5 - Design of a Responsive Vaccine Supply Chain under Supply and Demand Uncertainty
Stef Lemmens, KU Leuven, Naamsestraat 69 Box 3555, Leuven, 3000, Belgium, stef.lemmens@kuleuven.be, Nico Vandaele, Catherine Decouttere

Both literature and industrial evidence emphasize the challenge and the importance of the design of a responsive vaccine supply chain. We model the interrelationships between multi-echelon inventory, production capacity and lead time and take supply and demand uncertainty into account by the use of a methodology which combines the guaranteed service approach and queueing theory. Furthermore, we show the results of applying our methodology to a real-life industrial rotavirus vaccine supply chain.

SD79
79-Room 302, CC

Software Demonstration
Cluster: Software Demonstrations
Invited Session
1 - Artelys - See the Artelys KNTRO 10.0 Optimization Solver in Action
Richard Waltz, Senior Scientist, Artelys Corp

KNTRO is the premier solver for nonlinear optimization and recent winner of the GECCO 2015 black-box optimization competition, finishing first among 28 solvers. This software demonstration will highlight the latest KNTRO features, including a new object-oriented interface and new SQP algorithm for derivative-free optimization (DFO). The demo will also provide an overview of how to effectively use KNTRO in a variety of environments and applications, and present recent benchmarking results for DFO and nonlinear optimization.

2 - GAMS Development Corp - GAMS – An Introduction
Steve Dirkse, Director of Optimization, GAMS Development Corp

This workshop will show you how to use the General Algebraic Modeling System (GAMS) in an efficient and productive way. There will be an introduction to the system and a presentation of the key concepts in GAMS. The largest part of the workshop consists of hands-on exercises. Amongst others, it will be demonstrated how GAMS interacts with other applications and you will see how to analyze and debug problems using the tools available within GAMS.

Monday, 8:00am - 9:30am

MA01
01-Room 301, Marriott
Military O.R. and Applications III
Sponsor: Military Applications
Sponsored Session
Chair: Michael Hirsch, ISEA TEK, 620 N. Wymore Rd., Ste. 260, Maitland, FL, 32751, United States of America, mhirsc@iseatek.com

1 - Electronic Attack Decision Framework using Pomdp
Brandon Ha, Sr. Systems Engr II, Raytheon Company, 2000 E. El Segundo Blvd, E1/B2208D, El Segundo, CA, 90245, United States of America, Brandon.C.Ha@raytheon.com

The objective of this research is to develop a suite of machine learning algorithms to address the need for engaging with future advanced unknown agile RF threats and co-evolve with the adversary’s response. Our approach uses POMDP to represent the unobservable elements in the environment and actions that can provide partial information about these elements – to learn (characterize) the unknown emitters and then to predict the intent and deploy optimal EA technique(s).

2 - Pursuit on a Graph using Partial Information: Max-delay
David Casbeer, Dr., Air Force Research Laboratory, 2210 8th Street, B20146 R300, Wright Patterson AFB, OH, 45433, United States of America, david.casbeer@us.af.mil, Krishna Kalyanam, Meir Pachter

The optimal control of a “blind” pursuer searching for an evader on a graph is presented. At specific locations on the graph (road network), unattended ground sensors (UGS) have been placed which detect the intruder. The pursuer (UAV) visits the sensors and decides where to travel in order to capture the evader. An algorithm is presented to compute the maximum initial delay for which capture is guaranteed. The algorithm also returns the corresponding optimal pursuit policy.

3 - Improved Sensor Placement in Multistatic Sonar Networks
W. Matthew Carlyle, Naval Postgraduate School, mcarlyle@nps.edu, Emily Craparo, Munirat Karatas, Christoph Hof

Multistatic sonar networks containing non-collocated sources and receivers represent an important generalization of traditional sonar systems. Although they convey many tactical and operational advantages, multistatic sensor networks are difficult to model and to employ optimally. We discuss the multistatic sensing problem and describe generalizations for placing sources and receivers.

4 - Optimal Deployment of Network Defenses
David Myers, Research Engineer, United States Air Force, 26 Bedford Drive, Whitesboro, NY, 13492, United States of America, david.djm.myers@gmail.com

Optimally deploying an ever-growing slate of network defense capabilities, while maintaining the ability to perform the mission, is a critical component of future USAF operations. Utilizing a system’s attack graph, this defense configuration problem (DCP) is a network interdiction problem where the network defender is the interdictor and the attacker is the evader. The purpose of this presentation is to formulate and describe the DCP and discuss extensions into a dynamic posture problem.

MA02
02-Room 302, Marriott
Game Theory in Practice for Homeland Security
Cluster: Homeland Security
Invited Session
Chair: Milind Tambe, USC, 941 Bloom Walk, Los Angeles, CA, United States of America, tambe@usc.edu

1 - Game Theoretic Applications in Coast Guard Operations
Erich Stein, USCG, 1 Chelsea St., New London, CT, 06339, United States of America, Erich.V.Stein@uscg.mil, Craig Baldwin, Sam Cheung

The Coast Guard has tested and operationalized game theory applications in several mission areas including port security and fisheries. A model was created to mitigate effects of illegal fishing and generate schedules for USCG assets. The Port Resilience Operational Tactical Enforcement to Counter Terrorism (PROTECT) game model optimizes limited security resource allocations. Finally, development of innovative patrol strategies for drug and migrant interdiction efforts is ongoing.
2 - New Trends in Perence Modeling of Adversary Decisions
Ali Abbas, Professor of Industrial and Systems Engineering and Public Policy and Director of Create, University of Southern California, 3710 McClintock Avenue, RTB 314, Los Angeles, CA, United States of America, alibass@price.usc.edu
This talk will discuss the need for new models of preferences in both competitive and cooperative games. Simulation results and videos of cooperative autonomous vehicles will also be presented using new models of preferences.

MA03
03-Room 303, Marriott
Teaching Modern Project Management
Cluster: Scheduling and Project Management
Invited Session
Chair: Nicholas G. Hall, The Ohio State University, Fisher College of Business, Columbus, OH, United States of America, hall.33@osu.edu
1 - Modern Project Management Curriculum
Ted Kla淀粉, Professor, University of Washington, Foster School of Business, Box 353226, Seattle, WA, 98195-3226, United States of America, tedk@uwashington.edu
Empirical evidence has documented the failure to adequately manage many complex projects, including IT and new product development projects. At the same time, the need to successfully manage large and risky projects has never been greater. As a result, the need for effectively educating students in the project management (PM) area is critical. In this talk, I will explore the main directions and concepts that should be included in a PM curriculum and how this differs from current courses.

2 - Designing a Project Management Game
Enno Siemsen, Associate Professor, University of Minnesota, 321 19th Ave S, Minneapolis, MN, 55455, United States of America, siemns017@umn.edu
As a capstone event in my project management class, I have designed a game to capture organizational dynamics in the context of a project management organization. Teams in the game form a hierarchy, with players taking the role of Vice Presidents, Project Managers or Resources. Having different incentives, these three types of roles need to learn to cooperate to see their projects to completion.

3 - Everything is a Project
Nicholas G. Hall, The Ohio State University, Fisher College of Business, Columbus, OH, United States of America, hall.33@osu.edu
This talk describes the development of an MBA course on project management that is the most popular elective at Fisher College of Business. The course uses various teaching methods - games and group activities, graded in-class problem solving exercises, guest speaker presentations with hands-on activities, HBS simulations, case reports with student presentations, along with traditional lecture and class discussion. The course currently enrolls students from seven graduate programs across campus.

4 - Teaching a Quantitative Approach to Project Management
Rainer Kolisch, Technische Universität München, TUM School of Management, Arcisstraße 21, Munich, Germany, rainer.kolisch@wmi.tum.de
I will report on my course “Project Management – A quantitative approach”. The course is an elective in the third (and final) year of the undergraduate program in Management and Technology at TUM School of Management, Germany. The course covers a number of quantitative topics ranging from operational to strategic project management. I will report on the content of the course, pedagogical concepts used and feedback received from the students.

MA05
05-Room 305, Marriott
Applying Advanced Analytics to Social Media data
Cluster: Social Media Analytics
Invited Session
Chair: Mohsen Parsafard, University of South Florida, 4202 E. Fowler Avenue ENG 214, Tampa, FL, 33620, United States of America, parsafard@mail.usf.edu
1 - Estimating Social Media’s Financial Contribution to the Hospitality Sector
Mark Gerner, Sr. Lead Economic Scientist, Booz Allen Hamilton, 22 Batterymarch St., Boston, MA, United States of America, gerner_mark@bah.com
In this paper we present a methodology leveraging natural language processing and machine learning techniques to estimate the reputational and financial contribution from customer social media conversation, customer ratings, and associated comments from multiple online travel sites.

2 - Efficient Community Partition Algorithm in Networks
Jiaolei Zhong, CSGB, Dept. of Comp Sci., 25800 Carlos Bee Blvd, Hayward, CA, United States of America, jayzhong08@gmail.com, David Hale, Ehsan Kamalinejad
One fundamental problem in analyzing complex big data sets is the task of classification of the data. Community partitioning plays a crucial role in data analysis of scientific, social, and technological networks. As the study of isoperimetric inequalities is a well-explored field, it is possible to extend specific mathematical theory to its equivalent form in data clustering. We propose an efficient community partition algorithm to analyze the relationships among data via the network topology.

3 - Topic Dependent Edge Importance Measures in Social Media Platforms
George Michalidis, University of Florida, 1 University Ave, Gainesville, FL, United States of America, gmkahal@ufl.edu
Social media platforms produce large amounts of both structured and unstructured data. A key question for such platforms is to identify important interactions between nodes in the corresponding user network. We address this problem by using a stochastic model of interacting counting processes on a graph, so that topic dependent interactions can also be identified. We illustrate the results of our model on a US Senators Twitter data set.

4 - Role of Social Media in Healthcare via Analytics
Sinjini Mitra, Assistant Professor, California State University, Fullerton, ISDS Department, 800 N State College Blvd, Fullerton, CA, 92831, United States of America, smitra@exchange.fullerton.edu
The advance of computing resources and increased availability of large amounts of data in the recent decade has made it possible to use extensive analytics for effective decision-making in the healthcare industry. Based on a member survey of a large health plan, we identify factors (demographic, clinical and technological) that are significantly associated with member interest in adopting social and mobile media for obtaining health information via predictive and descriptive analytics.

5 - Time Geography Based Mobility Measures for Geo-tagged Twitter Data
Mohsen Parsafard, University of South Florida, 4202 E. Fowler Avenue ENG 214, Tampa, FL, 33620, United States of America, parsafard@mail.usf.edu, Guangqin Chi, Xiaoping Li
Social media data present tremendous opportunities for studying individuals’ travel behaviors. In this study, we propose a set of fundamental measures to quantify the bounds of an individual’s spatial and temporal activity range. We further develop an interpolation approximation method to improve the computation efficiency of these measures. Our results reveal an interesting pattern of people’s traveling and tweeting behavior, where the proposed measures follow a power-law distribution.

MA06
06-Room 306, Marriott
Financial Engineering
Sponsored: Financial Services
Sponsored Session
Chair: Xuefeng Gao, Assistant Professor, The Chinese University of Hong Kong, xliao@se.cuhk.edu.hk
1 - Mean Field Game with Singular Controls
Joon Seok Lee, UC Berkeley, 2033 Haste St. #313, Berkeley, CA, 94704, United States of America, ljhope@berkeley.edu, Xin Guo
We introduce a mean field game framework with singular controls. To solve this singular control problem with multiple agents, we derive the Fokker-Planck equation for the singular control, which is a generalization of the mean field game with regular controls. Both single controls of a bounded velocity and of a finite variation will be discussed. Finally, we will present some applications to optimal execution and systemic risk.

2 - Algorithmic Trading under the Effects of Volume Order Imbalance
Ryan Donnelly, EPFL, Quartier UNIL - Dorigy, Extranel 214, 1013, Lausanne, Switzerland, ryan.donnelly@epfl.ch
Shortcomings of some order book models are noted with motivation provided by data from the NASDAQ. The influence of volume order imbalance on order book dynamics is incorporated into a model which allows the agent to adjust their strategy based on an easily observable quantity. The imbalance allows the agent to
3 - Bettering Investment Performance using Market Implied Information

Dan Li, Professor, The Chinese University of Hong Kong, Dept of Systems Eng. & Eng. Manag., Shatin, Hong Kong · PRC, dll@se.cuhk.edu.hk

Financial markets are heavily driven by people’s expectations of the future. Thus portfolio decisions should take into consideration the market implied forward-looking information, in addition to the backward-looking information from historical data. This talk discusses a formal framework in identifying hidden utilities of different representative investor groups by analyzing market implied information using inverse optimization solution schemes.

4 - Optimal Spread Crossing in a Limit Order Book

Xueleng Gao, Assistant Professor, The Chinese University of Hong Kong, xlgao@se.cuhk.edu.hk, Nan Chen, Xiang Ma

We study when a precommitted trader converts a limit order to a market order in response to execution of orders. We formulate the problem as an optimal stopping problem. We present structural properties of the optimal strategy and show how it depends on market conditions. We also study the optimal spread crossing problem under a Bayesian learning model for the fundamental value of an asset. Our numerical experiments illustrate how the price-learning affects the optimal spread crossing time.

MA07

07-Room 307, Marriott

Systemic Risk Measurement: Data and Algorithmic Aspects

Cluster: Risk Management

Invited Session

Chair: Andreea Minca, Cornell University, Ithaca, NY, United States of America, acm299@cornell.edu

1 - Systemic Impact in Fund Networks – Part I

Somya Singhvi, Cornell University, Ithaca, NY, United States of America, ss999@cornell.edu, Divya Singhvi, Andreea Minca

We analyze portfolios of equity funds to understand their impact on other portfolios. Further, we develop an algorithm that calculates the systemic impact of a fund on a network of funds. The algorithm captures the premature liquidation in response to investor outflows for different funds. Finally, we also show that our algorithm converges.

2 - Systemic Impact in Fund Networks Part II

Divya Singhvi, Cornell University, 516 University Ave. Apt. B8, Ithaca, NY, 14850, United States of America, ds576@cornell.edu, Andreea Minca, Somya Singhvi

Using the holdings data for US equity funds, we implement the systemic risk measure algorithm. We analyze the second order impact of a fund on the other funds. Our analysis suggest that the network structure leads to a significant additional impact on other funds. Further, we show that the funds begin to cluster themselves into groups of high and low impact based on their network properties.

3 - Inhomogeneous Financial Networks and Contagious Links

Andreea Minca, Cornell University, Ithaca, NY, United States of America, acm299@cornell.edu

We propose a framework for testing the possibility of large cascades in financial networks. This framework accommodates a variety of specifications for the probabilities of emergence of ‘contagious links’, where a contagious link leads to the default of a bank following the default of its counterparty. We give bounds on the size of the first order contagion and testable conditions for it to be small.

MA08

08-Room 308, Marriott

Topics in Innovative and Entrepreneurial Operations

Cluster: Business Model Innovation

Invited Session

Chair: Onesun Steve Yoo, University College London, Gower Street, London, WC1E 6BT, United Kingdom, o.yoo@ucl.ac.uk

1 - The Time-money Trade-off for Entrepreneurs: When to Hire the First Employee?

Onesun Steve Yoo, University College London, Gower Street, London, WC1E 6BT, United Kingdom, o.yoo@ucl.ac.uk, Charles Corbett, Guillaume Roels

Hiring the first employee is a major step in a firm’s life cycle, marking the transition from an entrepreneur-dominated firm to a phase of rapid growth. It is also a significant operational problem because how an entrepreneur operates with an employee is fundamentally different than without. We present hiring as a time money tradeoff for entrepreneurs and examine when the entrepreneur should make the hiring decision depending on whether time or money is the chief bottleneck constraint.

2 - Collective Choice in Dynamic Public Good Provision: Real Versus Formal Authority

George Georgiadis, Assistant Professor, Northwestern University, 2001 Sheridan Rd, Evanston, IL, 60208, United States of America, g.georgiadis@kellogg.northwestern.edu, Renee Bowen, Nicolas Lambert

We study a game in which two heterogeneous agents exert effort over time to bring a project to completion, and the project scope can be determined at any point via collective choice. A larger project scope requires greater cumulative effort and delivers higher benefits on completion. We show that the efficient agent prefers a smaller project scope than the inefficient agent, but their preferences are time-inconsistent. We study the optimal allocation of property rights to minimize disagreement.

3 - Third Party Legal Funding under Asymmetric Information

Noam Shamir, Assistant Professor, Tel-Aviv University, Haim Levanon, Tel-Aviv, Israel, nshamir@post.tau.ac.il, Julia Shamir

Third party legal funding describes the phenomenon in which a company that has no direct stake in a legal claim, covers the legal costs of this claim in exchange for future share of the monetary outcome of the claim. We study the implications of this phenomenon in terms of its effect on the litigation strategy and court congestion.

4 - Entrepreneurship Company Formation from University Technology Commercialization

Vish Krishnan, UCSD, La Jolla, CA, 92037, United States of America, vkrishnan@ucsd.edu, Kanetaka Maki

We study how the commercialization of university technologies leads to company formation and collaboration with industrial partners. Specifically, using a mathematical model and empirical testing, we detail the way in which the technology transfer offices both moderate and mediate collaboration.

MA09

09-Room 309, Marriott

Understanding Knowledge Sources and Politics in Technology Management

Cluster: Technology, Innovation Management & Entrepreneurship

Sponsored Session

Chair: Zhijian Cui, Assistant Professor of Operations and Technology Management, IE Business School, Calle de Maria de Molina 12, Madrid, 28006, Spain, Zhijian.Cui@ie.edu

1 - The Differential Effect of Knowledge Sources on Innovation Strategy: A Contingency Approach

Beatriz Rodriguez-Prado, University of Valladolid, Avda. Valle del Esgueva, Valladolid, 47011, Spain, bprado@eco.uva.es, Elena Revilla, Zhijian Cui

We examine how innovation strategy determines the sources of knowledge (own-generated, bought-in and co-developed) and their impact on innovation performance. Data of 9054 firms belonging to fourteen European Countries constitute the empirical base of the study. Results derived from Cluster analysis, ANOVAs and Generalized Linear Models strongly indicate investments in innovation activities may generate differential value depending on key contextual factors.

2 - The Effects of Outsourcing Knowledge on the Dynamics of Outsourcing Modes

Qiong Chen, University of Science and Technology of China, School of Management, USTC, 96 Jin Zhai Road, Bao He District, Hefei, 230026, China, qiong@clemson.edu, Shouliang Wang, Gulru Ozkan-Seely, Aleda Roth

We evaluate buyer’s dynamic choice of outsourcing channels: directly through in-house procurement department or indirectly through an intermediary. Using a two-period game theoretic model, we demonstrate the critical yet interesting role of outsourcing knowledge and highlight effects of direct and indirect learning on the change of buyer’s strategies over time.
3 - Politics as an Impediment to Technology Strategy Implementation
Marc Finkelstein, IE Business School, 52 Lawrence Ave West, Toronto, ON, M5M1A4, Canada, marc.finkelstein@gmail.com
Organizations expend significant resources to develop a technology strategy, yet often fail to accomplish it. They commonly perceive the failure to stem from a lack of resources and capabilities, yet exploratory research suggests that organizational politics are significantly more impactful. Research will outline the types of political maneuvering exhibited and how it is impactful to the achievement of the technology strategy.

MA10
10-Room 310, Marriott
Economics of Digital Channels
Sponsor: E-Business
Sponsored Session
Chair: Yi-Chun (Chad) Ho, Assistant Professor, George Washington University, 2201 G Street NW, Washington, DC, 20052, United States of America, chadhocom@gwu.edu
1 - Loyalty Program: The Dilemma of Shipping Fee
Xue Tan, University of Washington, 4747 30th Ave NE J171, Seattle, WA, 98105, United States of America, xuetan@uw.edu, Yi-chun (chad) Ho, Yong Tan
Loyalty programs that offer one year of free shipping after consumers prepay a membership fee has become prevalent in recent years. This paper studies the mechanism of membership fee free shipping and compare it with membership free shipping which waives the shipping fee when the order size reaches a threshold in a game theoretical setting. By changing the speed consumers receive their products, membership free shipping changes the product value.

2 - Help Doesn’t Help: A Partially Ordinal Discrete Choice Model on Review with Review in Review
Jinyang Zheng, PhD Student, University of Washington, Mackenzie Hall (MKZ), Room 342, University of Washington, Seattle, WA, 98105, United States of America, zhengji@uw.edu, Yong Tan, Qin Xing Qu
We investigate the objectivity of content on review platform with review in review function. By applying a partially ordinal discrete choice model, our research identifies the social capital maximization behavior when user gives rating. We find that rating giving distribution is generated by a mixed distribution of quality driven incentives and expected RIR performance driven incentives, which indicates a consequence of less objectivity of reviewers and less variety of the system.

3 - Corporate Information Disclosure: Social Media Vs. Investor Website
Behnaz Bojz, University of Washington, Seattle WA, United States of America, behnaz@uw.edu, Yong Tan, Qixing Qu
Traditionally, investors’ had access to key information only through the company’s websites. Nowadays, companies can also use social media platforms such as Twitter and Facebook, to release information and communicate with the market and shareholders. In this study we compare the nature of information disseminated on each channel and estimate their effectiveness on market behavior.

4 - Incentive Pricing and Quality Screening in Two-sided Markets: The Case of Zocdoc.com
Yuan Jin, University of Connecticut, School of Business, OIPIM, 2100 Hillside Road Unit 1041, Storrs, CT, 06269, United States of America, yuan.jin@business.uconn.edu
Patients and doctors can schedule appointments on an online two-sided market platform. ZocDoc.com. ZocDoc’s profits depend on its doctors’ market quantity and this quantity is associated with patients’ market quantity, which is in turn determined by doctors’ market quantity and quality. In this paper, I study the effect of pricing in ZocDoc’s case, and conclude that the addition of monetary incentives for high-quality doctors can improve both profits and overall doctor quality.

MA11
11-Franklin 1, Marriott
Convexification Techniques in Mixed-Integer Programming
Sponsor: Optimization/Integer and Discrete Optimization
Sponsored Session
Chair: Sercan Yildiz, PhD Student, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, syildiz@andrew.cmu.edu
1 - Sparse Cuts for Sparse Integer Programs
Qiayi Wang, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, crow200x@gmail.com, Marco Molinaro, Santanu Dey
In this talk, we present an analysis of the quality of sparse cuts for IPs with sparse formulations. In order to accomplish this analysis, we define a notion of an induced graph based on the constraint matrix. Then, we are able to relate the strength of sparse cutting-planes to graph-theoretic parameters of the induced graph.

2 - Envelopes of Bilinear Functions over Polytopes with Application to Network Interdiction
Danial Davarnia, University of Florida, 303 Weil Hall, Gainesville, FL, United States of America, d.davarnia@uf.edu, Mohit Tawarmalani, Jean-philippe P Richard
We present a convexification technique to obtain, in the space of their defining variables, a linear description of the convex hull of graphs of bilinear functions over the Cartesian product of a general polytope and a simplex. We apply this procedure to study envelopes of various bilinear functions over certain polytopes.

3 - Convexification Techniques for Disjunctive Conic Sets
Sercai Yildiz, PhD Student, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, syildiz@andrew.cmu.edu, Fatma Kilinc Karzan
We study the convex hull of disjunctions applied to a set defined as the intersection of a cone with an affine subspace. The resulting nonconvex sets are of fundamental importance in mixed-integer conic programming where they are used to derive valid inequalities. We identify and study the cases where a single convex inequality is sufficient to describe the convex hull and where this inequality can equivalently be expressed in an appropriate conic form.

4 - How to Convexify the Intersection of a Second Order Cone and a Nonconvex Quadratic
Samuel Burer, Professor, University of Iowa, 5346 Pappajohn Business Building, Iowa City, IA, 52242-1994, United States of America, samuel-burer@uiowa.edu, Fatma Kilinc Karzan
We study how to convexify the intersection of a second-order cone and a nonconvex quadratic. Under several easy-to-verify conditions, we derive a simple, computable convex relaxation. Under further conditions, we prove that this relaxation captures precisely the corresponding convex hull. Our approach unifies and extends previous results, and we illustrate its applicability and generality with many examples.

MA13
13-Franklin 3, Marriott
Distributionally Robust Optimization
Sponsor: Optimization/Optimization Under Uncertainty
Sponsored Session
Chair: Karthik Natarajan, Singapore University of Technology and Design, Singapore, Singapore, 487372, Singapore, karthik_natarajan@sutd.edu.sg
1 - Robust Optimization using Inconsistent Overlapping Marginals
Anulekha Dhara, Postdoctoral Fellow, Singapore University of Technology and Design, 8 Somapah Road, Singapore, 487372, Singapore, anulekha@sutd.edu.sg, Karthik Natarajan
In this paper, we consider a robust linear optimisation problem with random objective coefficients belonging to a Frechet class of distributions with inconsistent overlapping marginal. For this class of problem the goal is to find the tightest possible bound on the expected optimal value. To solve this problem we apply the notion of closest consistent marginal to obtain an approximate upper bound.
2 - Sparse but Efficient Operation: A Conic Programming Approach
Gao Yini, National University of Singapore, 1 Business Link, Singapore, Singapore, yini.gao@u.nus.edu, Chung Plaw Teo, Zhenzhen Yan

Standardization and flexibility are two competing paradigms in designing efficient operations. We ask whether there is a sparse but flexible operation mode to reap the benefits of both. Using conic programming, we develop a new mechanism which gives sparse but efficient network structures. It recovers k in the context of process flexibility. We further apply it to Singapore Changi Airport “roving team” deployment problem and obtain a sparse yet efficient deployment network.

3 - SDP Reformulation of CP Programs: Best-worst Choice and Range Estimation Applications
Karthik Natarajan, Singapore University of Technology and Design, Singapore, 487372, Singapore, karthik.natarajan@sutd.edu.sg, Chung Plaw Teo

We show that the worst case moment bound on the expected optimal value of a mixed integer linear program with a random objective is obtained from a SDP reformulation of a completely positive program. We illustrate the usefulness of the distributionally robust bounds in estimating the expected range of random variables with two applications arising in random walks and best-worst choice models.

4 - Robust Inventory Models with Demand Partitioning Information
Joline Uichanco, Asst. Professor, University of Michigan, Ross School of Business, 701 Tappan Ave, Ann Arbor, MI, 48109, United States of America, jolineu@umich.edu, Karthik Natarajan, Melvyn Sim

We present the distributionally robust newsvendor with demand asymmetry information through partition statistics. We derive a closed-form for the robust order quantity under the special case of semivariance, implying a simple rule-of-thumb for setting order quantities under limited information. The distribution can be calibrated from primitive demand data. We demonstrate the performance of the method in computational experiments on data from an automotive spare parts company.

MA14
14-Franklin 5, Marriott
Stochastic Optimization Applications to Renewable Energy Integration
Sponsor: Optimization/optimization under Uncertainty
Sponsored Session
Chair: Lindsay Anderson, Assistant Professor, Cornell University, 316 Riley Robb Hall, Ithaca, NY, 14853, United States of America, landerson@cornell.edu

1 - Multi-Objective Optimal Sensor Deployment under Uncertainty for Advanced Power Systems
Urmila Diwekar, President, Vishwamitra Research Institute, 2714 Crystal Way, Crystal Lake, IL, 60012, United States of America, urmila@vri-custom.org, Pallabi Sen, Kinnar Sen

Advanced power plants using an integrated gasification combined cycle (IGCC) offer a competitive and economical means to produce electricity with reduced emission levels. An efficient, safe, and reliable operation of an IGCC plant requires effective strategies for monitoring and control. The results of this multi-objective framework for optimizing observability, efficiency, and cost for an IGCC system are presented in this work.

2 - Optimal Microgrid Design under Load and Photovoltaic Power Uncertainty
Alex Zolan, University of Texas at Austin, 204 E. Dean Keeton Street, Stop C2200, Austin, TX, 78712, United States of America, alex.zolan@utexas.edu, Alexandra Newman, David Morton

We present a model for establishing the design and energy dispatch for a microgrid that minimizes cost and fuel requirements given the set of technologies (diesel generators, solar arrays and batteries, photovoltaic power (pv)) availability on location, and probability model that governs the load and pv availability of a forward operating base. We introduce a policy-based restriction of the problem that allows for the solution of a multiple scenario problem while preserving solution quality.

3 - Tracking a Stochastic Generate-pump Schedule for a Pumped-storage Hydroelectric Unit
Bismark Singh, The University of Texas at Austin, 204 E. Dean Keeton Street, Stop C2200 ET, Austin, TX, 78705, United States of America, bismark.singh@utexas.edu, Surya Santoso

Using a stochastic dynamic program, we first optimize the generate-pump schedule for a pumped-storage hydroelectric unit to maximize profit. Since energy prices are stochastic, we find an adaptive policy for the schedule. And, since we must submit bids to an ISO, we seek a bidding strategy that will allow us to track the desired generate-pump schedule. Thus, we solve a model that yields an optimal block-bidding policy in the sense of tracking the desired stochastic generate-pump policy.

4 - A Stochastic Model to Determine Probabilistic Reserves Requirements for Unit Commitment Problems
Gabriela Martinez, Cornell University, Ithaca, NY, United States of America, gabriela.martinez@cornell.edu, Lindsay Anderson

In this work, we propose a stochastic unit commitment model to decide appropriate spinning and non-spinning reserve requirements for a power system with high penetration of renewable energy. The day-ahead scheduling of the systems is formulated as a chance-constrained model in which the network power balance of the systems is ensured with a high-probability level and the system reserves are allocated in a risk-averse fashion by selection of quantiles of the uncertain generation.

MA15
15-Franklin 5, Marriott
Radiation Therapy Optimization
Sponsor: Optimization in Healthcare
Sponsored Session
Chair: Arka Roy, Bowling Green State University, 440 W. Barry Ave., Chicago, IL, United States of America, arkaroy1@gmail.com

1 - A Robust Optimization Method for Homogeneous Magnet Design in MR-guided Radiation Therapy Optimization
Iman Dayarian, University of Toronto, 5 King’s College Road, Toronto, ON, M4Y 2P9, Canada, iman@mie.utoronto.ca, Timothy Chan, Teodor Stanescu

Magnetic resonance imaging uses a magnetic field generated by a configuration of coils to image patients. An optimization-generated coil configuration can be sensitive to small perturbations that affect the homogeneity of the magnetic field. This sensitivity is especially important when the coils are mounted on a treatment device that rotates during treatment, which is the case in MR-guided radiation therapy (MRgRT). This talk presents a robust optimization approach to magnet design for MRgRT.

2 - Incorporating Lung Ventilation Function in Intensity-modulated Radiation Treatment Planning
Fujun Lan, Postdoctoral Fellow, University of Maryland, Baltimore, 22 S. Greene St., GCJ02, Baltimore, MD, 21201, United States of America, flan@email.arizona.edu, Warren D’Souza, Hao Zhang

4DCT-derived ventilation images were used for pencil-beam intensity modulation to achieve functional sparing of lung on a voxel-by-voxel basis. This functional approach was compared to the conventional anatomical planning on 10 patients retrospectively. Significant reductions (p-values < 0.001) of V20 (lung volume receiving >=20 Gy) (11%), functional V20 (18%), mean lung dose (MLD) (%) and functional MLD (%) were achieved without significantly increasing doses to the other organs-at-risk.

3 - Optimizing Global Liver Function in Stereotactic Body Radiotherapy Treatment Planning
Victor Wu, PhD Student, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, vwwu@umich.edu, H. Edwin Romeijn, Marina Epelman, Martha Matuszak, Yue Cao, Mary Feng, Hesheng Wang, Randall Ten Haken

We propose a radiotherapy treatment planning optimization model for liver cancer cases. In this work, we plan treatment using voxel-based liver dose-response model: post-treatment liver function depends on its pre-treatment function and the dose received. We maximize predicted post-treatment global liver function. We approximately solve the resulting non-linear non-convex problem with a customized mixed-integer linear programming-based algorithm. 2D synthetic and 3D clinical cases were studied.

4 - Robust Adaptive Optimization in Radiation Therapy
Arka Roy, Bowling Green State University, 440 W. Barry Ave., Chicago, IL, United States of America, arkaroy1@gmail.com, Omid Nohadani

Radiotherapy treatments degrade over time in the presence of uncertainties. Robust models leap beyond such limitations. However, traditional robust models solve for the worst-case realization of the uncertainty prior to the start of the treatment, which may be too conservative at later fractions. We propose a robust two-stage approach that adapts to the first-stage decisions during treatment. The results are demonstrated through a clinical prostate case.
1 - Approximation Schemes for Linear Programming in Inner Product Spaces
Sergei Chubanov, University of Siegen, Kohlbettstr. 15, Siegen, Germany, sergei.chubanov@uni-siegen.de

The size of an LP is the sum of binary sizes of the coefficients describing this LP. Such LPs are known to be polynomially solvable. The situation changes if each element of the data can be accessed only via an oracle and the size is defined as the size of the data used by the oracle. This class includes dynamic flows and IP formulations of some other NP-hard problems. A further generalization leads to LPs in inner product spaces. In this talk, we discuss a new algorithm for such problems.

2 - Solving General Convex Conic Problems with First-order Methods
James Renegar, Professor, Cornell University, 224 Rhodes Hall, Ithaca, NY, 14853, United States of America, renegar@cornell.edu

We present recent results in ongoing research pertaining to a framework that is novel in allowing any convex, conic optimization problem to be recast as an equivalent convex optimization problem whose only constraints are linear equations and whose objective function has Lipschitz constant no greater than one, to which a broad class of first-order methods can be applied.

3 - New Computational Guarantees for First-order Methods for Convex Optimization, via a Function Growth Constant
Robert Freund, Professor, MIT Sloan School of Management, Building E62-567, 77 Massachusetts Ave., Cambridge, MA, 02139, United States of America, rfreund@mit.edu, Hailu Lu

We present new algorithms and complexity bounds for solving convex optimization problems using first-order methods. We presume we are given a strict lower bound on \( f^* \). We introduce a new functional measure called the growth constant \( G \) for \( f(x) \) that measures how quickly the function level sets grow and that plays a fundamental role in the complexity analysis. We present new computational guarantees for non-smooth and smooth optimization that improves on existing complexity bounds in many ways.

1 - Approximation Schemes for Linear Programming in Inner Product Spaces
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Network Optimization under Uncertainties
Sponsor: Optimization/Network Optimization
Sponsored Session
Chair: Neng Fan, University of Arizona, 1127 E. James E. Rogers Way Room 111, Tucson, AZ, 85721, United States of America, nfan@email.arizona.edu

1 - Identifying Critical Nodes of Interdependent Networks by Integer Programming
Shanshan Hou, University of Arizona, Tucson, AZ, 85721, United States of America, shanshanh@email.arizona.edu, Neng Fan, Andres Garrido

In this talk, we analyze the vulnerability of interdependent networks by identify a set of nodes in power grid, whose removal results high impacts by the cascading failures in the interdependent communication network and itself. We propose an approach by integer programming to identify such set of nodes. Knowing the behavior of these networks can help to more be prepared before attacks and failures that may affect the power network supply and functionality.

2 - Improving the Global Pre-positioning Network for Natural Disaster Recovery
Adam Prokop, Graduate Msc Student In Supply Chain Management, Wilfrid Laurier University, 75 University Avenue West, Waterloo, ON, N2L 3C5, Canada, prok3910@mylaurier.ca

Pre-positioning critical supplies in strategic locations can increase the effectiveness of humanitarian relief aid for natural disasters. An optimization model, utilizing recent global disaster risk indexes, was developed to evaluate the current United Nations Humanitarian Response Depot network. Alterations of the current network were shown to significantly minimize the average distance between pre-positioning facilities and demand regions.

Network Optimization under Non-linear Utility
Chair: Shouyi Wang, Assistant Professor, University of Texas at Arlington, 3105 Birch Ave, Grapevine, TX, 76051, United States of America, shouyiw@uta.edu

Sponsored Session
Chair: Danica Xiao, PhD Candidate, University of Washington, Seattle, 3900 Northeast Stevens Way, Seattle, WA, 98195, United States of America, xiao@uw.edu

1 - A Dynamic Active-Set Method for Linear Programming
Alireza Noroziroshan, University of Texas at Arlington, 600 Grand Ave, Apt#103, Arlington, TX, 76010, United States of America, alirezanorozi.en@gmail.com, Bill Corley, Jay Rosenberger

An active-set method obtains solution for linear programming problems by adding one or more constraints at a time to solve smaller problems iteratively. We present an efficient constraint selection rule for adding varying numbers of constraints at each iteration. This approach is significantly faster than the standard linear programming algorithms.

2 - Big Data Analytics for RFID-Enabled Logistics Data from Ubiquitous Manufacturing Shopfloors
Ray Y. Zhong, Post-doctoral Fellow, The University of Hong Kong, 8-16 Haking Wong Building, IMSE, Pokfulam Road, HKU, Hong Kong, Hong Kong - PRC, zhongzy@gmail.com, George Q. Huang

RFID has been widely used in logistics and supply chain management. This paper discusses the manufacturing shopfloor where typical logistics resources are converted into smart manufacturing objects (SMOs) by using RFID and wireless technologies to create a RFID-enabled intelligent shopfloor environment. In such environment, enormous RFID data has been captured and collected. This paper introduces a Big Data Analytics for the RFID logistics data by defining different behaviors of the SMOs.

3 - On the Mixed Set Covering, Packing and Partitioning Polytope
Yong-Hong Kuo, Research Assistant Professor, The Chinese University of Hong Kong, Shatin, N.T., Hong Kong - PRC, ykkuo@cuhk.edu.hk, Janny Leung

We study the polyhedral structure of the mixed set covering, packing and partitioning problem, derive the mixed odd hole inequality, and identify sufficient condition for it to be facet-defining. In the special case when the induced graph is a (mixed) odd hole, the inclusion of this new facet-defining inequality provides a complete polyhedral characterization. Computational experiments show that these new valid inequalities achieve a significant time reduction in solving the mixed problems.

4 - Using Big-Data Analytics for Identifying Hot Spots of Border Security
Haibo Wang, Killam Distinguished Asso Prof, Texas A&M International University, 5201 University Blvd, Laredo, TX, United States of America, hwang@tamii.edu, Yaquan Xu, Jun Huang, Wei Wang

This project develops a comprehensive data aggregation and analysis system to provide the decision support for identifying hot spots of border security using a complex network model for transportation infrastructure in the border region. All these research related data will be aggregated on both space and time dimensions and analyzed by using “big data” models and tools developed in this study.
1 - Object-parallel Solution of Large-scale Lasso Problems

Gyorgy Matyasfalvi, Doctoral Candidate, Rutgers University, 100 Rockafeller Road, Piscataway, NJ, 08854, United States of America, matyasfalvi@gmail.com, Jonathan Eckstein

We describe an “object-parallel” C++ approach to implementing first-order optimization methods. Using a “symbolic temporary” technique to improve operator loading efficiency, high-performance parallel algorithms may be expressed with MATLAB-like simplicity. As an example application, we solve large-scale Lasso problems on a distributed-memory supercomputer with the spectral projected gradient (SPG) method. We can efficiently accommodate highly imbalanced sparsity patterns.

2 - Decentralized Mixed Integer Programming

Mohammad Javad Feizollahi, Assistant Professor of Business Analytics, Robinson College of Business, 35 Broad St. NW, Room 1109, Georgia State University, Atlanta, GA, 30303, United States of America, mfeizollahi@gsu.edu

We propose a decentralized mixed integer programming (MIP) approach based on adding primal cuts and restricting the Lagrangian relaxation of the original MIP problem. A key challenge is that, because of the non-convex nature of MIPs, classical distributed and decentralized optimization approaches cannot be applied directly to find their optimal solutions. We test the proposed method on the unit commitment problem and discuss its pros and cons comparing to the central MIP approach.

3 - Dealing with Asynchrony and Information Delays in Parallel Optimization

Hamid Reza Feyznahavvian, PhD Student, Royal Institute of Technology (KTH), Osquid, Väg 10, Floor 6, Stockholm, 10444, Sweden, hamidreza@kth.se, Arda Aytekin, Mikael Johansson

This talk presents an asynchronous and parallel mini-batch algorithm for regularized stochastic optimization problems that allows multiple workers to work at different rates and perform computations independently of each other. Several examples are worked out to demonstrate that the impact of asynchrony on the convergence rate of the algorithm is asymptotically negligible, and a near-linear speedup in the number of workers can be expected.

4 - Deep Learning with Auxiliary Coordinates, with an Application to Fast Image Search

Miguel Carreira-Perpinan, Associate Professor, University of California, Merced, 5200 N. Lake Road, Merced, CA, 95343, United States of America, mcarreira-perpinan@ucmerced.edu, Ramin Raziperchikolaei

Many nonconvex problems in machine learning arise from nested functions consisting of nonlinear processing layers, such as deep neural nets. We describe a generic technique to train such models, the method of auxiliary coordinates. This introduces significant parallelism in the optimization, is easy to implement by reusing existing algorithms, and can handle nonsmooth layers. We illustrate it with a binary hashing application involving an intermediate layer of binary variables.

5 - Decentralized Approximation Methods for Potential Games under Exogenous Uncertainty

Harikrishnan Sreekumar, PhD Candidate, Purdue University, 315 N Grant St., West Lafayette, IN, 47906, United States of America, harikrishnan.sreekumar@gmail.com, Andrew Liu

We consider computing Nash equilibria of certain classes of games under exogenous uncertainty and analyze distributed algorithms for solving such problems. We establish convergence of parallel Gauss-Jacobi and sequential Gauss-Seidel type methods, when combined with approximation schemes such as Monte Carlo sampling. Implementation schemes and numerical results for the proposed approach are presented for applications such as traffic routing and network design games.

2 - A Stochastic Programming Approach to Reduce Patient Wait Times and Overtime in an Outpatient Infusion Center

Jeremy Castraing, University of Michigan, IOE 1205 Beal Ave., Ann Arbor, MI, United States of America, jctig@umich.edu, Amy Cohn, Brian Denton

Chemotherapy infusion treatments for cancer have significant and unpredictable variability in duration. We present an algorithm for designing patient appointment schedules under uncertainty in treatment times. The objective is to minimize a trade-off between expected patient wait times and expected total time required to treat patients. Computational experiments based on real-world data are presented and used to draw managerial insights.
Women with breast density, family history of breast or ovarian cancer, or BRCA1 and BRCA2-mutation-carriers are at higher risk of breast cancer. For such women, non-mammographic modalities such as ultrasound or MRI, adjunct to or instead of mammogram, can be beneficial but they lead to an increased screening cost. Considering both potential health benefits and financial aspects, we study this multi-modality breast cancer screening problem and identify cost-effective optimal screening policies.

We develop a methodology to identify high probability sources of contamination in the event of large-scale outbreaks of foodborne disease based on a graph-theoretic Bayesian inference algorithm. We present results from 2 modeling frameworks used to develop the inference algorithm: analytical models of stylized versions of the problem leading to new, general insights, and a Bayesian Network model used to support decision making and targeted information gathering during investigations.

New Advances in Stochastic Networks

Yuri Suhov, Professor, University of Cambridge/Penn State University,yms.maths.cam.ac.uk

I am going to present and discuss new analytic results on a class of reversible networks with several types of interactive customers. The main result is product-type formulas for the equilibrium distributions.

We study networks where some activities require the simultaneous processing by multiple types of multitasking human or indivisible resources. The capacity of such networks is generally smaller than the bottleneck capacity. This paper shows how this capacity is achieved through, and affected by, dynamic queue control. Prioritizing specific queues comes at a significant loss of capacity. We present policies that balance capacity and queue control while guaranteeing stability and optimal scaling.

Ergodic Control of Multiclass Multi-pool Networks in the Halfin-Whitt Regime

Ari Arapostathis, Professor, University of Texas at Austin, Electrical and Computer Engineering, Austin, United States of America, ari@ece.utexas.edu, Guodong Pang

We study the scheduling and routing control of Markovian multiclass multi-pool networks under the long-run average (ergodic) cost criteria in the Halfin-Whitt regime. We develop a new framework to study the associated ergodic diffusion controls and characterize the optimal solutions via the HJB equations. The asymptotic optimality results are established via a spatial truncation technique to approximate the solutions to the HJB.

Pricing Server Information in Distributed Systems

Mauro Escobar, Columbia University, 500 W 120th Street, 3rd Floor, New York, NY, 10027, United States of America, mce2533@columbia.edu, Mariana Olvera-Cravioto

We consider a queuing network where each job consists of a random number of pieces to be served in parallel, and such that all the pieces of a same job must begin their processing simultaneously. We analyze the performance of two models, one where the different pieces are routed to a random subset of servers and another one where they are optimally assigned to the servers with the shortest workloads. We illustrate how to use these two models to evaluate intermediate routing policies.
many have fleeting interests and only generate noise that skew analyses. Thus we propose an automated and scalable approach to identify top hacker participants in big online communities. Specifically, we utilize discrete-time duration modeling with recurrent events for extracting top participating hackers among large hacker IRC communities.

