeley, 330 Blum Hall, Berkeley CA 94720, United States of America, lfleming@berkeley.edu, Benjamin Balsmeier, Gustavo Manso

We develop a model and present supporting evidence for how friendly boards influence the innovative search strategies of a firm. Shareholders hire a manager to run a firm for two periods. To supervise the manager, shareholders appoint a board of directors. In each period, the manager reports to the board of directors, proposing a strategy, which the board decides whether or not to approve. Riskier and "explorative" search strategies are more likely with friendlier boards. Empirical identification relies on regulatory changes that caused shareholders to appoint a majority of independent directors. We find that firms with friendly boards are more likely to explore less crowded and newer and new-to-the firm technologies and to hire younger and new-to-the firm inventors. Firms with less friendly boards tend to patent more and get more citations to their patents, though these effects are strongly mediated by an increase in claims and insignificant in the tales of the citation distributions (completely failed and breakthrough inventions are less influenced by the friendliness of the board).

4 - Patents and Cumulative Innovation: Causal Evidence from the Courts

Alberto Galasso, University of Toronto, Toronto, ON, Canada, alberto.galasso@rotman.utoronto.ca

This paper studies the causal effect of removing patent protection through court invalidation on subsequent research related to the focal patent, as measured by later citations. We exploit random allocation of judges at the U.S. Court of Appeal for the Federal Circuit to control for the endogeneity of patent invalidation. We find that patent invalidation leads to a 50 percent increase in citations to the focal patent but the impact is highly heterogeneous.

■ MC03

Hilton- Golden Gate 7

Data-Driven Analysis in eBusiness

Sponsor: eBusiness

Sponsored Session

Chair: Hong Guo, University of Notre Dame, 356 Mendoza College of Business, Notre Dame, IN, 46556, United States of America, hguo@nd.edu

1 - Large Scale Network Analysis for Online Social Brand Advertising

Kunpeng Zhang, Assistant Professor, University of Illinois at Chicago, 601 S Morgan St., Chicago, IL, 60607, United States of America, kzhang6@uic.edu

This paper proposes an audience selection framework for on-line brand advertising based on user historical activities on social media platforms. It builds implicit brand-to-brand networks and analyzes their structural properties. We propose hierarchical community detection, distributed influential brand identification, and sentiment analysis to find target users. The experiments conducted on Facebook data show that our framework can obtain performance improvement compared to baselines.

2 - Text Mining for Marketing Importance: Decomposing Firm Value

Brent Kitchens, University of Florida, 4046 NW 60th Ave, Gainesville, FL, 32653, United States of America, brent.kitchens@warrington.ufl.edu, Debanjan Mitra, Joseph Johnson, Praveen Pathak

We use a novel text mining technique to extract firm marketing news. This enables us to address a longstanding big picture question raised by marketing scholars – is marketing losing its importance? We compare marketing news to firm abnormal returns and find that marketing is important to investors. Moreover, we find no sustained diminishing trends in marketing's importance, but rather that this importance is counter-cyclical – decreasing with macroeconomic growth and increasing with adversity.

3 - Bidding Behavior in Sealed-bid Construction Contracts: An Empirical Study

Gulver Karamemis, University of Florida, Warrington College of Business Administr, Gainesville, United States of America, gkaramemis@ufl.edu, Anand Paul

We uncover patterns of bidding behavior in sealed bid contracting in the construction industry in a large US state by analyzing longitudinal data spanning several years, and across a wide range of construction projects. We compare and contrast our findings with predictions from contract theory.

4 - Hierarchical SVMs for Personal Event Detection in Social Networking Sites

Shengli Li, Xi'an Jiaotong University, Xianning West Road 28, Xi'an, China, lishengli@mail.xjtu.edu.cn, Hong Guo, Haldun Aytug, Praveen Pathak

Users announce and discuss their personal events with their friends on the social networking sites.This paper models personal event detection in social networking sites as a classification problem and proposes a hierarchical SVM model to capture the unique nested structure of social networking data.Using a large-scale real-life dataset, we test the performance of the proposed hierarchical SVMs and compare it to other existing methods.

■ MC04

Hilton- Continental 1

New Topics in Supply Chain Network and Design

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Yehua Wei, Assistant Professor, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, yehua.wei@duke.edu

1 - Designing Flexible Systems

Andre Calmon, Assistant Professor, INSEAD, Boulevard de Constance, Fontainebleau, France, acalmon@mit.edu, Dragos Florin Ciocan

We propose a novel theoretical framework for flexibility in supply chains and service systems. Using this framework, we develop tools aimed at guiding the design of large scale flexible systems. In addition, we apply this approach to the design and analysis of an on-line resource allocation scheme. Finally, we illustrate our results through numerical experiments.

2 - Managing Disruptions with Uncertain Duration in Supply Chain Networks

Peter Y. Zhang, Massachusetts Institute of Technology, 77 Mass Ave., Cambridge, 02139, United States of America, pyzhang@MIT.EDU, William Schmidt, David Simchi-Levi, Yehua Wei

Firms with complex supply chains are exposed to a variety of risks, including low-probability / high-impact events that can completely halt the production of supplier sites for an extended duration. We use a linear optimization model to quantify the performance impact of disruptions, and identify inventory / flow decisions that minimize such impact. We also develop a Pareto robust strategy to identify dominant solutions if the disruption duration is uncertain.

3 - Competition in Supply Chain Networks in the Presence of Disruption Risk

Ozan Candogan, Fuqua School of Business, Duke University, Durham, NC, 27708, United States of America, ozan.candogan@duke.edu, Kostas Bimpikis, Shayan Ehsani

This paper considers multi-tier supply chains in the presence of disruption risk. A network structure determines the set of potential supply relationships and the extent of competition among firms in a given tier. We provide a characterization of the equilibrium of the strategic interaction between the firms, which highlights the interplay between the network structure and the resulting prices, production quantities, and profits associated with each of the firms.

4 - Approximation Algorithms for Perishable Inventory Systems with Setup Cost

Huanan Zhang, University of Michigan, 2797 IOE Building, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, zhanghn@umich.edu, Xiuli Chao, Cong Shi

This work studies perishable inventory systems with setup costs. Little is known about the structures of optimal policies for such systems in the literature. The design and computation of an effective heuristic policy has been an open challenge. We describe the first computationally efficient policy that admits a worst-case performance guarantee between 3 and 4 under a large class of correlated demand processes.

■ MC05

Hilton- Continental 2

MSOM Student Paper Competition Finalists

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Goker Aydin, Associate Professor, Indiana University, Kelley School of Business, Bloomington, IN, 47405, United States of America, ayding@indiana.edu

Co-Chair: Guillaume Roels, UCLA, 110 Westwood Plaza, B511, Los Angeles, CA, 90066, United States of America, guillaume.roels@anderson.ucla.edu

Co-Chair: Gil Souza, Associate Professor, Indiana University, Kelley School of Business, Bloomington, IN, 47405, United States of America, gsouza@indiana.edu

1 - 2014 MSOM Student Paper Competition Finalists

Gil Souza, Associate Professor, Indiana University, Kelley School of Business, Bloomington, IN, 47405, United States of America, gsouza@indiana.edu

The MSOM Student Paper Competition is awarded annually by the Manufacturing & Service Operations Management Society at the INFORMS Annual Meeting for papers judged to be the best in the field of operations management.

■ MC06

Hilton- Continental 3

Operations and Marketing Interface

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Ozge Sahin, Johns Hopkins University, 100 International Drive, Baltimore, MD, 21231, United States of America, ozge.sahin@jhu.edu

1 - Pricing of Conditional Upgrades in the Presence of Strategic Consumers

Yao Cui, PhD Candidate, University of Michigan, 701 Tappan Ave, Ann Arbor, MI, 48109, United States of America, cuiyao@umich.edu, Izak Duenyas, Ozge Sahin

We study a conditional upgrade strategy that has recently become common in travel industry. A consumer can accept an upgrade offer after making a reservation and pay the fee to upgrade at check-in if the high-quality product type is still available. Consumers decide which product type to book and whether to accept an upgrade offer based on the anticipated upgrade probability. We characterize the firm's optimal upgrade pricing strategy and identify multiple benefits of conditional upgrades.

2 - B2B Pricing Optimization for Resellers

Ozden Engin Cakici, American University, Washington, DC, cakici@american.edu, Itir Karaesmen

In electronics, health care, and retail industries, it is common for surplus inventory, returned merchandise, used goods, or waste to be sold to resellers. A reseller (or broker) matches the demand for such goods with the supply. The resellers operational decisions include how much to bid for the supply and how to allocate the supply among its existing customers. We show how a reseller's problem can be formulated as a two-stage stochastic model and how the optimal solution can be obtained.

3 - Consumer Choice Models with Endogenous Network Effects

Ruxian Wang, Assistant Professor, Johns Hopkins Carey Business School, 100 International Dr, Baltimore, MD, 21202, United States of America, ruxian.wang@jhu.edu, Zizhuo Wang

Network externality arises when product utility not only depends on attribute valuations, but also the number of users. We propose and analyze a new class of choice models by taking into account the endogenous network effects. We show the optimality of a new class of assortments, called a quasi-revenue-ordered assortment, consisting of a revenue-ordered assortment plus one item. Empirical results by using a new iteration-based estimation method show that our model is statistically significant.

4 - Personal Selling in an Emerging Market

Tinglong Dai, Assistant Professor, Johns Hopkins University, 100 International Drive, Baltimore, MD, 21202, United States of America, dai@jhu.edu, Jian Ni

We develop a principal-agent type model to study how a multinational manufacturer constructs its personal-selling networks when entering an emerging market. Under information asymmetry and product/cost differentiation, we show that a strong regulatory environment may facilitate the entry of the multinational manufacturer. Our paper helps explain asymmetric distribution structures empirically observed in emerging markets.

■ MC07

Hilton- Continental 4

Cloud Computing for Optimization

Cluster: Tutorials

Invited Session

Chair: Jeff Linderoth, Professor, University of Wisconsin-Madison, United States of America, linderoth@wisc.edu

1 - Cloud Computing for Optimization

Jeff Linderoth, Professor, University of Wisconsin-Madison, United States of America, linderoth@wisc.edu

I will describe experiences with using ubiquitous, convenient, on-demand, shared computing resources to solve large-scale optimization problems. In olden days, these computing resources were known as a "metacomputer." In the early 2000's, the name changed to the "computational grid," and now using computing resources in this way is known as "cloud computing." I will also survey the landscape of cloud computing and its use and potential for Operations Research and Optimization.

■ MC08

Hilton- Continental 5

George Dantzig's Continuing Impact on Advances in Optimization

Cluster: Celebrating George B. Dantzig's 100th Birthday and His Influence on MS/OR

Invited Session

Chair: Robert Freund, Professor, MIT, Sloan School of Management, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, rfreund@mit.edu

1 - How Good is the Simplex Method, Continued?
Ilan Adler, UC Berkeley, Berkeley CA, United States of America adler@ieor.berkeley.edu

Ever since G.B. Dantzig introduced the Simplex method in 1947, it has become a phenomenally successful tool for solving real world problems. However, for almost as long, researchers have been working intensely to develop a theory to explain its success. We will trace the practical success of the method as well as the underlying theoretical developments, highlighting Dantzigπs continuing impact.

2 - About George B. Dantzig's Homework
Roger Wets, Research Professor, University of California, Davis, Department of Mathematics, Davis, 95616, United States of America, rjbwets@ucdavis.edu

A famous anecdote about G. Dantzigπs student-time experience was that he arrived late for a class taught by his advisor, Jerzy Neyman, and he found on the blackboard a couple of questions. Surmising that these must be homework questions, he turned in his `solution' and was surprised to learn that these where actually open questions related to the famous Neyman and Pearson lemma.

3 - Efficiency of the Simplex and Policy Iteration Methods for Markov Decision Processes
Yinyu Ye, Professor, Stanford University, Huang 308, Stanford, CA, 94025, United States of America, yyye@stanford.edu

We prove that the simplex method with the most-negative-reduced-cost pivoting rule is a strongly polynomial-time algorithm for solving discounted Markov decision processes (MDP) of any fixed discount factor. This is surprising since almost all such results on the simplex method are negative, while in practice it is widely successful. We also present a result to show that the simplex method is strongly polynomial for solving deterministic MDPs regardless of discount factors.

■ MC09

Hilton- Continental 6

Appointment Scheduling Models

Sponsor: Manufacturing & Service Operations Management/Healthcare Operations

Sponsored Session

Chair: Sarang Deo, Assistant Professor, Indian School of Business, Hyderabad, 500032, India, sarang_deo@isb.edu

1 - Dynamic Patient Scheduling For a Multi-Appointment Health Care Program
Adam Diamant, Adam.Diamant09@Rotman.Utoronto.Ca, Joseph Milner, Fayez Quereshy

We formulate a Markov Decision Process to dynamically schedule patients to appointments in a pre-surgical health care setting. Patients have a series of appointments, undergoing multiple assessments prior to being eligible for surgery. There are a significant numbers of no-shows. We use approximate dynamic programming to develop several heuristic policies and compare them via simulation. We apply our results to a dataset collected from a bariatric surgery clinic at a large hospital in Toronto.

2 - Combining the Advanced and Appointment Scheduling Problems
Jonathan Patrick, Associate Professor, University of Ottawa, 55 Laurier Avenue, Ottawa, ON, K2G 3A6, Canada, patrick@telfer.uottawa.ca, Antoine Sauré, Mehmet Begen

Appointment scheduling and advanced scheduling have generally been addressed as two separate problems despite being highly dependent on each other. We present work in which we attempt to join these two problems together by taking advantage of past work by the authors on both problems.

3 - Stochastic Scheduling for Chronic Care
Armagan Bayram, Northwestern University, 2145 Sheridan Road, Evanston, IL, United States of America, abayram@northwestern.edu, Seyed Iravani, Karen Smilowitz, Sarang Deo

We present a study motivated by an ongoing collaboration with a mobile asthma care provider. Our study focuses on appointment allocation rules by considering stochastic nature of the problem. Using actual data and integrating it into a stochastic dynamic framework, we identify some results on optimal appointment allocation rules.

■ MC10

Hilton- Continental 7

New Advancements in Classic Inventory Problems

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Li Chen, Associate Professor, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, li.chen@duke.edu

Co-Chair: Jing-Sheng Song, Professor, Duke University, 100 Fuqua Drive, Durham, United States of America

1 - Serial Inventory Systems with Markov-Modulated Demand: Derivative Analysis, Solution Bounds, Insight
Yue Zhang, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, yueyue.zhang@duke.edu, Li Chen, Jing-Sheng Song

We derive bounds for the optimal policies for serial inventory systems with markov-modulated demand (MMD). Our bounds generalize the existing newsvendor bounds for serial systems with stationary demand. We further prove that the relative errors between our bounds and the optimal solutions converge to zero as the lead time increases, with the rate of convergence being square root of the lead time.

2 - Conveying Demand Information in Serial Supply Chains with Capacity Limits
Rodney Parker, The University of Chicago, Booth School of Business, Chicago, IL, 60637, United States of America, rodney.parker@chicagobooth.edu, Roman Kapuscinski

We construct two mechanisms to manage inventory in serial multi-echelon systems subject to production capacity limits which utilize local knowledge only. We demonstrate that these mechanisms (which differ based on timing assumptions) can replicate the known optimal and equilibrium policies. That is, sufficient information about the market demand is conveyed through the orders only. Also, a strong relationship between the mechanisms is demonstrated for channels of differing lengths.

3 - Optimal Policies for Assembly Systems: Completing Rosling's Characterization
Alp Muharremoglu, Associate Professor, University of Texas at Dallas, Richardson, TX, United States of America, alp@utdallas.edu, Shaokuan Chen

We study an assembly system, the model studied in Rosling (1989), one of the classical papers in inventory theory. Rosling characterized the optimal policy as a balanced echelon base stock policy, assuming that the initial state of the system possesses a "long-run balance" property. We characterize the optimal policy starting with any arbitrary initial state. The optimal policy is essentially a balanced echelon base stock policy, but with dynamically evolving echelon base stock levels.

4 - Measuring the Bullwhip Effect with Material Flow Data: Biases and Remedies
Wei Luo, IESE Business School, Av. Pearson 21, Barcelona, Spain, wluo@iese.edu, Li Chen, Kevin Shang

This paper concerns the accuracy of estimating bullwhip effect with material flow data in serial supply chains. We derive conditions under which overestimation occurs and characterize four driving factors: stocking level, lead time, supply chain location, and demand correlation. We also provide simple remedies to correct such biases based on the sample autocovariances of the sales and shipment data.

■ MC11

Hilton- Continental 8

Incentives for Socially-beneficial Goods

Sponsor: Manufacturing & Service Operations Management/Supply Chain

Sponsored Session

Chair: Terry Taylor, Associate Professor, U.C. Berkeley, Haas School of Business, 2220 Piedmont Ave., Berkeley, CA, 94720, United States of America, taylor@haas.berkeley.edu

Co-Chair: Wenqiang Xiao, NYU, 44 W 4th St, New York, United States of America, wxiao@stern.nyu.edu

1 - Demand vs. Supply-side Investment in Humanitarian Operations

Karthik Natarajan, Carlson School of Management, 321 19th Ave South, minneapolis, MN, 55454, United States of America, knataraj@umn.edu, Jayashankar Swaminathan

Both supply- and demand-side constraints impact program coverage in humanitarian settings. We study the problem of identifying the optimal mix of supply- and demand-side investments in a budget-constrained environment and offer insights into the impact of supply- and demand-side parameters on the investment mix. We also consider a decentralized setting where demand mobilization activities are contracted to a third party and identify coordinating performance-based contracts.

2 - Subsidizing New Technology with a Strategic Supplier: Commitment vs. Flexibility

Ruben Lobel, University of Pennsylvania, 3730 Walnut St, JMHH - suite 500, Philadelphia, PA, 19104, United States of America, rlobel@wharton.upenn.edu, Jonathan Chemama, Maxime Cohen, Georgia Perakis

We study how policy adjustments in subsidy programs (e.g. solar panels) interact with production decisions. We model the interaction between a government and an industry player in a two-period game setting under uncertain demand. We show how the timing of decisions will affect the cost of the subsidy program. In particular, we show that when the government commits to a fixed policy, it spends less on the subsidy program because it signals the supplier to produce more in the earlier stage.

3 - Fleet Management Coordination in Decentralized Humanitarian Operations

Sameer Hasija, Assistant Professor of Technology and Operations Management, INSEAD, 1 Ayer Rajah Avenue, Singapore, Si, 138676, Singapore, Sameer.Hasija@insead.edu, Alfonso Pedraza-Martinez, Luk Van Wassenhove

We study incentive alignment for the coordination of operations in humanitarian settings. The incentive alignment issue is complex because traditional instruments based on financial rewards and penalties are not considered to be viable options. This problem is further complicated by information asymmetry in the system due to the dispersed geographical locations of the parties. We design a novel mechanism based on an operational lever to coordinate incentives in this setting.

4 - Donor Product-Subsidies: Implications of Consumer Awareness and Profit-maximizing Intermediaries

Wenqiang Xiao, NYU, 44 W 4th St, New York, United States of America, wxiao@stern.nyu.edu, Terry Taylor

In the developing world, consumption of socially-desirable products (e.g., recommended malaria drugs) depends on consumers' awareness of their benefits and prevailing prices. This paper studies how the consumer awareness level and the presence of profit-maximizing intermediaries in the distribution channel influences how donors should design subsidies for such products.

■ MC12

Hilton- Continental 9

Green Business Models and Strategies

Sponsor: Manufacturing & Service Operations Management/Sustainable Operations

Sponsored Session

Chair: Ioannis Bellos, Assistant Professor, George Mason University, 4400 University Drive, MS 5F4, Fairfax, VA, 22030, United States of America, ibellos@gmu.edu

1 - Bike Share: Accessibility and Availability Tradeoff

Ashish Kabra, INSEAD, Boulevard de Constance, Fontainebleau, 77305, France, Ashish.Kabra@insead.edu, Karan Girotra

We study bike-share systems as implemented in large cities such as Paris, London, New York. We develop a structural empirical model that captures the elasticity of user demand w.r.t. distance to a station as well as long-term and short-term effects of service level. We find that station designs denser than the current designs can increase ridership by as much as 9% in Velib'.

2 - Measuring Consumer Willingness-to-Pay for Socially Responsible Products

Leon Valdes, PhD Student, Massachusestts Institute of Technology, Sloan School of Management, Boston, MA, 02142, United States of America, lvaldes@mit.edu, Tim Kraft, Karen Zheng

We study consumers' Willingness-to-Pay (WTP) for socially responsible products via an incentivized human-subject experiment. We are interested in how WTP is impacted by: (i) the effort a company exerts toward ensuring socially responsible practices within its supply chain; and (ii) the precision of the information the company presents to consumers. To better understand the motives behind consumers' decisions, we also examine the role reciprocity plays in determining consumers' WTP.

3 - Leasing vs. Selling and Product Modularity

Atalay Atasu, Associate Professor, Georgia Institute of Technology, 800 West Peachtree Street NW, Atlanta, GA, 30308, United States of America, atalay.atasu@scheller.gatech.edu, Vishal Agrawal, Sezer Ülkü

We analyze the interactions between lease-sell and product architecture (i.e., modular versus integral product design) choices of a firm. One would expect that leasing and modular product architectures would be complementary when jointly exercised. However, this combination is rarely observed in practice, with a few exceptions such as Xerox. In this paper, we investigate the drivers of this discrepancy.

4 - Toward Mass Adoption of Electric Vehicles: Impact of the Range and Resale Anxieties

Ying Rong, Assistant Professor, Shanghai Jiao Tong University, No. 535 Fahua Road, Shanghai, 200052, China, yrong@sjtu.edu.cn, Michael Lim, Ho-Yin Mak

We study the impact of two major barriers to mass adoption of electric vehicles (EVs), range and resale anxieties, on prevalent business models in the market. We find that the combinations of battery owning/leasing with enhanced charging service typically yield the best societal outcome. To induce the private sector to employ such business models, policymakers should carefully rebalance the surplus from consumers to the firm through proper policies.

■ MC14

Imperial B

Best Practices in Reviewing Papers

Sponsor: Junior Faculty Interest Group

Sponsored Session

Chair: Andrew Trapp, Worcester Polytechnic Institute, 100 Institute Rd., Worcester, MA, 01602, United States of America, atrapp@wpi.edu

Co-Chair: Ozgun Caliskan Demirag, Penn State Erie, 5101 Jordan Road Burke 259, Erie, PA, 16563, United States of America, ozc1@psu.edu

1 - Best Practices in Reviewing Papers

Andrew Trapp, Worcester Polytechnic Institute, 100 Institute Rd., Worcester, MA, 01602, United States of America, atrapp@wpi.edu, Ozgun Caliskan Demirag, Haresh Gurnani, Kim Needy, Ted Ralphs, J. Cole Smith

This panel discussion will focus on the best practices in reviewing scholarly articles. Panelists from different areas of OR/MS will discuss various aspects of the peer review process, including but not limited to: how to perform a constructive review, what makes a good referee report, how to respond to referees' comments, and tips for success. With live Q&A, the panel aims to help academics and research-active industry professionals alike to improve their paper-reviewing skills.

■ MC15

Hilton- Exec. Boardroom

Banking and Manufacturing Applications

Cluster: Data Envelopment Analysis

Invited Session

Chair: Kankana Mukherjee, Associate Professor, Babson College, Economics Division, 231 Forest Street, Babson Park, MA, 02457, United States of America, kmukherjee@babson.edu

1 - Operational Efficiency of Bank Branches: Evidence from Indian Banking

Kankana Mukherjee, Associate Professor, Babson College, Economics Division, 231 Forest Street, Babson Park, MA, 02457, United States of America, kmukherjee@babson.edu, Abhiman Das, Subhash Ray

In this study, we examine the efficiency of branches located in the main metropolitan Indian cities of a major Indian bank with national presence. We utilize Data Envelopment Analysis to analyze data for the year 2007. We conceptualize the role of bank branches along the production approach and estimate a non-radial input-oriented Russell type measure of efficiency with a special focus on labor use.

2 - Variable Selection Techniques for DEA – An Empirical Case from a Retail Bank

Juha Eskelinen, Dr., Aalto University, School of Business, P.O.Box 21220, 00076 Aalto, Helsinki, Finland, juha.p.eskelinen@aalto.fi

If there are too few units compared to inputs and outputs, the nonparametric efficiency evaluation suffers from lack of discrimination. Various statistical techniques have been proposed to support the variable selection. The variable reduction procedure of Jenkins and Anderson (2003) and the efficiency contribution measure (Pastor, Ruiz, and Sirvent, 2002) were compared in a retail bank context. They led to different interpretations of the performance complementing each other.

3 - Overcoming the Shortcomings of Energy Intensity Index: An Application on Japanese and Chinese Manufacturing Industries

Osman Zaim, Dean, Faculty of Economics Administrative and Social Sciences, Kadir Has University, Central Campus, Kadir Has Cad. Cibali, Istanbul, 34083, Turkey, osman.zaim@khas.edu.tr

In multilateral comparisons of environmental performance over time, energy intensity measures especially "real" energy intensity computed by index decomposition approach is one of the most commonly used measure. While its intuitiveness and computational ease make this index an attractive one, its time series properties create considerable challenges in performing informative and fair comparisons among the energy efficiency levels of units considered. The theoretical part of this paper shows how one can overcome the shortcomings of the energy intensity measure by constructing a new energy index using directional technology distance functions. The new index constructed in this study not only overcomes the shortcomings of the energy intensity measures but also satisfies the axiomatic properties of index numbers that are laid down by Fisher. An empirical application on Japanese and Chinese manufacturing industries further complements existing studies.

■ MC16

Hilton- Franciscan A

Mitigating Supply Risk

Sponsor: M&SOM/ iForm (Interface of Finance, Operations, and Risk Management)

Sponsored Session

Chair: Sammi Yu Tang, Assistant Professor, University of Miami, 5250 University Drive, Coral Gables, FL, 33146, United States of America, ytang@miami.edu

1 - Does Punishment Work? On the Value of Buyer's Commitment in Supplier's Dynamic Improvement

Morteza Pourakbar, Rotterdam School of Management, Erasmus University, BurgMeester Oudlaan 50, 3000 DR, Rotterdam, Netherlands, mpourakbar@rsm.nl, Mehmet Gumus, Saied Samiedaluie, Mohammad Nikoofal

There are evidences suggesting that the stability in buyer-supplier relationship influences supplier commitment to improve its reliability. We develop models allowing the supplier to improve its reliability through offering punishment and commitment contracts. Our analysis reveals that punishment contract is more effective in incentivizing supplier to improve its reliability.

2 - Quality in Downstream Supply Chain Encroachment

Xiaoyang Long, HKUST, LSK Building, Clear Water bay, Kowloon, Hong Kong - PRC, xlongaa@ust.hk, Albert Ha, Javad Nasiry

We incorporate quality as an operational consideration in downstream supply chain encroachment decision by a manufacturer. We show that the retailer is always worse off if the manufacturer determines the quality of the product to sell through the two channels. Further, in contrast to conventional understanding, we show that product differentiation is not always in the best interest of the retailer and this practice can negatively affect the retailer.

3 - Operational Strategies under Consumer-Driven Bankruptcy

Michelle Xiao Wu, University of Chicago, wuxiao.nw@gmail.com, John Birge, Rodney Parker, S. Alex Yang

Financially distressed retailers are often forced to run liquidation sales. Traditional and social media enable consumers to be better informed of these sale opportunities and time their purchases strategically. We show that strategic waiting in anticipation of a potential liquidation sale can exacerbate a firm's current financial distress significantly.

4 - Farm-yield Management When the Production Rate is Yield Dependent

Kwan Eng Wee, Singapore Management University, 50 Stamford Road #04-01, Singapore, 178899, Singapore, kewee@smu.edu.sg, Onur Boyabatli

This paper analyzes the impact of farm-yield uncertainty when the unit production rate is yield dependent. We model a firm that procures an input through a contract in advance of the selling season; and through the open market on the day in a single period so as to maximize its expected profit. We investigate the impact of yield uncertainty on the optimal contract volume and the profitability of the firm, and underline the role of yield-dependent production rate on our results.

5 - Production Chain Disruption: Inventory and Interruption Insurance

Sammi Yu Tang, Assistant Professor, University of Miami, 5250 University Drive, Coral Gables, FL, 33146, United States of America, ytang@miami.edu, Lingxiu Dong, Brian Tomlin

We analytically explore the use of BI insurance and inventory to mitigate disruption risk in a multi-stage production chain. We characterize the firm's optimal insurance policy-the deductible and coverage limit-and the optimal inventory level at each stage. We examine the interaction between insurance and inventory investments.

■ MC17

Hilton- Franciscan B

Pricing and Strategic Behavior in Queueing Systems

Sponsor: Manufacturing & Service Operations Management/Service Operations

Sponsored Session

Chair: Philipp AfËche, Rotman School of Management; University of Toronto, 105 St.George Street, Toronto, Canada, Philipp.Afeche@Rotman.Utoronto.Ca

1 - Paying More to Get it Faster: When Should it be Considered?

Tava Olsen, Professor, University of Auckland, 12 Grafton Road, Auckland, New Zealand, t.olsen@auckland.ac.nz, Riccardo Mogre

In this study, we identify efficient expediting policies, explicitly quantifying the cost reduction ensuing from the use of expediting. We also investigate the relationship between expediting and the ability to offer express orders, shedding new light on how expediting policies could be strategic for companies. Finally, we consider the interaction of such policies with the offering of super-saver discounts and how this interaction affects a company's revenues and costs.

2 - Revenue Maximization for Cloud Computing Services

Cinar Kilcioglu, Columbia Business School, ckilcioglu16@gsb.columbia.edu, Costis Maglaras

We study a stylized model of revenue maximization for cloud computing services. We analyze price data traces from the biggest cloud service provider, Amazon, providing some possible explanation for price spikes based on intuitive asymptotic analysis arguments in systems with large capacity and large market potential. We study the service provider's revenue maximization problem in an infinite capacity system and in a market with heterogeneous customers.

3 - Signaling Quality via Price or Wait Time?

Laurens Debo, Associate Professor, University of Chicago, 5807 S Woodlawn Ave, Chicago, IL, 60637, United States of America, laurens.debo@chicagobooth.edu, Uday Rajan, Senthil Veeraraghavan

When the quality of a capacitated service is not known to a fraction of the potential market, not only the price, but, also congestion (wait time) can signal high quality. Ex ante, it is not clear whether short or long wait times are signals of high quality. We study this question via the analysis of a queuing-game theoretic model. We find that the degree of convexity of the cost of capacity is a main determinant of the direction of distortion of a firm's waiting time to signal quality.

4 - Rational Abandonment from Priority Queues: Equilibrium Strategy and Pricing Implications

Vahid Sarhangian, Rotman School of Management; University of Toronto, 105 St.George Street, Toronto, ON, Canada, vahid.sarhangian11@rotman.utoronto.ca, Philipp AfËche

The literature on the economics of queues predominantly focuses on the queue-joining decisions of customers and ignores subsequent abandonment decisions. Such abandonment behavior is particularly important in priority queues, which are quite prevalent in practice. We study the equilibrium joining and abandonment behavior of utility-maximizing customers in the context of an observable two-class priority queue and identify novel pricing implications.

■ MC18

Hilton- Franciscan C

Practice-driven Revenue Management I

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: So Yeon Chun, Assistant Professor, McDonough School of Business, Georgetown University, 3700 O St NW, Washington, United States of America, sc1286@georgetown.edu

1 - Dynamic Management of Loyalty Programs

Dan Iancu, Stanford Graduate School of Business, 655 Knight Way, Stanford, United States of America, daniancu@stanford.edu, So Yeon Chun, Nikos Trichakis

We formulate a model that can guide the dynamic management of loyalty and reward programs. Our model touches on several important considerations that arise in practice, including accounting, financial and marketing functions, and discusses how these influence and are influenced by revenue management.

2 - Understanding Markdown Recommendations Overriding

Felipe Caro, Associate Professor, UCLA Anderson School of Management, fcaro@anderson.ucla.edu

Since 2008, Zara has been using a model-based process to support its markdown decisions during clearance sales. We study the adoption of the tool by the country managers and analyze the impact that key user interface modifications have had on pricing decisions.

3 - Personalized Bundle Recommendations: A Data-Driven Online Sales Approach

Anna Michelle Papush, Massachussetts Institute of Technology, Cambridge, MA, United States of America, apapush@mit.edu, Pavithra Harsha, Georgia Perakis

With the continuously growing trend in online shopping and sales, the development of a more sophisticated product recommendation system can provide the necessary competitive edge for any Internet retailer. By considering this problem from a new angle, this work presents a model that combines both diverse recommendations and personalized pricing based on a consumer's purchase history and inventory at risk of being marked down.

4 - Strategic Consumers, Revenue Management and the Design of Loyalty Programs

So Yeon Chun, Assistant Professor, McDonough School of Business, Georgetown University, 3700 O St NW, Washington, United States of America, sc1286@georgetown.edu, Anton Ovchinnikov

We study an interaction between revenue management and premium-status (e.g., Gold) loyalty program, and the role of strategic consumers. We compare volume-based and spending-based designs and show that when coordinated with revenue management, how the loyalty program allows the firm to benefit from the behavior of strategic consumers who would fly/spend more in order to qualify for the premium-status.

■ MC19

Hilton- Franciscan D

New Applications in Pricing and Revenue Management

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Mehmet Sekip Altug, Assistant Professor, George Washington University, School of Business, Washington, DC, 20052, United States of America, maltug@gwu.edu

1 - Quality and Pricing Decisions when Consumers Perceive Recycled Content Differently

Monire Jalili, PhD Student, University of Oregon, 1208 University of Oregon, Eugene, OR, 97405, United States of America, mjalili@uoregon.edu, Tolga Aydinliyim, Nagesh Murthy

We consider a monopolist selling ordinary and green product variants to consumers whose differential (dis)utility vary by consumer type, and is a function of the firm's quality decision (i.e., the amount of recycled content.) We discuss how the optimal quality and pricing decisions drive demand and profit.

2 - Loss Aversion and the Uniform Pricing Puzzle

Javad Nasiry, Assistant Professor, HKUST, LSK Building, HKUST, Hong Kong, Hong Kong - PRC, nasiry@ust.hk, Pascal Courty

We develop a behavioral model based on loss aversion to explain why a monopolist may sell high quality products at the same price as low quality ones despite the fact that quality is perfectly observable and that there are no obvious costs of adjusting prices.

3 - A Behavioral Study of Capacity Allocation in Revenue Management

Bahriye Cesaret, PhD Student, The University of Texas at Dallas, 800 West Campbell Road SM 30, Richardson, TX, 75080, United States of America, bahriye.cesaret@utdallas.edu, Elena Katok

We present a set of laboratory experiments that investigate how human subjects solve the two-class capacity allocation revenue management problem. We study the problem with ordered and unordered arrival, as well as a simplified version - making an upfront decision at the beginning of the selling season. We find that making decisions up-front improves (resp., does not hurt) performance in the ordered (resp., unordered) arrivals case. We also identify several behavioral regularities.

4 - The Impact of Endogenous Secondary Markets on Retailer's Profitability

Mehmet Sekip Altug, Assistant Professor, George Washington University, School of Business, Washington, DC, 20052, United States of America, maltug@gwu.edu, Garrett van Ryzin

One of the main assumptions in the newsvendor model is that the salvage value is exogenous and that retailers can sell their excess stock at this fixed salvage value. However, in retailing, the salvage value of excess stock is mostly determined endogenously in secondary markets by firms and that raises several interesting questions such as the value of consolidated vs. firm-specific secondary markets. We analyze these questions using a stylized model with an endogenous secondary market.

■ MC20

Hilton- Yosemite A

Joint Session Analytics/CPMS: Business Analytics in Higher Education Industry

Sponsor: Analytics & CPMS, The Practice Section

Sponsored Session

Chair: Roger Gung, Sr. Manager of Business Analytics and Optimization, University of Phoenix, 4025 S Riverpoint Parkway, Phoenix, AZ, 85040, United States of America, roger.gung@phoenix.edu

1 - Marketing Mix Optimization

Roger Gung, Sr. Manager of Business Analytics and Optimization, University of Phoenix, 4025 S Riverpoint Parkway, Phoenix, AZ, 85040, United States of America, roger.gung@phoenix.edu, Hussain Khaleeli, Suxing Zeng, Jason Holechek

Marketing spend allocation drives the volume of new marketing inquiries (NMI) and enrollments. Two-stage non-linear regression models were built to formulate NMI channels with respect to marketing spends which were defined as either endogenous, exogenous or instrument variables. The optimization model was formed by aggregating all NMI channels' regression models into one objective function. The optimal spend allocation was then derived from the model every quarter to guide marketing strategies.

2 - New Degree Enrollments Forecasting Model
Yun Ouyang, Operations Research Scientist, University of Phoenix, 4025 S Riverpoint Parkway, Phoenix, AZ, 85040, United States of America, yun.ouyang@phoenix.edu, Roger Gung, Suxing Zeng

New Degree Enrollments forecasting has been one of the keys for revenue management in higher education industry. We developed semi-parametric regression-based survival models to forecast enrollments for given market inquiries and registrations. We applied time-dependent variables to handle holidays and breaks where enrollments are pushed to the subsequent weeks. We compared K-M plot and fitted curve to check in-sample performance and performed holdout test to evaluate out-sample performance.

3 - Lifetime Value Modeling
Suxing Zeng, Operations Research Scientist, University of Phoenix, 4025 S Riverpoint Pkwy, Phoenix, AZ, 85040, United States of America, suxing.zeng@phoenix.edu, Roger Gung, Jason Holechek

Existing students' lifetime value has been one of the keys for revenue management in higher education industry. We developed semi-parametric regression-based survival models to estimate each student's expected lifespan, starting from the Degree Enrollments. We applied the results to profile students by attributes, and identified successful students and value propositions for the University.

4 - Analytics Framework for Higher Education
Grace Lin, VP, Advanced Research Institute, Institute for Information Industry, No. 133, Section 4, Minsheng East Road, Taipei, 105, Taiwan - ROC, gracelin@iii.org.tw

We present an end-to-end anlytics framework for higher education industry that covers solution methods with using big data for the management on enrollments, learning platform, academic performance and institutional finance.

■ MC21

Hilton- Union Sq 1

Freight Fleets Logistics and Management

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Ilke Bakir, PhD Student, Milton H. Stewart School of Industrial and Systems Engineering, Georgia Institute of Technology, Atlanta, GA, United States of America, ilkebakir@gatech.edu

1 - Third Party Logistics Planning and Production Scheduling Integration
Farshid Azadian, Assistant Professor, Embry Riddle Aeronautical University, College of Business, 600 S Clyde Morris Blvd., Daytona Beach, FL, 32114, United States of America, azadianf@erau.edu, Ratna Babu Chinnam, Alper Murat

We address the operational problem of a make-to-order contract manufacturer that seeks to integrate production scheduling and transportation planning under commit-to-delivery model. The manufacturer produces customer orders on unrelated parallel processors, accounting for release dates and sequence dependent setup times. Set of shipping options with different costs and transit times is available for order delivery. The objective is to minimize total cost, including delivery tardiness penalties.

2 - Stochastic Auto-Carrier Loading Problem
Benita Mordi, PhD Student, Texas A&M University, College Station, TX, United States of America, bmordi@tamu.edu, Saravanan Venkatachalam, Lewis Ntaimo

This talk presents the tactical planning regarding the number and type of auto-carriers required under uncertainty in the demand of vehicles. This auto-carrier loading problem considers actual dimensions of the vehicles, regulations on total height of the auto-carriers and maximum weight of the axles, and safety requirements. The problem is modeled using two-stage stochastic integer programming and preliminary results using real data are presented.

3 - Outbound Logistics Optimization Coordinating Production-Distribution and Vehicle Routing Decisions
Gopalakrishnan Easwaran, United States of America, geaswaran@stmarytx.edu, Halit Uster

We consider an integrated approach to coordinate aggregate level production-distribution planning and operational level weekly vehicle route planning for outbound trucks from a production facility. We present a heuristic framework with production/inventory, vehicle routing, and multi-objective shipment splitting modules as well as computational results and analysis illustrating efficiency of the approach.

4 - Greening the Fleet with Alternative Fuel Long-Haul Trucks
Ilke Bakir, PhD Student, Milton H. Stewart School of Industrial and Systems Engineering, Georgia Institute of Technology, Atlanta, GA, United States of America, ilkebakir@gatech.edu

Recent increase in environmental concerns and petroleum prices initiated effort for transitioning to alternative fuel long-haul trucks. But fleet replacement planning under strict operational requirements remains a challenge. We present a fleet replacement model for greening the fleet while maintaining feasible operations, and propose a decomposition-based solution approach that provides economically justifiable replacement plans for the transition from a petroleum-fueled fleet to a greener one.

■ MC22

Hilton- Union Sq 2

Application of Machine Learning in Transportation

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Mahdieh Allahviranloo, PhD Candidate, University of California Irvine, 4000 Anteater Instruction and Research B, Irvine, CA, 92697, United States of America, mallahvi@uci.edu

1 - Proactive Vehicle Routing with Inferred Demand to Solve the Bike Sharing Rebalancing Problem
Robert Regue, PhD Candidate, University of California Irvine, 4000 Anteater Instruction and Research B, Irvine, CA, 92697, United States of America, rreguegr@uci.edu

We use gradient boosting machines as a forecasting technique to feed a dynamic routing problem to rebalance a bike sharing system. The use of anticipated demands turns it into a proactive rather than responsive approach and increases system level of service and customer satisfaction.