2 - Semi-supervised Learning for Structured Regression on Partially Observed Attributed Graphs
Zoran Obradovic, Laura H. Carnell Professor Of Data Analytics; Director, Center For Data Analytics & Biomedical Informatics; Professor, Computer And Information Sciences Department; Professor, Statistics Department, Temple University, 1925 N. 12th St., 386 SERC, Philadelphia, PA, 19122, United States of America, zoran.obradovic@temple.edu, Jelena Stojanovic, Djordje Gilgorjevic, Milos Jovanovic

We propose a structured regression model for temporal applications where a large fraction of observations is missing. The benefits are demonstrated on precipitation prediction and on hundreds of evolving graphs with up to 80% labels missing under various mechanisms. The proposed method and result were published at SDM 2015 conference proceedings.

3 - From Spot Market to Customized Contract: Role of Reputation on Market Choice of Crowdsourcing Vendors
Xiao Han, Shanghai Jiaotong University, 1954 Huashan Rd, Shanghai, China, hanxiao@sjtu.edu.cn, Pei-yu Chen, Bin Gu, Pengzhu Zhang

Based on a unique dataset obtained from a large online crowdsourcing platform with different markets in China, we examine the effect of reputation on vendors’ winning chance and revenues as well as their market choices over time. Our results show that as vendors become more experienced and establish more successful relationships with buyers, they will move from spot market to customized contract market, at the same time, they will win more and earn more.

4 - The Heterogeneity of Online Searching and Its Impact on Stock Returns
Qiang Ye, Harbin Institute of Technology, School of Management, Harbin, China, yeqiang@hit.edu.cn, Xianwei Liu

Internet search frequency on stocks has been widely used to measure investor attention in recent studies. Researchers found that weekly searching frequency strongly associated with weekly returns for certain stocks. But we have limited knowledge about the heterogeneity of Internet searches under different circumstances and its varying impact on stock market. In this study, we seek to explore whether searches done on different circumstances guarantee equal attention.

■ MA25
25-Room 402, Marriott
Exchanging the Social Crowd
Sponsor: Information Systems
Sponsored Session
Chair: Gordon Burch, Assistant Professor, University of Minnesota, 321 19th Ave. S., Minneapolis, MN, 55455, United States of America, gburch@umn.edu

1 - Motivating Group Donation: Evidence from a Large Field Experiment
Tianhui Sun, University of Maryland Smith School of Business, 3330 Van Munching Hall, College Park, MD, 20740-2840, United States of America, tianshusun@rhsmith.umd.edu, Gordon Gao, Ginger Zhe Jin

Using a randomized field experiment involving 80,000 participants, we study how mobile messaging can leverage recipients’ social connections to increase blood donation. We find 1) blood banks can motivate group formation to increase donation, but only with group reward. 2) group reward works through a sorting mechanism. 3) participants donate more blood when donating in a group. Our study provides insights on the optimal design of mobile messaging for charities to leverage donors’ social network

2 - Field Experiment on the Impact of Recommender Systems on Sales Volume and Diversity
Dokyun Lee, Carnegie Mellon University, Pittsburgh, PA, United States of America, leedokyun@gmail.com, Kartik Hosanagar

We investigate the impact of collaborative filtering recommender algorithms, commonly used in e-commerce, on sales volume and diversity. We do this by running a randomized field experiment with a top retailer in North America. We show results for sales volume and diversity. We further investigate the genre cross-purchase behavior to shed insight into mechanism behind diversity shift.

3 - Randomized Experiment(s) Evaluating the Drivers of User Content Generation
Gordon Burch, Assistant Professor, University of Minnesota, 321 19th Ave. S., Minneapolis, MN, 55455, United States of America, gburch@umn.edu, Kevin Hong, Ravi Bapna, Vladas Griskevicius

UGC under-provision is a persistent problem in many online communities. We undertake a set of randomized experiments aimed at understanding the drivers of increased UGC production, in terms of both quantity and quality. We consider i) the role of peer feedback on past content (state approval vs. downloads), and ii) incentives to contribute (social vs. monetary).

■ MA26
26-Room 403, Marriott
2015 INFORMS Special Session for JIPE and IJOR
Cluster: Globalization and International Activities
Invited Session
Chair: Kuo-Hao Chang, National Tsing Hua University, Hsinchu, Taiwan, China, chang@mx.nthu.edu.tw

1 - An Activity-Driven Optimization Model for Smart Space
Kuo-Hao Chang, National Tsing Hua University, Hsinchu, Taiwan, China, chang@mx.nthu.edu.tw

In this paper, we propose an activity-driven optimization model, followed by the development of a solution method, to enable the optimal and automatic control of environmental conditions, including humidity and temperature, so as to provide people with the most comfortable environment but with the least energy consumption. A computational study based on instances of realistic size is conducted at the end to show the viability of the research.

2 - Optimal Arc Restoration Schedules with Resource Constraints for Recovering Nodes in a Network of Damaged Arcs
I-Lin Wang, Professor, Department of Industrial and Information Management, National Cheng Kung University, Tainan, Taiwan, China, llinwang@mail.ncku.edu.tw

Consider a network containing some damaged arcs with estimated restoration time and resource. In order to access all nodes in minimum time, we aim to find optimal arc restoration schedules that determine the timing and resources required for restoring some damaged arcs. We will show that special cases of this problem can be converted to minimum spanning tree, shortest path, and NP-hard parallel machine scheduling problems. Finally, proposed IP formulations and solution methods will be discussed.

3 - The Coopetition Game in International Liner Shipping
Dung-Ying Lin, Associate Professor, Department of Transportation and Communication Management Science, National Cheng Kung University, Tainan 70101, Taiwan, China, dylin@mail.ncku.edu.tw

In maritime freight transportation, carriers build a collaborative relationship with other carriers while competing with each other to optimize their own profits. In this scenario, a game of coopetition is formed. We formulate a nonlinear mixed-integer problem to determine the optimal levels of coopetition for a single company and embed the resulting problem into a general game theoretic framework. A diagonalization algorithm that incorporates an ascent direction search technique is developed to effectively evaluate the game. The numerical results show that carriers choose similar coopetition levels to maximize their profits, and the coopetition game can reach equilibrium under general conditions.

■ MA27
27-Room 404, Marriott
Theory and Applications of the Analytic Network Process
Sponsor: Multiple Criteria Decision Making
Sponsored Session
Chair: Orrin Cooper, University of Memphis, 332 Fogelman, Memphis, TN, United States of America, olcooper@memphis.edu

1 - Coherence within the ANP Supermatrix
Orrin Cooper, University of Memphis, 332 Fogelman, Memphis, TN, United States of America, olcooper@memphis.edu, Idil Yavuz

In an ANP network there is both the ability and the need to check for additional levels of consistency and coherence. A Supermatrix with priority vectors that were obtained from either perfect or nearly perfect consistent pairwise comparison can generate suboptimal decisions. Simulations demonstrate the frequency of these events in general ANP networks. A form of cross validation within the Supermatrix called linking validation and a Linking Coherency Index (LCI) is developed and demonstrated.
2 - Using an AHP Approach for Eyewitness Identification
Enrique Mu, Carlow University, Pittsburgh, PA, United States of America, emu@carlow.edu, Tingting Rachel Chung, Lawrence Reed

Eyewitnesses of a crime are usually asked to identify a potential criminal out of a lineup of suspects. An online experiment using Amazon MT was conducted. Results show that an AHP approach may offer better eyewitness identification success and more importantly less false positive identification ratios than currently sequential lineup approach.

3 - Modeling the Sensitivity and Stability of Preferences Among Colorectal Cancer Screening Alternatives
Magda Gabriela Sava, PhD Candidate, Joseph M. Katz Graduate School of Business, University of Pittsburgh, 241 Mervis Hall, Pittsburgh, PA, 15260, United States of America, mgsava@katz.pitt.edu, Luis Vargas, James G. Dolan, Jerrold H. May

Patients are faced with multiple alternatives when selecting the preferred method for colorectal cancer screening, and there are multiple criteria to be considered in the decision process. We model the patient's choice using an Analytic Network Model and propose a new approach for characterizing the idiosyncratic preference regions for each patient. We show how to use that characterization to derive insights as to the sensitivity and stability of a patient's individual choice of alternative.

4 - A Stakeholder-theory Based Employer Health Plan Selection Model
Mehdi Amini, Professor, The University of Memphis, Department of Marketing & SCM, Fogelman College of Business & Economics, Memphis, TN, 38152, United States of America, mamin@memphis.edu, Orrin Cooper, Mike Racer

Organizations are called to re-evaluate current plan offerings and potentially, for the first time, select new healthcare providers and policies to ensure that a minimum level of coverage required by law. A new stakeholder-theory based Analytic Network Process (ANP) model is developed to capture a health plan selection decision with the consideration of multiple stakeholders' interests. What-if analysis is used to explore the robustness of the selected plan.

MA28
28-Room 405, Marriott
Matching Markets and Their Applications
Cluster: Auctions
Invited Session
Chair: Thayer Morrill, NC State University, Raleigh, NC, United States of America, thayer_morrill@ncsu.edu

1 - Incentives in the Course Allocation Problem
Hoda AtfYekta, University of Connecticut School of Business, Storrs, CT, United States of America, Hoda.AtfYekta@business.uconn.edu

Kominers et al. (2011) introduced a heuristic for comparing incentives among the course allocation problem (CAP) algorithms. We investigate their method and adapt it to a more realistic setting with course overlap and a limited number of courses for each student. We compare algorithms including the bidding-point mechanism, the draft mechanism and recently proposed algorithms like the proxy-agent second-price algorithm in their vulnerability to non-truthful bidding.

2 - Near-optimal Stochastic Matching with Few Queries
John Dickerson, CMU, 9219 Gates-Hillman Center, Pittsburgh, PA, 15213, United States of America, dickerson@cs.cmu.edu, Avrim Blum, Nika Haghtalab, Ariel Procaccia, Tuomas Sandholm, Ankit Sharma

In kidney exchange, patients with kidney failure swap donors. Proposed swaps often fail before transplantation. We explore this phenomenon through the lens of stochastic matching, which deals with finding a maximum matching in a graph with unknown edges that are accessed via queries, and its generalization to k-set packing. We provide adaptive and non-adaptive algorithms that perform very few queries, and show that they perform well in theory and on data from the UNOS nationwide kidney exchange.

3 - The Secure Boston Mechanism
Thayer Morrill, NC State University, Raleigh, NC, United States of America, thayer_morrill@ncsu.edu, Unut Dur, Robert Hammond

We introduce the first mechanism that Pareto dominates the Deferred Acceptance algorithm (DA) in equilibrium. Our algorithm, the Secure Boston Mechanism (sBM), is a hybrid between the Boston Mechanism and DA. It protects students that are initially guaranteed a school but otherwise adjust priorities based on student rankings. We demonstrate that sBM always has an equilibrium that weakly dominates the DA assignment, and that in equilibrium no student receives worse than a fair assignment.

MA29
29-Room 406, Marriott
Applied Analytics Across Industries
Sponsor: Analytics
Sponsored Session
Chair: Polly Mitchell-Guthrie, Sr. Mgr., Advanced Analytics Customer Liaison Group, SAS Institute, SAS Campus Dr., Cary, NC, 27513, United States of America, Polly.Mitchell-Guthrie@sas.com

1 - Tracking the Regional Economy in Real Time (through Rain and Snow)
Michael Boldin, Federal Reserve Bank of Philadelphia, 10 Independence Mall, Philadelphia, PA, 19106-1574, United States of America, Michael.Boldin@phil.frb.org

The project involves enhancing real-time econometric tracking models for a regional economy to use weather station measurements. Most econometric models use pre-filtered data that excludes seasonal patterns that can distort the effects of important weather events. This project makes use of data that is not pre-filtered and simultaneously derives normal seasonal patterns, the effects of specific weather events, and a measure of the adjusted 'health' of the regional economy.

2 - A Stakeholder-theory Based E mployer Health P lan
John Toczek, ThreadLab, Philadelphia, PA, United States of America, toczek@gmail.com

ThreadLab is a startup company that provides a convenient and customer-friendly online clothing service to men. It elegantly solves a common challenge for a majority of men: Men simply do not like to shop for clothes. ThreadLab takes the work out of clothes shopping by moving the entire decision process onto an analytics platform. All decisions at ThreadLab are based on data that is not pre-filtered and simultaneously derives normal seasonal patterns, the effects of specific weather events, and a measure of the adjusted 'health' of the regional economy.

3 - Geospatial Analysis of Bike Share Data
Matthew Windham, Director, Analytics, NTELX, Inc., 1945 Old Gallows Rd, Vienna, VA, 22182, United States of America, mwindham@ntelx.com

We will explore an end-to-end example of processing Washington DC Bike Share data with BASE SAS. We will walk through the data ingest, cleaning, analysis, and visualization. The results will be visualized in Google Earth. All of the SAS code will be made available to attendees, including the code to write Google Earth KML files that underpin the visualization and exploration capabilities.

MA30
30-Room 407, Marriott
2015 Edelman Finalists Reprise
Sponsor: OPMS
Sponsored Session
Chair: Pooja Dewan, BNSF Railway, Fort Worth, TX, 76092, United States of America, Pooja.Dewan@bnsf.com

1 - Maximizing U.S. Army’s Future Contribution to Global Security using Capability Portfolio Analysis
Matthew Hoffman, Sandia National Laboratories, P.O. Box 5800 MS 1188, Albuquerque, NM, 87185-1188, United States of America, mhoffm@sandia.gov, Scott Davis, Shatiel Edwards, David Bassett, Gerald Teper, Brian Allord, Craig Lawton, Lilianna Shelton, Stephen Henry, Darryl Melander, Frank Muldoon, Roy Rice, Michael McCarthy, Scott Johnson

The Army and supporting team developed and applied the Capability Portfolio Analysis Tool (CPAT), which employs a novel multi-phase mixed integer linear program to optimize fleet modernization programs under complex cost, production, and schedule constraints. Army leadership can now base investment decisions on rigorous portfolio analytics, allowing billions of taxpayer dollars to be optimally prioritized and providing maximum capability and protection to U.S. troops in the decades to come.
1 - Assortment Planning for Consumers Learning their Tastes
Canan Ulu, Assistant Professor, Georgetown University, McDonough School of Business, Washington, DC, 20057, United States of America, Canan.Ulu@georgetown.edu, Dorothee Honhon
We study a firm that offers novel products to consumers who do not have set preferences. Consumers try different products to learn which product suits their tastes better.

2 - Optimal Stocking Decisions in a Multi-channel Retail Environment
Nevin Mutlu, PhD Candidate, Virginia Tech, Department of Industrial and Systems Engineering, Blacksburg, VA, 24061, United States of America, nnmutlu@vt.edu, Ebru Bish, Erick Wikum
As traditional brick-and-mortar retailers are expanding their sales channels to online and mobile channels, consumer adoption rates of these emerging channels is increasing over time. We develop a novel, dynamic demand model, and integrate it within an optimization model to understand the implications of this dynamic environment on the retailers' optimal stocking decisions considering different products and different market settings.

3 - Inventory Mirroring in a Heterogeneous Network
Zhiwei (Torry) Qin, Staff Data Scientist, Walmart Labs, 850 Cherry Ave, San Bruno, CA, 94066, United States of America, TQin@walmartlabs.com
Inventory mirroring determines how many fulfillment centers (FC) and where each stock-keeping unit (SKU) should be stocked. Optimizing inventory mirroring is necessary when the FCs have SKU count limits. We propose an approximate inventory mirroring algorithm for a heterogeneous network, where the fulfillment centers (FC) have different capacities and SKU type eligibilities. We present analysis results of the output to validate the effectiveness of algorithm.

4 - Parameter Estimation Procedures for a Hierarchical Assortment Planning Decision
Matthew Lanham, Doctoral Candidate, Virginia Tech, Department of Business Information Technology, Blacksburg, VA, 24061, United States of America, malanham@gmail.com, Ralph Badinelli
Estimating a consumer's propensity to purchase a product as well as their substitution behavior are critical parameters to a retailer's assortment decision. We investigate the methodologies used to understand consumer demand, substitution behavior, and formulate a novel approach that could be used strategically in a hierarchical assortment planning decision model.

2 - Integrated Allocation and Utilization of Airport Capacity to Mitigate Air Traffic Congestion
Alexandre Jacquillat, PhD Candidate, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Building E40-240, Cambridge, MA, 02116, United States of America, alexandre.jacquillat@gmail.com
This thesis jointly optimizes airport operating procedures at the tactical level and flight scheduling interventions at the strategic level for congestion mitigation. It relies on an original modeling architecture that integrates an Integer Programming scheduling model, a Dynamic Programming operational model and a Stochastic Queueing Model of congestion. Results suggest that operating enhancements and limited, targeted scheduling adjustments can significantly reduce delays at busy airports.

3 - Design and Analysis of Matching and Auction Markets
Daniela Saban, Stanford University, 655 Knight Way, Stanford, CA, United States of America, dbsaban@stanford.edu
Auctions and matching mechanisms have become an increasingly important tool for planners to allocate scarce resources among competing individuals or firms. This thesis addresses several questions that arise when designing and analyzing such markets. For example, we design auctions to construct catalogs of goods for government use, and matching mechanisms that can potentially be used to handle appeals in the public school assignments of thousands of incoming high school students.

4 - Evaluating Policy and Network Interventions to Improve Dental Accessibility and Availability for Children
Ben Johnson, Georgia Institute of Technology, Georgia Institute of Technology North Avenue, Atlanta, GA, 30332, United States of America, benjohnson@gatech.edu
Many countries experience disparities in the distribution of health professionals. There is evidence that trainable from a rural background are more likely to choose to practice in rural areas. Our proposed optimization model incorporates interests of two main stakeholders in the system, namely the regulator and the health professionals, and provides the optimal training locations and required background of trainees in each location.

4 - O ptim al Stocking Decisions in a Multi-channel Retail Environment
Nevin Mutlu, PhD Candidate, Virginia Tech, Department of Industrial and Systems Engineering, Blacksburg, VA, 24061, United States of America, nmmutlu@vt.edu, Ebru Bish, Erick Wikum
We discuss the health policy conclusions one can draw from a detailed and validated agent-based network simulation model of HIV, gonorrhea, and chlamydia spread among young men who have sex with men (YMSM) in Chicago. We focus on racial disparities and the operational issues of expanding HIV and STI testing such as combined testing, cost-effectiveness, roll-out speed, and uptake behavior.

4 - Evaluating Policy and Network Interventions to Improve Dental Accessibility and Availability for Children
Ben Johnson, Georgia Institute of Technology, Georgia Institute of Technology North Avenue, Atlanta, GA, 30332, United States of America, benjohnson@gatech.edu, Nicoletta Serban, Paul Griffin, Susan Griffin
We develop an intervention optimization model to match supply and need for pediatric dental care in Georgia under different dental care policies and provider networks. The model is used to assess the trade-off between efficiency (expenditure) and equity (systematic variations in accessibility and availability) under different policies for managing decision making and outcomes. Network and policy interventions are then determined to provide optimal improvements in dental access.
MA34

34-Room 411, Marriott

Managing Healthcare Services

Sponsor: Health Applications

Sponsored Session

Chair: Vishal Ahuja, Southern Methodist University, P.O. Box 750333, Dallas, TX, United States of America, vahuja@smu.edu

1 - Coordination between Service Professionals in Health Care Delivery: A Multiple-case Study

Claire Scnot, Tulane University, 7 McAlister Dr., New Orleans, LA, United States of America, csnot@tulane.edu, Aravind Chandrasekaran, Peter T. Ward

We investigate the specific coordination challenges faced by hospital's caregivers (physicians and nurses) and the organizational mechanisms that allow them to combine their expertise. We employ a case study methodology that involves 49 semi-structured interviews from the heart-failure units of five U.S. acute care hospitals.

2 - Patient Portals in Primary Care: Impacts on Patient Health and Physician Productivity

Hessam Bavafa, Assistant Professor, Wisconsin School of Business, Madison, WI, United States of America, hibavafa@bus.wisc.edu

Interest in innovative healthcare delivery models has increased due to measures such as the Affordable Care Act, which is designed to expand insurance coverage and contain healthcare costs. One innovation that has been forwarded as a low-cost alternative to physician office visits is “e-visits,” or secure messaging between patients and physicians. We evaluate the effect of e-visit adoption on patient health and physician productivity using a panel dataset from a primary care provider in the US.

3 - Quantifying the Impact on Care Coordination on Health Outcomes

Vishal Ahuja, Southern Methodist University, P.O. Box 750333, Dallas, TX, United States of America, vahuja@smu.edu, Hari Balasubramanian, Ian McCarthy

This paper quantifies the impact of care coordination on patient health outcomes, using data on outpatient health encounters for diabetes patients. Considering that a PCP's task is to consciously facilitate the patient's navigation of the health system, we use the number of PCP visits as a proxy for care coordination. We define new measures to capture the fragmentation of care.

4 - Does Medical Litigation Against Physicians Increase Inpatient Hospital Costs?

Zeynal Karaca, Senior Economist, Agency for Healthcare Research and Quality, 540 Gaither Road, Rockville, MD, United States of America, zeynal.karaca@ahrq.hhs.gov, Mehmet Averyc, Turgay Ayer, Herbert Wong

We empirically assess the impact of medical litigations against physicians on hospital inpatient costs using Healthcare Cost and Utilization Project (HCUP) State Inpatient Databases. We separately assess the cost impact on individual physicians facing the lawsuit and other physicians colleagues (spillover effects). We find increased inpatient costs due to medical litigation and substantial variation in the degree of impact acrossboard certified medical specialties.

MA35

35-Room 412, Marriott

Health Policy

Sponsor: Public Sector OR

Sponsored Session

Chair: Diana Prieto, Assistant Professor, Western Michigan University, 1903 W. Michigan Ave., Kalamazoo, MI, United States of America, diana.prieto@wmich.edu

1 - A Bilevel Optimization Model for Health Information Exchange Policy Design

Diego A. Martinez, Postdoctoral Fellow, Johns Hopkins School of Medicine, 733 N Broadway, Baltimore, MD, 21205, United States of America, dmart101@jhu.edu, Tapas K. Das, Jose L. Zaya-Castro, Felipe Feljoo

Health information exchange (HIE) requires collaboration among competitors. While exceptions exist, reluctance to engage in information sharing is abundant from small medical practices to large hospital systems. To study the potential impact of federal policy stimulating HIE participation, we present a strategic gaming model formulated as a bilevel optimization program. Numerical examples from a hospital network in Florida are presented.

2 - Mapping Chikungunya Disease Transmission and Implications for Surveillance

Elaine Noosee, Assistant Professor, IHME, University of Washington, 2301 5th Avenue Suite 600, Seattle, WA, United States of America, en22@uw.edu

A Chikungunya virus epidemic, which started in December 2013 in the Caribbean island of St. Martin has spread to several countries and islands in the Americas, affecting an estimated one million people within a year. We applied a comprehensive approach involving the integration of data from multiple sources to assess and map the global occurrence of Chikungunya. A thorough knowledge of Chikungunya transmission globally has significant implications for surveillance and burden estimation.

3 - Value of Perfect Information and Perfect Implementation: Anti-VEGF Therapy for Ophthalmologic Use

David Hutton, Assistant Professor, Department of Health Management and Policy, University of Michigan, 1420 Washington Heights, Ann Arbor, MI, 48109, United States of America, dwhutton@umich.edu, Eric Ross, Joshua Stein

We discuss differences between the value of information and value of implementation in the case of high-cost anti-VEGF therapy for ophthalmologic use. We review uncertainty in clinical trial data and discuss how it is used to create prior distributions necessary to assign value of information. We review Markov modeling and Monte Carlo methods for calculation, provide examples of these results for anti-VEGF therapy (billions of dollars), discuss next steps, and insights for other diseases.

4 - Data-driven Monitoring of Medical Recommendations for Breast Cancer Treatment

Milton Soto, PhD Candidate, Western Michigan University, 4601 Campus Drive, Kalamazoo, MI, 49008, United States of America, miltonren.e.sotettari@wmich.edu, Diana Prieto

Medical recommendations for Breast Cancer healthcare may create overtreatment or undertreatment. Overtreatment may occur when aggressive courses are prescribed to patients with low risk of cancer spreading, while undertreatment may be generated by patients’ behaviors, as well as by social, economical or racial disparities. We describe techniques for the monitoring of over or undertreatment using data mining methods to identify possible mistreatment candidates.

5 - Performance of Machine Learning Models in Predicting Presence of BRCA Mutations

Mehrnaz Abdollahian, University of South Florida, 4202 East Fowler Avenue, Tampa, FL, 33620, United States of America, mehrnaz@mail.usf.edu, Tapan K. Das

BRCA1/2 gene mutations drastically increase chances of developing breast and ovarian cancers. These mutations are present in most hereditary breast and ovarian cancer patients. It is common practice for the physicians to require genetic BRCA testing for those that fit the rules of national cancer comprehensive network. However, historically 70% of tested are found negative. We have examined the power of predicting BRCA mutations using machine learning models on a nation-wide survey data. 

MA36

36-Room 413, Marriott

Resilient Public Health Supply Chains

Sponsor: Public Sector OR

Sponsored Session

Chair: Jacqueline Griffin, Assistant Professor, Northeastern University, 334 Snell Engineering Center, 360 Huntington Ave, Boston, MA, 02125, United States of America, ja.griffin@neu.edu

1 - Minor Disruptions Lead to a Major Problem for the U.S. Saline Supply Chain

Rana Aghandi, Northeastern University, 334 Snell Engineering Center, 360 Huntington Ave, Boston, MA, 02125, United States of America, rana.aghandi@gmail.com, Ozlem Ergun, Jacqueline Griffin

In January 2014, FDA announced an ongoing national shortage of saline which has resulted in increased health risks for patients across the country. The underlying cause of this shortage has been the simultaneous occurrence of many small disruptions such as recalls and increased demand. A system dynamics model is used to analyze the saline supply chain network and to characterize how such a phenomenon results from minor supply disruptions due to feedback processes.
2 - New Strategies for Quantifying the Resilience of Supply Chains to Temporally Distinct Disruptions
Jasminne Griffin, Assistant Professor, Northeastern University, 334 Snell Engineering Center, 360 Huntington Ave, Boston, MA, 02125, United States of America, ja.griffin@neu.edu,
Ozlem Ergun, Shiqing Liu
The saline supply chain network flow formulation applied for a multi-level supply chain with lead time between each level and concerning about how factors would influence each other in different time periods. We present closed form expressions to characterize the resilience of a supply chain network to varying combinations of temporally distinct disruptions.

3 - Exploring Strategies for Private Sector Transportation in Uganda
Jarrod Goenzel, MIT, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, goenzel@mit.edu,
Mark Brennan, Emily Gooding
New product technology is commonly introduced in developing countries through subsidized pilot programs run by non-governmental organizations (NGOs). Low landed cost is key for further scaling up product distribution through the private sector. This study uses a pilot program for agricultural storage products in Uganda to explore strategies to reduce transportation cost.

4 - Tracking Healthcare Associated Infections at Individual Level over Dynamic Human Networks
Ziye Zhou, The Chinese University of Hong Kong, William M W Mong Engineering Bldg., Hong Kong, Hong Kong - PRC, zhouzy@se.cuhk.edu.hk, Chun-hung Cheng, Dobin Ng
Healthcare associated infections (HAIs) have become a major challenge to public healthcare. This work addresses the problem of tracking the transmission of HAIs at an individual level. We present a framework with three key components of time-varying contact network construction, individual-level transmission tracking and HAI parameter estimation. Experiments on human positioning data collected in a four-month tracking study in a hospital are conducted to evaluate the performance.

MA37

Health Care Modeling and Optimization VI

1 - Shift Scheduling for an Anesthesiology Residency Program
Herman Abeledo, Associate Professor, George Washington University, 800 22 St. NW, Washington, DC, 20052, United States of America, abeledo@gwu.edu, Michael Kanter, Ian Morgan, Jean - Max Buteau, Liam Nealon
Creating shift schedules for resident physicians is a notoriously difficult task that is typically done manually by the chief residents. Shift assignments need to observe a large number of rules, as well as adhere to fairness and desirability factors while populating a very complex schedule structure. We present an integer programming model developed to schedule anesthesiology residents at the George Washington University hospital.

2 - Shift Scheduling for Medical Residency Programs
Anthony Coudert, George Washington University, 800 22 St. NW, Washington, DC, United States of America, coudert@gmail.com,
Herman Abeledo
Creating shift schedules for resident physicians is a tedious task that is typically done manually by the chief residents. Shift assignments need to observe a large number of rules, as well as adhere to fairness and desirability factors while populating a very complex schedule structure. We present integer programming models used to schedule residency programs at the George Washington University Hospital.

3 - Open-access Outpatient Clinic Scheduling
Yu Fu, ISEN Dept. Texas A&M University, 3131 TAMU, College Station, TX, 77843, United States of America, yfu@tamu.edu,
Amanath Banerjee
This study aims at exploring cost-efficient offline and online scheduling methods under the open access policy which allows the visits of the same-day-request patients and walk-in patients as compensation for no-shows of regular patients to improve clinic performance and revenue benefit. The offline scheduling uses approximation and heuristic methods on scenarios and data generated by prediction and simulation. The online scheduling relies on heuristic methods and stochastic programming models.

MA38

38-Room 415, Marriott

1 - Value of Communication in a One-leader, Two-followers Partially Observed Markov Game
Yanling Chang, PhD Candidate, Georgia Institute of Technology, 765 Ferst Dr, Atlanta, GA, 30332, United States of America, changyanling@gatech.edu, Alan Erera, Chelsea White
We consider a one-leader, two-followers partially observed Markov game and analyze how the value of the leader’s criterion changes due to changes in the communication quality between the two followers. We present conditions under which the value of the leader’s criterion degrades or improves, as a function of this communication quality and the type of game (collaborative or non-collaborative).

2 - Multi-period Corporate Survival Probability Estimation with Stochastic Covariates
Ahmad Reza Pourghaderi, Assistant Professor, Abdullah Gul University, Department of Industrial Engineering, Melikgazi, Kayseri, 38039, Turkey, pourghaderi@u.nus.edu, Ebrahim Sadreddin
We propose an econometric method to obtain maximum likelihood estimation of multi-period corporate survival probabilities conditional on macroeconomic and firm-specific covariates. We then provide an empirical implementation of the proposed method for about 300 Iran-listed Industrial firms. Our method combines traditional duration analysis of the dependence of default intensity on time varying covariates with time-series analysis of covariates.

3 - Managing Capacity with Optimal Buffer Size Selection
Melda Ormeci Matoglu, University of New Hampshire, 10 Garrison Ave., Durham, NH, 03824, United States of America, melda.ormecimatoglu@unh.edu
We model the problem of managing capacity and determining optimal buffer size in a BTO environment as a Brownian drift control problem. We seek a policy that minimizes long-term average cost. The controller can, at some cost, shift the processing rate among 2 rates and has the option of rejecting orders and idling. We show that the optimal policy follows a simple policy and determine the optimal policy parameters. We also calculate important policy performance metrics.

4 - Modeling and Predicting Purchasing Behavior with an Erlang-2 Poisson Lognormal Model
Giang Trinh, Senior Research Associate, Ehrenberg-Bass Institute, University of South Australia, 70 North Terrace, Adelaide, SA, Australia, giang.trinh@marketingscience.info
We note some practical and theoretical shortcomings of the Erlang-2 Poisson gamma mixture model or the condensed NBD, which has been successfully employed for modeling and predicting consumer purchases. We develop a new model, the Erlang-2 Poisson lognormal mixture model, which has a sounder theoretical base. We derive the conditional expectation of the new model and use it to predict future purchases. We show that the new model predicts future purchases better than the condensed NBD model.
2 - Should I Stay or Should I Go: Movement of Artists and Producers between Labels When New Music Categories Emerge
Eugene Paik, University of Arizona, Tucson, AZ, pailth@email.arizona.edu, Joseph P. Broschak
The 1950’s began the rise of new genres of recorded American music. We investigate how, in the wake of new genres emerging, music label identity changes (e.g., changes in the portfolio of music genres that labels choose to produce) affected the mobility of music artists and producers between music labels.

3 - Employee Mobility and Firm Performance: An Integrative Theoretical Framework and Research Agenda
John Mawdsley, University of Illinois at Urbana Champaign, Urbana, IL, mawdslej1@illinois.edu, Deepak Somaya
We review of research on employee mobility and its organizational impacts, and casting it within a novel integrative theoretical framework. We highlight the various organizational impacts of employee mobility, describe how contextual factors moderate the transfer of human and relational capital through mobile individuals, and how constraining factors that impede employee mobility may also be used for effectuating the same organizational impacts as mobility events.

4 - Individual Status Attainment and Entrepreneurial Entry: The Mobility of Award Winning Creative Directors in the Advertising Industry
Michelle Rogan, INSEAD, Boulevard de Constance, Fontainebleau Cedex 77305, France
Michelle.Rogan@insead.edu, Andrew von Nordenflycht
This study is an investigation into the type of firms to which “stars” are likely to move. In particular, we examine the effect of stardom on the likelihood of moving to a higher status firm vs. starting or joining an entrepreneurial firm, in other words choosing status or autonomy. We test our arguments on a sample of award winning creative directors in the advertising industry. We find that industry awards provide a means of resource redistribution and new organizational foundations.

5 - Ideological Misfits: Political Affiliation and Employee Departure in the Private Equity Industry
Y. Sekou Bermiss, University of Texas, Austin, TX, United States of America, ysb@utexas.edu, Rory McDonald
Building on social psychological theories of organizational fit we develop theory to explain how ideological mismatch between an individual and their immediate peers impacts their likelihood of firm departure. Tracking the movement of over 40,000 investment professionals within the U.S. private equity industry over ten years, we investigate how impact of ideological misfit that arises when individuals hold political ideologies that depart substantially from the dominant ideology of the firm.

MA39

39-Room 100, CC
Topics in Mental Accounting, Newsvendor and Pricing
Cluster: Operations/Marketing Interface
Invited Session
Chair: Jun Ru, Assistant Professor, University at Buffalo, Buffalo, NY, United States of America, jrunru@buffalo.edu
1 - Dynamic Pricing with a Fare-lock Option
Ming Chen, Assistant Professor, California State University Long Beach, 1250 Bellflower Blvd, Long Beach, CA, 90840, United States of America, ming.chen@cslub.edu, Zhi-Long Chen
We study a dynamic pricing problem frequently seen in the airlines industry where customers are offered an option to lock a fare at a small fee for a certain period of time. The free 24 hour cancellation enforced by DOT can be viewed as a special case of this problem. This provides a valuable option for those undecided travelers when finalizing their travel plans. We build a dynamic pricing model to investigate the implications of this type of practice on both the airlines and the passengers.

2 - Mental Accounting and Payment Schemes in Manufacturer’s Returns Policies
Charles Wang, Associate Professor, University at Buffalo, Buffalo, NY, United States of America, cswang@buffalo.edu, Jun Ru
Returns policies have been used between the manufacturer and retailer in supply chains with uncertain demand. This research extends our understanding of returns policies by adopting the concept of mental accounting to describe the manufacturer’s behavioral decisions under returns policies. We also investigate two alternative payment schemes that help mitigate the manufacturer’s mental accounting effect in returns policies and improve channel performance.

3 - Price Discount and Capacity Planning under Demand Postponement with Opaque Selling
Zhengping Wu, Associate Professor, Syracuse University, 721 University Ave, Syracuse, NY, 13244, United States of America, zwu12@syr.edu, Jianghua Wu
We consider the opaque selling strategy of a firm that uses a price discount to induce demand postponement. Under demand postponement, the firm offers a price discount to advance customers in exchange for the option to fulfill their orders after the spot demand has been satisfied. In effect, the price discount enables the firm to create a capacity buffer for the spot demand. We characterize the firm’s optimal capacity and price discount decisions.

4 - A Two Product News Vendor Problem with Partial Demand Substitution
Jun Zhang, Associate Professor, Fudan University, 670 Guoshun Rd, Faculty Building 520, Shanghai, China jxj063000@outlook.com, Jun Ru, Ruixia Shi
We show that a two-product news vendor problem with partial demand substitution is equivalent to the classical news vendor problem with the same economic parameters but an adjusted demand. By comparing the adjusted demand and the primary demand stochastically, we examine the impacts of substitution of the expected profit and optimal order quantities. Our analysis does not rely on assumptions on particular demand distributions or correlation structures.

MA40

40- Room 101, CC
Inventing Mobility Dynamics within Markets and Organizations
Sponsor: Organization Science
Sponsored Session
Chair: Y. Sekou Bermiss, University of Texas, Austin, TX, United States of America, ysb@utexas.edu
1 - Racial Disparity in Promotion Rates of NFL Coaches
Chris Rider, Georgetown University, Washington, DC, chris.rider@georgetown.edu, Jim Wade, Anand Swaminathan, Andreas Schwab
We examine differences in the rates at which white and black coaches are promoted within the NFL between 1985 and 2012. We demonstrate continuing race-based sorting into positions with limited upward mobility chances (e.g., RB coach) and lower mobility rates conditional on attaining any position (e.g., LB coach). We discuss how high-level interventions designed to increase representation at the highest levels are likely to be ineffective absent accompanying lower level interventions.

MA41

41-Room 102A, CC
Joint Session MSOM-Health/HAS: Data-Driven Modeling in Healthcare II
Sponsor: Manufacturing & Service Operations Management/Healthcare Operations
Sponsored Session
Chair: Yichuan Ding, UBC, 2053 Main Mall, Sauder School of Business, Vancouver, BC, V6T2Z2, Canada, daniel.ding@sauder.ubc.ca
Co-Chair: Nan Liu, Columbia University, 722 W 168th St., New York, United States of America, nl2320@columbia.edu
1 - What Drives the Geographical Differences in Deceased Donor Organ Procurement in the United States?
Mazhar Arikan, Assistant Professor, University of Kansas, 1300 Sunnyside Ave., Lawrence, KS, 66045, United States of America, mazhar@ku.edu, Baris Ata, Rodney Parker, John J Friedewald
The deceased-donor kidney allocation system suffers from severe shortages of available organs while there is significant variation in the procurement rates across different geographies in the US. The empirical analysis reveals that the intent of procurement increases with organ quality, the median waiting time for a transplant, and the competition among transplant centers. A counterfactual study shows that broader sharing of lower quality organs leads to an increase in the procurement rates.
2 - Assignment of Emergency Department Patients to Primary and Secondary Inpatient Units
Derya Kilinc, Arizona State University, 699 S. Mill Ave., Tempe, AZ, 85281, United States of America, dkilinc@asu.edu,
Soroush Saghafian, Stephen J. Traub

One of the main reasons for Emergency Department (ED) crowding is the long boarding time, of patients who are waiting for admission to inpatient wards. We study suitable mechanisms to overflow such patients to alternative wards. An overflow policy can improve ED waiting times and Length of Stay (LOS), but may reduce the quality of care. We study an MDP-based approach to gain insights into the impact of overflow policies on waiting times and quality of care.

3 - Data Driven Staffing of Hospital Support Staff
Cassandra Hall, PhD Student, Northwestern University.

We study hospital patient transport requests as a multi-class queue with server specialization and construct an approximation for the minimum number of servers required to achieve a probabilistic bound on the patient waiting time. We also explore the effects of different specialization and routing policies on performance at a given staffing level. Output is then compared with theoretical worst case waiting time bounds derived from the literature.

4 - A Clinical Decision Support System for Treatment-resistant Depression: A Pilot Study
Martin Cousineau, Desautels Faculty of Management, McGill University, 1001 Sherbrooke Street West, Montreal, QC, H3A 1G5, Canada, martin.cousineau@mail.mcgill.ca, Gustavo Turecki, Vedat Verter, Joelle Pineau

This research project aims to develop a clinical decision support system to assist psychiatrists seeking to achieve remission in treatment-resistant depression patients. This system is based on a longitudinal dataset of outpatient mental health clinic patients, and consists of (1) a predictive model of the patient outcome depending on the selected treatment, and (2) a decision-theoretic module for recommending treatment strategies based on similar patient files.

5 - An Empirical Study of Patient Prioritization in Emergency Department Triage Systems
Mahesh Nagarajan, University of British Columbia, 2053 Main Mall, Vancouver, BC, V6T1Z2, Canada, mahesh.nagarajan@sauder.ubc.ca, Eric Park, Yichuan Ding

We analyze patient choice behavior of the ED personnel who decides which patient waiting in the ED will be seen by the next available physician. We use a discrete choice framework consistent with random utility theory. The choice maker's valuation of each patient depends on both the patient's medical and operational characteristics including wait time and ED congestion. We study over 270,000 patient choices in five EDs using the Canadian Triage and Acuity Scale (CTAS).

6 - Dynamic Assignment of Emergency Department Patients to Primary and Secondary Inpatient Units

7 - Evaluating Peer-to-peer Performance of Anesthesiology Fellows using Data Envelopment Analysis
Vikram Tiwari, Vanderbilt University Medical Center, Nashville, TN, United States of America, vikram.tiwari@vanderbilt.edu, Avinash Kumar

Factors that contribute to the success of individuals at a critical care fellowship have not been well studied. We explore what aspects of the educational program and work characteristics contribute the most to an individual fellow's success as determined by year end Multidisciplinary Critical Care Knowledge Assessment Program scores and summative evaluations. We show the feasibility of using data envelopment analysis to evaluate the academic performance of fellows compared to their peers.

MA43

43-Room 103A, CC

Game Theoretic Models in Revenue Management I
Sponsor: Revenue Management and Pricing
Sponsored Session
Chair: Ozan Candogan, University of Chicago, Booth School of Business, Chicago, IL, United States of America, ozan.candogan@chicagobooth.edu
Co-Chair: Santiago Balseiro, Assistant Professor, Duke University, 100 Fuqua Drive, Durham, NC, 27708, United States of America, sbalseiro@duke.edu

1 - Customer Referral Incentives and Social Media
Ilan Lobel, NYU, 44 W 4th St, New York, NY, 10012, United States of America, ilobel@stern.nyu.edu, Evan Sadler, Lav Varshney

We study how to optimally attract new customers using a referral program. Whenever a consumer makes a purchase, the firm gives her a link to share with friends, and every purchase coming through that link generates a referral payment. The firm chooses the referral payment function and consumers play an equilibrium in response. We show that the optimal payment function is nonlinear and complex, and prove revenue properties of simple approximate solutions such as linear and threshold policies.

2 - Dynamic Reserve Prices for Repeated Auctions: Learning from Bids
Yash Kanoria, Assistant Professor, Columbia University, New York, NY, United States of America, ykanoria@columbia.edu, Hamid Nazerzadeh

A large fraction of online advertisements are sold via repeated second price auctions. In these auctions, the reserve price is the main tool for the auctioneer to boost revenues. We present a simple approximately incentive-compatible and optimal dynamic reserve mechanism that can significantly improve the revenue over the best static reserve when there is uncertainty in the distribution of valuations.

3 - A Dynamic Model of Crowdfunding
Mehdi Mostagir, Assistant Professor, University of Michigan Ross School of Business, 701 Tappan Ave, 48109, Ann Arbor, MI, United States of America, mosta@umich.edu, Saeed Alaei, Azaraksh Malekian

Crowdfunding has emerged as an alternative to traditional methods of funding new products. Backers arrive over time and decide whether to pledge money to a crowdfunding campaign. If the total contribution reaches a certain threshold, the campaign is successful and production takes place. We identify a fundamental tension in these environments that leads to a sharp characterization of empirical outcomes, and we show how to determine the optimal duration and price to maximize campaign success.

4 - Effect of Network Perturbation on Aggregate Performance
Azaraksh Malekian, Rotman School of Management, University of Toronto, Toronto, Canada, azaraksh.malekian@rotman.utoronto.ca, Oliver Baron, Ming Hu

In this work, we characterize the role of perturbing network interactions in macroeconomic aggregate performance. We then provide a fairly tight characterization of the aggregate performance under worst-case network perturbation as well as average-case random network perturbation. Finally, we identify robust networks under perturbation.
better profits than others. In this talk, we will discuss some practical issues frequently encountered in the modeling of price and revenue optimization, and we will go through several real world examples to illustrate some of the best practices.

2 - Revenue Functions: Demand Aggregation for Fleet Allocation in Car Rental Industry
Manu Chaudhary, Scientist, PROS, 3100 Main Street, Suite #900, Houston, TX, 77002, United States of America, mchaudhary@pros.com

Fleet allocation for car rental industry is a multi-dimensional, large scale network optimization which is computationally expensive. We address this complexity by introducing an intermediate optimization that generates Revenue Functions which aggregate the demand forecast to a higher level. This reduces the dimensional complexity of the modified fleet allocation problem significantly and makes it feasible to run in a live production system.

3 - Identifying a More Accurate Historical Data Subset from a Noisy Historical Dataset: A Forecasting Example
Gregory Vogel, Manager, Revenue Science, Holland America Line, 300 Elliott Ave W, Seattle, WA, 98119, United States of America, gvoegel@hollandamerica.com

When looking at similar products that have overlapping booking periods, noise is common. It is common practice to compile a dataset for processes such as demand forecasting by compiling the complete set of relevant history. We ask the question, can we identify a subset of history that will produce a more accurate forecast? We utilize a cruise example to demonstrate and improved forecast and present the method developed.
2 - An Approximation for the Bed Occupancy Process in Inpatient Wards
Ohad Perry, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60208, United States of America, ohad.perry@northwestern.edu
We consider queueing dynamics of bed-occupancy processes in inpatient wards. These are time varying, and have departures that are highly concentrated within a short time period each day, following the physicians’ daily inspection round. We characterize a necessary and sufficient condition for the system to be stable, and employ a fluid approximation to prove an asymptotic periodic behavior of the system. That “periodic equilibrium” can be used to optimize systems’ performance.

3 - Operations Management of a Stool Bank for Fecal Transplantations
Abbas Kazerouni, Stanford University, Electrical Engineering Department, Stanford, CA, United States of America, abbash@stanford.edu, Lawrence Wein
We describe our work with Openbiome, a nonprofit firm that enables fecal transplants for treating Clostridium difficile, which is responsible for 25,000 deaths and $1 billion annually in the U.S. We optimize the timing of new donor acquisitions and the individualized (based on donor production rate) testing frequency for each donor, with the goal of meeting nonstationary demand (increasing at 10% per month) at minimum cost.

4 - Queues with Time-varying Arrivals and Inspections with Applications to Hospital Discharge Policies
Carri Chan, Columbia Business School, 3022 Broadway, Uris Hall, Room 410, New York, NY, 10027, United States of America, cwchan@columbia.edu, Linda Green, Jing Dong
To discharge a patient from a hospital unit, a physician must determine that the patient is stable enough to be discharged. As such, patients may occupy a bed longer than medically necessary. Motivated by this phenomenon, we introduce a queueing system with time-varying arrival rates in which servers who have completed service cannot be released until an inspection occurs. We examine how such a dynamic impacts system dynamics and consider how to optimize the timing of inspections.

3 - Is Electricity Storage “GREEN”? A Case Study with Commercial Buildings for Reducing Demand Charge
Yanglang Zhou, Assistant Professor, Lee Kong Chian School of Business, Singapore Management University, Singapore, Singapore, helenzhou@smu.edu.sg
Electricity storage systems, e.g., grid-scale industrial batteries, are known in the literature to increase carbon emission when used for arbitrage. However, we show that when these storage systems are used for reducing demand charge (on peak load), they can potentially decrease carbon emission. We model the problem of managing electricity storage and solar panels in a commercial building (e.g., those for hotels, banks, and supermarkets), and examine the “greenness” of storage with real data.

4 - Dynamics of Capacity Investment in Renewable Energy Projects
John Birge, Professor, University of Chicago Booth School of Business, 5807 S Woodlawn Ave, Chicago, IL, 60637, United States of America, john.birge@chicagobooth.edu, Nur Sunar
We study the dynamics of the capacity investment for renewable power generators. Using a continuous time Brownian model, we explicitly identify the optimal dynamic capacity investment strategy of a renewable power generator. Our analysis offers important insights for renewable power generators. We also include some numerical analysis to shed light on the optimal strategy.
Energy Operations and Sustainability

Sponsor: Manufacturing & Service Oper Mgmt/Supply Chain

Chair: Nur Sunar, Assistant Professor, University of North Carolina, Kenan-Flagler School of Business, Chapel Hill, NC, United States of America, Nur_Sunar@kenan-flagler.unc.edu

1 - New Business Models for Green Technology Adoption in Split Property Rights and Rents Situations
Anton Ovchinnikov, Queen’s University, 143 Union St. West, Kingston, Canada, anton.ovchinnikov@queensu.ca

In many situations, the owner of the asset that is being improved with green technology is not one that enjoys the benefits from the improvement. For example, the landlord may incur the costs of energy-efficiency upgrades, while the tenant will enjoy the savings in energy costs. Such split in property rights and rents is a major determinant in the adoption of green technologies. We will discuss two case studies highlighting the industry practice and issues, and opportunities to resolve them.

2 - The Impact of Extended Producer Responsibility on Selling and Leasing Strategies
Ni Fang, HEC Paris, 1, Rue de la Liberation, HEC Paris, Jouy en Josas, DI, 78351, France, ni.fang@hec.edu, Andrea Masini

While product take-back legislation based on the Extended Producer Responsibility (EPR) concept is becoming an increasingly popular instrument to reduce waste, its actual operational and environmental impact remains unclear. This paper examines how EPR legislation affects the optimal channel allocation decisions of a firm that either sells, leases, or concurrently sells and leases durable products, and it discusses the competitive and environmental implications of regulation.

3 - The Buyer’s Role in Improving Energy Efficiency in Supply Chains
Jason Nguyen, University of Minnesota, 321 19th Ave S, Minneapolis, MN, 55455, United States of America, nguy1762@umn.edu, Karen Dotohule, Milli Mehrotra

We investigate the equipment-focused EE investment decision in the context of a supply chain where a capital constrained manufacturer sets the investment level and its buyer sets contract prices. We investigate the impact of different factors including policy incentives and global competition on the investment decisions.

Models for Fashion Operations Management

Sponsor: Manufacturing & Service Operations Management

Chair: Victor Martínez-de-Albéniz, Associate Professor, IESE Business School, Av. Pearson 21, Barcelona, 08034, Spain, Valbeniz@iese.edu

1 - Assortment Planning Decisions in a Two-sided Market
Ying Cao, University of Texas at Dallas, 800 W. Campbell Rd, Richardson, TX, 75080, United States of America, Ying.Cao@utdallas.edu, Dorothy Honhong, Sridhar Seshadri

We consider the problem of a firm optimizing its assortment when facing a two-sided market. The firm receives revenues from customers purchasing the products as well as from advertising companies who offer to pay various amounts for reaching customers from different segments. We explore structural properties of the optimal assortment and compare it to the solutions of the one-sided market problems.

2 - Managing Online Content to Build a Follower Base: Model and Applications
Felipe Caro, University of California Los Angeles, 110 Westwood Plaza, Box 951481, Los Angeles, CA, 90095-1481, United States of America, felipe.caro@anderson.ucla.edu, Victor Martínez-de-Albéniz

Content providers typically manage a dual objective of generating interest for current content and at the same time reaching out to new audiences that may become repeat users. The pace at which content is created must thus take into account how much current content contributes to the follower base. We develop a simple model to study base build-up dynamics, and use it to optimize the total traffic received from the content provider through stochastic dynamic programming.

3 - Choosing an Assortment Rotation Strategy to Boost Sales
Kris Johnson Ferreira, Harvard Business School, Morgan Hall 492, Boston, MA, 02163, United States of America, kferreira@hbs.edu, David Simchi-Levi

Assortment rotation strategies vary widely across fashion retailers; the flash sales industry uses a frequent assortment rotation strategy, introducing new products every day. We build a finite-horizon stochastic dynamic programming model to better understand the consumer’s purchase decisions under this strategy. We analyze and compare our model to the setting where all products are offered for the entire selling season and explore under what conditions the retailer should employ each strategy.

4 - Estimating and Optimizing the Impact of Inventory on Consumer Choices in Fashion Retail
Víctor Martínez-de-Albéniz, Associate Professor, IESE Business School, Av. Pearson 21, Barcelona, 08034, Spain, Valbeniz@iese.edu, Pol Boada

We empirically study the impact of inventory (as opposed to availability) on sales. We develop a market share model where we show that product-level inventory has a large impact on its market share within the category. This supports the idea that inventory plays a major role in helping customers choose a particular product within the assortment. We finally describe how a retailer should optimally decide its inventory levels within a category.
1 - Investigating Performance Insights: Leveraging Online Text Reviews using Natural Language Processing
Hyun Jeong Han, National Research University Higher School of Economics, Moscow, Russia, hhyun@hse.ru, Rohit Verma, Joon Goh, Nagesh Gavirneni, Shawn Mankad
In this study, we quantify the relationship between textual content of reviews and financial performances. To achieve our research objectives and to illustrate our methodologies, we partnered with leading hotel review website and hotel data company to obtain their reviews and performance data on many hotels in Moscow, Russia.

2 - Explore Resource Configuration and Performance Link through Thick and Thin
Jie Zhang, Assistant Professor, University of Vermont, 55 Colchester Ave., Burlington, VT, 05401, United States of America, jie.zhang@uvm.edu, Rohit Verma
We study the patterns of resource configurations at operating unit level through the peaks and troughs of a business cycle. Using a large panel dataset from the US hotel industry, we identify subgroups of distinct resource configurations and link their resource configuration choices to performance.

3 - Who Wants to Share? Understanding the Participants of the Sharing Economy
Rohit Verma, Professor, Cornell University, School of Hotel Administration, 338 Statler Hall, Ithaca, NY, 14853-6902, United States of America, rohit.verma@cornell.edu, Lu Kong, Robert Kwok
The models of sharing economy including renting, bartering, loaning, gift giving, swapping and forms of shared ownership such as cooperative structures. However, the academic cognition of sharing economy is lagging behind the public cognition. Thus, more research questions need to be asked and answered to unveil the essence and potential of sharing economy. In this article, we try to find out who the people participating in sharing economy are and what personality traits they share.

MA53

53-Room 107B, CC

Behavioral Issues in Coordination and Pricing

Sponsor: Behavioral Operations Management
Sponsored Session
Chair: Elena Katok, Ashbel Smith Professor of Supply Chain Management, University of Texas at Dallas, 800 W. Campbell Rd., Dallas, TX, 75080, United States of America, ekatok@utdallas.edu

1 - An Experimental Investigation of Managing Quality through Deferred Payment Mechanisms
Andrew Davis, Cornell University, 401J Sage Hall, Ithaca, NY, 14850, United States of America, adavis@cornell.edu, Kyle Hyndman
We conduct an experiment investigating the efficacy of deferred payment mechanisms in inducing high quality products from suppliers. In particular, we explore a setting where a retailer offers a supplier a fixed fee and a bonus, where the bonus constitutes a deferred payment that is only paid out after a review period has passed and the product is deemed high quality. In one set of our treatments, in both one-shot and repeated settings, we observe significantly higher quality and efficiency.

2 - Size Matters: Supplier Coordination with Endogenously-selected Groups
James Fan, PhD Student, Pennsylvania State University, 426A Business Building, University Park, PA, 16802, United States of America, jfl187@psu.edu, Tony Kwasnica
We study the endogenous selection of supplier groups via experimental coordination games. Players first choose between one of two groups, one with an entry fee and one without; they then simultaneously makes a capacity choice. The minimum choice within each group dictates profits for members. The group with an entry fee always observes higher capacity outcomes. This group also has fewer players, suggesting that players recognize the increasing difficulty of coordination in larger groups.

4 - A Behavioral Study of Competitive Dynamic Pricing with Fixed Capacities
Bahriye Cesaret, PhD Student, The University of Texas at Dallas, 800 W Campbell Rd, Richardson, TX, 75080, United States of America, bahriye.cesaret@utdallas.edu, Elena Katok
We consider two firms that offer substitutable capacity to the same customer pool. Customers arrive sequentially to the market and demand exactly one unit of capacity, and price is the main consideration for the purchasing decisions. Each firm quotes a price for its current unit of capacity simultaneously. We use a 2x2 between-subjects design with two levels of arrival uncertainty and two different length of selling horizon. We report on the results of these laboratory experiments.
This study investigates the technical efficiency of NA and T/SC engines to identify varying technology adoption patterns as well as breakthrough engines over the past 10 years. The results indicate that T/SC engines are enlarging their dominance on the technology frontier and if current environmental and fuel economy regulations continue to be stiff, a return to high displacement unknown engines is unlikely to happen without a major breakthrough in the NA technologies.

1 - Selective Newsvendor Problem with Quantity-dependent Leadtime and Marketing Decisions
Jianing Zhi, The University of Alabama, 300 Alston Hall, 361 Stadium Drive, Tuscaloosa, AL, 35487, United States of America, jzhil@crimson.ua.edu, Burcu Keskin

We consider a selective newsvendor problem with limited sales force and quantity-dependent leadtime to maximize the expected profit for a company. We evaluate our models with demands, capabilities of agents, leadtime, and waiting time tolerance of customers to estimate their impacts on the profit, ordering policies, and marketing decisions.

2 - Constrained Connected Facility Location Problems
Maria Gisela Bardossy, Assistant Professor, University of Baltimore, 1420 N. Charles Street, Merrick School of Business, Baltimore, MD, 21201, United States of America, mbardossy@ubalt.edu

We investigate and propose heuristics for two variants of the Connected Facility Location (ConFL) problem: degree constrained and hop constrained. The ConFL problem combines features of the uncapacitated facility location problem with the Steiner tree problem and is known to be NP-complete. However, in certain practical applications, the number of connections at the facility nodes and/or the connections between open facilities is limited, which we address in this presentation.

3 - A Supply Chain Network Design Problem Considering Market Cannibalization
Yanzi Zhang, Tsinghua University, Beijing, China, zhzhang@mail.tsinghua.edu.cn

The paper studies a supply chain network design problem with cannibalization of new products sales by remanufactured products. Location, inventory, and pricing decisions are considered in a two-tier supply chain network. New and remanufactured products are supplied together with price-dependent demands. The cannibalization effect of them is considered. The problem is formulated as a nonlinear program. Managerial insights are explored by numerical experiments.

4 - Stochastic Inventory Modulated Capacitated Facility Location Models
Kayse Lee Maass, Ph.D. Candidate, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, leekayse@umich.edu, Mark Daskin, Siqian Shen

We compare various approaches to modeling a stochastic capacitated facility location problem in which processing facilities are able to accept demands in excess of the capacity constraint for short periods of time. We show that the location and allocation decisions obtained from our models can result in significantly reduced costs when compared to models that do not account for the likelihood that demands may exceed capacity on some days.

INFORMS Philadelphia – 2015

3 - Efficiency Analysis of Internal Combustion Engines: Naturally Aspirated vs Turbo/super-charged
Dong-Joon Lim, Portland State University, 1900 SW 4th Ave, Suite LL-50-02, Portland, OR, United States of America, dongjoon@pdx.edu, Tim Anderson

The cannibalization effect of them is considered. The problem is formulated as a presentation.

We study supply function competition among power generators with different levels of flexibility. We analyze how generators’ (in)flexibility affects the equilibrium behavior and market price. We also investigate the impact of intermittent renewable energy on the equilibrium, focusing on the effects of renewable energy penetration level, dispatch priority, and the production-based subsidies. We find that the economic curtailment policy increases market competition and reduces price volatility.
2 - Big Data in the Energy Industry
Margery Connor, Chevron, 6001 Bollinger Canyon, P-2080, San Ramon, CA, 94583, MICO@chevron.com
This presentation will discuss our internal efforts to build a big data platform. It will include a couple of use cases. It will also include challenges and lessons learned.

3 - Emerging Applications of Optimization in the Energy Industry
Haraldur Haraldsson, Aimsms Optimization Specialist, AIMMS, 500 108th Avenue NE, Ste. 1780, Suite 1780, Bellevue, WA, 98004, United States of America, haraldur.haraldsson@aimms.com
With data analytics and optimization gathering focus in many organizations, there is an increased opportunity to leverage advanced analytics. We will share some examples on potential use of advanced analytics in the energy industry for future cases.

MA59
59-Room 1108, CC
Strategy, Innovation, and Entry
Cluster: Strategy Science
Invited Session
Chair: Hart Posen, University of Wisconsin, 4263 Grainger Hall, 975 University Avenue, Madison, WI, 53705, United States of America, hposen@bus.wisc.edu
1 - Spinout Formation and Parent Firm Performance: A Multi-industry Examination
Seth Carnahan, University of Michigan, 701 Tappan St., R4460 Ross School of Business, Ann Arbor, MI, 48104, United States of America, scarnaha@umich.edu, Benjamin Campbell, Rajshree Agrawal
Some scholars find an increase in firm performance when former employees create startup organizations ("spinouts"), while others find a decrease. We articulate the competing mechanisms that underlie these positive and negative differences. We use a multi-industry sample based on US Census microdata that allows us to identify and test the competing mechanisms.

2 - Spinout Formation: Do Opportunities and Constraints Benefit High Human Capital Founders?
Natarajan Balasubramanian, Syracuse University, 721 University Ave, Syracuse, NY, United States of America, nabalasu@syr.edu, Mariko Sakakibara
Using a large sample of individuals who formed spinouts and their co-workers who did not, we how industry contexts affect the relative advantage of high human capital founders. We find that such individuals are less likely to form spinouts in capital-intensive and R&D-intensive industries. This suggests that in capital intensive industries, high human capital founders face greater constraints while R&D intensive industries offer opportunities for both high and low human capital founders.

3 - Entrepreneurial Joiners
Michael Roach, Cornell University, Dyson School, Ithaca, NY, 14853, United States of America, michael.roach@cornell.edu, Henry Sauermann
Startups rely not only on founders, but also on "joiners"—individuals attracted to entrepreneurship as an employee rather than a founder. We find that individuals with joiner interests share preferences for entrepreneurial job attributes often considered unique to founders, but differ with respect to contextual factors. This study reveals that preferences and context interrelate in unique ways to shape entrepreneurial interests and highlights joiners as a distinct type of entrepreneurial actor.

4 - (how) Do Individual Characteristics Influence Resource Allocation and Competitive Advantage?
Michael Leiblein, Ohio State University, Fisher College of Business, Columbus, OH, 43220, United States of America, leiblein.1@osu.edu, Barclay Burns, Sheen Levine
A fundamental issue in the field of strategic management regards the identification of sources of competitive advantage. Why do firms differ and how do managers influence firm behavior? If individuals matter and theories of competitive advantage are correct, then unique individuals should differ in their resource allocation decisions and outcomes. This proposal promises to report emerging evidence associating individual characteristics, resource allocation decisions, and competitive advantage.

MA60
60-Room 111A, CC
Enabling Business Students to Use OR
Sponsor: INFORMS
Sponsored Session
Chair: Thomas Grossman, Professor, University of San Francisco, School of Management, 101 Howard St., Suite 500, San Francisco, CA, 94105, United States of America, tagrossman@usfca.edu
1 - Teaching Modeling to Business Students
Wendy Roth, Assistant Professor, Georgia State University, 6230 Forest Park Dr, Signal Mountain, TN, 37377, United States of America, wroth@gsu.edu
Due to the popularity of business analytics, interest in business modeling classes appears to be increasing. When considering the student skill level as compared to a few years ago, this has resulted in a broader variety of student backgrounds, not necessarily self-selected based on a strong math background. This session will discuss some of those differences and modifications made to the classroom to help address these differences.

2 - Teaching Distribution Planning: A PBL Approach
Alex Grasas, Associate Professor, EADA Business School, Arago 204, Barcelona, Spain, agrasas@eada.edu, Helena Ramalhinho
This work presents a problem-based learning (PBL) activity that uses a decision support system (DSS) to teach one of the most fundamental topics in distribution planning: vehicle routing. This pedagogical activity, employed in a logistics and supply chain management course, also seeks to create awareness among students on the importance of DSS for complex problems. The paper is written as a teaching guide for other instructors, detailing how the activity may be carried out in class.

3 - Spreadsheet Engineering: The Foundation for OR/MS Applications by Business Students
Vijay Mehrotra, Professor, University of San Francisco, School of Management, 101 Howard St., Suite 500, San Francisco, CA, 94105, United States of America, vmehrotra@usfca.edu, Thomas Grossman, Mouwolac Sidaoui
To access the power of OR/MS on non-trivial models, business students must first learn to apply software engineering principles to develop high quality spreadsheets. We have developed a methodology for teaching this skill to business students, many of whom have little or no relevant technical experience prior to our course. This talk describes how we successfully teach business students to build complex spreadsheet models that then serve as the foundation for OR/MS applications.

MA61
61-Room 111B, CC
Transmission and Generation Expansion Planning
Sponsor: ENRE – Energy I – Electricity
Sponsored Session
Chair: Enzo Sauma, Pontificia Universidad Catolica de Chile, Santiago, Chile, csauma@ing.puc.cl
1 - Risk-averse Transmission and Generation Planning: A WECC Case Study
Harry Van Der Weijde, University of Edinburgh, The King's Buildings, Mayfield Road, Edinburgh, EH9 3JL, United Kingdom, h.vanderweijde@ed.ac.uk, Francisco Munoz, Benjamin Hobbs, Jean-paul Watson
We investigate the effects of risk aversion on optimal transmission and generation expansion planning. To do so, we formulate a stochastic model in which transmission and generation planners minimize a weighted average of expected costs and their conditional values at risk. This model is then applied to a 240-bus representation of the Western Electricity Coordinating Council, in which we examine the impact of risk aversion on levels and spatial patterns of investment, costs, and prices.

2 - Robust Transmission Expansion Planning
Antonio Conejo, Prof., The Ohio State University, 286 Baker Systems Engineering, 1971 Neil Avenue, Columbus, OH, 43210, United States of America, conejona@osu.edu
This presentation discusses a number of critical issues to successfully design and implement transmission expansion planning algorithms using an adaptive robust optimization approach. These issues include formulation format, selection of robust sets, sensitivity analysis, and out-of-sample simulation.
3 - The Economic Effects of Interregional Trading of Renewable Energy Certificates in the WECC
Francisco Munoz, Assistant Professor, Universidad Adolfo Ibáñez, Diagonal Las Torres 2640, Santiago, Chile, elpanchomunoz@gmail.com, Benjamin Hobbs, Andres Perez, Enzo Sauma

In the U.S., individual states enact RPSs for renewable electricity production with little coordination. Using a co-optimization (transmission and generation) planning model, we quantify the long run economic benefits of allowing flexibility in the trading of Renewable Energy Credits (RECs) among the U.S. states that belong to the WECC. We find that up to 90% of the economic benefits are captured if approximately 25% of unbundled RECs are allowed to be acquired from out of state.

4 - Reliable Transmission Expansion Planning for Large Renewable Energy Penetration
David Pozo, PUC, Ave. Vicuna MAcKenna 4860, Santiago, Chile, davidpoopecamara@gmail.com, Alexandre Moreira, Alexandre Street, Enzo Sauma

We present a novel approach to jointly address transmission network and renewable capacity expansion planning dealing with renewables variability under multiple n - k security criteria. An adjustable robust optimization approach is presented to circumvent the tractability issues associated with conventional contingency-constrained methods relying on explicitly modeling the whole contingency set and renewables generation scenarios. The adjustable robust model is formulated as a two-level problem.

1 - Using Analytics to Enhance Shelf Space Management in a Food Retailer
Teresa Bianchi-Aguilar, University of Porto and LITplabs, INESC TEC & Faculty of Engineering, Portugal, mbaugar@fe.up.pt, Elka Silva, Luis Guimarães, Maria Antónia Carravalla, José F. Oliveira, Jorge Liz, João Gonther Amaral, Sérgio Lapela

This talk describes a collaboration with the leading Portuguese food retailer, addressing the allocation of products to shelves. The result is GAP, a DSS that is today used on a daily basis. GAP has a modular structure and systematically applies tailor-made mathematical programming models combined with heuristics. It is able to incorporate different merchandising rules, allowing the company to test several product allocation strategies with a trade-off between customization and optimization.

2 - Strategic Re-design of Urban Mail and Parcel Networks at La Poste
Stefan Spinler, Professor, WHU-Otto Beisheim School of Management, Burgplatz 2, Vallendar, 56179, Germany, stefan.spinler@whu.edu, Alain Roset, Matthias Winkenbach

We devise a decision model that allows La Poste, the French postal operator, to assess the benefits of merging the urban mail and parcel delivery networks which used to be run as separate entities. Based on data from the French city of Nantes, we find that merging the mail and parcel delivery yields cost benefits of around 3% which prove to be robust under various scenarios tested. These findings corroborated management’s expectation of cost savings and entailed a new organizational structure.

1 - Assessing Technical Risk Dependencies in Pharmaceutical Drug Development
Elayne Ko, Pfizer, 500 Arcola Road, Collegeville, PA, 19426, United States of America, Elayne.Ko@pfi zer.com

The presentation explores the process and framework of evaluating pharmaceutical R&D investment projects with technical risk dependencies. This occurs when either 1) compounds in the portfolio share the same mechanism of action or 2) a compound is being developed for more than one indication. Assuming probability independence and simply aggregating individual compound exploitations into portfolio view would not adequately reflect the risks of the compounds.

2 - Play the Portfolio Game
Chris Dalton, Syncopation Software, 6 State Street, Suite 308, Bangor, ME, 04401, United States of America, cdalton@syncopation.com, Phil Breece, Elayne Ko

This segment will feature an interactive portfolio management exercise designed to foreshadow and highlight the central concepts of the talks that follow. Participants will work in small groups, selecting the best portfolio they can from a pool of risky projects. Uncertainties will be resolved throughout the session, so that a final portfolio value can be calculated. There will be prizes for the winning team.

1 - Portfolio Assessment of Run-of-River Hydrokinetic Power Generation
Seth Blumsack, Associate Professor, Pennsylvania State University, 153 Hosler Building, University Park, PA, 16802, United States of America, sethb@psu.edu, Mehdi Shahriri, Frank Liu, Ben Hodges

Spatially distributed run-of-river hydrokinetic power generation resources are a portfolio of assets whose value varies with prices and output. We quantify the locational contribution of hydrokinetic generation to the value of a spatial portfolio and derive a variance decomposition indicating how variance in portfolio value depends on variance in output, prices and spatial co-fluctuations. Individual sites have nearly uniform value contributions over fast time scales, but not longer time scales.

2 - Towards a Holistic Modeling of River Networks
Radu Marculescu, Professor Of Electrical And Computer Engineering, Carnegie Mellon University, Dept. of ECE, Pittsburgh, PA, 15213, United States of America, radum@cmu.edu, Diana Marculescu, Paul Bogdan

River dynamics are dependent on both terrain and environmental conditions. While AR-based models can be sufficiently accurate for forecasting river dynamics, we show that spatio-temporal variability can only be uncovered through a multi-fractal spectrum formalism. Moreover, a network-based model of cloud movement can estimate precipitation levels, thereby providing a first step towards modeling the complete hydrological cycle and developing control methods for run-of-river power projects.

3 - Hydro-structural Design Optimization for Marine Hydrokinetic Turbines
Ashwin Vinod, Graduate Student, Lehigh University, 19 Memorial Drive West, Mechanical Engineering & Mechanics, Bethlehem, PA, 18015, United States of America, asv312@lehigh.edu, Arindam Banerjee

An optimization methodology for a fixed pitch horizontal axis hydrokinetic turbine will be presented using a combination of a coupled hydro-structural analysis and genetic algorithm based optimization. Preliminary hydro-structural analysis indicates low hydrodynamic performance and high flap-wise bending stresses developed in turbine blades. A multi-objective optimization methodology is used to design a variable chord, twisted blade turbine which yielded improved hydro-structural performance.
3 - Global Uncertainties in Pharma R&D Portfolio Management
Chris Dalton, Syncopation Software, 6 State Street, Suite 308, Bangor, ME, 04401, United States of America, cdalton@syncopation.com

R&D portfolio management in pharma tends to be focused on individual project risk factors, technical and commercial. Global risk factors affecting many projects are usually ignored, on the theory that while they may change the value of the portfolio they are unlikely to alter the project ranking. The possibility of far-reaching changes in government policy suggests that this assumption should be tested. This talk examines the impact of some potential policy changes on a notional portfolio.

4 - Manufacturing Investments in Pharmaceutical R&D: Should I Pull the Trigger?
Phil Becce, White Deer Partners, Westlake Village, CA, United States of America, phil@becce.com

Capital investments to manufacture biopharmaceuticals require long lead times and large expenditures that require board approval. These facilities produce multiple products in highly competitive markets with uncertain demand, and if not planned carefully, can result in a loss of economic value or inefficient allocation of scarce resources. Based on recent case studies, we will explore how decision analytics helps guide manufacturing choices.

1 - Importance Measures and Value of Information
Alessandra Cillo, Assistant Professor, Bocconi University, Via Rongien 1, Milan, Italy, alessandra.cillo@unicubocconi.it, Emanuele Borghonovo

The importance measures are sensitivity indices. Despite their wide use, no work has systematically addressed the relationships among them. We provide new probabilistic relationships that link each measure to the remaining ones. These new relationships also allow us to introduce new importance measures, value of information based. We compare an importance measure and the value of information-based measure, which depends upon the same measure: interesting differences emerge.

2 - Integral Sensitivity in Linear Programming
Richard Wendell, Professor, University of Pittsburgh, Katz Graduate School of Business, Pittsburgh, PA, 15238, United States of America, wendell@katz.pitt.edu, Emanuele Borghonovo, Greg Buzzard

Herein we provide a general framework merging two well known sensitivity analysis approaches, namely, the tolerance sensitivity and global sensitivity approaches. This unification leads to a series of novel results, ranging from analytical formulas for computing global sensitivity measures to conditions ensuring that uncertainty in the parameters is immaterial. Moreover, the results provide the basis for a numerical approach for assessing key problem drivers and determining tolerance regions.

3 - Robust Importance Measures
Emanuele Borghonovo, Professor, Bocconi University, Via Rongien 1, Milan, 20136, Italy, emanuele.borghonovo@unicubocconi.it

Importance measures are probabilistic indicators that deliver information about key risk drivers. They are defined for aleatory uncertainty. We show that, relying on their probabilistic meaning, one can obtain a natural extension of importance measures also when probabilities are not known.

1 - Modeling Airport Operations for Capacity Planning by Airport Planners and Individual Carriers
L. Douglas Smith, University of Missouri-St. Louis, St. Louis, MO, United States of America, ldsmit@umsl.edu, Jan Fabian Ehmke, Deng Pan, Liang (Leon) Xu, Ziyi Wang

We discuss a blend of statistical modelling, LP optimization and discrete-event simulation that was used in the construction, calibration, validation and application of a model for capacity planning at commercial airports. With results from simulated scenarios, we examine the effects of changing usage of runways, taxiways, ramps and gates under different traffic conditions. We also see how concentration of activity at hub airports can cause flight delays to cascade for individual carriers.

2 - Real-time Gate Assignment
Diego Klabjan, Northwestern University, Evanston, IL 60208, United States of America, d-klabjan@northwestern.edu

Due to unpredictable airlines have to frequently adjust gate assignments. We propose a network flow model that also considers crew and passenger connections. A thorough computational study is presented based on data from a big US airport.

3 - An Alternative Approach to Capacity Allocation at Congested Airports
Amedeo Odoni, Professor, MIT, Room 33-219, MIT, 77 Mass Ave, Cambridge, MA, 02139, United States of America, arodoni@mit.edu, Alexandre Jacquillat

Current slot allocation at congested airports worldwide is based on long-standing guidelines developed by IATA. An alternative approach, developed after extensive research, will be outlined: it is more responsive to airline preferences, integrates airport operating capabilities, minimizes interference with airline competitive scheduling and is based on achieving user-specified performance goals, instead of being solely driven by arbitrary and administratively-determined capacity constraints.

4 - Airline Passenger Origin-Destination Reaccommodation with Spare Aircraft
Peng Wei, Assistant Professor, Iowa State University, Aerospace Engineering Department, 2312 Howe Hall, Ames, IA, 50011, United States of America, pwei@iastate.edu

The researchers at Amadeus have presented a method to formulate airline passenger origin-destination reaccommodation into a multi-commodity flow problem, for which they also designed the solution algorithm. In this paper we consider the Airline Passenger Origin-destination Reaccommodation with Spare Aircraft, which no one has tackled before.

1 - Public Sector Initiatives Sustainable Urban Freight Systems Part I
Johanna Amaya, Rensselaer Polytechnic Institute, 110 8th St. JEC 4037, Troy, NY, 12180, United States of America, amayaj@rpi.edu

Transportation policy should ensure freight is moved efficiently as it is a physical manifestation of the economy. In this study, planners are provided with guidelines to implement initiatives addressing freight issues. Initiatives were organized as part of a continuum from supply to demand side; underpinned by stakeholder engagement. This paper discusses pricing, incentives, taxation, logistical management; and freight demand/land use, along with a methodology to identify potential initiatives.
2 - Quantifying the Impacts of City Logistics Strategies in the Mexico City Metropolitan Area
Miguel Jaller, Assistant Professor, University of California, Davis, One Shields Ave, Ghausi Hall, 3143, Davis, CA, 95616, United States of America, mjaller@ucdavis.edu, Sergio Sanchez, Joanne Green
This paper discusses the assessment of the potential impacts of city logistics strategies proposed for the Metropolitan Area of the Mexico City Valley: off-hour delivery programs; cargo consolidation to decrease empty trips; and preferential truck routes. The analyses consider the impacts on travel distances, travel times, accidents, emissions and health impacts under various scenarios. The paper discusses the proposed strategies, the methodology, information and the assumptions adopted.

3 - Factors Influencing the Performance of Urban Consolidation Schemes
Sonke Behrends, Chalmers University of Technology, Technology Management and Economics, Logistics and Transportation, Gothenburg, Sweden, sonke.behrends@chalmers.se
Many urban consolidation centers (UCC) have struggled to operate on a commercial basis and are either terminated or depend on government subsidies. Hence there is a general scepticism about their commercial viability among practitioners. This paper contributes to a better understanding under which preconditions UCCs can be feasible. This paper quantifies a UCCs impact on the key stakeholders in urban logistics and analyses the relevance of several factors for the UCC performance.

4 - Land Use Patterns, Logistics, and Emissions
Erica Wygonik, RSG, 55 Railroad Row #101, White River Junction, VT, 05001, United States of America, ewygonik@gmail.com, Nathan Mayes, Anne Goodchild
This work compares and contrasts two approaches to quantifying the relationships between landuse, logistics, and emissions. These two approaches are used to consider a variety of delivery strategies, including personal travel to stores and delivery services on cost, CO2 emissions; as well as criteria pollutants. Conclusions can be drawn as to the most efficient distribution strategies under different urban forms.

5 - Economic and Environmental Comparison of Different Order Scheduling Policies
Dincer Konur, Assistant Professor, Missouri University of Science and Technology, 206 EM 600 W, 41th St., Rolla, MO, 65409, United States of America, konur@msst.edu, James Campbell
This study analyzes a continuous review inventory model with multiple carriers under carbon trading regulation. We analyze and compare the optimal carrier selection and order splitting decisions with single sourcing and two alternative delivery schedules for multi-sourcing, namely, sequential ordering and sequential delivery. For each of the three order scheduling policies, a solution method is proposed and these policies are compared in terms of both economic and environmental performance.

Electric Vehicles II
Sponsor: Transportation, Science and Logistics
Sponsored Session
Chair: M. Hadi Amini, PhD Fellow, Carnegie Mellon University, 5700 Centre Ave, Apt 317, Pittsburgh, PA, 15206, United States of America, amini@cmu.edu

1 - Routing Aspects of Electric Vehicle Users and Their Effects on Network Performance
Shubham Agrawal, Purdue University, West Lafayette, IN 47906, United States of America, shubham@purdue.edu, Amit Kumar, Srinivas Peeta, Hong Zheng
This study investigates the dynamic equilibrium for mixed traffic involving Battery Electric Vehicles (BEVs) and Internal Combustion Engine Vehicles (ICEVs). The BEVs’ routing behavior with preference to minimize battery consumption and reduce range anxiety is modeled and analyzed. Due to the energy efficiency considerations in route selection for BEVs, the network performance in terms of total travel time is analyzed under different market penetrations of BEVs.

2 - A Continuum Approximation Model for Electric Vehicle Sharing
Xiaopeng Li, University of South Florida, Department of Civil and Environmental Engineering, 4202 E. Fowler Avenue, Tampa, FL, 33620, United States of America, xiaopengli@usf.edu, Jiaqi Ma, Jianxun Cui, Fang Zhou, Amir Ghiasi
This paper proposes a Continuum Approximation (CA) model for design of a one-way Electrical Vehicle (EV) sharing system that serves a metropolitan area. This model determines the optimal EV sharing station locations and the corresponding EV fleet sizes to minimize the comprehensive system cost (including station construction investment, vehicle maintenance, transportation, and vehicle balancing) under stochastic and dynamic trip demands.

3 - Modeling Network Equilibrium with Mixed Flows of Electric and Gasoline Vehicles
Xiaozheng He, Research Associate, Purdue University, NextTrans Center, 3000 Kent Avenue, West Lafayette, IN, 47906, United States of America, seanhe@purdue.edu, Srinivas Peeta, Hong Zheng
This study develops a variational inequality formulation for the network equilibrium of mixed traffic flows consisting of electric and gasoline vehicles, where energy consumption is modeled as a function of traffic flow and considered in the drivers perceived travel cost. Numerical examples illustrate the impact of energy prices on network equilibrium and provide insights for policy-making to promote the usage of electric vehicles.

4 - On the Effect of Electric Vehicle Parking Lots’ as Dispatchable Loads on the Power System Loss
M. Hadi Amini, PhD Fellow, Carnegie Mellon University, 5700 Centre Ave, Apt. 317, Pittsburgh, PA, 15206, United States of America, amini@cmu.edu, Marija D. Ilic, Orkun Karabasoglu
We investigate the effect of parking lots characteristics (charging rate, capacity in terms of number of EVs, and location of the power network) on the network’s hourly loss and daily energy loss. Parking lots are modeled as EV demand aggregators. To this end, we define four scenarios to determine the effect of charging rate and distribution of EVs over the network on the system loss. We also evaluate the effect of EV parking lot’s location on the system loss.

MA69
69-Room 201C, CC
Facility Logistics III
Sponsor: TSL/Facility Logistics
Sponsored Session
Chair: Pratik Parikh, Associate Professor, Wright State University, 207 Russ, 3640 Col Glenn Hwy, Dayton, OH, 45435, United States of America, pratik.parikh@wright.edu

1 - Multiple-shelf Space Optimization in Automated Dispensing Cabinets
Nazarin Esmaili, PhD Candidate, University of Pittsburgh, 1048 Benedum Hall, Pittsburgh, PA, United States of America, nae22@pitt.edu, Bryan Norman, Jayant Rajgopal
We propose a novel MIP approach for stocking Automated Dispensing Cabinets (ADCs) in a hospital so as to maximize savings in expected staff effort required to retrieve out-of-stock items from central storage. We investigate both position-free and grid-based position paradigms to allocate shelf space optimally under constraints designed to reduce selection errors. We also develop model enhancements to facilitate solving large real-world instances, and investigate the robustness of the results.

2 - Consideration of Product Exposure in Retail Design
Corinne Mowrey, Wright State University, 3640 Colonel Glenn Hwy., Dayton, OH, 45435, United States of America, mowrey@wright.edu, Pratik Parikh, Kevin R. Gue
We discuss an approach to quantify exposure, what the customer sees, an important aspect of retail design. We consider that some locations are exposed to shoppers more frequently than others, referred to as the intensity of exposure, and explore how intensity changes with rack orientation. Accounting for bidirectional traffic flow, we explore the effect rack orientation has on exposure and investigate how optimal rack orientation for a pathway changes when the amount of directional flow varies.

3 - Covering and Connectivity Constraints in Designing a Loop Flow Pattern
Ardavan Asel Vaziri, Professor, California State University, Northridge, 18111 Nordhoff Street, Northridge, CA, 91330-8245, United States of America, ardavan.asel-vaziri@csub.edu, Gilbert Laporte
The shortest loop covering the workstations in a facility layout is an instance of the generalized traveling salesman problem. The optimal solution to this problem is a promising design for most types of conveyors and power-and-free systems where the length of the loop is the main driver of the total costs. This design further provides a promising solution to minimize the total loaded and empty flow in systems such as automatic guided vehicles. Our formulation is in the favor of this requirement.

MA68
68-Room 201B, CC
4 - A Network Design Model for Dual-channel Commerce with Uncertain Demand
Guojing Zhang, Professor, University of Windsor, 401 Sunset, Windsor, ON, Canada, gzhang@uwindsor.ca
We study the supply network problem with dual-channel, where a manufacturer or a retailer sells their products from both direct channel and traditional retail channel. An optimization model is established to examine central and local distribution/fulfilling center strategies, and determine inventory levels at each location and market allocation with taking into account uncertain demands from both channels.

■ MA70
70-Room 202A, CC
Rail Safety and Risk Analysis
Sponsor: Railway Applications
Sponsored Session
Chair: Xiang Liu, Assistant Professor, Rutgers University, CoRE 606, 96 Frelinghuysen Road, Piscataway, NJ, 08854-8018, United States of America, xiang.liu@rutgers.edu
1 - Using Text Mining and Data Visualization to Analyze Railroad Grade Crossing Accidents
Trefor Williams, Professor of Civil Engineering, Rutgers University, 96 Frelinghuysen Rd, Piscataway, NJ, 08540, United States of America, tpw@rci.rutgers.edu, John Betak
This paper will discuss how probabilistic topic modeling, clustering, text visualization and data visualization have been used to study the nature of accidents that occur at grade crossing. The data analyzed were from the Federal Railroad Administration grade crossing accident database. The paper will illustrate how trucks, particularly tractor-trailer trucks have been identified as a major cause of highway-railroad accidents from analysis of the text fields of grade crossing accident reports.

2 - Comparative Train Accident Analysis for Class I U.S. Freight Railroads
Zhao Wang, Graduate Research Assistant, University of Illinois at Urbana-Champaign, 205 N. Mathews Ave., B-118 Newmark Engineering Laboratory, MC, Urbana, IL, 61801, United States of America, zwang144@illinois.edu, Christopher Barkan, Mohd Rapik Saat
This paper studies the U.S. Class I freight train accident rates between 2004 and 2013. By utilizing train accident data and statistical theories, the investigation compares and contrasts train accident rates, trends, accident cause distributions, and accident severity between two time periods. The decreasing trend in accident rate and the changing trend in accident cause distributions are analyzed.

3 - Fault Tree Analysis of Train Accidents on Shared-use Rail Corridor
Chen-Yu Lin, Graduate Research Assistant, University of Illinois at Urbana-Champaign, 205 N. Mathews Ave., Urbana, IL, 61801, United States of America, clin69@illinois.edu, Mohd Rapik Saat, Christopher Barkan
Safety issues regarding shared-use rail corridors are emerging due to the introduction of faster and more frequent passenger trains. In this research, a general risk framework is presented for shared-use rail corridors. A standard risk management procedure is implemented to identify potential hazards and evaluate the risk associated with them. Fault tree analysis is performed to hazards with higher level of risk. An example fault tree for a specific hazard, adjacent track accident, is presented.

4 - Risk-based Rail Inspection and Repair
Xiang Liu, Assistant Professor, Rutgers University, CoRE 606, 96 Frelinghuysen Road, Piscataway, NJ, 08854-8018, United States of America, xiang.liu@rutgers.edu
Broken rails are the leading causes of freight-train derailments in the United States. Each year, the railroad industry spends millions of dollars on rail inspection and repair. This research develops a simulation-based risk analysis model to optimize ultrasonic rail inspection and repair strategies.

■ MA71
71-Room 202B, CC
Alternative Fuel Vehicles and Sustainable Transportation II
Sponsor: TSL/Urban Transportation
Sponsored Session
Chair: Jee Eun Kang, Assistant Professor, University at Buffalo, 409 Bell Hall, Buffalo, NY, United States of America, jeeunka@buffalo.edu
1 - Locating Battery Exchange Facilities on Lines and Trees
Pitu Mirchandani, Arizona State University, Tucson, AZ, United States of America, pitu@asu.edu, Yazhu Song
We introduce a new location problem for battery exchange facilities (BEF) for Electric Vehicles. First we study the problem of location feasibility on lines. Given feasibility, the location problem becomes “where should BEFs be located to minimize a charge-related objective”. e.g., the objective of minimizing the maximum distance between BEFs minimizes the anxiety of the drivers. Scenarios include single OD pair, multiple OD pairs, round trips, etc. Extensions to tree networks is discussed.

2 - Design for EV Market Systems
Namwoo Kang, Research Fellow, University of Michigan, 2350 Hayward Street, Ann Arbor, MI, 48109, United States of America, nwkang@umich.edu, Papas Papalambros, Fred Feinberg
Electric Vehicle (EV) market systems are generally run by three key players: EV manufacturers, charging station operators, and government. This study presents a decision-making framework for the players to maximize profits and greenhouse gas reductions by quantitative modeling and linking of consumer demand prediction (marketing), charging station sitting (operations), EV powertrain design (engineering), and investment allocations (public policy). Several scenarios and case studies are examined.

3 - Optimal Deployment of Charging Lanes in Transportation Networks
Zhibin Chen, University of Florida, 365 Weil Hall, Gainesville, United States of America, yafeng@ce.ufl.edu, Fang He, Yafeng Yin
This paper attempts to develop a mathematical model to optimally deploy in a large-scale highway network charging lanes that charge electric vehicles while they are on the move. We first describe network flow equilibrium conditions under a particular deployment plan of charging lanes, and then formulate the design of charging lanes as a mathematical program with equilibrium constraints.

4 - Modeling Intra-household Interactions for the Use of Battery Electric Vehicles
Yashar Khayati, Graduate Research Assistant, State University of New York at Buffalo, 327 Bell Hall, Buffalo, NY, 14226, United States of America, yasharkh@buffalo.edu, Jee Eun Kang
This study assesses the potential use of Battery Electric Vehicles in place of conventional Internal Combustion Engine Vehicles at household level. A sequential activity allocation and insertion heuristic is developed to implement on HAPPIEV. The results show that if BEVs would be used at household level the travel disutility of households can be decreased about $42 per day in average. In comparison, if a BEV is used to do exact same activity pattern the average saving for the day is only $7.