2 - Closed-Loop Optimal Traffic Control using Reinforcement Learning: Traffic Signal and Ramp Control
Baher Abdulhai, Professor, Department of Civil Engineering, University of Toronto, 35 St. George St., #105, Toronto, ON, M5S 1A4, Canada, baher.abdulhai@utoronto.ca, Samah El-Tantawy, Kasra Rezaee

Optimal traffic control is the most environmentally sustainable and plausible solution to the today's traffic system's extensive congestion. We present a decentralized approach to optimal Ramp Metering, to control the entrance flow to freeways, and Adaptive Traffic Signal Control, to control the flow on surface streets, based on Reinforcement Learning and Game Theory. Evaluations of the methods using a high fidelity computer model of Downtown Toronto resulted in significant travel time savings.

3 - Data Mining Application to Infer Individuals' Activity Type, Socio-economic Attributes By GPS Data
Mahdieh Allahviranloo, PhD Candidate, University of California Irvine, 4000 Anteater Instruction and Research B, Irvine, CA, 92697, United States of America, mallahvi@uci.edu

Using boosting techniques we predict activity types and their sequence given only spatial-temporal data for southern California. Activity patterns are clustered to study the statistical distributions of socio-demographic characteristics for further pattern inferences. We compare the predicted spatial-temporal distribution of activities in the network with the observed pattern in TransCad. The methodology can be used to mine large amount of historical location data generated by smart devices.

■ MC23

Hilton- Union Sq 3

Multimodal Transportation

Sponsor: TSL/Freight Transportation & Logistics

Sponsored Session

Chair: Irina Benedy, birina@purdue.edu

1 - Scenario-based Dynamic Model of Investment Decision Process for Multimodal Freight Facilities Under Stochastic Demand
Irina Benedy, birina@purdue.edu, Srinivas Peeta, Hong Zheng, Ananth Iyer, Yuntao Guo

Shift in world trade patterns and changes in the U.S. import/export commodity flows leads to demand uncertainty for multimodal freight facilities. This issue leads to an investment decision problem both for construction of new facilities and upgradation of existing ones. We use a dynamic model to formulate the investment decision process and investigate policy insights under various sources of perturbation.

2 - Integrated Intermodal Network Design Considering Non-linear Transportation Costs

Mohammad Ghane-Ezabadi, Graduate Research Assistant, Oregon State University, 204 Rogers Hall, Corvallis, OR, 97321, United States of America, ghaneezm@onid.oregonstate.edu, Hector A. Vergara

Logistics network topology has a significant effect on decisions at the tactical and operational levels in intermodal transportation systems. In this research study, decisions on route and mode selection are integrated within the mathematical formulation of the hub location problem to improve the performance of the intermodal transportation system as a whole. A heuristic that takes advantage of both genetic algorithms and the shortest path algorithm is applied to solve several instances of this problem in reasonable times. Heuristic solutions are compared to optimal solutions in small instances to evaluate the performance of the proposed solution method.

3 - Impact of ETA on the Capacity Utilization of the Actors in the MTC - A Simulation Based Approach

Fabian Walter, Chair of Management and Logistics, Technische Universität Darmstadt, Hochschulstr. 1, Darmstadt, D-64289, Germany, walter@bwl.tu-darmstadt.de, Ralf Elbert

In maritime transport chains (MTC) each actor needs to improve his capacity utilization. For the intermodal operator (IO) no containerized estimated time of arrival (ETA) exists. With increasing container vessel capacity, for IO decision on container disposition, this inter-related data have great influence. We gathered 261,361 real container based data. The results of a monte carlo simulation show, that based on ETA information IO can significantly improve the utilization of container wagons.

4 - Shipper Attitudes for Container Transportation on the North Sea Route

Irina Benedy, birina@purdue.edu, Srinivas Peeta

This study seeks to explore opportunities and barriers for freight shippers to use the North Sea Route. A stated preference survey is conducted for freight shippers in East Asia and Europe. Econometric models are used to investigate the attitudes towards the usage of the North Sea Route, and identify key factors which influence them.

■ MC24

Hilton- Union Sq 4

Network Science and Transportation

Sponsor: TSL/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Alireza Khani, Postdoctoral Fellow, University of Texas at Austin, 1616 Guadalupe St, Suite 4.202, Austin, TX, 78701, United States of America, akhani@utexas.edu

1 - An Efficient Algorithm for Solving Reliable Shortest Path Problem

Alireza Khani, Postdoctoral Fellow, University of Texas at Austin, 1616 Guadalupe St, Suite 4.202, Austin, TX, 78701, United States of America, akhani@utexas.edu, Stephen Boyles

The efficient frontier for the solution of path problem with minimum Mean and Std. Deviation (P1) is shown to be similar to those of path problem with minimum Mean and Variance (P2). An algorithm is developed to efficiently search in the P2 frontier and find the optimal solution for P1.

2 - An Algorithm for Non-additive Shortest Path Problem

Mehrdad Shahabi, mshahabi@mix.wvu.edu, Avinash Unnikrishnan, Stephen Boyles

An outer approximation algorithm has been customized for solving the multi-attribute non-additive shortest path problem. Theoretically, outer-approximation is capable of providing the exact global solution for problems with convex travel cost functions. Numerical experiments based on different utility functions show the promising performance of the outer-approximation in handling large size problems.

3 - Measures of Travel Time Variability of Emergency Vehicles on Arterials

Qing He, University at Buffalo (SUNY), 225 Ketter Hall, Buffalo, NY, 14260, United States of America, qinghe@buffalo.edu, Zhenhua Zhang, Jizhan Gou, Xiaoling Li

Travel time is very critical for emergency vehicle (EV) operations. This study obtains 2.5 year EV travel time data in North Virginia using preemption records at the signalized intersections. A utility-based model is proposed to measure the travel time reliability of the road links and several assumptions are made and validated.

4 - A Double-queue Model and Its Applications in Dynamic Network Modeling

Xuegang (Jeff) Ban, Associate Professor, RPI, 110 8th Street, Room JEC 4034, Troy, NY, 12180, United States of America, banx@rpi.edu, Rui Ma

A double-queue model was recently introduced in the literature to model traffic flow dynamics of a network link. The model captures realistic congestion effects such as queue spillbacks in a simplified mathematical framework. Some theoretical and numerical results of the model are presented. Applications of the model in dynamic network modeling problems are also discussed.

■ MC25

Hilton- Union Sq 5

Recent Advances in Day to Day Traffic Assignment

Sponsor: TSL/Urban Transportation

Sponsored Session

Chair: Xiaozheng He, NEXTRANS, 3000 Kent Ave, West Lafayette, IN, 47906, United States of America, seanhe@purdue.edu

1 - A Marginal Utility Day-to-Day Traffic Assignment Model

Xiaozheng He, NEXTRANS, 3000 Kent Ave, West Lafayette, IN, 47906, United States of America, seanhe@purdue.edu, Srinivas Peeta

Inspired by the marginal decision rule in economics, this study proposes a conceptual shift in the definition of rationality in the modeling of day-to-day traffic evolution. A new marginal utility day-to-day traffic evolution model is developed by additionally introducing the notion of marginal cost rather than just the notion of marginal benefit considered in classical day-to-day traffic evolution models. Theoretical properties of the proposed model are rigorously analyzed.

2 - Day-to-Day Dynamics in a Traffic Network under Bounded Rationality

Srinivas Peeta, Professor, Purdue University, 550 Stadium Mall Drive, West Lafayette, IN, 47907, United States of America, peeta@purdue.edu, Amit Kumar, Xiaozheng He

We develop a dynamical system based model to represent the evolution of path flows resulting from the day-to-day dynamics in traffic disequilibrium under static demand. The proposed model is based on the proportional-switch adjustment process under the assumption of bounded rationality. The solution methodology is discussed and computational results are presented for a study network.

3 - Approximation Methods for a Link-based Day-to-Day Traffic Assignment Model

Jian Wang, Ph.D student, Purdue University, 3000 Kent Ave, West Lafayette, IN, 47906, United States of America, wang2084@purdue.edu, Xiaozheng He, Srinivas Peeta

Seeking to reduce the high computational cost for analyzing traffic evolutionary characteristics, this study proposes four sensitivity-analysis-based approximation approaches for a link-based day-to-day traffic assignment model. Sufficient conditions for applying these four approaches are identified. Numerical examples show that they can approximate well the link flow evolutionary trajectory when the sufficient conditions are satisfied.

■ MC26

Hilton- Union Sq 6

New Directions in Location Research

Sponsor: Location Analysis

Sponsored Session

Chair: Dmitry Krass, Professor, Rotman School of Management, Univ. of Toronto, 105 St. George St., Toronto, ON, M5S 3E6, Canada, krass@rotman.utoronto.ca

1 - Discrete Budget Allocation in Competitive Facility Location

Tammy Drezner, California State University, Fullerton, CA, United States of America, tdrezner@fullerton.edu, Zvi Drezner

The competitive location problem using the gravity model with a limited budget constraint to improve the attractiveness of existing facilities and locating new ones is considered. The problem is optimally solved by assigning budgets which are multiples of a basic budget unit such as multiples of 0.1% of the available budget.

2 - Dynamic Long-Term Planning of Ambulance Locations and Assignments

Oleksandr Shlakhter, Senior Researcher, Alberta Health Services, 10030-107 Street, Edmonton, AB, T5J 3E4, Canada, alex.shlakhter@rotman.utoronto.ca, Dmitry Krass

In this paper we analyze Emergence Medical Services (EMS) with stochastic dynamic demand. We present new perspectives on the problem of long-term planning of emergency medical services, including station locations and ambulance assignments. The problem is formulated as multi-period location/queueing model with two non-preemptive priority classes of events (calls), with each class consisting of two types of events: events which require transport to a hospital and events without transport.

3 - Competitive Location Models and Comparison Shopping

Vladimir Marianov, Professor. Department of Electrical Engineering., Pontificia Universidad CatÛlica de Chile, Av. Vicuña Mackenna 4860. Macul., Santiago, 7820436, Chile, marianov@ing.puc.cl, HA Eiselt

Customers searching for a product require comparing at least two varieties sold by different competing facilities before purchasing. A new firm enters the market and competes with the existing firms. A mathematical optimization model is formulated that maximizes the market share of a new firm that enters the market.

4 - A Competitive Location Model with Multipurpose Shopping

HA Eiselt, professor, University of New Brunswick, Fredericton, NB, Canada, haeiselt@unb.ca, Vladimir Marianov

In contrast to traditional competitive location models, customers in our model purchase two goods at existing firms. A new firm then enters the market and competes with one of the existing firms. We formulate a mathematical optimization problem that maximizes the market share of the new firm.

■ MC27

Hilton- Union Sq 7

Models for Fleet Management and Scheduling

Sponsor: Railway Applications

Sponsored Session

Chair: Xuesong Zhou, Associate Professor, Arizona State University, School of Sustainable Engineering and th, Tempe, AZ, United States of America, xzhou74@asu.edu

1 - An Integrated Model for Train Timetabling and Platforming in High Density Double Track Corridor

Mahendra Birhade, Nanyang Business School, Nanyang Technological University, Singapore, Singapore, Mahendra1@e.ntu.edu.sg, Rohit Bhatnagar, S Viswanathan

This paper is motivated by the train scheduling problem in high density, double track corridors. We develop a novel MIP formulation of the Integrated Train Timetabling and Platforming Problem(ITTPP). Unlike existing literature that treats Train Timetabling and Train Platforming as distinct problems, our ITTPP formulation directly generates feasible timetables. We develop two heuristic algorithms that provide close to optimal solutions for real problem sets from Indian Railways.

2 - Fleet Management in Rail Transport: Petroleum Rakes in Indian Railways

Vishal Rewari, MTech Student, IIT Bombay, IEOR Department, Roll Number- 123190002, Mumbai, MH, 400076, India, rewari.vishal@gmail.com, Raja Gopalakrishnan, Narayan Rangaraj

This paper presents a decision-support model for assignment of petroleum rakes using MILP for firm demands and a predictive method for deciding the direction of empty rake repositioning for meeting expected demands. It minimizes empty rake running while maintaining service levels for the industry taking into consideration the maintenance and rake-product compatibility constraints. It also attempts to answer long-term issues of investments in rakes and capacity of maintenance depots.

3 - Efficient Scheduling Operations for Dedicated Freight Corridors Corporation of India Ltd (DFCCIL)

Nomesh Bolia, Dr, IIT Delhi, Dept of Mechanical Egineering, IIT Delhi, New Delhi, 110016, India, nomesh@mech.iitd.ac.in, Amit Upadhyay

Empty car allocation, train formation and train scheduling are complex optimization problems for large railroads. Motivated by Indian dedicated freight corridors (DFC), an integer programming formulation of the dynamic problem of empty car allocation and train scheduling is developed by considering the unique characteristics of the DFC. A constructive heuristic is proposed as the solution method. Computational experiments show that the heuristic can provide high quality solution in a short time.

4 - Design of a Railway Network Resiliency Model

Carl Van Dyke, Managing Director, TransNetOpt, 6 Snowbird Ct, West Windsor, NJ, 08550, United States of America, carl@cvdzone.com

Railroads are complex, network enterprises, where disruptions such as the closure of a line due to flooding can cause ripple effects that impact many other parts of the network. The objective of this discussion is to provide a practical approach to modeling railroad networks that can be used to assess the impact of network disruptions to rail lines and yards, including the potential reroutes of traffic, and limitations on network throughput due to reduced network capacity.

■ MC28

Hilton- Union Sq 8

Airline Operations

Sponsor: Aviation Applications

Sponsored Session

Chair: Jon Dunsdon, Chief Technology Officer, Taleris, 2623 Camino Ramon Suite 500, San Ramon, CA, 94583, United States of America, jon.dunsdon@taleris.com

1 - Flight Trajectory Optimization

Srinivas Bollapragada, Chief Scientist, GE Global Research, One Research Circle, Niskayuna, NY, 12309, United States of America, bollapragada@research.ge.com

We developed and implemented a novel algorithm to control the trajectory of an aircraft flight to reduce the costs it incurs. Our algorithm computes the values for the parameters to be entered into the aircraft's flight management system to minimize the fuel and schedule-adherence costs incurred on the flight. We implemented it in a prototype software system that is currently in use at GE Aviation Services.

2 - Fast & Furious with Feedback: The Machine for Next-Gen Airline Operations Optimization

Julian Loren, Senior Product Manager, GE Software, 2623 Camino Ramon, San Ramon, CA, 94583, United States of America, loren@ge.com

In complex, regulated, and competitive environments, we increase return on operations by finding better solutions that consider a growing number of factors in a shrinking period of time. We chase Operational Excellence down a path of increasing pressure and constraint. In this paper, we explore pressures related to decision support at scale and approaches to alleviate them—the motivations driving our development of a fast & furious operations optimization machine with feedback mechanisms.

3 - From Reactive to Proactive: Changing the Recovery Paradigm

Jon Petersen, Operations Research Scientist, Taleris, petersej@taleris.com

While industry practitioners and academics have made advancements in managing operations under irregularity, the prevailing assumption is that decisions are made reactively only after the disruption has been revealed. By mining over a vast field of aircraft sensor data, we introduce the ability to predict aircraft failure before it occurs allowing an airline to proactively manage its operations. We discuss how optimization is used in concert with big data and show the benefit of prediction.

4 - Anomaly Detection and Prognostics for Air-Conditioning System of Commercial Aircraft

Kyungjin Moon, Analytics Engineer, Taleris, 400 W 15th St., Suite 1000, Austin, TX, 78701, United States of America, Kyungjin.Moon@taleris.com

This paper describes Taleris' on-going anomaly detection and prognostics development for the air-conditioning (AC) system of commercial aircraft. In order to detect temporal anomalous patterns of the system behavior, data-driven static models are generated to represent nominal states of the system using Quick Access Recorder (QAR) data. Then these models are used to determine the possible anomalous deviations of the system from their estimated nominal states.

■ MC29

Hilton- Union Sq 9

Joint Session Wagner/CPMS: Daniel H. Wagner Prize for Excellence in Operations Research Practice

Cluster: Daniel H. Wagner Prize for Excellence in Operations Research Practice & CPMS, The Practice Section

Invited Session

Chair: C. Allen Butler, President, Daniel H. Wagner, Associates, Inc., Hampton, VA, United States of America, Allen.Butler@va.wagner.com

1 - Daniel H. Wagner Prize

C. Allen Butler, President, Daniel H. Wagner, Associates, Inc., Hampton, VA, United States of America, Allen.Butler@va.wagner.com

The competition for the 2014 Daniel H. Wagner Prize for Excellence in Operations Research Practice resulted in six finalists, who submitted papers to the judging committee and who will present their results in three sessions . In this keynote, the winner of the competition will be announced and the authors will give a reprise of the winning presentation.

2 - Identifying Risks and Mitigating Disruptions in the Automotive Supply Chain

Don Zhang, Technical Expert, Research & Advanced Engineering, Ford Motor Company, Dearborn, MI, United States of America, xzhang35@ford.com, William Schmidt, David Simchi-Levi, Yehua Wei, Michael Sanders, Oleg Gusikhin, Yao Ge, Keith Combs, Peter Y. Zhang

Firms are exposed to a variety of low probability / high impact risks which may disrupt their operations and supply chains. These risks are difficult to predict and quantify, and therefore difficult to manage. As a result, managers may deploy countermeasures sub-optimally, leaving their firms exposed to some risks while wasting resources to mitigate other risks that would not cause significant damage. In a three-year research engagement with Ford Motor Company, we address this practical need by developing a novel risk exposure model that assesses the impact of a disruption originating anywhere in the firm's supply chain. Our approach defers the need to estimate the probability associated with any specific disruption risk until after the company learns how the realization of such a disruption will impair its operations. As a result, the company can make more informed decisions about where to focus its limited risk management resources. We demonstrate how Ford has applied this model to identify previously unrecognized risk exposures, evaluate pre-disruption risk mitigation actions, and develop optimal post-disruption contingency plans, including circumstances in which the duration of the disruption is unknown.

3 - Statistical and Optimization Techniques for Laundry Portfolio Optimization at P&G

Ivan Oliveira, SAS, 100 SAS Campus Dr, Raleigh, United States of America, ivan.oliveira@sas.com, Kevin Miller, Kevin Norwood, Ming Zhao, Nats Esquejo, Rob Pratt

The Procter & Gamble (P&G) Fabric Care business oversees a broad portfolio of products, including household brands such as Tide, Dash, and Gain. We describe a novel analytical framework that uses visual statistical tools and advanced mathematical programming methods, helping P&G determine ingredient levels and product and process architecture to create some of the world's best laundry products. This framework has provided targeted consumer benefits while enabling cost savings in the order of millions of dollars.

4 - Gerrymandering for Justice: Redistricting U.S. Liver Allocation

Sommer Gentry, Associate Professor, United States Naval Academy, 572-C Holloway Road, Mailstop 9E, Annapolis MD 21402, United States of America, gentry@usna.edu, Eric K.H. Chow, Allan Massie, Dorry Segev

U.S. policy sequesters livers from deceased donors within arbitrary geographic zones, frustrating the intent of offering livers according to medical urgency. We used a zero-one integer program to partition the U.S. into districts that minimize disparity in access to livers. Redistricting liver allocation would save hundreds of lives and make transplantation more equitable. Our redistricting concept garnered unprecedented unanimous support in the Liver Committee that manages allocation policy.

■ MC30

Hilton- Union Sq 10

Uncertainty and Cooperation

Cluster: Scheduling and Project Management

Invited Session

Chair: Nicholas G. Hall, The Ohio State University, 2100 Neil Avenue, Columbus, OH, United States of America, hall.33@osu.edu

1 - Cooperation and Contract Design in Project Management with Outsourcing

Xiaoqiang Cai, Professor, The Chinese University of Hong Kong, Dept of Systems Engineering, Shatin, NT, Hong Kong, Hong Kong - PRC, xqcai@se.cuhk.edu.hk, Nicholas G. Hall, Feng Zhang

We consider a project management problem where the prime contractor outsources tasks to a set of subcontractors, which involves (i) coordination among the subcontractors; and (ii) contract design by the prime contractor, to incentivize the subcontractors. We study the two issues by a cooperative game and a principal-agent model, respectively.

2 - Minimizing Value-at-Risk in Single-Machine Scheduling

Kerem Bulbul, Assoc. Professor, Sabanci University, Sabanci University, Orhanli, Tuzla, Istanbul, 34956, Turkey, bulbul@sabanciuniv.edu, Semih Atakan, Nilay Noyan

We consider single-machine scheduling problems with uncertain parameters. We impose a probabilistic constraint on the random outcome and introduce a generic risk-averse stochastic programming model with the objective of finding a non-preemptive static job sequence that minimizes the value-at-risk of the random outcome. Our solution approach relies on Lagrangian relaxation-based scenario decomposition with numerical results that demonstrate its efficacy and the value of the proposed model.

■ MC31

Hilton- Union Sq 11

Service Queues

Sponsor: Service Science

Sponsored Session

Chair: Alan Scheller-Wolf, Professor, Carnegie Mellon University, Tepper School of Business, Carnegie Mellon University, Pittsburgh, PA, 15213, United States of America, awolf@andrew.cmu.edu

1 - Service Outsourcing with Strategic Collaboration of Competing Servers

Ying Xu, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, yingx1@andrew.cmu.edu

This paper studies a client who outsources service tasks to two service providers. Previous work mainly focused on how to incentivize or utilize capacity investments of the servers. We extend the literature by incorporating the option of strategic collaboration between servers. Collaboration reduces waiting but dampens capacity competition, so its impact on the client is unclear. This paper studies how the client could affect the degree of collaboration via demand allocation and SLA requirements.

2 - Value-driven Load Balancing

Sherwin Doroudi, Tepper School of Business; Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, sdoroudi@andrew.cmu.edu, Esa Hyytia, Mor Harchol-Balter

To date, the study of dispatching in server farms with Processor-Sharing servers has focused on response time, where all jobs are assumed to be equally delay sensitive. Our work departs from this assumption: we model each arrival as having a randomly distributed value, independent of its size. The correct metric is no longer response time, but rather, value-weighted response time. We propose new dispatching policies and deduce many unexpected results regarding dispatching with this metric.

3 - Non-asymptotic and Asymptotic Analysis for Extended Erlang A Models

Katsunobu Sasanuma, PhD Candidate, Carnegie Mellon University, Heinz College, Carnegie Mellon University, Pittsburgh, PA, 15213, United States of America, katz@cmu.edu, Robert Hampshire, Alan Scheller-Wolf

We study an extension of the Erlang A model, which represents a system with customer abandonment under congestion-based control schemes. Our model may have either reneging or state-dependent balking, and can cope with possible adjustments to the arrival/service rates when there is a queue. We derive non-asymptotic and asymptotic Normal representations of performance indicators and discuss the congestion properties of the extended Erlang A model from non-asymptotic and asymptotic perspectives.

4 - Optimal Staffing for Sales Transaction Support Centers
Aliza Heching, IBM TJ Watson Research Center, Mathematical Sciences, Yorktown Heights, NY, 10598, United States of America, ahechi@us.ibm.com, Emre Barut

Sales transaction support centers reduce the amount of transaction work performed by sellers allowing them to spend more time with customers and increase revenue generation. Adequate staffing ensures that staff with appropriate skills is available to support incoming service requests. We describe a suite of analytical tools including hierarchical forecasting and request assignment to determine staffing requirements. These tools were deployed across multiple geographies and lines of business.

■ MC32

Hilton- Union Sq 12

Service Science Best Paper Award

Sponsor: Service Science

Sponsored Session

Chair: P K Kannan, University of Maryland, Smith School of Business, College Park, MD, United States of America, PKannan@rhsmith.umd.edu

1 - Adaptive Mobile News Personalization using Social Networks
Roland Rust, U. of Maryland, R.H. Smith School of Bus., College Park, MD, 20742, United States of America, rrust@rhsmith.umd.edu, Michel Wedel, Tuck Siong Chung

We present an adaptive personalization system for personalizing news feeds on mobile devices. It learns from an individual's reading history, automatically discovers new material as a result of shared interests in the user's social network and adapts the news feeds shown to the user. We show that using article choices from an individual's social network improves the quality of personalization, leading to more readership of the news articles provided.

2 - Managing Customer Arrivals in Service Systems with Multiple Servers
Christos Zacharias, New York University, Stern School of Business, New York, NY, 10012, United States of America, czachari@stern.nyu.edu

We analyze a discrete multi-server queueing model for scheduling customer arrivals in service systems with parallel servers. Theoretical and heuristic guidelines are provided for the effective practice of appointment overbooking to offset no-shows. The benefits of resource-pooling are demonstrated in decreasing operational costs and increasing customer throughput.

3 - Impact of Economic Uncertainty on Product Line Design and Capacity Management
Muge Yayla-Kullu, RPI Lally School of Management, 110 8th Street, Troy, NY, 12180, United States of America, YAYLAH@rpi.edu, Jennifer K. Ryan, Jayashankar Swaminathan

We study the effects of uncertainty in consumer spending due to economic volatility on the product line decisions of a firm with limited resources. We consider a firm that offers services with differing qualities, unit costs, and resource consumption rates. Consumers are heterogeneous in their purchasing behavior and the parameters of this behavior is only resolved after capacity investments are made.

■ MC33

Hilton- Union Sq 13

Managing Uncertainty in Innovation

Cluster: New Product Development

Invited Session

Chair: Pascale Crama, Assistant Professor, Singapore Management University, 50 Stamford Road, Singapore, Singapore, pcrama@smu.edu.sg

Co-Chair: Fabian Sting, Rotterdam School of Management, Erasmus University, Burgemeester Oudlaan 50, Rotterdam, Netherlands, fsting@rsm.nl

1 - University Research Funding: The Benefits of Local Knowledge
Pascale Crama, Assistant Professor, Singapore Management University, 50 Stamford Road, Singapore, Singapore, pcrama@smu.edu.sg, Anand Nandkumar, Reddi Kotha

University research is financed through university and federal funds. The federal grant application process has been shown to be biased towards older PIs and less innovative projects. We study how university funding can address this issue by using a different selection process. This is particularly valuable for young researchers and innovative projects, which fare badly in the project selection process used by federal agencies. We test our predictions with data from a Midwestern university.

2 - Identifying Overestimated Ideas in Organizations: The Case of Process Innovations
Christoph Fuchs, Rotterdam School of Management, Erasmus University, cfuchs@rsm.nl, Maik Schlickel, Fabian Sting

Drawing on a process innovation database, we find that process innovation ideas are more likely to be overestimated by their creators. The degree of overestimation is stronger for ideas (1) that were created by higher- versus lower-ranked individuals, (2) that were generated collectively versus individually, and (3) that were generated by individuals with previously lower idea implementation success. These findings help companies to reduce uncertainty in the management of innovations.

3 - The Role of Decision Rights in Collaborative Development Initiatives
Nektarios Oraiopoulos, University of Cambridge, Judge Business School, Trumpington Street, Cambridge, CB2 1AG, United Kingdom, n.oraiopoulos@jbs.cam.ac.uk, Vishal Agrawal

In this paper, we study initiatives for co-development of new products and technologies. In such settings, it may be difficult a priori to specify contracts contingent on the outcome. Therefore, we investigate the efficacy of different contractual structures, which instead specify the decision-making process.

4 - Competitive Intelligence and Market Research in R&D Markets
Yi Xu, University of Maryland, yxu@rhsmith.umd.edu, He Chen, Manu Goyal

We develop a dynamic model where two risk-neutral firms compete to develop a new product whose market value is uncertain and the firms can actively manage their information - acquiring information through market research or acquiring information on competitor's decisions through competitive intelligence. We show that competitive intelligence emerges endogenously as an optimal information acquisition strategy even though market research is costless and can perfectly resolve market uncertainty.

■ MC34

Hilton- Union Sq 14

Humanitarian Logistics

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Bahar Yetis Kara, Associate Professor, Bilkent University, Bilkent, Ankara, Turkey, bkara@bilkent.edu.tr

1 - Compromising System and User Interests in Shelter Location and Evacuation Planning
Vedat Bayram, Bilkent University, Endustri Muhendisligi Bolumu, Ankara, 06800, Turkey, bayram@bilkent.edu.tr, Barbaros Tansel, Hande Yaman Paternotte

Traffic management and the decision of where to locate the shelters are critical for an evacuation plan. We develop a nonlinear MIP model that optimally locates shelters and assigns evacuees to the nearest shelter sites using shortest paths, within a given degree of tolerance, so that the total evacuation time is minimized. We develop a solution method that can handle practical size problems using second order cone programming techniques. This research is supported by TUBITAK grant no. 213M434.

2 - A Decision Support Tool for Post-Disaster Debris Operations
Alvaro Lorca, Georgia Institute of Technology, 765 Ferst Drive NW, Atlanta, GA, 30332, United States of America, alvarolorca@gatech.edu, Pinar Keskinocak, Melih Celik, Ozlem Ergun

Effective management of post-disaster debris removal is crucial due to the size, cost, and complicated nature of the problem. In this talk, we present a decision support tool that makes use of a mixed integer programming model and addresses pre- and post-disaster debris removal decisions regarding processing facility location, process selection and debris flow. The impact of the tool is illustrated on a disaster dataset based on Hurricane Andrew.

3 - Evacuation Management under Hazardous Convective Weather Events
Hasan Manzour, University of Oklahoma, School of Industrial and Systems Eng, Norman, United States of America, smh.manzour@ou.edu, Suleyman Karabuk

Hazardous convective weather events (e.g., tornadoes) cause hundreds of fatalities and thousands of injuries in the US every year. We propose evacuation as a response policy; identify the challenges involved; discuss and assess the potential benefits and costs. We uncover important characteristics of optimal evacuation plans, which can affect practical implementations. In addition, we quantify the benefits of forecast lead time, contributing to the discussions in weather forecast research area.

4 - Locating Temporary Shelter Areas after an Earthquake: A Case for Turkey

Bahar Yetis Kara, Associate Professor, Bilkent University, Bilkent, Ankara, Turkey, bkara@bilkent.edu.tr, Firat Kilci, Burcin Bozkaya

In this study, we address the problem of locating temporary shelter areas after a disaster. We have developed a shelter location-allocation optimization model and a GIS-based decision support system for TRC. In this talk, we first propose a mixed integer linear programming based methodology for selecting the location of temporary shelter sites. We validate the mathematical model by generating a base case scenario using real data on Kartal, Istanbul, Turkey.

■ MC35

Hilton- Union Sq 15

Socially Responsible Operations

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Betzabe Rodriguez Alamo, University of Puerto Rico - Mayaguez, Call Box 9000, Mayaguez, PR, 00682, United States of America, betzabe.rodriguez@upr.edu

1 - Finding Solutions to Cattle-Farmers Financial Crisis: Blasting the Payment System

Dhania Silva, University of Puerto Rico, Mayagüez, Mayagüez, PR, United States of America, Dhania.silva@upr.edu, Betzabe Rodriguez Alamo

The milk industry in Puerto Rico is the most important activity for the agricultural sector; hence, is heavily regulated. In the intent to ensure farmers' fair remuneration, some government policies have been prejudicial; resulting in a decrease of 1.6 percent on the number of farmers per year. We propose a mathematical model of the cattle farmer payment system that will consider social paradigms on equity and fairness, and focuses on influencing operational decisions towards societal needs.

2 - An Agent-based Model to Analyze the Emerging Advanced Biofuel Supply Chain

Leilei Zhang, Iowa State University, 3004 Black Engineering, Ames, IA, 50011, United States of America, leileizh@iastate.edu, Guiping Hu

We develop an agent-based model to investigate the interactions of different stakeholders along the biofuel supply chain. Decisions are analyzed on famers' land allocation, biofuel production, biofuel blending, and biofuel market prices. The agent-based model is built upon decision making process faced by each entity along the advanced biofuel supply chain. The results from the agent-based model are evaluated and compared with a bottom-up equilibrium model.

3 - A Stochastic CVaR Approach to Disaster Relief with Social Costs

Amy Givler, Graduate Research Assistant, Rensselaer Polytechnic Institute, 2215 5th Ave, Troy, NY, 12180, United States of America, givlea@rpi.edu, John Mitchell

In many disaster relief problem formulations, social costs, or costs incurred by the population suffering from the disaster, are neglected. This stochastic scenario-based formulation focuses on pre-positioning of points of distribution (PODs) while incorporating social costs in the form of walking costs. Additionally, the risk measure used for these social costs is conditional value at risk (CVaR), a convex monotonic risk measure that focuses on the expectation in the worst scenarios.

4 - Vulnerability to Natural Disasters: A Decision Theory Approach

Saylisse Davila, saylisse.davila@upr.edu, Roy Ruiz, Fernando Salazar, Juan Ayala

This work presents an innovative application of decision theory as the conceptual model for tsunami vulnerability assessments. The model fuses expert knowledge in the form of qualitative data with high-dimensional quantitative data and addresses the gaps in the literature where models disregard the hierarchical nature of the data and the relationships among variables. Preliminary work on the vulnerability to tsunamis of Puerto Rican coastal communities will be shown.

5 - Design Factors for Medical Device Functionality in Developing Countries

Lourdes Medina, Assistant Professor, UPRM, Call Box 9000, Mayaguez, PR, 00680, United States of America, lourdes.medina@upr.edu, Ana Gauthier, Ilka Rodriguez, Giovanni Cruz

This study focuses on determining which design factors of medical devices are most important when designing for developing countries. The determination of the importance of a design factor is based on a literature review, a statistical analysis of current products designed for these countries and a survey developed to be sent to individuals who have had heavy involvement with medicine in the developing world.

■ MC36

Hilton- Union Sq 16

Network Traffic Modeling

Sponsor: Telecommunications

Sponsored Session

Chair: Soumyo Moitra, Senior Member of Technical Staff, SEI/Carnegie mellon, 4500 Fifth Avenue, Pittsburgh, PA, 15213, United States of America, smoitra@sei.cmu.edu

1 - Entity-Centric Network Modeling

Markus De Shon, Founder and Principal Threat Scientist, E8 Security, 720 University Ave, Suite 200, Palo Alto, CA, 94301, United States of America, mdeshon@gmail.com

Raw network and log data is often only weakly identified with the real entities active on the network: users and hosts. We present a comprehensively entity-centric modeling approach that identifies hosts and users on the network, models those entities, associates ephemeral and permanent identifiers with those entities, and tracks them over time.

2 - Modeling and Visualizing Behavioral Anomalies for Network Security

Bryan Olsen, Cyber Security Engineer, Pacific Northwest National Laboratory, PO Box 999, Richland, WA, 99352, United States of America, bryan.olsen@pnnl.gov, Daniel Best, Ryan Hafen, William Pike

Identifying useful anomalies in high-volume computer network traffic (such as emerging threats or network configuration changes) is difficult due to evolving adversary tactics and the large number of network actors. We present CLIQUE, a modeling and visualization system that supports behavior-based situational awareness and investigation. CLIQUE detects and displays emerging anomalies in live network traffic, and supports drill down into details on the individual behaviors underlying them.

3 - Inferring Patterns in Network Traffic: Time Scales and Variation

Soumyo Moitra, Senior Member of Technical Staff, SEI/Carnegie mellon, 4500 Fifth Avenue, Pittsburgh, PA, 15213, United States of America, smoitra@sei.cmu.edu

In this paper we analyze time series from network traffic and develop some metrics related to variation in traffic patterns. These metrics depend on the time scale used in their estimation and therefore we explore the effect of varying time scales. The metrics are illustrated with public data and the implications of the results are discussed.

■ MC37

Hilton- Union Sq 17

DM2: Data Mining in Decision Making with Theory & Applications

Sponsor: Artificial Intelligence

Sponsored Session

Chair: Dr. Asil Oztekin, Assistant Professor, University of Massachusetts Lowell, One University Ave., Southwick 201D, Lowell, MA, 01854, United States of America, Asil_Oztekin@uml.edu

1 - A Data Analytic Approach to Predict the Success of Heart Transplants

Dr. Asil Oztekin, Assistant Professor, University of Massachusetts Lowell, One University Ave., Southwick 201D, Lowell, MA, 01854, United States of America, Asil_Oztekin@uml.edu, Ali Dag, Dr. Fadel Megahed, Ahmet Yucel

Predicting the survival of heart transplant patients is an important yet challenging problem for researchers. Without re-balancing the training set, data mining classification algorithms can generate deceptively high accuracy rates overall but still perform poorly on detecting the minority class. The objective of our study is to improve the prediction of 1-, 5- and 9-year survival outcomes following a heart transplant surgery by examining a large, nation-wide dataset.

2 - Automatic Recognition of Adverse Events in News: A Data Mining Approach

Weiguo Fan, Professor of Accounting & Information Systems, Virginia Tech, 3007 Pamplin Hall, Blacksburg, VA, 24061, United States of America, wfan@vt.edu, Alan G. Wang, Xuan Zhang, Mi (Jamie) Zhou

Corporate adverse events are important resources for investors. However, adverse events are often scattered across different news media and difficult to recognize. By using three years of news data collected for S&P 500 companies, we identify relevant adverse events, extract event features, train and optimize a classification model. This classification model can then be used to automatically recognize adverse events from multiple news channels.

3 - EMS Dispatch Priorities: Comparing Logistic Regression Model Performance with Established Protocol

Michael Dohan, Lecturer (Information Systems), Lakehead University, 955 Oliver Road, Thunder Bay, ON, P7B 5E1, Canada, msdohan@lakeheadu.ca, Joseph Tan, Tim Hardie, Norm Gale, Dave Johnson

Assessing ambulance call priority accurately is crucial to emergency medical service (EMS) performance. Calls dispatched at a priority higher than necessary amount to an inefficient use of EMS resources. This article shows that an established EMS prioritization protocol is outperformed by a proposed logistic regression model, created with a historical dataset of EMS calls. This research identifies factors associated with increased accuracy, providing direction for improving dispatch practice.

4 - Business Analytics for Undergrads

David Olson, Professor, University of Nebraska Lincoln, CBA 209, Lincoln, NE, 68588-0491, United States of America, david.olson@unl.edu, Demet Batur

We view business analytics as an evolution in emphasis to expose students to database concepts (extended to big data), knowledge management (from information systems), quantitative modeling (to include visualization as well as analytic/simulation modeling), and data mining (tools useful for making decisions in typical business data mining applications). This presentation describes what we found others doing, and presents our design of a business undergraduate core course in business analytics.

■ MC38

Hilton- Union Sq 18

Scheduling Staff and Space in Healthcare

Cluster: Healthcare Systems and Medical Informatics

Invited Session

Chair: Amy Cohn, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, United States of America, amycohn@med.umich.edu

1 - Block Scheduling for a Pediatric Residency Program

Peter Mayoros, University of Michigan, Ann Arbor, MI, United States of America, pmayoros@umich.edu, Amy Cohn

In a residency program, the block schedule determines what service (e.g. inpatient, ICU, NICU, emergency department, etc.) each resident works on during each month across a full year. The schedule must meet both the patient care needs of the health system and also the educational and personal needs of the resident. We present an integer programming-based approach used to create the block schedule for incoming interns at the University of Michigan Mott Children's Hospital.

2 - Block Scheduling for a Surgical Residency Program

William Pozehl, University of Michigan, Ann Arbor, MI, United States of America, pozewil@umich.edu, Amy Cohn

Residents in a surgical residency program must complete many different rotations to complete their educational requirements. Meanwhile, program directors must schedule residents from multiple different programs and even different institutions to also ensure adequate coverage for patient care. We present models for and analysis of this complex, multi-criteria combinatorial optimization problem.

3 - Shift Scheduling in Pediatric Emergency Medicine

Young-Chae Hong, University of Michigan, Industrial and Operations Engineering, 1205 Beal Avenue, Ann Arbor, MI, 48109-2117, United States of America, hongyc@umich.edu, Amy Cohn

When scheduling residents to staff a pediatric emergency department, many complex constraints must be satisfied to ensure a feasible solution. In addition, there are several different criteria (based on patient coverage, resident educational training, and resident personal preferences) upon which the quality of a schedule is judged. We present models and algorithms for addressing the multi-criteria nature of this problem, with real-world results from Mott Children's Hospital.

4 - Coordination of Surgical Blocks and Ambulatory Clinics at a Large Teaching Hospital

Brian Lemay, University Of Michigan, Industrial and Operations Engineering, 1205 Beal Avenue, Ann Arbor, MI, 48109-2117, United States of America, blemay@umich.edu, Amy Cohn

We consider the challenge of coordinating surgical block time and ambulatory clinic time across an array of heterogeneous surgeons at a major teaching hospital. Models, algorithms, and analysis are presented to address this multi-criteria combinatorial optimization problem.

■ MC39

Hilton- Union Sq 19

Innovations in Healthcare Delivery Systems

Sponsor: Health Applications

Sponsored Session

Chair: Mili Mehrotra, University of Minnesota, 321 19th Ave South, Minneapolis, United States of America, milim@umn.edu

1 - Managing Office Revisit Intervals and Patient Panel Sizes in Primary Care

Hessam Bavafa, Assissant Professor, Wisconsin School of Business, 975 University Ave, Madison, WI, 53706, United States of America, bavafa@wharton.upenn.edu, Christian Terwiesch, Sergei Savin

In recent years, the drive to contain health care costs in the US has increased scrutiny of the traditional mode of delivering primary care where a patient is treated by his primary care physician during a face-to-face visit. In particular, two approaches, the use of "e-visits" and greater reliance on non-physician providers, have been suggested as lower-cost alternatives to the traditional set-up. We quantify the overall impact of using these two approaches on patients and physicians.