■ MA72
72-Room 203A, CC
2015 QSR Best Student Paper Competition
Sponsor: Quality, Statistics and Reliability
Sponsored Session
Chair: Eunshin Byon, Assistant Professor, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, ebyon@umich.edu
1 - 2015 QSR Best Student Paper Award
Eunshin Byon, Assistant Professor, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, ebyon@umich.edu
Best Student Paper Award recognizes excellence among QSR student members. Four finalists for the Best Student Paper Award will make presentations. The winner will be announced at the QSR business meeting during the conference.
2 - Real-Time Monitoring for Additive Manufacturing using Online Sparse Estimation Based Classification
Kaveh Bastani, Research Assistant, Virginia Tech University, 106 Durham Hall (MC 0118) 1145 Perry St, Blacksburg, VA, United States of America, kaveh.vt.edu, Zhenyu Kong

The objective of this work is to realize real-time monitoring of additive manufacturing processes using multiple sensor signals. To achieve this objective, an approach invoking the concept of sparse estimation called online sparse estimation-based classification (OSEC) is proposed. The OSEC approach is equipped with a novel computationally fast sparse estimation algorithm to facilitate real-time monitoring applications.

3 - Diagnostic Monitoring of Multivariate Process via a LASSO-BN Formulation
Yan Jin, University of Washington, 530 NE 103rd St, Seattle, WA, 98125, United States of America, yanjinuwu.edu, Guang Wang, Shuai Huang, Houtao Deng

Fault detection and root-cause diagnosis are usually considered as two separate tasks in most existing process monitoring methods. While they could reinforce each other, we propose a diagnostic monitoring approach that unifies monitoring and root-cause diagnosis by integrating process monitoring, Bayesian network, and sparse learning.

4 - Multi-stage Nanocrystal Growth Identifying and Modeling via In-situ TEM Video
Yanjun Qian, PhD Candidate, TAMU, 1501 Harvey Rd, Apt 806, College Station, TX, 77840, United States of America, qianyanjun09@gmail.com

While in-situ transmission electron microscopy technique has caught a lot of recent attention, one of the bottlenecks appears to be the lack of automated and quantitative analytic tools. We introduce an automated tool suitable for analyzing the in-situ TEM videos. It learns and tracks the normalized particle size distribution and identifies the phase change points delineating the stages in nanocrystal growth. We furthermore produce a quantitative physical-based model.

5 - Rul Prediction Based on Noisy Condition Monitoring Signals using Constrained Kalman Filter
Junbo Son, PhD Candidate, University of Wisconsin-Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, jsong@wisc.edu, Shiyu Zhou, Chaitanya Sankavaram, Yilu Zhang, Xinya Du

In this paper, a robust statistical prognostic method is proposed to predict the remaining useful life of individual units based on condition monitoring signals that are contaminated by severe noises. The proposed method defines a set of inequality constraints so that satisfactory prediction accuracy can be achieved regardless of the noise level. The advantageous features of the proposed method is demonstrated by both numerical studies and a case study with real-world automotive battery data.

2 - Broaching Process Modeling Based on Non-repeating Cyclic Signals
Meituan Liu, Assistant Professor, UW-Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, klilu@wisc.edu

Broaching is often used to produce complex contours by sequentially removing material via multiple cutting teeth. The broaching force signal exhibits a non-repeating cyclic pattern. A new approach is proposed to model the non-repeating cyclic signals and thus detect changes in a broaching process.

3 - Heterogeneous Recurrence T^2 Charts for Monitoring and Control of Nonlinear Dynamic Processes
Yun Chen, University of South Florida, 4202 E. Fowler Ave. ENB118, Tampa, FL, United States of America, ychen@usf.edu, Hui Yang

This paper presents a new approach of heterogeneous recurrence T^2 control chart for online monitoring and anomaly detection in nonlinear dynamic processes. An effective partition scheme is firstly developed to delineate local recurrence regions in the multi-dimensional continuous state space. Further, we designed a new fractal representation of state transitions among recurrence regions, and then develop new measures for online monitoring and predictive control of process recurrences.

2 - Integrating OCB and GA to Find the Approximate Pareto Patient Flow Distribution
Jie Song, Peking University, Room 312, Fangzheng Building, Beijing, China, song@coe.pku.edu.cn, Zekun Liu, Yunjie Qiu

We develop a methodology to find the optimal macro-level patient flow distribution in terms of multi-dimension inputs and outputs for the hierarchical healthcare system. The proposed method integrates the discrete event simulation, the multi-objective optimization, and the simulation budget allocation to comprehensively improve the overall system performance. A case study based on the real data is carried out to validate and implement the proposed method.

3 - Improving Response-Time Performance in Acute Care Delivery: A Systems Approach
Xiaolei Xie, Department of Industrial Engineering, Tsinghua University, 614 Shunde Building, Tsinghua University, Beijing, China, xxie@tsinghua.edu.cn, Colleen Swartz, Paul Depriest, Jingshan Li

In response to a patient with acute physiological deterioration, we study the probability that an appropriate decision is made within a desired time period, referred to as response time performance (RTP). First, a closed formula to evaluate RTP is derived by assuming exponential response time, which is followed by bottleneck analysis. Then, under general case, an approximation approach is proposed to evaluate RTP. Finally, a case study is introduced to illustrate the applicability of the method.

4 - Spatiotemporal Differentiation of Myocardial Infarctions
Chen Kan, University of South Florida, 4202 E. Fowler Ave. ENB118, Tampa, FL, United States of America, chenk@ms.state.edu, Hui Yang

This paper presents a novel warping approach to quantify the dissimilarity of disease-altered patterns in 3-lead VCGs. The hypothesis testing shows that there are significant space-time differences between healthy and diseased subjects. Further, we optimize the embedding of each VCG as a feature vector in the high-dimensional space that preserves the dissimilarity distance matrix. Experimental results demonstrated that this novel approach improves the performance of predictive models.

Data Analytics for Quality Control and Improvement I
Sponsor: Quality, Statistics and Reliability
Sponsored Session
Chair: Kaibo Liu, Assistant Professor, UW-Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, klilu@wisc.edu

1 - A Distribution Free Procedure for Fault Identification in High-Dimensional Processes
Mehmet Turkoz, Rutgers University, 16 Rachel Terrace, Piscataway, NJ, 08854, United States of America, turkoz@scarletmail.rutgers.edu, Sangahn Kim, Young-seon Jeong, Myong K. (MK) Jeong, Elsayed Elsayed, K.N. Al-khalifa, Abdel Magid Hamouda

In a process with high-dimension, identifying which variables cause an out-of-control signal is a challenging issue for quality problems. Even though there are many procedures for fault identification, most of them assume the normal distribution. However, many real life problems come from multivariate non-normal distribution. We present a new fault identification method that does not assume any specific probability distribution.

2 - Broaching Process Modeling Based on Non-repeating Cyclic Signals
Meituan Liu, Graduate Student, Virginia Tech, 250 Durham Hall, Blacksburg, VA, 24060, United States of America, tian0414@vt.edu, Jaime Camello, Ran Jin, Lee Wells

Broaching is often used to produce complex contours by sequentially removing material via multiple cutting teeth. The broaching force signal exhibits a non-repeating cyclic pattern. A new approach is proposed to model the non-repeating cyclic signals and thus detect changes in a broaching process.

3 - Heterogeneous Recurrence T^2 Charts for Monitoring and Control of Nonlinear Dynamic Processes
Yun Chen, University of South Florida, 4202 E. Fowler Ave. ENB118, Tampa, FL, United States of America, yunchen@mail.usf.edu, Hui Yang

This paper presents a new approach of heterogeneous recurrence T^2 control chart for online monitoring and anomaly detection in nonlinear dynamic processes. An effective partition scheme is firstly developed to delineate local recurrence regions in the multi-dimensional continuous state space. Further, we designed a new fractal representation of state transitions among recurrence regions, and then develop new measures for on-line monitoring and predictive control of process recurrences.
4 - Optimize the Signal Quality of Health Index via Data Fusion for Degradation Modeling and Prognostics
Aldallah Chehade, UW-Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, chehade@wisc.edu, Changye Song, Kalbo Liu

In this talk, a new signal-to-noise ratio (SNR) metric that is tailored to the needs of degradation signals is proposed. By maximizing this new metric, we develop a data fusion model to construct a health index (HI) via fusion of multiple degradation-based sensor data. The case study was based on the degradation dataset of aircraft gas turbine engines, which will demonstrate the effectiveness of developed HI for better characterization and prediction of the health condition of units.

■ MA75
75-Room 204B, CC
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 - Technology Readiness Levels at 40: A Study of State-of-the-art Use, Challenges, and Opportunities
Alison Ochowski, MIT, School of Engineering, Cambridge, United States of America, alison@mit.edu, Steven Eppinger, Nitin Joglekar

Since their introduction by NASA in the 1970s, the Technology Readiness Levels (TRLs) have become a widely used scale for assessing technology maturity during new product and system development. We empirically investigate current TRL usage in a cross-industry study, identifying challenges related to TRL implementation and use in technology-related decision-making. Some challenges are already addressed by uncommon best practices however others are opportunities for new methods and models.

2 - Idea Generation and the Role of Feedback
Joel Wooten, University of South Carolina, Columbia, SC 29208, United States of America, joel.wooten@moore.sc.edu, Karl Ulrich

In many innovation settings, ideas are generated over time and managers face a decision about if and how to provide in-process feedback about the quality of submissions. We use invention tournament field experiments to examine the effect of feedback on idea generation and show individual-level differences between no feedback, random feedback, and directed feedback.

3 - Sole Inventor vs Team of Inventors: What’s Best?
Tian Chan, INSEAD, 1 Ayer Rajah Avenue, Singapore, 138676, Singapore, TianHeong.Chan@insead.edu, Jurgen Mihm, Manuel Sosa

History has often attributed sole individuals as the source of innovative breakthroughs. However, recent research has shown that teams of individuals are the ones that tend to produce breakthroughs. In this work we use patent data covering both function and form to systematically analyze the source of successful innovations. Our work moves towards reconciling the sole versus team conundrum by finding evidence of situations where the sole individual shine, and of situations where they do not.

■ MA76
76-Room 204C, CC
Simulation Optimization and Ranking and Selection
Sponsor: Simulation
Sponsored Session
Chair: Demet Batur, Assistant Professor, University of Nebraska-Lincoln, CBA 209, Lincoln, NE, 68588, United States of America, dbatur@unl.edu

1 - Probability of Correct Selection: More May Not Be Better!
Yijie Peng, Fudan University, School of Management, Shanghai, China, 10110690016@fudan.edu.cn, Michael Fu, Jianqiang Hu, Chun-hung Chen

We present a simple counterexample where the probability of correct selection decreases with additional sampling under certain allocation schemes. We then characterize the general setting where this phenomenon may occur, which highlights the importance of an appropriate allocation scheme. Simulation experiments illustrate our findings.

2 - Asymptotic Validity of the Bayes-inspired Indifference Zone Procedure
Saül Toscano- Palmerín, 113 Lake Street, Ithaca, NY, 14850, United States of America, st684@cornell.edu, Peter Frazier

This talk considers the indifference-zone (IZ) formulation of the ranking and selection problem. Conservatism leads classical IZ procedures to take too many samples in problems with many alternatives. The Bayes-inspired Indifference Zone (BIZ) procedure, proposed in Frazier (2014), is less conservative than previous procedures, but its proof of validity requires strong assumptions. In this talk, we present a new proof of asymptotic validity that relaxes these assumptions.

3 - Reconstructing Input Models via Simulation Optimization
Aleksandrina Goeva, Boston University, 111 Commington Mall, Boston, MA, 02215, United States of America, ageova@bu.edu, Henry Lam, Bo Zhang

We consider the inverse problem of calibrating the distribution of a stochastic input model from only output data, in contexts where the input-output relation is accessible via stochastic simulation. We take a nonparametric approach, and formulate this problem as a stochastic program by maximizing the entropy of the input distribution subject to moment or tail-probability matching between simulation and empirical output. We propose an iterative scheme to approximately solve the program.

4 - Quantile Based Comparison for System Selection
Demet Batur, Assistant Professor, University of Nebraska-Lincoln, CBA 209, Lincoln, NE, 68588, United States of America, dbatur@unl.edu, Fred Choobineh

We present a fully-sequential selection procedure for comparing simulated systems based on a quantile of interest. The quantile of interest corresponds to a specific quantile of the simulated probability distribution of a comparison metric. The procedure is designed to asymptotically guarantee the selection of the best system or the best set of equivalent systems with a pre-specified probability of correct selection.

■ MA77
77-Room 300, CC
Supply Chain Management V
Contributed Session
Chair: Pritha Dutta, Doctoral Student, University of Massachusetts, Amherst, Isenberg School of Management, Amherst, MA, 01003, United States of America, pdutta@umass.edu

1 - The Value of Conversion for a Refinery Firm with Both Forward and Spot Procurement
Mengmiao Chen, Fudan University, Lidasan Building, School of Management, 670 Guishun Rd, Yangpu District, Shanghai, China, 12110690007@fudan.edu.cn

Our work analyzes the optimal procurement strategy, processing, and production decision of a refinery firm with both forward and spot procurement (hereafter “dual sourcing”). Also the firm is capable of converting which improves the quality. A four-stage stochastic model is applied to investigate the value of dual sourcing and conversion. We find that both dual sourcing and conversion adds value to the refinery by improving the quality, unit profit, and enlarging the feasible producing region.

2 - Do Responsible Buyers Source from Responsible Suppliers?
Hsiao-Hui Lee, Assistant Professor, University of Hong Kong, KKL 814 School of Business, Hong Kong - ROC, hlee@hku.hk

I examine the role of corporate social responsibility (CSR) in supply-chain formation. I first introduce the CSR similarity between buyers and suppliers as a selection criterion and examine why good (bad) buyers source from good (bad) suppliers. However, concerns over sourcing cost moderates the CSR similarity effect for good buyers, explaining why good buyers buy from bad suppliers. Supplier transparency (CSR signals) serves as a moderator to explain why bad buyers buy from good suppliers.

3 - The Effect of Commitment Completeness on Opportunism
Alex Scott, Penn State University, 463A Business Building, University Park, PA, 16802, United States of America, alexscott@psu.edu

Buyers often solicit non-contractual commitments from suppliers to provide services as the need arises. The level of detail of these commitments vary because, for instance, more detailed commitments are more costly consuming to develop than less detailed commitments. In this study, we examine how commitment completeness interacts with active and passive opportunism. We explore this question using a transactional dataset in the for-hire trucking sector.
Markovian purchasing costs can reflect a market situation in a global supply chain and tend to influence the dynamics in a supply chain design and planning obtained in a practical project for a multi-stage production-distribution network. Finally, we identify gaps in current research and delineate future research avenues.

Product recalls are ubiquitous in a variety of industries. We focus on product categories where an individual firm's product recall may have negative consequences for the entire category. In such contexts, competitors in the category would have to respond to the recall through their sales effort. We provide a prescriptive road map for firms facing this decision based on several factors such as the anticipated category level loss and economies of scope in sales resource use across categories.

A Parametric Study of Risk-Averse Inventory Models
Sungyong Choi, Assistant Professor, Yonsei University, 1 Yonsei-daegil, Wonju, Korea, Republic of, sungyongchoi@gmail.com

I study a few dynamic risk-averse inventory models using additive utility functions. I add Markovian behavior of purchasing costs in my models. Such Markovian purchasing costs can reflect a market situation in a global supply chain such as random fluctuations at exchange rates or the existence of product spot markets. I provide my parametric analytical results with finite and infinite MDP (Markovian Decision Process) problems.

4 - Product Recalls, Category Effects and Competitor Response
Ram Bala, Santa Clara University, 500 El Camino Real, Santa Clara, CA, 95050, United States of America, rbalacscu.edu, Pradeep Bhardwaj, Pradeep Chintagunta

Product recalls are ubiquitous in a variety of industries. We focus on product categories where an individual firm's product recall may have negative consequences for the entire category. In such contexts, competitors in the category would have to respond to the recall through their sales effort. We provide a prescriptive road map for firms facing this decision based on several factors such as the anticipated category level loss and economies of scope in sales resource use across categories.

5 - A Parametric Study of Risk-Averse Inventory Models
Sungyong Choi, Assistant Professor, Yonsei University, 1 Yonsei-daegil, Wonju, Korea, Republic of, sungyongchoi@gmail.com

I study a few dynamic risk-averse inventory models using additive utility functions. I add Markovian behavior of purchasing costs in my models. Such Markovian purchasing costs can reflect a market situation in a global supply chain such as random fluctuations at exchange rates or the existence of product spot markets. I provide my parametric analytical results with finite and infinite MDP (Markovian Decision Process) problems.
4 - Command and Control Metrics in Studies of Unit Structure and Effectiveness
Doug Samuelson, InfoLogix, Inc., 8711 Chippendale Court, Annandale, VA, 22003, United States of America, samuelson@infoLogix.com

The recent Marine Corps Development Command study, "Composition of the Infantry Battalion," raised a number of issues, especially: better metrics to assess likely leader effectiveness; leadership structures, communication methods and protocols; decision-making about logistics and intelligence; and the extent to which joint training improves coordinated effect. We summarize findings to date and sources cited and suggest future assessments of unit structure and resulting effectiveness.

■ MB02
02-Room 302, Marriott
MAS Tutorial: A Brief Introduction To Predictive Analytics
Sponsor: Military Applications
Sponsored Session
Chair: Greg Parlier, Past President, MAS of INFORMS, 255 Avian Lane, Madison, AL, 35758, United States of America, gparlier@kinology.net

1 - A Brief Introduction to Predictive Analytics
Thomas Willemain, Smart Software, Inc., Niskayuna, NY, United States of America, twillemain@smartsoftware.com

This tutorial will introduce a few key methodologies in the field of predictive analytics: extrapolative time series forecasting, linear and logistic regression, and tree models including random forests. The emphasis will be on matching methods to problems, understanding the inputs required by and outputs supplied by the methods, and perspectives on the strengths and weaknesses of the methods.

■ MB03
03-Room 303, Marriott
Supply Chain Scheduling
Cluster: Scheduling and Project Management
Invited Session
Chair: Zhi-Long Chen, Professor, University of Maryland, Robert H. Smith School of Business, College Park, MD, 20742, United States of America, zchen@rhsmith.umd.edu

1 - Integrated Production and Delivery with Multiple Factories and Customers
Joseph Leung, New Jersey Institute of Technology, 4202 GTRC, Department of Computer Science, Newark, United States of America, joseph.y.leung@njit.edu, Xia Zhang, Bai-Yi Cheng, Kai Li

We consider a scheduling problem where machines are geographically distributed and hence the production costs are different. The delivery costs are also different, depending on where the products are produced. Given a threshold U of the total cost, we want to minimize the makespan or total completion time, subject to the constraint that the total cost is not more than U. Heuristics are proposed and their performances are evaluated through computational studies.

2 - Personnel Scheduling and Supplies Provisioning in Emergency Relief Operations
Lian Qi, Rutgers Business School, Department of Supply Chain Management 5R, Rutgers, United States of America, lqian@business.rutgers.edu, Lei Lei, Michael Pinedo, Shengbin Wang, Jian Yang

The practice of emergency operations often involves travelling of medical teams and distribution of medical supplies. The coordination of the scheduling of the medical teams and supplies is critical. We introduce a math programming based rolling horizon heuristic that is able to quickly find near optimal solutions. A polynomial time solvable case, which leads to the design of the proposed heuristic, is discussed. Managerial insights drawn from numerical studies are provided.

■ MB04
04-Room 304, Marriott
Panel: Topics for PhD students
Sponsor: Minority Issues Forum
Sponsored Session
Chair: Maria Mayorga, Associate Professor, University of North Carolina, Dept. of Industrial & Systems Engineering, Campus Box 7906, Raleigh, NC, 27695-7906, United States of America, memayorg@ncsu.edu

1 - Topics of Interest for PhD Students
Moderator: Maria Mayorga, Associate Professor, University of North Carolina, Dept. of Industrial & Systems Engineering, Campus Box 7906, Raleigh, NC, 27695-7906, United States of America, memayorg@ncsu.edu

This session will serve as a panel discussion on topics of interest for PhD students nearing graduation. Topics include: - deciding on industry versus academia - how to prioritize objectives towards their end of the PhD Process - work/life balance when pursuing tenure - networking to achieve a desired faculty position - how to position yourself when pursuing the market - networking at conferences such as INFORMS

■ MB05
05-Room 305, Marriott
Tutorial: Analyzing Social Media with LIWC
Cluster: Social Media Analytics
Invited Session
Chair: Sara Beth Elson, Behavioral Scientist, MITRE Corporation, 7515 Colshire Drive, McLean, VA, United States of America, Selson@mitre.org

1 - Tutorial: Analyzing Social Media with LIWC
Sara Beth Elson, Behavioral Scientist, MITRE Corporation, 7515 Colshire Drive, McLean, VA, United States of America, Selson@mitre.org

This tutorial will introduce the Linguistic Inquiry and Word Count (LIWC) software – a tool that can enable users to track emotion levels expressed in social media across time. Attendees will walk through an example of how to analyze social media using LIWC and how to view the emotion levels expressed.
Industrial Symbiosis is a resource-sharing strategy that encourages traditionally separate industries to exchange water, energy, and by-products. Inspired by the paper-sugar industrial complex, we model and analyze symbiotic systems and establish that competition from firms that produce only regular (both regular and green) products encourages (discourages) implementation of industrial symbiosis.

2 - Is Buying Grocery Online Good for the Environment?
Ekaterina Astashkina, INSEAD, Boulevard de Constance, Fontainbleau, 77305, France, ekaterina.astashkina@insead.edu
Elena Belavina, Karan Girotta
Buying groceries online is catching on. We compare the carbon footprint of offline and online grocery retail. The different economies in the two lead to distinct supply chain structures, inventory management policies and customer ordering behavior, and, consequently, differences in transportation and food waste related emissions.

3 - Adoption of Residential Solar Energy Systems under Third-party Ownership and Direct Ownership
Ernesto Guerra, University of California Berkeley, Berkeley, CA, United States of America, ernestoguerra@berkeley.edu
Jose Guajardo
We formulate an empirical model to characterize the adoption of solar energy systems under third-party ownership and direct ownership in the U.S. residential market. The analysis is developed in the context of government incentives and supply-side determinants.

4 - The Potential of Servicing as a Green Business Model
Vishal Agrawal, Assistant Professor, Georgetown University, Washington, DC, United States of America, va64@georgetown.edu, Ioannis Bellos
In recent years, manufacturers in various industries have begun to orient their practices towards selling the use of the product as opposed to selling the product itself. We investigate the economic and environmental implications of the manufacturer's design and pricing decisions under different forms of servicing business models.
4 - Shifting LOCI of Innovation: A Study of Knowledge Boundaries, Identity and Innovation at NASA
Hila Lifshitz-assaf, NYU, 100 Bleecker street, 13B, New York, NY, 10012, United States of America, h@nyu.edu
This dissertation explores how the ability to innovate is being transformed by the Web and the information age, as well as the challenges and opportunities it entails. It is based on an in-depth, longitudinal field study at NASA, exploring their work with online open innovation platforms and communities. I investigate the impact of using open innovation on the process of knowledge and innovation production on R&D professionals, and its boundary conditions for successful problem solving.

Economics of Digital Goods and Services
Sponsor: E-Business
Sponsored Session
Chair: Mingdi Xin, Assistant Professor, University of California, Irvine, Paul Merage School of Business, SBI-3423, Irvine, CA, 92697, United States of America, mingdi.xin@uci.edu
1 - Modeling the Dynamics of Network Technology Adoption and the Role of Converters
Soumya Sen, University of Minnesota, Minneapolis, MN, United States of America, ssen@umn.edu, Youngmi Jin, Kartik Hosanagar, Roch Guerin
We study the role of converters in the adoption of competing network technologies by heterogeneous users. Converters can play an ambiguous role in the adoption process: they allow entrants to overcome the effect of incumbent’s user base but also introduce performance degradation and functionality limitations. Our analysis reveals a number of interesting and unexpected outcomes in this competition between network technologies.
2 - The Diffusion and Business Value of User Generated Content on Social Media: Evidence from Twitter
Lanfiei Shi, University of Maryland Smith School of Business, Van Munching Hall, College Park, MD, 20742, United States of America, lanfiei@rhsmith.umd.edu, Siva Viswanathan, Tianshu Sun
Social media platforms and user generated content (UGC) have become valuable marketing aids to firms; however, there is little systematic understanding of whether, and how, the diffusion of UGC through these platforms creates value for firms. Collaborating with one of the leading IT firms in the US, we examine the conditions under which the diffusion of UGC on Twitter adds value, with a specific focus on the role of content and user characteristics in creating value.
3 - Piracy and Information-goods Supply Chain
Antino Kim, PhD Candidate, Foster School of Business, University of Washington, Seattle, WA, 98195-3200, United States of America, antino@uw.edu, Atanu Lahiri, Debabrata Dey
In the presence of a retailer between the manufacturer and consumers of information goods, the legal channel faces two menaces; the internal issue of channel coordination and the external issue of piracy. We develop an economic model to study the interaction of the two.
4 - Issues in Supporting Older Versions of Software: A Game-theoretic Model
Atanu Lahiri, University of Texas at Dallas, Jindal School of Management, Richardson, TX, 75080-3021, United States of America, atanu.lahiri@utdallas.edu, Debabrata Dey, Abhijeet Ghoshal
A software manufacturer needs to stop supporting older versions of its product to encourage consumers to upgrade to the newest version. Consumers, however, can respond by holding out, to compel the manufacturer to do exactly the opposite, as it cannot really afford leaving too many nodes vulnerable in the user network. What should the manufacturer do then, and what are the welfare implications?
2 - A Novel Strategy for General Polynomial Partitions in
Multiparametric Programming
Stratos Pistikopoulos, Texas A&M University, Artie McFerrin Dept. of Chem. Eng., College Station, TX, 77843, United States of America, strat6@tamu.edu, Richard Oberdieck
Currently, the solution to multiparametric mixed-integer programming problems is presented as a polyhedral partitioning of the considered parameter space, because no strategy exists to explicitly handle any nonconvex partitions. In this work, we demonstrate a novel approach which allows for the handling of general, polynomial partitions in multiparametric programming using a combination of suitable linearizations and global optimization strategies.

3 - Polyhedral Cut Generation for Global Optimization of Problems
with Edge-concave Intermediates
Yash Puranik, Carnegie Mellon University, Pittsburgh, PA, ypp@andrew.cmu.edu, Nikolaos Sahinidis
We describe a branch-and-cut implementation for obtaining facet defining cuts that utilizes a highly efficient solution strategy for linear separation problems. These cuts are valid for edge-concave functional forms which admit polyhedral convex envelopes. Computational performance results of this implementation are presented on standard test libraries.

4 - Recent Developments in BARON for Global Optimization
of NIPS and MINLPS
Mustafa Kilinc, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, United States of America, mkilinc@andrew.cmu.edu, Nikolaos Sahinidis
We report recent developments in the integer arsenal of branch-and-reduce and their implementation in the global optimization software BARON. Extensive computational results will be presented on problems from a collection of test sets.

MB13
13-Franklin 3, Marriott
Distributed Stochastic Optimization for Large-Scale Machine Learning
Sponsor: Optimization/Optimization Under Uncertainty
Sponsored Session
Chair: Qihang Lin, The University of Iowa, 21 East Market Street, Iowa City, IA, 52245, United States of America, qihang-lin@uiowa.edu
1 - Adding vs. Averaging in Distributed Primal-dual Optimization
Chenxin Ma, PhD Student, Lehigh University, 200 West Packer Avenue, Bethlehem, PA, 18015, United States of America, machenin622@gmail.com, Peter Richtárik, Virginia Smith, Martin Jaggi, Michael Jordan, Martin Takac
Reducing communication makes the efficient aggregation of partial work from different machines more challenging. We present a novel generalization of the recent communication efficient primal-dual coordinate ascent framework (CoCoA). Our framework, CoCoA+, allows for additive combination of local updates to the global parameters at each iteration, whereas previous schemes only allowed conservative averaging.

2 - DISCOVR: A Randomized Asynchronous Algorithm for Distributed Learning with Parameter Server
Adams Wei Yu, PhD Student, Carnegie Mellon University, Pittsburgh, PA, United States of America, adamsyuwei@gmail.com, Qihang Lin, Xin Xiao, Weizhu Chen
Machine learning with big data often involves big models, where the number of variables in a model can be too large for frequent communication and synchronization. In this case, we can set up a parameter server to maintain the overall model and coordinate updates of subsets of the parameters at different machines. We propose an algorithm DISCOVR, which exploits the double partitions in both data and model to gain parallelism, and applies periodic variance reduction to achieve linear convergence.

3 - Massively Distributed Optimization: Beyond the Traditional Setting
Jakub Konecny, University of Edinburgh, James Clerk Maxwell Building, 5406, Peter Guthrie Tait, Road, Edinburgh, EH9 3DF, United Kingdom, j.konecny@sms.ed.ac.uk, Brendan McMahan
The purpose of this work is to present a new, increasingly important setting for distributed optimization in machine learning. Main assumption is that we have a very large number of computers available, each of which has access to relatively small number of training examples. This is arising if the data are not stored on datacenters owned by companies, but instead kept at users’ devices, a arising trend driven primarily by privacy concerns. We demonstrate that encouraging results are achievable.

MB14
14-Franklin 4, Marriott
Statistical Optimization
Sponsor: Optimization/Optimization Under Uncertainty
Sponsored Session
Chair: Mengdi Wang, Assistant Professor, Princeton University, 302 Trinity Ct #2, Princeton, NJ, 08540, United States of America, mengdili@princeton.edu
1 - Minimax-optimal Private-preserving Sparse PCA in Distributed Systems
Jian Ge, Princeton University, Operations Research and Financial Engine, Sherrerd Hall, Charleston Street, Princeton, NJ, 08544, United States of America, jiaoge@exchange.princeton.EDU
We propose a distributed private-preserving sparse PCA (DPS-PCA) algorithm that generates a minimax-optimal sparse PCA estimator in polynomial time under differential privacy constraints. Data providers can use this algorithm to collaboratively analyze the union of their data sets in a distributed system while limiting the disclosure of their private information.

2 - Upper Bounds for the Correlated Bayesian Information Filtering Problem
Bangrui Chen, Cornell University, 55 Lois Ln, Ithaca, NY, 14850, United States of America, bc496@cornell.edu, Peter Frazier
We present a Bayesian sequential decision-making formulation of the information filtering problem, in which an algorithm presents items (blog posts, scientific papers, emails) arriving in a stream, learning relevance from user feedback on presented items. Our formulation uses a linear model, and is similar to a Bayesian linear bandit. We compute an upper bound on the value of the optimal policy, which allows computing an optimality gap for heuristic policies, and motivates an index policy.

3 - Statistical Limits of Convex Relaxations
Zhaoran Wang, Graduate Student, Princeton University, Sherrerd Hall, Charleston Street, Princeton, NJ, United States of America, zhaoran@exchange.princeton.EDU, Quanquan Gu, Han Liu
In this paper, we study the statistical limits of convex relaxations. Particularly, we consider two problems: Mean estimation for sparse principal submatrix and edge probability estimation for stochastic block model. We exploit the sum-of-squares relaxation hierarchy to sharply characterize the limits of a broad class of convex relaxations. Our result shows statistical optimality needs to be compromised for achieving computational tractability using convex relaxations.

4 - Post-regularization Confidence Bands for High Dimensional Nonparametric Models with Local Sparsity
Junwei Lu, Princeton University, Sherrerd Hall, Charleston St., Princeton, NJ, 08540, United States of America, junwei@princeton.edu, Mladen Kolar, Han Liu
We propose a novel high dimensional nonparametric model named ATLAS which is a generalization of the sparse additive model. We aim to estimate high dimensional function using a novel kernel-sieve hybrid regression estimator that combines the local kernel regression with the B-spline basis approximation. We show the estimation rate of true function in the sup-norm norm. We also propose two types of confidence bands for true function.

MB15
15-Franklin 5, Marriott
Unconstrained and Bound-Constrained Optimization
Sponsor: Optimization/Nonlinear Programming
Sponsored Session
Chair: Daniel Robinson, Assistant Professor, Johns Hopkins University, 3400 N. Charles Street, Baltimore, MD, 21218, United States of America, daniel.p.robinson@gmail.com
1 - A Solver for Nonconvex Bound-constrained Quadratic Optimization
Daniel Robinson, Assistant Professor, Johns Hopkins University, 3400 N. Charles Street, Baltimore, MD, 21218, United States of America, daniel.p.robinson@gmail.com, Hassan Mohy-ud-din
I present a new method for optimizing quadratic functions subject to simple bound constraints. If the problem happens to be strictly convex, the algorithm reduces to an efficient method by Dostal and Schober. Our algorithm, however, is also able to efficiently solve nonconvex problems. During this talk I will present the algorithm, a sketch of the convergence theory, and numerical results for convex and nonconvex problems.
2 - Handling Negative Curvature in Gradient Methods for Unconstrained and Bound Constrained Optimization
Wei Guo, Lehigh University, 200 W Packer Ave, Bethlehem, PA, 18015, United States of America, wegu@lehigh.edu, Frank E. Curtis
A gradient-descent method is proposed for unconstrained and bound constrained optimization. Emphasis is placed on techniques for computing appropriate step sizes when negative curvature is present. It extends Ranzani-Borwein two-point step size method, its variants and gradient projection method for unconstrained and bound constrained optimization. Global convergence is guaranteed under mild assumptions. Numerical results illustrate the benefits of the method in the presence of non-convexity.

3 - A Trust Region Algorithm with a Worst-case Iteration Complexity of O(eps^(-3/2))
Mohamadreza Samadi, Lehigh University, 200 West Packer, Bethlehem, PA, 18015, United States of America, mos213@lehigh.edu, Daniel Robinson, Frank E. Curtis
We present a trust region method for unconstrained nonconvex optimization that is able to drive the norm of the gradient of the objective below a prescribed threshold eps > 0 after at most O(eps^(-3/2)) iterations, while maintaining standard global and fast local convergence guarantees through employing modified step acceptance criteria and a novel trust region updating mechanism. We also present ideas for the constrained case and show numerical results.

4 - A Modified DC Algorithm for Solving Linear Programs with Equilibrium Constraints
Francisco Jara-Moroni, Northwestern University, 2145 Sheridan Road, Room C210, Evanston, IL, 60208, United States of America, franciscojaramoroni2013@u.northwestern.edu, Jong-Shi Pang, Andreas Waechter
We propose a method for finding local optima of linear programs with equilibrium constraints. The complementarity restriction is handled by a penalty term that can be expressed as the difference of convex functions. The reformulated problem is solved to optimality by the difference-of-convex functions algorithm with some variations exploiting the specific structure of the penalization.

1 - Clique and Clique Relaxations
Niao He, Georgia Tech, Atlanta, GA
United States of America, nhe6@gatech.edu
We examine convex optimization problems involved with misspecified parameters or distributions, while only a limited number of indirect observations are available. We establish safe and computationally tractable approximations of these problems and equip them with efficient algorithms. We show that in several important cases, the estimates yielded by our approach exhibit consistency and sublinear convergence. We also demonstrate the efficiency of our approach through several examples.
4 - Applications of Big Data Summarization through Polyhedral Uncertainty Sets
Anushka Chadhababu, Research Scholar, IIITB, 26/C, Electronic City, Bangalore, India, anushka.babu@iiitb.org, Prasanna Gns
We present our works of summarizing structured or unstructured big data into polyhedral uncertainty sets, orders of magnitude smaller than the original data using a generalized multi-dimensional German tank method. Relational algebraic operations to check disjointness, subset or intersecting relationships between such polyhedral objects can be performed. We show the results of such big data summarization using real world data to solve specific business needs.

5 - Assessing Demand Trends using Real Time Order Transaction Data
Parvaneh Jahanl, University of Louisville, 781 Theodore Burnett Ct., Apt. 2, Louisville, KY, 40217, United States of America, p0jaha01@louisville.edu, Suraj Alexander
Assessing demand trends using real time order transaction data is essential aspect of warehouse management system. Selecting the method of demand forecasting differs for different demand trends. We propose a new approach for classification of Stock Keeping Units (SKUs) demand trends using Control Charts Pattern Recognition (CCPR). After demand trend class recognition, the best method of forecasting is selected. Bootstrapping method is used for forecasting intermittent demand time series.

6 - Unsupervised Ensemble, or Consensus Clustering, Consists in Finding the Optimal Combination Strategy
Ramazan Unlu, University of Central Florida, 12100 Sterling University Ln, Apt. 2-2419, Orlando, FL, United States of America, ramazanunlu@gmail.com
Unsupervised ensemble, or Consensus clustering, consists in finding the optimal combination strategy of individual clusterings that is robust with respect to the selection of the algorithmic clustering pool. In this paper, we propose a weighting policy for this problem that is based on internal clustering quality measures and compare against other popular approaches.

MB19
19-Franklin 9, Marriott
Chair: Scott Sanner, Asst. Professor, Oregon State University, 1148 Kelley Engineering Center, Corvallis, OR, 97331, United States of America, sanner@gmail.com

1 - Pruning in Decision Diagrams for Optimization
Christian Tjandraatmadja, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, cjandra@andrew.cmu.edu, Willem-jan Van Hoeve
Many enumerative techniques to solve discrete optimization problems benefit greatly from using bounds to prune the search tree. We study the application of pruning strategies to decision diagrams, which can be viewed as a compact form of enumeration trees. In particular, we discuss how pruning strategies can be incorporated in relaxed and restricted decision diagrams to obtain improved primal and dual bounds.

2 - Concise Representation of Near-optimal Solutions with Decision Diagrams
Thiago Serra, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, tserra@cmu.edu, John Hooker
Decision diagrams have recently been used to compactly encode sets of solutions to discrete optimization problems. In this talk we study Sound Decision Diagrams (SDDs), which encode near-optimal solutions along with worse feasible and infeasible solutions. We provide a formal characterization of SDDs and algorithms to find those with minimum size. Empirical results show that SDDs are smaller than conventional decision diagrams representing the same near-optimal solution set as its gap increases.

3 - Stochastic Optimization of the Scheduling of a Radiotherapy Center
Antoine Legrain, Polytechnique Montreal, C.P. 6079, Succursale Centre-ville, Montreal, QC, H3C 3A7, Canada, antoine.legrain@polymtl.ca, Marie-andrée Folin, Nadia Lahrichi, Louis-Martin Rousseau, Marino Widmer
Radiotherapy centers can improve their efficiency by optimizing the utilization of the linear accelerators. We propose an online method to schedule patients on such machines taking into account their priority, the maximum waiting time, and the preparation of this treatment (dosimetry). We have implemented a genetic algorithm and a constraints program, which schedule the dosimetry. This approach ensures the beginning of the treatment on time and thus avoids the cancellation of treatment sessions.

MB20
20-Franklin 10, Marriott
Chair: Yue Tan, The Ohio State University, 1971 Neil Ave, Columbus, OH, 43210, United States of America, tanyue01@gmail.com

1 - Cyber Vulnerability Maintenance Policies for Universities
Chengjun Hou, Graduate Research Associate, The Ohio State University, 1971 Neil Ave., Columbus, Oh, 43210, United States of America, hou.91@buckeyemail.osu.edu, Theodore Allen
The case study application of Markov decision processes and generalizations to a real world University policy design problem is described. Related mathematical issues are briefly explored. The derived policy includes incentives for not continuing the use of vulnerable software. The magnitude of saving in dollars is estimated.

2 - throughput Scalability of Fork-join Queueing Networks with Blocking
Yun Zeng, The Ohio State University, 1971 Neil Ave, Columbus, OH, United States of America, zeng.153@buckeyemail.osu.edu, Augustin Chaintreau, Don Towsley, Cathy Xia
With emerging applications such as cloud computing and big data analytics, modern information networks are growing increasingly complex. A critical issue concerns the throughput performance as the system expands to large scale. This paper models the distributed information processing systems as fork-join queueing networks with blocking. We present necessary and sufficient conditions to ensure throughput scalability. Algorithms to check these features for given networks are proposed.

3 - Data-driven Decision Making via Adaptive Control for Cyber Password Management
Yue Tan, The Ohio State University, 1971 Neil Ave, Columbus, OH, 43210, United States of America, tanyue01@gmail.com, Cathy Xia
Cyber attacks have been widely recognized as a major international and domestic cyber security threat. Although an increasing number of high technology mechanisms have been developed, passwords remain as the frontline against cyber attacks both for personal and organizational security settings in cloud services. In this talk, we present a data-driven adaptive control framework that converges to the optimal password expiry duration which balances between accounts safety and user experience.
3 - Examining Change in Hospital Quality and Efficiency after ACA using Dynamic Network DEA
Yasar Ozcan, Professor, Virginia Commonwealth University, P.O. Box 982023, Richmond, VA, 23298-0203, United States of America, ozcan@vcu.edu, Jaya Khushalani
Dynamic Network DEA was used to examine change in both quality and efficiency of hospitals between 2009 and 2013, pre and post Affordable Care Act (ACA). Quality and efficiency improved significantly with no trade-off between the two. Urban and teaching hospitals were less likely to improve quality and efficiency together.

4 - Robust Decisions for the Partially Diversified Disease Management Model
Shuyi Wang, Lehigh University, 200 W Packer Ave, Bethlehem, PA, United States of America, shw210@lehigh.edu
We discuss a model to help pharmaceutical companies determine the optimal strategy under high uncertainty for a business model called the Partially Diversified Disease Management Model, which includes disease care pathways as well as health management, diagnostics-devices, and medication, and incentivizes patients’ health. Our MIP provides a tradeoff between diversification and specialization.

5 - When is the Outside Care Utilization Optimal for Acos?
Trade-off Between Cost, Access, and Quality
Tannaz Mahootchi, Postdoctoral Research Associate, Northeastern University, 360 Huntington Ave, Boston, MA, 02115, United States of America, t.mahootchi@neu.edu
Accountable Care Organizations (ACOs) are responsible for the health outcomes and the care expenses of their patients. We investigate the details of patient diversion process to an alternative provider when the primary ACO is experiencing congestion. ACOs choose the alternative provider based on the performance measures and the costs of patient diversion. We derive the transfer price and the performance measures that makes the diversion decision optimal.

- MB22
22-Franklin 12, Marriott
Learning and Random Graphs
Sponsor: Applied Probability
Sponsored Session
Chair: Marc LeLarge, INRIA-ENS, 23 Avenue d’Italie, Paris, France, marc.lelarge@ens.fr
1 - Typical Distances in Directed Random Graphs
Mariana Olvera-Cravioto, Associate Professor, Columbia University, New York, NY, 10027, United States of America, mo2291@columbia.edu
We study the distance between two randomly selected nodes in a directed configuration model under the assumption that the degree distributions have finite variance. In particular, we show that the distance grows logarithmically in the size of the graph. The method of proof uses a coupling between a graph exploration process and a weighted branching tree, since unlike the undirected case, we need to keep simultaneous control of both the in-degrees and the out-degrees.

2 - Competitive Contagion in Networks
Moez Draief, Imperial College London and Huawei Research Paris, South Kensington Campus, London, United Kingdom, moez.draief@huawei.com
There has been a growing interest, over the past few years, in studying models of competing products/opinions on social networks. The question of interest is what is the impact of the first adopters of a product on the outcome of a series of adoption by other nodes in the system influenced by those initial nodes. More precisely, the decision of a node to adopt a product is influenced by the behaviour of its neighbours in the social network. This raises challenging and intriguing mathematical, algorithmic and game theoretic questions. In this talk, I will present an overview of recent developments in this topic.

3 - Learning in Networks: Multi-armed Bandits with Structure
Richard Combes, Assistant Professor, Centrale-Supelec, Plateau de Moulon, 3 rue Joliot-Curie, Gil-Sur-Yvette, 91192, France, richard.combes@supelec.fr
The design of networks and online services can often be mapped to a multi-armed bandit problem with structure. With this approach, problems such as link adaptation, resource allocation, or ad-display optimization can be solved in a provably optimal manner. Namely, the learning speed of the proposed schemes matches a fundamental limit verified by any scheme. A review of the relevant mathematical tools and literature is provided.

4 - Community Detection with the Non-backtracking Operator
Marc LeLarge, INRIA-ENS, 23 Avenue d’Italie, Paris, France; marc.lelarge@ens.fr, Charles Bordenave, Laurent Massoulié
Community detection consists in identification of groups of similar items within a population. In the context of online social networks, it is a useful primitive for recommending either contacts or news items to users. We will consider a particular generative probabilistic model for the observations, namely the so-called stochastic block model and prove that the non-backtracking operator provides a significant improvement when used for spectral clustering.