2 - Bundled Payments for Healthcare Services

Diwakar Gupta, University of Minnesota, 111 Church Street SE, Minneapolis, MN, 55455, United States of America, guptad@me.umn.edu, Mili Mehrotra

We model the proposer-selection and information-sharing problems that arise when implementing CMS' bundled payment for care improvement initiative. Possessing private information, proposers compete for beneficiaries but not for selection. We show that an optimal strategy for CMS, under its current approach, may be to either announce a fixed threshold or keep the selection process uncertain, depending on market characteristics. We also characterize parameters of an optimal menu of contracts.

3 - Stochastic Optimization for Multi-unit nurse Planning under Patient Volume Uncertainty

Kibaek Kim, Argonne National Laboratory, 9700 S. Cass Avenue, Argonne, IL, 60439, United States of America, kibaekkim@mcs.anl.gov

We study the problem of nurse planning for multiple care units in the presence of patient volume uncertainty. The problem is formulated as a two-stage stochastic integer program with mixed-integer recourse. We present a novel decomposition method, which allows us to solve real-world problems. Using patient census data from Northwestern Memorial Hospital, we analyze the value of the stochastic planning solutions and the cost implications of using cross-trained nurses.

4 - Towards Cost-effective Multiple Disease Screening

Mohsen Bayati, Stanford Graduate School of Business, Stanford, CA, 94305, United States of America, bayati@gsb.stanford.edu, Sonia Bhaskar, Andrea Montanari

Recently, in response to the rising costs of healthcare, companies have been investing in programs to improve the health of their workforce. These programs aim to reduce the incidence of chronic illnesses which impact future costs and require a low-cost annual screening to detect individuals with a high risk of developing chronic disease. We offer a multiple disease screening procedure that highly maximizes the predictive ability based on multi-task learning from machine learning.

■ MC40

Hilton- Union Sq 20

Methodologies for Health Policy Making

Sponsor: Health Applications

Sponsored Session

Chair: Monica Gentili, Visiting Assistant Professor, Institute for People and Technology, Georgia Institute of Technology, Atlanta, Georgia, mgentili3@mail.gatech.edu

1 - Primary Care Network Development: The Regulator's Perspective

Vedat Verter, Professor, McGill University, 1001 Sherbrooke Street West, Montreal, QC, H3A 1G5, Canada, vedat.verter@mcgill.ca, Anna Graber, Michael Carter

A mixture of fee-for-service, capitation and salary remuneration schemes is often used for funding primary care. These payment mechanisms often vary with the type of facility in the primary care network. We propose a formulation that allows the regulator to identify the most appropriate primary care network configuration. The proposed framework focuses on cost, accessibility and appropriateness of provided care. We illustrate the model use on the geographical area of Kingston, Ontario, Canada.

2 - Modeling the Spread of HIV and HCV among Injection Drug Users: A Network-based Model

Rui Fu, Stanford University, 74 Barnes CT, Stanford, CA, 94305, United States of America, ruif@stanford.edu, Margaret Brandeau

To capture the biological and behavioral variability among IDUs, we construct a network-based model that simulate the transmission of HIV and HCV. We include two types of relationships (edges): sexual partner and needle sharing buddy. Empirical degree distribution derived from survey data informs the initialization and evolution of simulated network. Efficacy of several intervention programs that target the IDU population are evaluated using this model.

3 - What are the Areas in Need for Improving Spatial Access to Pediatric Primary Care?

Monica Gentili, Visiting Assistant Professor, Institute for People and Technology, Georgia Institute of Technology, Atlanta, Georgia, mgentili3@mail.gatech.edu, Nicoleta Serban, Julie Swann

We make inferences on the geographic access to pediatric primary care across 14 states in the U.S. Our measurement models for geographic access are based on optimization models that match patients with providers considering a series of user and provider system constraints. We will compare the derived measures for two population groups, children insured by Medicaid and/or CHIP and other children on private insurance or health insurance exchange.

■ MC42

Hilton- Union Sq 22

Healthcare Operations and Scheduling

Sponsor: Health Applications

Sponsored Session

Chair: Greg Zaric, Ivey Business School, 1255 Western Road, London, ON, N6G 0N1, Canada, gzaric@ivey.uwo.ca

1 - Forecasting Patient Arrivals and Census in an Emergency Department

Azaz Sharif, PhD Candidate, Western University, 1151 Richmond Street, London, ON, N6A 3K7, Canada, asharif9@uwo.ca, David Stanford, Greg Zaric

Emergency Department (ED) physician pay in Ontario is determined in part on pay-for-performance contracts based on operational benchmarks. To assist in planning and meeting these benchmarks we built a forecasting model to produce short-term forecasts of arrivals and ED census. We used regression and time series techniques to model arrivals in each of the 5 'Canadian Triage and Acuity Scale' categories. This analysis provides ED managers with valuable insight to efficiently allocate ED resources.

2 - Distributed Surgical Case Scheduling via Logic-based Benders Decomposition

Vahid Roshanaei, PhD Student, University of Toronto, 5 King's college road, Toronto, Canada, vroshana@mie.utoronto.ca, Dionne Aleman, Curtiss Luong, David Urbach

We study the problem of surgical case scheduling where patients are collaboratively planned amongst a coalition of multiple hospitals in a strategic network. A novel general integer programming model along with a logic-based Benders decomposition approach are developed. Computational experiments demonstrate that our LBBD approach is able to find optimal solutions 98.7% faster than the integer model solved via Gurobi optimizer on small-to-medium test cases, and 75.3% faster on large test cases.

3 - Addressing Overcrowding in an Outpatient Clinic through New Room Allocation Policies

Jacqueline Griffin, Northeastern University, 334 Snell Engineering Center, 360 Huntington Avenue, Boston, MA, 02115, United States of America, ja.griffin@neu.edu, Vahab Vahdatzad, James Stahl

In order to examine overcrowding in a cardiovascular outpatient clinic, we construct a discrete-event simulation model focusing on patient flow, appointment room availability, and staffing. A simulation-optimization approach is used to define new policies for the reallocation of a fixed number of beds among different physicians within the clinic. Specifically, the impact of a hybrid allocation policy, using a balance of both pooled and designated room allocation is examined.

4 - Design and Scheduling of Home Health Care Services

Onur Ozturk, PhD, Ivey Business School, Western University 1255 Western Road, London, ON, N6G0N1, Canada, oozturk@uwo.ca, Mehmet Begen, Greg Zaric

Home health care (HHC) has become a growing service sector in most countries due to aging population, increasing costs and limited resources. In HHC, healthcare providers design and deliver medical care to patients with home visits. We investigate an efficient and robust design of HHC services to provide home visit schedules subject to limited resources and regulatory restrictions. Besides planning HHC visits, we also quantify trade-offs between HHC investment and desired service levels.

■ MC43

Hilton- Union Sq 23

Decision Diagrams in Optimization I

Sponsor: Computing Society

Sponsored Session

Chair: John Hooker, Carnegie Mellon University, Tepper School of Business, Pittsburgh, United States of America, jh38@andrew.cmu.edu

1 - MDD-Based Lagrangian Relaxation

Andre Augusto Cire, University of Toronto Scarborough, 1265 Military Trail, Toronto, ON, M1C 1A4, Canada, andre.cire@gmail.com, Willem-Jan van Hoeve, David Bergman

Decision diagrams have been used to obtain tight relaxations for a number of practical applications, including single-vehicle routing problems and employee rostering. We demonstrate that such relaxations can be greatly enhanced by incorporating dual information in the form of Lagrangian multipliers. Computational experiments on scheduling problems indicate that this technique can improve solving times substantially in a branch-and-bound framework.

2 - Zero-Suppressed Binary Decision Diagrams

David Morrison, University of Illinois, Urbana-Champaign, 1624 T St Apt 4, Sacramento, CA, 95811, United States of America, drmorr0@gmail.com, Edward Sewell, Sheldon Jacobson

Zero-suppressed binary decision diagrams (ZDDs) are a modification of standard binary decision diagrams (BDDs) that exhibit better compression for many combinatorial optimization problems. In this talk we discuss the advantages of ZDDs over BDDs, and present a characterization of ZDDs for the maximal independent set problem.

3 - Dualization using Decision Diagrams and Its Application for Itemset Mining

Takahisa Toda, Graduate School of Information Systems, the University of Electro-Communications, 1-5-1 Chofugaoka, Chofu, To, 1828585, Japan, toda.takahisa@gmail.com

Dualization of Boolean functions is one of the most fundamental problems on Boolean functions. Many problems in data mining, logic, artificial intelligence etc are known to be equivalent to dualization. We present a dualization algorithm using decision diagrams over modern SAT solver, and propose its application for itemset mining.

4 - Compact Representations of All Members of an Independence System

Utz-Uwe Haus, IFOR, D-MATH, ETH Zurich, Raemistr 101, Zurich, Switzerland, uhaus@ethz.ch, Carla Michini

We show that for every independence system there exists a top-down construction rule for a binary decision diagram (BDD) representing all independent sets.For packing and covering problems with logarithmically bounded bandwidth the width of the BDD is bounded by the number of variables.Besides enumerating or counting all solutions and optimizing a class of nonlinear objective functions that includes separable functions,the results can be applied for effective evaluation of generating functions.

■ MC44

Hilton- Union Sq 24

Multi-Channel Advertising

Sponsor: Information Systems

Sponsored Session

Chair: Vibhanshu Abhishek, Assistant Professor, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PE, 15213, United States of America, vibs@andrew.cmu.edu

1 - Beyond the Last-Touch: Attribution in Online Advertising

Ron Berman, United States of America, ronber@wharton.upenn.edu

Advertisers that utilize multiple publishers typically compensate them based on effort (CPM) or performance (CPA) and Last-Touch attribution. Our analytical model shows that CPA causes moral-hazard while existence of a baseline conversion rate by consumers causes adverse selection. We resolve these issues using the Shapley value and requiring that publishers run an experiment as proof of effectiveness. We then proceed to demonstrate the advantages of this method on several live campaigns.

2 - Media Exposure through the Funnel: A Model of Multi-Stage Attribution

Vibhanshu Abhishek, Assistant Professor, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PE, 15213, United States of America, vibs@andrew.cmu.edu

Consumers are exposed to ads across a number of channels, which can jointly affect the conversion behavior. In this paper, we propose a HMM of an individual consumer's behavior based on the conversion funnel to measure the effect of every ad and assign due credit. The model is estimated on a large online auto campaign. We observe that different ad formats affect consumers differently based on their underlying states. Finally, only a fraction of online conversions are driven by online ads.

■ MC45

Hilton- Union Sq 25

Field Experiments

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Ryan Buell, Assistant Professor, Harvard Business School, Morgan Hall 429, Boston, MA, 02163, United States of America, rbuell@hbs.edu

Chair: Jun Li, Assistant Professor, Ross Business School, University of Michigan, 701 Tappan Street, Ann Arbor, MI, 48109, United States of America, junwli@umich.edu

1 - The Impact of Fit Information in Online Retail

Antonio Moreno-Garcia, Kellogg School of Management, 2001 Sheridan Rd, MEDS Department, Evanston, IL, 60208, United States of America, a-morenogarcia@kellogg.northwestern.edu, Santiago Gallino

We describe a field experiment studying the impact of offering better product fit information to customers in online retail.

2 - Dynamic Pricing in Online Retailing: Evidence from Field Experiments

Jun Li, Assistant Professor, Ross Business School, University of Michigan, 701 Tappan Street, Ann Arbor, MI, 48109, United States of America, junwli@umich.edu, Santiago Gallino, Marshall Fisher

Competition among online retailers is intense. Prices and availability have been made transparent to customers as well as to competing retailers. We designed a series of field experiments to measure price elasticity accounting for demand substitution among similar products and competing retailers, and to test a best response pricing algorithm in real business environment.

3 - Creating Reciprocal Value through Operational Transparency

Ryan Buell, Assistant Professor, Harvard Business School, Morgan Hall 429, Boston, MA, 02163, United States of America, rbuell@hbs.edu, Tami Kim, Chia-Jung Tsay

We investigate whether organizations can create value by introducing operational transparency between consumers and producers. Although existing theory posits that increased contact between the two parties can diminish performance, we conducted two field and two laboratory experiments in food service contexts that suggest that the introduction of transparency improves service quality and efficiency.

4 - Sharing Delay Information in Services: A Field Study

Qiuping Yu, Assistant Professor, Kelley School of Business, Indiana University, 1275 E 10th St, Bloomington, IN, 47405, United States of America, yqp2009@gmail.com, Gad Allon, Achal Bassamboo

We explore the impact of delay announcements by conducting a field experiment at a medium sized call center. The call center provides announcements to customers on certain days of the week, while provides no announcements to customers of the same type on other days of the week. With such experimental design, we investigate the problem of whether and how customers use the announcements as points of reference when they make abandonment decisions.

■ MC46

Hilton- Lombard

Advances in MIP Modeling Systems

Sponsor: Optimization/Integer and Discrete Optimization

Sponsored Session

Chair: Miles Lubin, MIT Operations Research Center, 77 Massachusetts Avenue, Bldg. E40-149, Cambridge, MA, 02139, United States of America, mlubin@mit.edu

1 - Modeling with Meaning: Metaconstraints and Semantic Typing

Tallys Yunes, University of Miami, School of Business Administration, Coral Gables, FL, 33146, United States of America, tallys@miami.edu, John Hooker, Andre Cire

Metaconstraints are constraints possessing behavioral parameters for relaxation, branching, and inference. Relaxations of metaconstraints create auxiliary variables related to other variables in the model. Semantic typing facilitates the detection and enforcement of such relations by giving specific meaning to variables, yielding stronger models. It also provides other modeling benefits, such as consistency checking and error detection. We motivate and illustrate these concepts through examples.

2 - Solver-independent MILP Callbacks in JuMP with Applications to Robust Integer Optimization

Iain Dunning, MIT Operations Research Center, 77 Massachusetts Avenue, Bldg. E40-149, Cambridge, MA, 02139, United States of America, idunning@mit.edu, Dimitris Bertsimas, Miles Lubin, Joseph Huchette

We present the unique solver-independent callback functionality of JuMP, a modeling language embedded in the Julia language. Users can write efficient code for lazy constraints, user cuts, and heuristics, which we demonstrate for classic problems like the travelling salesman problem. We then demonstrate a JuMP extension, JuMPeR, for robust optimization. We can solve robust MILPs with either reformulations or cutting planes while not concerning the user with details of the underlying solver.

3 - Leveraging Model Transformations in Algebraic Modeling Systems

John Siirola, Analytics, Sandia National Laboratories, P.O. Box 5800, MS 1326, Albuquerque, NM, 87185, United States of America, jdsiiro@sandia.gov, William Hart, Jean-Paul Watson

"Flat" algebraic representations force modelers to explicitly convert or relax high-level constructs, which can obscure much of the structure in the model. We will show how high-level non-algebraic modeling constructs in Coopr can be coupled with automated model transformations to improve model clarity and abstraction. This allows modelers to explicitly apply transformations that link the structured model to a solver, thereby separating the core model from subsequent reformulation decisions.

4 - Conveying Logical Conditions to MIP Solvers through an Algebraic Modeling Language

Robert Fourer, President, AMPL Optimization Inc, 2521 Asbury Ave, Evanston, IL, 60201, United States of America, 4er@ampl.com, David M. Gay, Victor Zverovich

Although algebraic modeling languages get their name from traditional numerical algebra, they are readily extended to "logical" constraints that appear naturally in applications. Logic extensions have indeed been available in modeling languages for some time. We describe our experiences incorporating logic into the AMPL language; the challenges have proved to be not so much in generalizing language forms and processing, as in communicating the resulting optimization problems to popular solvers.

■ MC47

Hilton- Mason A

Stochastic Optimization for Natural Resources

Sponsor: Optimization/Optimization Under Uncertainty

Sponsored Session

Chair: Miguel Lejeune, Associate Professor, George Washington University, 2201 G Street, NW, Washington, DC, 20052, United States of America, mlejeune@gwu.edu

1 - Building a Stochastic Problem from its Roots: A Forestry Management Example

Ignacio Rios, Universidad de Chile, Jose Miguel Carrera 439 D215, Santiago, RM, Chile, irios@ing.uchile.cl, Roger Wets, Ignacio Rios, Andres Weintraub

We analyze how to deal with the uncertainty before solving a stochastic optimization problem and we apply it to a forestry management problem. In particular, we start from historical data to build a stochastic process for wood prices and for bounds on its demand. Then, we generate scenario trees considering different number of scenarios and different scenario generation methods. Finally, we describe a procedure to compare the solutions obtained with each approach and we apply it to our problem.

2 - Stochastic Programming with Reliability Requirements for Tactical Level Forest Harvesting

Janne Kettunen, Assistant Professor, The George Washington University School of Business, 2201 G Street, NW, Funger Hall 415, Washington, DC, 20052, United States of America, jkettune@gwu.edu, Miguel Lejeune

Major goals of private nonindustrial forest owners in harvesting include achieving a steady flow of revenues whilst reaching an overall satisficing revenue level. Accounting for these, we develop a stochastic programming framework. We use a Boolean reformulation method to linearize the proposed integer chance-constrained models and develop a computationally tractable approach. We demonstrate the model with real data and derive insights about optimal harvesting strategies.

3 - A Risk-averse Multistage Stochastic Programming Model in Forestry

Bernardo Pagnoncelli, Assistant Professor, Universidad Adolfo Ib·Òez, Diagonal las Torres 2640, Oficina 533-C, Santiago, RM, 7910000, Chile, bernardo.pagnoncelli@uai.cl, Adriana Piazza

An important source of uncertainty in forestry problems is timber price. I will present a one species model in which prices follow a geometric Brownian motion or an Ornstein-‹hlenbeck processes. Using stochastic dynamic programming techniques I will characterize the optimal policy for the first case and provide sufficient conditions for optimality in the second case. Risk aversion is represented by the Conditional Value-at-Risk and comparisons with the risk neutral case are provided.

4 - Stochastic Programming Models for Salmon Farming

Asgeir Tomasgard, NTNU- Trondheim, Norwegian University, Norway, asgeir.tomasgard@iot.ntnu.no

We present two models for the salmon farming value chain. The first model considers the fresh water stadium where the salmon is kept in tanks until it is ready for sea water (the smolt stadium) and minimizes the total expected costs related to smolt production. The next model considers making optimal smolt orders, deployment plans and finally harvesting in the seawater facilities. The most important sources of uncertainty are growth, temperature, price and mortality.

■ MC48

Hilton- Mason B

Network and Graphs 1

Contributed Session

Chair: Jordi Pereira, Universidad Catolica del Norte, Avda. Angamos 0610, Antofagasta, Chile, jorgepereira@ucn.cl

1 - Discovering and Exploring Overlapping Community Structures in Large Networks

Junming Yin, University of Arizona, McClelland Hall, Tucson, AZ, 85721, United States of America, junmingy@email.arizona.edu, Eric Xing, Qirong Ho

We present a novel scalable approach to detecting overlapping community structures in a large-scale network. Our approach builds on a new triangular characterization of networks and a fast stochastic variational inference (SVI) algorithm. Empirical results show that our triangular model SVI procedure is not only faster but also more accurate. We also demonstrate that our method is able to discover interesting communities on a massive IMDB co-actor network with 896K actors.

2 - Hybrid Statistical Data Mining Framework for Multi-Commodity Fixed Charge Network Flow Problems

Anurag Ladage, Graduate Student, Rochester Institute of Technology, 6000 Reynolds Drive, Rochester, NY, 14623, United States of America, aal1284@rit.edu, Scott Grasman, Ernest Fokoue

This paper presents a new approach to analyze the network structure in multi-commodity fixed charge network flow problems (MCFCNF). This methodology uses the historical data produced from traditional MCFCNF model as input for the machine-learning model. Further, we reshape the problem as a binary classification problem and employ machine-learning algorithms to predict the network structure. The quality of the solutions generated will be measured on basis of its feasibility and optimality gap.

3 - Whom Should we Tenure? Network Analysis for Predicting Research Impact

Shachar Reichman, Massachusetts Insitute of Technology, Sloan School of Management, 77 Massachusetts Ave, Cambridge, MA, 02459, United States of America, shachar@mit.edu, John Silberholz, Dimitris Bertsimas, Erik Brynjolfsson

We propose an analytics approach to support the tenure decision-making process at academic institutions. Using a large-scale bibliometric database of OR papers, we predict scholars' long-term performance using publication data from the first five years of their careers. These models select candidates with significantly better future citation counts and h-indexes than those selected by tenure committees, with similar performance on research awards, teaching awards, and journal editorships.

4 - A Numerical Method for Modelling Wavefront Propagation and Reflection from Rigid Boundary

Daisy Dahiya, Research Scholar, IIT Bombay, Department of Mathematics, Powai, Mumbai, 400076, India, daisydahiya@gmail.com

We present a numerical method based on the shortest path algorithm on graphs to model the propagation and reflection of a wavefront in an inhomogeneous moving medium with rigid boundary. The governing equation is the generalized eikonal equation. The solution of this equation may cease to be smooth and numerical methods are used to obtain the weak solution. Also if the medium of propagation has rigid boundaries then the wavefront may reflect after hitting the rigid boundary.

5 - Network Construction Problems with Maximum Lateness Minimization Objective

Jordi Pereira, Universidad Catolica del Norte, Avda. Angamos 0610, Antofagasta, Chile, jorgepereira@ucn.cl, Igor Averbakh

A network needs to be constructed by a single construction crew. A vertex is recovered when it becomes connected to the depot by an already constructed path. Each vertex of the network has a due date for its recovery time. The problem is to obtain a construction schedule that minimizes the maximum lateness of the vertices. We put forward the problem, discuss its computational complexity, and several solution methods. These methods are then compared on random and real life instances.

■ MC49

Hilton- Powell A

Networks Robustness and Vulnerability Analysis

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Foad Mahdavi Pajouh, University of Florida, 350 N Poquito Rd, Shalimar, Fl, 32579, United States of America, mahdavi@ufl.edu

1 - An Integer Programming Framework for Critical Elements Detection in Graphs

Alexander Veremyev, University of Florida, 1350 N. Poquito Road, Shalimar, FL, 32579, United States of America, averemyev@ufl.edu, Eduardo Pasiliao, Oleg Prokopyev

We study the problem of minimizing connectivity and cohesiveness of a graph by removing vertices and edges. We develop an integer programming approach under an assumption that the connectivity and cohesiveness metrics are general (possibly, nonlinear) functions of sizes of the remaining connected components and vertex degrees. Encouraging computational experiments are reported to illustrate the performance of the developed framework.

2 - The Minimum Edge Blocker Dominating Set Problem

Jose Walteros, University of Florida, Gainesville, FL, United States of America, jwalteros@ufl.edu, Foad Mahdavi Pajouh, Eduardo Pasiliao, Vladimir Boginski

The minimum edge blocker dominating set problem (EBDP) is to remove a subset of edges of minimum cardinality in a weighted undirected graph, such that the minimum weight of a dominating set in the remaining graph is bounded below by a given threshold. We develop an exact algorithm for solving the EBDP, which solves the proposed formulation via branch and cut where nontrivial constraints are added in a lazy fashion. We provide some computational results obtained by the proposed approach.

3 - An Integer Programming Approach for Fault-tolerant Connected Dominating Sets

Austin Buchanan, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, buchanan@tamu.edu, Je Sang Sung, Sergiy Butenko, Eduardo Pasiliao

This paper considers the minimum k-connected d-dominating set problem, which is a fault-tolerant generalization of the minimum connected dominating set (MCDS) problem. Three IP formulations are proposed and their integer hulls are studied. Despite having exponentially many constraints, the three LP relaxations can be solved in polytime. A lazy-constraint approach is proposed to solve the problem. For the MCDS problem (where k=d=1) the times are fastest in literature.

4 - New Analytical Lower Bounds for the Maximum Clique Number of a Graph

Vladimir Stozhkov, University of Florida, 2930 SW 23rd Ter, Apt 203, Gainesville, FL, 32608, United States of America, vstozhkov@ufl.edu, Eduardo Pasiliao, Grigory Pastukhov, Vladimir Boginski

We propose three new lower bounds for the maximum clique number of a graph. The first two are degree-adjacency-based and triangle-based, respectively. They both are derived from the Motzkin-Straus formulation. The third one is degree-based and derived from famous graph inequalities. We prove a variety of theoretical results for our new bounds. Finally, we conduct computational experiments to compare our three new bounds with well-known lower bounds by accuracy and complexity.

■ MC50

Hilton- Powell B

Service Parts Networks and Inventory Optimization

Cluster: Network Design

Invited Session

Chair: Stefan Minner, Technische Universität München, Arcisstr. 21, Munich, 80333, Germany, stefan.minner@tum.de

1 - Sustainable Multi-echelon Inventory Control with Shipment Consolidation and Non-linear Freight Costs

Johan Marklund, Professor, Lund University, Box 118, Lund, 22100, Sweden, Johan.Marklund@iml.lth.se, Olof Stenius, Sven Axsäter

We consider a 1-warehouse-N-retailer inventory system. Inventories are reviewed continuously while shipments from the warehouse are consolidated for groups of retailers and shipped periodically. We derive the probability distributions for the amount of goods on each shipment, enabling non-linear freight cost structures to be included in the model. The analysis is exact, encompassing joint optimization of multi-modal transportation and inventory decisions, with respect to costs and CO2 emissions.

2 - Determining Optimal Parameters of Expediting Level Policies

Ulrich Thonemann, University of Cologne, Albertus-Magnus-Platz, Koeln, 50923, Germany, ulrich.thonemann@uni-koeln.de, Raik Oezsen

We consider a situation where inventory managers have the option to expedite open orders. We incorporate an expediting level policy in a periodic-review base-stock inventory model and solve the model optimally. We numerically analyze the sensitivity of the inventory system with respect to the key parameters and quantify the benefit of order expediting using data from the service division of a global equipment manufacturer.

3 - Optimal and Heuristic Repairable Stocking and Expediting in a Fluctuating Demand Environment

Rob Basten, University of Twente, Postbus 217, Enschede, 7500AE, Netherlands, r.basten@utwente.nl, Joachim Arts, Geert-Jan Van Houtum

We consider a single stock point. Spare items are purchased at time zero and their demand follows a Markov modulated Poisson process. Defective items are sent to a repair shop that offers the option to expedite repairs. We formulate the decision to use this option as a Markov decision process, characterize the optimal policy, and propose a heuristic policy. We show how to compute optimal initial stocking levels in combination with those policies. A numerical study gives managerial insights.

■ MC51

Hilton- Sutter A

Recent Advances in First Order Methods

Sponsor: Optimization/Nonlinear Optimization

Sponsored Session

Chair: Fatma Kilinc-Karzan, Assistant Professor, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, fkilinc@andrew.cmu.edu

1 - Stochastic Subgradient Mirror-Descent Algorithm with Weighted Averaging

Angelia Nedich, UIUC, 1308 West Main Street, Urbana, Il, 61801, United States of America, angelia@illinois.edu

The talk is on a stochastic subgradient mirror-descent method for solving convex minimization problems. A method with weighted iterate-averaging and its per-iterate convergence rate are presented. The novel part of the approach is the choice of weights that are used to construct the averages, which allow us to recover the known optimal rates with simpler algorithms than those currently existing in the literature. Some new convergence results can also be obtained.

2 - Mirror Prox Algorithm for Multi-Term Composite Minimization and Semi-Separable Problems

Niao He, Georgia Institute of Technology, 765 Ferst Drive, Atlanta, United States of America, nhe6@isye.gatech.edu, Anatoli Juditsky, Arkadi Nemirovski

We present a composite version of Mirror Prox algorithm for solving monotone variational inequalities of special structure, which inherits the favourable efficiency estimate of its prototype. We demonstrate that the proposed approach can be successfully applied to Lasso-type problems with several penalizing terms and to problems of semi-separable structures considered in the alternating directions methods, implying in both cases methods with the O(1/t) complexity bounds.

3 - Algorithms and Theory for Nonconvex Quadratic Optimization: Phase Retrieval and Beyond

Mahdi Soltanolkotabi, UC Berkeley, 736 Escondido Road, Aprt. 341, Stanford, CA 94305, United States of America, mahdisol@stanford.edu, Emmanuel Candes

We consider recovery of the seemingly hidden phase of an object from intensity-only measurements. We show that a nonconvex formulation of the problem recovers the phase information exactly from a minimal number of magnitude-only measurements. To solve this nonconvex problem, we develop an iterative algorithm that escapes all local minima and provably converges to the global optimum with a geometric rate. Our proposed scheme is near optimal in terms of usage of computational and data resources.

4 - Block Successive Upper Bound Minimization Method of Multipliers for Linearly Constrained Convex OPT

Mingyi Hong, Research Assistant Professor, University of Minnesota, 3626 E 44th Street, Apt 309, Minneapolis, United States of America, mhong@umn.edu

Consider the problem of minimizing the sum of a smooth convex function and a separable nonsmooth convex function subject to linear coupling constraints. Problems of this form arise in many contemporary applications. Motivated by the huge size of these applications, we study a new class of first order primal-dual algorithms called the block successive upper-bound minimization method of multipliers to solve this family of problems.

■ MC52

Hilton- Sutter B

Recent Advances in Linear Programming and Complementarity Problems

Sponsor: Optimization/ Linear and Conic Optimization

Sponsored Session

Chair: Hande Benson, Drexel University, 3141 Chestnut Street, Philadelphia, PA, 19104, United States of America, hvb22@drexel.edu

1 - Constraint Optimal Selection Techniques (COSTs) for Nonnegative Linear Programming Problems

Alireza Noroziroshan, PhD Student, University of Texas at Arlington, 600 Grand Ave, Apt#103, Arlington, TX, 76010, United States of America, alireza.noroziroshan@mavs.uta.edu, Bill Corley, Jay Rosenberger

We describe an active-set, cutting-plane approach called Constraint Optimal Selection Techniques(COSTs)and present an efficient new COST for solving nonnegative linear programming problems. We give a geometric interpretation of the new selection rule and provide computational comparisons of the new COST with existing linear programming algorithms for some large-scale sample problems.

2 - Preconditioners for Linear Programming

Javier Pena, Professor, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, jfp@andrew.cmu.edu, Vera Roshchina, Negar Soheili

It is known that the behavior of algorithms for linear programming is determined by how "well conditioned" the problem instance is. We show that a combination of two preprocessing steps typically improves the conditioning of a problem. Our approach is based on a comparison among three different but related notions of conditioning for linear programming.

3 - Central Path Curvature for LP

Yuriy Zinchenko, University of Calgary, 2500 University Dr NW, MS524, Calgary, AB, T2N1N4, Canada, yzinchen@ucalgary.ca

Similarly to the diameter of a polytope, one may define its curvature based on the worst-case central path associated with solving an LP posed over the polytope. A continuous analogue of the Hirsch conjecture and a discrete analogue of the "average curvature" result of Dedieu, Malajovich and Shub may be introduced. A continuous analogue of a diameter d-step equivalence result may also be proved. We demonstrate how to construct a family of polytopes attaining the largest conjectured curvature.

4 - Fast Algorithms for Online Stochastic Convex Programming

Shipra Agrawal, Researcher, Microsoft Research, C702 Mantri Sarovar, Bangalore, India, shipra@microsoft.com, Nikhil Devanur

We introduce the online stochastic Convex Programming (CP) problem, a very general version of stochastic online problems, which allows arbitrary concave objectives and convex feasibility constraints. We present fast algorithms for these problems, which achieve near-optimal regret guarantees for both the i.i.d. and the random permutation models of stochastic inputs. Applications include many dynamic resource allocation and revenue management problems.

■ MC53

Hilton- Taylor A

Optimization and Financial Engineering

Cluster: Optimization in Finance

Invited Session

Chair: Martin Haugh, Columbia University, 500 West 120th Street, Room 332, New York, NY, 10027, United States of America, mh2078@columbia.edu

1 - A Drift Switching Jump-Diffusion Model for Reserve Management

Ning Cai, Hong Kong University of Science & Technology, Clear Water Bay, Kowloon, Hong Kong - PRC, ningcai@ust.hk

We propose a drift switching reflected jump-diffusion model for international reserve management to capture both the jump behavior in reserve dynamics and the leptokurtic feature of the reserve increment distribution. The model is simple and produces a closed-form expression for the total expected discounted cost of managing reserves.

2 - Multiperiod Portfolio Optimization with Many Risky Assets and General Transaction Costs

Victor DeMiguel, avmiguel@london.edu

We analyze the optimal portfolio policy for a multiperiod mean-variance investor facing many risky assets and general transaction cost. For proportional transaction costs, we give a closed-form expression for a no-trade region. For market impact costs, we show that at each period it is optimal to trade to the boundary of a state-dependent rebalancing region. Finally, we show empirically that the losses associated with ignoring transaction costs may be large.

3 - Dynamic Portfolio Optimization with Transaction Costs

John Birge, Jerry W. and Carol Lee Levin Professor of Operations Management, University of Chicago Booth School of Business, 5807 S Woodlawn Ave, Chicago, IL, 60637, United States of America, john.birge@chicagobooth.edu

Dynamic portfolio optimization presents multiple challenges, such as parameter estimation and incorporation of transaction costs. This talk will discuss results comparing comparing various approaches to this issue.

4 - Tax-Aware Dynamic Asset Allocation

Chun Wang, Columbia University, 323 S. W. Mudd Building, 500 W. 120th Street, New York, NY, 10027, United States of America, cw2519@columbia.edu, Martin Haugh, Garud Iyengar

The asset allocation problem with taxes has several variations depending on: (i) whether we use the exact or average tax-basis and (ii) whether we allow the full use of losses or the limited use of losses. It is a challenging problem due to high-dimension and path-dependence. We consider all of these variations, develop several sub-optimal trading policies and use duality techniques based on information relaxations to assess their performances. We show that much larger problems can be tackled.

■ MC54

Hilton- Taylor B

Default and Systemic Risk

Sponsor: Financial Services Section

Sponsored Session

Chair: Agostino Capponi, Johns Hopkins University, 3400 North Charles Street, Baltimore, MD, 21218, United States of America, acappon1@jhu.edu

1 - Repo Chains

Alireza Tahbaz-Salehi, Columbia Business School, 3022 Broadway, Uris 418, New York, NY, 10027, United States of America, alirezat@columbia.edu, Marco Di Maggio

We study the financial institutions' role as intermediaries between cash lenders (e.g. money market funds) and borrowers (e.g. hedge funds), and study how a chain of repurchase agreements can function as a mechanism for propagation and amplification of risk.

2 - Funding without Tears: A Unified Approach to XVA

Stephan Sturm, Assistant Professor, WPI, 100 Institute Road, Worcester, MA, 01609, United States of America, ssturm@wpi.edu, Agostino Capponi, Maxim Bichuch

The financial crisis lead to an opening of the LIBOR-OIS spread. Default risk has become a real possibility and banks can no longer borrow and lend at the same rate. Also traders face different rates when financing their hedging positions. Many large banks have created unified XVA desk that takes care of the total value adjustment. We propose a unified methodology for the calculation of the XVA and provide a detailed study of hedging a stock option with defaultable corporate bonds.

3 - Likelihood Estimation for Large Financial Systems

Justin Sirignano, Stanford University, 3 Gibbs Court, Irvine, CA, 92617, United States of America, jasirign@stanford.edu, Gustavo Schwenkler, Kay Giesecke

We consider the problem of parameter estimation for large interacting stochastic systems. Maximum likelihood estimation is computationally intractable due to the scale and complexity of such systems. Weak convergence results are exploited to develop approximate maximum likelihood estimators for such systems. An important application is systemic risk in banking systems and other large financial systems.

4 - Systemic Risk and Network Topology

Peng-Chu Chen, PhD Student, Purdue University, 315 N. Grant Street, West Lafayette, 47906, United States of America, chen621@purdue.edu, Agostino Capponi

We provide an analytical framework to rank financial networks based on level of systemic risk. We introduce the concept of majorization to quantify the degree of network homogeneity and compare the losses generated after interbank clearing occurs. We analyze balancing and unbalancing networks. Given two balancing networks, if one majorizes the other, it generates smaller losses. Oppositely, given two unbalancing networks, one generates smaller losses than the other only if it is majorized by it.

■ MC55

Hilton- Van Ness

MINLP Methodology and Applications

Sponsor: Optimization/Global Optimization & MINLP

Sponsored Session

Chair: Merve Bodur, PhD Student, University of Wisconsin-Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, mbodur@wisc.edu

1 - Global Optimization of Mixed-integer Nonlinear Optimization Problems in BARON

Mustafa Kilinc, Carnegie Mellon University, Department of Chemical Engineering, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, mkilinc@andrew.cmu.edu, Nick Sahinidis

We report recent developments in BARON. New features include integrality-based techniques, such as preprocessing, probing, constraint management, branching and node selection rules. Specific cutting plane generation now produces knapsack cuts, GUB cuts, clique cuts, implication cuts and flow cuts. Mixed-integer linear programming relaxations are solved to construct new feasible solutions and improve relaxations at nodes of the search tree. Extensive computational results will be presented.

2 - A Risk-averse Two-stage Stochastic Programming for Retrofitting Transportation Networks

Jie Lu, Clemson University, 102 Calhoun St., Apt. 130, Clemson, SC, 29631, United States of America, jlu3@clemson.edu, Yongxi Huang, Akshay Gupte

We develop a risk-averse two-stage stochastic programming model with the conditional-value-at-risk (CVaR) as the risk measure. This approach considers a variety of random outcomes to provide more robust solutions and generalizes prior modeling efforts. A mixed integer nonlinear programming problem is formulated with integer variables appearing in the second stage. We develop a decomposition algorithm based on generalized Benders decomposition method and present numerical implementations.

3 - On Convex Relaxations of Network Interdiction Problems

Danial Davarnia, University of Florida, 303 Weil Hall, Gainesville, FL, 32611, United States of America, d.davarnia@ufl.edu, Jean-Philippe P Richard, Mohit Tawarmalani

Network interdiction problems are often reformulated as bilinear mixed integer programs through dualization of the inner problem. We develop convex relaxations for these models. In particular, we give a procedure to derive the convex envelope of a single bilinear term over a relaxation of the model. We also describe the corresponding triangulation. We conclude by comparing these results to those obtained through KKT reformulations of interdiction problems.

■ MC56

Hilton - Green Room

Software Demonstrations

Cluster: Software Demonstrations

Invited Session

1 - Maximal Software, Inc. - Server-Based Version of the MPL OptiMax Component Library

Bjarni Kristjansson, President, Maximal Software Inc., 2111 Wilson Boulevard, Suite 700, Arlington, VA, 22201, United States of America, bjarni@maximalsoftware.com

We will be demonstrating the server-based version of the MPL OptiMax Component Library, which makes implementing and deploying real-world optimization applications for servers, clouds, and mobile platforms a relatively quick and easy process, using standard programming languages, such as CSharp, Visual Basic, C/C++ or Python.

2 - See the New KNITRO SQP Algorithm in Action

Richard Waltz, President, Ziena Optimization LLC, waltz@ziena.com

KNITRO is the premier solver for nonlinear optimization problems. This software demonstration will highlight the new KNITRO SQP algorithm. The KNITRO SQP algorithm offers improved performance on select models, as well as warm-start and re-optimization capabilities. We will provide comparisons with the existing active-set and interior-point methods in KNITRO, and examples highlighting the advantage of the SQP approach.

■ MC64

Parc- Cyril Magnin I

POMDPs and Applications

Sponsor: Applied Probability Society

Sponsored Session

Chair: David Brown, Duke University, 100 Fuqua Drive, Durham, United States of America, dbbrown@duke.edu

1 - Bayesian Inventory Management with Change-Points in Demand

Adam Mersereau, Associate Professor, UNC Chapel Hill, CB 3490, Chapel Hill, NC, 27599-3490, United States of America, ajm@unc.edu, Zhe Wang

We consider an adaptive inventory control problem in which at some known points in time, the demand process may change abruptly with some probability. The underlying demand process is never revealed to the decision maker. Using a Bayesian framework, we analyze the optimal policy as demands are observed. We prove structural properties and we construct two novel lower bounds. From our bounds we develop two heuristic policies that exhibit small optimality gaps in numerical testing.

2 - Improving Intelligence Collection through Social Networks

Nedialko Dimitrov, Naval Postgraduate School, Monterey, Monterey, United States of America, ned@nps.edu, Moshe Kress

Intelligence analysts face a glut of information. To produce a complete analysis quickly, an analyst has to identify relevant information within that glut. In this talk, we discuss novel methods of assisting this intelligence collection task by exploiting social network structure.

3 - Near-optimal Regret Bounds for Reinforcement Learning in Factored MDPs

Ian Osband, Stanford University, MS&E Dept, Stanford, Ca, 94305, United States of America, iosband@stanford.edu, Benjamin Van Roy

Any learning algorithm over MDPs will have worst-case regret which grows with the square root of the number of state-action pairs. In many cases of interest the state and action spaces are so huge that it is impossible to guarantee good performance on any reasonable time frame. We show that, if the system can be represented as a factored MDP, we can obtain regret bounds polynomial in the number of parameters of the MDP, which may be exponentially smaller than the number of states or actions.

4 - Duality and Observability in Partially Observable Markov Decision Processes

Stefan Rampertshammer, Duke University, 100 Fuqua Dr, Durham, United States of America, stefan.rampertshammer@duke.edu, David Brown

We examine a continuation-value iteration technique for studying POMDPs which operates without reference to beliefs. We propose a relaxation of the observation structure which leverages the geometry of continuation-value iteration to greatly improve tractability.