5 - Rumor Source Obfuscation
Peter Kairouz, Graduate Research Assistant, University of Illinois at Urbana Champaign, 408 E Clark St, Apt. 6, Champaign, IL, 61820, United States of America, kairouz2@illinois.edu, Sewoong Oh, Pramod Viswanath
Anonymous messaging platforms have recently emerged as important tools for sharing one’s thoughts without the fear of being judged by others. Such platforms are crucial in nations with authoritarian regimes where the right to free expression depends on anonymity. Existing messaging protocols are vulnerable against adversaries who can collect metadata. We introduce a novel messaging protocol and show that it spreads the messages fast and achieves perfect obfuscation of the source.

- MB23
23-Franklin 13, Marriott
Role of Information in Large-scale Stochastic Resource Allocation Problems
Sponsor: Applied Probability
Sponsored Session
Chair: Kuang Xu, Stanford University, Stanford, CA, United States of America, kuangxu@stanford.edu
1 - Centralized Seat Allocation for Engineering Colleges in India
Yash Kanoria, Assistant Professor, Columbia University, New York, NY, United States of America, ykanoria@columbia.edu
The central government funds over 75 engineering colleges in India with 50,000 seats a year, and a diversity of programs and admissions criteria. We deploy a new, centralized, seat allocation mechanism, that accounts for the preferences of students as well as the admissions criteria for different colleges/programs using a deferred acceptance inspired approach.

2 - Learning to Optimize via Information-directed Sampling
Daniel Russo, Stanford University, 218 Ayshire Farm Lane, Apt. 102, Stanford, CA, 94305, United States of America, djrusso@stanford.edu, Benjamin Van Roy
We offer a fresh, information-theoretic perspective on the exploration/exploitation trade-off and propose a new algorithm—information-directed sampling—for a broad class of online optimization problems. We establish a general expected regret bound and demonstrate strong simulation performance for the widely studied Bernoulli, Gaussian, and linear bandit problems. Simple analytic examples show information-directed sampling can dramatically outperform Thompson sampling and UCB algorithms.

3 - Online Advertising Matching in the Large Market
Jian Wu, Cornell University, Ithaca, NY, United States of America, jw926@cornell.edu, Peter Frazier, J. G. Dai
We study online advertising matching in a large market asymptotic regime, in which the number of opportunities and the number of advertisers increase simultaneously. We develop a matching policy based on the LP solution to a certain deterministic problem. Under certain conditions, we prove that the policy is asymptotically optimal under the fluid-scaling to maximize click-through-rate (CTR) while satisfying all contractual agreements with overwhelming probability.

4 - Robust Scheduling in a Flexible Fork-join Network
Yuan Zhong, Columbia University, 500 W. 120th Street, New York, NY, 10027, United States of America, yy2561@columbia.edu, Ramtin Pedarsani, Jean Walrand
We consider a general flexible fork-join processing network, motivated by applications in e.g., cloud computing, manufacturing, etc, in which jobs are modeled as directed acyclic graphs, and servers are flexible with overlapping capabilities. A major challenge in designing efficient scheduling policies is the lack of reliable estimates of system parameters. We propose a robust scheduling policy that does not depend on system parameters, and analyze its performance properties.
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MB24

24-Room 401, Marriott
Data Mining and Network Inference for Social and Health Application II
Sponsor: Artificial Intelligence
Sponsored Session
Chair: Sung Won Han, New York University, 650 First Avenue, New York, NY, United States of America, sungwonhan2@gmail.com
Co-Chair: Chen Kan, University of South Florida, 4202 E. Fowler Ave. ENB118, Tampa, FL, United States of America, chenkans@gmail.usf.edu
1 - Optimizing Display Advertising in Online Social Networks
Zeinalb Abbasi, PhD Candidate, Columbia University,
1214 Amsterdam Ave, 450 CSB, New York, NY, 10027, United States of America, za2135@columbia.edu

Conventional online advertising methods need to be customized for OSNs. We propose probabilistic models and study the problem: given a number of impressions, what is the optimal order of users to show the ad to, to maximize the expected number of clicks? We show that this problem is hard to approximate. Therefore, we propose several heuristic algorithms. We evaluate the performance of these heuristics on real data sets, and observe that our two-stage heuristic outperforms baselines.

2 - Blood Donation Tailoring Problem to Improve Blood Supply Management
Guven Kaya, PhD Student, Industrial Engineering, University of Houston, E206 Engineering Bldg 2, Houston, TX, 77204, United States of America, gkaya@central.uh.edu, Ali Ekiç

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.

MB26

26-Room 403, Marriott
Data Analytics Applications for Smart Industries
Cluster: Globalization and International Activities
Invited Session
Chair: Grace Lin, Data Analytic Technology and Applications (DATA), Data Analytic Technology and Applications (DATA), Taipei, Taiwan - ROC, gracelin@iii.org.tw
1 - Is the Conventional Association Analysis Practical for Big Data Analytics? New Perspectives on Application and Computation
Hao-Ting Pai, Data Analytics Technologies & Applications Research Institute, Institute for Information Industry, Taiwan - ROC, htpai@iii.org.tw

Association analysis has been proven an NP-Complete problem. Owing to the inevitable challenge, it is necessary to devise an alternative way of discovering representative patterns. We present relative patterns discovery (named RPD) for big data analytics, which possesses four features: effectiveness, efficiency, functionality, panorama, and scalability.

2 - Towards Industry 4.0: Applying Big Data Analytics to Improve Manufacturing Performance
Fish Yu, Data Analytics Technologies & Applications Research Institute, Institute for Information Industry, Taiwan - ROC, fishyu@iii.org.tw

As a step towards the development of cyber-physical systems which play an important role in the transformation of manufacturing industry to the next generation known as Industry 4.0, this talk describes a log analytics framework that is capable of collecting, managing and analyzing large amount of machine data to enable real-time and predictive decision-making across various manufacturing processes. Experimental results using realistic data from semiconductor packaging tools show the effectiveness of the proposed framework.

3 - Green Multi-temperature Logistics using Time-dependent Data Analysis
Wei-Ting Chen, Data Analytics Technologies & Applications Research Institute, Institute for Information Industry, Taiwan - ROC, weitingchen@iii.org.tw

Multi-temperature food logistics contributes a considerable amount of greenhouse gas due to fuel burn and HFCs and PFCs generated by refrigeration. In this talk, we will introduce how to estimate emissions depend on various levels of traffic condition, temporal demand patterns, delivery time windows, and different temperature control techniques. It helps carriers to respond to green policies of governments.

4 - Emerging Trends in ICT: using Big Data Analytics to Infuse New Energy into Smart Tourism Industry
Tim Lin, Data Analytics Technologies & Applications Research Institute, Institute for Information Industry, Taiwan - ROC, timlin@iii.org.tw

As many leading global organizations have applied Big Data Analytics to various public and commercial areas, valuable applications such as consumer insight, business operations optimization, and service innovation have been continuously increasing. In this talk, we will introduce a smart tourism solution which provides tourists real-time, personal, and proactive services by leveraging Big Data Analytics, resulting in a deep and authentic experience. The developed solution can support tourism-related businesses to connect with prospective customers and build responsive, efficient, and health smart cities and homelands.

MB27

27-Room 404, Marriott
Advances in Multiobjective Programming
Sponsor: Multiple Criteria Decision Making
Sponsored Session
Chair: Margaret Wieck, Department of Mathematical Sciences, Clemson University, Clemson, SC, 29634, United States of America, wmland@clemson.edu
1 - Parametric Simplex Algorithm for Linear Vector Optimization Problems
Firdevs Ulus, Princeton University, ORFE, Sherrerd Hall, Princeton, NJ, 08544, United States of America, fulus@princeton.edu, Birgit Rudloff, Robert Vanderbei

A parametric simplex algorithm for linear vector optimization problems is proposed. The efficiency of the algorithm is compared with Benson’s algorithm and the multiobjective simplex algorithm. For nondegenerate problems Benson’s algorithm excels the simplex-type algorithms; however, the proposed algorithm performs much better than the multiobjective simplex algorithm.

2 - An LP-based Branch-and-bound Algorithm for Biobjective Mixed Integer Programs
Nathan Adelgren, Clemson University, Department of Mathematical Sciences, Clemson, SC, 29634, United States of America, nadelgr@g.clemson.edu, Akshay Gupta

We introduce a new LP-based branch-and-bound (BB) method for solving biobjective mixed integer linear programs (BOMILP). New branching, fathoming, cutting plane and node relaxation techniques are incorporated into a traditional BB framework. Computational results show that this method is competitive with current techniques for BOMILP.

3 - The Quadrant Shrinking Method for Solving Triobjective Integer Programs
Martin Savelsbergh, Prof, H. Milton Stewart School of Industrial & Systems Engineering, Georgia Institute of Technology, 765 Ferst Dr NW, Atlanta, GA, 30332-0205, United States of America, martin.savelsbergh@isye.gatech.edu, Hadi Charkhgard, Natasha Boland

We present a new variant of the full (p-1)-split algorithm for finding all non-dominated points of a triobjective integer program. The algorithm is easy to implement and solves at most 3*n+1 integer programs, where n is the number of non-dominated points. Computational experiments demonstrate its efficacy.

4 - Optimizing a Linear Function Over the Efficient Set of a Multi-objective Integer Program
Hadi Charkhgard, University of Newcastle, University Drive, Callaghan, Australia, hadi.charkhgard@gmail.com, Natasha Boland, Martin Savelsbergh

We present a new algorithm to optimize a linear function over the set of efficient solutions of a multi-objective integer program. Because the algorithm maintains both a lower and an upper bound on the optimal objective value, it can easily be converted into a fast approximation algorithm. Finally, we demonstrate that the algorithm can be used to efficiently compute the nadir point of a multi-objective integer program.
2 - Managing Customer Arrivals in Service Systems with Multiple Servers
Chistos Zacharias, Visiting Assistant Professor, University of Miami, School of Business Administration, Miami, FL, United States of America, czacharias@miami.edu, Michael Pinedo
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 containing operational costs and increasing customer throughput.

3 - A Hierarchical Bayes Model of No-show Rates
Joseph Johnson, Associate Professor, University of Miami, 5250 University Drive, 501 Kosar Epstein Building, Coral Gables, FL, 33146, United States of America, jjohnson@bus.miami.edu, Yu Tang, Yutian Li
Patient no-shows in US clinics can sometimes shoot up to 80%. Accurate predictions of no-shows help clinics optimally schedule appointments. We develop a Hierarchical Bayes logit model which improves prediction accuracy over the widely-used simple logit model. The accuracy gain arises from the individual patient-level coefficients provided by the Bayesian method. Comparison of model fit on 12-months of appointment data shows that the Bayesian model vastly outperforms the simple logit model.

4 - Appointment Scheduling with No-shows and Cancellations
Shannon Harris, Katz Graduate School of Business, 241 Mervis Hall, Pittsburgh, PA, 15213, United States of America, ssharris@katz.pitt.edu, Jerrold H. May, Luis Vargas
Appointment no-shows and cancellations can be disruptive to clinic operations. Scheduling strategies such as overbooking or overtime slot assignments can assist with mitigating these disruptions. We propose a scheduling model that accounts for both no-show and cancellation rates, and show properties of optimal scheduling models under specific conditions.
The rapid growth of functional genomic data makes it possible to build models for predicting one high-throughput genomic data type from another data type. This can be formulated as a challenging big-data regression problem which involves fitting millions of high-dimensional regressions simultaneously. To cope with the high dimensionality and heavy computation, we developed BIRD algorithm that leverages the correlations structure in the data to make computation fast and predictions accurate.

3 - Semi-automated Human Genome Annotation using Chromatin Data

Michael Hoffman, Scientist, Assistant Professor, Princess Margaret Cancer Centre/University of Toronto, Toronto Medical Discovery Tower 11-311, 101 College St, Toronto, ON, M5G 1L7, Canada, michael.hoffman@utoronto.ca

Segway is an integrative method to identify patterns from multiple functional genomics experiments. It discovers joint patterns in multiple genomic datasets using a dynamic Bayesian network model, simultaneously segmenting the genome and identifying clusters of similar segments. We apply Segway to ENCODE ChIP-seq and DNase-seq data and identify patterns associated with transcription start sites, gene ends, enhancers, and repressed regions.

4 - Identifying Genetic Risk Factors for Complex Traits using Functional and Association Data

Jo Knight, Centre for Addiction and Mental Health, 250 College Street, Toronto, Canada, jo.knight@camh.ca, Mike Barnes, Mike Weale, Sarah Gagliano

Our aim is to identify the genetic risk variants that contribute to disease. Genome-wide association studies have identified some but many remain unknown. We seek to combine the association data with functional characteristics of the genome. Machine learning is used to derive a score to indicate whether a genetic variant is likely to be causal based on large amounts of functional data. We combine the functional score and the association score together in a Bayesian framework.

3 - Analysis of Triage Systems in Emergency Departments

Ozlem Yildiz, Simon Business School, University of Rochester, CSH 4-333. Simon Business School, Rochester, NY, 14627, United States of America, oyildiz@simon.edu, Tolga Tezcan, Michael Kamali

We study triage method decisions in emergency departments and provide a policy for determining when to apply provider triage (PT) based on operational and financial considerations using a queuing framework. We obtain closed-form expressions for the range of arrival rates in which PT economically outperforms traditional nurse triage using a steady-state many-server fluid approximation. We show via simulation experiments that the proposed policy performs within 0.82% of the best solution.
We present location-routing models for the assignment and scheduling of community health workers and their supervisors in remote settings. This work is a collaborative project with Last Mile Health, an NGO with the aim to expand access to health care in rural Liberia.

2 - Locating and Sizing FEMA's Disaster Recovery Centers
Julia Moline, FEMA, FEMA, Washington, DC, United States of America, julia.moline@fema.dhs.gov, Jarrod Goentzel, Erica Gralla
In East Africa, a region which suffers from chronic insecurity, the World Food Programme usually contracts with third-party carriers based on a competitive bidding mechanism; however, collected bids show inconsistencies with high variances. In such a context, determining fair market prices is a complex task. In this study, we analyze the factors that can explain these variances, such as seasonality and road condition. We provide recommendations for better transportation procurement practices.

3 - Aid Transportation Procurement Analysis: The Case of the World Food Programme in Kenya
Feyza Sahinyazan, PhD Candidate, McGill University, 1001 Rue Sherbrooke Ouest Room 520, Montreal, QC, H3A 1G5, Canada, feyza.sahinyazan@mail.mcgill.ca, Vedat Verver, Marie-Eve Rancourt
Using local manufacturing and distribution capacity in a humanitarian or development context has the potential to be more effective and sustainable. Examining the crop storage sector in Uganda, this study explores how NGOs quickly scaling up local capacity can help risk-averse firms increase profit and reduce costs through supply chain coordination.

4 - Facilitating Production of Grain Storage Products in Uganda
Mark Brennan, MIT, 77 Massachusetts Avenue, MIT, E38-648, Cambridge, MA, 02139, United States of America, mbrenn@mit.edu, Emily Gooding, Jarrod Goentzel
We study the logistic challenges of a food bank that coordinates food rescue operations on a daily basis, using limited resources. We model it as a routing-allocation problem, with the aim of maintaining equitable allocations to the different agencies, while delivering as much as possible in total. We then present characteristics of the optimal solution to the problem, an efficient algorithm to solve sub-problems of it, and heuristic approaches to solve the problem.
3 - Introducing Pro Bono Analytics
David Hunt, Manager, Oliver Wyman, One University Square, Suite 100, Princeton, NJ, 08540, United States of America, david.hunt@oliverwyman.com, Michael P. Johnson
Pro Bono Analytics is a new initiative within INFORMS to match INFORMS members willing to volunteer their operations research and advanced analytical skills with non-profit organizations working in underserved and developing communities. This presentation will provide an overview of the Pro Bono Analytics program, describe how OR/analytics professionals can make a difference, and show how you can become a Pro Bono Analytics volunteer.

4 - Predicting Areas of Low HPV Vaccination Coverage to Target Vaccination Promotion Efforts
Brittany Green, University of Cincinnati, Carl H. Lindner School of Business, 2925 Campus Green Dr., Cincinnati, OH, 45221, United States of America, brittanydiane@gmail.com, Josh Haupt, Louis Luangkesorn
The Jewish Healthcare Foundation is trying to promote Human Papillomavirus (HPV) vaccination efforts in southwestern Pennsylvania. HPV is a sexually transmitted disease which can be prevented with a three dose vaccine. However, vaccination rates among adolescents is short of target rates. We develop a predictive model of vaccination coverage based on the National Immunization Survey. We then apply this model to census data to identify zip codes to target HPV vaccination promotion programs.

5 - An Ordering Heuristic for RBCS under Multiple Independent Sources of Supply
Karti Puranam, Assistant Professor, La Salle University, 1900 W Olney Ave, Philadelphia, PA, 19141, United States of America, puranam@lasalle.edu
We introduce a multi-period, perishable inventory model under two independent sources of supply, where blood is randomly transferred from hospitals to a large blood bank. We formulate a dynamic program to solve the multi-period cost minimization problem. We compare our results to the ordering policy that was followed in practice.

1 - Statistical Inference Theory using Truncated Statistics with Applications
Byung Rae Cho, Professor, Clemson University, 152 Freeman Hall, Clemson, SC, 29634, United States of America, bcho@clemson.edu, Russell Krenek
There are many production situations where specification limits on a process are implemented externally, and the endpoint is typically reworked or scrapped if its performance does not fall in the tolerance range. As such, the actual distribution after inspection becomes truncated. The purpose of this presentation is to develop a set of hypothesis testing procedures under this truncated environment and explore application areas.

2 - Development of Convolutions for Industrial and Service Processes
Russell Krenek, Graduate Student, Clemson University, 129 Freeman Hall, Clemson, SC, 29634, United States of America, rkrenek@g.clemson.edu, Byung Rae Cho
Understanding truncated random variables and their roles in production inspection processes is a key to modern industry, as this type of research arises in many engineering applications. It is important to note that these production inspection processes require the convolution of truncated distributions due to multiple production stages. This paper focuses on the development of the convolutions resulting from truncated normal and truncated skew normal random variables, and their applications.

3 - Condition-based Repair Prioritization in Repairable Inventory Supply Chains
Chiel Van Oosterom, PhD Student, Eindhoven University of Technology, P.O. Box 513, Eindhoven, 5600MB, Netherlands, c.d.v.oosterom@tue.nl, Geert-Jan Van Houtum
We propose a model for exploiting condition information to dynamically prioritize repairs in a capacitated repair shop. The repair shop supports a system with a number of different repairable components. The system is down whenever a component fails and no ready-for-use spare part is available for that component. The objective in prioritizing repairs is to maximize the long-run availability of the system.

4 - Calendar-based Age Replacement Policy with Dependent Renewal Cycles
Maliltech Aramon, Dow Chemical Company, University of Toronto, Unit 804, 141 Davisville Ave, Toronto, ON, M4S 1G7, Canada, maramon@mie.utoronto.ca, Dragan Banjevic
We introduce an age-based replacement policy in which the preventive replacements are restricted to specific calendar times. This policy is logistically applicable in industries, having large and geographically diverse populations of deteriorating assets with different installation times. Using the theory of Markov chains with general state space and a suitably defined ergodic measure, we analyze the policy, minimizing the long-run expected cost per unit time.
1 - Signaling Trustworthiness using a Buy-back Contract
Shouqiang Wang, Assistant Professor, Clemson University. 131D Sirrine Hall, Clemson, SC, 29672, United States of America, shouqiw@clemson.edu
Not all suppliers are trustworthy; retailers face risk dealing with suppliers who may not honor their buy-back contracts. We examine whether an upstream manufacturer is able to signal her trustworthiness via the buy-back contract terms (i.e., the wholesale and return prices) offered to a retailer; and if so, how such a buy-back contract needs to be structured.

2 - Optimal Design of Services Channel
Huaqing Wang, Asst Professor, University of Wisconsin Stout, 262 JHTW, 410 10th Ave E, Menomonie, United States of America, wangh@uwstout.edu, Haresh Gurnani, Yu Tang
Customers buying certain products may lack functional knowledge and need help after purchase. The retailer (or manufacturer) can invest in pre-sales effort to educate customers; We study the service channel design problem with different structures and show that the retailer would even be worse off in a cost-sharing contract.

3 - Quality Provision with Heterogeneous Consumer Reservation Utilities
Rachel Chen, Associate Professor, University of California, Davis, CA, United States of America, rachen@ucdavis.edu, Lian Qi, Leon Chu
This paper examines a firm’s quality and price decisions when consumers differ in both their willingness-to-pay for quality and in their reservation utility for the basic product. We find that the optimal quality may increase with a negative shift in consumers’ reservation utilities. When the firm offers a vertically differentiated product line, the concern for cannibalization may distort the quality upwards under heterogeneous reservation utilities.

4 - Dynamic Matching in a Two-sided Market
Yun Zhou, University of Toronto, 105 St. George Street, Toronto, Canada, Yun.Zhou3@Rotman.Utoronto.Ca, Ming Hu
A two-sided market often shares a common structure that engages three parties: the supply side, the demand side and an intermediate firm facing intertemporal uncertainty on both supply/demand sides. We propose a general framework of dynamically matching supply with demand of heterogeneous types (with horizontally or vertically differentiated types as special cases) by the intermediary firm and explore the optimal and heuristic matching policies.

2 - When Does a Stakeholder Attack Become a Reputational Crisis? Stakeholder Capital and the Micro-Foundations of Corporate Reputation
Sinziana Dorobantu, New York University, New York, NY, sdoroban@stern.nyu.edu, Witol J. Henisz, Liz Nartery
We provide and demonstrate empirical support for theoretical arguments on the micro-foundations of corporate reputation thereby explaining which stakeholder attacks are more likely to become organizational reputational crises that destroy financial value. We evaluate stakeholder reactions to attacks targeting 19 gold mining firms between 2000 and 2008 as reported in over 20,000 media articles, and link these reactions to the daily abnormal returns of these publicly traded companies.

3 - Micro-foundations of Corporate Social Responsibility and Irresponsibility
Olga Hawn, UNC Kenan-Flagler Business School, Chapel Hill, NC, United States of America, Olga_Hawn@kenan-flagler.unc.edu, Catherine Shea
This study examines how two fundamental dimensions of social perception/awareness and competence mediate and moderate the effects of corporate social responsibility (CSR) and irresponsibility (CSI) on specific outcomes. The results of our experimental studies suggest that firms from high-warmth countries receive lower benefits for CSR and pay higher penalties for CSI than firms from low-warmth countries; furthermore, this effect reverses when combined with high competence.

4 - The Economic Case for CSR: Competitive Advantage of For-profit Firms in the Market for Social Goods
Jiao Luo, University of Minnesota, 321-19th Ave S, Suite 3-365, Minneapolis, MN, 55455, United States of America, luoj@umn.edu, Aseem Kaul
We develop a formal model of CSR, examining competition between a for-profit firm and a nonprofit in the supply of social goods. We argue that firms can benefit both stakeholders and shareholders only if their CSR efforts are sufficiently differentiated from those of non-profits. Thus, our paper makes an economic case for CSR, specifying conditions under which CSR is Pareto optimal, and highlighting the potentially divergent effects of CSR activities for shareholders and stakeholders.

1 - Do Mandatory Overtime Laws Improve Quality? Staffing and Operational Flexibility of Nursing Homes
Lauren Lu, Associate Professor, University of North Carolina at Chapel Hill, Kenan-Flagler Business School, Chapel Hill, NC, 27599, United States of America, lauren_lu@unc.edu
Co-Chair: Feng Lu, Assistant Professor, Purdue University, 403 W State St, West Lafayette, IN, 47907, United States of America, luf428@purdue.edu
During the 2000s, over a dozen U.S. states passed laws that prohibit health care employers from mandating overtime for nurses. Using a nationwide panel dataset from 2004 to 2012, we find that these mandatory overtime laws reduce the service quality of nursing homes. This outcome can be explained by two undesirable changes in the staffing hours of registered nurses: decreased hours of permanent nurses and increased hours of contract nurses per resident day.

2 - The Hidden Costs of Hospitals’ “Custom Contracting” with Group Purchasing Organizations
Avi Seidmann, Simon Business School, University of Rochester, Rochester, NY, 14627, United States of America, avi.seidmann@simon.rochester.edu, Vera Tilson, Rajib Saha
Most hospitals in the US join Group Purchasing Organizations (GPOs) to lower procurement costs by demand aggregation. Some larger hospitals further negotiate private deals through custom contracts directly with the GPO vendors. We present a game-theoretic model where the decisions by the hospitals and the vendor are endogenous, and we prove that – counter to the industry’s expectations - the resulting savings for the hospitals are always lower when the GPOs go for custom contracting.
3 - Resource Pooling and Flexibility to Improve Ed Boarding
Aaron Ratcliffe, Assistant Professor, University of North Carolina at Greensboro, 438 Bryan Building, P.O. Box 26170, Greensboro, NC, 27402, United States of America, aaron.ratcliffe@ung.edu, Alex Mills

ED boarding worsens health outcomes and compromises hospital care. We investigate how resource pooling can improve ED boarding by aligning ED admissions with inpatient discharges using a dynamic queueing model. We compare strategies which jointly manage inpatient resources under a traditional and pay-for-performance setting.

4 - Optimal Mobile Healthcare Delivery Aimed at Minimizing Social Healthcare Costs
Jiu Song, Nanyang Technological University, 50 Nanyang Avenue, Singapore 639798, Singapore, jiusong@ntu.edu.sg, Fang Liu, Pengfei Guo, Yulan Wang

Developing countries set up mobile health programs to improve public health service and people's access to medical care in the remote regions. We model the disease progression following a discrete time Markov chain and focus on improving the efficiency of the mobile healthcare delivery system. We identify the conditions under which mobile healthcare is beneficial, and find the optimal duration a mobile hospital visits a community. We provide some managerial insights through numerical study.

[SESSION MB42]

42-Room 102B, CC

Joint Session MSOM-Health/HAS: Designing Healthcare Systems to Improve Patient and Provider Experience
Sponsor: Manufacturing & Service Operations Management/Healthcare Operations

Sponsored Session
Chair: Vera Tilson, Simon School of Business, University of Rochester, Rochester, NY, 14627, United States of America, vera.tilson@simon.rochester.edu

1 - Slow First, Fast Later: Empirical Evidence of Speed-up in Service Episodes of Finite Duration
Aditya Jain, Baruch College, New York City, New York, NY, United States of America, aditya.jain@baruch.cuny.edu, Sarang Deo

In service episodes of finite duration with time-varying dynamics, operating variables that affect work speed have not been rigorously studied. We employ the trade-off faced by workers between cost of providing service and cost of customer wait to identify two previously unexplored drivers of work speed: time within the episode and anticipated remaining workload. We empirically test our predictions using data from a high-volume, tertiary care outpatient department.

2 - Designing a Network of Accident-and-emergency Facilities to Improve Cost Efficiency for the Elderly
Houyuan Jiang, University Senior Lecturer, University of Cambridge, Judge Business School, Cambridge, United Kingdom, h.jiang@jbs.cam.ac.uk, Mannohar Sodhi

We concern ourselves with the elderly in an Accident-and-Emergency system. The system, while already stressed with a rapidly increasing load, faces an increasing percentage of the elderly as in many other countries, and closure of facilities due to costs. We characterize the sufficient and necessary conditions for one Accident-and-Emergency to have a split or pooled system and for a network of two Accident-and-Emergency departments to be merged or operated separately.

3 - Dynamic Exam Room Allocation to Improve Patient Wait Time and Provider Satisfaction
Sarah Kadish, Director Performance Measures And Improvement, Dana-Farber Cancer Institute, 450 Brookline Avenue, Boston, MA, 02215, United States of America, Sarah_Kadish@dci.harvard.edu, Beth Overmoyer, Kristen Camuse, Courtney Haskett, Chris Reilly, Lillian Pedulla, Craig Bun nell

Allocation of exam rooms drives capacity, provider efficiency, and patient wait time. We sought to improve our algorithm for allocating rooms from a static provider-to-room ratio to a dynamic model, utilizing a Real-Time Locating System. Post-implementation, 83% of providers reported the rooming process was efficient compared with 43% at baseline, corroborated by a statistically significant reduction in patient wait time.

[SESSION MB43]

43-Room 103A, CC

Innovation, Technology Management and Networks
Sponsor: Revenue Management and Pricing

Sponsored Session
Chair: Nur Sunar, Assistant Professor, University of North Carolina, Kenan-Flagler School of Business, Chapel Hill, United States of America, Nur_Sunar@kenan-flagler.unc.edu

1 - A Simple Model of Cascades in Networks
Asu Ozdaglar, Massachusetts Institute of Technology, 32 Vassar St, Cambridge, MA, United States of America, asuman@mit.edu, Yongwhan Lim, Alex Teytelboym

We consider a stochastic linear threshold model of cascades in networks. We define a new measure of an agent's ability to influence a cascade in a given network, called cascade centrality, which is the expected size of the cascade when the agent is the only seed in the network. We prove analytical characteristics of cascade centrality for certain network topologies. We also study a combination model in which firms seed their products and products diffuse according to the threshold model.

2 - Risk Aversion, Information Acquisition, and Technology Adoption
James Smith, Duke University, Fuqua School of Business, Durham, NC, United States of America, jes9@duke.edu, Canan Ulu

We study the impact of risk aversion and uncertainty on technology adoption decisions using a dynamic programming model: in each period, the consumer may adopt or reject the technology or pay to acquire a signal about the technology's uncertain benefit. With risk neutrality, the value functions and optimal policies satisfy natural monotonicity properties. However, with risk aversion, the policies need not be monotonic unless we impose additional assumptions on the utility functions involved.

3 - Innovation Internalization in Technology-intensive Supply Chains
Vish Krishnan, UCSD, La Jolla, CA, 92037, United States of America, vkrishnan@ucsd.edu, Jwonghee Lee, Hyoduk Shin

We study supply chains where technology is a critical determinant of product success and is often licensed from upstream firms by downstream supply chain entities through a royalty contract. We investigate the impacts of two prevalent royalty bases, Full System Base (FSB) and Sub System Base (SSB). We derive optimal royalty approaches for different market settings. FSB, despite its similarity to revenue sharing, is not always Pareto-efficient in technology supply chains.

4 - Dynamic Product Development and Optimal Launch for a Customer Network
Nur Sunar, Assistant Professor, University of North Carolina, Kenan-Flagler School of Business, Chapel Hill, NC, United States of America, Nur_Sunar@kenan-flagler.unc.edu, Siniti Vitavastirat, John Birge

Development and the launch of products with network externalities require a deep understanding of social or commercial relationships among customers. Using a continuous time Brownian model, we analyze the optimal dynamic product development and launch strategies of a firm that sells an indivisible product to a network of customers. Our analysis shows that the network structure has a drastic impact on the optimal product quality and timing of the product launch.
1 - Dynamic Pricing for Pharmaceutical Manufacturers Distributing through a Common PBM

Nan Yang, Assistant Professor, University of Washington at St. Louis, St. Louis, MO, 63130, United States of America, yangn@wustl.edu, Yixuan Xiao, Panos Kouvelis

We model the competition among branded drug manufacturers on prices when contracting with a common PBM, who manages the prescription drugs of all manufacturers on behalf of their clients. We analyze the PBM’s optimal formula

design problem and characterize the equilibrium pricing behavior of competing drug manufacturers. We discuss the impact of various parameters on the equilibrium outcomes for plan enrollees, PBM, and drug manufacturers.

2 - Bundle Payments vs. Fee-for-Service: Impact of Payment Scheme on Performance

Elodie Adida, University of California at Riverside, Riverside, CA, elodie.goodman@uct.edu, Hamed Mamani, Shimaa Nassiri

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 Bundled Payments that remove such incentives. We analyze effects of different payment schemes on the extent of patient selection and treatment intensity decisions by a risk-averse provider. We benchmark performance on the socially optimal outcome. We investigate modified payment systems that induce this social optimum.

3 - Information Elicitation and Influenza Vaccine Production

Sameer Hasija, Assistant Professor, INSEAD, 1 Ayer Rajah Avenue, Grange Heights, Singapore, Singapore, Sameer.Hasija@insead.edu, Javad Nasiry, Stephen Chick

We explore the procurement of influenza vaccines by a government whose objective is to minimize the expected social costs (including vaccine, vaccine administration, and influenza treatment costs) when a for-profit vaccine supplier has production yield uncertainty, private information about its productivity (adverse selection) and potentially unverifiable production effort (moral hazard).

1 - Dynamic Pricing and Learning with Online Retail Rankings

Arnoud Den Boer, Assistant Professor, University of Twente, Gebouw Zilverling, kamer 4013, Drienerloolaan 5, Enschede, 7922 NB, Netherlands, a.v.denboer@utwente.nl, Bora Keskin

In online market environments such as Amazon or Google Shopping, firms receive advertisement space if they satisfy certain conditions. It is beforehand not clear if the benefits of this increased exposure outweigh the potential costs. We investigate this question in a dynamic pricing-and-learning setting.

2 - Personalized Assortment Planning with Finite Inventory and Demand Uncertainty

David Simchi-Levi, Professor, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Cambridge, MA, 02139, United States of America, dlev@mit.edu, Clark Pixton

Motivated by the trend among consumers of smartphone usage for shopping online, we develop an algorithm for personalized assortment optimization over a finite horizon with finite inventory, in the case where customer choice parameters are not known. The algorithm simultaneously balances short term revenues, marginal cost of inventory, and exploration to achieve good performance in terms of regret.

3 - Stochastic Market Equilibrium for RM

Floren Ciocean, INSEAD, Boulevard de Constance 77305, Fontainebleu, France, floren.ciocean@insead.edu, Vahab Mirrokni, Mohammadhossein Bateni, Yiwei Chen

We present a dynamic pricing scheme for a seller who is allocating a volatile stream of goods to a set of budgeted buyers. Our prices are computed as a stochastic market equilibrium. We provide performance guarantees both in terms of revenues for the seller and in terms of fairness for the buyers. We apply our scheme to online ad allocation and using a dataset from a large ad network we empirically compare the performance of our scheme with the second price ad auction which is currently run.

1 - Contracting with Overconfident Customers in Car Sharing

Guangwen Kong, University of Minnesota, 111 Church Street SE, Minneapolis, MN, 55455, United States of America, gkong@umn.edu

Although the economic and environmental benefits of car-sharing services are well documented, many potential customers are reluctant to utilize such services. This has been attributed to, in part, the lack of flexibility of short-term rental contracts. We study potential impact of customers’ overconfidence when making reservations, and design the contracts that incorporate customers’ bounded rationality.

2 - Inventory Rebalancing in Vehicle Sharing Networks

Sail Benjaafar, Professor, University of Minnesota, 111 Church Street SE, Minneapolis, MN, 55455, United States of America, sail@umn.edu, Xiaofo Li, Xiang Li

We study the problem of inventory rebalancing in vehicle sharing networks. We characterize the structure of an optimal policy.

3 - Dynamic Service Management of One-way Car Sharing Systems

Ho-Yin Mak, University of Oxford, Saod Business School, Park End Street, Oxford, United Kingdom, makho06@gmail.com, Guangru Ma

One-way car sharing services (e.g., Car2go) are gaining popularity. The key operational challenge is unbalanced flow of vehicles within the service region, as customers are allowed to return cars anywhere within the service region. We investigate dynamic service blocking, i.e., restrictions of the set of return locations, as a possible measure to counter imbalance. We formulate a model that determines the blocking policy dynamically, incorporating customer destination choice behavior.
1 - Extended Producer Responsibility (EPR) for Pharmaceuticals
Isil Alev, Georgia Tech, Atlanta, GA, United States of America, isilavet@gatech.edu, Atalay Atasu, Ozlem Ergun, Beril Toktay
EPR-based approaches have gained traction for managing pharmaceutical overage. In our work, we analyze the effectiveness of these approaches, particularly Source Reduction and End-of-Pipe Control, by developing a game-theoretic model of pharmaceutical chain with a focus on factors causing overage. We uncover conditions for effective EPR implementation from the welfare perspective and obtain critical factors determining stakeholder perspectives in the pharmaceuticals context.

2 - Extended Producer Responsibility and Secondary Markets
Atalay Atasu, Associate Professor, Georgia Tech, 800, West Peachtree Street, Atlanta, GA, 30318, United States of America, Atalay Atasu@scheller.gatech.edu, Vishal Agrawal, Isil Alev
EPR-based take-back legislation is the prevalent policy for several durable products such as electronics. However, existing research on EPR ignores durable nature of the products and secondary markets. Accordingly, we analyze EPR implementations in the presence of secondary markets and provide policy guidelines that can help improve the effectiveness of EPR.

3 - Optimal Service Infrastructure Planning for New Product Adoption under Network Externalities
Yiwei Wang, UC Irvine, 4293 Pereira Drive, Irvine, United States of America, willwangyiwei@gmail.com, Luqi Gui
Introducing services that complement a new product (e.g., charging service for electric vehicles) can accelerate adoption of the new product. The success of such strategies critically depend on how service infrastructure is deployed and adjusted over the product’s life-cycle. We study this issue by a product diffusion analysis and derive insights regarding the optimal deployment strategy for complementary services.

4 - Lemons, Trade-ins, and Remanufacturing
Ximin (natalie) Huang, Scheller College of Business, Georgia Institute of Technology, 800 West Peachtree, NW Atlanta, Georgia, Atlanta, GA, United States of America, ximin.huang@scheller.gatech.edu, Atalay Atasu, Beril Toktay
Trade-in programs have been shown to partially mitigate the lemons problem in secondary markets. In this paper, we show when and how remanufacturing traded-in products can further improve the efficiency in secondary markets.

2 - Buyer-backed Purchase-order Financing for Suppliers Facing Yield Uncertainty
Arun Chockalingam, Assistant Professor, Eindhoven University of Technology, Den Dolech 2, Eindhoven, 5612AZ, Netherlands, A.Chockalingam@tue.nl, Matthew Reindorp, Richa Jain
We consider a retailer whose supplier is prone to severe yield shortfall. The threat of shortfall entails that the supplier cannot independently finance production. In a single period setting, we find that the retailer can increase profit for both parties by offering a purchase order commitment that incorporates a (partial) loan guarantee. We determine the retailer’s optimal commitment and the benefits for both parties. We show how the commitment varies with the supplier’s yield uncertainty.

3 - Integrated Risk Management in Commodity Markets
Fehmi Tanrisever, Bilkent University, Bilkent, Ankara, Turkey, tanrisever@bilkent.edu.tr
In this paper, we examine the integrated operating and financial hedging decisions of a value maximizing firm, in the presence of capital market frictions. We show that the working capital and the hedging policies of the firm interact with each other in a multi-period dynamic inventory model. In particular, looser working capital policies lead the managers to take relatively more speculative position in the market to maximize firm value. This issue may also be mitigated by asset based financing.

4 - The Midas Touch: Operational Flexibility and Financial Hedging in the Gold Mining Industry
Panos Markou, IE Business School, Calle Maria de Molina 12 Bajo, Madrid, 28006, Spain, pmarkou.phd2016@student.ie.edu, Daniel Corsten
We examine the commodity risk management strategies of gold mining firms over 36 quarters. Miners use financial hedging and operational flexibility to mitigate exposure to volatile gold prices. We find that, in line with theory, hedging reduces firm profit variance and inventory levels. On the other hand, operational flexibility increases profit variance and inventory. However, operational flexibility becomes valuable when used in a complementary fashion with financial hedging.
4 - Online Reuse Marketplaces: An Empirical Analysis
Suvrat Dhanorkar, Assistant Professor, Penn State University, University Park, State College, PA, United States of America, dhanorkar.suvrat@gmail.com

Online Reuse Marketplaces promote matching between producers and consumers of used products. We examine questions related to the evolution and design of one such marketplace.

■ MB50
50-Room 106A, CC
Supply Chain Risk Management Strategies
Sponsor: Manufacturing & Service Operations Management
Sponsored Session
Chair: Yiming Wang, Arizona State University, Department of Supply Chain Management, Tempe, AZ, 85287, United States of America, yiming_wang@asu.edu

1 - Payment Timing in Multiechelon Supply Chains: Cost Assessment, Incentives, and Coordination
Greg Decroix, Professor, University of Wisconsin-Madison, 975 University Avenue, Madison, WI, 53706, United States of America, gdecroix@bus.wisc.edu, Jeannette Song, Jordan Tong

Developments in information technology have led to increased variety in payment arrangements between supply chain members. In this paper we introduce a new system for capturing the financing costs resulting from a general class of such payment schemes. Under wholesale price contracts, we use this framework to demonstrate the impact of payment timing on firm incentives, and show that partially delayed payments can achieve coordination in settings where standard or fully delayed payments cannot.

2 - Global Sourcing under Yield Uncertainty
Shahyari Gheibi, Doctoral Candidate, Syracuse University, 721 University Ave., Syracuse, NY, 13244, United States of America, sghelbi@syr.edu, Burak Kazaz, Scott Webster

We study the sourcing policies of a firm operating in an agricultural environment where yield uncertainty influences the firm's crop supply. Our analysis examines the direct trade sourcing policy which is perceived as an alternative to the fair trade policy. It is often believed that hedging is not advantageous in risk-neutral settings; our work, however, shows that there are conditions when the firm benefits from utilizing futures contracts simultaneously with direct trade sourcing policies.

3 - Wine Analytics: Fine Wine Pricing and Selection under Weather and Market Uncertainty
Mert Hakan Hekimoglu, Doctoral Candidate, Syracuse University, 721 University Avenue, Syracuse, NY, 13244, United States of America, mhekimog@syr.edu, Burak Kazaz, Scott Webster

We investigate a distributor's portfolio selection problem of wine futures and bottled wine. Using Liv-ex.com data, we first empirically show how the evolution of futures prices for young wines can be predicted by changes in weather and market conditions. We then examine the distributor's investment decisions in wine futures, bottled wine, and cash position analytically using a Value-at-Risk measure.

4 - Production Decisions for New Products under Yield and Demand Learning
Candace Yano, University of California, Berkeley, IEOR Dept.and Haas School of Business, Berkeley, CA, 94720, United States of America, yano@haas.berkeley.edu, Kai-chuan Yang

Manufacturers launching new products can schedule the first production run well before product introduction, allowing them to learn about the uncertain yield. But early production would occur before an accurate demand forecast is available, thus risking overproduction. We explore how a firm facing capacity constraints should optimize these decisions when new products share capacity with existing products whose demands are uncertain but whose yields are more predictable.

■ MB51
51-Room 106B, CC
Behavior-driven Operations Management
Sponsor: Manufacturing & Service Operations Management
Sponsored Session
Chair: Fuqiang Zhang, Olin Business School, Washington University, St. Louis, MO, United States of America, f2hang22@wustl.edu

1 - Are Strategic Customers Bad for a Supply Chain?
Ali Parlakturk, Associate Professor, UNC Kenan-Flagler Business School, 300 Kenan Center Drive, MC #4708, Chapel Hill, NC, 27599, United States of America, Ali_Parlakturk@kenan-flagler.unc.edu, Yen-Ting Lin, Jayashankar Swaminathan

We contrast the results of forward-looking strategic customers with the myopic customers benchmark in a supply chain of a manufacturer and a retailer. The combination of Strategic customer behavior and decentralization does not necessarily result in the worst supply chain performance. In fact, when customers are sufficiently patient, a decentralized supply chain that faces strategic customers outperforms the supply chain with only one of those factors at play.

2 - Managing Social Responsibility in Multi-tier Supply Chains
Robert Swinney, Associate Professor, Duke University, 100 Fuqua Dr, Durham, NC, 27708, United States of America, robert.swinney@duke.edu, Lu Huang, Jeannette Song

We examine a three level supply chain in which a Tier 2 supplier sells to a Tier 1 supplier which sells to a downstream (Tier 0) firm, and consider whether Tier 0 should manage social responsibility in Tier 2 directly or delegate to Tier 1. We focus on the impact of external stakeholder behavior (consumers, NGOs, and governments) on the Tier 0 firm's optimal strategy, and show that increasing pressure from these stakeholders may backfire and lead to a less responsible supply chain.

3 - A Model of Rational Retrials in Queues
Shiliang Cui, Georgetown University, McDonough School of Business, Washington, DC, 20057, United States of America, shiliang.cui@georgetown.edu, Senthil Veeraraghavan, Xuanming Su

Consumers suffer dis-utility 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.

4 - CEO Overconfidence, Inventory Management, and Firm Performance
Fuqiang Zhang, Olin Business School, Washington University, St. Louis, MO, United States of America, f2hang22@wustl.edu, Tianjun Feng, Qing Zhang

Using the data of U.S. manufacturing firms during 1999-2011, we investigate the relationship between CEO overconfidence and firm inventory management. We find that firms with overconfident CEOs have lower inventory levels. In addition, we provide empirical evidence of the mediation effect of inventory level on firm financial performance.