■ MC65

Parc- Cyril Magnin II

Stochastic Systems

Sponsor: Applied Probability Society

Sponsored Session

Chair: Mark Squillante, IBM T.J. Watson Research Center, 1101 Kitchawan Rd, Yorktown Heights, United States of America, mss@us.ibm.com

1 - A Service System with On-demand Agent Invitations

Alexander Stolyar, Bell Labs, Alcatel-Lucent, 600 Mountain Ave., 2C-322, Murray Hill, NJ, 07974, United States of America, Sasha.Stolyar@alcatel-lucent.com, Guodong Pang

We consider a system where service agents are invited on-demand, and respond (accept or decline) after a random delay. Arriving customers and accepting agents are matched in the order of their arrival/acceptance. We study asymptotic behavior of a queue-based feedback agent invitation scheme, as the system scale becomes large.

2 - An Infinite-dimensional Skorokhod Map, with Applications to Fluid Limits

Kavita Ramanan, Professor, Brown University, 182 George St, Providence, RI, 02912, United States of America, kavita_ramanan@brown.edu

Scheduling policies such as Earliest-Deadline-First and Shortest-Remaining-Processing-Time serve jobs according to a continuous parameter priority. For both policies, we obtain new formulations of fluid equations and establish convergence to these equations. Our main tool is the introduction of an infinite-dimensional Skorokhod map on the space of measure-valued processes, which may be of independent interest. This is joint work with Rami Atar, Anup Biswas and Haya Kaspi.

3 - Insensitivity of Proportional Fairness in Heavy Traffic

Bert Zwart, CWI, Science Park 123, Amsterdam, Netherlands, Bert.Zwart@cwi.nl, Maria Vlasiou, Jiheng Zhang

A Bandwidth Sharing Network is a mathematical abstraction of a communication network like the Internet. For a network with proportial fairness and a dense class of service requirement distributions, we establish a diffusion limit through a state space collapse result. The invariant distribution is determined by first moments only, confirming a conjecture of Kelly et al.

4 - Improving the Scalability of Search in Networks Through Multiple Random Walks

Mark Squillante, IBM T.J. Watson Research Center, 1101 Kitchawan Rd, Yorktown Heights, United States of America, mss@us.ibm.com, Don Towsley, Sean Barker

Efficient search is of fundamental importance in communications/social networks. Assuming an underlying n-node network topology of expander graphs with bounded degree, we derive hitting time results for multiple random walks (RWs) and establish that multiple RWs scale very well: O(log n) search latency, asymptotically zero search failure probability, and O(1) overhead per query. However, to achieve these properties, it is important to tailor the number of RWs to the popularity of the content.

■ MC66

Parc- Cyril Magnin III

Joint Session QSR/DM: Panel Discussion: Funding Opportunities

Sponsor: Quality, Statistics and Reliability & Data Mining

Sponsored Session

Chair: Hui Yang, Assistant Professor, University of South Florida, 4202 East Fowler Avenue, ENB 118, Tampa, FL, 33620, United States of America, huiyang@usf.edu

1 - Panel Discussion: Funding and R&D Opportunities

Moderator: Hui Yang, Assistant Professor, University of South Florida, 4202 East Fowler Avenue, ENB 118, Tampa, FL, 33620, United States of America, huiyang@usf.edu, Panelists: Ashit Talukder, Romeijn Edwin, Alexandra Medina-Borja

In this panel, program officers and division chief from NSF and NIST will talk about funding opportunities. The panelists are: Dr. Edwin Romeijn and Dr. Alexandra Medina-Borja from National Science Foundation; Dr. Ashit Talukder from NIST.

■ MC67

Parc- Balboa

IIE Transactions Session

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Jianjun Shi, Professor, Georgia Institute of Technology, 765 Ferst Dr NW, Atlanta, United States of America, jianjun.shi@isye.gatech.edu

1 - Ensemble Modeling for Data Fusion in Manufacturing Process Scale-up

Ran Jin, Virginia Tech, Virginia Polytechnic Institute and State, University, 111 Durham Hall,, Blacksburg, VA, 24061, United States of America, jran5@vt.edu, Xinwei Deng

In manufacturing scale-up, design of experiments is widely used to identify optimal process settings, followed by production runs to validate the settings. Both experimental and observational data are collected. However, a single type of data set is often used to model the process. We propose an ensemble modeling strategy to integrate the two types by constrained likelihood approach. Simulations and a case study of wafer manufacturing are provided to illustrate the merits of the proposed method.

2 - High-dimensional Process Monitoring using Embedding Distribution in Reproducing Kernel Hilbert Space

Shuai Huang, Assistant Professor, University of Washington, Industrial and Systems Engineering, United States of America, shuaihuang@usf.edu

We propose a novel RKHS-based control chart and a change point detection method that can be applied to high-dimensional processes with sophisticated process distributions, to detect a wide range of process changes beyond the ones that are detected by traditional SPC methods. Extensive experiments on both simulated and real-world processes demonstrated that the proposed methods lead to improved statistical stability, fault detection power, and robustness.

3 - Optimal Offline Compensation of Shape Shrinkage for 3D Printing Processes

Qiang Huang, Associate Professor, University of Southern California, 3715 McClintock Avenue, Los Angeles, CA, 90089, United States of America, qiang.huang@usc.edu, Jizhe Zhang, Arman Sabbaghi, Tirthankar Dasgupta

Dimensional accuracy is a key control issue in direct 3D printing. We develop a new approach to (1) model and predict part shrinkage, and (2) derive an optimal shrinkage compensation plan to achieve dimensional accuracy. Experimental results demonstrate the ability of the proposed compensation approach to achieve an improvement of one order of magnitude in reduction of geometric errors for cylindrical products.

■ MC68

Parc- Davidson

Recent Trends in Composing Heterogeneous Simulation Models

Sponsor: Simulation

Sponsored Session

Chair: Peter Haas, IBM Almaden Research Center, 650 Harry Road, San Jose, CA, 95120, United States of America, phaas@us.ibm.com

1 - Complex Events Modeling, Simulation, and Analysis (CEMSA)

Nabil Adam, Distinguished Professor and Assoc Provost for Research, Rutgers University, 1 Washington Park, Newark, NJ, 07102, United States of America, adam@adam.rutgers.edu

CEMSA enables analysts quickly integrate data, simulation models, and expertise to arrive at credible consequence analysis of complex events (e.g., a coordinated cyber/physical attack that disables transportation and causes the release of a toxic chemical plume). CEMSA aims to reduce turnaround time and costs, provide enhance interoperability within and across organizations. We present technical detail of some CEMSA components and discuss an example of its possible use.

2 - A Reflective Middleware Framework for Next Generation Multisimulations

Sharad Mehrotra, Professor, University of California, Irvine, 2084 Donald Bren Hall, Irvine, CA, 92617, United States of America, uci.sharadmehrotra@gmail.com, Nalini Venkatasubramanian

We present a reflective middleware framework, RAISE, to integrate multiple autonomous simulators to model complex scenarios. RAISE extracts metamodels from simulators, observes their execution, facilitates information exchange, and reflects the modified features in the integrated simulation. Using a case study from emergency response, we discuss several challenges in enabling accurate multisimulations.

3 - Accelerating the Execution of Stochastic Composite Simulation Models

Peter Haas, IBM Almaden Research Center, 650 Harry Road, San Jose, CA, 95120, United States of America, phaas@us.ibm.com

Stochastic composite simulation models can be used to study complex stochastic "systems of systems". For a composite model made up of loosely coupled component models, we provide a method for speeding up composite-model simulations. To run n Monte Carlo replications of the composite model, we execute certain component models fewer than n times, re-using results as needed. The number of component-model replications is chosen to maximize an efficiency measure as in Glynn and Whitt (1992).

4 - AROMA: A Spatial Agent-Based Software Platform for Integrated Modeling of Natural Resources

Saeed Ghafghazi, PostDoctoral Fellow, Institute for Energy and Environmental Policy, Queen's University, #2312-2424 Main Mall, Vancouver, BC, V6T1Z4, Canada, saeed.ghaf@queensu.ca

This paper presents the development and use of AROMA (Agent-based Resource Optimization Modeling Arena). AROMA is a GIS- and agent- based software platform that allows integrated modeling of natural resources related systems. A case study investigating the impact of supplier-buyer and lumber market dynamics on wood fiber supply chain in Northeastern Ontario is presented and implications for economic and environmental sustainability of the emerging biorefineries in the region are discussed.

■ MC69

Parc- Fillmore

Carbon Footprint and the Management of Supply Chains

Sponsor: Energy Natural Resources and the Environment/ Sustainability and Environment

Sponsored Session

Chair: Arda Yenipazarli, Assistant Professor of Operations Management, Georgia Southern University, College of Business Administration, Department of Management, Statesboro, GA, 30460, United States of America, ayenipazarli@georgiasouthern.edu

1 - Cap and Trade Emissions Trading: An Economic Analysis

Arda Yenipazarli, Assistant Professor of Operations Management, Georgia Southern University, College of Business Administration, Department of Management, Statesboro, GA, 30460, United States of America, ayenipazarli@georgiasouthern.edu

Carbon emissions trading emerges as an effective market-based mechanism to curb the carbon emissions. Using a utility-based model, this paper studies the optimal policy of production and carbon trading decisions of a firm operating in a segmented customer market, and examines the impacts of carbon trade, carbon price and carbon cap on these decisions.

2 - Optimal Carbon Capture and Storage Contracts using Historical CO2 Emissions Levels

Wenbo (Selina) Cai, Assistant Professor, New Jersey Institute of Technology, MEC 308, University Heights, Newark, NJ, 07102, United States of America, cai@njit.edu, Dashi Singham

In an effort to reduce carbon emissions to the atmosphere, carbon capture and storage technology is developed to collect carbon from emissions generators and store it underground. We develop optimization models to facilitate a storage operator's decisions on the price and volume of service contracts to maximize his expected profit subject to the limited capacity at the storage site while encouraging the participation of the emissions sources.

3 - Modeling Carbon Control Policies: Tax versus Cap-and-Trade

Arvind Sainathan, Nanyang Business School, NTU, S3-B2A-03 50 Nanyang Avenue, Singapore, Singapore, asainathan@ntu.edu.sg, S. Viswanathan

We consider and compare the performance of two key carbon control policies: tax and cap-and-trade. We characterize the Stackelberg equilibrium under the tax policy, and the unique trading equilibrium in the cap-and-trade policy. We also consider other well-known mechanisms for carbon control, and compare them with these two policies. Finally, we propose two new schemes and derive key insights based on our analysis.

4 - Adjusting Closed Loop Transportation Capacities to Uncertain Carbon Tax with Stochastic Demands

Seyyed Ali Haddad Sisakht, Iowa State University, 3004 Black Engineering Bldg., Ames, United States of America, alihadad@iastate.edu, Sarah M. Ryan

We formulate a closed-loop supply chain network design problem under carbon tax uncertainty and stochastic demands. We propose a solution approach with adjustable robust optimization where mode transportation capacities and product flows can adapt to changing tax rates and product flows also vary by scenario. Solving the mixed-binary stochastic semidefinite program indicates that increasing carbon tax uncertainty in the initial periods expands the benefit of adjustability.

■ MC70

Parc- Hearst

Incorporating Ecological Concerns into Harvest Scheduling

Sponsor: Energy Natural Resources and the Environment/ Natural Resources

Sponsored Session

Chair: Erin Belval, Colorado State University, Campus Delivery 1472, Fort Collins, CO, United States of America, mccowene@gmail.com

1 - Incorporating Edge Effects Into Harvest Scheduling

Kai Ross, PhD. Student, University of Washington, Loew Hall 304, Seattle, WA, 98195, United States of America, mailkaiross@gmail.com, Sandor Toth

When a forest is cut, new edges are formed altering many ecological factors such as sun exposure and risk to wind throw. We introduce a new harvest scheduling model that incorporates the edge effects of these factors on yield. The mechanics of the model will be illustrated with a case study where the potential loss of yield to wind throw is commercially significant.

2 - Can Sustainable Forest Management Help Mitigate Climate Change?

Marc-André Carle, Assistant Professor, Université Laval, 1065, Avenue de la Médecine, Québec, QC, Canada, Marc-Andre.Carle@osd.ulaval.ca, Mathieu Bouchard, Steve Vallerand, Sophie D'Amours, Martin Simard

In the past decade, carbon concentration in the atmosphere has increased significantly. The potential of forests to help mitigating climate change has been widely acknowledged. This talk presents several modeling strategies for incorporating carbon accounting and sequestration into strategic forest management models. Three case studies from the Province of Quebec will be presented and discussed.

■ MC71

Parc - Lombard

Analysis of Matching Markets

Cluster: Auctions

Invited Session

Chair: Thayer Morrill, NC State University, NC, United States of America, thayer_morrill@ncsu.edu

1 - New Algorithms for Fairness and Efficiency in Course Allocation

Hoda Atef Yekta, PhD Candidate, University of Connecticut, School of Business, 2100 Hillside Road Unit 1041, Storrs, CT, 06269, United States of America, Hoda.AtefYekta@business.uconn.edu, Robert Day

This research formulates the course allocation problem as a multi objective mathematical model considering both efficiency and measures of fairness. Results of four proposed heuristic algorithms are compared with existing mechanisms and we show that our new algorithms can improve both efficiency and fairness of the results.

2 - Internally Stable Matchings and Exchanges

Yicheng Liu, liuyicheng1991@hotmail.com, Pingzhong Tang

We propose an alternative notion of stability for matchings and exchanges, coined internal stability, which only requires stability among matched agents. For internal stability, we analyze the social welfare bounds and computational complexity. Our results indicate that internal stability addresses both the social welfare and computational difficulties associated with traditional stability.

3 - The Secure Boston Mechanism

Thayer Morrill, NC State University, NC, thayer_morrill@ncsu.edu, Umut Dur, Robert Hammond

We introduce a new algorithm that is a hybrid between the Boston and Deferred Acceptance algorithm. While not strategy-proof, this ``secure" Boston algorithm significantly reduces the incentive for students to strategically manipulate their reported preferences while maintaining the desirable feature of the Boston mechanism of assigning as many students as feasible to their favorite school. We run an experiment in order to test the performance of our new assignment procedure.

4 - Two-sided Matching with Incomplete Information

Sushil Bikhchandani, UCLA Anderson School of Management, University of California, Los Angeles, CA, United States of America sushil.bikhchandani@anderson.ucla.edu

Stability in a two-sided matching model with non-transferrable utility (NTU), interdependent preferences, and one-sided incomplete information is investigated. The notion of incomplete-information stability used here is similar to that of Liu et al. (2014). With anonymous preferences, all strictly individually-rational matchings are incomplete-information stable. An ex post incentive-compatible mechanism exists for this model. Extensions to two-sided incomplete information are investigated.

■ MC72

Parc- Stockton

Optimization and Analysis of Smart Grids with Renewable Energy and Storage

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Masood Jabarnejad, PhD Student, Auburn University, 333 East Magnolia Ave. APT 44, Auburn, AL, 36830, United States of America, masood@auburn.edu

1 - Electricity Markets and Operations with Multi-stage Optimization
Alberto J. Lamadrid, Assistant Professor, Lehigh University, 621 Taylor Street, r451, Bethlehem, PA, 18015, United States of America, ajlamadrid@Lehigh.EDU

We present a two stage program for operations and market clearing of the electricity system with high penetrations of renewable energy sources. The formulation is a stochastic program with robust operational reserves for the system operator. The first stage is a multi-period, security constrained Optimal Power Flow (SC-OPF), with Markovian transitions over time, forecasting a fixed time horizon. The second stage is a single period SC-OPF, incorporating the realizations of stochastic variables.

2 - Financial Rights for Energy Storage
Josh Taylor, Asst. Professor, U. Toronto, 10 King's College Rd., Toronto, Canada, josh.taylor@utoronto.ca

The strong analogy between energy storage and transmission motivates us to ask: should storage buy and sell power at wholesale market prices, or should its physical and financial operations be decoupled? The latter case is non-traditional and is the subject of this talk. We define financial storage rights, which enable passive storage to recover costs, redistribute the system operator's budget surpluses, and enable market participants to hedge against nodal price volatility.

3 - Optimization Models and Algorithm for Layouts of Ocean Wave Energy Farms
M. Mohsen Moarefdoost, Lehigh University, 200 W Packer Ave, Bethlehem, PA, United States of America, mom211@lehigh.edu, Lawrence V. Snyder

We present models and algorithms for choosing optimal locations of wave energy conversion (WEC) devices within an array, or wave farm. The location problem can have a significant impact on the total power of the farm due to the complicated hydrodynamic interactions among the devices and ocean waves. The wave energy converter location problem (WECLP) is non-linear and non-convex, so we propose an iterative heuristic for the general problem as well as the model's analytical properties.

4 - Techno-Economic Optimization of a High-Flux Solar Thermal Receiver using Surrogate Models
Michael Wagner, Mechanical Engineer, National Renewable Energy Laboratory, 15013 Denver West Parkway, Golden, CO, 80401, United States of America, Michael.Wagner@nrel.gov, Alexandra M. Newman, Rob Braun

We optimize a novel concentrating solar power tower receiver technology by choosing geometry and optical design. We use computationally expensive engineering models to generate surrogates that represent the objective function, which accounts for revenue as a function both of the design of the system and of the annual plant electricity production. Solar flux and material temperature constraints are highly nonlinear, making it difficult to determine a feasible solution; we present results.

■ MC73

Parc- Mission I

Investment in Electricity Markets

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Golbon Zakeri, Dr., University of Auckland, #70 ymonds street, Auckland, New Zealand, g.zakeri@auckland.ac.nz

1 - A Column Generation Approach for Generation Expansion Planning with High Renewable Penetration
Angela Flores, Research Assistant, Energy Center, University of Chile, Av. Tupper 2007, Santiago, Chile, angelafq@gmail.com, Rodrigo Moreno, Rodrigo Palma, Golbon Zakeri

The high penetration of renewables that is envisaged in future power systems will significantly increase the need for flexible operational measures and generation technologies. These sources of flexibility will need to be properly considered in system expansion models. In this framework, we propose a column generation approach that permits the consideration of Unit Commitment constraints in long-term system planning problems in an efficient fashion.

2 - Investment in Electricity Markets with Risk Averse Agents
Golbon Zakeri, Dr., University of Auckland, #70 ymonds street, Auckland, New Zealand, g.zakeri@auckland.ac.nz, Corey Kok, Andy Philpott

We will present investment results from competitive equilibrium models over electricity markets with risk averse generators and retailers. We will compare investment levels under different risk mitigating structures such as vertical integration with when risk trade through instruments such as contract for differences are implemented.

3 - The Value of Electricity Storage for Intermittent Renewable Integration: A Hybrid Modeling Approach
Claudia Octaviano, Research Associate, MIT, 77 Massachusetts Ave, E19-411, Cambridge, MA, 02139-4307, United States of America, claus@mit.edu

Renewable electricity faces several integration challenges due to its intermittency. While critical to decarbonize the power sector, renewables require storage devices and demand response to reach large-scale deployment. To assess the value of storage, a capacity expansion model with renewable resources at the hourly time-scale is coupled to the MIT EPPA model, a global general equilibrium model. We discuss economy-wide implications of the availability of storage for long-term climate policy.

4 - Including Short-Term Operation Details in Strategic Generation Expansion Models
Adelaida Nogales, Research Assistant, Institute for Research in Technology, Alberto Aguilera, 23, Madrid, Ma, 28015, Spain, adelaida.nogales@iit.upcomillas.es, Efraim Centeno, Sonja Wogrin

Renewable technologies are expected to reach large penetration levels in electric power systems. These technologies are changing the unit commitment of the rest of the generation facilities and therefore, operation-related issues become more relevant for an adequate analysis of generation expansion problems. We propose a generation expansion equilibrium model including an oligopolistic market representation and with key operation-related details. An efficient resolution methodology is proposed.

■ MC74

Parc- Mission II

Stochastic and Robust Optimization in Electric Power Systems Operations and Planning

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Andy Sun, Assistant Professor, Georgia Institute of Technology, 765 Ferst Drive NW, Atlanta, GA, 30332, United States of America, andy.sun@isye.gatech.edu

1 - Strategic Offering for a Wind Power Producer: A Stochastic MPEC Approach
Luis Baringo, Postdoctoral researcher, ETH Zurich, EEH - Power Systems Laboratory, Physikstrasse 3 - ETL G 23, Zurich, 8092, Switzerland, luis.baringo@eeh.ee.ethz.ch, Antonio J. Conejo

A stochastic mathematical program wind equilibrium constraints (MPEC) is proposed to derive the optimal offering strategy of a wind power producer participating in the day-ahead and balancing markets. This producer owns a large enough wind power capacity and is able to behave strategically in order to alter market prices according to its own interest. Uncertainties concerning wind power productions, market prices, and rivals' offering decisions are efficiently modeled using a set of scenarios.

2 - Distributionally Robust Congestion Management with Dynamic Line Ratings
Jianhui Wang, Decision and Information Sciences Division/Argonne National Laboratory, 9700 S. Cass Avenue, Bldg. 221, Argoone, IL, 60439, United States of America, jianhui.wang@anl.gov, Feng Qiu

Dynamic Line Rating or DLR, which monitors the ambient environment to estimate the thermal rating of a transmission line, has been shown to be very effective in utilizing the capacity of transmission lines. In this work, we propose a new distributionally robust optimization based congestion management model that selectively uses DLR to alleviate system congestion while keeping the overloading risk at the system level within a safe range.

3 - Multistage Stochastic Power Generation Expansion Planning

Jikai Zou, Graduate Research Assistant, Georgia Institute of Technology, 765 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, jikai.zou@gatech.edu, Shabbir Ahmed, Andy Sun

We consider a power generation expansion problem with uncertainty in demand and fuel price. In particular, we develop a multistage stochastic mixed integer programming approach to determine the numbers of power plants to be built during the planning horizon. The differences among two-stage, multistage and a "hybrid" models are addressed. We propose an efficient approximation scheme by exploiting a special substructure, and give an analytical bound on the optimality gap of the algorithm.

4 - Do-Not-Exceed Limits for Renewable Resources with Robust Corrective Topology Control

Kory Hedman, Assistant Professor, Arizona State University, PO Box 875706, GWC 206 School of ECEE, Tempe, AZ, 85287-5706, United States of America, Kory.Hedman@asu.edu, Akshay Korad

Do-not-exceed (DNE) limits specify a desired dispatch range that a renewable power producer must stay within in order to maintain reliability. These DNE limits can be determined with robust optimization. Corrective transmission topology control can be used to manage congestion and renewable uncertainty in the smart grid. This talk will present how corrective topology control can be used to improve do-not-exceed limits for renewable resources.

■ MC75

Parc- Mission III

Operations Research to Inform Health Policies

Sponsor: Minority Issues Forum

Sponsored Session

Chair: Maria Mayorga, Associate Professor, North Carolina State University, 111 Lampe Dr., Raleigh, NC, 27695, United States of America, memayorg@ncsu.edu

1 - A Dynamic Programming Model to Assess when it is Optimal to Stop a Trial of Labor

Karen Hicklin, North Carolina State University, 111 Lampe Drive, Campus Box 7906, Raleigh, NC, 27695, United States of America, kthickli@ncsu.edu, Vidyadhar Kulkarni, Meera Viswanathan, Evan Myers, Julie Ivy

The cesarean section rate in the U.S. was reported to be 32.8% in 2011, rising from 4.5% in 1970. Due to the increased risk of short-term complications associated with cesarean sections, among other things, there is general consensus that current rates are too high. A dynamic programming decision model was created to provide time-based thresholds conditional on dilation for when to stop a trial of labor in order to maximize the expected utility of healthy outcomes for the mother and child.

2 - Modeling Smoking Cessation Aid Choices and Outcomes

Rachel Townsley, North Carolina State University, 400 Daniels Hall, College of Engineering, NCSU, Raleigh, NC, 27695, United States of America, rmtownsl@ncsu.edu, Maria Mayorga

Despite declining prevalence, cigarette smoking remains the leading cause of preventable death in the developed world. We use discrete event simulations informed by statistical choice models to model behavior and disease progression and evaluate policy strategies to improve cessation rates in a heterogeneous US population. We focus on quantifying the impact of incentivizing the use of cessation aids to alter smoker choice in a quit attempt, evaluating policies by QALYs gained and societal cost.

3 - The Effect of Mindfulness Meditation on Decreasing the Stroke Incidence in the US

Raj Ambavane, Clemson University, 220 Elm St #321, University Place, Clemson, SC, 29631, United States of America, rambava@g.clemson.edu, Amin Khademi, Lu Shi

Mindfulness meditation has shown promise in clinical trials in reducing systolic blood pressure, one of the main causes of stroke. We develop an agent-based simulation model simulating the stroke trend in the US to estimate the effect of mindfulness meditation on the incidence of strokes. Our results show that mindfulness meditation, if properly utilized along with the regular antihypertensive medication, could be effective in ultimately reducing the incidence of strokes.

4 - A Microsimulation Population Model to Evaluate Sodium Reduction Initiatives in Los Angeles County

Irene Vidyanti, Los Angeles Department of Public Health, 3530 Wilshire Boulevard, Los Angeles, CA, 90010, United States of America, irenevidyanti@gmail.com, Ricardo Basurto-Davila

The Future Elderly Model (FEM) is a microsimulation model originally developed to examine health and health care costs among the elderly national Medicare population. FEM is adapted for use in Los Angeles (LA) County by re-weighting and calibrating to various data sources to form FEM-LA. FEM-LA is then used to evaluate long term health impact of Los Angeles County Department of Public Health's sodium reduction initiatives in population 51 years old and older.

■ MC76

Parc- Embarcadero

The Data Lifecycle - Selected Case Studies

Sponsor: The Practice Track

Sponsored Session

Chair: Rainer Dronzek, Director-Operations Research, McDonald's, 1253 N Schmidt Road, Romeoville, IL, 60446, United States of America, rainer.dronzek@us.mcd.com

1 - The Data Lifecycle: A QSR Case Study

Rainer Dronzek, Director-Operations Research, McDonald's, 1253 N Schmidt Road, Romeoville, IL, 60446, United States of America, rainer.dronzek@us.mcd.com

The lifecycle of data begins with collection and progresses through preparation, analysis, presentation, activation, storage, reuse and destruction. Several specific data sets in the Quick Service Restaurant industry will be presented and the lessons learned, successes and opportunities for each step of the data lifecycle will be discussed. The session will also highlight the realities of dealing with real world data.

2 - So Much Data, So Little Time - A Customer Analytics Perspective

Ben Fuqua, Vice President, Elicit, 525 Third Street North, Suite 509, Minneapolis, MN, 55401, United States of America, ben.fuqua@elicitinsights.com, Jim Sawyer

Analytics professionals can encounter real world problems and wrestle with Big Data with a pragmatic perspective. Understanding what data is important, such as deciding how to gauge Customer's response a retailer's value proposition affords us the opportunity to consider novel solution possibilities and data combinations. The data lifecycle and quality are always restrictions. But navigating those restrictions and leading Senior Executives to data driven decisions requires additional skills.

3 - Sentiment Analytics with Automatic Facial Expression Recognition Software

Marian Bartlett, Co-Founder & Lead Scientist, Emotient, 4435 Eastgate Mall, Suite 320, San Diego, CA, 92121, United States of America, marni@emotient.com, Ed Colby

Dr. Bartlett will explain a state-of-the-art approach applying machine learning, computer vision and cognitive science to facial expression recognition. She will demonstrate the data lifecycle from collection via a standard camera; frame-by-frame processing (detecting emotions, overall sentiment and gender demographics); and show the aggregate, anonymous data visualized as emotion-based heat maps. She will conclude by discussing how this data can be interpreted to derive key business insights.

4 - Too Much Data - When to Focus on What

Oliver Bandte, Customer Analytics Team Manager, The Boston Consulting Group, 35 State St, Boston, MA, United States of America, oliver.bandte@bcg.com

As traditional data scientists have always longed for higher quantities of data to feed the prevalent statistical techniques, we may have come in many organizations to a point where data integrity has to be called into question due to the variety of its sources. Dr. Bandte will demonstrate a few real life examples where "more data" did not always mean "more insght"as data integrety, analytical rigor, and insight actionability started to suffer from data abundance.

■ MC77

Parc- Market Street

Joint Session Analytics/HAS: Predictive and Prescriptive Analytics for Reducing Health Risks

Sponsor: Analytics & Healthcare

Sponsored Session

Chair: Doug Popken, Chief Data Scientist, Next Health Technologies, 5347 S Valentia Way, Englewood, CO, 80111, United States of America, doug.popken@nexthealthtechnologies.com

1 - An Adaptive Risk Grouper for Predicting Health Plan Member Health, Cost, and Attrition Risks

Tony Cox, Chief Sciences Officer, Next Health Technologies, 5347 S Valentia Way, Englewood, CO, 80111, United States of America, tony.cox@nexthealthtechnologies.com

We consider how to optimize the performance of multi-criteria risk "groupers" that predict individual member risks (health, cost, and attrition risks) by adaptively clustering members based on high-information combinations of predictor values. Performance is improved by re-training as new data arrive and using an ensemble of the resulting models to make final predictions. Cross-validation shows the lift from adaptively optimized grouping compared to traditional non-adaptive risk groupers.

2 - E-Cigarettes: Promise, Peril, and Probabilistic Population Prediction

Bill Poland, VP & Lead Scientist, Pharsight, A Certara Company, 100 Mathilda Place Suite 160, Sunnyvale, Ca, 94086, United States of America, bill.poland@certara.com

E-cigarettes, which deliver nicotine without carcinogenic tar, hold the promise to save the lives of many smokers who switch to them, but risks include failure to quit cigarettes (dual use), increased initiation to nicotine products among youth, relapse of former smokers to e-cigarettes, and e-cigarettes becoming a "gateway to smoking." To capture these uncertainties and weigh benefits vs. risks, prediction of e-cigarette health impacts must use a broad range of probability-weighted scenarios.

3 - Big Data Assembly for Optimizing Health Care Metrics

Doug Popken, Chief Data Scientist, Next Health Technologies, 5347 S Valentia Way, Englewood, CO, 80111, United States of America, doug.popken@nexthealthtechnologies.com

Health care insurers want to manage their members in order to maximize retention, minimize costs, and maximize health. Prescriptive approaches being developed by NextHealth Technologies include "nudging" member behavior via targeted messaging. Implementation requires assembling a wide array of historical data at the member level to feed into the models. This talk discusses the content and structure of data required to enable our prescriptive modeling framework.

■ MC78

Parc- Mason

Dynamic Decision Making

Sponsor: Decision Analysis

Sponsored Session

Chair: Robert Winkler, Duke University, Fuqua School of Business, Box 90120, Durham, NC, 27708-0120, United States of America, rwinkler@duke.edu

1 - Idea Generation and Idea Execution

Kevin McCardle, Professor, UCLA Anderson School of Management, 110 Westwood Plaza, Los Angeles, CA, 90095, United States of America, kevin.mccardle@anderson.ucla.edu, Ilia Tsetlin, Robert Winkler

We develop a stochastic dp to determine whether to start and when to stop investing effort on a research project. A project is characterized by: probability it can be successfully completed, arrival rate of that conditional success, payoff if successful, fixed start-up costs, and opportunity cost. The idea is to make opportunity cost endogenous, in the sense that if the current project is abandoned, the only option is to search for similar projects. Analytic and numeric results are presented.

2 - Risk Aversion, Information Acquisition and Technology Adoption

Canan Ulu, Georgetown University, McDonough School of Business, Georgetown University, Washington, DC, 20057, United States of America, cu50@georgetown.edu, James E. Smith

We study the impacts of risk aversion and uncertainty on technology adoption decisions, using a dynamic programming model. The effects of risk aversion on optimal policies can be complex and subtle.

3 - Empirical Stopping Rules

John Mamer, Professor, UCLA Anderson School of Management, Suite D518, 110 Westwood Plaza, Los Angeles, CA, 90095, United States of America, john.mamer@anderson.ucla.edu, Manel Baucells

The classical solution to the optimal stopping problem depends heavily on the decision maker's knowledge of the offer distribution. We explore a general approach to the optimal stopping problem when the offer distribution is not known. Our approach replaces knowledge of the offer distribution with the empirical distribution function, and offers simple decision rules. We explore the performance of these rules both analytically and with Monte Carlo simulation.

4 - Dismissing Decision Tasks: The Optimality of the M–Shaped Structure

Saed Alizamir, Yale University, New Haven, CT, United States of America, saed.alizamir@yale.edu, Francis de Vericourt, Peng Sun

We consider a sequential hypothesis-testing problem where the Decision Maker faces a random stream of decision tasks that accumulate over time, creating congestion. The agent needs to dynamically choose when to terminate the information collection process and make a final decision. The DM can also dismiss tasks from the queue, in the sense that she makes her decision a priori without running any test. We model the problem as a MDP and our analysis reveals the optimality of an M-shaped structure.

■ MC79

Parc- Powell I

50th Anniversary Update from Some Ramsey Award Winners

Sponsor: Decision Analysis

Sponsored Session

Chair: Sam Bodily, John Tyler Professor, Darden School, UVA, 100 Darden Boulevard, Charlottesville, VA, 22903, United States of America, BodilyS@Darden.virginia.edu

1 - Description of Session by Session Chair

Sam Bodily, John Tyler Professor, Darden School, UVA, 100 Darden Boulevard, Charlottesville, VA, 22903, United States of America, BodilyS@Darden.virginia.edu

The 3 speakers will each present 20 minutes of new expository material about what is important to the DA community today. This may include their work on some aspect of DA that has been advanced since they received their award. They have been asked to leave the audience with some provocative questions regarding work in our field. After they speak, I will moderate about 30 minutes of interactive discussion involving the speakers and the audience on their questions and the future of DA.

2 - MultiAttribute Utility: The Next 40 Years

David Bell, Harvard Business School, Boston, MA, United States of America, dbell@hbs.edu

In the early 1970's Keeney and Raiffa started this branch of Decision Analysis. A lot has been accomplished. Is it now a mature field? Or has this been just the beginning?

3 - DA Challenges and Opportunities: An Idiosyncratic View of Decision Analysis

Bob Clemen, Professor Emeritus, Duke University, 100 Fuqua Dr, Box 90120, Durham, NC, 27707, United States of America, robert.clemen@duke.edu

I will present my own view of challenges that decision analysis faces now and in the foreseeable future. Those challenges provide many opportunities, but there are substantial barriers. The future of DA, in my opinion, is not for the weak of heart.

4 - The Past Suggests the Future

James Dyer, The University of Texas at Austin, 2110 Speedway Stop B6500, Austin, TX, United States of America, j.dyer@mccombs.utexas.edu

Experiences from the past still suggest research on unsolved problems, such as conditional probabilities in decision trees and descriptive utility models.

■ MC80

Parc- Powell II

Price, Ambiguity and Value of Information

Sponsor: Decision Analysis

Sponsored Session

Chair: Emanuele Borgonovo, Full Professor, Bocconi University, Via Roentgen 1, Milan, Italy, emanuele.borgonovo@unibocconi.it

1 - Prescriptive Modeling of Ambiguity Aversion: Is it Necessary?
Gordon Hazen, Full Professor, Northwester University, United States of America, gbh305@northwestern.edu

After Ellsberg, we know that individuals tend to be ambiguity (uncertainty) averse for probabilities, a behavior inconsistent with expected utility theory (EU). Here we remind listeners that many decision models have plausible reformulations in which ambiguity aversion can still occur but as a consequence of EU risk aversion. We present examples involving plant licensing, accident analysis, and medicine. We thereby question the need for prescriptive modeling of ambiguity averse preferences.

2 - A Model of Mental Accounting and Reference Price Adaptation
Woonam Hwang, PhD Candidate, London Business School, Regent's park, London, NW14SA, United Kingdom, whwang@london.edu, Manel Baucells

We propose a model of mental accounting for consumption and payment decisions. Consumers hold reference prices in mind, which they use to compare with the benefit of consumption and with the price paid for an item. Reference prices are determined by a memory-based psychological process of adaptation to "price reminders". The model explains a wide array of observed anomalies such as sunk-cost effects, payment depreciation, reluctance to trading, preference for pre-payment, and the flat-rate bias.

3 - Ambiguity-Risk Model and Ambiguity Measure: Separating Ambiguity from Risk in Preference Model
Ying He, Assistant Professor, University of Southern Denmark, Campusvej 55 DK-5230 Odense M, Odense, Denmark, ying.he08irom@utexas.edu, James Dyer, John Butler, Jianmin Jia

We propose a preference condition to separate ambiguity from risk in utility model where ambiguity is modeled by second order lottery. Such a separation model provides an ambiguity measure based on preference. Applying Taylor expansion to this measure, we show that this ambiguity measure is reduced to the variance of the second order lottery. Finally, by assuming further preference conditions, we obtain an additive utility model over three components, namely, value, risk, and ambiguity.

4 - Decisions and Reliability
Alessandra Cillo, Bocconi University, Italy, alessandra.cillo@unibocconi.it, Emanuele Borgonovo

It is critical to understand the relative importance of systems in a decision-making process. Importance measures serve for this purpose. However, the value-sensitivity measures might not be fully informative when the selection among competing alternatives is of concern. While value of information has been invoked as an appropriate sensitivity measure, its link to traditional importance measures has not been discussed yet. This work provides such link.

5 - Probabilistic Sensitivity Analysis: Foundations and Estimation
Emanuele Borgonovo, Full Professor, Bocconi University, Via Roentgen 1, Milan, Italy, emanuele.borgonovo@unibocconi.it, Elmar Plischke, Gordon Hazen

Value of information, density-based, variance-based sensitivity measures can all be obtained from a common rationale. We prove a convergence result for all these techniques that shows that they can be estimated from the same Monte Carlo sample.

■ MC81

Parc- Divisadero

Joint Session Data/AI/HAS: Big Data Analytics and Smart Health II

Sponsor: Data Mining, Artificial Intelligence, & Healthcare

Sponsored Session

Chair: Sung Won Han, New York University, 650 First Avenue, New York, United States of America, sungwonhan2@gmail.com

1 - A Stochastic Appointment Scheduling System for an Outpatient Physical Therapy Service
Peifang Tsai, Assistant Professor, National Taipei Univ of Technology, 1, Sec. 3, Zhongxiao E. Rd., Taipei, 10608, Taiwan - ROC, p.jennifer.tsai@gmail.com

Motivated by an outpatient physical therapy service, the aim of this research is to develop a stochastic overbooking model to enhance the service quality and to increase the utilization of multiple resources. When patients call, they are assigned to appointment blocks. A patient might require more than one resource and a probability of no-show. Two estimation methods were proposed and a numerical example was used to compare this stochastic model with traditional appointment systems.

2 - Recent Development in Methodology for Gene Network Problems and Inferences
Sung Won Han, New York University, 650 First Avenue, New York, NY, United States of America, sungwonhan2@gmail.com, Judy Hua Zhong

This presentation discusses the recent development of methodologies for estimating cancer gene networks, which has been a very important problem in genomic projects for decades. To estimate the network, a directed acyclic graph in terms of probabilistic graphical modeling has been used. However, with those ultra-high dimensional data, the estimation of the gene networks is a very challenging problem. We discuss the recent development based on the score-and-search approach.

3 - Predicting Outcomes of Chemotherapy for Non-Small-Cell Lung Cancer (NSCLC) By Aggregate Level Data
Frank Puk, PhD Student, University of Texas at Arlington, pukkinming@gmail.com, Haomiao Jin, Shinyi Wu

This study aims to develop prediction models that forecast outcomes of chemotherapy for NSCLC using aggregate level data collected from a systematic review. Two methods were explored: 1) a multivariate meta-regression model was developed to predict outcomes of new clinical trials; and 2) a patient-level prediction model was developed using individual data simulated from aggregate level characteristics. The derived models can assist both new clinical trial design and customized chemotherapy.

■ MC82

Parc- Haight

Exact Methods for Multi-Objective Combinatorial Optimization

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Pekka Korhonen, Professor, Aalto University, School of Business, Aalto, FI, 11000, Finland, Pekka.Korhonen@Aalto.fi

1 - Exact Methods for Multi-Objective Combinatorial Optimization
Matthias Ehrgott, Professor, Lancaster University, Bailrigg, Lancaster, United Kingdom, m.ehrgott@lancaster.ac.uk

In this tutorial I will summarise exact approaches to the solution of multi-objective combinatorial optimisation (MOCO) problems. These include generalisations of algorithms for single objective ombinatorial optimisation problems, the two-phase method as a specific approach to solving MOCO problems whose single objective versions are "easy" in a certain sense, general scalarisation techniques and adaptations of branch and bound to deal with multiple objectives.

■ MC83

Parc- Sutro

Big Data Analytics for Various Applications

Sponsor: Data Mining

Sponsored Session

Chair: Seoung Bum Kim, Associate Professor, Korea University, Anam-Dong, Seongbuk-Gu, Seoul 136-713, Seoul, Korea, Republic of, sbkim1@korea.ac.kr

1 - Adaptive Clustering-based Control Chart for Time-varying and Multimode Process Control

Jihoon Kang, PhD Candidate, Korea University, Anam-dong, Seongbuk-gu, Chang-ee guan 816, Seoul, Korea, Republic of, jihoon.kang82@gmail.com, Seoung Bum Kim

Traditional control charts have become restricted in that many manufacturing processes now have unprecedented characteristics. A clustering-based mahalanobis (CBM) control chart integrating a control chart with a clustering algorithm has recently been introduced, and it effectively handles the limitations caused by the distributions containing multimode in-control observations. In the present study, we enhance CBM chart for adaptive monitoring of multimode process under time-varying situation.

2 - Exploring the Relation of Twitter Activity with the Movements in Turkish Stock Market

Mustafa Gökce Baydogan, Assistant Professor, Department of Industrial Engineering, Bogaziçi University, Bebek, Istanbul, 34342, Turkey, mustafa.baydogan@boun.edu.tr, Özgür Güney, Hazan Deniz Marti, Hande Acet

This study explores if social media (especially Twitter) can provide information about the future movements in Turkish Stock Market. Specifically, various features are extracted from tweets for each day to predict the next day activity (i.e. trading volume, percent change in the index). We also explore the use of these features at different granularities (i.e. hourly) to see whether Twitter activity within the day or between the days has better predictive power.

3 - A New Spatial Anomaly Detection Algorithm with Multiple Spatial Maps in Multistage Manufacturing System

Byunghoon Kim, PhD Student, Rutgers University, United States of America, byungkim@scarletmail.rutgers.edu, Young-Seon Jeong, Seung Hoon Tong, In-Kap Chang, Myong-Kee Jeong

The prompt detection of abnormal dynamic random access memory (DRAM) wafers based on multiple spatial maps is one of the primary issues that challenge the process to increase yield rates and product qualities. In this talk, we present a new spatial anomaly detection algorithm for detecting abnormality of a DRAM wafer with multiple spatial maps. The proposed procedure is validated using real-life DRAM wafers for practical viability.

Monday, 4:30pm - 6:00pm

■ MD01

Hilton- Golden Gate 6

Analytics for Surviving Austerity: Doing More with Less

Sponsor: Military Applications Society

Sponsored Session

Chair: Aaron Burciaga, Senior Manager, Operations Analytics, Accenture, Arlington, VA, United States of America

1 - Optimizing Marine Security Guard Assignments

Maro Enoka, Senior Operations Research Analyst, United States Marine Corps, 14014 Trawler Drive, Woodbridge, VA, 22193, United States of America, maro.enoka@gmail.com

The USMC manually assigns 1,500 Marines to 149 embassies annually while attempting to satisfy many assignment requirements. Historically, this has been a laborious process requiring over 6,000 hours per year. This paper introduces an assignment tool that uses a multi-commodity network flow formulation to optimally assign Marines to embassies. The tool dramatically reduces labor hours and creates assignments that are superior to manual assignments with regard to several measures of effectiveness.

2 - Manpower Reductions: Leveraging Existing Tools to Solve Problems beyond Their Design

Randal Allen, Lone Star, 4555 Excel Parkway, Suite 500, Addison, TX, 75001, United States of America, rallen@lone-star.com, Don Hanks

Decision support tools, created to solve specific problems associated with predictive analytics, can be leveraged to answer questions beyond the designer's original intent. Understanding how to map new problems into existing architectures and translate data into tool inputs, is the key to success in extending the utility of existing tools. A powerful example is the use of a decision support tool to measure the impacts of manpower reductions in air traffic control resources.

3 - Delivering High Performance Analytics to USA DoD/GSA Supply Chain Clients

Will Donovan, Accenture, Sowwah Square, 9th Floor, Abu Dhabi, United Arab Emirates, william.c.donovan@accenture.com

The USA General Services Administration was seeking a supply chain solution for war fighter and contractor clients in Afghanistan via supply sourses in Central Asia, and required a complex algorithm to understand actual cost avoidances by consolidating freight in Almaty, Kazakhstan. By combining data from ERP, Transport, Cataloging and a Cloud Based Meta Data Repository into a powerful data application (based in Qlikview), the client received contract mission impact assurance in real-time.

■ MD02

Hilton- Golden Gate 7

TIMES Distinguished Speaker - Haim Mendelson

Sponsor: Technology, Innovation Management and Entrepreneurship

Sponsored Session

Chair: Cheryl Druehl, George Mason University, 4400 University Drive, Fairfax, United States of America, cdruehl@gmu.edu

1 - Online Business Models

Haim Mendelson, Stanford Graduate School of Business, 655 Knight Way, Stanford, US, 94305-7298, United States of America, haim@stanford.edu

There's a lot of talk about business models these days, especially in innovation and entrepreneurship circles. I'll start by suggesting a simple way to think about business models, and we'll apply it to a number of online and offline scenarios. We'll then consider the business models of Facebook applications and discuss quantitative metrics that characterize them, based on joint research with Ken Moon.

■ MD03

Hilton- Golden Gate 7

Experimental Economics in E-Commerce

Sponsor: eBusiness

Sponsored Session

Chair: Rajiv Mukherjee, Assistant Professor, Southern Methodist University, 6212 Bishop Blvd., Dallas, TX, 75275, United States of America, rmukherjee@mail.smu.edu

1 - Evolution of Trust under Information Sharing, Advice and Delegation

Yu Wang, Assistant Professor, The University of Texas at Dallas, 800 W Campbell Rd, United States of America, yuwang@utdallas.edu, Özalp Özer, Upender Subramanian

Trust has been identified as a crucial success factor for channel cooperation. For example, despite the potential for opportunistic behavior, some retailers rely upon manufacturers who have more information about their product to assist them in store-level decisions. Using laboratory experiments, we study (i) to what extent trust develops or deteriorates over time and (ii) how different forms of assistance affect the evolution of trust and cooperation.

2 - Flexibility and Consumption: An Experimental Investigation

Sreekumar Bhaskaran, Associate Professor, Southern Methodist University, 6212 Bishop Blvd., Dallas, TX, 75275, United States of America, sbhaskar@mail.cox.smu.edu, Sanjiv Erat, Rajiv Mukherjee

In this paper, we investigate how the flexibility to defer or advance consumption affects a consumer's decision about to when to actually consume a product or service. The effect of this flexibility on capacity choice is also considered.

3 - Learning under Uncertainty with Multiple Priors - An Experiment
Yaroslav Rosokha, Assistant Professor, Purdue University, yrosokha@purdue.edu

We investigate the learning process under uncertainty using the multiple priors model of Epstein and Schneider (2007). We gather data for subjects making a sequence of decisions that are concurrent with arrival of new information (signals). We estimate the set of priors, the worst- and the best- case scenarios considered by subjects at different moments in time.

4 - Prediction Markets and Biases
Karthik Kannan, Purdue University, 403 W State Street, West Lafayette, IN, United States of America, kkarthik@purdue.edu

We analyze how biases such as homophily and social influence affect the efficacy of prediction markets. Using an analytical model as well as an experimental setup, we confirm the negative impact of such biases on information aggregation and suggest insights into mitigating the negative effects. Thus, we evaluate the role of network structure on the efficacy of the wisdom of crowd activities.

■ MD04

Hilton- Continental 1

Social Operations Management

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Ming Hu, Assistant Professor, Rotman School of Management, University of Toronto, 105 St George Street, Toronto, ON, Canada, Ming.Hu@rotman.utoronto.ca

1 - Dynamic Pricing in the Presence of Social Learning and Strategic Consumers
Yiangos Papanastasiou, London Business School, Regent's park, London, United Kingdom, yiangosp@london.edu, Nicos Savva

When a product of uncertain quality is first introduced to market, consumers may be enticed to strategically delay their purchasing decisions in anticipation of the product reviews of their peers. This paper investigates how the presence of social learning affects the strategic interaction between a dynamic-pricing monopolist and a forward-looking consumer population.

2 - Dynamic Pricing of Experience Goods: The Impact of Consumer Reviews
Man Yu, HKUST Business School, Clear Water Bay, Hong Kong, Hong Kong - PRC, manyu@ust.hk, Laurens Debo, Roman Kapuscinski

In this talk, we focus on dynamic pricing of experience goods whose quality is initially unknown both to consumers and to the firm, but the early buyers can communicate their experiences after consumption via e.g. word-of-mouth, websites, smartphones applications or other media.

3 - Peer Effect of iPhone Adoption in Mobile Communication Networks
Tony Ke, UC Berkeley, IEOR, Etcheverry Hall, Berkeley, CA, 94720, United States of America, kete@berkeley.edu, Zhuqing Yang

We construct a social network using one year's mobile calls between all subscribers in a big city in China. The strength of social ties is measured by call duration. Based on the network, we identify the peer effect of iPhone adoptions, by using subscribers' birthdays as an instrument variable. Implications on how network ties and network structures modulate the peer influence will be covered.

■ MD05

Hilton- Continental 2

MSOM Student Paper Competition Finalists

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Guillaume Roels, UCLA, 110 Westwood Plaza, B511, Los Angeles, CA, 90066, United States of America, guillaume.roels@anderson.ucla.edu

Co-Chair: Goker Aydin, Associate Professor, Indiana University, Kelley School of Business, Bloomington, IN, 47405, United States of America, ayding@indiana.edu

Co-Chair: Gil Souza, Associate Professor, Indiana University, Kelley School of Business, Bloomington, IN, 47405, United States of America, gsouza@indiana.edu

1 - 2014 MSOM Student Paper Competition Finalists
Gil Souza, Associate Professor, Indiana University, Kelley School of Business, Bloomington, IN, 47405, United States of America, gsouza@indiana.edu

The MSOM Student Paper Competition is awarded annually by the Manufacturing & Service Operations Management Society at the INFORMS Annual Meeting for papers judged to be the best in the field of operations management.

■ MD06

Hilton- Continental 3

Nonprofit Operations

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Sripad Devalkar, Indian School of Business, ISB Campus Gachibowli, Hyderabad, India, sripad_devalkar@isb.edu

1 - Nonprofit Logic Models as Production Process Maps
Natalie Privett, Assistant Professor of Management and Policy, Robert F. Wagner Graduate School of Public Service, 295 Lafayette St, 2nd Floor, New York University, New York, NY, 10012, United States of America, natalie.privett@nyu.edu

Nonprofit organizations ultimately strive to produce social change by means of delivering specific goods and services. In the nonprofit sector, the logic model is a popular strategic management tool that visually links an organization's resources, activities, outputs, and outcomes. From an operations perspective, logic models have the potential to be leveraged as production process maps to increase operational efficiency, bridge nonprofit and operations theory and ultimately achieve outcomes.

2 - Signaling Operational Efficiency through Intermediate Results in Non-profit Markets
Milind Sohoni, Associate Professor, Indian School of Business, milind_sohoni@isb.edu, Sripad Devalkar

A common concern with non-profit markets is the lack of credible information about a NPO's operational efficiency. We study a model that allows a NPO to monitor, and release information about, intermediate benefits delivered to signal efficiency to donors. The trade-off, in such situations, is between the additional overhead and the increased probability of raising donations. We analyze when such a model could result in higher sustainability of a development project.

■ MD07

Hilton- Continental 4

Simulation Based Education in Supply Chain and Project Management

Cluster: Tutorials

Invited Session

Chair: Yale T. Herer, Technion - Israel Institute of Technology, Faculty of Industrial Engineering, Haifa, 32000, Israel, yale@technion.ac.il

1 - Simulation Based Education in Supply Chain and Project Management
Avinoam Tzimerman, Technion - Israel Institute of Technology, Faculty of Industrial Eng. and Manage., Haif, 32000, Israel, AvinoamT@Technion.ac.il, Avraham Shtub, Yale T. Herer

We present two state-of-the-art simulators for simulation based training (SBT) in Operations Management education. Both simulators are built on the concepts of ease of use, scenario based training, flexibility, and supportive data. We present an overview of SBT and demonstrate the two simulators by presenting exercises that highlight the benefits of using educational simulators along with classroom instruction. Attendees will gain an appreciation of how these simulators can help them in the classroom.

■ MD08

Hilton- Continental 5

Nicholson Student Paper Prize

Cluster: Nicholson Student Paper Prize

Invited Session

Chair: Kavita Ramanan, Professor, Brown University, 182 George st, Providence, RI, 02912, United States of America, kavita_ramanan@brown.edu

1 - Nicholson Student Paper Prize
Kavita Ramanan, Professor, Brown University, 182 George st, Providence RI 02912, United States of America, kavita_ramanan@brown.edu

The George Nicholson Student Paper Competition is held each year to identify and honor outstanding papers written by a student in any area represented by INFORMS. The top participants in this competition are selected as finalists by the prize committee and invited to present their work in these sessions.

■ MD09

Hilton- Continental 6

Big Data Optimization for Data Mining and Statistical Analysis

Sponsor: Optimization/Computational Optimization and Software

Sponsored Session

Chair: Joshua Griffin, SAS Institute Inc., 100 SAS Campus Drive, Cary, United States of America, joshua.griffin@sas.com

1 - High Performance Second-Order Procedures for Dense SVM and Quantile Regression
Yan Xu, Senior Manager, SAS Insitute Inc., 100 SAS Campus Dr., Cary, NC, 27519, United States of America, yan.xu@sas.com, Joshua Griffin

Quantile Regression and SVM classifiers require solutions to large-scale linear and quadratic optimization problems respectively. In special cases, a low-rank factorization of the reduced primal-dual Augmented system is available. This factorization can be exploited in a parallel computing environment, permitting dense problems with billions of observations to be efficiently solved.

2 - Quasi-Newton Extensions of an Active-set Approach for Mixed Linear Models
Wenwen Zhou, SAS Institute Inc., Cary, United States of America, Wenwen.Zhou@sas.com

A primal-dual regularized augmented Lagrangian active-set approach is modified to accept inexact second-order Quasi-Newton approximation. This is crucial for many optimization problems arising in statistics and data mining where the true Hessian is expensive and or unavailable

3 - Distributed Hessian-Free Optimization for Data Mining Applications
Joshua Griffin, SAS Institute Inc., 100 SAS Campus Drive, Cary, United States of America, joshua.griffin@sas.com, Ben-Hao Wang

This talk focuses on several Hessian-free approaches in a distributed environment for bound constrained optimization with expensive function evaluations, where Hessian matrices, as well as Hessian-vector products, are either prohibitive computationally or unavailable.

■ MD10

Hilton- Continental 7

Disruptive Technologies and Business Models

Sponsor: Manufacturing & Service Operations Management

Sponsored Session

Chair: Vibhanshu Abhishek, Assistant Professor, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PE, 15213, United States of America, vibs@andrew.cmu.edu

1 - Agent Behavior in the Sharing Economy: Evidence from AirBnB
Jun Li, Assistant Professor, Ross Business School, University of Michigan, 701 Tappan Street, Ann Arbor, MI, 48109, United States of America, junwli@umich.edu, Dennis Zhang, Antonio Moreno-Garcia

Using availability and pricing data from a rising peer-to-peer online hospitality service platform — AirBnB, we study agent behavior in the sharing economy.

2 - Agent Behavior in the Sharing Economy: Evidence from AirBnB
Dennis Zhang, Kellogg School of Management, Evanston, IL, 60208, United States of America, zjj1990228@gmail.com, Antonio Moreno-Garcia, Jun Li

Using availability and pricing data from a rising peer-to-peer online hospitality service platform — AirBnB, we study agent behavior in the sharing economy.

3 - Sharing Economy - A Model of Shared Resource Utilization
Vibhanshu Abhishek, Assistant Professor, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PE, 15213, United States of America, vibs@andrew.cmu.edu, Jose Guajardo

The emergence of shared resource utilization as a consumer trend in many markets is imposing new challenges for incumbent firms in certain markets. These enjoyed economies of scale and hence created high entry barriers for new entrants to compete profitable. However, the use of spare capacity to provide services has started to present a credible threat to incumbent firms in these markets. In this paper, we formulate a model that characterizes the supply side when faced with a sharing economy.

4 - Channel Integration & Sales Concentration: Empirical Evidence
Ioannis Stamatopoulos, PhD Student, Northwestern University, 1400 Chicago, Evanston, IL, 60201, United States of America, aikalaaa@gmail.com, Antonio Moreno-Garcia, Santiago Gallino

Competing for an increasingly demanding customer pool, retailers progressively integrate their B&M and Online channels. In this paper, using a proprietary dataset coming from the implementation of a Ship to Store (StS) capability of a large US housewares retailer, we find that StS causes a statistically and economically significant drop in sales concentration.

■ MD11

Hilton- Continental 8

Managing Relationships in Supply Chains

Sponsor: Manufacturing & Service Operations Management/Supply Chain

Sponsored Session

Chair: Sammi Yu Tang, Assistant Professor, University of Miami, 5250 University Drive, Coral Gables, FL, 33146, United States of America, ytang@miami.edu

1 - Inspection and Cooperation in Supply Quality Management
Cuihong Li, University of Connecticut, 2100 Hillside Road, Storrs, CT, United States of America, Cuihong.Li@business.uconn.edu

We study a buyer purchasing from a supplier with the concern of quality. The buyer can inspect the incoming units to penalize the supplier for defects, or cooperate with the supplier to improve the quality. We consider both complementary and substitutable relationships between the buyer's and supplier's quality improvement efforts.

2 - Resource Allocation in Humanitarian Setting: Inventory and Disease Progression
Jayashankar Swaminathan, Professor, UNC-CH, McColl Bldg., Chapel Hill, NC, United States of America, msj@unc.edu, Karthik Natarajan

In this paper we study inventory management in the context of supplementary food and disease progression in a finite time horizon. In addition to presenting structural properties, we will explore the efficacy of pragmatic heuristics in this context.

3 - Supplier Diversification under Random Yield and Price Dependent Demand
Nan Yang, Assistant Professor, Olin Business School, Washington University in St. Louis, Campus Box 1156, 1 Brookings Drive, St. Louis, MO, 63130, United States of America, yangn@wustl.edu, Lingxiu Dong, Guang Xiao

We consider a firm's supply diversification problem when it faces supply random yield and price sensitive demand. We study two pricing schemes: responsive pricing and ex ante pricing. We characterize the sourcing decisions under each pricing scheme and compare them to study the strategic relation between diversification and pricing in hedging against supply uncertainty.

4 - Managing Competition and Cooperation in Supply Chains
Shuya Yin, University of California, Irvine, Merage School of Business, Irvine, CA, 92697, United States of America, shuya.yin@uci.edu, Saibal Ray, Yuhong He

Upstream suppliers often need to decide whether or not to reply on dominant retailers in the market place when they sell through the downstream partners. On one hand, powerful retailers would help the upstream suppliers gain strong market shares. But on the other hand, these retailers may use their market dominance to negotiate better contract terms with their suppliers. We propose an economic model to gain some understanding of the basic trade-offs involved in such decision making processes.

5 - Procurement Contracting under Product Recall Risk
Gang Wang, University of North Carolina at Chapel Hill, Kenan-Flagler Busienss School, Chapel Hill, NC, 27599, United States of America, Gang_Wang@kenan-flagler.unc.edu, Lauren Lu, Jayashankar Swaminathan

Managing product quality and mitigating the financial impact of product recalls pose great challenges to manufacturers due to demand uncertainty and non-contractibility of suppliers' quality effort. To understand the interdependence of supply chain quantity and quality decisions, we develop a procurement contractual framework under both demand and recall risks.

■ MD12

Hilton- Continental 9

Empirical Operations Management and Sustainability

Sponsor: Manufacturing & Service Operations Management/Sustainable Operations

Sponsored Session

Chair: Ruben Lobel, University of Pennsylvania, 3730 Walnut St, JMHH - suite 500, Philadelphia, PA, 19104, United States of America, rlobel@wharton.upenn.edu

1 - Drivers of Product Expiration in Retail Supply Chains
Arzum Akkas, MIT, 77 mass ave, cambridge, ma, 02142, United States of America, aakkas@mit.edu, David Simchi-Levi, Vishal Gaur

Using a zero inflated negative binomial model applied to propriety archival data, we examine the degree to which product expiration of consumer packaged goods at retail stores is related to store operations, supply chain practices, and product configuration decisions. Our work identifies how much manufactures versus retailers contribute to the drivers of expiration. This will help alleviate the incentive issues related to reimbursement schemes for the cost of expired products.

2 - Understanding Customers Retrials in Call Centers: An Empirical Study
Gad Allon, Northwestern University - Kellogg, 2001 Sheridan Rd., Evanston, IL, United States of America, g-allon@kellogg.northwestern.edu, Achal Bassamboo, Kejia Hu

We study the impact of waiting times and service quality on the retrial behavior of customers in a call center.

3 - An Empirical Investigation of the Productivity Paradox
Kamalini Ramdas, London Business School, Regent's Park, London, United Kingdom, kramdas@london.edu, Jonathan Williams

Research in economics and operations management has identified huge variation in productivity within the same geographic regions, industries, and even firms. Using data from the US automotive industry, we examine key drivers of variation in productivity in automotive assembly plants. We develop insights for managers and highlight avenues for future research.

4 - Operations Management in Sustainable Production Systems
Farnaz Ghazi Nezami, Assistant professor, Kettering University, Industrial and Manufacturing Engineering Department, 1700 University Ave., Flint, MI, United States of America, fghazinezami@kettering.edu

In this study, a mathematical model is presented to investigate the integrated maintenance-production planning problem. The objective is to minimize the total cost of production, maintenance and energy with respect to demand, reliability and energy consumption profile of the machine in a multi-period, multi-product environment.

■ MD14

Imperial B

External Letters of Recommendation for Tenure: Hear from those Who Write and Read Them

Sponsor: Junior Faculty Interest Group

Sponsored Session

Chair: Hakan Yildiz, Assistant Professor, Michiagn State University, 632 Bouge Street, East Lansing, Mi, 48824, United States of America, yildiz@bus.msu.edu

1 - External Letters of Recommendation for Tenure: Hear from those who Write and Read Them
Hakan Yildiz, Assistant Professor, Michiagn State University, 632 Bouge Street, East Lansing, Mi, 48824, United States of America, yildiz@bus.msu.edu, Alice E. Smith, Manus Rungtusanatham, Ravi Anupindi, James Bookbinder, Raghu Raghavan

External letters of recommendation are required as part of the tenure process. These letters are solicited from leading scholars in the relevant discipline at peer institutions. In this panel, we will hear from a diverse set of leading scholars who have been involved in several tenure evaluations, both in the form of acting as an external reviewer and internal decision maker. If you have any questions/topics that you want the panel to address, please send an e-mail to yildiz@msu.edu

■ MD15

Hilton- Exec. Boardroom

Applications of DEA

Cluster: Data Envelopment Analysis

Invited Session

Chair: John Ruggiero, University of Dayton, Dayton, OH, United States of America, jruggiero1@udayton.edu

1 - Evaluating MMA Judging Nonparametrically
John Ruggiero, University of Dayton, Dayton, OH, United States of America, jruggiero1@udayton.edu

In this paper, we analyze decision making of mixed martial arts judges. We extend the nonparametric DEA model to estimate indifference curves. The approach allows us to derive a measure of consistency of a given judges performance. Our application focuses on controversial fights in the UFC.

2 - Likelihood Ranking of Decision Making Units
Markku Kallio, Professor, Aalto University, Runeberginkatu 22-24, Helsinki, Finland, markku.kallio@aalto.fi

For decision making units (DMUs), we assume that the input-output vectors represent a random sample of some probability distribution, for example, a multi-variate log-normal distribution. For efficiency analysis of the DMUs we employ common prices for all DMUs and choose such prices based on maximum likelihood estimates. We define the profit based ranking criterion for each DMU by the likelihood that the random profit is at most the profit of that DMU. Return based ranking is defined similarly.

3 - Malmquist and Hicks-Moorsteen Productivity Indexes for Cluster Analysis
Diogo Filipe Cunha Ferreira, Dr, Instituto Superior Tècnico (IST), University of Lisbon, Av. Rovisco Pais, Lisbon, 1049-001, Portugal, diogo.cunha.ferreira@tecnico.ulisboa.pt, Rui Cunha Marques

This work discusses the usefulness of Malmquist and Hicks-Moorsteen indexes for cluster efficiency spread and productivity gaps analysis. It is proposed working out with geometric distance functions and super-efficient slack-based directional distance functions that may account for subjective criteria. Finally, a robust three-step bootstrap-based algorithm is presented, which overcomes a lot of non-parametric methods shortcomings and incorporates environmental information when it is required.

4 - Input Substitutability in English Higher Education
Jill Johnes, Senior Lecturer Economics, Lancaster University, LUMS, Lancaster, LA14YX, United Kingdom, j.johnes@lancaster.ac.uk

This paper investigates input substitutability in English higher education and compares merging and non-merging institutions. A stochastic frontier translog output distance function is estimated using a thirteen-year panel of data for all institutions in England. Some differences between merging and non-merging institutions in labour and capital substitutability are revealed, and administrative input becomes an abundant resource for merged institutions. Policy implications are discussed.

5 - Performance Benchmarking of School Districts in New York State
Thomas Sexton, Stony Brook University, 317 Harriman Hall, Stony Brook University, Stony Brook, NY, 11790-3775, United States of America, Thomas.Sexton@StonyBrook.edu, Kelly Stickle, Shane Higuera, Christie Comunale

We apply DEA as a benchmarking methodology to measure the performance of New York State school districts and provide detailed alternative improvement programs for each district. In the 2011-12 academic year, New York State's 695 school districts spent $53.7 billion to educate almost 2.7 million elementary and secondary pupils, at a cost of over $19,000 per pupil. Elementary and secondary education accounts for nearly one-quarter of all state and local expenditures in New York State.

■ MD16

Hilton- Franciscan A

New Models in Revenue Management and Pricing

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Sami Najafi-Asadolahi, Assistant Professor, Santa Clara University, Leavey School of Business, 500 El Camino Real, Santa Clara, CA, 95053, United States of America, snajafi@scu.edu

1 - Impact of Sourcing on Retailers' Optimal Store-Brand Quality and Pricing Decisions
Candi Yano, Professor, IEOR Dept. and Haas Sch. of Bus., UC Berkeley, Berkeley, CA, 94720, United States of America, yano@ieor.berkeley.edu, Bo Liao

Store brand products may be produced in-house, by a third-party supplier, or by a national-brand manufacturer of competing products. We derive equilibrium results to show how the combination of sourcing and pricing power affects the retailer's optimal store-brand quality and prices for both the store- and national-brand products. Among other things, we find that the retailer may use the lever of store-brand quality in unintuitive ways to improve his profitability in this competitive setting.

2 - Price Incentives for Online Retailers using Social Network Information
Ludovica Rizzo, MIT, lrizzo@mit.edu, Xubo Sun, Georgia Perakis, Maxime Cohen, Marjan Baghaie

We consider an online retailer with social network information about its customers (friends, referrals, etc.). Since its customers are heterogeneous, we propose and analyze a clustering model according to social network information to estimate the buying probability of customers and subsequently a model for providing targeted discounts to "influencers". This gives rise to a bilevel optimization problem. We test our approach with real data. This work is in collaboration with an online retailer.

3 - A La Carte or Buffet: Pricing for Grocery Delivery
Elena Belavina, Assistant Professor, University of Chicago Booth School of Business, 5807 S Woodlawn Ave, Chicago, United States of America, belavina@uchicago.edu, Karan Girotra

Grocery delivery is a market that many try to conquer. Appropriate pricing is key for success. There is little consensus among different players (at times even within one firm operating in different locations) on what is the best pricing scheme. For example, Amazon Fresh in Seattle is using per order pricing while in San Francisco - subscription fee. We provide recommendation for the preferred pricing scheme based on various characteristics (delivery logistics, demand variability etc.).

4 - Is Over-Promising of Product Features Desirable When Consumers are Loss-Averse?
Sami Najafi-Asadolahi, Assistant Professor, Santa Clara University, Leavey School of Business, 500 El Camino Real, Santa Clara, CA, 95053, United States of America, snajafi@scu.edu, Nishant Mishra, Andy Tsay

We consider a firm selling two versions of a single product at different times to consumers who are loss-averse. In the first period, each consumer decides whether to buy a single unit of the first version, and if he does, whether to continue buying a single unit of the second version when it is released. We find that over-promising the features in the first version may benefit the firm's profitability by increasing consumers' willingness to buy the second version.

■ MD17

Hilton- Franciscan B

Innovation in Services and Retail

Sponsor: Manufacturing & Service Operations Management/Service Operations

Sponsored Session

Chair: Antonio Moreno-Garcia, Kellogg School of Management, 2001 Sheridan Rd, MEDS Department, Evanston, IL, 60208, United States of America, a-morenogarcia@kellogg.northwestern.edu

1 - Inventory Showrooms in Online Retail
Antonio Moreno-Garcia, Kellogg School of Management, 2001 Sheridan Rd, MEDS Department, Evanston, IL, 60208, United States of America, a-morenogarcia@kellogg.northwestern.edu, David Bell, Santiago Gallino

Using data from a leading online retailer of eyewear, we study the effect of opening brick and mortar showrooms to display inventory that can be ordered online.

2 - User-Path Approach and Efficient Implementation in Online Content Recommendation Services
Yonatan Gur, Assistant Professor, Stanford University, 655 Knight Way, Stanford, CA, United States of America, ygur@stanford.edu, Omar Besbes, Assaf Zeevi

A new class of online services allows media sites to direct readers from articles they currently read to other suggested web-based content. Based on a rich database we propose a class of user-path focused heuristics for creating recommendations. We validate and measure the value captured by suggested policies compared to current practice through a controlled experiment. Our work is based on collaboration with a leading provider of online content recommendations.

3 - Learning Local Relationships in Networks with Observational or Experimental Data
Spyros Zoumpoulis, INSEAD, Boulevard de Constance, Fontainebleau, 77305, France, szoumpou@mit.edu

We infer local relationships between networked entities based on data, focusing on quantifying the rate of learning. Our theoretical results are guarantees on the rate of learning expressed in terms of the number of needed samples/experiments. We show applications in (i) making marketing decisions; (ii) inferring how consumers influence one another in the context of mobile app installations; (iii) inferring causal relations between brain regions during epileptic seizure events.

4 - Inventory Management for Luxury Goods
Ruslan Momot, INSEAD, Boulevard de Constance, Fontainebleau, 77305, France, Ruslan.Momot@insead.edu, Elena Belavina, Karan Girotra

Firms selling conspicuous goods face a trade-off: producing more allows for extracting more revenues but compromises the product's reputation for exclusivity. We capture this trade-off in a dynamic model of strategic customer and firm behaviour that includes limited memory. Firms should follow stationary cyclic strategies alternating scarcity and overproduction. The former builds a reputation whereas the latter exploits it. The longer the customer memory, shorter is the overproduction phase.

■ MD18

Hilton- Franciscan C

Practice-driven Revenue Management II

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: So Yeon Chun, Assistant Professor, McDonough School of Business, Georgetown University, 3700 O St NW, Washington, United States of America, sc1286@georgetown.edu

1 - Dynamic Pricing and Inventory Control for Nonperishable Products with Demand Learning
Boxiao Chen, University of Michigan, 1919 McIntyre Drive, Ann Arbor, MI, 48105, United States of America, boxchen@umich.edu, Xiuli Chao, Hyun-Soo Ahn

We consider a finite horizon problem of dynamic pricing and inventory control for a nonperishable product. We develop an data-driven policy that does not require explicit information about random demand and show that it is asymptotically optimal with a provable bound.

2 - Dynamic Pricing and Loyalty-reward Program

Hakjin Chung, University of Michigan, Tappan St 701, R4431, Ann Arbor, MI, 48109, United States of America, hakjin@umich.edu, So Yeon Chun, Hyun-Soo Ahn

We study the impact of loyalty program on the seller's pricing strategy and revenue. In particular, we examine how the option to pay with reward points influence a consumer's choice on how she/he buys. We then incorporate the consumer's behavior into a dynamic pricing problem and study how the terms of reimbursement (i.e., the revenue that the seller receives from reward sales) affect the seller's pricing strategy.

3 - Optimal Pricing of Reservations and Advance Selling in Queues

Jaelynn Oh, Assistant Professor, University of Utah, jaelynn.oh@business.utah.edu, Xuanming Su

Customers who make reservations in advance do not have to wait in line when they arrive for service. We study whether and how firms should charge for reservations and relate our results to advance selling strategies.

4 - Pricing Sponsored Content in Wireless Networks with Multiple Content Providers

Martin I Reiman, DMTS, Alcatel-Lucent Bell Labs, 600 Mountain Ave., Murray Hill, NJ, 07974, United States of America, martyreiman@gmail.com, Matthew Andrews, Yue Jin

We consider a wireless service provider (SP) that offers a 'sponsored content' service to multiple content providers (CPs), modeling it as a sequential game. The SP moves first, setting prices for sponsoring. Then the CPs react by deciding how much content to sponsor. Finally the end users react by accessing content depending on what has been sponsored. We solve this problem under a variety of assumptions related to the SP's knowledge of parameters and ability to price discriminate.

■ MD19

Hilton- Franciscan D

Product Quality, Information, Social Learning, and Pricing

Sponsor: Revenue Management & Pricing

Sponsored Session

Chair: Xuying Zhao, University of Notre Dame, 361 Mendoza College of Business, Notre Dame, IN, 46545, United States of America, Xuying.Zhao.29@nd.edu

1 - The Impact of Online Consumer Review Valence on a Firm's Pricing

Xuying Zhao, University of Notre Dame, 361 Mendoza College of Business, Notre Dame, IN, 46545, United States of America, Xuying.Zhao.29@nd.edu, Zhan Pang

For experience products or services, prior users' experiences and review ratings will impact the remaining potential consumers' willingness to pay (or valuation). We study the the impact of online consumer review valence on a firm's pricing and profit.

2 - Quality Provision with Heterogeneous Consumer Reservation Utilities

Rachel Chen, University of California at Davis, 3208 Gallagher Hall, Davis, CA, 95691, United States of America, rachen@ucdavis.edu, Lian Qi, Leon Zhu

We study how a monopolist selects its optimal quality level and price when consumers differ in their willingness-to-pay (WTP) for quality and reservation utility for the basic product. We find that firms might want to offer higher quality products during an economic recession. For the optimal product line, we show that due to the heterogeneity in consumer reservation utilities the concern for cannibalization may distort the product quality upwards.

3 - Optimal Procurement Design in the Presence of Asymmetric Yield and Cost Information

Xiang Fang, University of Wisconsin-Milwaukee, 3202 N Maryland Avenue, Milwaukee, WI, 53211, United States of America, fangx@uwm.edu, Yuanjie He

We study a two-tier decentralized supply chain with a supplier and a retailer. The supplier's production process is subject to a random yield. The retailer faces uncertain demand. The supplier may hold private information regarding its random yield distribution and/or production costs. We derive the optimal menu of contracts for the retailer and then we analyze the value of information to the supplier, the retailer and the entire supply chain.

4 - Overbooking and Cancellation under Dynamic and Static Policies

Wei Wang, Scientist, PROS Inc, 3100 Main St, #900, Houston, TX, 77002, United States of America, weiwang@pros.com, Darius Walczak

Overbooking and cancellation are important topics for revenue management and pricing, and much research including a dynamic programming based solution have been done on these topics. However in practice airlines today are still applying static approaches. We present a comparison on modelling overbooking and cancellation using both dynamic and static policies.

■ MD20

Hilton- Yosemite A

Transportation Analytics

Sponsor: Analytics

Sponsored Session

Chair: Sudip Bhattacharjee, University of Connecticut, 2100 Hillside Road, U-1041, Storrs, CT, United States of America, sbhattacharjee@business.uconn.edu

1 - Stack Train Aerodynamic Optimization

Steven Tyber, General Electric, 1 Research Circle, K1-4A66, Niskayuna, NY, 12309, United States of America, tyber@ge.com, Bex Thomas, Amal Desilva

Over the past 20 years, the growth of intermodal (IM) freight has exceeded that of every other commodity group transported via rail. Revenues generated by IM freight are currently on pace to supplant coal as the largest single source of revenue for railroads. Despite its widespread use, IM trains are generally less fuel efficient than other rolling stock owing to greater aerodynamic drag. We explore the role of loading on drag and develop a MIP approach to produce aerodynamic load assignments.

2 - Rail Fleet Optimization

Amal Desilva, General Electric, 3475 Piedmont Road, NE, Suite 250, Atlanta, GA, United States of America, amal.desilva@ge.com

Many companies use Railroads to ship products and commodities using various types of railcars. An optimization model that optimizes the use of railcars is presented. Shippers can own or lease their own private railcars or they can use railcars owned by railroads. The output from the model is an optimal shipping plan for the planning period using either shipper's cars or railroad cars. A Mixed Integer Linear Programming solver is used to solve the optimization model.

3 - Mitigating Passenger Impacts under Airline Disruptions

Jon Petersen, Operations Research Scientist, Taleris, petersej@taleris.com

Airlines continually face irregularities which preclude their original schedules from being operated. Recovering from disruptions are of central importance but extraordinarily complex, so airlines typically decompose the problem into separable components at the cost of solution quality. We show how passenger delays and misconnections are improved upon by concurrently optimizing schedule and passenger resources through the use of mixed integer programming over a superimposed time-space network.

4 - Big Data Analytics to Improve Operational Decision Making in Rail Networks

Sudip Bhattacharjee, University of Connecticut, 2100 Hillside Road, U-1041, Storrs, United States of America, sbhattacharjee@business.uconn.edu, Erdem Telatar, Onur Dulgeroglu, Kimberly Mallory

Rail schedules are complex operations, where multiple categories of trains share the same network and infrastructure. To ensure that the different categories of trains run efficiently, scheduling and planning take center stage. We present a data analytics framework on a large data set to measure key performance indicators (KPI), and identify root causes of delays, to help scheduling and planning operations. We also discuss big data challenges and data quality issues of field data.

■ MD21

Hilton- Union Sq 1

Electrical Vehicles Routing

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Mahyar Nejad, Wayne State University, United States of America, mahuar@wayne.edu

1 - Electric Vehicle Routing and Recharging with Uncertain Charging Station Availability

Irina Dolinskaya, Assistant Professor, Northwestern University, Evanston, IL, 60208, United States of America, dolira@northwestern.edu, Diego Klabjan, Timothy Sweda

Planning long-distance trips with an electric vehicle depends on both the locations and availabilities of charging stations. We consider an adaptive routing problem in which an electric vehicle driver chooses his or her path and recharging stops based on the availability of nearby charging stations. We present a dynamic programming algorithm for finding an optimal routing and recharging policy and derive properties of optimal policies.

2 - Route Choice Decisions of Electric Vehicle Drivers under Different Traffic Conditions

Shubham Agrawal, United States of America, shubham@purdue.edu, Srinivas Peeta

The limited range of electric vehicles makes drivers more sensitive to trip energy consumption than conventional vehicles for route choice decisions. This study analyzes the impact of traffic condition on electric vehicle routing decisions by computing generalized user travel costs that factor battery discharge patterns. Computational results are illustrated using a simulation framework.

3 - Evaluation of Market Penetration Rate of Electric Vehicles on Network Performance

Amit Kumar, Purdue University, West Lafayette, IN, United States of America, kumar44@purdue.edu, Shubham Agrawal, Hong Zheng, Srinivas Peeta

This study seeks to establish the linkage between market penetration rates of electric vehicles and network performance that can be leveraged by the policy makers to improve system performance. We analyze the route choice behavior of electric vehicle drivers by factoring battery recuperation profiles in a dynamic user equilibrium setting. Numerical results are illustrated.

4 - Optimal Routing for Plug-in Hybrid Electric Vehicles

Mahyar Nejad, Wayne State University, United States of America, mahuar@wayne.edu, Ratna Babu Chinnam

We introduce the Energy-Efficient Routing problem (EERP) for Plug-in Hybrid Electric Vehicles (PHEVs). The objective of the EERP is to not only find a path to any given destination, but also to identify the predominant operating mode for each segment of the path in order to minimize the fuel consumption. We propose two exact algorithms, and a Fully Polynomial Time Approximation Scheme to solve the EERP. The results show that incorporating our proposed algorithms during route planning leads to significant energy savings for PHEVs.

■ MD22

Hilton- Union Sq 2

Energy Logistics and Supply Chains

Sponsor: Transportation Science & Logistics

Sponsored Session

Chair: Yao Zhao, Associate Professor, Rutgers University, 1 Washington street, Newark, NJ, 07102, United States of America, yaozhao@andromeda.rutgers.edu

1 - Energy Supply Chain: Future Energy Security of Pakistan

Raza Rafique, Rutgers Business School, 1 Washington Park, Newark, NJ, 07102, United States of America, razaalirafique@gmail.com, KwonGi Mun, Yao Zhao

Pakistan is experiencing 25-40% shortfall of electricity supply nation-wide which hampers economic growth, and give rise to political turmoil and social instability. We formulated a dynamic model to gradually build up end-to-end energy supply chain with limited budget. Results obtained demonstrated great potential and can provide guideline to ensure future energy security of Pakistan.

2 - A Design of Energy Supply Network: Insights, Security, and Sustainability

KwonGi Mun, Rutgers Business School, 1 Washington Park, Newark, NJ, 07102, United States of America, kwongmun@pegasus.rutgers.edu, Yao Zhao, Endre Boros, Rafique Raza

By testing an optimal energy supply network in Pakistan, we found that a design of energy supply network may cause an inefficient supply of electricity unless it is optimized with an integrated network. We test and design heuristics and an optimal decision model for introducing new strategies to design energy supply network. A main contribution is that well-formulated energy supply network can explain how to ensure energy supply and energy security.

3 - Fast Algorithms for Two-stage Robust Security Constrained Unit Commitment Problem

Wei Yuan, PhD candidate, IMSE,USF, 4202 East Fowler Avenue, ENB 118, Tampa, FL, 33620, United States of America, weiyuan@mail.usf.edu, Tongxin Zhen, Eugene Litvinov, Bo Zeng

Unit Commitment (UC) is the cornerstone in energy industry. Two-stage Robust UC has been developed to deal with the uncertainties in power systems: renewable energy, demand uncertainty, etc. However, this tri-level optimization model is difficult to solve considering large-scale power systems. In this research, we investigate the strong formulations for basic UC model, derive new valid inequalities considering network constraints and implement a novel cutting plane generation procedure.