■ MB52
52-Room 107A, CC
Best Paper Award
Sponsor: Service Science
Sponsored Session
Chair: Tor W. Andreassen, Professor, NHH Norwegian School of Economics, Helleveien 30, Bergen, Norway, tor.w.andreassen@nhh.no

1 - Design of Informatics-based Services in Manufacturing Industries: Case Studies and Discussion
Chie-Hyeon Lim, Post-doc, POSTECH, Engineering Building #4-316, Pohang, 790-784, Korea, Republic of, arachon@postech.ac.kr, Jun-yeon Heo, Min-Jun Kim, Kwang-jae Kim

A key component of servitization in manufacturing industries is informatics, which transforms product and customer data into information for customers. Informatics-based service is defined as a type of service wherein informatics is crucial to customer value creation. In this talk, we introduce two case studies on the design of informatics-based services in manufacturing industries. Various aspects of informatics-based service design in manufacturing are also discussed.
2 - An Analytical Framework for Value Co-Production in Services
Guillaume Roels, Associate Professor, UCLA, 110 Westwood Plaza, Los Angeles, CA, 90095, United States of America, guillaume.roels@andromeda.ucla.edu, Uday Karmarkar

Although services are often defined as co-constructive of value, the concept of value is often difficult to measure. Yet, measuring value is not necessarily a prerequisite for service process improvement. In this paper, we propose a general framework for the modeling and analysis of services with co-production. The framework identifies three major process stages: (i) the production stage, which involves co-production, (ii) the output sharing stage, and (iii) the consumption stage.

■ MB53
53-Room 107B, CC
Social Media, Sales and Pricing
Sponsor: Behavioral Operations Management
Sponsored Session
Chair: Wedad Elmaghraby, Associate Professor, University of Maryland, 4311 Van Munching Hall, College Park, MD, 20742, United States of America, elmaghraby@rhsmith.umd.edu
1 - Scarcity Strategies under Quasi-Bayesian Social Learning
Nitin Bakshi, London Business School, Regent's Park, London, United Kingdom, nbakshi@london.edu, Nicos Savva

The introduction of popular experiential products is often accompanied by temporary stock-outs. This paper proposes a mechanism based on an empirically-motivated behavioural model of social learning. We show that such strategies may be beneficial for the firm and may also increase consumer surplus.

2 - Integrating Social Media Metrics
Wendy Moe, University of Maryland, 3469 Van Munching Hall, College Park, MD, United States of America, wendy_moe@rhsmith.umd.edu, David Schweidel

The primary goal of this paper is to offer a modeling approach that integrates multiple social media metrics. We do this by jointly modeling the number of mentions, the number of co-mentions and expressed sentiment across brands in a given market as a function of a latent map that represents the underlying competitive landscape in the industry. We demonstrate how a brand can use this model to establish benchmark metrics and calculate a measure of differentiation.

3 - Optimizing Donation Campaigns with Social Media
Shawn Mankad, Assistant Prof Of Business Analytics, University of Maryland, 4316 Van Munching Hall, College Park, MD, 21201, United States of America, smankad@cornell.edu, William Rand, Chen Wang

The rising popularity of social media has resulted in organizations of all types attempting to use the social streams to inform managerial decisions. However, using social media data can be challenging due to its varied and dynamic nature. In this work, we discuss show donations to a major nonprofit organization can be substantially increased by integrating Twitter usage around crisis events to determine the timing and targeting of marketing communications.

■ MB54
54-Room 108A, CC
Markov Decision Processes
Cluster: Tutorials
Invited Session
Chair: Andrew J. Schaefer, University of Pittsburgh, 3700 O’Hara Street, Benedum Hall 1048, Pittsburgh, PA, 15261-3048, United States of America, schaefer@ic.pitt.edu
1 - Tutorial: Markov Decision Processes in Healthcare
Andrew J. Schaefer, University of Pittsburgh, 3700 O’Hara Street, Benedum Hall 1048, Pittsburgh, PA, 15261-3048, United States of America, schaefer@ic.pitt.edu

The last decade has seen a large number of Markov decision processes (MDPs) applied to various healthcare settings. In this tutorial we review some of the healthcare decisions for which MDPs may be appropriate. We discuss some of the unique challenges that arise in healthcare modeling. Finally, we discuss future directions for MDPs in healthcare.

■ MB55
55-Room 108B, CC
Applications of DEA II
Cluster: Data Envelopment Analysis
Invited Session
Chair: Alan Pritchard, University of Maryland, Robert H. Smith Scholl of Business, Van Munching Hall, College Park, MD, 20742, United States of America, apritchard@rhsmith.umd.edu
1 - Nurse Staffing Performance Evaluation: Data Envelopment Analysis vs. Expert Assessment
Fan Tseng, University of Alabama in Huntsville, Dept of Mgt, Mkt, & IS, Huntsville, AL, 35899, United States of America, tsengf@uah.edu, Karen Frith, Faye Anderson, Patricia Patrician

When using Data Envelopment Analysis (DEA) to evaluate the efficiency of nurse staffing, the results are greatly influenced by the selection of input and output metrics. To evaluate different DEA models for their usefulness, we enlisted experts in nurse administration to evaluate the performance of nursing units using data from multiple hospitals. We compare the results between experts and the models, and discuss the issues in DEA modeling for evaluating nurse staffing performance.

2 - IT Productivity Paradox: A New Frameworks Integrating Configuration Theory and Dynamic DEA
Liu Jiawen, PhD, Huazhong University of Science and Technology, 1037 Luoyu Road, Wuhan, 430074, China, jiawen_liu@hust.edu.cn, Yeming Gong

While some research argues that information technology (IT) can improve organizational productivity, others maintains that the impact of IT may be negative. This paper advances a new perspective based on data envelopment analysis (DEA) to investigate the IT productivity paradox. We propose a new theoretical framework based on dynamic two-stage network DEA models, considering multiple periods, multiple inputs and multiple outputs, to study and understand IT productivity paradox.

3 - An Oligopolistic Emissions Trading System with Uncertain Demand
Arielle Tajbaksh, PhD Candidate, DeGroote School of Business, McMaster University, 1280 Main St. W, Hamilton, ON, L8S 4L8, Canada, arieltaj@mcmaster.ca, Elkahfi Hassini

We propose a static Cournot oligopoly game to investigate a perfectly competitive market in which supply chains compete in a non-cooperative manner in their product markets. Partners of each supply chain engage in a cooperative triopoly game where initial permit allocations of the pollutants are given on the basis of their sustainability performance that is derived from a data envelopment analysis model.

4 - Product Variety and Productivity: Evidence from the North American Beverage Industry
Alan Pritchard, University of Maryland, Robert H. Smith Scholl of Business, Van Munching Hall, College Park, MD, 20742, United States of America, apritchard@rhsmith.umd.edu, Martin Dresner, Xiang Wan

Using data taken directly from a major North American soft drink beverage bottler and distributor, we examine distribution center (DC) productivity. First, we employ data envelopment analysis (DEA) and a double bootstrapping procedure to estimate the relative efficiency of 108 DCs over a four year period (2008-2011). Then, we use a Tobit regression model to investigate the factors that influence DC productivity – that is, unexplained variation in efficiency, over time.

■ MB56
56-Room 109A, CC
Recent Advances in Location Analysis
Sponsor: Location Analysis
Sponsored Session
Chair: Sibel Alumur, University of Waterloo, 200 University Avenue West, Waterloo, ON, N2L 3G1, Canada, sibel.alumur@uwaterloo.ca
1 - Green Charging Station Location Problem
Okan Arslan, Bilkent University, Department of Industrial Engineering, Ankara, Turkey, okan.arslan@bilkent.edu.tr, Oya E. Karasan

We deal with ‘charging station location problem’ as a variant of ‘flow refueling location problem’ (FRLP) by additionally considering the hybrid vehicles such as PHEVs. The objective is to maximize the environmental benefits through maximizing electricity usage in transportation. To solve the problem, we propose an arc-cover model, and apply Benders decomposition. The structure of this formulation allows us to construct Pareto-optimal cuts without having to solve any linear programming problems.
2 - Regenerator Location Problem in Flexible Optical Networks
Baris Yildiz, Bilkent University, Universitei MAH., Ankara, 06800, Turkey, baris.yildiz@bilkent.edu.tr, Oya E. Karasan
We present the regenerator location problem in flexible optical network that solves the regenerator placement, routing, bandwidth allocation and modulation selection problems jointly. We propose a novel branch and price algorithm for this challenging problem. Our results show that making routing, bandwidth allocation, modulation selection and regenerator placement decisions in a joint manner, is possible to obtain drastic capacity enhancements with a limited regeneration capability.

3 - Risk Based Facility Location by using Fault Tree Analysis in Disaster Management
Ibrahim Akgun, Assoc. Prof., Abdullah Göl University, Department of Industrial Engineering, Kayseri, 38080, Turkey, ibrahim.akgun@agr.edu.tr
We develop an optimization model that minimizes the risk that a disaster-prone area may be exposed to because it is not supported by facilities located for prepositioning supplies. The risk is calculated as the multiplication of threat, vulnerability of the area, and consequence. The vulnerability is computed by using fault tree analysis and incorporated into the optimization model innovatively. The resulting non-linear integer program is linearized and solved as a linear integer program.

4 - Service System Design with Economies-of-scale and Congestion
Samir Elhedhli, University of Waterloo, 200 University Avenue, Waterloo, Canada, elhedhli@uwaterloo.ca
We formulate and provide solution methodologies for the service system design problem with immobile servers, stochastic demand, and capacity economies of scale. We start by reformulating the problem, and then provide solution approaches based on piecewise linearization, Second Order Cone Programming (SOCP), and Lagrangian Relaxation. Numerical results are provided

■ MB57
57-Room 109B, CC
Optimization of Power Systems Planning and Operation
Sponsor: ENRE – Energy I – Electricity
Sponsored Session
Chair: Miguel Anjos, Polytechnique Montreal, Mathematics and Industrial Engineering, Montreal, Canada, miguel-l.anjos@polymtl.ca
1 - Chance-constrained Generation Expansion Planning Incorporating Bus Sensitivities
William Rosehart, Schulich School of Engineering, University of Calgary, Calgary, AB, Canada, rosehart@ucalgary.ca,
Monisha Manick, Miguel Anjos
A Generation Expansion Planning problem with load uncertainty is formulated based on joint chance-constrained programming. Sensitivities are used to allow greater emphasis to be placed on regions with high demand relative to generation, and similarly to allow for lesser emphasis on regions that are generation-rich. Numerical results are presented for IEEE test systems.

2 - Interrelationship Between Power Transmission and Storage Elements of the Power Network
Enzo Sauma, Pontificia Universidad Catolica de Chile, Santiago, Chile, esauma@ing.puc.cl, Carlos Bustos, David Pozo, Javier Contreras, Sebastian De La Torre, Jose Aguado
We study the interrelationship between the construction of new power transmission lines to integrate wind farms and the installation of new power-storage components into the power system over the optimal transmission expansion plan. We illustrate our analysis using a stylized version of the Chilean main power system (Sistema Interconectado Central).

3 - Bilateral Contract Optimization in Power Markets
Miguel Anjos, Polytechnique Montreal, Mathematics and Industrial Engineering, Montreal, Canada, miguel-l.anjos@polymtl.ca, François Gilbert, Patrice Marcotte, Gilles Savard
We consider an energy broker linking its customers and the power grid through a two-sided portfolio of bilateral contracts. The contracts cover a number of actions taken by the customers on request within specified periods. Managing this portfolio raises a number of modelling and computational issues due to the aggregation of disparate resources. We propose an innovative algorithmic framework that models short-term decisions factoring in long-term information obtained from a separate model.

■ MB58
58-Room 110A, CC
Analytics in the Petrochemical and Petroleum Industries II
Sponsor: ENRE – Natural Resources II – Petrochemicals & Petroleum
Sponsored Session
Chair: Tejinder Singh, Sr. Research Scientist, Delaware Research and Technology Center - Houston, TX, tejinder.singh@airliquide.com
1 - A Simulation and Optimization Framework for Petroleum Refinery Operations
Ariel Uribe, Ecopetrol S.A., Km 7 Via Piedecuesta, Piedecuesta, Colombia, ariel.ubrie@ecopetrol.com.co, Sandra Montagut,
Omair Guerra
In this work we present a framework for the simulation and optimization of petroleum refinery operations at strategic and tactical decision levels. Concerning the adequate modeling of processing units, the developed framework allows for the integration of economic models with both linear and non-linear empirical process models based on historical data, rigorous process simulators, or pilot plant data using scale up techniques.

2 - Long-term Demand Forecasting in Industrial Gas Markets
Bin Yu, Air Liquide, 200 GBC Dr, Newark, DE, 19702, United States of America, bin.yu@airliquide.com, Adel Basili,
Guillelms Bonnier, Athanasios Kountopoulos, Brian Besanceney
In this talk we will focus on long-term demand forecasting of liquid oxygen and liquid nitrogen in the U.S. in 5-10 years. We analyzed the predictive performance of several forecasting techniques for IP in each sector using the employment and GDP as leading and associated variables. Moreover, we developed the method of decomposing the demand from the national level to local markets and identified the key regions that drive or restrain market growth in each local market.

3 - A Multi-period MINLP Model for Long-term, Quality-sensitive Shale Gas Development
Markus G. Droeven, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, mdroeven@cmu.edu, Ignacio E. Grossmann
In this work we address the long-term shale gas development problem which involves determining the optimal development strategy for drilling and fracturing gas wells, and designing a pipeline gathering infrastructure. The problem is formulated as a large-scale nonconvex MINLP involving convective investment costs and bilinear terms in the flow balances. We present a solution strategy that relies on an MILP approximation coupled with a restricted MINLP which yields near optimal global solutions.

■ MB59
59-Room 110B, CC
Panel Discussion: The Impact of the Value-Based Approach on the Field of Strategy
Cluster: Strategy Science
Invited Session
Chair: Nicolaj Siggelkow, University of Pennsylvania, 2000 SHDH, Philadelphia, PA, 19104, United States of America, siggelkow@wharton.upenn.edu
1 - The Impact of the Value-Based Approach on the Field of Strategy
Moderator: Michael Ryall, University of Toronto, Rotman School, Toronto, ON, Canada, m.ryall@smkeryall.com, Panelists: Peter Zemsky, Tomasz Obloj, Harborne Stuart
Value-based strategy provides an intuitive, economic theory for business strategy. An immediate benefit is that it provides a coherent alternative to ad-hoc frameworks, and, in the process, it makes explicit the fact that profits are typically part of some larger economic pie. More broadly, by providing a theory for the economic aspect of strategy, it allows strategy research to focus on some of the richer issues in strategy, including, for example, organizational design, leadership, and execution. The discussion will also consider the empirical questions that arise from the general value capture model (i.e., bi-form games applied in the context of strategy). The mathematics indicate novel issues for empirical investigation. For example, whether the distinction between “competitive” vs “persuasive” resources is meaningful (as the model suggests it should be) and, if so, in which real-world settings one type is more efficacious than the other for superior returns.
1 - Strategies for using Cases in the Undergraduate Classroom
Matthew Drake, Associate Professor Of Supply Chain Management, Duquesne University, 925 Rockwell Hall, 600 Forbes Avenue, Pittsburgh, PA, 15282, United States of America, drake987@duq.edu

Students often develop a better understanding of quantitative material by applying the analytical techniques to realistic decision scenarios. Cases provide OR/MS instructors with an effective vehicle to introduce applications of business analytics in practice. While they are common at the graduate level, cases are not used as often with undergraduates. In this session we will discuss strategies for using cases effectively with undergraduate students.

2 - On the Development of Case Studies for an Undergraduate Business Analytics Course
Eric Huggins, Professor Of Management, Fort Lewis College, 1000 Rim Drive, Durango, CO, 81301, United States of America, huggins_e@fortlewis.edu

Over the past three years I have developed half a dozen case studies for an undergraduate business analytics course. Each case study started as a big data set with a few objectives attached to it, and with the help of my students, they have evolved into current (for now), relevant (I think), interesting (I hope) OR-related case studies.

3 - Where Do I Find Classroom Cases?
James Cochran, Professor Of Applied Statistics And The Rogers-spivey Faculty Fellow, University of Alabama, P.O. Box 870226, Tuscaloosa, AL, 35487-0226, United States of America, jcochran@ua.edu

Many OR/analytics instructors want to incorporate short cases into their undergraduate courses but have difficulty finding suitable, relevant, and topical cases. Where can an instructor find such cases? If s/he is willing to experiment with writing cases, s/he can find the bases of cases in the news, popular culture, and her/his own life (and perhaps publish their efforts in INFORMS Transactions Today). We will demonstrate through several examples from the speaker's experience writing cases.

4 - Teaching Undergraduate Analytics using Cases
Peter Bell, Ivey Business School at Western University, 1255 Western Road, London, ON, N6G 0N1, Canada, pbell@ivey.uwo.ca, Mehmet Begen, Fredrik Odegaard

Ivey’s undergraduate analytics courses have used cases extensively for many years. This interactive presentation will discuss some of the benefits (and costs) of a case-based approach to undergraduate teaching.

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1 - Two-stage Distributionally Robust Unit Commitment with Generalized Linear Decision Rules
Yuanyuan Guo, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, yuanng@umich.edu, Ruiwei Jiang, Jianhui Wang

It is challenging to accurately estimate the joint probability distribution of the renewable energy. In this paper, based on a small amount of marginal historical data, we propose a two-stage distributionally robust unit commitment model that considers a set of plausible probability distributions. This model is less conservative than classical robust unit commitment models and more computationally tractable by using generalized linear decision rules.

2 - Stochastic Unit Commitment with Topology Control Recourse for Renewables Integration
Jiaying Shi, University of California, Berkeley, CA, United States of America, jshijy07@berkeley.edu, Shmuel Oren

We introduce a two-stage stochastic unit commitment formulation in which the second stage recourse actions include possible reconfiguration of the transmission grid through line switching. Switching action in the second stage are determined by a heuristic method. Such topology control capability can mitigate adverse variability in realized renewables output and improve unit commitment efficiency.

3 - Multistage Robust Unit Commitment with Dynamic Uncertainty Sets
Alvaro Lorca, Georgia Tech, 251 10th St. NW Apt. A622, Atlanta, GA, 30318, United States of America, alvarolorca@gatech.edu

We present a multistage robust unit commitment model with renewables and storage using a simple but effective affine policy for dispatch decisions, while considering dynamic uncertainty sets that integrate wind and solar power resources taking into account spatial and temporal correlations. Our solution algorithm contains enhancements that allow solving the resulting problem efficiently. We also present simulation experiments to evaluate the benefits of our approach.

4 - Multi-stage Stochastic Unit Commitment with SDDP
Jikai Zou, Graduate Research Assistant, Georgia Institute of Technology, 755 Ferst Dr. NW, Atlanta, GA, 30332, United States of America, jikai.zou@gatech.edu, Shabbir Ahmed, Andy Sun

Despite the great amount of research, stochastic unit commitment (UC) problems, where binary commitment decisions adapt to uncertainty with a multi-stage structure, still remain one of the most challenging stochastic programming problems. In this paper, we investigate a sampling based algorithm that combines stochastic dual dynamic programming (SDDP) and the integer L-shaped method for solving multistage stochastic UC. Numerical results and algorithmic improvement will be discussed.

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1 - Optimal Inspection of Imports to Prevent Invasive Pest Introduction
Robert Haight, USDA Forest Service, Northern Research Station, St. Paul, MN, United States of America, rhaight@fs.fed.us, Rebecca Epanchin-niell, Cuicui Chen

Based on our work with USDA-APHIS, we study an acceptance sampling problem that incorporates several features of quality control in public safety programs, including the simultaneous inspection of many heterogeneous lots, a budget constraint that limits inspection, inspection error, and an objective of minimizing cost to consumers. We apply our results to inspecting live plant imports to prevent invasive pest introduction.

2 - Cost-effective Planning of Invasive Species Surveillance with the Maximum Expected Coverage Concept
Denys Yemshanov, Research Scientist, Natural Resources Canada, Canadian Forest Service, Great Lakes Forestry Centre, 1219 Queen Street East, Sault Ste Marie, ON, P6A2E5, Canada, Denys.Yemshanov@NRCan-RNCan.gc.ca, Robert Haight, Frank Koch, Bo Lu, Jean Turgeon, Ronald Fournier

We present two invasion survey models based on the maximum expected coverage principle (MECP). The models maximize the expected number of invaded sources that are covered by the surveys, where a source is covered if at least one of its transmission pathways connects to a surveyed destination. We present one- and two-stage models designed to survey invasive forest pests in Canada and the U.S. Overall, the approach provides flexible solution to survey the long-distance spread of invasive pests.
3 - A Multistage Stochastic Programming Model for the Optimal Surveillance & Treatment of Invasive Species
Eyyub Kibis, Graduate Research Assistant, Wichita State University, 1845 N Fairmount, Wichita, KS, 67260, United States of America, eyyyubyunus@gmail.com, Esra Buyuktahtakin, Robert Haitg

In this study, we develop a multistage stochastic programming model to address the invasive species surveillance and treatment while minimizing the expected damages of invasive species. We use a discontinuous discrete decision tree and incorporate discretized surveillance decisions along with the probabilities of each scenario into the spatially-explicit model. The model allows policy makers to take the best surveillance and treatment decisions over time by exploiting various scenarios.

4 - Import Inspections: Harnessing Enforcement Leverage to Prevent Invasive Species Introductions
Rebecca Epanchin-Niell, Resources for the Future, Washington DC, United States of America, epanchin-niell@rff.org, Michael Springborn, Amanda Lindsay

Allocating scarce border inspection resources over a diverse set of imports to prevent invasive pest entry presents a substantial policy design challenge. We develop a risk-based inspection system in which sampling intensities vary across imports based on risk. We determine optimal sampling of imports to minimize invasive pest introduction accounting for strategic responses of exporters.

**MB63**

63-Room 112B, CC
Daniel H. Wagner Prize Competition II
Cluster: Daniel H. Wagner Prize Competition
Invited Session

Chair: Allen Butler, President & CEO, Daniel H. Wagner Associates, Inc.
2 Eaton Street, Hampton, VA 23669, United States of America, Allen.Butler@va.wagner.com

1 - Integrated Planning of Multi-type Locomotive Service Facilities under Location, Routing and Inventory Considerations
Kamalesh Somani, CSX Transportation, 500 Water St, Jacksonville, FL, 32202, United States of America, kamalesh_somani@CSX.com, Xi Chen, Yanfeng Ouyang, Siyang Xie, Zhaodong Wang, Jing Huang

Long-term infrastructure planning of locomotive service facilities is vital to the efficiency of the railroad. We developed a large-scale optimization model that integrates decisions on (i) location, capability, and capacity of fixed facilities, (ii) home location and routing plan of movable facilities, and (iii) assignment of a variety of service demands. A decomposition-based solution framework was developed and shown to bring significant economic benefits in full-scale implementations.

2 - Scheduling Crash Tests at Ford Motor Company
Daniel Reich, Leadership Program, Ford Motor Company, Dearborn, MI, United States of America, dereich@ford.com, Amy Cohn, Ellen Barnes, Yuhui Shi, Martina Epelman, Erica Klampfl

We present the problem of scheduling crash tests for new vehicle programs at Ford. We developed a completely custom-made scheduling system that transforms a labor-intensive scheduling process relying on high levels of expertise, to a more automated one that utilizes optimization and institutionalizes expert knowledge. Our system enables engineers and managers to consider multiple scheduling scenarios, using efficient interfaces to specify problem instances and efficient methods to solve them.

**MB64**

64-Room 113A, CC
Joint Session DAS/ENRE: Environmental Decision Analysis: Theory and Applications
Sponsor: Decision Analysis
Sponsored Session

Chair: Melissa Kenney, Research Assistant Professor, University of Maryland, 5823 University Research Court, Suite 4001, College Park, MD, 20740, United States of America, kenneny@umd.edu

1 - Decision Analysis for Sustainable Management of the Yellow River Delta
Liang Chen, Student, Johns Hopkins University, 3900 N Charles St, Apt. 1302, Baltimore, MD, 21218, United States of America, chenliang1468@gmail.com, Benjamin Hobbs, Jeff Nitrrouer, Hongbo Ma, Andrew Moodie

We develop a stochastic programming model for channel management and flood control that can characterize risks and impacts of possible natural avulsions, and provides solutions for prevention and mitigation. Reflecting the physical mechanism in coastal delta, our model imbeds a 1D hydrodynamic model to simulate sediment transport, channel aggradation and flooding. Our case study is Huanghe (Yellow River) Delta, China, one of the world's most dynamic and heavily urbanized coastal landscapes.

2 - Adaptive Stormwater Management with Green Infrastructure using Two-stage Stochastic Programming
Fengwei Hung, Student, The Johns Hopkins University, 3400 N Charles Street, Ames Hall 313, Baltimore, MD, 21218, United States of America, fhwung0807@gmail.com, Benjamin Hobbs, Arthur Mogarity

Green Infrastructure manages stormwater with natural processes involving significant uncertainty. Thus, many cities choose to implement it adaptively to learn how it works. We define “learning” as updating of distribution parameters of the stochastic program’s coefficients, representing automatic learning, triggering learning, multi-state learning, and multi-stage learning with technology improvement. Finally, we calculate risk-return tradeoffs for a Philadelphia stormwater case study.

3 - Framing Effects Created by Ambiguity Aversion in Static Decisions
Erin Baker, University of Massachusetts, MIE Department, 220 ELAB, Amherst, MA, United States of America, edbaker@ecs.umass.edu, Eva Regnier

In climate policy-making, many respected economists recommend using ambiguity-averse decision rules. The vulnerabilities created by ambiguity aversion in dynamic decision making have been demonstrated previously. We show that even in static, one-time, decisions, ambiguity-averse decision rules make policy makers susceptible to bias created by framing effects.

4 - Using Multi-criteria Decision Analysis to Explore Management Options in the Grand Canyon
Michael C. Runge, USGS Patuxent Wildlife Research Center, 12100 Beech Forest Road, Laurel, MD, 20708, United States of America, mrunge@usgs.gov, Kendra Russell, Kirk E. Lagory

The Bureau of Reclamation and the National Park Service are developing a Long-term Experimental and Management Plan (JTEMP) for managing water releases from the Glen Canyon Dam and related activities. We conducted multi-criteria decision analysis to evaluate the proposed alternatives, integrating scientific input from a dozen modeling teams, and values-focused input from a wide set of deeply-involved stakeholder groups. We used value-of-information analysis to inform experimental design.
2 - Similar Days? A Story Based on User-defined Similarity

Yi Liu, UC Berkeley, 107 McLaughlin Hall, Berkeley, CA, 94720, United States of America, liuyi.feier@gmail.com, Mark Hansen, Alexey Pozdnukhov

In this work, we propose a supervised data-mining algorithm for measuring similarity between two days. First, the algorithm trains the distance matrix between hours according to user-defined similarity and dissimilarity. Then it calculates the daily distance as a weighted sum of hourly distances. The approach can be applied to measure similarity between two days post-operation or identify similar days in the past for a given day.

3 - Representative Traffic Management Initiative Decisions

Alex Este, University of Maryland-College Park, 3117 AV Williams, College Park, MD, 20742, United States of America, aeste@math.umd.edu, Michael Ball, David Lovell

We provide a method for presenting data on traffic management initiatives so that it may more easily be interpreted by researchers or by TMI decision makers. This method involves solving a dominating set problem to produce a set of TMI decision statements which are representative of the range of TMI decisions that have been taken in the past.
5 - Data Mining for Problem-Specific State Space Design in Routing Applications
Dirk Mattfeld, Technische Universität Braunschweig, Braunschweig, 38106, Germany, d.mattfeld@tu-braunschweig.de, Ninja Soeffker, Marlin Ulmer

We consider a dynamic routing problem, where a vehicle serves customer requests arriving stochastically over time. Due to a time limit, not every request can be served. Rejections are feasible to maximize the overall number of served requests. For anticipation of future requests, we apply value function approximation (VFA). For improvement of the approximation process, we combine VFA with data mining operations to derive a problem-specific VFA-state space based on the observed problem states.

MB68
68-Room 201B, CC
Green Vehicle Routing
Sponsor: Transportation, Science and Logistics
Sponsored Session
Chair: Mesut Yavuz, Associate Professor, University of Alabama, Alston Hall Box 870226, Tuscaloosa, AL, 35487, United States of America, myavuz@cba.ua.edu

1 - Pathways to Green Logistics: Past, Present and Future of the Green Vehicle Routing Problem (GVRP)
Sevgi Erdogan, Faculty Research Associate, University of Maryland-NCSG, 1112 J Peirinkert Field House, College Park, MD, 20742, United States of America, serdogan@umd.edu

This talk will give a brief background to the GVRP and a review of the variants and extensions to the problem as well as techniques to their modeling and solution. A close analysis of the state of literature will be given. Pathways for future research will be discussed.

2 - The Electric Fleet Size and Mix Vehicle Routing Problem with Time Windows and Recharging Stations
Richard Hartl, Professor, University of Vienna, Oskar-Morgenstern-Platz 1, Vienna, Austria, richard.hartl@univie.ac.at, Gerhard Hriemen, Jakob Puchinger, Stefan Ropke

When routing electrical vehicles, limited battery capacity makes detours to recharging stations necessary. We introduce the E-Fsvrptw model to model decisions regarding the fleet composition and the actual routing including the choice of recharging times and locations. We propose a branch-and-price method as well as an ANLS with an embedded local search and labelling procedure. The effectiveness of the proposed approach is shown on a newly created set of benchmark instances and existing benchmarks.

3 - An Iterated Beam Search Algorithm for the Green Vehicle Routing Problem in Service Fleets
Mesut Yavuz, Associate Professor, University of Alabama, Alston Hall Box 870226, Tuscaloosa, AL, 35487, United States of America, myavuz@cba.ua.edu

We present a novel Iterated Beam Search (IBS) solution to the Green Vehicle Routing Problem (GVRP) in Service Fleets. The problem allows internal and external refueling and aims to minimize the total travel distance of a homogeneous fleet. Two mathematical formulations (vehicle flows and set partitioning) are built and a lower bound is obtained for each. Two heuristics (savings and insertion) are adopted for upper bounding. We also present preliminary results of a computational experiment.

4 - Fleet Sizing and Scheduling for Mixed Fleets with Alternative Fuel Vehicles
Ismail Capar, Texas A&M University, College Station, TX, United States of America, capar@tamu.edu

We present a mixed-integer formulation for a new type of fleet sizing and scheduling problem. The formulation considers special need for refueling of alternative fuel vehicles due to their limited range and/or limited refueling infrastructure, such as availability of charging stations for electric vehicles. We provide results of numerical analysis together with managerial insights.

MB69
69-Room 201C, CC
Facility Logistics IV
Sponsor: TSL/Facility Logistics
Sponsored Session
Chair: Debjit Roy, Associate Professor, Indian Institute of Management Ahmedabad, Vastrapur, Ahmedabad, 380015, India, debjit@iimahd.ernet.in

1 - Robust Supply Chain Design and Operation under Uncertainty
Deniz Tursun, Postdoctoral Research Associate, University of Illinois Urbana Champaign, 3308 Sharp Drive, Champaign, IL, 61822, United States of America, utursu2@illinois.edu

Robust supply chain design and operation under uncertainty problems lead to confluence of integer and continuous variables, which call for Mixed-Integer Nonlinear Programming (MINLP) algorithms. We consider a comprehensive random projection algorithm for a subclass of MINLPs, where the objective and constraints are defined by convex functions and integrality restrictions are imposed on a subset of the decision variables.

2 - Batching Decisions in Stock-to-Picker Order Picking
Debjit Roy, Associate Professor, Indian Institute of Management Ahmedabad, Vastrapur, Ahmedabad, 380015, India, debjit@iimahd.ernet.in, Vibhuti Dhingra, Jennifer Pazour

We develop new analytical models to analyze performance of static vs. dynamic batching policies in stock-to-picker order pick systems. In particular, we analyze the effect of batch size, variability in item inter-arrival times, and item commonality on order pick performance.

3 - Branch-and-Price for the Capacitated Mobile Facility Location Problem
S. Raghavan, Professor, Smith School of Business & Institute for Systems Research, University of Maryland, College Park, MD, 20742, United States of America, raghavan@umd.edu, Mustafa Sahin, Sibel Salman

The Capacitated Mobile Facility Location Problem (CMFLP) is a combinatorial optimization problem with applications in supply chain operations and distribution of medical services. We propose two Mixed Integer Programming formulations for the CMFLP and discuss a branch-and-price algorithm for a set partitioning formulation, where the linear programming relaxation is solved with a column generation procedure. We demonstrate the quality of the algorithm on instances adapted from the literature.

4 - Store Fulfillment for Online Orders: A Planning Model in a Collaborative Store Environment
Ming Ni, SUNY Buffalo, 326 Bell Hall, University at Buffalo, Amherst, NY, 14260, United States of America, mingni@buffalo.edu, Arun Hampapar, Qing He, Xuan Liu

This study on online order fulfillment aims to identify the seasonal planning dimensions from local retailing outlook perspective. It develops optimization models and heuristic algorithms which solve order assignment and fleet sizing problems to construct the supply chain plan. The numerical examples are derived from same day delivery from a real-world retailer store network.

MB70
70-Room 202A, CC
Joint Session RAS/TSL/AAS: Real-Time Decision Support Practice
Sponsor: Railway Applications
Sponsored Session
Chair: Ravindra Ahuja, President, Optym, 7600 NW 5th Place, Gainesville, FL, 32607, United States of America, ravindra.ahuja@optym.com

1 - Simulation-guided Optimization Algorithms for Real-time Train Scheduling
Pedram Sahba, Senior Systems Engineer, Optym, 7600 NW 5th Place, Gainesville, FL, 32607, United States of America, pedram.sahba@optym.com, Ravindra Ahuja, Abbas BozorgiR

In this presentation, we will describe several algorithms for real-time train scheduling (also known as meet-pass planning) using simulation, mixed integer programming and network optimization techniques including their computational results. These algorithms are in production at a railroad in Australia and we will give a demonstration of the system using these algorithms. We will also share our lessons about how these algorithms evolved, what worked, and what did not work.
2 - Real-time Airline Schedule Recovery
Dejun Hang, Jeppesen, Englewood, CO, United States of America, Darren.Hang@jeppesen.com
In airline daily operations, the schedule is often disrupted by events unforeseen at the planning stage. Recovering the disrupted schedule as fast as possible with good quality is critical to protect revenue. We present how Jeppesen's Fleet Management System approaches this problem. We will discuss the underlying models and algorithms used to solve the aircraft and crew schedule recovery problems, and also some of the critical support processes.

MB71
71-Room 202B, CC
Mobility Choices in Urban Transportation
Sponsor: TSL/Urban Transportation
Sponsored Session
Chair: Hai Jiang, Tsinghua University, Dept of Industrial Engineering, Beijing, China, hajiang@tsinghua.edu.cn
1 - Determinants of Private Vehicle use Intensity: Evidence from Disaggregate Household Data in China
Hai Jiang, Tsinghua University, Dept of Industrial Engineering, Beijing, China, hajiang@tsinghua.edu.cn, Zhao Zhang
The level of congestion is primarily determined by the number of vehicles owned by the residents and their use intensity (that is, annual vehicle miles driven). Existing literature typically conduct the analysis using aggregated macroeconomic variables. In this talk, we use disaggregate household data to identify determinants of private vehicle use intensity in China. We find that gasoline price plays little role in use intensity, which is consistent with results from existing literature using macroeconomic data. We also find that the socioeconomic characteristics of the household has considerable effect in vehicle use intensity.

2 - A Comparison of Mixed Logit and Latent Class Methods for Mode Choice Analysis
Yuntao Guo, Purdue University, Lyles School of Civil Engineering, West Lafayette, IN, 47907-2051, United States of America, guo187@purdue.edu, Jian Wang, Srinivas Petra
This study aims to investigate the differences between the mixed logit and the latent class methods in terms of model fit, model insights, predicted travel mode choice, and spatial transferability using a large sample of revealed preference travel mode choice data. The model can help planners to develop effective strategies to foster more sustainable transportation mode choice behaviors by reducing automobile dependency and encouraging the usage of alternative modes of travel.

3 - Traffic Equilibrium and Pricing with Information in a Correlated Network
Song Gao, Associate Professor, University of Massachusetts Amherst, Department of Civil and Env. Engineering, 214C Marston Hall 130 Nat. Resources Rd, Amherst, MA, 01003, United States of America, sga@engin.umass.edu, Andre de Palma
We study the impacts of correlation and information penetration rate in a network with correlated, random link capacities, in terms of the types of equilibrium solution (corner vs interior for informed and uninformed respectively), the user cost for informed and uninformed, the social cost, and the optimal price for system optimum.

MB72
72-Room 203A, CC
Journal of Quality Technology (JQT) Invited Session
Sponsor: Quality, Statistics and Reliability
Sponsored Session
Chair: Fugee Tsung, Prof., HKUST, Clear Water Bay, Kowloon, Hong Kong - PR, ftsung@ust.hk
1 - An Introduction to Statistical Issues and Methods in Metrology
Joanne Wendelberger, Los Alamos National Laboratory, Statistical Sciences Group, MS F600, Los Alamos, NM, 87545, United States of America, joanne@lanl.gov, Michael Hamada, Max Morris, Stephen Vandeman, J. Marcus Jobe, Tom Burr, Huaqing Wu, Leslie Moore
Statistical science and metrology provide valuable concepts and approaches for assessing the quality of measured data. Measurement quality impacts the knowledge that can be gained by collecting and analyzing data using statistical methods, and appropriate data collection and analysis quantifies the quality of measurements. An overview of statistical issues and methods in metrology is presented that includes both frequentist and Bayesian methodologies.

2 - From Profile to Surface Monitoring: SPC for Cylindrical Surfaces via Gaussian Processes
Bianca Colosimo, Professor, Politecnico MILANO, via La Masa, I, Milan, 20136, Italy, biancacolosimo@polimi.it, Massimo Pacella
Quality of machined products is often related to the final shapes of the manufactured surfaces. This paper presents a novel method for surface monitoring, which combines Gaussian processes to model the manufactured shape and multivariate control charting for monitoring the deviations of the actual surface from the in-control pattern. Regardless of the specific case study, the proposed approach is general and can be extended to deal with different kinds of surfaces or profiles.

3 - Multimode Geometric Profile Monitoring with Temporally Correlated Image Data
Abhishek Shrivastava, Assistant Professor, FAMU-FSU College of Engineering, Dept of Industrial & Manufacturing Eng, Tallahassee, FL, 32310, United States of America, ashrivastava@fsu.edu, Park Chiwoo
We propose a new method for monitoring changes in geometrical profiles of objects in a dynamic process; changes in profiles occur in various modes. This work is motivated by the need for monitoring changes in geometrical shape and sizes of nanoparticles during self-assembly process. The proposed multimode geometric profile monitoring method addresses three specific issues: profiling of functional data, monitoring of multimode processes, and monitoring of time-correlated processes.

MB73
73-Room 203B, CC
Game-theoretical Models in Maintenance and Reliability
Sponsor: Quality, Statistics and Reliability
Sponsored Session
Chair: Maryam Hamidi, PhD Candidate, University of Arizona, 1127 E. James E. Rogers Way, Room 111, P.O. Box 210020, Tucson, AZ, 85721, United States of America, mhamidi@email.arizona.edu
1 - A Cooperative Game of Spare-Parts Systems
Ulus Ozen, Ozyegin University, Ozyegin University Cekmekoy Campus, Istanbul, Turkey, ulas.ozen@ozyegin.edu.tr
We consider a group of firms that keep spare-parts inventory to maintain their equipments. The firms can cooperate by pooling their spare-parts inventory and reduce costs. One important question is how the benefit of such cooperation should be shared between the participating firms. The firms’ spare-parts investment problem is modeled as a queueing model and we study the associated cooperative game. We show that the resulting game has a non-empty core. Several extensions are studied further.

2 - Non-cooperative Game Theory Analysis in Supply Chain Internal Financing
Wanying Shi, Western New England University, 1215 Wilbraham Street, Springfield, MA, 01119, United States of America, wanying.shi@wne.edu, Julie Drzymalski
This paper evaluates the effect of wholesale price discount contract on coordinating non-cooperative supply chain financing between a liquid supplier and a capital constrained retailer at a risk-free rate. Optimal policies for retailer and supplier are found. Profits and efficiencies of retailer, supplier and supply chains are compared in both the retailer- and supplier-led Stackelberg games. Results show that internal financing will increase overall profits.
3 - A Competitive Dynamics Approach to Supply Chain Management: Competitive Action and Performance
Xinyi Ren, PhD Student, University of Maryland, 3330 Van Munching Hall, College Park, MD, 20742, United States of America, xinyi.ren@rlsmith.umd.edu, Christian Hofer, Curtis Grimm, David Cantor

This study investigates how the actions of supplier and manufacturer (local firm) dyads impact local firm’s performance. Grounded in competitive dynamics and the relational view, theory will be developed regarding actions and performance. A panel dataset will be built combining data from FACTSET, Compustat and LexisNexis. This paper will contribute to both the competitive dynamics literature and relational view by studying competitive actions in a supply chain context.

**MB74**

74-Room 204A, CC
Sustainable Operations in the Manufacturing Industry
Sponsor: Quality, Statistics and Reliability
Sponsored Session
Chair: Wilkistar Otieno, Assistant Professor, University of Wisconsin-Milwaukee, 3200 N Cramer St, Milwaukee, WI, 53209, United States of America, otieno@uw.edu

1 - Inventory Optimization in a Three Echelon Closed Loop Supply Chain with Stochastic Quality in Return
Sajjad Farahani, PhD Student, University of Wisconsin-Milwaukee, 4046 N Wilson Dr Apt 2, Milwaukee, WI, 53211, United States of America, farahani@uw.edu, Farshid Zandi, Wilkistar Otieno

We considered three echelon closed loop supply chain in which returned product arrive to the re-manufacturing system with different quality level inspect to estimate needed time to re-manufacture as a new product. We proposed an analytical queuing models with the time value of money consideration to optimize inventory level of two warehouses and the admission decision, which decide on the acceptance of returned products based on quality and processing time.

2 - A Simulation Based Model for Performance Evaluation of Control Drive Remanufacture
Thomas Onwando, Graduate Student, University of Wisconsin-Milwaukee, 3200 N Cramer St. EMS 503, Milwaukee, WI, 53211, United States of America, onwando@uw.edu, Wilkistar Otieno

Process complexities and uncertainties in product remanufacture affect system performance. In this study a discrete event simulation approach is employed to model process performance with the objective of improving system performance. A case study of two product families in control drive remanufacture is used to illustrate the applicability of the model. A sensitivity analysis is carried out to assess the effect of changes in various decision variables on the overall system performance.

3 - Warranty Analysis of Remanufactured Electrical Products
Yuxi Liu, Graduate Student, University of Wisconsin-Milwaukee, 3438 N Oakland Ave #302, Milwaukee, WI, 53211, United States of America, yuxiliu@uw.edu, Wilkistar Otieno

This study considers a remanufactured electrical product under warranty. Warranty is key ensuring a good manufacturer-consumer relationship. Manufacturers hope to minimize warranty costs while consumers believe warranty promises product quality. This paper presents an optimal warranty period from the perspective of a manufacturer to maximize the total expected profits, while sustained consumer relation. We use data from a local company with a global supply chain to provide a numerical example.

**MB75**

75-Room 204B, CC
Managing Search and Problem Solving in Innovation Settings
Cluster: New Product Development
Invited Session
Chair: Sezer Ülkü Associate Professor, Georgetown University McDonough School of Business, 545 Hariri Building, 37 & O Streets, Washington, DC, 20057, United States of America, su@georgetown.edu

1 - When to Leave the Building? Search and Pivoting in a Lean Startup
Onesun Steve You, University College London, Gower Street, London, WC1E 6BT, Kingdom, o.yoo@ucl.ac.uk, Kenan Avrifoğlu, Tingliang Huang

An early stage entrepreneurial firm with a new product concept must maximize the chance of successful product launch. To avoid developing an unwanted product, practitioners suggest a lean approach to development, i.e., a firm should iteratively launch an unfinished product to learn what the consumers want and to alter the final product goal whenever necessary. We formalize this approach via the Bayesian learning framework, and investigate the optimal development strategy.

2 - How (and When) to Encourage Cooperation Across Projects
Fabian Sting, Erasmus University Rotterdam, Rotterdam School of Management, 3000 DR Rotterdam, Netherlands fsting@rsm.nl, Pascale Crama, Yaozhong Wu

Inspired by an innovative practice, we model a Project Management system that incorporates and shapes cooperative problem solving. Help is at the core of this system, in which project managers may ask for and provide help. We find that companies should take a nuanced approach when designing help exchange and time-based incentives.

3 - Search under Constraints - An Experimental Study
Sezer Ülkü, Associate Professor, Georgetown University McDonough School of Business, 545 Hariri Building, 37 & O Streets, Washington, DC, 20057, United States of America, su@georgetown.edu

In contexts of innovation, slack resources are required due to the many unknowns. At the same time, according to some, “necessity is the mother of invention”, and resource constraints might improve innovative performance. Through a series of experiments, we examine how constraints influence search strategies, and the ultimate performance.