■ MD23

Hilton- Union Sq 3

Same-Day Delivery and Routing

Sponsor: TSL/Freight Transportation & Logistics

Sponsored Session

Chair: Alejandro Toriello, Assistant Professor, Georgia Tech ISyE, 765 Ferst Dr NW, Atlanta, GA, 30332, United States of America, atoriello3@isye.gatech.edu

1 - Same Day Delivery for Online Purchases

Stacy Voccia, PhD Candidate, University of Iowa, 108 John Pappajohn Business Building, Room S210, Iowa City, IA, 52242, United States of America, stacy-voccia@uiowa.edu

Same day delivery for online purchases is a recent trend in online retail. Same day delivery, however, is a logistically complicated and expensive service to operate. We introduce a dynamic pick-up and delivery problem with deadlines that incorporates key features associated with same day delivery logistics. In order to make better-informed decisions, our solution approach incorporates information about future orders into routing decisions.

2 - Strategies for Handling Temporal Uncertainty in Pick-up and Delivery Problems with Time Windows

Niels Agatz, Rotterdam School of Management, Burgemeester Oudlaan 50, Rotterdam, 3000DR, Netherlands, nagatz@rsm.nl, Jordan Srour

We develop and compare different routing strategies for a pickup and delivery problem with inaccurate advance time window information. In this problem, the pickup locations are known in advance but the time window information is inaccurate until shortly before the desired service.

3 - The One-dimensional Dynamic Dispatch Waves Problem

Mathias Klapp, Ph.D. Student, Georgia Tech ISyE, 765 Ferst Dr NW, Atlanta, GA, 30332, United States of America, maklapp@gatech.edu, Alan Erera, Alejandro Toriello

We study same-day delivery (SDD) distribution systems by formulating the dynamic dispatch wave problem (DDWP) that models a warehouse where orders arrive randomly throughout the day. The decision maker dispatches a vehicle to serve a subset of open orders at each action period (wave), to minimize operational costs and charges for unserved requests. We study the DDWP with requests over a line; we efficiently solve the deterministic case and give heuristics and dual bounds for the stochastic case.

■ MD24

Hilton- Union Sq 4

Parking and Network Modeling Innovations

Sponsor: TSL/Intelligent Transportation Systems (ITS)

Sponsored Session

Chair: Yingyan Lou, Assistant Professor, Arizona State University, P.O. Box 873005, Tempe, AZ, 85287-3005, United States of America, yingyan.lou@asu.edu

1 - Parking Search Equilibrium on a Network

Shoupeng Tang, Stephen Boyles

All the vehicles need to park at some location on a network, but before arriving at the location, a vehicle does not know if there are available parking spaces. However, the probability of existing a specific number of available parking spaces can be calculated based on the flow arriving rate and the leaving rate of that location. While the leaving rate is known, the arriving rate should be calculated through the equilibrium process. A solution algorithm is developed with the help of a transformed network to get to stochastic traffic equilibrium with parking search uncertainties.

2 - A Dynamic User Equilibrium Formulation with Dynamic Parking Pricing

Rui Ma, University of California, Davis, CA, United States of America, drma@ucdavis.edu, H. Michael Zhang

We extend the differential complementarity system based dynamic user equilibrium formulation with the impacts of dynamic parking pricing for urban networks. We show that this formulation can simultaneously capture departure-time, route, mode and parking choices. We also show how the proposed framework can be used to determine the optimal dynamic parking pricing schemes to maximize the social welfare.

3 - Impacts of Traveler Information Provision Strategies on Parking Searching Problem

Peiheng Li, Arizona State University, P.O. Box 873005, Tempe, AZ, 85287-3005, United States of America, peihengl@asu.edu, Xuesong Zhou, Yingyan Lou

We analyze the parking search problem using a simple network, with explicit considerations of spatial capacities of parking lots and travelers' searching processes between and within each parking lot. The impacts of information provision on route choices of travelers and on network performance are further evaluated under three different information provision strategies.

4 - The Optimal Control of Day-to-day Traffic Dynamics under Hysteresis

Feng Xiao, Southwest Jiaotong University, Chengdu, China, xiaofeng@swjtu.edu.cn, Hai Yang, Hongbo Ye

Understanding the mechanism of network flows' evolution can help design more efficient demand-control schemes.Inspired by previous studies, the optimal control of the new system developed in this study is realized by utilizing the link-based dynamic congestion pricing. The Pontryagin's maximum principal is used in our paper to find the optimal toll scheme with various targets, such as the minimum total convergence time, minimum toll revenue or minimum system cost towards system optimum and combined objectives. Necessary conditions for optimal congestion prices are analyzed to uncover bang-bang charging strategy. Numerical examples will be provided to illustrate the resulting trajectory of the flow evolution under the optimal control schemes.

■ MD25

Hilton- Union Sq 5

Transportation Network Design and Pricing

Sponsor: TSL/Urban Transportation

Sponsored Session

Chair: Lu Tong, Beijing Jiaotong University, School of Traffic and Transportation, Beijing Jiaotong University, Beijing, 100044, China, tonglu57@gmail.com

1 - A Network Equilibrium Model to Evaluate Distance-based Fare Pricing Policies in Toronto

Anchor Chin, Ryerson University, 350 Victoria Street, Toronto, ON, Canada, anchor.chin@ryerson.ca, Joseph Y.J. Chow

We propose a systematic way to analysis the adoption of distance- or path-based fare system for a public transit network. A stochastic user equilibrium model was developed to evaluate distance-based fare pricing policies by modifying Lam et al's (1999) model to include paths that belong in two OD sets (station-to-station, zone-to-zone). The model is applied to an original network constructed from the Toronto Transportation Commission subway system to derive insights for adoption of smart card fare system.

2 - Parking Management to Improve Urban Efficiency: A Dynamic Performance-based Pricing Game

Daniel Mackowski, University of Illinois at Urbana-Champaign, Urbana, IL, United States of America, mackows2@illinois.edu, Yanfeng Ouyang, Yun Bai

In this paper we develop a dynamic pricing model for parking spaces in urban areas that is implementable with current technologies. Given real-time demand information, the bi-level model adjusts prices regularly with the objective of eliminating unnecessary vehicle circling (while looking for parking). An illustration shows the benefits of frequent, informed pricing updates as provided by this model compared to current "smart parking" systems.

3 - Transportation Network Design Model for Maximizing Activity-Travel Accessibility

Lu Tong, Beijing Jiaotong University, School of Traffic and Transportation, Beijing Jiaotong University, Beijing, 100044, China, tonglu57@gmail.com, Xuesong Zhou, Harvey Miller

Accessibility is an important performance measure which is often neglected in transportation network design models. This talk presents a linear integer programming model to maximize end-to-end accessibility within space-time constraints. A time-dependent network representation and a Lagrangean relaxation based solution method are then developed to solve this problem in real-world applications.

■ MD26

Hilton- Union Sq 6

Reliable Facility Location Models

Sponsor: Location Analysis

Sponsored Session

Chair: Kayse Maass, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, leekayse@umich.edu

1 - Decomposition of Facility Disruption Correlations via Augmentation of Virtual Supporting Stations

Siyang Xie, University of Illinois at Urbana-Champaign, 3150 Newmark Civil Engineering Lab, 205 N. Mathews Ave, Urbana, IL, 61801, United States of America, sxie13@illinois.edu, Xiaopeng Li, Yanfeng Ouyang

This paper proposes a new framework for analyzing service facility disruptions under general spatial correlation. We show equivalence among multiple types of correlation representations, and develop transformation and decomposition methods that can transform any correlated disruption pattern into one (by adding auxiliary supporting stations) with independent disruptions only. Numerical studies are conducted for insights.

2 - Reliable Facility Location under Uncertain Correlated Disruptions

Mengshi Lu, University of California, Berkeley, 4141 Etcheverry Hall, University of California, Berkeley, CA, 94720-1777, United States of America, mengshi@berkeley.edu, Zuo-Jun Max Shen

We present a reliable facility location model that allows disruptions to be correlated with an uncertain joint distribution, and minimizes the expected cost under the worst-case distribution. We believe this robust optimization model could serve as an alternative approach for solving reliable facility location problems. Compared to the traditional approach, it better captures disruption propagation effect, requires much less computational effort, and delivers more favorable designs.

3 - Service Reliability, Availability and Survivability Models on Vulnerable Stochastic Networks

Jose Santivanez, Associate Porfessor, Universidad del Turabo, PO Box 3030, Gurabo, PR, 00778, Puerto Rico, santivanezj@suagm.edu, Emanuel Melachrinoudis

Networks providing some critical service in the form of flow are vulnerable to intentional or unplanned disruptions. This paper focuses on the comparison of different network topologies using survivability-based metrics and on the location of facilities on existing networks so that service availability/survivability is maximized when demands for service and disruptions occur.

4 - Location Problem for Interdependent Critical Infrastructure Networks under Disruption Risks

Xiaopeng Li, Assistant Professor, Mississippi State University, PO Box 9546, 235L Walker Hall, 501 Hardy Road, Starkville, MS, 39762, United States of America, xli@cee.msstate.edu, Fang Zhou, Jiaqi Ma

This paper studied a location design problem that determines optimal facility location of multiple types of facilities where each facility is subject to a capacity loss risk. The system interdependence is specified as that the productivity of a facility of a type may be dependent of resource inputs from facilities of other types or transshipment from facilities of the same type. We construct a mathematical model with a customized solution approach to describe and solve this problem.

■ MD27

Hilton- Union Sq 7

Railway Operations Modeling and Analysis

Sponsor: Railway Applications

Sponsored Session

Chair: Matthew Petering, Associate Professor, University of Wisconsin-Milwaukee, P.O. Box 784, Milwaukee, WI, 53201, United States of America, mattpete@uwm.edu

1 - Cyclic Timetabling and Platforming of Heterogeneous Traffic on a Unidirectional Railway Line

Matthew Petering, Associate Professor, University of Wisconsin-Milwaukee, P.O. Box 784, Milwaukee, WI, 53201, United States of America, mattpete@uwm.edu

We present the literature's first two MILP models of a cyclic, combined train timetabling and platforming problem. The objectives of these models are to minimize (1) the timetable period and/or (2) the total journey time of all train types. The first model falls outside the framework of the well-known periodic event scheduling problem (PESP) and considers objectives 1 and 2. The second model nearly falls within the PESP framework and focuses on objective 2. Experimental results are discussed.

2 - Cyclic Timetabling and Platforming of Mixed Train Types on a Bidirectional Railway Line

Mojtaba Heydar, mheydar@uwm.edu, Matthew Petering

We consider cyclic timetabling and platforming of heterogeneous traffic on a single-track, bidirectional railway line. Two objectivesóminimizing timetable cycle length and the total journey time of all train types dispatched during one cycleóare considered. Constrains include headways on the main line and on the sidings in each station. Heuristic and exact methods are combined with a math model to solve large, real-world problem instances. The impact of various factors on capacity is discussed.

3 - Freight Rail On-time Performance in Scandinavia

Hans Boysen, Lic.Eng., Royal Institute of Technology (KTH), Department of Transport Science, Stockholm, SE-10044, Sweden, heboysen@kth.se

Shipper and consignee supply chain reliability, operator asset utilization and network capacity all depend on on-time operation and arrival of freight trains. The experience of on-time performance of freight rail operations in Scandinavia is reviewed, including definitions, performance targets and levels achieved.

4 - Delivering Actionable Intelligence to Point of Performance

Kandukuri Raju, Consultant, Tata Consultancy Services, Kensington B, Powai, Hiranandani, Mumbai, 400072, India, kandukuri.raju@tcs.com, Kshitij Goel

Paper describes structured process to arrive at appropriate performance metrics to monitor and organize them in a meaningful dashboard view to convey actionable intelligence to the decision maker at point of performance on real time and it brings out an approach to utilize historic data from different sources. Customer order prioritization to improve customer retention will be presented as an example.

■ MD28

Hilton- Union Sq 8

Aviation Applications Section: Keynote Presentation

Sponsor: Aviation Applications

Sponsored Session

Chair: Thomas Vossen, University of Colorado Boulder, Leeds School of Business, UCB0419, Boulder, CO, 80309, United States of America, Vossen@Colorado.edu

1 - The Case for Autonomy in Airspace Operations

Thomas Vossen, University of Colorado Boulder, Leeds School of Business, UCB0419, Boulder, CO, 80309, United States of America, Vossen@Colorado.edu

Parimal Kopardekar, Principal Investigator for NASA's NextGen Airspace projects will present a keynote address entitled "The Case for Autonomy in Airspace Operations".

■ MD29

Hilton- Union Sq 9

The George B. Dantzig Disseration Award

Cluster: George B. Dantzig Dissertation Award

Invited Session

Chair: Sudhendu Rai, Xerox, Webster, NY, United States of AmericaSudhendu.Rai@xerox.com

1 - The George B. Dantzig Disseration Award

Sudhendu Rai, Xerox, Webster, NY, United States of America Sudhendu.Rai@xerox.com

The George B. Dantzig Disseration Award recognizes dissertations that are innovative and relevant to the practice of operations research and the management sciences. The award has been established to encourage academic research that combines theory and practice and stimulates greater interaction between doctoral students, their advisors and the world of practice. Problem scope and potential magnitude of impact of research are considered. In this session, the award finalists will present their research.

■ MD30

Hilton- Union Sq 10

Contemporary Scheduling

Cluster: Scheduling and Project Management

Invited Session

Chair: Joseph Leung, Distinguished Professor, New Jersey Institute of Technology, University Height, Newark, NJ, 07102, United States of America, joseph.y.leung@njit.edu

1 - Fast Approximation Algorithms for Bi-criteria Scheduling with Machine Assignment Costs

Kangbok Lee, Assistant Professor, York College, CUNY, 94-20 Guy Brewer Bldv., Jamaica, NY, 11451, United States of America, klee5@york.cuny.edu, Joseph Leung, Bertrand Lin, Zhao-hong Jia, Wenhua Li, Michael Pinedo

Parallel machine scheduling problems are considered where the processing of the jobs on the machines involves two types of objectives. The first type is one of two classical scheduling objectives (total completion time or the makespan) while the second type involves an actual cost associated with the processing of a specific job on a given machine. Fast heuristics are proposed and their worst-case analysis is presented.

2 - Scheduling Jobs with Release Dates, Equal Processing Times, and Inclusive Processing Set Restriction

Chung-Lun Li, Chair Professor of Logistics Management, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong - PRC, chung-lun.li@polyu.edu.hk, Qingying Li

We consider the problem of scheduling a given set of n jobs with equal processing times on m parallel machines to minimize the makespan. Each job has a given release date and is compatible to only a subset of the machines. The machines are ordered and indexed in such a way that a higher-indexed machine can process all the jobs that a lower-indexed machine can process. We present a solution procedure to solve this problem in O(n^2 + mn log n) time. Some extensions of our results are discussed.

3 - Scheduling Jobs on Parallel Batch Machines with Non-identical Capacities to Minimize Makespan

Jun Qiang Wang, Professor, Northwestern Polytechnical University, POX 504, NPU, Xi'an, Xi'an, China, wangjq@nwpu.edu.cn, Joseph Leung

We schedule a set of equal-processing-time jobs with arbitrary job sizes on a set of batch machines with different capacities to minimize makespan. We show that there is no polynomial algorithm with an absolute worst-case ratio less than 2, unless P = NP. We then give a polynomial algorithm with an absolute worst-case ratio exactly 2. Moreover, we give a polynomial algorithm with asymptotic worst-case ratio of 3/2. Computational experiments show that our algorithm performs very well in practice.

4 - Production and Logistics Scheduling with Batching in Steel Industry

Lixin Tang, Chair Professor, Northeastern University, 3-11 Wenhua Road, Heping District, Shenyang, 110004, China, lixintang@mail.neu.edu.cn

The optimization of production and logistics scheduling problems is a kind of key issues in steel industry. Since these problems are mainly characterized by huge equipment and high operating cost, they are organized in batches in order to reduce the total setup and operating cost. In this talk we will discuss three important problems in operation management in the steel industry: the batching decision problem, production scheduling with batching, and logistics scheduling

with batching.

5 - Level Workforce Planning for Multistage Transfer Lines
George Vairaktarakis, Professor, Case Western Reserve University, 10900 Euclid Ave, 323 PBL, Cleveland, OH, 44106, United States of America, gxv5@po.cwru.edu, Joseph Szmerekovsky, Jiayan Xu

We study the maximin workforce size and the min workforce range leveling objectives for serial paced transfer lines. The number of workers needed to complete each operation of a job in precisely c periods is given. For two stations we develop fast algorithms even though the range problem is NP-complete. For 2-stations, we show that level workforce schedules perform well even when evaluated on other metrics. Our algorithms are shown to perform less well for m-stations.

■ MD31

Hilton- Union Sq 11

Digital Services in the Sharing Economy

Sponsor: Service Science

Sponsored Session

Chair: Siva Viswanathan, Associate Professor, University of Maryland College Park, 4313 Van Munching Hall, R.H. Smith School of Business, UMD, College Park, MD, 20742, United States of America, sviswana@rhsmith.umd.edu

1 - Finishing School for Entrepreneurs? Invisible Work and Innovation in the Sharing Economy
Arun Sundararajan, Professor of Information, Operations and Management Sciences, Leonard N. Stern School of Business, NYU, 44 West 4th Street, New York, United States of America, asundara@stern.nyu.edu, Vivian Li

We model the supply-side mechanisms by which peer-to-peer platforms like Airbnb, eBay, Etsy, Lyft, and Kickstarter are gateways for innovation, catalyze entrepreneurship and induce economic growth, testing our theories using transactional data from two large peer-to-peer marketplaces, and supplemented by data from a nationwide survey. (This research is supported by grants from the Ewing Marion Kauffman Foundation and Google Inc.)

2 - Understanding Effects of Message Design on Platform-mediated Information Sharing: A Field Experiment
Tianshu Sun, PhD Candidate, Smith School of Business, University of Maryland, 3330 Van Munching Hall, PhD Student Office, College Park, MD, 20742, United States of America, tianshusun@rhsmith.umd.edu, Siva Viswanathan, Elena Zheleva

Information Sharing is central in sharing economy. Despite digital platforms increasing ability to mediate information sharing, few studies have examined their optimal design choices. We examine whether and how a platform can enhance effectiveness of information sharing, by varying message shared between customers. Through a randomized field experiment on a digital deal platform, we test effectiveness of two pieces of information in message: sender's purchase and existence of referral rewards

3 - Design of Effective Reward Scheme on Crowdfunding Platform
Yong Tan, Professor, University of Washington, Michael G. Foster School of Business, Seattle, WA, 98195-3226, United States of America, ytan@u.washington.edu, Shengsheng Xiao, Jane Xue Tan

Designing effective reward schemes on online crowdfunding platform is a problem faced by project creators. In this paper, we investigate the effect of reward scheme on project success. Specifically, we examine the factors such as the number of reward tiers, price of each tire, and two popular strategies (i.e. "above all" and "backer limitation").

■ MD32

Hilton- Union Sq 12

Workforce Planning I

Cluster: Workforce Management and Engineering

Invited Session

Chair: Yun Fong Lim, Associate Professor, Singapore Management University, Lee Kong Chian School of Business, 50 Stamford Road, Singapore, 178899, Singapore, yflim@smu.edu.sg

1 - Makespan Minization with Individual Learning
Huan Jin, University of Iowa, huan-jin@uiowa.edu, Michael Hewitt, Barrett Thomas

We consider the problem of minimizing the makespan of a set of tasks while accounting for the impact of learning. The challenge is that learning models are nonlinear, limiting exact methods. We use a recent linear reformulation technique to overcome the nonlinearity. The resulting linearity at the cost of increased problem size. To overcome the problem size, we introduce a computationally efficient method of finding an initial solution and introduce bounds for some of the problem variables.

2 - Effects of Work Structure on Worker Allocation Models with Learning and Forgetting
Austin Chacosky, Rochester Institute of Technology, atc7417@mail.rit.edu, Scott E. Grasman

This talk presents the expansion of worker allocation models with human learning and forgetting to include work structures. Utilizing a reformulation technique to counteract the increased solve times of learning curve incorporation, realistically-sized production systems are modeled. Results advise production managers on assignment and cross-training levels, as well as how their production structure may impact those responses.

3 - Workforce Agility and Workforce Flexibility: What are the Differences?
Ruwen Qin, Missouri University of Science and Technology, United States of America, qinr@mst.edu

Workforce agility, the strategic management of organizational labor capability in dynamic business environments, is a key facet of an organization's overall agility. However, the literature dealing specifically with workforce agility is limited. In this paper we review the research literature on workforce agility to define and clarify distinctions between workforce agility and workforce flexibility. We further identify key gaps in the literature to promote the development of this area.

4 - Cellular Bucket Brigades with Hand-Off Times
Yun Fong Lim, Associate Professor, Singapore Management University, Lee Kong Chian School of Business, 50 Stamford Road, Singapore, 178899, Singapore, yflim@smu.edu.sg

We introduce a new design of bucket brigades to boost their productivity. We assume hand-off times are significant and propose simple rules for workers to share work. We identify a sufficient condition for the system to self-balance. Our results suggest that the new design could be substantially more productive than traditional bucket brigades.

■ MD33

Hilton- Union Sq 13

Organizing for Successful Product Development

Cluster: New Product Development

Invited Session

Chair: Svenja Sommer, HEC Paris, 1 Rue de la Libération, Jouy en Josas, France, sommers@hec.fr

1 - The Role of Customer Interaction on Product Innovation Success
Philipp Cornelius, UCL, Management Science and Innovation, London, United Kingdom, philipp.cornelius.12@ucl.ac.uk, Bilal Gokpinar

Using a large-scale dataset of new product development projects from a crowdfunding platform, this paper first provides strong causal evidence on the beneficial economic effect of customer interaction on product development success. We then address two important questions regarding customer interaction. First, do organisations actually incorporate and benefit from ideas generated as a result of customer interaction? Second, what kind of customers should organisations listen to for NPD success?

2 - Incentivizing Collaboration in Global Product Development Teams
Sara Rezaee Vessal, HEC Paris, 1 Rue de la Liberation, Jouy en Josas, FR, 78350, France, sara.rezaee-vessal@hec.edu, Svenja Sommer

To successfully compete on an international scale, multinationals increasingly turn towards globally dispersed product development teams, both to draw on a diverse set of expertise and to access more accurate local market knowledge. However, dispersion also creates additional challenges for collaboration, which can have negative effects on project performance. In this study, we compare dispersed and co-located teams and address the question how to incentivise them.

3 - Modular Product Development for Risky Programs: Co-development versus Collaboration
Suri Gurumurthi, University of North Carolina, 1210 Environ Way, Chapel Hill, NC, 27517, United States of America, Suri_Gurumurthi@kenan-flagler.unc.edu

Using simple optimization models, we compare the benefits of just having a modular design of the product, to those resulting from a modular approach to pairing key resource groups and tasks in the development process. The benefits to time-to-market and development cost are compared. Further, we show that deploying self-contained and modular co-development teams (as opposed to independent collaborating teams) can yield greater dividends in the presence of risk and uncertainty.

■ MD34

Hilton- Union Sq 14

Community-Based Operations Research

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Michael Johnson, Associate Professor, University of Massachusetts Boston, 100 Morrissey Blvd., McCormack Hall Room 3-428A, Boston, MA, 02125-3393, United States of America, Michael.Johnson@umb.edu

1 - Optimal Physician Traveling Assignment for Improving Care Access in an Outpatient Care Network

Yan Li, Purdue University, West Lafayette, IN, 47907, United States of America, li528@purdue.edu, Nan Kong, Qipeng Zheng

We develop a mixed integer programming model to assign physicians for outpatient care networks to improve patient access to care. We term our model the multi-commodity capacitated traveling facility location problem. We use mental health in the veterans integrated service networks as a case study. Our numerical studies demonstrate conditions under which the idea of scheduling sessions at satellite clinics is appealing and show the efficiency of our column generation-based primal heuristics.

2 - Food Retailers and Obesity in US Adults

Paul Griffin, Penn State, University Park, State College, United States of America, pmg14@engr.psu.edu, Renfei Yan

Food environment has been shown to be associated with obesity rate. We estimate the marginal effect on obesity rate in U.S. adults based on the addition of a new food retailer type in a community. We consider loan and grant subsidies to strategically design a food store establishment plan.

3 - Evaluating the Effectiveness of Tutoring and Mentoring Programs at Homewood Children's Village

Ran Bi, Graduate Student, University of Pittsburgh, 2700 O'Hara St., Pittsburgh, United States of America, rab172@pitt.edu, Xin Jin, Louis Luangkesorn

Many community organizations seek to improve their communities through providing children and teenagers with tutoring and mentoring. However, there is little understanding on the effect of these interventions on academic and behavioral outcomes. We analyze interventions and academic data for students with a goal of identifying interventions that have the most effect on academic outcomes at a community based program working with Pittsburgh Public Schools.

4 - Community-engaged Decision Modeling for Local Economic Development

Michael Johnson, Associate Professor, University of Massachusetts Boston, 100 Morrissey Blvd., McCormack Hall Room 3-428A, Boston, MA, 02125-3393, United States of America, Michael.Johnson@umb.edu, Sandeep Jani, Leibiana Feliz

Main Street organizations develop local development initiatives that support economic and social goals. This requires appropriate data and capacity to apply analytic methods. We discuss a pilot study for Boston Main Streets that links values, data, communication, analysis and action. Results demonstrate the benefits of qualitative and quantitative methods to enable practitioners to make best use of primary and secondary data for decision-making and information systems design.

5 - Pro Bono O.R.: an Operational Research Society initiative

Graham Rand, g.rand@lancaster.ac.uk

The Operational Research Society recently appointed a O.R. Pro Bono Manager, to oversee a scheme that provides free O.R. support by O.R. professionals to Third Sector organisations (mainly charities). How projects and volunteers are found and matched will be described. The advantages for the organisations, for the ORS and for the volunteers will be explained, as well as some of the difficulties faced. Examples will be given of completed projects.

■ MD35

Hilton- Union Sq 15

Operations Research in Public Policy Analysis

Sponsor: Public Programs, Service and Needs

Sponsored Session

Chair: Ronald McGarvey, Assistant Professor, University of Missouri, E3437 Lafferre Hall, Columbia, MO, 65211, United States of America, mcgarveyr@missouri.edu

1 - Structuring a Waste Collection Contract using Robust Optimization

Maryam Nikouei Mehr, University of Missouri, Columbia, OH, 65211, mcgarveyr@misssouri.edu, Ronald McGarvey

The University of Missouri has a contract with the City of Columbia to provide waste collection services on campus. An interesting aspect of this contract is that the University is charged according to a fee structure that is different for different types of receptacles. Our research aims to analyze the location and utilization of receptacles across the campus in order to identify a strategy that minimizes the contract expenses to accommodate the University's demand for waste services.

2 - Technical Barriers to, and Policy Options for, Large-Scale Solar Electricity Deployment in India

Aimee Curtright, Physical Scientist, RAND Corporation, 4570 Fifth Avenue, Pittsburgh, PA, 15213, United States of America, acurtrig@rand.org, N.C. Thirumalai, Zhimin Mao, Oluwatobi Oluwatola

RAND and CSTEP are studying the technical barriers and policy options for meeting India's aggressive solar goal of 22 GW by 2022. CSTEP's techno-economic models explore the economic viability of solar, specifically in the Indian context (e.g., locational-specific solar resource data). This presentation examines the sensitivity of costs to different financial mechanisms, technology improvements, and solar resource assumptions, and the policy implications of tradeoffs between them.

3 - Integrating the Location and Inventory Decisions of a Supply Chain

Fang Fang, Ph. D. Student, School of Business Administration, University of Miami, University of Miami, Coral Gables, FL, 33146, f.fang@umiami.edu, Harihara Natarajan

Jointly determining location and inventory decisions in a supply chain is important to ensure low costs. To integrate these decisions, we develop a model that employs a novel approach, incorporating both cycle and safety inventories without introducing nonlinearities. Preliminary computational results suggest that our model and method can be effective.

4 - Optimal Design of Personalized HPV Vaccination Program

Shengfan Zhang, Assistant professor, University of Arkansas, United States of America, shengfan@uark.edu, Fan Wang

The human papillomavirus (HPV) is the most common sexually transmitted virus in the U.S. To prevent multiple cancers attributable to the HPV, HPV vaccine is recommended for preteens and teens who have not been exposed to HPV. We develop a simulation model for the optimal design of personalized HPV vaccination program, which incorporates multiple social-behavioral and demographic risk factors. The efficacy of the HPV vaccination program is evaluated in terms of the HPV-related health outcomes.

■ MD36

Hilton- Union Sq 16

Topics In Telecommunications

Sponsor: Telecommunications

Sponsored Session

Chair: Stanko Dimitrov, University of Waterloo, 200 University Avenue West, Waterloo, Canada, sdimitro@uwaterloo.ca

1 - A Defragmentation Problem of Wavelength Assignment for the Next Generation ROADM Networks

Youngho Lee, Korea University, Sung Buk Ku, Seoul, Korea, Republic of, yhlee@korea.ac.kr, Gilhyun Do, IkKyun Jeong, Jeongyi Moon, Junsang Yuh, Binnam Kim

This talk presents a defragmentation problem of channel assignment in deploying the next generation network of reconfigurable optical add drop multiplexers (ROADM). We develop mixed integer programming models for the problem and propose a novel branch and cut procedure for solving large-scale problems. Promising computational results are presented.

2 - On the Geographic Expansion and Integration Strategies of Telecommunications Service Providers

Steven Powell, Professor Emeritus, CIS Department, California State Polytechnic University, Pomona, 3801 W. Temple Avenue, Pomona, CA, 85248, United States of America, srpowell@csupomona.edu

In order to achieve higher growth and economies of scale telecommunications service providers (TSPs) have expanded their wireless and wireline services geographically and integrated their service offerings. Using a decision model based on the performance and risk characteristics of a TSP's business portfolio, this paper analyzes the geographic expansion and service integration strategies of a cross-section of major TSPs from 2000 to 2012.

3 - A Game-theoretic Model of Network Throughput and Reliability: Survey & Prospects

Yupo Chan, University of Arkansas at Little Rock, 2801 South University Ave, Little Rock, United States of America, yxchan@ualr.edu

A network is only useful if it is reliable, secure, and functioning properly. It has to be devoid of unexpected failures due to natural/technological disasters and outside attacks. A stochastic network, characterized by arcs (links) and nodes that can fail unexpectedly, is proposed to mimic such unpredicted interruptions. Through such a stochastic-network model, we identify game-theoretic strategies and tactics to prevent disruptions caused by natural/technological hazards and hostile tampering.

■ MD37

Hilton- Union Sq 17

Supply Chain Optimization and Analytics

Sponsor: Artificial Intelligence

Sponsored Session

Chair: Dahai Xing, Data Scientist, Walmart Labs, 2000 Sierra Point Parkway, Brisbane, CA, 94005, United States of America, DXing@walmartlabs.com

1 - Multivariate Time Series Forecasting using Matrix Completion Algorithms

Ashin Mukherjee, Staff Data Scientist, WalmartLabs, 850 Cherry Avenue, San Bruno, CA, 94066, United States of America, AMukherjee1@walmartlabs.com

Forecasting multivariate time series data is a common problem in business and industrial statistics. In this work we propose a novel matrix completion based algorithm when the underlying data shows strong correlations across time series. The proposed method is completely non-parametric and does not require extraneous estimation of seasonality or trend. The effectiveness of the proposed methodology is demonstrated through a multivariate demand forecasting problem in an e-commerce setting.

2 - Supply Chain Analytics: Simple vs. Complex

Homarjun Agrahari, Director, Supply Chain Analytics, FleetPride, Inc., 600 E. Las Colinas Boulevard, Irving, TX, 75039, United States of America, homarjun.agrahari@fleetpride.com

Most Supply Chain Analytics projects deal with complex solutions for complex problems. However, there is beauty (and lots of money) in simple solutions. I will talk about how simple Analytics has helped FleetPride supply chain. I will also discuss skills every student must have if she/he plans to build a career in industry.

3 - Transportation Challenges in the Multi-channel Retail World

Dahai Xing, Devadas Pattathil

The speakers will introduce the challenges and solutions in the multi-channel retail world. A multi-channel retailer not only has to transport inbound goods from offshore and domestic vendor, but it also has to handle outbound small package delivery. The operational challenges and complexity multiplies when the retailer also handles returns process; and provides warehouse-to-warehouse transfers, inter-store transfers, etc.

4 - Optimal Lead Time and Stocking Levels under Dynamically Evolving Demand in Multi-Channel Retailing

Nevin Mutlu, PhD Candidate, Virginia Tech, 607 Clay St. Apt 10., Blacksburg, VA, 24060, United States of America, nmutlu@vt.edu, Ebru Bish, Erick Wikum

As traditional brick-and-mortar retailers expand their sales channels to online and mobile orders, the consumer adoption rates of these emerging channels is increasing over time. We develop a novel, dynamic demand model to realistically represent the demand across channels in our multi-period optimization model. We perform numerical studies to show that the retailers' optimal decisions in this dynamic environment differ significantly from those under the presence of static demand.

5 - Use of Optimization in Store Selection for Online Order Fulfillment

Guru Pundoor, Scientist, Supply Chain Optimization, Walmart eCommerce, 850 Cherry Avenue, San Bruno, CA, 94066, United States of America, GPundoor@walmart.com

A primary consideration in eCommerce is customer order fulfillment. Different companies employ different strategies with the conflicting objectives of improving service level while controlling costs. In this talk, we will focus on how a multi-channel retailer can use optimization technology to make strategic sourcing decisions by using the brick and mortar network for fulfilling online orders.

■ MD38

Hilton- Union Sq 18

OR Techniques to Improve Patient Scheduling

Cluster: Healthcare Systems and Medical Informatics

Invited Session

Chair: Amy Cohn, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, United States of America, amycohn@med.umich.edu

1 - Reducing Patient Delays in Outpatient Infusion Centers

Sarah Bach, University of Michigan, Ann Arbor, MI, United States of America, sbach@umich.edu, Amy Cohn

Patients receiving chemotherapy in outpatient infusion centers often must get blood work done in the lab, visit their physician in the clinic, and have the pharmacy prepare their drugs before receiving the infusion. We use collaboration with nurses and physicians in the clinical environment, data collection and analysis, simulation, and optimization techniques to develop ways to improve the patient experience and reduce delays in this complex series of activities.

2 - Improving Patient Access for an Outpatient Endocrinology Clinic

Joanna Fleming, University of Michigan, Ann Arbor, MI, United States of America, flemjo@umich.edu, Amy Cohn

A new weight loss and management program for high-risk patients has is under investigation, but requires a frequent and carefully-structured series of visits to the endocrinology clinic. Limits in clinic capacity are hampering the ability of the program to be implemented and effectively evaluated. We use observation, data analysis, simulation, and optimization to assess potential for improving access to timely appointments.

3 - Causal Analysis of Emergency Department Delays

Shervin AhmadBeygi, Director of Systems Redesign, Deparment of Veterans Affairs - Washington DC Medical Center, 50 Irving Street N.W., Washington DC, DC, 20422, United States of America, shervin@umich.edu

Emergency Department (ED) delay is a widespread problem that negatively affects patient safety, quality of care, and patient and provider satisfaction. We employ novel data analytics approaches such as causal networks and competing risk analysis and use historical data to study the causes of ED delays. The results of this analysis provide recommendations on how to alleviate the problem of excess ED delays.

■ MD39

Hilton- Union Sq 19

Operations Analysis for Health Care

Sponsor: Health Applications

Sponsored Session

Chair: Tinglong Dai, Assistant Professor, Johns Hopkins University, 100 International Drive, Baltimore, MD, 21202, United States of America, dai@jhu.edu

1 - Optimal Mix of Elective Surgical Procedures under Stochastic Patient Length of Stay

Hessam Bavafa, Assissant Professor, Wisconsin School of Business, 975 University Ave, Madison, WI, 53706, United States of America, bavafa@wharton.upenn.edu, Sergei Savin, Lerzan Ormeci

We consider the problem of allocating daily hospital service capacity among several types of elective surgical procedures. Our focus is on the interaction between two major constraining hospital resources: operating room and bed capacity. In our model, each type of surgical procedure has an associated revenue, deterministic procedure duration and stochastic hospital length of stay.

2 - Pricing and Operational Performance in Outpatient Services of China's Public Hospitals

Xiaofang Wang, Associate Professor, Renmin University of China, School of Business, 59 Zhongguancun St, Haidian, Beijing, China, wangxiaofang@rbs.org.cn

Inefficient and unnecessary care has contributed the growing cost and increased congestion at government-run public hospitals in China. Among other healthcare reform policies, adjusting fees for outpatient services plays an important role in eliminating Yi Yao Yang Yi to make health care more accessible and affordable. We develop a model to jointly determine the optimal pricing and the optimal service policy to maximize the benefits collected by the hospital and provide policy insights.

3 - Resource Allocation Considering Quality of Care in Hospice Operations

Leela Nageswaran, Tepper School of Business, Carnegie Mellon University, Pittsburgh, PA, 15213, United States of America, lnageswa@andrew.cmu.edu, Alan Scheller-Wolf, Aliza Heching

We study the problem of allocating nurses in hospices, factoring in the interplay between staffing choices and realized quality of care. The hospice has a choice of overworking their full-time nurses or hiring per diem nurses. The resulting quality of care impacts the rates at which new patients enroll with, and existing patients leave, the provider. We model the problem as a discrete time Markov chain and obtain characteristics of the optimal resource allocation policy.

4 - If You'd Give, You'll Get: Analysis and Remedies of Donor Priority Rule

Tinglong Dai, Assistant Professor, Johns Hopkins University, 100 International Drive, Baltimore, MD, 21202, United States of America, dai@jhu.edu

It has been proposed that registered organ donors should be given a higher priority over non-donors when they need organ transplants in the future. We use a queueing and game theoretic model to predict the equilibrium under this policy. Our analysis provides insights into potential policy-induced welfare distortions. As a result, the overall social welfare can be lower due to the policy. We provide simple and effective remedies to correct these distortions.

■ MD40

Hilton- Union Sq 20

Bundled Payments and Payment Systems

Sponsor: Health Applications

Sponsored Session

Chair: Margret Bjarnadöttir, Assistant Professor of Management Science and Statistics, University of Maryland, 4324 Van Munching Hall, College Park, MD, 20742, United States of America

1 - Opportunities for OR/MS in Healthcare Payment Reform

Renata Konrad, Worcester Polytechnic Institute, 100 Institute Rd, Worcester, United States of America, rkonrad@wpi.edu, Margret Bjarnadöttir, Ruben Proano, David Anderson

Healthcare reimbursement is at the forefront of healthcare reform debates in the US. Bundled payment systems have been proposed as a practical and promising reimbursement alternative to induce incentives that lower healthcare expenditures. Significant evidence suggests that such systems achieve improved quality outcomes, and better coordinated care at a lower cost. This talk provides an overview of bundled payments and discusses directions for operations research and management science.

2 - Bundled Payments: A Post-Acute Care Provider Prospective

Brenda Courtad, University of Cincinnati, 2925 Campus Green Dr, Cincinnati, OH, 45221, United States of America, courtabl@mail.uc.edu, Michael Magazine

Taking part in the Bundled Payment for Care Improvement Demonstration with Medicare requires many decisions to be made. We will present and discuss some of these decisions from a post-acute care provider prospective.

3 - Optimal Facility In-network Selection for Healthcare Payers under Reference Pricing

Aurelie Thiele, Visiting Associate Professor, MIT, 77 Mass Ave, Rm E40-121, Cambridge, MA 02139, United States of America, aut204@lehigh.edu, Victoire Denoyel, Laurent Alfandari

In reference pricing (RP), a payer determines a maximum amount for a procedure; patients who select a provider charging more pay the difference. This has strong potential in cost reduction for payers, quality increase for patients & visibility for high-value providers. Inspired by a CalPERS program, we use robust optimization to set a reference price and providers subject to it. We present & analyze a MIP to fill the gap of quantitative insights on RP w.r.t price, quality & geographic coverage.

4 - Automatic Detection of Episodes of Care in an Insurance Claims Repository

Ruben Proano, Assistant Professor, Rochester Institute of Technology, Rochester, NY, United States of America, rpmeie@rit.edu, Margrét BjarnadÛttir, Renata Konrad, David Anderson

This talk presents the ongoing efforts to automatically determine what medical services should be bundled as an episode of care. The ability to determine these bundles is key for an eventual adoption of bundled payments as a healthcare cost reimbursement strategy, instead of the commonly used fee-for-service. This talk focuses on the efforts to mine a large aggregated insurance claims repository with six years of data for Upstate New York.

■ MD41

Hilton- Union Sq 21

Stochastic Models in Healthcare Delivery

Sponsor: Health Applications

Sponsored Session

Chair: Mucahit Cevik, University of Wisconsin - Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, cevik2@wisc.edu

1 - Hypertension Management under Noise-Free Paradigm: Insights to the Optimal Medication Prescriptions

Abdolmanaf Zargoush, PhD Candidate, McGill University, 1001 Sherbrooke, Montreal, QC, H3A1G5, Canada, abdolmanaf.zargoush@mcgill.ca, Stella Daskalopoulou, Vedat Verter, Mehmet Gumus

We formulate the "antihypertensive prescription problem" as a finite-horizon Markov Decision Process (MDP). The optimal policies, which are of threshold nature, provide valuable insights on the key question in hypertension management: "which medication" and "when" should be prescribed given the patient's blood pressure level and age?

2 - A MDP Model for Breast and Ovarian Cancer Intervention Strategies for BRCA1/2 Mutation Carriers

Mehrnaz Abdollahian, PhD. Student, University of South Florida, 4202 East Fowler Avenue, ENB 118, Tampa, FL, 33620, United States of America, mehrnaz@mail.usf.edu, Tapas Das

Women with BRCA1/2 mutations have higher risk for breast and ovarian cancers. Available interventions vary significantly in cost, cancer prevention, and in resulting death from other causes. We developed a Markov decision process model to obtain optimal intervention strategies using both cost and quality-adjusted life years as rewards.

3 - Multi-dose Vial Administration with Non-Stationary Demand and Delayed Service

Maryam Hasanzadeh Mofrad, PhD. Student, University of Pittsburgh, Pittsburgh, PA, 15261, United States of America, hasanzadeh.mofrad@gmail.com, Jayant Rajgopal, Lisa M. Maillart, Bryan A. Norman

Previous work on determining dynamic vaccine administration policies to minimize open vial waste assumes that unvaccinated customers are lost and that the arrival rate is stationary both throughout the replenishment cycle as well as within each session. We reformulate the Markov decision process model to account for these factors and present the results of extensive numerical study for both clinic-level and country-level performance.

4 - Effects of Budgetary Restrictions on Mammography Screening Policies

Mucahit Cevik, University of Wisconsin - Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, cevik2@wisc.edu, Turgay Ayer, Oguzhan Alagoz

The consideration of a budget constraint on the total available resources for mammography screening becomes a necessity especially for resource-limited countries. We formulate an MDP model to assess changes on mammography screening decisions and risk of getting cancer, when only a limited budget per woman is available.

■ MD42

Hilton- Union Sq 22

Health Care Supply Chain, Competition, and Risks Management

Sponsor: Health Applications

Sponsored Session

Chair: Wen-Ya Wang, San Jose State University, One Washington Square, San Jose, CA, United States of America, wenya.wang@sjsu.edu

1 - Integrated Pharmaceutical Supply Chains: Dynamic and Oligopolistic Competition Perspectives

Sung Chung, New Mexico Institute of Mining and Technology, 801 Leroy Place, Socorro, United States of America, schung@nmt.edu, Changhyun Kwon

We propose an integrated pharmaceutical supply chain management framework that allows us to explicitly consider the dynamic control of medication inventories at distribution centers and demand markets. We address the issues pertaining to pharmaceutical supply chains such as price fluctuations as a result of competition across firms, and changes in pharmaceutical supply flows over time. We also provide a case study in which managerial insights are derived.

2 - No Silver Bullet: Identifying Security Vulnerabilities Of Hospital Databases

Liam O'Neill, Associate Professor, University of North Texas - Health Science Center, 3500 Camp Bowie Blvd, Fort Worth, TX, 76107, Liam.ONeill@unthsc.edu, Guatam Das, Nan Zhang, Heng Huang

Analytical processing was used to identify security vulnerabilities in public hospital databases. Using medical domain knowledge, we recovered the real age of 64 patients, the gender of 796 patients, and the zip codes of 1,219 patients. We demonstrate that standard methods to mask personal health information can be reversed, thereby increasing the risk of re-identification of individual patients.

3 - Inventory Management of Reusable Surgical Instruments

Adam Diamant, Adam.Diamant09@Rotman.Utoronto.Ca, Joseph Milner, Fayez Quereshy

We study inventory policies for surgical instruments that must be sterilized between uses. We model the process as a discrete-time Markov chain, obtaining the steady-state probabilities for the amount of usable inventory on-hand at the beginning of each day. By showing several structural properties, we derive an expression for the optimal number of instrument sets to carry. We apply our theoretical results to a dataset collected from a surgical unit at a large hospital in Toronto.

4 - Price Competition under Subsidization: Application to Medicare Reform

Lijian Lu, PhD, Columbia Business School, 3022 Broadway, New York, NY, 10027, United States of America, llu16@gsb.columbia.edu, Awi Federgruen

We consider price competition models, in which a significant part of the price is subsidized by a third party. We characterize the equilibrium behavior and derive comparison results for the price equilibria under alternative subsidy schemes. Applying our results to the Medicare insurance market, we estimate the impacts of various proposals, in particular the Wyden-Ryan plan, on government cost, insurer, and beneficiary's welfare.

■ MD43

Hilton- Union Sq 23

Decision Diagrams in Optimization II

Sponsor: Computing Society

Sponsored Session

Chair: John Hooker, Carnegie Mellon University, Tepper School of Business, Pittsburgh, United States of America, jh38@andrew.cmu.edu

1 - Solving Binary Quadratic Programming Problems with Binary Decision Diagrams

David Bergman, School of Business, University of Connecticut, One University Place, Stamford, United States of America, david.bergman@business.uconn.edu, Andre Augusto Cire

Binary decision diagrams (BDDs) have recently been proposed as a mechanism for solving discrete optimization problems. This talk discusses an extension of this work to the binary quadratic programming problem. A set of instances is described for which the BDD technique outperforms existing state-of-the-art technique.

2 - Parallel Combinatorial Optimization with Decision Diagrams

Willem-Jan van Hoeve, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, United States of America, vanhoeve@andrew.cmu.edu, David Bergman, Andre Cire, Vijay Saraswat, Horst Samulowitz, Ashish Sabharwal

We propose a new approach for parallelizing search for combinatorial optimization that is based on a recursive application of approximate decision diagrams. This generic scheme can, in principle, be applied to parallelize MIP, SAT, or CP search, provided that a decision diagram representation for the problem is available. We demonstrate our method on the maximum independent set problem, and show that our parallel search scales effectively up to 256 workers.

3 - Weighted —AND/OR Multivalued Decision Diagrams (AOMDD) for Sum and Max Queries

Rina Dechter, Professor, UCI, Irvine, CA 92697-3425, Irvine, United States of America, dechter@ics.uci.edu, William Lam

I will present Weighted AOMDDs which capture problem decomposition, multi-valued variables, and can express real-valued functions. I will show that the AOMDD size exponential in the problem's semantic-width, a new, and more informative parameter (though hard to compute). Specific demonstration as well as empirical evaluation will be given.

4 - Optimization with Zero-suppressed BDDs: Case Study Research in Power Distribution Networks

Takeru Inoue, NTT Network Innovation Labs., Hikarinooka 1-1, Yokosuka, Ka, 2390847, Japan, inoue.takeru@lab.ntt.co.jp, Ryo Yoshinaka, Keiji Takano, Takayuki Watanabe, Jun Kawahara, Akihiro Kishimoto, Koji Tsuda, Shin-ichi Minato, Yasuhiro Hayashi

Determining loss minimum configuration in a power distribution network is a hard discrete optimization problem involving many variables. Since existing methods employ local updates, they eventually get stuck at local minima. We present an optimization method providing global optimal solution utilizing a compressed search space represented by zero-suppressed BDDs. Our method is also remarkably efficient; optimization of a large-scale network with 468 switches was solved just in a minute.

■ MD44

Hilton- Union Sq 24

Information, Information Accuracy and Information Policy in E-commerce Applications

Sponsor: Information Systems

Sponsored Session

Chair: Juan Feng, Associate Professor, City University of Hong Kong, Kowloon Tung, Hong Kong, Hong Kong - PRC, juafeng@gapps.cityu.edu.hk

1 - Does Screening Mechanism Hurt or Help Crowdsourcing Contests?

Jiahui Mo, Assistant Professor, Nanyang Technological University, jiahui.mo@utdallas.edu

In crowdsourcing contests platforms, seekers are allowed to adopt screening mechanism within a contest. Some seekers use two stage contests, with the first stage as the screening stage to select candidates and the second stage as the winner selection stage. Some other seekers do not have screening stage but select winners directly. This research explores how screening mechanism in crowdsourcing contests influences solvers, seekers and platforms.

2 - IT Investment under Competition: The Role of Value Uncertainty

Mingdi Xin, Assistant Professor, University of California at Irvine, United States of America, mingdi.xin@uci.edu, Vidyanand Choudhary

How does competition impact firms' incentive to invest in information technology (IT)? On one hand, firms in highly competitive industries may be more motivated to invest in IT to improve performance and competitive position. On the other hand, firms' investment incentive depends on their ability to appropriate the return, and the value of IT investment is more likely to be competed away in competitive industries. This paper examines firms' IT investment decisions in a game theoretic model.

3 - The Effect of Consumer Rating Behavior in an App Market

Lin Hao, Assistant Professor, Mendoza College of Business, University of Notre Dame, lhao@nd.edu, Xiaofei Li, Jiuping Xu, Yong Tan

This paper investigates the influence of consumer rating behavior on three players in an app market, the app developer, app consumers, and the platform owner. Specifically we studies under the uncertainty about the horizontal characteristics of an app, how consumers' different rating behaviors could affect their app purchase decisions, the developer's quality and price decision, and the platform owner's decision on the sharing percentage in the app revenue sharing contract.

4 - When Online Reviews Meets Sales Volume Signal: Does More Information Leads To A Happy Ending?
Juan Feng, Associate Professor, City University of Hong Kong, Hong Kong, Hong Kong - PRC, juafeng@cityu.edu.hk, Yang Liu, Xiuwu Liao

We study the impact of two types of information, that is, sales volume signal and online review, on consumers' purchase decision and on firms' optimal pricing strategies over time. We find that more information, or more accurate information, does not always lead to a welfare increase to firms or consumers.

■ MD45

Hilton- Union Sq 25

Opportunities in Behavioral Operations: Different Perspectives

Sponsor: Behavioral Operations Management

Sponsored Session

Chair: Andrew Davis, Assistant Professor, Cornell University, 401J Sage Hall, Ithaca, NY, 14853, United States of America, adavis@cornell.edu

1 - Laboratory Experiments on the Operations-Finance Interface
Vishal Gaur, Cornell University, Johnson School, Ithaca, NY, United States of America, vg77@cornell.edu

I shall identify some opportunities for testing theoretical models on the interface of operations management and finance through controlled experiments in the lab or the field.

2 - Human Behavior in Production and Supply Chain Systems
Wallace Hopp, University of Michigan, Ross School of Business, Ann Arbor, MI, 48109, United States of America, whopp@umich.edu

Considering human behavior can alter the structure of operations management problems in some classical settings, and can present entirely new problems in other settings. In this talk, we will explore the impact of behavioral issues, such as motivation, trust and fairness in production and supply chain settings. The focus will be to identify common threads apparent from results so far, and to highlight areas of potential future research interest.

3 - Behavioral Opportunities in Revenue Management and Pricing
Serguei Netessine, Professor, INSEAD, 1 Ayer Rajah Avenue, Singapore, 138676, Singapore, serguei.netessine@insead.edu, Jun Li

Behavioral work in operations management has paid relatively little attention to the issues if revenue management and pricing. In this talk we will discuss empirical evidence suggesting that there are ample opportunities for behavioral researchers.

■ MD46

Hilton- Lombard

Cutting Plane and Formulation Techniques for Mixed Integer Programming

Sponsor: Optimization/Integer and Discrete Optimization

Sponsored Session

Chair: Sina Modaresi, Graduate Research Assistant, University of Pittsburgh, 1048 Benedum Hall, Pittsburgh, PA, 15261, United States of America, sim23@pitt.edu

1 - Valid Inequalities for the Pooling Problem
James Luedtke, Associate Professor, University of Wisconsin-Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, jrluedt1@wisc.edu, Jeff Linderoth, Claudia D'Ambrosio

We investigate relaxations for the non-convex pooling problem, which arises in production planning problems in which products with are mixed in intermediate pools in order to meet quality targets at their destinations. We derive valid nonlinear convex inequalities, which we conjecture define the convex hull of this non-convex set for some special cases. Numerical illustrations will be presented.

2 - Obtaining Deeper Intersection Points for Generalized Intersection Cuts
Aleksandr Kazachkov, Ph.D. Student, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, akazachk@cmu.edu, Egon Balas, Francois Margot, Selvaprabu Nadarajah

Generalized intersection cuts offer a non-iterative method to generate cuts for mixed-integer linear programs, by finding a collection of intersection points that can be used to generate cuts through a linear program. We demonstrate theoretical properties of proper collections of intersection points and empirically evaluate several procedures for generating points. The goal is to obtain deeper intersection points, so that the corresponding cut-generating program yields better cuts.

3 - Lifted Mixing Inequalities for a Generalized Mixing Set
Ayse Arslan, University of Florida, 3700 Windmeadows Blv., P180, Gaineville, FL, 32608, United States of America, nur.arslan@ufl.edu, Jean-Philippe P Richard, Yongpei Guan

In this paper, we study a generalization of the mixing set introduced by Pochet and Gunluk, 2001. We show that the traditional mixing inequalities can be used to obtain facet-defining inequalities for the set in consideration through lifting. We further prove that the associated lifting function is subadditive. We therefore use an efficient lifting procedure to obtain a family of facet-defining inequalities for the set in consideration.

4 - On Some Generalizations of Split Cuts
Diego Moran, Dr., United States of America, dmoran@gatech.edu, Sanjeeb Dash, Oktay Gunluk

Split cuts form a well-known class of valid inequalities for mixed-integer programming problems (MIP). Cook et al. (1990) showed that the split closure of a rational polyhedron P is again a polyhedron. In this paper, we extend this result from a single rational polyhedron to the union of a finite number of rational polyhedra. We also show how this result can be used to prove that some generalizations of split cuts, namely cross cuts, also yield closures that are rational polyhedra.

■ MD47

Hilton- Mason A

Joint Session Optim/ MIF: Developments in Stochastic Integer Programming Methods

Sponsor: Optimization/Optimization Under Uncertainty & Minority Issues Forum

Sponsored Session

Chair: Lewis Ntaimo, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, ntaimo@tamu.edu

Co-Chair: Saravanan Venkatachalam, Texas A&M University, Industrial and Systems Engineering Dept, College Station, TX 77843, United States of America, saravanan@entc.tamu.edu

1 - A Branch-and-Bound Method for Stochastic Integer Bilinearly-Constrained Programs
Christopher Hagmann, Purdue University, 480 Stadium Mall Dr., West Lafayette, United States of America, chagmann@purdue.edu, Nan Kong, Pratik Parikh

The warehouse-inventory-transportation problem was developed to integrate warehousing decisions in developing distribution plans in supply chain practice. The resultant problem is a two-stage stochastic integer bilinearly-constrained program. We propose an algorithm that decomposes the problem by branching on variables responsible for the bilinearity. The resulting tree of SIPs is searched and fathomed using scenario decomposition. Various strategies are compared for the test instances.

2 - Fenchel Decomposition for SIP with Second-Stage Integer Variables
Saravanan Venkatachalam, Texas A&M University, Industrial and Systems Engineering Dept, College Station, TX 77843, United States of America, saravanan@entc.tamu.edu, Lewis Ntaimo

This talk presents a computational study of a Fenchel decomposition algorithm for two stage stochastic integer programs having integer variables in second stage with special structure. A Benders' decomposition framework is used and a new heuristics is devised to aid in generating Fenchel cuts in a stage-wise decomposition setting.

3 - Exploiting Submodularity in Integer Programming under Uncertainty
Shabbir Ahmed, Professor, Georgia Institute of Technology, 755 Ferst Drive NW, Atlanta, GA, 30332-0205, United States of America, sahmed@isye.gatech.edu

Various classes of integer programming models under uncertainty can be reformulated into deterministic mixed integer nonlinear programming (MINLP) formulations involving nonlinear functions of binary variables that exhibit a diminishing marginals property known as submodularity. This talk will discuss various approaches to exploit this submodularity to develop effective mixed integer linear programming (MILP) based methods for such MINLP problems.

4 - Fenchel Disjunctive Decomposition for Mean-Risk Stochastic Integer Programs

Lewis Ntaimo, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, ntaimo@tamu.edu, Michelle Alvarado, Guglielmo Lulli

Mean-risk stochastic integer programs (SIPs) include both expectation and a dispersion statistic in the objective function and are difficult to solve. We derive an integrated Fenchel and disjunctive decomposition method for mean-risk SIPs with fixed recourse for the absolute semideviation mean-risk measure. Fenchel decomposition cuts are generated based on a subset of scenarios and are lifted and translated using disjunctive programming so that they are valid for the rest of the scenarios.

■ MD48

Hilton- Mason B

Network and Graphs 2

Contributed Session

Chair: Yongwhan Lim, PhD, MIT, 70 Pacific Street, Cambridge, MA, 02139, United States of America, yongwhan@mit.edu

1 - Multi-factor Stock Analysis using Graph Theory

Deepika Pardasani, Columbia University, 116th St and Broadway, New York, NY, 10027, United States of America, dp2673@columbia.edu, Yared Nigussie, Bo Zhang

We use graph theory to understand structural properties of stock markets. We consider different market graphs: one based on stock returns, others with vertices weighted by factors like liquidity measure, Dividend Yield, and Price-to-Earnings Ratio. We investigate portfolios at various time horizons to derive meaningful economic information by examining clustering coefficients, correlation distributions and changing temporal properties of market graphs.

2 - Dynamical Network Structures in Multi-Layered Networks

Rene Janssen, Netherlands Defence Academy, Faculty of Military Sciences, Enys House, Het Nieuwe Diep 8, Den Helder, 1781 AC, Netherlands, rhp.janssen@nlda.nl, Herman Monsuur, AriÎn van der Wal

In modeling (inter)actions and cooperation as networks, actors may be represented as nodes that simultaneously belong to multiple interdependent networks. We present a method that is used to implement, analyze and evaluate basic principles that may be used by the actors in an organization to drive the process of constant change. We demonstrate our approach to networks in which two basic principles are operational: reciprocity and covering.

3 - Stochastic Linear Threshold Model of Diffusion in Networks

Yongwhan Lim, PhD, MIT, 70 Pacific Street, Cambridge, MA, 02139, United States of America, yongwhan@mit.edu, Alex Teytelboym, Asuman Ozdaglar

We provide an analytical expression for the expected number of adopters in any network with any seed in terms of a new centrality measure. We describe network topologies that maximize and minimize diffusion when the seed is random. We also pin down the topology that maximizes overall diffusion when the seed can be targeted. For certain topologies, we derive the exact number of adopters, as the network grows large. We discuss how the structure of the network affects early history of diffusion.

4 - Efficient Parallel Algorithms for Network Interdiction Problems

Dia St. John, University of Arkansas, Bell Engineering Center, Fayetteville, AR, 72701, United States of America, destjohn@uark.edu, J. Cole Smith, Chase Rainwater

Network interdiction is a well-known problem class with many important applications, including disruptions in supply chain infrastructures and communication networks. This work focuses on decreasing the computational run time required to solve large-scale network interdiction models to optimality through the use of new parallel computing methodologies.

■ MD49

Hilton- Powell A

Supply Chain Network Competition: Advances in Models, Methods, and Applications

Sponsor: Optimization/Network Optimization

Sponsored Session

Chair: Anna Nagurney, John F. Smith Memorial Professor, Isenberg School of Management, University of Massachusetts Amherst, Amherst, MA, United States of America, nagurney@isenberg.umass.edu

1 - Supply Chain Network Competition with Information Asymmetry in Quality and Minimum Quality Standards

Dong Li, Doctoral Student, Isenberg School of Management, University of Massachusetts, 121 Presidents Drive, Amherst, MA, 01003, United States of America, dongl@som.umass.edu, Anna Nagurney

We construct a supply chain network model with information asymmetry in product quality. The competing firms with, possibly, multiple manufacturing plants, which may be located on-shore or off-shore, are aware of the quality of the product that they produce but consumers only know the average quality. We propose the models and demonstrate how minimum quality standards can be incorporated. The numerical examples, accompanied by sensitivity analysis, reveal interesting results and insights.

2 - The Closed-loop Supply Chain Network with Competition and Design for Remanufactureability

Qiang Qiang, Penn State Univ., 30 E. Swedesford Rd., Malvern, PA, 19355, United States of America, qzq10@psu.edu

A two-period closed-loop supply chain network is investigated. In the first period, each manufacturer decides on the production quantity and level of remanufactureability, which has impact on the cost of both new and remanufactured products. In period two, manufacturers can manufacture and/or remanufacture products, taking into account that consumers have different valuations of new and remanufactured products. Through a series of case studies, we answer several important research questions.

3 - Supply Chain Network Sustainability under Competition and Frequencies of Economic Activities

Min Yu, Assistant Professor, Pamplin School of Business, University of Portland, Portland, OR, United States of America, yu@up.edu, Jonas Floden, Anna Nagurney

We develop a competitive supply chain network model with multiple firms, each of which produces a differentiated product by brand and weights its generated emissions in an individual way. The supply chain network economic activities have associated with them distinct capacities and the firms seek to determine their optimal product flows and frequencies of operation so that their utilities are maximized where the utilities consist of profits and weighted emissions.

4 - Supply Chain Supernetwork Model with Suppliers Risk Diversification

June Dong, Professor, School of Business, SUNY, Oswego, NY, United States of America, june.dong@oswego.edu, Jun Ma

Recently, supply chain risks are getting higher and higher. Firms are now seeking ways to diversify their suppliers. We consider multiple competitive supply chains that serve multiple demand markets. Each player seeks to maximize its profit, while each manufacturer also manages to diversify its suppliers. We develop a supernetwork model to capture the nature of the problem. Risk parameters are introduced. Variational Inequality formulations are derived and numerical examples are provided.

■ MD50

Hilton- Powell B

Optimization, Network 1

Contributed Session

Chair: Cenk Caliskan, Associate Professor, Department of Finance and Economics, Woodbury School of Business, Utah Valley University, Orem, UT, 84058, United States of America, cenk.caliskan@uvu.edu

1 - The Least Cost Influence Problem (LCIP) in Dynamic Social Networks

Dilek Gunnec, Assistant Professor, Ozyegin University, Cekmekoy, Istanbul, Turkey, dilek.gunnec@ozyegin.edu.tr, Raghu Raghavan

Identifying critical nodes on a social network is an important problem in both marketing and epidemiological settings. The LCIP is an NP-Hard problem that is polynomially solvable on tree networks under the assumption that all neighbors of a node exert equal influence. We explore the extensions of the LCIP to a dynamic social network setting. The two important aspects of the problem include modeling of dynamic social networks and the integration of these dynamic effects to spreading behavior.

2 - Optimizing Social Media Message Dissemination Problem for Emergency Communication

Xin Ma, Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, xma@tamu.edu, Justin Yates

We introduce a formal model for the Social Media Message Dissemination (SMMD) problem, which includes emphasis on single and multiple message scenarios and examines key communication characteristics in the development of more targeted messaging strategies in extreme events. We present a detailed experimental design on random networks and real Twitter sub-networks and discuss our findings. We also include analysis of heuristics for SMMD and discuss the potential use in real-world applications.

3 - Transmission Expansion Planning Considering Energy Storage Systems

Cameron MacRae, Phd candidate, School of Mathematical and Geospatial Sciences, RMIT University, GPO Box 2476, Melbourne, 3001, Australia, cameron.macrae@rmit.edu.au, Andreas Ernst, Melih Ozlen

In the electricity grid, energy storage systems (ESS) provide a way of both smoothing supply and matching demand. We develop an extension to the transmission network expansion planning (TEP) problem that considers the installation of both ESS and additional circuits. The model is tested on the well known Garver 6-bus and IEEE 25-bus test circuits and some preliminary results are discussed.

4 - Optimizing Information Flow In an Adaptive Network

Mohsen Dadashi, University of Arkansas, Department of Industrial Engineering, 4207 Bell Engineering Center, Fayetteville, AR, 72701, United States of America, mdadashi@uark.edu, Chase Rainwater, Edward Pohl

In this talk, information flow in an organization is modeled as a social network. Actors are classified into different levels. Actors have multiple states which represent their willingness to reveal their known information. The model analyzes the information received by a specific targeted actor. First, a sensitivity analysis is done to identify the influence of current network parameters on the result. Second, network modifications are examined in order to optimally create new connections.

■ MD51

Hilton- Sutter A

First-order Methods for Large-scale Convex Optimization

Sponsor: Optimization/Nonlinear Optimization

Sponsored Session

Chair: Necdet Serhat Aybat, Assistant Professor, Penn State University, Dept. of Industrial Engineering, University Park, PA, 16802, United States of America, nsa10@psu.edu

1 - Practical Inexact Proximal Quasi-Newton Method with Global Complexity Analysis

Xiaocheng Tang, Lehigh University, Industrial and Systems Engineering Dept., United States of America, xiaocheng.t@gmail.com, Katya Scheinberg

Recently several methods were proposed for sparse optimization which make careful use of second-order information to improve local convergence rates. Here we propose a general framework, and also a new algorithm, which uses limited memory BFGS Hessian approximations, and provide a global convergence rate analysis in the spirit of proximal gradient methods, which includes analysis of method based on coordinate descent.

2 - Low-rank Matrix and Tensor Recovery: Theory and Algorithms

Donald Goldfarb, Professor, Dept. of Industrial Engineering and Operations Research, Columbia University, New York, NY, 10027, United States of America, goldfarb@columbia.edu, Cun Mu

To exploit structured data, convex low-rank completion and robust PCA models for matrices have been extended to tensors. We establish recovery guarantees for these models and introduce a new convex relaxation for the tensor Tucker rank, which is theoretically and empirically much better than the one most commonly used. We propose first-order algorithms to solve both models, and empirically investigate their recoverability properties, and the computational performance of our algorithms.

3 - A Parallel Method for Large Scale Convex Regression Problems

Zi Wang, PhD Candidate, Penn State University, Dept. of Industrial Engineering, University Park, PA, 16802, United States of America, zxw121@psu.edu, Necdet Serhat Aybat

Convex regression (CR) problem deals with fitting a convex function to a finite number of observations. Computing the least squares (LS) estimator via solving a quadratic program (QP) is the most common technique. However, computing the LS estimator is not practical using interior point methods when the number of observations is very large. The first-order method proposed in this paper efficiently solves large-scale instances of CR problem with limited memory through parallelization.

4 - An Evolving Gradient Resampling Method for Machine Learning

Stefan Solntsev, Northwestern University, stefans@u.northwestern.edu, Jorge Nocedal

We propose an optimization method for machine learning that is neither purely batch nor purely stochastic method. It belongs to the class of semi-stochastic methods that have recently received much attention, and that include the Stochastic Average Gradient and Stochastic Variance Reduced Gradient methods. The novel feature of our algorithm is that, unlike the two methods just mentioned, it is appropriate even in the case of an infinite training set.

■ MD52

Hilton- Sutter B

Algorithms for Optimization and Learning

Sponsor: Optimization/ Linear and Conic Optimization

Sponsored Session

Chair: Angelia Nedich, UIUC, 1308 West Main Street, Urbana, Il, 61801, United States of America, angelia@illinois.edu

Co-Chair: John Mitchell, Professor, Rensselaer Polytechnic Institute, 325 Amos Eaton, Math Sciences, 110 Eighth St, Troy, NY, 12180, United States of America, mitchj@rpi.edu

1 - Distributed Optimization over Directed Graphs

Alexander Olshevsky, University of Illinois, 1308 West Main Street, Urbana, IL, 61801, United States of America, olshevsky.alex@gmail.com, Angelia Nedich

The widespread availability of copious amounts of data has created a pressing need to develop optimization algorithms which can work in parallel when input data is unavailable at a single place but rather spread throughout multiple locations. We consider the problem of optimizing a sum of convex functions in a network where each node knows only one of the functions and develop a stochastic gradient method which is fully decentralized and robust to unpredictable node and link failures.

2 - A New Exact Algorithm for the Bilevel Linear Programming Problem

Lizhi Wang, Associate Professor, Iowa State University, Iowa State University, Ames, IA, 50011, United States of America, lzwang@iastate.edu, Pan Xu, Mohammad Rahdar, Bokan Chen

We present a new exact algorithm for the bilevel linear programming problem. This algorithm adopts a branch-and-bound framework but uses a new approach to the separation problem to eliminate bilevel infeasible solutions from the linear programming relaxation. We will report preliminary numerical results.

3 - Complementarity Formulation for l0 Norm Minimization Problems

Xin Shen, Rensselaer Polytechnic Institute, 110 8th Street, Troy, NY, United States of America, shenx5@rpi.edu, Mingbin Feng, John Mitchell, Jong-Shi Pang, Andreas Waechter

Recently l0 norm minimization has become a remarkably active area of research in optimization. The problem is NP-hard and replacing it by the l1 norm is a common way to get an approximate solution. We consider an alternative way of formulating the problem as a mathematical program with complementary constraints. We further discuss the completely positive relaxation and compare the properties of various formulations, including stationary conditions, local and global optimality.

■ MD53

Hilton- Taylor A

Portfolio Optimization and Solution Methods

Cluster: Optimization in Finance

Invited Session

Chair: David Brown, Duke University, 100 Fuqua Drive, Durham, NC, United States of America, dbbrown@duke.edu

1 - Dynamic Portfolio Choice and Learning for a Regime Switching Model

Andrew Lim, Professor, National University of Singapore, 15 Kent Ridge Drive, Singapore, 119245, Singapore, andrewlim@nus.edu.sg, Poomyos Wimonkittiwat

We discuss approximate methods for solving dynamic portfolio choice problems with learning when the underlying market is driven by a hidden markov model with unknown parameters and unobserved regime. These methods illustrate how sampling methods from Bayesian statistics can be used to approximately solve dynamic portfolio choice problems.

2 - A Fast Regression Approach to Solving the Dual Problems of Dynamic Programs

Helin Zhu, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, 30332, United States of America, hzhu67@gatech.edu, Enlu Zhou, Fan Ye

In recent years, the primal-dual approach has become a powerful procedure in solving (reward maximization) dynamic programs by providing lower-upper bound pairs of the value functions. In practice, obtaining tight upper bounds on the value function requires good approximations of the optimal penalty function, which might be a time-consuming process. In this talk, we present an efficient least-squares regression approach to generate good approximations of the optimal penalty function.

3 - Accounting for Risk Measure Ambiguity when Optimizing Financial Positions

Jonathan Li, Assistant Professor, Telfer School of Management, 55 Laurier Avenue East Ottawa, Ottawa, Canada, jonathan.li@telfer.uottawa.ca, Erick Delage

While many risk measures have been proposed in the past, it is still a great challenge today to select a risk measure that faithfully represents a decision maker's true risk attitude. In this work, we present new robust forms of measures that account precisely for the risk preference of a decision maker when comparing and optimizing financial positions. Such measures can be evaluated and optimized through solving linear programs. Examples of portfolio optimization are provided.

■ MD54

Hilton- Taylor B

Joint Session FSS/OPT: Optimal Portfolio Management and Execution

Sponsor: Financial Services Section & Optimization

Sponsored Session

Chair: Liming Feng, Associate Professor, University of Illinois at Urbana-Champaign, 104 S Mathews Ave, Urbana, IL, 61801, United States of America, fenglm@illinois.edu

Co-Chair: Jingnan Chen, Assistant Professor, Singapore University of Technology and Design, Singapore, amy11011@gmail.com

1 - Optimal Dynamic Portfolio Liquidation Strategies

Somayeh Moazeni, Princeton University, Princeton, NJ, United States of America, somayeh@Princeton.edu

In the execution cost problem, an investor wants to minimize the total expected cost and risk in the execution of a portfolio of risky assets in order to achieve desired positions. In this talk, we discuss optimal stochastic dynamic programming strategies with linear temporary and permanent price impact models and the importance of market condition on the computed strategy.

2 - Asset Allocation under Generalized Hyperbolic Distribution: Optimal Portfolios and Performance

Luis Chavez-Bedoya, Research Professor, Esan Graduate School of Business, Alonso de Molina 1652, Surco, Lima, Peru, l.chavezbedoya@gmail.com, John Birge

We analyze the asset allocation problem under generalized hyperbolic (GH) distribution of returns. We provide expressions to compute the optimal portfolio weights. Also, the optimal mean-variance (MV) portfolio is studied and new conditions under which the MV framework is consistent with expected utility maximization are derived. Finally, we define general measures of performance to assess the effectiveness of a set of common portfolio rules.

3 - Optimal Portfolio Liquidation with a Markov Chain Approximation Approach

Jingnan Chen, Assistant Professor, Singapore University of Technology and Design, Singapore, amy11011@gmail.com

We consider the optimal portfolio liquidation problem where the objective is to minimize trading cost and risk when financial portfolios are liquidated over a short period of time. We propose Markov chain approximation approaches for computing the optimal trading strategies numerically and for studying analytical properties of such strategies.

■ MD55

Hilton- Van Ness

Optimization Modeling and Methodologies in Big Data

Sponsor: Optimization/Global Optimization & MINLP

Sponsored Session

Chair: Jiming Peng, University of Houston, Houston, United States of America, jopeng@uh.edu

1 - Optimization via Clustering in Machine Learning

Young Woong Park, Northwestern University, 2145 Sheridan rd, Evanston, IL, 60208, United States of America, ywpark@u.northwestern.edu, Diego Klabjan

We propose a clustering-based iterative algorithm for optimization problems, where we start by aggregating the original data and then in subsequent steps iteratively disaggregate. We apply the algorithm to common machine learning problems such as the least absolute deviation regression and support vector machine. We derive problem-specific data aggregation/disaggregation procedures. We also show optimality, convergence, and optimality gap in each iteration. A computational study is provided.

2 - Alternating Direction Methods for Penalized Classification

Brendan Ames, Assistant Professor, University of Alabama, Department of Mathematics, Tuscaloosa, AL, 35487, United States of America, bpames@ua.edu

Linear Discriminant Analysis is a classical technique for dimension reduction in supervised classification. However, this technique relies on the fact that the data being processed contains fewer features than observations, which typically fails to hold in a high-dimensional setting. In this talk, we present a modification, based on l1-regularization and the alternating direction method of multipliers, for performing LDA in the high-dimensional setting.

3 - The Bundle Recommendation Problem

Tao Zhu, Data Scientist, WalmartLabs, 850 Cherry Ave, San Bruno, CA, 94066, United States of America, tzhu@walmartlabs.com

Recent research on recommender systems has been mainly concentrating on improving the relevance or profitability of individual recommended items. But in reality, users are usually exposed to a set of items and they may buy multiple items in a single order. Thus, the relevance or profitability of one item may actually depend on the other items in the set. In this paper, we introduce a novel problem called the Bundle Recommendation Problem (BRP) and discuss how to solve it in practice."

■ MD56

Hilton - Green Room

Software Demonstrations

Cluster: Software Demonstrations

Invited Session

1 - Statistics.com - XLMiner V2015: Text Mining, Ensemble Methods, Feature Selection and More

Peter Bruce, President, Statistics.com, 612 N Jackson Street, Arlington, VA, 22201, United States of America, peterbruce@statistics.com, Daniel H. Fylstra

XLMiner software, used for years in MBA education, is now an industrial-strength data mining tool, enabling you to easily create forecasting, classification, prediction and affinity analysis models, using datasets far exceeding traditional Excel worksheets. Attend this session for a preview of XLMiner V2015 and learn how you can apply powerful text mining methods, ensemble methods, and feature selection methods for better-than-ever results – rivalling the best enterprise data mining software with far less cost and risk.

2 - ARTELYS Corp. - Artelys Crystal Super Grid, a Power Systems Modeling Software for Cost-Benefit Analysis of Energy Projects

Guillaume Tarel, Vice President, Artelys Corp., Montreal, QC, H3H2P5, Canada, guillaume.tarel@artelys.com

This presentation focuses on the use of Artelys Crystal Super Grid, a power systems modeling software developed by Artelys. Our users are investors, regulation authorities and independent system operators (ISO), ministries, consultants or transmission system operators (TSO/RTO). Their objective is to evaluate in detail the interest of specific projects (generation/transmission/storage) in terms of revenue, social welfare, pollutant emissions and security of supply in a region. To this purpose, Artelys Crystal Super Grid uses built-in libraries of power assets and indicators, along with a powerful optimization engine, to simulate systems with tens of interconnected regions on an hourly basis. Its intuitive interface allows for efficient analysis, comparison and evaluation of large number of scenarios.

■ MD64

Parc- Cyril Magnin I

Markov Lecture

Sponsor: Applied Probability Society

Sponsored Session

Chair: Peter Glynn, Stanford University, Huang Engineering Center 357, Stanford CA 94305, United States of America, glynn@stanford.edu

1 - Perspectives on Traffic Modeling

Peter Glynn, Stanford University, Huang Engineering Center 357, Stanford CA 94305, United States of America, glynn@stanford.edu

A fundamental "model input" to most stochastic models used in operations settings is the "traffic model" describing the exogenous flow of work into the system. Many of the major research contributions in our field relate to limit theorems and approximations developed for such systems. Such limit theorems are usually used as a tool for predicting key performance measures associated with model outputs. But such theory also can be interpreted as providing insights into the main features of the model input that determine performance. In this talk, we will propose some general principles for traffic modeling, and discuss the role that limit theorems play in offering insight into the key features that must be captured in order to obtain model predictions of reasonable quality. This work is joint with Harsha Honnappa, Jeff Hong, and Xiaowei Zhang.

Discussant

Presenting Author: Assaf Zeevi,Columbia University, United States of America, assaf@gsb.columbia.edu

Discussant

Presenting Author: Pierre L'Ecuyer,University of Montreal, Montreal, Canada, lecuyer@iro.umontreal.ca

■ MD65

Parc- Cyril Magnin II

Modeling & Simulation in Healthcare Service Delivery

Sponsor: Simulation

Sponsored Session

Chair: Taesik Lee, Associate Professor, KAIST, 291 Daehak-ro, Yuseong-gu, E2-2102, Daejeon, Korea, Republic of, taesik.lee@kaist.edu

1 - Primary Care Design: Appointment Template and Staffing Model

Jingshan Li, Associate Professor, University of Wisconsin - Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, jingshan@engr.wisc.edu, Tingmao Wang, Molly Williams, Jeffrey Sleeth, Sally Kraft, Xiang Zhong

This work is dedicated to investigating the optimized appointment template and staffing model in primary care clinics under different clinic settings. A discrete event simulation model is developed to analyze the patient flow in the primary care processes with complex interactions among patients, care providers, and resources. Using the simulation model, different appointment templates and team structures are investigated.

2 - Selecting Hierarchical Facility Locations for Healthcare Planning

Taesik Lee, Associate Professor, KAIST, 291 Daehak-ro, Yuseong-gu, E2-2102, Daejeon, Korea, Republic of, taesik.lee@kaist.edu, Hoon Jang

We develop a location model to analyze locations of EDs in three-level EMS system in Korea. This problem is a multi-flow, nested, and non-coherent hierarchical facility location problem. While most hierarchical location models use median, covering, and fixed charge objectives, we use a cooperative covering objective. The cooperative covering objective is a more appropriate choice for assessing the accessibility to EMS, which provides more useful information to decision makers in public health.

3 - A Simulation Study of a Hospital Emergency Department in Hong Kong

Yong-Hong Kuo, Research Assistant Professor, The Chinese University of Hong Kong, Big Data Decision Analytics Res. Centre, The Chinese University of Hong Kong, Shatin, New Territories, Hong Kong - PRC, yhkuo@cuhk.edu.hk, Janny Leung, Colin Graham, Omar Rado, Benedetta Lupia

This paper presents a case study which uses simulation to analyze patient flows in a hospital emergency department in Hong Kong. We will talk about the challenges that we faced when developing our simulation model and present our findings by using the model.

4 - Optimization and Simulation Analyses for Optimal Liver Allocation Boundaries

Chun-Hung Chen, Professor, George Mason University, 4400 Univ Dr, Fairfax, VA, 22030, United States of America, cchen9@gmu.edu, Rajesh Ganesan, Naoru Koizumi, Monica Gentili

The U.S. organ transplant system has geographic disparities in access to and outcomes of transplantation. Researchers still report that a number of key elements that determine equity in transplantation vary significantly depending on the location of a patient. This study used a mathematical programming model to explore: (i) optimal locations of liver transplant centers; and (ii) optimal lowest boundaries as an alternative to the existing OPO boundaries across the contiguous United States.

5 - Real-time ECG Monitoring for the Early Diagnosis of Myocardial Infarction

Heeyoung Kim, Assistant Professor, KAIST, 291 Daehak-ro, Yuseong-gu,, Daejeon, Korea, Republic of, heeyoungkim@kaist.ac.kr

The electrocardiogram (ECG) is the most important source for the early diagnosis of myocardial infarction. We propose a new wavelet-based method to extract ECG features that discriminate the normal and abnormal subjects, and to monitor the extracted features for a real-time fault detection. The proposed method is shown to be computationally efficient and effective in monitoring the health condition via numerical experiments.

■ MD66

Parc- Cyril Magnin III

Applied Probability and Bayesian Models for Industrial Statistics

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Refik Soyer, George Washington University, Washington, DC, United States of America, soyer@gwu.edu

1 - Utility-based Inventory Management

Suleyman Ozekici, Professor, Koc University, Department of Industrial Engineering, Istanbul, Turkey, sozekici@ku.edu.tr, Filiz Sayin, Fikri Karaesmen

We take a utility-based approach to the newsvendor model where we suppose that there is random demand and supply which may be correlated with the financial markets. The newsvendor exploits this correlation and manages his risks by investing in a portfolio of financial instruments. The decision problem therefore includes not only the determination of the optimal ordering policy, but the selection of the optimal portfolio that reduces inventory risks.

2 - New Maximum Entropy Methods for Modeling Lifetime Distribution

Ehsan Soofi, Distinguished Professor, University of Wisconsin-Milwaukee, Lubar School of Business, P.O. Box 742, Milwaukee, WI, 53201, United States of America, esoofi@uwm.edu

We introduce two new maximum entropy methods for modeling the distribution of time to an event. One method is within the classical maximum entropy framework and provides characterizations of change point models such as the piecewise exponential distribution. The second method uses the entropy of the equilibrium distribution for the objective function and provides new characterizations of the exponential, Weibull, Pareto, and uniform distributions. With the same moment constraints, the two methods provide different models for the inter-arrival time are different.