**MB76**

76-Room 204C, CC
Simulation Optimization and Input Uncertainty
Sponsor: Simulation
Sponsored Session
Chair: Enlu Zhou, Assistant Professor, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, United States of America, enlu.zhou@isye.gatech.edu

1 - Insights on Ranking and Selection when there is Input Uncertainty
Barry Nelson, Walter P. Murphy Professor, Northwestern University, Dept. of IEMS, 2145 Sheridan Road, C210, Evanston, IL, 60208, United States of America, nelsonb@northwestern.edu, Eunhye Song

We examine the impact of input uncertainty (inaccuracies in the stochastic input models that have been estimated from real-world data) on the simplest form of simulation optimization: ranking and selection among a finite number of alternatives. We show that the conclusions from the optimization must be altered, establish the limits of what can be attained by increased simulation effort alone, and suggest alternative ways to attack the problem that lead to interpretable conclusions.
2 - Distributionally Robust Stochastic Optimization using Divergences- A Data Driven Strategy
Anand Vidyashankar, Associate Professor, George Mason University, Department of Statistics, Volgenau School of Engineering, Fairfax, VA, 22030, United States of America, avidyash@gmu.edu, Jie Xu
We propose a new paradigm for data-driven distributionally robust stochastic optimization (DRSO). This paradigm integrates existing approaches to decision making under uncertainty with robust and efficient statistical procedures. Specifically, it extends the scope of DRSO by centering the ambiguity sets on density estimates neighborhoods in the space of probability densities. The proposed approaches are transparent, theoretically justified, and accessible to researchers and decision makers.

3 - Some Statistical Perspectives on Optimization under Parameter Uncertainty
Henry Lam, Assistant Professor, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, 48109, United States of America, khlam@umich.edu, Jeff Ito
We consider approaches to improve the quality of solutions for optimizations under parameter uncertainty, in the case of limited data. We analyze two computationally tractable methods: bootstrap aggregation, or bagging, and Bayes estimator in the decision-theoretic framework. Both are simulation-based schemes that aim to improve the distributional behavior of the optimality gap by reducing its frequency of hitting large values.

4 - Simulation Optimization When Facing Input Uncertainty
Enlu Zhou, Assistant Professor, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, United States of America, enlu.zhou@isye.gatech.edu, Xie Wei
This talk makes an attempt at the question of what is a good formulation for simulation optimization when there is input uncertainty. We propose a risk formulation of simulation optimization that tries to balance the trade-off between optimizing under the estimated input model and hedging against the risk brought by input uncertainty.

MB77
77-Room 300, CC
Supply Chain Management VI
Contributed Session
Chair: Bisheng Du, Assistant Professor, Ningbo University, 818 Fenghua Road, Ningbo, China, dubisheng@nbu.edu.cn
1 - Supplier Development Investments under Competition
Tarun Jain, IIM Bangalore, FPM Office, IIM Bangalore, Baterghatta R, Bangalore, India, tarun.jain@iimb.ernet.in, Jishnu Hazra
We model a case, where a buyer is evaluating a new supplier. The buyer allocates some capacity to the incumbent supplier and makes supplier development investments in the entrant supplier. Both incumbent and entrant supplier also exert improvement investments. We find the optimal investments strategy of these players and the optimal capacity allocation strategy of the buyer.

2 - Analysis and Design of Retail Backrooms and its Impact on Supply Chain
Lita Das, Student, MIT, 77 Massachusetts Avenue, E40-286, Cambridge, MA, 02139, United States of America, litudas@mit.edu, Edgar Blanco
Backroom space management and supply chain operations are closely linked. We propose a model to optimally manage backroom space and demonstrate the impact on retail supply chain planning and design.

3 - An Evaluation of the Progressive Formulation (PF) through the Modeling of the PCSA
Daniel Mota, Researcher, MIT, Rua Jose de Magalhaes 373, Vila Clementino, Sao Paulo, SP, 04026, Brazil, dannmota@mit.edu, Roberto Perez-franco
Progressive Formulation (PF), an ad-hoc approach recently proposed for formulating a supply chain strategy, has shown potential in applied projects but has never been objectively evaluated. This paper attempts a first evaluation of the merits of the PF approach, by modeling PF as a greedy algorithm and comparing its results against an optimal solution for the same data set. Results are compared in terms of the quality of the solution generated and the amount of information needed to achieve it.

4 - Capacity Planning over a Finite Time Horizon with Dual Contracts: An Optimization Approach
Ramya Ravi, Student, Indian Institute of Technology, Madras, Chennai, 600036, India, ramya.tcemdu@gmail.com, Haritha Thirrulama, Rajendran Chandrasekharan, Vivekanandan Srinivasan
We consider a supply chain with multiple products manufactured using processes outsourced to suppliers by the manufacturer. Capacity planning contracts (i.e., fixed charge and options, with setup/order costs) are considered. We present an algorithm to determine the capacity investments, considering the total supply chain profit over a finite time horizon.

MB78
78-Room 301, CC
Shipping and Transportation for Supply Chains
Contributed Session
Chair: Sherif Masoud, Operations Research Analyst, RockTenn, 3950 Shackelford Rd., Duluth, United States of America, smasoudphd@gmail.com
1 - Port Logistics and the Voice of the Customer
Richard Monroe, Visiting Assoc Prof, Longwood Univ, College of Business and Econ, 201 High Street, Farmville, VA, 23901, United States of America, rickmon53@gmail.com
Customers are key stakeholders for logistics services through the various modes which include seaports, trucking, rail and inland ports. Primary customers such as manufacturers and retailers are highly dependent on the smooth flow of freight through the logistics system. Customer expectations for logistics services have received limited attention in previous research. This paper will utilize a combination of approaches to explore the voice of the customer in the port logistics setting.

2 - A New Formulation for the Cyclic Inventory Routing Problem and the Solution Method
Zhe Liang, Professor, Tongji University, No. 1239, Siping Road, Shanghai, 200092, China, liangzhe@tongji.edu.cn, W. Art Chaowatimoswong
We study a cyclic inventory routing problem (IRP). The traditional exact methods for IRP use an arc-based model, in which a variable represents a possible vehicle flow between a pair of customers. We develop a Dantzig-Wolfe reformulation for the arc-based model. To solve the problem efficiently, we develop a set of valid inequalities and a column generation algorithm. Computational results show that the new model can obtain near optimal solutions to very large test cases in a reasonable time.

3 - Robust Supply Chain System under Yield Uncertainty
Samir Alsobhi, Ph.D Candidate, Wichita State University, 11328 E Pine Meadow Ct, Wichita, KS, 67206, United States of America, samiralsobhi@gmail.com, Krishna Krishnan
Products are often damaged in transit. These damages are stochastic in nature. To minimize the impact of damage, the selection of routes should consider not only the expected damage but also the variability of damage. In this research, the first model is of the supply chain network in order to minimize total cost, which consists of product cost and transportation cost while considering multiple routes and products. In the second model, the concept of robust design has been applied to minimize damage.

4 - A Floating Price Contract for the Ocean Freight Industry
Ruina Yang, Xi’an Jiaotong University, No. 28 West Xianning Road, Xi’an, China, rnyang@mail.xjtu.edu.cn
We propose a floating price policy to address the shipper default issue. Specifically, the shipper has to make a tradeoff between not fulfilling all committed capacity to secure a lower spot price in the low season and purchasing the capacity at a higher floated price in the high season. The results reveal that the non-capacity commitment contract serves both parties’ interests under a tight-capacity market, while the floating price contract is the most effective in an over-capacity market.
5 - Minimizing Automotive Supply Chain Costs under Mixed Transportation Modes
Shelf Mason, Operations Research Analyst, RockTenn, 3950 Shackelford Rd., Duluth, MN, United States of America, smasondph@gmail.com, Scott Mason
We present an industry-motivated integrated production and transportation problem focused on short-term automotive supply chain planning. We consider multiple, heterogeneous modes of transportation that offer a cost vs. delivery time option to the manufacturer. Computational results demonstrate the efficiency of a proposed metaheuristic-based solution approach, given the problem's NP-hard computational complexity.

■ MB79
79-Room 302, CC
Software Demonstration
Cluster: Software Demonstrations
Invited Session
1 - AMPL - Developing Optimization Applications Quickly and Reliably with Algebraic Modeling
Robert Fourer, President, AMPL Optimization Inc., 2521 Ashby Ave, Evanston, IL, 60201, United States of America, 4er@ampl.com
Can you negotiate the complexities of the optimization modeling lifecycle, and deliver a working application before the problem owner loses interest? Algebraic languages were invented to streamline the key steps of model formulation, testing, and revision. Today they are supported by powerful facilities for embedding models into larger systems and deploying them to users. This presentation introduces algebraic modeling for optimization through examples using classic and recently introduced features of the AMPL language and system.

2 - Gurobi Optimization, Inc. – Modeling with the Gurobi Python Interface
Renan Garcia, Optimization Support Engineer, GAMS Development Corp
Are you looking for an environment that combines the expressiveness of a modeling language with the power and flexibility of a programming language? The Gurobi Python interface allows you to build concise and efficient optimization models using high-level modeling constructs. Moreover, Python itself has a vast ecosystem of packages designed to increase your productivity, such as a notebook-style interface (iPython Notebook), data access capabilities and web development tools. This tutorial will provide an overview of these features, including detailed examples that show how to use the Python interface to build models that can be turned into full optimization applications.

Monday, 12:30pm - 2:30pm
Exhibit Hall A
Monday Poster Session
Contributed Session
Chair: Wenjing Shen, Drexel University, Philadelphia, PA, United States of America, ws84@drexel.edu
Co-Chair: Allen Holder, Rose-Hulman Mathematics, Terre Haute, IN, United States of America, holder@rose-hulman.edu
Co-Chair: Min Wang, Drexel University, 3141 Chestnut Street, Philadelphia, PA, United States of America, mw638@drexel.edu
1 - Big Data
Marwah Halwani, University of North Texas, 2812 Loon Lake Road, Denton, TX, 76210, United States of America, marwahhalwani@my.unt.edu, Victor Prybutok, Adam Corwin, Daniel Peck
The Big Data Model developed to provide a foundation for the proper use of Big Data and Data Visualization in Social Media environments that will drive positive bottom-line results. This research addresses how can Big Data represented with Data Visualization in a Social Media environment contribute to better decisions.

2 - Brightness-location Congruency Effects on Consumer Behavior in Retail Context
Takesumi Sunaga, Professor, Kwansei Gakuin University, 1-1-155, Uegahara, Nishinomiya, Hyogo, 662-8501, Japan, sunaga@kwansei.ac.jp, Jaewoo Park
The study investigates the effects of the crossmodal correspondence between colour and visual heaviness on consumer purchase behavior. The results of the experiments demonstrate that brightness-location congruence, specifically products with bright (dark) colour at the higher (lower) shelf positions, increases shoppers’ perceptual fluency and promotes their purchase behaviour.

3 - A Kalman Filter Algorithm for Artillery Firing Shift
Michael Bendersky, Ben Gurion University of the Negev, Beersebaba, Israel, michael.bendersky@gmail.com, Israel David
We propose an innovative algorithm for artillery firing shift using the Kalman Filter approach. Firing shift implies an immediate artillery engagement of a target (“fire for effect”) without a prior fire adjustment (by a forward observer). The capability of firing shift provides undeniable operational advantages. Implementing the Kalman Filter allows sequential fire adjustment relying on multiple auxiliary targets.

4 - Demand Forecasting and Area Marketing for Gas Appliances
Kosuke Shaku, Toyokogas, 1-5-20, Kaigan, Minato-ku, Tokyo, Japan, shaku@toyokyo-gas.co.jp
Tokyo gas has been utilizing OR to a lot of fields such as marketing, emergency response, and so on. Demand Forecasting of gas appliances has been a big problem for gas appliances sales. We managed to establish the method of quantitatively rational demand forecast by utilizing the CRM data of appliances stocks, survival analysis, and transience of appliances types in replacement. The result of this work has been adopted to many Tokyo gas measures such as sales goal setting and area marketing.

5 - Who to Call Predictive Modeling of Potential Customers Based on Customer Behavior Data
Liu Shi, Kihiti Network Information Systems Technology, China, shili@baixing.com
A telemarketing campaign is operated in a classified advertisements website Baixing.com. A model is needed to predict the possibility of customers order and then call the one with highest possibility can be selected. The model is designed and implemented a practical decision support system which could generate and distribute customer lists to sales representative. The poster introduces the object, business background, specific aims, modeling procedures, modeling data, final result, and the conclusions of the work. Four techniques have been used to compare the performance. Random forest gives the best result. The final dynamic model integrates customers online behavior data, which is also called click-stream data as indicators of willingness to pay. The result from field study inspired that in the future work, we may push dynamic modeling for more robust and precise prediction.

6 - The Opportunity Cost of Federal Subsidies for Electricity Generation in the U.S.
James Gibson, USMC, 2414 Turtle Bay Dr, New Bern, NC, 28562, United States of America, gibson.james.r@gmail.com
This study is the first investigation of the opportunity cost associated with electric utility sector federal subsidies using the mean-variance portfolio theory. The application of portfolio theory provides for an examination of how policy decisions influence electricity generation costs. The results indicate federal subsidies have an uncertain effect on electricity generation costs and the associated tax burden becomes an opportunity cost assumed by society and individual taxpayers.

7 - The Effect of Shape and Semantic Novelty in Product Design Usage
Leyla Zhuhadar, Assistant Professor, Western Kentucky University, 1906 College Hills Blvd, Grise Hall, Bowling Green, KY, 42101, United States of America, leyla.zuhadar@WKU.edu
In this research, we have developed a marketing application for data mining with the goal of publicizing a new product to those customers with a high affinity for it. We assembled suitable data to test and evaluate different mining algorithms on it. We have used the buyers of our product of interest as “model customers” for finding similar customers among the non-buyers. Finally, we deployed our final model to our customer base.

8 - Who Wants My Product? Affinity-based Marketing
Anna Danandeh, University of South Florida, Tampa, FL, 33613, United States of America, annadanandeh@mail.usf.edu, Bo Zeng, Brian Buckley
A challenge in UC is the impact of uncertain factors such as ambient temperature on generation and transmission capacities. Since system capacity is mostly determined statically, weather changes can cause outages and/or congestions. We developed a 2 stage robust security-constraint UC formulation that dynamically rates the assets and hedges against possible efficiency drops. Leveraging the correlation between weather and load, it yields a less conservative decision and a faster computation.
10 - Advanced Decision-making Procedures in Massive Failure Data Classification
Keivan Sadeghizadeh, Northeastern University,
27 Payne Rd, Newton, MA, 02461, United States of America,
k.sadeghizadeh@neu.edu
In many professional areas, management-decision-making process is based on the type and size of data where data classification is a necessary procedure. Massive amount of data in high-dimensions are increasingly accessible from various sources and it has become more difficult to process the streaming data in traditional application approaches. This poster presents advanced procedures to analyze high-dimensional failure data in order to facilitate decision-making through data classification.

11 - Exploring Residents Attitude Towards Solar Photovoltaic System Adoption in China
Yaqin Sun, Drexel University, 38 Clarence Avenue, Bridgewater, PA, United States of America, yys523@drexel.edu, Xiangrong Liu
The research aimed to identify the drivers and dynamics that most encourage Chinese customers to install solar PV systems (SPS) in their residential buildings. A survey was designed and conducted among Chinese residents. The first hand data indicated the importance of increasing awareness of SPS among potential customers. This research also assessed the impacts of gender on their knowledge of, concerns, and attitudes towards PV adoption. However, no significant difference among gender was found.

12 - Design of Financial Incentive Programs to Promote Net Zero Energy Buildings
Alirea Ghahfarokhi, University of South Florida, Tampa, FL, United States of America, alirea@mail.usf.edu, Tapas Das
Promoting net zero energy buildings (NZEB) is among key carbon emissions reduction approaches in the U.S. and in the EU countries. We presented a mixed integer programming (MIP) model to determine the minimum thresholds of financial incentives that would accelerate their growth in NZEBs. Several combinations of production tax credit and loan interest rates have been investigated for different commercial buildings in Tampa, FL. The results indicate the threshold values of the incentive program parameters.

13 - Multi-objective Scenario Discovery for Climate Change Adaptation
Julie Shortridge, PhD Student, Johns Hopkins University, 3400 N. Charles St., Ames Hall 317, Baltimore, MD, 21218, United States of America, julieshortridge@gmail.com, Seth Guikema
New methods for decision support under non-probabilistic uncertainty are becoming increasingly popular in the climate change adaptation field. Scenario discovery, as part of the robust decision making framework, uses machine learning to identify multivariate scenario where a plan or system will perform poorly. In this work, we evaluate different methods for incorporating multiple criteria into the scenario discovery process to assess whether the method impacts the scenarios identified.

14 - The Unit Commitment Model for Power Interruption Contracts
Lakshmi Palaparibili Dinesh, PhD Candidate, University of Cincinnati, 221 Redmon Avenue Apt. 21, Cincinnati, OH, 45219, United States of America, lakshmi063@gmail.com, Jeffrey Camm
The term unit commitment implies which power generation units should be turned on or off in a power plant. When the demand for power is high, power could either be bought from the spot market or the customers could be interrupted using a contract. The problem deals with choosing the right set of customers for interruption using a technique called joint optimization and hence reducing the overall costs for the supplier.

15 - Virtual Metrology for Copper Clad Laminate Manufacturing
Misuk Kim, Seoul National University, 39-339, Gwanak-ru, Gwanak-gu, Seoul, Korea, Republic of, mikske88@naver.com
Virtual metrology predicts wafer quality properties based on sensor values of the equipment in semiconductor manufacturing. It reduces the cost associated with physical metrology as well as identifies important equipment sensor values. We applied it to copper clad laminate for printed circuit board with data from a Korean manufacturer. We not only obtained prediction models with a high accuracy, but also found a number of important, yet previously unknown to engineers, equipment sensors.

16 - Goodness of Fittest for Multimodal Model with Clustered Data
Zhiheng Xie, PhD Candidate, University of Kentucky, Lexington, KY, 40503, United States of America, zhiheng.xie@uky.edu
Discrete-time Markov chains have been used to analyze the transition of subjects from intact cognition to dementia with transient states, and death as competing risk. We proposed a modified chi-square test statistic which can deal with the clustering effects for the multimodal assumption. We showed our new statistic has a better type I error control when clustering effects presents. We apply the test to the data from the NUN Study, a cohort of 461 participants.

17 - Discrete Event Dynamic Simulation for Modeling a Real Job Shop System
Golsan Madraki, Ohio University, 15 Station St, Apt. F, Athens, OH, 45701, United States of America, gm709913@ohio.edu
A new approach for simulating a job shop system is introduced. The interarrival time of jobs, processing time of machines, time between failures, repair time have general distribution. Previous models consider these parameters deterministic or exponentially distributed. We facilitate estimation of maximum production rate, where Buffers capacity, Number of machines in each shop, Number of Lift-truck are efficient.

18 - Optimization of Food Production (Ready-To-Eat Meat Sticks)
Rebecca Brusky, Data Science Student, University of Nebraska Omaha, 3602 Lincoln Blvd, Omaha, NE, 68131, United States of America, rbrusky@unomaha.edu, Betty Love
In the production of ready-to-eat meat sticks, the bottlenecks (dependencies) need to be minimized and number of sticks produced needs to be maximized. Dependent components include equipment flow constraints, smoke room duration and cleaning downtime. The longest downtime factor is the required four-hour cleaning when switching to a non-compatible flavor. This poster documents how a six-flavor production line governed by a set of flavor ordering rules and production demands can be optimized.

19 - Rethinking Principal Component Analysis in EEG Classification
Xiaoxia Li, North Dakota State University, 124 East Bison Court, Fargo, ND, 58108-6050, United States of America, xiaoxia.li@ndsu.edu
Principal Component Analysis (PCA) is considered to be a powerful tool in dimension reduction. However, it is worth thinking of the suitability of application for EEG signal data. Two EEG datasets collected from alcoholic and control groups were used to test the prediction accuracy before and after PCA transformation with SVM and KNN methods. Based on the classification results, we found that PCA is not valid in EEG signal processing. We also concern that other factors might be confounding.

20 - Strategic Exclusive Supply Contract for Carbon Fiber Reinforced Plastic in the Aviation Industry
Kenju Akai, The University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo, Japan, akai@css.t.u-tokyo.ac.jp, Kazuma Sakamoto, Nariaki Nishino, Kazuro Kageyama
We investigate the rationality of an exclusive supply contract for Carbon Fiber Reinforced Plastic (CFRP) between Boeing and a Japanese CFRP supplier, Toray. We build a mathematical model of the market for CFRP comprising Toray and the oligopolistic market for aircraft, assuming Airbus, as Boeing's rival. The subgame perfect Nash equilibrium show that both Boeing and Toray obtain the higher profits rather than that in the Cournot Competition.

21 - Hand Motion Identification from Electroencephalography Recordings using Recurrent Neural Network
Jinwon An, SNU, 1 Gwanak-ro, Gwanak-gu, Seoul 151-742, Seoul, Korea, Republic of, jinwon@dm.snu.ac.kr, Sungzoon Cho
Neurological disabled patients can be aided by brain-computer interface (BCI) prosthetic devices. Grasp and lift tasks are basic actions that needs to be implemented in those devices. In this study, grasp and lift tasks were analyzed by using electroencephalography (EEG) recordings. Various recurrent neural network models were used. It shows that EEG can identify hand motions such as reaching, grasping, loading and retracting with high accuracy.

22 - On Optimization of Carbon Capture, Utilization, and Storage Supply Chains under Uncertainty
Mahnaz Aghari, Virginia Tech, 1406 University City Blvd., Blacksburg, VA, 24060, United States of America, mahnaz@vt.edu, Hamed Shakouri Ganjavi
Carbon capture, utilization, and storage (CCUS) is a crucial technology to mitigate climate change. Due to the high costs of the technology, a great deal of attention has been focused on how the captured CO2 can be optimally utilized or stored. We study optimizing CCUS supply chains under uncertain environment. In this poster, we present an algorithm to generate a candidate network for CO2 transportation and a model for optimizing the utilization and storage of the captured CO2 in CCUS systems.

23 - On Two-row Chvatal-Gomory Cuts
Babak Badri Kohi, Doctoral Student, Virginia Tech, 1406 University City Blvd., Blacksburg, VA, 24060, United States of America, babakk2@vt.edu, Diego Moran
Chvatal-Gomory (CG) cuts are a very important class of cutting planes for solving mixed-integer programs. CG cuts for a polyhedron P are obtained by computing integer hulls of its 1-row relaxations. We study 2-row CG cuts, a generalization of CG cuts that are obtained by computing integer hulls of 2-row relaxations of P. In this poster, we present some basic properties of 2-row CG cuts and discuss their relation to other well-known classes of cuts such as split cuts and (crooked) cross cuts.
24 - Stable Strategic Marriages
James Bailey, Graduate Student, Georgia Institute of Technology, 116 Ponce De Leon Ave NE, Atlanta, GA, 30308, United States of America, james.baily@gaitech.edu, Craig Tovey

The effect of lying on the stability of marriages is a long standing open problem. When men and women behave strategically, an ideal decision mechanism selects a marriage that is (1) stable, and (2) egalitarian, with respect to sincere preferences. We provide a positive result to (1) and a negative result to (2) under two natural conditions. We strengthen current results about the Gale-Shapley algorithm, showing that the woman-optimal marriage is the only obtainable one when men propose.

25 - Decision Analytics for Managing Invasive Wild Pigs
Matthew Brondum, U.S. Army Corps of Engineers, 3909 Halls Ferry Rd., Vicksburg, MS, 39180, United States of America, matthew.c.brondum@usace.army.mil, Igor Linkov, Zach Collier, Buddy Goatcher

Wild pigs pose significant environmental, economic, and social risks to the United States and around the world. A number of wild pig eradication and control measures exist, but many eradication campaigns are ultimately unsuccessful due to a variety of complexities across multiple domains. We are developing a decision analytic tool which will assist affected landowners in deciding which eradication technique best suits their site-specific interests.

26 - The Regional Logistics Hubs Location Problem Based on the Topsis and Genetic Algorithm: A Case of Sichuan
Si Chen, Southwest Jiaotong University, #1 Jinggu Road, Emei, China, chenswju.edu.cn, Qian Guo, Mi Gan

The regional logistics demand, which are the key factors for logistics hubs location problem, are changing with the developing regional economic and the structure of industry. Then we aim to modeling this problem with an integrated approach of multi-criteria decision making and integer programming model. And the real data case of Sichuan is employed to verify the feasibility of proposed models and approach. Moreover, the numerical results are corresponding to the actual logistics situation.

27 - Promotional Mix and Pricing Strategy with Risk-averse Buyers in the Age of Social Media
Wei-ju Kevin Chang, City University of Hong Kong, P7614, Academic I, Hong Kong, Hong Kong - PRC, wchiang@cityu.edu.hk, Qiao Wang, Lu Qiang

How should a firm minimize the wastage on marketing expenditure with an efficient promotional mix? The firm has two promotional strategies, i.e., advertising campaign (HAC), which refers to a basic publicity that makes consumers aware of the product’s existence, and referral reward program (RRP), which refers to an incentive-based program that offers rewards to the existing buyers for bringing in new buyers. We study the firm’s optimal promotional mix and pricing strategy with risk-averse buyers.

28 - A Game Theoretic Analysis of Electricity Time-of-use (TOU) Tariff for Residential Customers
Dong Gu Choi, Senior Researcher, Korea Institute of Energy Research, 152, Gajeong-ro, Yusung-gu, Daejeon, 34129, Korea, Republic of, d.g.choi@kier.re.kr, Valerie Thompson

We properly formulate a game-theoretic model for analyzing not only the optimal behaviors of both an electric utility and residential customers but also their monetary gains or losses under a TOU tariff. With two heterogeneous customer types in terms of consumption pattern, we identify that a win-win situation is not possible. Also, we emphasize our analytic results by describing a numerical example, and we discuss the implications of our results for electric utilities and regulatory agencies.

29 - Why Classical Hybrids are so Risky for Entrepreneurs, and What to do About it
Gaston De Los Reyes, Assistant Professor, George Washington University School of Business, 2201 G St. NW, Funger 615, Washington, DC, 20008, United States of America, gdl@gwu.edu

Williamson (1991) insufficiently characterized the institutions of hybrid governance, emphasizing forms that feature neoclassical devices to co-govern past contract close. Entrepreneurs, however, frequently resort to hybrids of classical form, lacking terms to protect from ‘lawful’ opportunism in case of disruption. I explicate the implications, drawing upon my dissertation study of contract law. I discuss a novel institutional solution and managerial strategies for the status quo.

30 - An Integrated Make-pack-Route Problem of Fresh Agri-food Online Retailing in China
Mu Du, Institute of Systems Engineering, Dalian University of Technology, No.2 Lingguang Road, Dalian, China, dumu.dlu@gmail.com, Xiangpei Hu, Nan Kong

Fresh agri-food sold by farm-to-home online retail is produced through a make-pack-route process at farm’s distribution centers. Due to the large variety of produce and high cost of intermediate storage, an integrated decision model is employed to coordinate these different operations. We introduce a make-pack-route model that minimizes the total cost and propose an effective heuristic method. We report a case study based on real-world business practice in China.

31 - Decision Analytic Modeling of the Five Competitive Forces in the Residential Solar Industry
Karim Farhat, PhD Candidate, Management Science and Engineering, Stanford University, 475 Via Ortega, Huang Engineering Center 245A, Stanford, CA, 94305, United States of America, kfarhat@stanford.edu

Using a first-of-kind quantitative decision-analytic model of Michael Porter’s five competitive forces, we investigate an international solar firm’s plan to enter and properly position in the US residential solar PV industry. Applying a Bayesian probabilistic approach, the model assesses the uncertain profitability of the overall competitive market, and it provides several insights on the firm’s go-to-market strategy, including: regional focus, vertical integration, and customer finance.

32 - Portfolio Analysis for Army Corps of Engineers Business Line Integration
Cate Fox-lent, US Army Corps of Engineers, 333 Massachusetts Ave 7, Arlington, MA, 02474, United States of America, catherine.fox-lent@usace.army.mil, Matthew Bates, Christy Foran

Portfolio analysis is used to demonstrate opportunities to leverage synergies across business lines. Coastal systems can benefit from reduced cost, reduced environmental impact, or increased project performance when planning for Navigation, Environmental Restoration, and Coastal Storm Risk Management projects is intentionally integrated. Long-term project and investment quantification of project interactions can lead to improved utility of this type of analysis.

33 - Incorporating Passenger Recovery Decisions During Airline Operations Recovery
Dinakar Gade, Senior Operations Research, Sabre, 3150 Sabre Drive, Southlake, TX, 76092, United States of America, dinakar.gade@sabre.com, Sureshan Karchiter, Shahram Shahnoup

Airlines are faced with several types of disruptions that impede regular operations. The Sabre AirCentre Recovery Manager (OpS) helps airlines quickly recover both the schedule and aircraft rotations from disruptions. We introduce a new feature of Recovery Manager called the Passenger Flow Module (PFM) that incorporates passenger re-accommodation decisions during schedule recovery. The solutions generated reduce the impact to passenger flows in the network and reduce passenger inconvenience.

34 - The Impact of Roadway Traffic Flow in Regional Network Design Problem
Mi Gan, Dr, Southwest Jiaotong University, 111 N 2nd Bound Erhuan Road, Chengdu, SC, 610031, China, migan@swju.edu.cn, Si Chen

In order to solving the problem that the existed logistics network design models(LND) are lack of consider on roadway traffic flow. The uncover degree function of logistics facility nodes based on impedance function was constructed. Then, integrated logistics network design models and corresponding algorithms were proposed with the basis of uncover degree function. The comparison of general LND models and models we developed by real case reveals the impact of roadway traffic flow on LND.

35 - Evaluating Zoning Strategies for Demand Responsive Transit Systems
Eric Gonzales, University of Massachusetts, Amherst, Department of Civil & Environmental Eng., 130 Natural Resources Road, Amherst, MA, 01003, United States of America, gonzales@umass.edu, Malhour Rahimi

DRT systems often divide their service area into smaller regions in order to simplify operations. However, this management strategy can create inefficiencies. This paper develops an analytical formulation to explain the relation between agency cost and zoning strategies. The two main objectives are to understand when a service area needs to be divided into smaller regions to reduce the total costs of a DRT system and how the split should be done in order to be the most cost effective.

36 - Supply Enhancement in Capital-constraint Assembly System: Financing Suppliers or Dual Sourcing?
Chaocheng Gu, PhD Candidate, Huazhong University of Science and Technology, 1037 Luoyu Rd., 326 School of Management, Wuhan, HB, 430074, China, chaocheng@hust.edu.cn, Shiming Deng

We study two mechanisms for supply reliability enhancement in capital constraint assembly system. Financial mechanism. Three financial strategies are examined: that is, bank finance, buyer finance and a combined peer finance. The manufacturer can also avail of a more expensive backup sourcing. When bank finance and buyer finance both present, the manufacturer always prefer buyer finance. The optimal mechanism switches back and forth as the equilibrium order quantity increases.
37 - Rating Aggregation in Multi-dimensional Rating Systems: How do Reviewers Form Overall Ratings?
Dominik Gutt, PhD Candidate, University of Paderborn, Warburger Str. 100, Paderborn, 33098, Germany.
dominik.gutt@wiwi.uni-paderborn.de, Dennis Kundisch

A recent strain of literature on online product reviews has focused in particular on multi-dimensional product reviews. Multi-dimensional product reviews usually allow the reviewer to rate a product first, based on one overall rating, and second, based on a set of several sub-dimensions. Mostly, overall ratings do not equal e.g. the calculated mean of the sub-dimensions. Our research will shed light on the question, which heuristics reviewers use to form an overall rating.

38 - Cyclic Timetabling and Platforming of Mixed Train Types on a Bidirectional Railway Line
Mohamed Zohdy, University of Newcastle, University Drive, Callaghan, Australia, mohamed.zohdy@newcastle.edu.au

We present a mixed integer program for cyclic train timetabling and platforming. It is assumed that there are different types of trains moving on a single, bidirectional railway line. Two objectives: a timetable cycle length and total journey time of all train types are considered. Constraints include infrastructure characteristics, safety regulations, and operational rules. Heuristics and exact methods are combined with math model to solve large problem instances are solved and discussed.

39 - The Impact of Platform Update Interval on Platform Diffusion in a Cooperative Mobile Ecosystem
Yoo S. Hong, Professor, Seoul National University, 1 Gwanak-ro, Gwanak-gu, Seoul, 08826, Korea, Republic of, yhong@snu.ac.kr, Gyesik Oh

Periodic platform upgrading is one of the effective strategies for potential participants as well as existing stakeholders. However, the diffusion of an updated platform is ineffective in a cooperative mobile ecosystem where a manufacturer modifies a platform released as open-source software on its smartphones. This paper models the effectiveness of platform diffusion with respect to the platform update interval in consideration of the manufacturer's decision mechanism.

40 - Operational Health Information Exchange Platform
Kang-yu Hsu, PhD Student, Purdue University, 610 Purdue Mall, West Lafayette, IN, 47907, United States of America, hsu66@purdue.edu, Poching Delaurentis, Yuehwen Yli, Rich Zink

Health Information Exchange (HIE) has been focusing on utilizing patient electronic health records to improve service quality and patient safety. The exploitation of HIE, however, can go beyond patient records. This study aims to build an infusion drug limit library database and embedded analytical tools as a pilot for the operational HIE platform that may house and utilize other types of data with similar usage and functionality.

41 - Design and Pricing of Crop Insurance Based on NDVI
Jing Huang, Hohai University, No.8 Feicheng Road, Nanjing, China, huangjinghu@hotmail.com, Anna Shi, Huimin Wang, Jingping Tong

The crop-index-insurance is a possible approach to solve the dilemmas in traditional crop insurance. In this study, the crop insurance contract is designed based on remote sensed Normalized Difference Vegetation Index (NDVI). Then the crop yield estimation models in different expectations is proposed. Lastly, the pure rate of premium is presented under different triggers using nonparametric kernel density model. The paddy rice in three cities in Yunnan Province, China are chosen as an example.

42 - An Infinite Time Horizon Portfolio Optimization Model with Delays
Azmat Hussain, PhD Student, North Carolina State University, Raleigh, NC, 27606, United States of America, ahussain@ncsu.edu

We consider a portfolio optimization problem over an infinite time horizon. The problem is formulated as a stochastic control problem and the state is governed by a stochastic process with delay. The goal is to choose investment and consumption controls such that the total expected discounted utility is maximized. Under some conditions, the corresponding HJB equations for exponential, log and HARA utility functions are solved and verification results and the optimal control are also established.

43 - Optimization of the Order-up-to and Reorder Levels for Each Item in the Forward Area of Warehouse
Takashi Irohara, Professor, Sophia University, 7-1 Kioi-cho, Chiyoda, Tokyo, 1028554, Japan, irohara@sophia.ac.jp

We propose an optimization procedure to solve a forward reserve allocation problem and determine the order-up-to and reorder levels for each item in the forward area. In the target warehouse or distribution center, the forward area stores items in a unit of piece for efficient order picking and the reserve area stores items in a unit of case. There is a tradeoff between replenishment frequency and inventory space in the forward area. We show the effectiveness of the proposed method.
50 - Behavioral Ordering Decision under Downward Substitution
Yan Li, Dr., China University of Mining and Technology, Dings 11, Xueyuan Road, Beijing, China, liyan@cumb.edu.cn, Bojiao Mu
Downward substitution is one common strategy for selling multi-class products. The previous research assumes perfect rationality. This paper relaxes the assumption and utilizes the MNL model to depict the ordering behaviors for substitutable products. We compare the ordering quantity considering substitution with that without substitution. The substitution effect shows non-monotonicity regarding the extent of rationality and is superior to the one predicted by rationality.

51 - Optimal Capital Structure and Credit Spread under Partial Information
Bo Liu, UESTC, No. 4, Section 2, North Jiashie Rd., Chengdu, China, libu@uestc.edu.cn
The paper first incorporates partial information friction to extend the classic optimal capital structure model. We derive closed-form results for the value of risky debt, credit spread, default threshold, and for optimal capital structure. We find that under partial information, dynamic learning significantly increases the optimal coupon level and firm's leverage, and improves the tax advantage to debt.

52 - Optimal Production and Inventory Policy in Solar Photovoltaic Supply Chain
Xiangrong Liu, Bridgewater State University, 95 Grove Street, Bridgewater, MA, United States of America, xiangrliu@bridgew.edu, Chuanhui Xiong
The development and utilization of solar photovoltaic (PV) energy has progressed at a very fast pace. With decreasing price of PV module and uncertain government incentives, this research models production and inventory strategies in the setting of a PV supply chain with a PV manufacturer, an installer and an end customer. Based on the manufacturer's and installer's optimal decision, this study discusses how to improve supply chain performance through parameters setting in contract design.

53 - Optimal Stopping Game with Investment Spillover Effect
Akira Maeda, Professor, The University of Tokyo, 3-8-1 Komaba, Meguro, Tokyo, 153-8902, Japan, maeda@global.c.u-tokyo.ac.jp, Motoh Tsuchimura, Ryuta Takashima
The purpose of this study is to analyze the game over optimal choice of firm's investment time, focusing on the case that there is positive externality in the effect of investment. We consider a situation where firms can increase their subsequent revenue stream by making an irreversible investment, and the investment has a spillover effect to other firms. This setup describes gaming over optimal stopping problems. We examine the property of the subgame perfect Nash equilibrium.

54 - Recent Trends in Blood Banking Systems: A Supply Chain Perspective
Amir Masoumi, Assistant Professor Of Management, Manhattan College, 4513 Manhattan College Parkway, DLS 504, Riverdale, NY, 10471, United States of America, amir.masoumi@manhattan.edu
Blood service operations are a key component of the healthcare system all over the world. In the US prior to 2008, there were several reported cases of blood shortages; however, the scenario has significantly changed thereafter. The total number of whole blood and red blood cells collected annually decreased from 17.3 to 17.7 million units during the 2008-2010 period. We investigate the recent trends in supply and demand management of blood banking systems from a logistics perspective.

55 - Optimal Sizing of a Price-maker Energy Storage Facility Considering Uncertainty
Elsin Nasrolaphour, University of Calgary, 2500 University Dr. NW, Calgary, AB, Canada, e.nsrola@ucalgary.ca
This paper proposes a strategic investment model for a price-maker energy storage facility considering market uncertainties. The proposed model is a stochastic bi-level optimization problem where planning and operation decisions of the energy storage facility are made in the upper level, and market clearing is modeled in the lower level under different operating conditions. The bi-level optimization problem is recast as an Mathematical Program with Equilibrium Constraints (MPEC).

56 - Army Materiel Systems Analysis Activity (AMSAA)
Joseph Oolah, AMSAA, 192 Hopkins Road, APG, MD, United States of America, joseph.molah.civ@mail.mil, Tiffany Gutowski
AMSAA is the Army’s independent source of data, modeling & simulation, and material lifecycle & logistics systems analysis to support the Army’s Equipping, Sustaining and Warfighting decisions. AMSAA’s Core Competencies include: Independent Materiel Performance and Effectiveness Analysis, Independent Logistics Analysis, Field Data Collection and Analysis, Program Management of DoD’s JTCG-ME Program, Strategic/Corporate Level Decision Analysis, and Certified System Level Performance Data.

57 - Reinforcement Learning Algorithm for Blood Glucose Control in Diabetic Patients
Mahsa Oroojii Mohammad Ja, Northeastern University, 334 Snell Engineering, Boston, MA, United States of America, oroojeni.m@husky.neu.edu
In this paper a reinforcement learning algorithm is proposed for regulating the blood glucose level of Type I diabetic patients. In the proposed reinforcement learning algorithm body weight and A1C level define the strap of a diabetic patient. For the agent, insulin dose levels constitute the actions. As a result of a patient’s treatment, after each time step, the patient receives a numerical reward depending on the response of the patient’s health condition.

58 - Modeling the Stockist
Omkar Pulsale Desai, Associate Professor, Indian Institute of Management Indore, Prabhand Shikhkar, Rau Pithampur Road, Indore, MA, 453556, India, omkarjpdl@iiimidh.ernet.in, Ananth Iyer
We focus on the problem of distribution to the millions of small shops that constitute the retail sector in India, as well as many other developing countries. We model the role of a stockist - a supply chain entity whose role is to facilitate distribution. We use a principal agent model structure, with a complements or substitutes relationship between manufacturer assistance and retailer impact, to understand the optimal contract structure, i.e., level of assistance and associated retail margin.

59 - Automatic Design of Methods for Combinatorial Optimization Problems
Lucas Parada, General Manager, Universidad de Concepcion, Avenida Inglesa 1342, 2404049, Concepcion, Ols Parkada20@gmail.com
Designing an method to solve an optimization problem is a complex intellectual task. However, to design an algorithm is also an optimization problem. To solve this second level problem we combine and evolve elementary algoythms through genetic programming. The produced algorithms show promising features such as low solution errors and small computational times for several classical optimization problems.

60 - Bayesian Adjusted Uplift Modeling for Direct Mail Campaign
Yidong Peng, Conclusive Analytics, 13620 Reese Boulevard E, Suite 300, Huntersville, NC, 28078, United States of America, yidong.peng@nds.edu
The study compares the performance of traditional respond model, uplift model and our proposed Bayesian adjusted uplift model on selecting customers for direct mail campaign. The proposed model applies customers' responses to historical campaign to generate the posterior uplift estimates based on result of uplift model. A case study is conducted to verify that the proposed model provides higher sales lift by using the real monthly directly campaign data from a top auto-parts retail company.

61 - How to Make Big Blue (IBM) Business Segments Fast and Responsive
Alan Picciotto, Senior Technical Staff Member / Lead Request For Service Business Analyst In R5, IBM, 2435 South Road, Poquilekamp, NY, 12096, United States of America, alanpiccus.ibm.com, Jose Cano, Skip Jahn
This poster will describe how a big company like IBM can be nimble and fast and responsive. Over the past 3 years - in the growth segment (hundreds of millions of dollars yearly) of IBM's Global Technology Services unit, an impactful set of analytics and actions have been deployed to dramatically improve business revenue by tens of millions of dollars, via a 65% improvement in cycle time.

62 - Continuum Approximation Modeling of Freight Distribution Systems
Mahour Rahimi, University of Massachusetts, Amherst, 139 Marston Hall, 130 Natural Resources Rd., Amherst, MA, 01003, United States of America, mrahi@umass.edu, Eric Gonzales
This study presents a continuum approximation model for truck deliveries which relate the operating parameters to the characteristics of the service and network, service area, and demand rate. The objective of this study is to minimize the total cost of distributing multimmodity freight from an origin to randomly distributed points, with or without transshipments, and within a limited amount of time. Two different distribution methods are considered: peddling, and peddling with transshipment.

63 - Modeling Relation Between Natural Problems and Formal Structures: A Health Systems Application
Edmond Ramly, University of Wisconsin-Madison, 20 Sherman Terrace, Unit 6, Madison, WI, 53704, United States of America, edmond.ramly@gmail.com
We formulate a class of cyber-social systems where formal (mathematical) and natural (problem structuring) operations research are complementary and insufficient separately. We adapt the Hertz-Rosen Modeling Relation from systems biology as a unifying framework relating natural and formal systems with encoding and decoding operations. We present a category-theoretic axiomatization and a demonstration of complementarity in a health IT evaluation case.
64 - Analytic Network Process: Assisting Computers to Think Like Humans?  
Elena Roubi, Chief Research Officer, Creative Decisions Foundation, Ellsworth Ave, Pittsburgh, PA, United States of America, erroubi@gmail.com

Whatever your stance is on Artificial intelligence, it is generally admitted that it has not yet enabled computers to make satisfactory decisions. Methods like Neural Networks, can train computers to make decisions for simpler types of tasks, but the ANP can factor in morality, ethics and broader considerations associated with complex decisions. We want computers to think more like humans, thoughtful and compassionate in their choices, and ANP enables this type of higher-level decision-making.

65 - An Energy-aware Multiobjective Scheduling Optimization Framework for Sustainable Manufacturing  
Saeed Rubalae, Wichita State University, 2119 Malcolm Street, Wichita, KS, 67208, United States of America, ssaal21@gmail.com, Mehmet Bayram Vildiran

The goal of this paper is to minimize the total tardiness and total energy cost under time-of-use electricity tariffs, where energy prices vary hourly, on a non-preemptive single-machine. The problem is modeled using a mixed-integer multi-objective mathematical programming model to obtain an approximate Pareto front. Results show that the proposed multiobjective NSGA-II genetic algorithm finds a good approximate Pareto front with better diverse solutions and shorter computational CPU times.

66 - Early Warning Methods and Predictive Models for Hospital Risk and Readmissions  
Jakkia Sairamesh, CEO And President, CapsicoHealth, Inc, 2225 E Bayshore Rd STE 200, Palo Alto, CA, 94303, United States of America, ramesh@capsicohealth.com, Ruichen Rong

This poster and research abstracts presents the effectiveness of methods for improving patient outcomes and reducing 30-day readmissions, based on clinical and cost-based factors. We will present early-warning methods to predict patients at risk of 30-day readmissions based on past admissions, ER visit rates, mortality rates, and charges. The dominant factors include clinical risk, costs, and emergency room visits and mortality rates. The prediction showed nearly 85 percent accuracy.