3 - Bayesian Perspectives in Reliability Growth Testing

Refik Soyer, George Washington University, Washington, DC, United States of America, soyer@gwu.edu, Thomas Mazzuchi

In this talk we consider inference and decision problems that arise in reliability growth tests. In doing so, we present a general Bayesian framework that enables us update our inferences as well as our decisions in a dynamic manner. We illustrate the implementation of our methods using actual data and discuss computational issues.

4 - Monitoring Remaining Project Completion Uncertainty, a Bayes Network Approach

Johan Rene van Dorp, Professor, George Washington University, 1776 G Street, NW, Suite 101, Washington, DC, 20052, United States of America, dorpjr@gwu.edu, Ifechukwu Nduka

A Bayesian Network approach is presented modeling statistical dependence amongst activity duration uncertainties in a project network using AGENA RISK. Traditional approaches, such as PERT, ignored statistical dependence or, when taking it into account, did not allow for monitoring of remaining project completion uncertainty given partial project completion in a coherent manner. Early results show a strong Bayes learning effect of in a small project example under a mild degree of dependence.

■ MD67

Parc- Balboa

Statistical Approaches to Personalized Healthcare I

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Abe Zeid, Northeastern University, 360 Huntington Ave, Boston, United States of America, zeid@coe.neu.edu

1 - Hospital 30-Day Non-index Readmission and Care Transitions

Wei Liu, Ph.D. Student, Purdue University, 315 N. Grant Street, West Lafayette, IN, 47906, United States of America, liu317@purdue.edu, Ping H. Huang, Steven M. Witz

We explored three types of care transition as measured by 30-day hospital readmissions. Descriptive statistic analyses were conducted to investigate the variations among these care transitions. In addition, hospital utilizations were compared among patient groups classified by the type of care transitions that they experienced. We also identified patient risk factors to assist decision support of care coordination among providers.

2 - Operating Room (OR) Scheduling under Uncertainty

Yazhuo Liu, University of South Florida, 4202 E. Fowler Ave., ENB 118, Tampa, FL, 33613, United States of America, yazhuoliu@mail.usf.edu, Peter Fabri, Jose Zayas-Castro

In this presentation, we propose an operating room (OR) scheduling model which considers doctors' preferred blocks, uncertain surgery durations, emergency levels of surgeries, and etc. We apply a stochastic programming approach to minimize operation cost while ensuring the quality of care for patients. Computational results based on the data from a local surgery center (SC) will be reported.

3 - Benefits of Distribution Flexibility using Newsvendor Model for Health-care Services

Yolanda Obaze, PhD Student, University of North Texas, 1155 Union Circle, Denton, TX, 76203, United States of America, yolanda.obaze@unt.edu, Victor Prybutok, Shailesh Kulkarni

This research examines a multi-process, multi-distribution newsvendor healthcare model. The contribution of the work includes examining the transportation, inventory and storage costs associated with meeting demand. The parameters for the constraints are the result of qualitative research conducted with Community Based Organizations that provide healthcare services.

4 - The Impact of Insurance Coverage and Unobservable Health Status on Readmission Rates

Sezgin Ayabakan, UT Dallas, 800 W Campbell Rd, UTD Naveen Jindal School of Management, Richardson, TX, 75080, United States of America, ayabakan@utdallas.edu, Zhiqiang (Eric) Zheng, Indranil Bardhan

Hospital readmission rate is adopted as a hospital quality metric. However, non-clinical factors such as patients' insurance coverage and unobservable health status can also impact readmissions. We develop a Hidden Markov Model to investigate their impact on readmissions. We utilize a comprehensive panel dataset of inpatient visits in North Texas. Our analyses reveals that focusing solely on readmission rates can be misleading, without regard to patients' health status and insurance coverage.

■ MD67

Parc- Balboa

Statistical Approaches to Personalized Healthcare I

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Abe Zeid, Northeastern University, 360 Huntington Ave, Boston, United States of America, zeid@coe.neu.edu

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■ MD68

Parc- Davidson

Recent Advances in Simulation Metamodeling Techniques

Sponsor: Simulation

Sponsored Session

Chair: Xi Chen, Assistant Professor, Virginia Polytechnic Institute and State University, Industrial and Systems Engineering, 1145 Perry St., Blacksburg, VA, 24060, United States of America, xchen.ise@vt.edu

1 - A Bayesian Framework for Quantifying Uncertainty in Stochastic Simulation

Wei Xie, Rensselaer Polytechnic Institute, 110 8th Street, Center for Industrial Innovation 5207, Troy, NY, 12180-3590, United States of America, xiew3@rpi.edu, Russell Barton, Barry Nelson

When we use simulation to estimate the performance of a stochastic system, the simulation often contains input models that were estimated from real-world data; therefore, there is both simulation and input uncertainty in the performance estimates. We propose a Bayesian framework to measure the overall uncertainty while simultaneously reducing the influence of simulation estimation error due to output variability. Our approach is supported with both theoretical analysis and an empirical study.

2 - Regularized Radial Basis Function Models for Stochastic Simulation

Yibo Ji, National University of Singapore, 1 Engineering Drive 2, #06-25, Singapore, 117576, Singapore, jiyibo@nus.edu.sg, Yibo Ji

In this paper, we study radial basis function models for stochastic simulation. We construct a RBF model by minimizing the regularized loss over a reproducing kernel Hilbert space (RKHS). We then show how the regularized RBF (R-RBF) model can be efficiently improved by a rank-one update, and derive the closed form of the leave-one-out cross-validation error for RBF models. We discuss connections between stochastic kriging and R-RBF based on RKHS duality theory and present numerical results.

3 - Large Scale Simulation Optimization with Additive Gaussian Process Models

Szu Hui Ng, National University of Singapore, 1 Engineering Drive 2, Singapore, 117576, Singapore, isensh@nus.edu.sg

Metamodels are commonly used as fast surrogates for the objective function to facilitate the optimization of simulation models. The Gaussian process model is a popular metamodeling tool due to its flexibility in global fitting. However, for large data sets, computational complexity hinders its application. In this research, we propose an additive Gaussian process model that eases the computational burden and incorporated in a sequential search algorithm for simulation optimization.

4 - Sequential Experimental Designs for Stochastic Kriging

Xi Chen, Assistant Professor, Virginia Polytechnic Institute and State University, Industrial and Systems Engineering, 1145 Perry St., Blacksburg, VA, 24060, United States of America, xchen.ise@vt.edu, Qiang Zhou

We establish a sequential experimental design framework for applying stochastic kriging to predicting performance measures of complex stochastic systems. The proposed framework enjoys the flexibility to adapt to a variety of design criteria and the ability to correctly account for sampling uncertainty inherent in a stochastic simulation. We propose several novel design criteria under the proposed framework, and compare their performances through illustrative examples.

■ MD69

Parc- Fillmore

Joint Session ENRE/DAS: Expert Judgment and Learning Curves in Energy & Environment & Decision Analysis

Sponsor: Energy Natural Resources and the Environment/ Sustainability and Environment

Sponsored Session

Chair: Max Henrion, CEO, Lumina Decision Systems, 26010 Highland Way, Los Gatos, Ca, 95033, United States of America, henrion@lumina.com

1 - Decision Frameworks for Energy Technology R&D Portfolio Analysis

Erin Baker, University of Massachussetts, Amherst, MA. edbaker@ecs.umass.edu

In this paper we apply two decision frameworks to a decision on public energy technology R&D portfolio selection in the face of climate change. We compare the results of the two frameworks across three expert elicitation studies (used to estimate probability distributions over technological outcomes) and three Integrated Assessment Models (used to estimate how the outcomes of technological change impact the economy and the cost of abatement), to look for robust policy insights.

2 - Optimal Energy R&D Investment Allocation under Uncertainty for a Low-carbon Future

Valentina Bosetti, Fondazione Eni Enrico Mattei (FEEM), corso Magenta 63, Milan, Lo, 20123, Italy, valentina.bosetti@feem.it, Giacomo Marangoni, Gauthier De Maere, massimo Tavoni

This paper provides insights on the optimal portfolio of EU RD&D energy investments, given the intrinsic and endogenous uncertainty of learning. The goal is to find optimal first stage R&D investments that maximize total welfare, where the second stage depends on the cumulated first stage R&D investments and the conditional realization of learning parameters which reflect expert elicitation data. We solve the problem using approximate dynamic programming.

3 - Keep it Simple to Keep it Cool: Understanding the Performance of Energy and Climate Forecasts

Ines Azevedo, Associate Professor, Carnegie Mellon University, Baker Hall 129, 5000 Forbes Avenue, Pittsburgh, 15213, United States of America, iazevedo@cmu.edu

Energy and climate modelers have often been using sophisticated and complex model to forecast energy and climate related quantities. In this work, I focus on forecasts of energy quantities, and assess in which cases simpler models could have performed better, and draw key conclusions for clime and energy policy.

4 - How to Recalibrate and Combine Overconfident Experts

Max Henrion, CEO, Lumina Decision Systems, 26010 Highland Way, Los Gatos, Ca, 95033, United States of America, henrion@lumina.com

Overconfidence in expert elicitations may be evident from low overlap between probability distributions from different experts. We use this evidence to estimate the degree of overconfidence by expert, and recalibrate them to obtain better calibrated aggregate distributions. We demonstrate the practical value of the method on expert elicitations of the future cost and performance of low-carbon energy technologies.

5 - using Expert Judgment, Modeling and Optimization to Inform Energy R&D Decisions

Gabriel Chan, Harvard Kennedy School of Government, Cambridge, MA, 02138, United States of America, gabe_chan@hksphd.harvard.edu, Laura Diaz Anadon

We propose design principles and a method to support public R&D decision-making. Our method utilizes inputs from an expert elicitation exercise that collected inputs from 100 experts. The elicitations parameterize an energy system model, which we use in a sampling and optimization framework to support public energy R&D allocation decisions.

■ MD70

Parc- Hearst

Supply Chain Management in the Forest Sector

Sponsor: Energy Natural Resources and the Environment/ Natural Resources

Sponsored Session

Chair: Marc-André Carle, Assistant Professor, Université Laval, 1065, Avenue de la Médecine, Quebec, QC, Canada, Marc-Andre.Carle@osd.ulaval.ca

1 - Supply Chain Design under Uncertainty for Advanced Biofuel Production Based on Bio-oil Gasification

Qi Li, Iowa State University, 0076 Black Engineering, Ames, IA, 50010, United States of America, qili@iastate.edu, Guiping Hu

A two-stage stochastic programming is formulated to maximize biofuel producers' annual profit considering uncertainties in supply chain. A case study based on Iowa illustrates that it is economically feasible to meet the desired demand using corn stover as the biomass feedstock. Also, farmers' participation can have a significant impact on the profitability and robustness of this supply chain.

2 - Industrial Routing Problem

Mikael Rönnqvist, Professor, Université Laval, Département de Génie Mécanique Pavillon, 1065, Avenue de la Médecine, Quebec, QU, G1V 0A6, Canada, mikael.ronnqvist@gmc.ulaval.ca, Patrik Flisberg, Marc-André Carle, Vincent Monbourquette, Philippe Marier

Routing problems in industrial setting can be very challenging with all extra real world constraints imposed. We propose an efficient solution method which accounts for many products, multiple periods with strict inventory considerations, several goals, special loading patterns, backhaul rules and many desirable characteristics for queuing issues. We report on its use at a large forest company and analyse its performance compared to manual planning.

3 - Stochastic Approaches to Sawmill Operations Planning Problem in a Rolling Horizon

Jorge Vera, Professor, Pontificia Universidad Catolica de Chile, Dept. Industrial and System Engineering, Vicuna Mackenna 4860, Santiago, 7820436, Chile, jvera@ing.puc.cl, Alfonso Lobos

Operations planning in sawmills is an example of decision making in different time horizons, where tactical decisions might not be optimal for short term operations, due to various sources of uncertainty. We address this problem using various stochastic and robust optimization models and we show how these could be solved in such a way to increase the probability that tactical decisions will be compatible with operational decisions. We simulate various cases in a rolling horizon decision process.

4 - Strategic Planning of Forest Residues Supply Chains with Environmental Considerations

Claudia Cambero, PhD Candidate, University of British Columbia, 2943-2424 Main Mall, Vancouver, BC, V6T1Z4, Canada, cambero.claudia@gmail.com, Taraneh Sowlati

We present an optimization model to design regional forest residues supply chains for the production of bioenergy and biofuels. The objective is to maximize the NPV of the entire supply network. The model considers expected changes in biomass supply and cost as well as in products' demand and price when deciding on the facilities' installation period. A case study is presented where we compare the environmental impact of the optimal solution against the current situation in the region.

■ MD71

Parc - Lombard

Dynamic Matching Markets

Cluster: Auctions

Invited Session

Chair: John Dickerson, CMU, 9219 Gates-Hillman Center, Carnegie Mellon University, Pittsburgh, PA, 15213, United States of America, dickerson@cs.cmu.edu

1 - Dynamic Matching using Approximate Dynamic Programming
Nikhil Bhat, Columbia University, nbhat15@gsb.columbia.edu, Ciamac Moallemi

We provide tractable algorithms for a large number of challenging dynamic decision making problems such as 1) Allocation of cadaveric kidneys to patients, 2) Matching ads with impressions, 3) Cyclic paired transfer of kidneys, by analyzing them using a general model. Our policies are easy to compute and interpret, and further come with approximation guarantees. With simulation experiments on kidney allocation, we show that we obtain gain over existing algorithms in literature.

2 - Dynamic Matching Market Design
Mohammad Akbarpour, Stanford University, 579 Serra Mall, 265F, Stanford, CA, 94305, mohamwad@stanford.edu, Shayan Oveis Gharan, Shengwu Li

We show that, in dynamic matching markets, waiting to thicken the market can be substantially more important than increasing the speed of transactions. In particular, simple local algorithms that wait to thicken the market can perform very close to optimal algorithms. We prove our claims by analyzing a simple but illuminating model of dynamic matching in networked markets where agents arrive and depart stochastically.

3 - The Roles of Common and Private Information in Two-Sided Matching with Interviews
Sanmay Das, Associate Professor, Washington University in St. Louis, sanmay@seas.wustl.edu, Zhuoshu Li

We consider two sided matching markets where employers have a fixed budget for the number of applicants they may interview. Employers receive noisy signals of how good each applicant is, and these signals include common and private components. We analyze how the strengths of these two components affect matching outcomes (both differentially across different quality candidates, and in the aggregate number of matches) when decisions about whom to interview are strategic.

4 - FutureMatch: Learning to Match in Dynamic Environments
John Dickerson, CMU, 9219 Gates-Hillman Center, Carnegie Mellon University, Pittsburgh, PA, 15213, United States of America, dickerson@cs.cmu.edu, Tuomas Sandholm

Kidney exchange, an innovation where willing but incompatible donor-patient pairs can exchange organs, is inherently dynamic. We present FutureMatch, an empirical framework for learning to match in a general dynamic model. We validate it on real data. Not only does dynamic matching result in more expected transplants than myopic, but even dynamic matching under economically inefficient (equitable) objectives can result in significant increases in social welfare over efficient myopic matching.

■ MD72

Parc- Stockton

Energy I

Contributed Session

Chair: Harikrishnan Sreekumaran, Doctoral Candidate, Purdue University, 315 N. Grant Street, West Lafayette, IN, 47907, United States of America, harikrishnan@purdue.edu

1 - Investigation of Bidder Asymmetry in Japanese Electric Power Procurement Auction
Shigeharu Okajima, Waseda University, 1-6-1 nishi waseda Shinjyuku ku, Tokyo, Japan, shigeharu.okajima@gmail.com, Hiroko Okajima

This paper investigates the differences in the bidding patterns between incumbents and entrants in Japanese electric power procurement auctions. we analyze Japanese electric power auction data to examine bidder asymmetry, which potentially reduces competition as shown in auction theory. We find that strong bidders change depending on types of auctions.

2 - Equilibrium Wind Hedge Contract Structures through Nash Bargaining
Harikrishnan Sreekumaran, Doctoral Candidate, Purdue University, 315 N. Grant Street, West Lafayette, IN, 47907, United States of America, harikrishnan@purdue.edu, Andrew Liu

Wind hedge contracts are to help wind project developers secure financing and manage risk. In such a contract, a strike price of electricity and a quantity are to be specified. We use Nash bargaining to study the equilibrium contract structures as a result of bargaining between the two parties involved. The resulting model is a bilinear, stochastic program, which is solved by the sample average approximation approach. Numerical results as well as comparative statics are provided.

3 - Security of Gas Supply in Europe: A Model-based Analysis
Tobias Baltensperger, ETH Zurich, ETL K22, Physikstrasse 3, Zurich, ZH, 8092, Switzerland, t.baltensperger@control.ee.ethz.ch

The security of gas supply is an intensely discussed issue in Europe since the continent relies heavily on external suppliers for its needs. In this talk, we try to provide insight into the mechanics of today's gas markets. To this end, we propose an equilibrium model of the global natural gas market and we show the consequences of potential supply disruptions on European consumers. Furthermore, we discuss cost-efficient ways of increasing security of supply for European countries.

4 - An Integrated Framework to Study Electricity and Reserve Markets with Storage Systems
Yang Chen, Mississippi State University, PO Box 9542, Mississippi State, MS, 39762, United States of America, yc352@msstate.edu, Mengqi Hu, Zhi Zhou

In this research, a general modeling framework for an electricity market with thermal units, renewable energy, storage devices and demand response is proposed, where energy and reserve services are jointly dispatched. A MIQP model is implemented based on the modified IEEE 118-bus data, and several metrics (e.g., system cost, electricity/reserve price) are used to analyze the impacts of different components (e.g., renewable energy, storage) to electricity and ancillary service markets.

5 - Delta-hedging of a Hydro Power Plant with Focus on Revenue from Ancillary Services using Stochastic
Hubert Abgottspon, ETH Zurich, Physikstrasse 3, Zürich, 8092, Switzerland, abgottspon@eeh.ee.ethz.ch

Provision of ancillary services offers revenue opportunities for hydro power producers. Such products influence the production schedule of the power plant considerably. It is however difficult to predict if ancillary services will be provided in future time stages, thus resulting to production risk. A stochastic program is proposed, which estimates the sensitivity of the production schedule for varying remuneration of ancillary services, which could then be used to lower the risk exposure.

■ MD73

Parc- Mission I

Energy/Climate Modeling, Policy and Decision Making

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Olaitan Olaleye, PhD Candidate, University of Massachusetts, 120A Marston Hall, University of Massachusetts, Amherst, Amherst, MA, 01003, United States of America, oolaleye@umass.edu

Co-Chair: Erin Baker, University of Massachussetts, Amherst, edbaker@ecs.umass.edu

1 - The Use of Rate-Based Constraints to Control CO2 Emissions
David Young, Senior Technical Leader, Electric Power Research Institute, 3420 Hillview Ave, c/o EPRI, Palo Alto, CA, 94304, United States of America, dyoung@epri.com

The EPA recently proposed regulations under the Clean Air Act 111(d) to limit carbon dioxide emissions from existing generation units. The proposed restrictions take the form of a constraint on the average emissions rate by state, rather than by the more familiar cap on total emissions. This work considers the challenges in modeling rate-based constraints, and compares compliance outcomes at the national level against equivalent caps using the US-REGEN model.

2 - Complementarity Modeling of Overlapping Biofuel Policies: Cost Containment Strategies in the LCFS

Adam Christensen, NSF SEES Fellow and Postdoctoral Researcher, Johns Hopkins University, 3400 N Charles ST, Ames Hall 313, Baltimore, MD, 21218, United States of America, adam.christensen@jhu.edu, Ben Hobbs, Sauleh Siddiqui, Chris Malins

The two most influential biofuel policies in the US are the federal Renewable Fuel Standard (RFS) and California based Low Carbon Fuel Standard (LCFS). In many cases a single gallon of biofuel can qualify for compliance under both programs. However, in the event of a lack of supply of low carbon fuels, it is possible that the LCFS compliance cost could grow to unreasonable levels. A detailed market model of both the RFS and LCFS is developed and cost containment strategies are presented.

3 - R&D Portfolio Allocation in Response to Climate Change

Olaitan Olaleye, PhD Candidate, University of Massachusetts, 120A Marston Hall, University of Massachusetts, Amherst, Amherst, MA, 01003, United States of America, oolaleye@umass.edu

We examine the role of technical advancement in a portfolio of Solar, Nuclear, CCS, Bio-Fuels, Bio-Electricity and Electric Transportation. We show that Bio-Electricity complements CCS, while most technology pairs are substitutes. We find that scenarios without CCS have significant cost drawback reaching full abatement. Portfolios with CCS stochastically dominate those without; and renewables-only portfolios are dominated. We also show how the optimal portfolio varies with risk.

4 - How to Choose an Appropriate Mathematical Model for Energy/climate Policy Analysis?

James Merrick, Stanford University, Huang Engineering Center, Stanford, CA, 94305, United States of America, jmerrick@stanford.edu

For certain classes of problems, the suitability of model structure cannot be tested via predictive power. So, how to choose an appropriate model? A framework is proposed to provide a logical basis for thinking about this issue. Conditions are stated where a given structure can be logically `more appropriate' than an alternate. The corollary follows that in other cases, appropriateness comes down to subjective judgement. For illustration, the framework is applied to energy-economic modelling.

■ MD74

Parc- Mission II

Stochastic Control and Optimization of Power Systems with Renewables

Sponsor: Energy, Natural Res & the Environment/Energy

Sponsored Session

Chair: Harsha Gangammanavar, Visiting Assistant Professor, University of Southern California, 3715 McClintock Ave, GER 240, Los Angeles, CA, 90089, United States of America, gangamma@usc.edu

1 - Real-time Pricing in Smart Grid: An ADP Approach

Andrew Liu, Assistant Professor, Purdue University, 315 N. Grant Street, West Lafayette, IN, United States of America, andrewliu@purdue.edu, Jingjie Xiao

We propose an approximate dynamic programming (ADP)-based modeling and algorithm framework to integrate wholesale markets' dispatch operation with demand response under electricity real-time pricing (RTP). With controllable charging/discharging of plug-in electric vehicles, our numerical results show that RTP can lower the expected values of wholesale electricity prices, increase capacity factors of renewable resources, and reduce system-wide CO_2 emissions.

2 - On the Identification of Generator Bid Stack from Public Market Data

Boris Defourny, Assistant professor, Industrial system engineering department at lehigh university, H.S. Mohler Laboratory, 200 West Packer, Bethlehem, Pa, 18015, United States of America, defourny@lehigh.edu

We study the problem of identifying aggregated bids from power generators, using high-frequency price data and load data publicly posted by independent system operators. We consider gas price data to identify bids sensitive to gas prices. We discuss results obtained with an inverse optimization approach based on the spot price formation mechanism.

3 - 99 Percent from Renewables? A Fresh Look at the Question of Maximum Penetration

Warren Powell, Professor, Princeton University, Sherrerd Hall, Charlton St, Princeton, NJ, 08544, United States of America, powell@princeton.edu, Javad Khazaei, Luke Cheng

We re-examine recent claims that we can provide 99 percent of our electricity using renewables and storage. We also use a streamlined, aggregate model which ignores grid capacity, but we introduce the important dimension that energy from fossil fuels can be purchased from the current generator stack, or at a very high price. We show that properly modeling the marginal cost of energy resources limits the maximum an economic portfolio would produce from renewables.

4 - Simulation and Optimization of Wind Energy for Modeling Sub-hourly Economic Dispatch

Harsha Gangammanavar, Visiting Assistant Professor, University of Southern California, 3715 McClintock Ave, GER 240, Los Angeles, CA, 90089, United States of America, gangamma@usc.edu, Suvrajeet Sen, Victor Zavala

We present a two-stage stochastic optimization method to address the operating paradigm change from hourly to sub-hourly dispatch in the presence of intermittent generation. The method is based on stochastic decomposition which can accommodate scenarios from external simulators. The scalability and performance of this method is demonstrated on a real scale power system for the state of Illinois.

■ MD75

Parc- Mission III

Joint Session MIF/HAS: Healthcare Analytics

Sponsor: Minority Issues Forum & Healthcare

Sponsored Session

Chair: Shannon LaToya Harris, University of Pittsburgh, 241 Mervis Hall, Pittsburgh, PA, 15213, United States of America, sharris@katz.pitt.edu

Co-Chair: Jerome Niyirora, Assistant Professor, SUNYIT, 100 Seymour Rd, Utica, NY, 13502, United States of America, jerome.niyirora@sunyit.edu

1 - The Analytics of a Service Network in Emergency Department

Jerome Niyirora, Assistant Professor, SUNYIT, 100 Seymour Rd, Utica, NY, 13502, United States of America, jerome.niyirora@sunyit.edu

Many factors that cause ED overcrowding are outside of the control of ED managers, except bottlenecks in the clinical processes. We propose using service-based networks in ED to streamline patient care. We construct a service network using CPT codes and then use centrality measures to identify services that are more influential and are more likely to help improve throughput, if administered at the point of care or resources are allocated to them appropriately.

2 - A Predictive Model for Advance Appointment Cancellations

Shannon LaToya Harris, University of Pittsburgh, 241 Mervis Hall, Pittsburgh, PA, 15213, United States of America, sharris@katz.pitt.edu, Jerrold May

Outpatient scheduling is complicated by advanced cancellations and patient no-shows. We built a model to predict advance cancellations, and how far in advance of the appointment such cancellations occur. The model is validated using data from VA Healthcare System outpatient clinics.

3 - Admission Control in a Two Class Loss System with Periodically Varying Parameters and Abandonments

Gabriel Zayas-Caban, Cornell University, 1731 Broadview Lane, Ann Arbor, MI, 48105, United States of America, gz63@cornell.edu

Customer demand and service processes for many service systems are time dependent, and customers in such systems may renege prior to or during service. Motivated by these considerations, we consider the control of admissions for a two class loss system with periodically varying parameters and where customers may abandon before completing service. We use a Markov decision process formulation and sample path arguments to determine properties of the optimal dynamic policy.

4 - The Erlang – A Model for Healthcare Applications

William Massey, Professor, Princeton University, Princeton University, Princeton, NJ, 08544, United States of America, wmassey@princeton.edu

The Erlang-A has many healthcare applications. As a Markov process, we can assume non-homogeneous Poisson arrivals for a multi-server queue with exponentially distributed service and abandonment times. Using fluid limits, we can use the resulting dynamical system to approximate controls for the transient, time-dependent behavior. We demonstrate how these techniques are relevant to the management of emergency rooms, hospital bed cleaning services, and nursing homes.

■ MD76

Parc- Embarcadero

O.R. Approaches to Plan and Build Data Networks

Sponsor: The Practice Track

Sponsored Session

Chair: Brian Eck, Quantitative Analyst, Google, Inc., 1300 Crittenden, Building CL3, Office 2S5, Mountain View, CA, 94043, brianeck@google.com

1 - How Data Network Traffic Measurement Effects Pricing, Behavior and Strategy

Muntazir Mehdi, Capacity Planner, Microsoft Corporation, 15803 Bear Creek Pkwy, E232, Redmond, 98052, United States of America, mumehdi@microsoft.com, Elena Helmer, Ivan Philips, Denver Maddux

Data traffic is monitored every second. The data has to be aggregated and mined for insights. Four aggregation schemes are used: Max,95P,Sum and Avg. These agg schemes have unique relevance in the data network context. By changing the order of operations; we can predict the peering/exchange contracts that best suit the bidirectional demand profiles. We demonstrate that such analysis can be leveraged to the entire span of data network strategy:capacity, peering contracts, interconnect/edge strategy.

2 - Optimization Techniques used in Fibre Optic Network Design

Chris Forbes, Optimisation Consultant, Biarri, 9 Vendale Ave, Brisbane, 4105, Australia, chris.forbes@biarri.com

With the increased popularity of fiber to the home networks across the world a commercial need arose to produce minimum cost designs. Construction costs often reach into the billions so even small percentage savings can have a significant impact for businesses. We will explore optimization techniques used in commercial fibre optic network design today; including a staged MIP approach as well as some more recent heuristic approaches based on the Capacitated Minimum Spanning Tree problem.

3 - Intra-Datacenter Network Capacity Planning at Google

Behdad Masih, Qauntitative Analyst, Google Inc., 1600 Amphitheatre Parkway, Mountain View, CA, 94043, United States of America, behdadm@google.com

In this talk, we will review how statistical techniques are used to provision networking resources at Google's infrastructure. By merging and aggregating the performance metrics of thousand of servers across Google's fleet, we forecast the required networking capacities at different layers of the network as a function of other hardware resources such as cpu and disk.

■ MD77

Parc- Market Street

Joint Session Analytics/CPMS: 2014 Innovative Applications in Analytics

Sponsor: Analytics & CPMS, The Practice Section

Sponsored Session

Chair: Pooja Dewan, General Director Decision Support, BNSF Railway, 2400 Western Center Blvd, Fort Worth, tx, 76131, United States of America, Pooja.Dewan@bnsf.com

1 - An SMS Text Classification System for UNICEF Uganda

Rick Lawrence, Manager, Machine Learning, IBM Research, Cognitive Computing Research, Yorktown Heights, NY, 10598, United States of America, ricklawr@us.ibm.com

U-report is an open-source SMS platform operated by UNICEF Uganda, designed to give Ugandan youth a voice on issues that impact them. Data received by the system are either SMS responses to polls conducted by UNICEF or unsolicited reports of problems occurring anywhere within Uganda. This talk describes an automated message- routing system deployed by IBM Research at UNICEF. We discuss a dual-supervision learning technique to leverage human-generated labels on both features and text examples.

■ MD78

Parc- Mason

Decision Analysis 1

Contributed Session

Chair: Purushothaman Ethiraj, Analytics Manager, Hewlett Packard, CV Raman Nagar, Bangalore, India, purushothaman.ethiraj@hp.com

1 - An Approximate Dynamic Programming Approach to Stochastic Resource Planning

Stan Solomon, Doctoral Candidate, University of Missouri-St. Louis, 1 University Blvd., 236 Express Scripts Hall, St. Louis, MO, 63121, United States of America, ssbcd@umsl.edu, Cipriano Santos, Haitao Li, Keith Womer

This research addresses the problem of assigning resources to tasks in a stochastic environment. Classic dynamic programming methods using Bellman's optimality equation suffer from the well-known curses-of-dimensionality and cannot be applied to large scale applications. To resolve the curse-of-dimensionality found in large applications, this research focuses on developing an Approximate Dynamic Programming algorithm. Hewlett-Packard's resource planning problem will be studied as an application.

2 - Resource Reallocation and Target Setting Based on Efficiency and Fairness

Wonghong Li, University of Science and Technology of China, Jinzhai Road 96, Hefei, 230026, China, liwh@mail.ustc.edu.cn

We develop a novel method for a resource reallocation problem that typically appears in organizations such as governmental agencies, universities, business firms and army units. The decision maker is interested in maximizing the efficiency and fairness simultaneously when reallocating available resources to decision-making units. We develop an approach based on data envelopment analysis to obtain a most preferred allocation plan. Numerical examples are used to illustrate the approach.

3 - A Decision Model for Supplier Selection

Baichun Feng, Webster University, 545 Garden Ave, St. Louis, MO, 63119, United States of America, baichunfeng18@webster.edu, Hong Ren

This paper proposes an new approach based on artificial intelligence to solve the supplier selection problem. This approach will learn the decision makers' preference from the historical data and solve the supplier selection problem subsequently. A numerical example is used to demonstrate the usefulness of this approach. Contribution to research in strategic supplier selection and suggestions for future research are discussed.

4 - Big Data, Databases and Decision Systems Interactions

Orhan Güvenen, Professor, Bilkent University, Bilkent University IISBF Z-03, Bilkent / «ankaya, Ankara, 06800, Turkey, gorhan@bilkent.edu.tr

Big data plays important role in every part of research, analysis and decision making. Effective, optimal and ethical decision making requires technologically advanced big data analysis techniques, databases in their analytic use, endogenizing security, minimum error margins and information distortion. Those requirements are necessary conditions in every strata for predictive, scientific, operational decision making and scientific management.

5 - Predicting Winning Probability of Open Deals of Sales Pipeline using Logistic Regression

Purushothaman Ethiraj, Analytics Manager, Hewlett Packard, CV Raman Nagar, Bangalore, India, purushothaman.ethiraj@hp.com, Atul Yadav

Effective sales pipeline management is one of critical part of sales management and forms an important lever in managing sales performance of an Organization. The present research will focus on identifying key variables that influence the deal conversions and predict the winning probability of all open deals in pipeline. Using binary logistic regression we have been able to predict the deal status correctly in 73.8% of total deals leading to accurate forecast and better business planning.

■ MD79

Parc- Powell I

Decision Analysis Society Awards

Sponsor: Decision Analysis

Sponsored Session

Chair: Jeffrey Keisler, Professor, Univ. of Massachusetts, Boston, 100 Morrissey Blvd, Boston, MA, 02125, United States of America, jeff.keisler@umb.edu

1 - 2014 Decision Analysis Student Paper Award

Seth Guikema, Assistant Professor, Johns Hopkins University, 313 Ames Hall, Department of Geog & Env. Engineering, Baltimore, MD, 21218, United States of America, sguikema@jhu.edu

The Student Paper Award is given annually to the best decision analysis paper by a student author, as judged by a panel of the Decision Analysis Society of INFORMS. Students who did not complete their Ph.D. prior to May 1, 2013 are eligible for this year's competition.

2 - 2014 Ramsey Medal Award

Jim Matheson, Chairman, SmartOrg, Inc., 855 Oak Grove Ave, Ste 202, Menlo Park, CA, 94025, United States of America, jmatheson@smartorg.com

The Ramsey Medal of the Decision Analysis Society is awarded for distinguished contributions in decision analysis. Distinguished contributions can be internal, such as theoretical and procedural advances in decision analysis, or external, such as developing or spreading decision analysis in new fields. We will introduce the 2014 Ramsey Medal winner, followed by a presentation by the winner.

3 - 2014 Decision Analysis Publication Award

Ali Abbas, Professor, University of Southern California, Industrial and Systems Engineering, Price School of Public Policy, Los Angeles, CA, United States of America, aliabbas@illinois.edu

This award is given annually to the best decision analysis article or book published in the second preceding calendar year (i.e. calendar year 2012 for consideration in 2014). The intent of the award is to recognize the best publication in "decision analysis, broadly defined." This includes, but is not limited to, theoretical work on decision analysis methodology (including behavioral decision making and non-expected utility theory), descriptions of applications, and experimental studies.

■ MD80

Parc- Powell II

Panel Discussion: Meet the Editors – Service Science Track

Sponsor: Service Science

Sponsored Session

Chair: Ming-Hui Huang, Professor, National Taiwan University, 1, Sec. 4, Roosevelt Rd., Taipei, 10617, Taiwan - ROC, huangmh@ntu.edu.tw

1 - Panel Discussion: Meet the Editors – Service Science Track

Moderator: P K Kannan, University of Maryland, Smith School of Business, College Park, MD, United States of America, PKannan@rhsmith.umd.edu

Panel discussion will include editors from Journal of Service Research, Service Science and Services Industries Journal.

■ MD81

Parc- Divisadero

Joint Session Data/Computing: Statistical Learning in Stochastic Optimization

Sponsor: Data Mining & Computing

Sponsored Session

Chair: Victoria Chen, Professor, The University of Texas at Arlington, Dept. Industrial & Manuf. Sys. Engr., P.O. Box 19017, Arlington, TX, 76019, United States of America, vchen@uta.edu

1 - Two-stage Stochastic Programming for Adaptive Interdisciplinary Pain Management

Na Wang, Ph.D student, The University of Texas at Arlington, 500 West First Street, Arlington, TX, 76019, United States of America, na.wang@mavs.uta.edu, Jay Rosenberger

This research proposes two-stage stochastic programing (2SP) to optimize personal treatment strategies for adaptive pain management. Previous research has predicted pain outcomes using non-convex quadratic statistical models. Based upon these nonconvex quadratic models, this research refits piecewise linear prediction models that have almost no loss of fidelity. With the piecewise linear models, 2SP can be modeled as a mixed integer linear program to optimize treatment.

2 - A Generalized MILP and DACE based Approximate Dynamic Programming and its Application

Zirun Zhang, Ph.D. student, The University of Texas at Arlington, 500 West First Street, P.O. Box 19017, Arlington, TX, 76019, United States of America, zirun.zhang@mavs.uta.edu, Victoria Chen, Jay Rosenberger

We develop a generalized Approximate Dynamic Programming method for finite horizon and non-stationary process by Mixed Integer Linear Programming, and Design and Analysis of Computer Experiment. Tree based supervised learning methods are employed to approximate value functions. A real world large scale stochastic multistage decision problem is formulated and solved by the method. The solution quality is compared by various methods and we conclude MILP and DACE based ADP is the best approach.

3 - A Design and Analysis of Computer Experiments-based Approach to Approximate Dynamic Programming

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This research seeks to develop a solution method called Design and Analysis of Computer Experiment (DACE)-based approach to solve an infinite horizon dynamic programming. Multivariate Adaptive Regression Splines (MARS) is used to approximate future value functions in stochastic dynamic programming (SDP) problems with continuous state variables. The training data set is updated sequentially based on the conditions. Three different algorithms presented based on the conditions of sampling process.

4 - Local Linear Regression and Low-Discrepancy Sampling for Approximate Dynamic Programming

Danilo Maccio, National Research Council, Via De Marini 6, Genoa, Italy, danilo.maccio@cnr.it, Victoria Chen, Cristiano Cervellera

Approximate Dynamic Programming is the standard method for the numerical solution of the well-known Bellman's equations. With such technique, two main issues arise: (i) the choice of a class of models to approximate the value functions; (ii) the definition of an efficient sampling of the domain where estimates of the value functions are computed. In this work the use of local linear regression based models is investigated when low-discrepancy sampling methods are used to sample the state space.

■ MD82

Parc- Haight

Preferences and Multiple Objectives

Sponsor: Multiple Criteria Decision Making

Sponsored Session

Chair: Gülser Köksal, Middle East Technical University, IE Dept., METU, Ankara, Turkey, koksal@metu.edu.tr

1 - An Interactive Approach to Two-Response Design Optimization Problem

Melis Ozates, Research Assistant, Middle East Technical University, METU, Industrial Engineering Department, Ankara, 06800, Turkey, mozates@metu.edu.tr, Murat Köksalan, Gülser Köksal

We develop an interactive approach to aid in determining the design parameter values for the case of two responses. The approach incorporates decision maker preferences interactively using an achievement scalarizing function. We capture the random nature of the responses statistically and guide the decision maker towards preferred solutions.

2 - Representing Preferences by Choquet Integral: Guideline to Specify Capacity Type and a Modification

Leman Esra Dolgun, Anadolu University, Endustri Muhendisligi Bolumu, Eskisehir, Turkey, ledolgun@anadolu.edu.tr, Nimetullah Burnak, Gülser Küksal

This study considers representing decision maker preferences by Choquet integral in existence of interactions among criteria. Structures of interactions that can be handled by different capacity types are studied and represented via interaction plots with the purpose of providing a guideline for specifying the capacity type in practical applications. A dummy region solution is proposed to relax some of these conditions and thus improve the ability of Choquet integral in handling interactions.

3 - A Chinese Postman Problem with Multi Objectives

Ezgi Eroglu, Graduate Student, Middle East Technical University, METU Universiteler Mah. Dumlupinar Blv., No:1 «ankaya, Ankara, 06800, Turkey, eroglu.ezgi.90@gmail.com, Meral Azizoglu

Our study considers a Chinese postman problem having multiple weights for each edge. Our aim is to minimize the total weight of the first weights while keeping the sum of the second weights below a threshold value. We investigate the properties of the optimal solution and the optimal solutions of the continuous relaxation. We develop an optimization algorithm and report its favorable results.

■ MD83

Parc- Sutro

Machine Learning, Data Mining, and Statistics II

Sponsor: Data Mining

Sponsored Session

Chair: Cynthia Rudin, MIT Sloan School of Management, 100 Main Street, Cambridge, MA, 02139, United States of America, rudin@mit.edu

1 - MIP Models and Methods for Interpretable Linear Classification

Berk Ustun, PhD Candidate, Massachusetts Institute of Technology, 5 Cambridge Center, 7-790, Cambridge, MA, 02139, United States of America, ustunb@mit.edu, Cynthia Rudin

We present a comprehensive approach to create accurate and interpretable linear classification models using mixed-integer programming. Our approach can build models that incorporate many interpretability-related qualities, and that strike a user-defined balance between accuracy and interpretability. We use our approach to create scoring systems and M-of-N rule tables for applications in medicine, marketing and crime. In addition, we propose methods to train models on large-scale datasets.

2 - Dynamic Ensemble-based Prediction of Equity Price Direction

Nick Street, Professor and Departmental Executive Officer, The University of Iowa, S210 Pappajohn Business Building, Iowa City, IA, 52242, United States of America, nick-street@uiowa.edu, Mike Rechenthin

We propose a dynamic ensemble classification technique designed specifically to predict short-term (around one minute) directional price movements in stocks. The model automatically adjusts for concept drift and transfers knowledge obtained from other stocks to improve its predictions. We demonstrate the effectiveness of this model and discuss some surprising insights regarding the effectiveness of different predictors.

3 - Interpretation Clustering of RNA Expression Data using Quadratic Programming

Kristin Bennett, Professor, Rensselaer Polytechnic Inst., Math Sciences, Dept AE327, 110 8th Street, Troy, NY, 12180, United States of America, bennek@rpi.edu, Chris Fasano, Elisabeth Brown, Chris Gatti

Typically one clusters data and then interprets the clusters. We take interpretations and then find clusters that fit the interpretations. We use quadratic programs to find all data fitting the profiles within experimental error. The resulting composite interpretations applied to RNA-Seq time series data from an embryonic stem cell model are used to help understand human cerebral cortex formation.