67 - Software License Optimization Model for Software Asset Management  
Seungbae Sim, Korea Institute for Defense Analyses, 3 Hoegi-ro, Seoul, Korea, Republic of, sbsim@kida.re.kr, Cheonsoo Yoo

Information System can be generally comprised of hardware and software. As software has been getting more important than hardware, most organizations must reduce increasing software costs and control software assets. Especially, commercial software can be licensed to end-users. We propose the mathematical model considering the complexity of software license types. Also, the case example is presented for validating the proposed optimization model.

68 - Optimization Problems Arising in Stability Analysis of Discrete Time Recurrent Neural Networks  
Jayant Singh, Dept. of Mathematics, North Dakota State University, 1210 Albrecht Boulevard Minard 408, Fargo, ND, 58102, United States of America, jayant.singh@ndsu.edu

We consider the method of Reduction of Dissipativity Domain to prove global Lyapunov stability of Discrete Time Recurrent Neural Networks. It involves a multi-step procedure with maximization of special nonconvex functions over polytopes on every step. We derive conditions which guarantee an existence of at most one point of local maximum for such functions over every hyperplane. This nontrivial result is valid for wide range of neuron transfer functions.

69 - Modular Function Deployment Adaptable to the Project Typology in the Development of Modular Products  
Monique Sonego, Universidade Federal do Rio Grande do Sul, Av. Osvaldo Aranha 99 - PPGEP 5andar, 90035-190, Porto Alegre, Brazil, hgmimonique@gmail.com, Angela Danilevicz, Márcia Echeveste

Modular Function Deployment (MFD) is one of the best-known methods for modularization in New Product Development. However, this method is not tailored to different project typologies. We propose an adaptation for the MFD method for different levels of complexity and novelty of each project. This adaptation provides companies with the possibility of choosing the setting of stages and tools that best fit their specific projects by customizing the application of the MFD.

70 - Enriching Competitiveness and Connectivity with HLED-inspired Air Service and Investment  
Andrew Stapleton, Professor Of Supply Chain Management, University of Wisconsin La Crosse, 1725 State Street, La Crosse, WI 54650, La Crosse, WI, 54650, United States of America, A stapleton@uwlac.edu

U.S. cargo and passenger airlines will have a greater opportunity to compete for a larger share of freight trade and traffic between the U.S. and Mexico when the new Air Services Agreement (ASA) takes effect January 2016. It is a key element of the U-Mexico High Level Economic Dialogue (HLED), that aims to promote competitiveness and connectivity, foster economic growth, productivity and innovation, and partner for regional and global leadership.

71 - The Value of Flexibility in Dynamic Ride-sharing  
Mitja Stiglic, University of Ljubljana, Kardeljeva Ploocad 17, Ljubljana, 1000, Slovenia, mitja.stiglic@ef.uni-lj.si, Mirko Gradisar, N.ıg Atagı, Martin Savesbergh

We consider a dynamic ride-sharing system that allows people with similar itineraries and time schedules to share rides. Participants are willing to somewhat adapt their trip plans in order to be matched. We study how participants' flexibility in departure times and the willingness of drivers to perform detours influence the matching rate and the sustainability of the system. We conduct an extensive computational study to quantify the impact on system performance in a variety of settings.

72 - Managing a Bike-sharing System using Wireless Mobility Data  
Rahul Swamy, University at Buffalo, 49 Englewood (Lower), Buffalo, NY, 14214, United States of America, rahuls@buffalo.edu, Jose Walteros

This research aims to provide a mathematical framework for operating a campus bike-sharing system. We use wireless network (WiFi) usage logs to generate a detailed estimation of the inter-building demand across campus. We propose solving a sequence of MILPs to determine: 1) the optimal location of bike stations, 2) the number of bikes to be added to or removed from each station every hour to satisfy the demand-supply needs, and 3) the redistribution logistics, while minimizing overall costs.

73 - Configurations of Distribution Strategies  
Jing Tang, Em-lyon Business School, 23 Avenue Guy de Collonguerear, Ecully, France, TJ11.Jessie@gmail.com, Yeming Gong

Based on 124 quantitative samples with both first-hand and second hand data, as well as 56 qualitative samples, this paper examines the strategic fit of distribution strategies from the perspective of configuration theory. We find that the fit between operational decisions including infrastructural and structural decisions, and operational competencies including cost and flexibility, has an important effect on business performance.

74 - Teaching Machine Learning Methods Based on Systematic Approach Derived from Potential Theory  
Nadia Udler, Fordham University, 113 West 60 St, New York, NY, United States of America, nadiakap@optonline.net

Many real-world problems can be reduced to black box optimization. One of the challenges in the design of black box optimization software is identifying a minimal set of modules for building hybrids for real applications. Existing software provides such building blocks but they are heuristic and difficult to teach. We discuss black box optimization library based on systematic approach derived from potential theory. It can be used as educational tool to teach machine learning techniques.

75 - Optimizing Player Lineups in Daily Fantasy Sports  
Nicholas Valentour, Graduate Student, University of Nebraska Omaha, Department of Mathematics, Omaha, NE, United States of America, valentour@unomaha.com, Betty Love

The growth of online fantasy sports has increased demand for providers of daily player projections and optimal fantasy lineups. Fantasy lineup optimization is a variant of the multiple choice knapsack problem. We develop an integer maximin programming algorithm to identify optimal daily lineups. Further, we combine the algorithm with forecasting to examine the overall fantasy performance on historical basketball data.

76 - Design and Operation of a Last Mile Transportation System  
Hai Wang, MIT ORC, 2D 550 Memorial Drive, Cambridge, MA, 02139, United States of America, haiwang@smu.edu.sg

The Last Mile Problem refers to the provision of travel service from the nearest public transportation node to a home or office. Last Mile Transportation Systems (LMTS) are critical extensions to traditional public transit systems. We study the design and operation of a LMTS from three perspectives: (1) performance evaluation from a queuing perspective; (2) system operation from an optimization perspective; and (3) demand estimation from an inference perspective.

77 - Competition Strategies of Platform-based Retailing  
Man Wang, Guanghua School of Management, Peking University, No.5 Yheyuan Road Haidian District, Beijing, China, dream26@pku.edu.cn, Lihua Shen

While collaborating with third-party sellers via opening infrastructure online, platform-based retailers and third-party sellers run into a head-to-head price competition. We show that when the inventory of the platform-based retailer is sufficient, higher service quality can bring larger competitive profits. However, it may not always be optimal for a platform-based retailer to improve its service quality. The platform-based retailer may be worse off when the inventory is shortage.
78 - Using Past Scores and Regularization to Create a Winning NFL Betting Model
Eric Webb, Graduate Student, Indiana University, 1309 E. 10th Street, Bloomington, IN, 47403, United States of America, ermwebb@indiana.edu, Wayne Winston

Is the National Football League betting market efficient? We have devised a profitable betting model that would win 52.9% of the 7,354 bets against the spread it would have made over 33 seasons. Scores from previous weeks are used to estimate the point value of each team’s offense and defense. These values predict next week’s scores, and a bet is placed against the advertised spread. The sum of squares of offensive/defensive point values are constrained to be less than a regularization constant.

79 - Self-organized Deliberative Agent and its Application in Medical Claim Editing
Jack Xue, Exec. Application Architect, National Government Services, Anthem, 8115 Knue St., Indianapolis, IN, 46250, United States of America, xinjian.xue@anthem.com

In this system each agent self-adjusts its organization per environments before execution and optimizes itself both in structure and in execution steps to meet Service Level Agreement. The scheduling algorithm is formatted as an LP or MILP then generalized to stochastic with uncertainty in phase transitions. The efficacy is demonstrated in a medical claim editing system that identifies irregularities in million claims with calculations of terabyte current and historical data, in near real-time.

80 - Behavioral Analysis of Participants in Community Outreach Intervention Projects
Haoxiang Yang, Northwestern University, 2145 Sheridan Road, Room C151, Evanston, IL, 60208, United States of America, haoxiangyang2019@u.northwestern.edu, David Morton, Alexander Gutfraind

The Community Outreach Intervention Projects (COIP) serves the Chicago metropolitan area, providing support for drug users to help prevent infectious diseases. Using about 10 years of data, we study the behavior of participants in COIP’s syringe exchange program, focusing on the temporal process governing their visits to storefronts and demographics. With a better understanding of the participants’ behavior, we aim to help develop an improved marketing plan for COIP.

81 - A Schatten-p Norm Perturbation Inequality and its Application in Low Rank Matrix Recovery
Man Chung Yue, The Chinese University of Hong Kong, RM 2511, Man Tai House, Tsz Man Est., Tsz Wan Shan, KLN, Hong Kong, Hong Kong - PRC, mcyue@se.cuhk.edu.hk, Anthony Man-cho So

Low-rank matrix recovery, with its applications in finance, network localization, etc, has recently attracted intense research and can be formulated as a rank minimization. Because of the NP-hardness, a common heuristic is to use the Schatten-p norm minimization as a surrogate. However, the equivalence property of this remains elusive and hinges on a conjectured matrix inequality. We prove this conjecture and derive sufficient conditions for low-rank matrix recovery using Schatten-p heuristics.

82 - Demand Prediction and Two-stage Inventory Policy for an Online Flash Sale Retailer
Mengchen Yang, University of Michigan, Stephen M. Ross School of Business, 701 Tappan Ave, Ann Arbor, MI, 48109, United States of America, zhenyuzh@umich.edu

We show the work cooperated with an online flash sale retailer in China. With millions history sales records, we use machine learning techniques to predict demand and propose a two stage inventory policy, which requires to response quickly to early-hour real sales and restock inventory thereafter. A model is built to explain positive and negative effects of our policy. Experimenting on real data, we help this firm increase profit by approximately 18% and reduce remaining inventory by over 50%.

83 - Heuristics for Bicycle Sharing System Repositioning Problem
Mary Kurz, Clemson University, 110 Freeman Hall, Clemson, SC, 29634, United States of America, mkkurz@clemson.edu, Ling Zu

This paper studies the static bicycle repositioning problem with real NYC Citi system data. It selects a subset of stations to visit, sequences them, and determines the pick-up/drop off quantities in each visited station. The study incorporates real problem characteristics by minimizing total penalties of lacking/overflowing bicycles and routing cost. A Viable Neighborhood Search heuristic is introduced to solve the described problem.

84 - Ranking Universities: Practices, Problems and Way Forward
Muhammad Mukhtar, Professor, American University of Ras Al Khaimah, (AURAK), Ras Al Khaimah 10021, United Arab Emirates, mukhtar.mukhtar@gmail.com, Sarah Mukhtar, Zahida Parveen, Brian Wigdahl

We report here a comparison of various global ranking systems of universities and their impacts in the society. Five global ranking systems parameters evaluations revealed that Times Higher Education Ranking System is more appropriate when compared with other ranking systems. Our analyses revealed that discipline wise ranking by various global rankers are creating dilemmas for the parents and public to decide about their children education. We propose normalization of ranking systems.

Monday, 1:30pm - 3:00pm

■ MC01
01-Room 301, Marriott
Military O.R. and Applications V
Sponsor: Military Applications
Sponsored Session
Chair: Michael Hirsch, ISEA TEK, 620 N. Wymore Rd., Ste. 260, Maitland, FL, 32751, United States of America, mhirsh@isatek.com

1 - Predicting the Use of Violence using Machine Learning Methods
Ermak Guresen, KHO, Dikmen, Ankara, Turkey, ermakguresen@gmail.com, Salih Tutun, Galgun Kayakutlu
Use of Violence by Ethno-Political Organizations is threatening not only individually countries but also all humanity. As a consequence governments are obliged to take measures in their budget for this threat. Obviously it does not mean that whole of security budgets consist of spending for Use of Violence, however it has important effects on them. For all these reasons, the aim of this study is to examine the predetermine models for use of violence.

2 - Unmanned Aerial Vehicle Routing in the Presence of Threats
Kamil Aloalibi, Taibah University, College of Engineering, P.O. Box 344, Almadinah Almunawawrah, PC41411, Saudi Arabia, kamilalotailbi@hotmail.com, Jay Rosenberger, Siriwat Visoldkophorn, Stephen Mattingly

We study the routing of Unmanned Aerial Vehicles (UAVs) in the presence of enemy threats. We formulate a mixed integer linear program that maximizes the total number of visited targets for multiple UAVs while maintaining both the route travel time and the total threat level to predetermined constant parameters. Several waypoint generation methods are proposed. Branch and price is used to solve the problem. A computational study is done and results for different scenarios are presented.

3 - Variants of the Target Visitation Problem
Michael Hirsch, ISEA TEK, 620 N. Wymore Rd., Ste. 260, Maitland, FL, 32751, United States of America, mhirsh@isatek.com

In this research, we consider the target visitation problem, and discuss some variants. Mathematical formulations are derived, heuristics are developed, and results are presented.

■ MC02
02-Room 302, Marriott
Logistics and Transportation Security
Cluster: Homeland Security
Invited Session
Chair: Gary Gaukler, Drucker School of Management, Claremont Graduate University, Claremont, CA, 91711, United States of America, Gary.Gaukler@cg.edu

1 - Cyber Vulnerability Models
Murat Karatas, The University of Texas at Austin, 1 University Station Austin TX 78712, United States of America, mkaratasa@utexas.edu, Nedialko Dimitrov

Infrastructures, such as university nuclear reactors, are controlled through cyber-physical systems. Assessing the vulnerability of these system is key in directing defensive investment. We present an MDP to compute an optimal attack policy. The MDP has an exponential number of states, and is based on tracking the set of available attacks for each link in the network. Surprisingly, we show it is possible to compute values for each MDP state, and optimal attack policies, using v+ reliability.
2 - Stochastic Network Interdiction with Risk Preference
Jing Zhang, University at Buffalo, SUNY, 338 Bell Hall, Buffalo, NY, 14221, United States of America, jzhang4@buffalo.edu, Jun Zhuo, Brandon Behrendorf

This paper studies the stochastic network interdiction problem, where the defender maximizes the length of the shortest path between a source and a destination by allocating sensors to the arcs with a limited budget. There is a detecting probability of the sensor, and the defender is unaware of the type of the attacker (strategic, non-strategic). We develop game-theoretic models, solution methods, and illustrate the models using a portion of the Arizona-Mexico border transportation network.

3 - Keeping Pace with Criminals: Designing Patrol Allocation Against Adaptive Opportunistic Criminals
Milind Tambe, USC, 941 Bloom Walk, Los Angeles, CA, United States of America, tambe@usc.edu, Arunesh Sinha, Chao Zhang

A distinctive feature of urban crimes is that criminals react opportunistically to patrol officers’ assignments. Opportunistic criminals are less strategic in planning attacks and flexible in executing them. Our goal is to recommend optimal police patrolling strategy against such opportunistic criminals. Our key contribution is to learn the criminal model from real-world crime and patrol data by representing the criminal behavior as parameters of a Dynamic Bayesian Network.

4 - Improving Logistics Security by using Distributed Container Inspection History Data
Gary Gaukler, Drucker School of Management, Claremont Graduate University, Claremont, CA, 91711, United States of America, gary.gaukler@cgu.edu

We present a two-stage interdiction model for smuggled nuclear materials in which prior container inspection data from an upstream inspection stage is used as a low-cost way of increasing overall interdiction performance. We provide insights into how a decision maker at a downstream inspection stage should optimally use detection data from the upstream stage to improve the overall detection capability.

4 - Optimal Schedule of Elective Surgery Operations Subject to Disruptions by Emergencies
Xiaoyang Cai, The Chinese University of Hong Kong, Shatin, Hong Kong, Hong Kong - PRC, xqcai@se.cuhk.edu.hk, Xianyi Wu, Xia Zhou

Elective surgery operations are to be scheduled at an operating theater, which can accommodate only one operation at a time. Emergency cases may arrive randomly, which have higher priority. Any operation, no matter it is normal or emergent, has to be processed until it is completed. Optimal dynamic policies are derived.

5 - Optimal Movement and Transshipment of Rail Freight Shipments
Chinmoy Mohapatra, PhD Candidate, University of Texas at Austin, 3500 Greystone Drive, Apt. 126, Austin, TX, 78731, United States of America, chinmoy@utexas.edu, Anant Balakrishnan

We study the problem of assigning shipments to scheduled transport services that share common capacitated resources. At each node, shipments using same outbound service are assigned in a first-in-first-out order. We develop modeling and algorithmic enhancements to effectively solve this large-scale optimization problem, and present computational results for real-life instances.

■ MC03
03-Room 303, Marriott

Innovative Scheduling Applications
Cluster: Scheduling and Project Management
Invited Session
Chair: Tolga Aydinliyim, Baruch College, One Bernard Baruch Way, Dept of Management Box B-240, New York, NY, United States of America, Tolga.Aydinliyim@baruch.cuny.edu

1 - Throughput Optimization in Single and Dual-gripper Robotic Cells
Manoj Vanajakumari, Texas A&M University, 3367 TAMU, College Station, TX, 77843, United States of America, manojv@tamu.edu, Chelliah Sriskandarajah, Sushil Gupta

In view of maximizing throughput, practitioners use a class of cycles known as 1-unit cycles in which the cell returns to the same state after the production of each unit. The complexity of throughput optimization in the class of 1-unit cycles in single and dual-gripper robotic cells is the main focus of this paper. We provide some insights for throughput optimization using two-unit cycles.

2 - A Decision Support System for Appointment System Templates with Operational Performance Targets
William Milliser, Associate Professor, Baruch College, One Bernard Baruch Way, Box B-240, New York, NY, 10011, United States of America, William.Milliser@baruch.cuny.edu, Emre Veral

We present a web-based scheduling system for outpatient services that meets user-defined operational targets to achieve managed/fair waiting times, dependable session end times, and minimal unintended idle time for providers. Using historical service times and an underlying model based on prior research, we demonstrate that appointments that meet these operational targets can be scheduled in a real-time environment, while the software provides dynamic assistance in selecting appointment slots.

3 - Improving Blood Products Supply through Donation Tailoring
Ali Ekici, Assistant Professor, Ozyegin University, Industrial Engineering, Nisan tepe Mah., Orman Sok, Cekmekoy, Istanbul, 34794, Turkey, ali.ekici@ozyegin.edu.tr, Elvin Coban, Okan Orsan Ozener

Multicomponent apheresis (MCA) allows the donation of more than one component and/or more than one transfusable unit of each component. It provides several opportunities including (i) increasing the donor utilization, and (ii) tailoring the donations based on demand. In this study, we develop mathematical models to develop donation schedules for repeat donors while considering factors such as blood products demand, shelf-life of the blood products, donation costs, and deferral times.

■ MC04
04-Room 304, Marriott

Joint Session JFIG/MIF: Panel Discussion on Tenure and Promotion
Sponsor: Junior Faculty Interest Group
Sponsored Session
Chair: Shengfan Zhang, Assistant Professor, University of Arkansas, 4207 Bell Engineering Center, Fayetteville, United States of America, shengfan@uark.edu
Co-Chair: Lauren Davis, North Carolina A&T State University, 1601 E. Market St., Greensboro, NC, United States of America, lbdavis@ncat.edu

1 - Department Chair Panel
Moderator: Shengfan Zhang, Assistant Professor, University of Arkansas, 4207 Bell Engineering Center, Fayetteville, United States of America, shengfan@uark.edu, Panelists: Mark Daskin, Scott Grasman, Ann Maruchcheck, Alice Smith

A session with IE and business department chairs on issues related to junior faculty.

■ MC05
05-Room 305, Marriott

Predictive Models of Human Behavior in Social Media
Cluster: Social Media Analytics
Invited Session
Chair: Tauhid Zaman, MIT Sloan School of Management, 50 Memorial Drive, Cambridge, MA, 02139, United States of America, zlisto@mit.edu

1 - Adaptive Searches in Twitter
Chris Marks, MIT, 50 Memorial Drive, Cambridge, MA, 02139, United States of America, cemarks@mit.edu

We present a methodology for adaptively collecting data from the Twitter microblogging application. Based on an initial search query or filter, our method uses network structure and count data from the returned results to update the search query so that additional relevant results are returned. Measures of result relevance will also be presented and discussed.

2 - Graph Control over Social Media: The Follow-back Problem
Krishnan Rajagopalan, Graduate Student, MIT, 50 Memorial Drive, Cambridge, MA, 02139, United States of America, krishri@mit.edu, Tauhid Zaman

We create a new influence maximization problem on social media where an agent seeks to form a connection with a specific user, the target, in an online social network. We model the problem as an MDP. We use transition probabilities, learned from analysis of Twitter data and find a policy that gives the agent the optimal sequence of interactions with the target’s friends to maximize the probability the target will form a connection with the agent. We identify heuristics for certain topologies.
3 - Influence Maximization Revisited
Paramveer Dhillon, MIT Sloan School of Management,
77 Massachusetts Avenue, Cambridge, MA, 02139,
United States of America, dhilloni@mit.edu, Sinan Aral

Most research on influence maximization has focused on a single task: to devise algorithms with better approximation guarantees for the NP-Hard discrete optimization problem. The influence models over which the optimization operates, however, remain simplistic and disconnected from empirical evidence on influence in real networks. We propose extensions to existing models of influence propagation that incorporate the most recent empirical evidence and study the implications of these extensions.

4 - Is Exercise Contagious? Evidence from a Global Natural Experiment
Christos Nicolaides, Postdoctoral Fellow, MIT Sloan School of Management,
100 Main St, E62-489, Cambridge, MA, 02142,
United States of America, chrisnic@mit.edu, Sinan Aral

Health-related behaviors, such as fitness habits, cluster amongst connected peers in social networks. Clustering of behaviors is in part attributable to causal social influence but can also arise through alternate means like homophily of preferences. Using fine grain individual running data from Nike+ we devise a natural experiment to quantify social contagion, identify influential members and groups and determine under which conditions influence is the dominant factor in behavior clustering.

MC06
06-Room 306, Marriott
INFORMS Section on Finance Student Paper Competition
Sponsor: Financial Services
Sponsored Session
Chair: Jim Bander, Toyota Financial, Chandler, AZ,
United States of America, jim.bander@gmail.com

1 - Revisiting Eisenberg - Noe: A Dual Perspective
Deung-geon Ahn, KAIST, #2111, E2-2, 291 Daehak-ro, Yuseong-gu, Daejeon, Korea, Republic of, deunggeon.ahn@kaist.ac.kr, Kyoung-kuk Kim

In this paper, we consider the Eisenberg-Noe framework for systemic risk with random shocks. Using duality, we characterize the amount of shock amplification due to the network structure and find the region for the shock vector that makes a specific bank default. These results enable us to improve some of the existing results of the network effect on systemic risk. More importantly, we propose efficient simulation schemes for the systemic risk measurement based on the characterization.

2 - A Partitioning Algorithm for MDPs and its Application to Limit Order Books with Stochastic Market Depth
Ningyuan Chen, Columbia University, S. W. Mud1 321, 500 W 120th Street, New York, NY, 10027, United States of America, nc2462@columbia.edu

The linear-quadratic control plays a central role in control theory, but its analytical solution, the so-called linear-quadratic regulator, fails in the presence of constraints. We consider a class of Markov decision processes (MDPs), with linear inequality constraints, non-convex quadratic cost, and linear state dynamics, governed by a Markov chain. By the proposed partitioning algorithm, we find the explicit solution to this class of MDPs: the value function and the optimal policy have analytical quadratic and linear forms, respectively, subject to a linear partition of the state space. The algorithm is applied to two applications. In the main application, we present a model for limit order books with stochastic market depth to study the optimal order execution problem. As a feature of our model, stochastic market depth is consistent with empirical studies and necessary to accommodate various order activities, such as limit order submission at and outside the best quotes and order cancellation, which may account for a large proportion of limit order activities. As a result, the optimal order execution policy is also stochastic and adapted to the random changes of market depth.

Xin Liu, Doctoral Student, The Chinese University of Hong Kong,
609, William Mong Engineering Building, Hong Kong, Hong Kong - PRC, liuxin@se.cuhk.edu.hk

We propose a combined estimation-optimization (CEO) approach that directly estimates the optimal trading strategy (optimal control), instead of separating the estimation and optimization procedures. This paper investigates a constrained S&O-15-minimization for estimating the optimal control and applies it to the mean-variance portfolio (MVP) problems under static and dynamic settings when the number of assets (p) is larger than the number of observation times (n). We prove that the classical sample-based MVP strategy makes the probability that the optimal portfolio will outperform the bank account tend to 0% for p>n and a large n. The CEO approach, however, converges to the true optimal solution. In addition, the CEO scheme automatically filters out unfavorable stocks based on historical data, and works for dynamic portfolio problems and non-Gaussian distributions. Simulations validate the theory and the behavior of the proposed approach. Empirical studies show that the CEO-based portfolios outperform the equally-weighted portfolio, the MVP with shrinkage estimators and other competitive approaches.

MC07
07-Room 307, Marriott
Modeling and Quantification of Risk
Cluster: Risk Management
Invited Session
Chair: Patrick Cheridito, Princeton University, ORFE, Princeton, NJ,
United States of America, dito@princeton.edu

1 - Assessing Financial Model Risk
Pauline Barrieu, Professor, London School of Economics,
Statistics Department, Houghton Street, London, WC2A 2AE,
United Kingdom, P.M.Barrieu@lse.ac.uk, Giacomo Scandolo
Model risk has a huge impact on any risk measurement procedure and its quantification is therefore a crucial step. In this paper, we introduce three quantitative measures of model risk when choosing a particular reference model within a given class: the absolute measure of model risk, the relative measure of model risk and the local measure of model risk. Each of the measures has a specific purpose and so allows for flexibility.

2 - Multivariate Shortfall Risk and Monetary Risk Allocation
Samuel Drapeau, Shanghai Jiao Tong University, 211 West Huaihai Road, Shanghai, 200030, China,
samuel.drapeau@gmail.com, Stephane Crepey, Yannick Armenti,
Antonis Papantoleon
We present a measure designed to address the global and intrinsic risk of interconnected system (banks, CCP...). The goal is twofold: first, provide the total amount of liquidity to be reserved to overcome financial stress situations. Second, address its allocation to each member in function of the systemic risk they put on the system. Finally, we present how these high dimensional computations can be solved in an efficient manner using Fourier methods.

3 - Variable Annuities with Guaranteed Withdrawal Benefits
Patrick Cheridito, Princeton University, ORFE, Princeton, NJ,
United States of America, dito@princeton.edu

Variable annuities with withdrawal benefits have become popular over the last couple of years. Their cost to the issuer not only depends on market conditions but also on policyholder behavior. In this talk we discuss a contract whose withdrawal guarantees are based on the running maximum of the account value. The optimal withdrawal strategy is derived, and the cost of the contract to the issuer is determined.
1 - Chanel Integration, Sales Dispersion, and Inventory Management
Ioannis Stamatoopoulos, Doctoral Candidate, Northwestern University, Kellogg School of Management, 2001 Sheridan, Evanston, IL, 60208, United States of America, i-stamatoopoulos@kellogg.northwestern.edu, Antonio Moreno-Garcia, Santiago Gallino
Channel integration initiatives are a rapidly increasing trend in retail, creating uncharted areas in marketing, logistics and inventory management. Using data from a leading retailer, we analyze the effects of implementing of a “ship-to-store” functionality, which improves access to SKUs not available in brick-and-mortar stores, to sales dispersion and inventories.

2 - Bike-share Systems: Accessibility and Availability
Ashish Kabra, INSEAD, Boulevard de Constance, Fontainebleau, France, ashish.kabra@insead.edu, Elena Belavina, Karan Girotra
This paper estimates the effects on ridership of station accessibility and of bike-availability. Our analysis is based on a structural demand model that considers the choices of spatially distributed commuters, and it is estimated using high-frequency system-use data from the bike-share system in Paris. To make the method computationally tractable, we develop a novel transformation of our estimation problem: from the time domain to the “station stockout state” domain.

3 - The Role of Surge Pricing: Managing Capacity and Competition in a Peer-to-peer Service Network
Kaitlin Daniels, The Wharton School, 3730 Walnut Street, Suite 500, Philadelphia, PA, United States of America, kaitld@wharton.upenn.edu, Gerard Cachon, Ruben Lobel
We study the incentive design problem of a platform that coordinates a network of service providers who encounter nontrivial, stochastic opportunity cost when they offer their services for hire through the service network. In particular, we examine the role of demand-contingent pricing in determining short and long term service capacity and measure the efficacy of a heuristic in approximating the optimal incentive scheme.

1 - Building Reputation through Charitable Giving in Online Social Networking Environment
Xue Tan, University of Washington, 4747 30th Ave NE J171, Seattle, WA, 98105, United States of America, xuetan@uw.edu, Yingda Lu, Yong Tan
When online social network introduces charity service, fundraising can be more efficient. Unlike in traditional channels, users of online social platforms can take the role of solicitor. This paper empirically examines the motivation of charitable giving through a leading microblogging platform where charity service is embedded. We employ a quasi-natural experimental setting resulting from platform design change, and identify different factors in individual donation decisions.

2 - An Empirical Study of Customer Strategic Switching Behavior in Multi-channel E-commerce System
Shahryar Doosti, PhD Student, University of Washington, Foster School of Business, University of Washington, Seattle, WA, 98195, United States of America, shahryar@uw.edu, Xi Chen, Yong Tan
This work uses a dataset from a leading e-retailer which offers multi-channels, such as TV shopping, websites, smart-phone applications, microblog-channel store, and call center, to examine how customers strategically select various methods to purchase. We also analyze how customers learn from their experience to gain knowledge about products and channel efficiency. We further run policy simulations to make suggestions for the retailer to improve its operational efficiency.

3 - Impact of Firm Social Media Engagement on Sales Revenue: Evidence from Taobao
Fei Wan, Peking University, Beijing, China, fanfei0304@pku.edu.cn, Yong Tan, Fei Ren
In this paper, we study the impact of marketer generated content on sales revenue. We collect data from taobao.com and its microblogging platform WeiTao.

We present evidence that MGC significantly promotes sales. Firms selling low-involvement products benefit more from MGC efforts, compared to those selling high-involvement products. Our findings suggest that MGC plays an important role in firm marketing activities.
11-Franklin 1, Marriott

Symmetry and Extended Formulations in Integer Programming

Sponsor: Optimization/Integer and Discrete Optimization
Sponsored Session

Chair: Sebastian Pokutta, Georgia Tech, 755 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, sebastian.pokutta@isye.gatech.edu
Co-Chair: Daniel Zink, Georgia Tech, 755 Ferst Drive, NW, Atlanta GA 30332, United States of America, zink.dani@gmail.com

1 - Strong Mixed-integer Formulations for the Floor Layout Problem
Joey Huchette, MIT, 77 Massachusetts Avenue, Bldg. E40-149, Cambridge, MA, 02139, United States of America, huchette@mit.edu, Juan Pablo Vielma, Santanu Dey

The floor layout problem (FLP) asks a designer to position a collection of rectangular boxes on a fixed floor in such a way that minimizes total communication costs between the components. This work presents a framework for generating mixed-integer formulations for the FLP by “encoding” a union of polyhedra in a higher dimensional space. We present theoretical and computational evidence for the strength of the resulting formulations and valid inequalities.

2 - Detecting Almost Symmetries of Graphs
Bernard Knuveen, University of Tennessee, 851 Neyland Dr, Knoxville, TN, 37996, United States of America, bknueven@vol.utk.edu, Sebastian Pokutta, Ben Knueven

We present a branching framework to solve the following problem. Given a graph G and an integer k, find the symmetries on subgraphs of G formed by removing no more than k edges. We call such symmetries “k-almost symmetries” of G. We specialize the framework and present an algorithm to find the best such subgraph for a given k. Computational results are reported, showing that for some popular graphs, few edges need be removed to induce additional symmetries.

3 - LP and SDP Inapproximability of Combinatorial Problems
Daniel Zink, Georgia Tech, 755 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, zink.dani@gmail.com, Sebastian Pokutta, Gábor Braun

Motivated by [arXiv:1309.0563], we provide a framework for studying the size of LP formulations as well as SDP formulations of combinatorial optimization problems without encoding them first as linear programs. As a result we define a consistent reduction mechanism that degrades approximation factors in a controlled fashion. As a consequence we establish strong linear programming inapproximability (for LPs with a polynomial number of constraints) for several problems that are not 0/1-CSPs.

4 - Maximizing a Class of Utility Functions Over the Vertices of a Polyhedron
Andres Gomez, PhD Student, University of California at Berkeley, 4141 Etchberger Hall, University of California Berkeley, Berkeley, CA, 94720-1777, United States of America, a.gomez@berkeley.edu, Alper Atamturk

Given a polyhedron, a concave univariate function g, and two vectors c and d, we consider the optimization problem of finding a vertex that maximizes the function c’x + g(d’x), which is NP-hard. We propose a 1/2-approximation algorithm. Improved approximation ratio of 4/5 is given for specific cases in project scheduling and reinforcement learning. Computational experiments indicate that the suggested approach finds solutions within 1% of the optimal solution for most of the instances quickly.

13-Franklin 3, Marriott

Robustness in Optimization, Complementarity, and Queueing systems

Sponsor: Optimization/Robust Optimization Under Uncertainty
Sponsored Session

Chair: Uday Shanbhag, The Pennsylvania State University, 310 Leonhard Building, University Park, PA, 16801, United States of America, udaybag@engr.psu.edu

1 - On Robust Solutions to Uncertain Linear Complementarity Problems and Their Variants
Yue Xie, Research Assistant, PSU IE, 351 Leonhard Building, University Park, PA, 16802, United States of America, xiyue1990@gmail.com, Uday Shanbhag

Complementarity problems have been well studied in modeling optimization and equilibrium problems. Yet, less progress has been seen in the uncertain context. We present an avenue for obtaining robust solutions to uncertain linear complementarity problems in a distribution-free environment by solving a low-dimensional problem. Particularly, robust solutions to uncertain non-monotone LCPs are provided by customizing an existing scheme. Preliminary numerics suggest that such solutions hold promise.

2 - Percentile Optimization in Multi-class Queueing Systems with Parameter Ambiguity
Austin Bren, PhD Student, Arizona State University, 1537 East Palmdale Drive, Tempe, AZ, 85282, United States of America, ahsbren@gmail.com, Sorosh Saghafian

In a multi-class queueing system that experiences system ambiguity through unknown service rate parameters, we incorporate robustness in control policies by applying a novel percentile optimization technique that allows for the expression of a controller’s optimism level and utilizes incoming data to learn the true system parameters. We identify structural results of the optimal policy and use our technique in a hospital emergency department application using data from Mayo clinic.

3 - A Convexity Result for Nonlinear Gaussian Chance Constraints
Miles Lubin, MIT, 77 Massachusetts Avenue, E40-149, Cambridge, MA, 02139, United States of America, miles.lubin@gmail.com, Juan Pablo Vielma, Daniel Bienstock

We present an extension of the well-known convexity result for linear chance constraints under Gaussian uncertainty. We derive an exact convex reformulation for certain nonlinear chance constraints, together with a tractable SOCP formulation with provable approximation guarantees. We apply these results to tackle a more challenging chance constraint which arises from nonlinear power flow equations.
finding optimal DC decompositions by appealing to the algebraic concepts of
are given as the difference of two convex functions. In this talk, we focus on
difference of convex (DC) optimization, where the constraints and the objective
results will be shown.

2 - Efficiency of Supply Function Equilibrium in Networked Markets
Ermín Wei, Assistant Professor, Northwestern University, 2145 Sheridan Rd, Tech L310, Evanston, IL, 60208, United States of America, ermin.wei@northwestern.edu, Chaitanya Bandi, Yuzhuang Xiao
We study the efficiency loss of the supply function equilibrium (SFE). Specifically, we consider a market where the demand is inelastic, the suppliers submit their supply functions, and a uniform price is set to clear the market. Literature is limited to the markets with no network structure, and suggest that SFE is asymptotically efficient. Motivated by power grid, we study how network topology affects the efficiency of SFE. We identify the structure where the intuition from literature holds.

3 - DC Decomposition of Nonconvex Polynomials with Algebraic Techniques
Georgina Hall, Princeton University, ORFE Department, Sherrerd Hall, Charlton Street, Princeton, NJ, 08540, United States of America, gh4@princeton.edu, Amir Ali Ahmadi
The concave-convex procedure is a majorization-minimization algorithm for difference of convex (DC) optimization, where the constraints and the objective are given as the difference of two convex functions. In this talk, we focus on polynomial optimization: we introduce LP SOCP and SDP based algorithms for finding optimal DC decompositions by appealing to the algebraic concepts of “DSOS-Convex, SDSOS-Convex, and SOS-Convex” polynomials.
2 - Generalizations of the Dominating Set Problem on Social Networks
Raghu Ramnathan, University of Maryland, Institute for Systems Research, A. V. Williams Building, College Park, MD, 20742, United States of America, raghvan@rhsmith.umd.edu, Rui Zhang
The positive influence dominating set problem is a generalization of the dominating set problem that arises on social networks. First, we show that it can be solved in linear time on trees. Next, we provide a tight and compact extended formulation, and derive a complete description of its polytope on trees. The formulation is also valid on general graphs, thus providing a new and stronger one. Facet defining conditions for the new inequalities are provided.

3 - Flow Networks with Interdependent Commodities
Kelli Sullivan, Assistant Professor, University of Arkansas, Fayetteville, AR, 72701, ksvlliv@uark.edu, Sarah Nurre, Matthew Robbins, Brian Lundquist
We model an extension of the minimum cost flow problem to a multi-layered network in which each layer is associated with a commodity that flows through the network. Nodes in this network must consume certain commodities before they are able to transport other commodities. We discuss model properties, solution approaches, and application of the model to characterize vulnerabilities in interdependent systems where disruptions may propagate across layers.

4 - Hybridizing Meta-Raps with Machine Learning
Fatemah Al-Duodi, Old Dominion University, Dep. of Eng.Mngt. and Systems Eng., 5115 Hampton Blvd., Norfolk, VA, 23529, United States of America, fateamah.aldoudi@gmail.com, Ghaih Rabadi
The performance of Meta-heuristics for Randomized Priority Search (Meta-RaPS) is improved by integrating a learning phase into its original construction and improvement phases. Information collected during the original Meta-RaPS phases is used by machine learning algorithms in the new learning phase. The proposed approach will be demonstrated using instances for the Capacitated Vehicle Routing Problem (CVRP).

5 - Extending Time-to-target Plots to Test Sets with Multiple Problem Instances
Celso Ribeiro, Universidade Federal Fluminense, Institute of Computing, Niterói, Brazil, celso@ic.ufrj.br, Alberto Reyes
Time-to-target plots (tttplots) or runtime distributions are a useful tool to characterize, evaluate, and compare the behavior of randomized algorithms. However, they are limited to the evaluation of one single problem instance at-a-time. In this work, we propose their extension to address sets of test problems with multiple instances. Numerical results for different problems illustrate the applicability and usefulness of the newly proposed m-tttplots tool.

[MC20]

19-Franklin 9, Marriott
Tools for Optimization Modeling
Sponsor: Computing Society
Sponsored Session
Chair: Robert Fourer, President, AMPL Optimization Inc., 2521 Asbury Ave, Evanston, IL, 60201, United States of America, 4er@ampl.com
1 - The Surprising Difficulties of Supporting Quadratic Optimization in Algebraic Modeling Languages
Robert Fourer, President, AMPL Optimization Inc., 2521 Asbury Ave, Evanston, IL, 60201, United States of America, 4er@ampl.com
Algebraic modeling languages can readily convey convex quadratic functions to general nonlinear solvers, but support for recent quadratic extensions to mixed-integer linear solvers has proven much more challenging. The difficulty is due in part to the limited range of representations that solvers recognize and in part to the variety of transformations that must be considered. This presentation surveys the principal issues, and their implications for anyone building large-scale convex quadratic models.

2 - Modeling by Learning: The Problem Definition Repair Process
Choat Inthawongse, Lehigh University/Ramkhamhaeng University, 200 W Packer Ave., Bethlehem, PA, 18015, United States of America, choat@lehigh.edu, George R. Wilson
This research puts forward a framework for restructuring the problem and decision analysis template, representing an important extension to the cognitive computing systems, powered by IBM Watson. We develop an optimization model representation for model redefinition as a steppingstone toward creation of a decision support system motivated by cognitive computing. Broadening from the former models representation by Geoffrion as a semantic instrument for solution-method association state.
3 - Towards Multi-resource Fairness in Big Data Systems
Zhenhua Liu, Assistant Professor, Stony Brook University, Stony Brook, NY, 11794, United States of America, zhenuhua.liu@stonybrook.edu

Big data systems nowadays involve multiple resources such as CPU, memory, network during multiple stages. On the other hand, these systems are usually shared among multiple tenants with different demand characteristics. How to optimally align these two complexities while maintaining fairness among tenants has significant theoretical challenges, which generates great practical value. In this talk, I will briefly introduce our recent progress along this.

Pierskalla Award Finalists
Sponsor: Health Applications
Sponsored Session
Chair: Mohsen Bayati, Assistant Professor, Stanford Graduate School of Business, 653 Knight Way, Stanford, CA, United States of America, bayati@stanford.edu
Co-Chair: Soo-Haeng Cho, Associate Professor, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, soohaeng@andrew.cmu.edu

1 - Pierskalla Award Finalists
Mohsen Bayati, Assistant Professor, Stanford Graduate School of Business, 653 Knight Way, Stanford, CA, United States of America, bayati@stanford.edu, Soo-Haeng Cho, Joel Goh
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 is named after Dr. William Pierskalla to recognize his contribution and dedication to improving health services delivery.

2 - Tractable Graphical Modeling and the Bethe Approximation
Tony Jehara, Professor, Columbia University, 500 West 120 St., Room 450, Mail Code 0401, New York, NY, 10027, United States of America, jehara@cs.columbia.edu

We consider three NP-hard graphical modeling problems. For maximum a posteriori inference, we identify the limits of tractability via perfect graph theory. For marginal inference, we provide efficient solutions using Bethe free energy approximations and discretization. For learning, we combine Bethe with a Frank-Wolfe algorithm to avoid intractable expectation functions. Applications include link prediction, social influence estimation, computer vision, financial networks, and power networks.

3 - Lifts of Graphs and Approximate Inference
Nicholas Ruozzi, Assistant Professor, UT Dallas, 2601 N. Floyd Rd. M3 EC31, Richardson, TX, 75080, United States of America, nicholas.ruozzi@utdallas.edu

The approximate maximum a posteriori inference problem (MAP) for graphical models over finite state spaces is an NP-hard problem in general. As a result, approximate MAP inference techniques based on convex relaxations are often employed in practice. These convex relaxations are relatively well-understood in the discrete case but many open questions remain in the continuous setting. I will discuss how to extend many of the discrete results to the continuous setting using lifts of graphs.

4 - Factor Graphs, Kramers-Wannier Duality, and the Sum-product Algorithm
Ali Al-Bashabsheh, Postdoc, The Chinese University of Hong Kong, Hong Kong, Hong Kong - PRC, entropyal@gmail.com, Pascal O. Vontobel
A key object associated with a graphical model is its partition function. Although the partition function is often intractable, it can be estimated (e.g., via the sum-product algorithm) or analyzed (e.g., via factor graph transforms). An example of the latter, and also the main focus of this talk, is the analysis of 2D Ising models via Kramers—Wannier duality. At various places we will point out connections to optimization problems.

Message Passing for Inference
Sponsor: Applied Probability
Sponsored Session
Chair: Jinwoo Shin, Korea Advanced Institute of Science and Technology, 291 Daehak-rye, Yuseong-gu, Daejeon, Korea, Republic of, jinwoo@kaist.ac.kr

1 - How Hard is Inference for Structured Prediction?
David Sontag, Assistant Professor, NYU, 715 Broadway, 12th Floor, Room 1204, New York, NY, 10003, United States of America, dsontag@cs.nyu.edu

Structured prediction tasks in machine learning involve the simultaneous prediction of multiple labels. This is typically done by maximizing a score function on the space of labels, which decomposes as a sum of pairwise terms, each depending on two specific labels. Although marginal and MAP inference for these models are NP-hard in the worst-case, approximate inference algorithms are often remarkably successful. In this talk, we develop a theoretical framework to explain why.

Network Modeling and Analysis
Sponsor: Artificial Intelligence
Sponsored Session
Chair: Junming Yin, University of Arizona, Department of MIS, Tucson, AZ, 85721, United States of America, junmingy@email.arizona.edu

1 - Analysis of Network Experiments with Nonnegative Treatment Effects
David Choi, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, United States of America, davidch@andrew.cmu.edu
Randomized experiments in network settings are potentially useful for understanding the effects of peer influence and other social mechanisms. However, the analysis of experiments is an open problem when the individuals in the experiment are assumed to be able to influence each other’s decisions. We propose a new method that requires much weaker assumptions than existing methods, which often impose stylized models of individual behavior that may not be valid in practice.
2 - Inter-firm Managerial Social Ties, IT Supplier Selection and IT Standardization
Oliver Yao, George N. Beckwith, Professor, Lehigh University, 621 Taylor Street, Bethlehem, PA, 18015, United States of America, yuy3@lehigh.edu, Ling Xue, Ke Yang
We empirically test links between inter-firm managerial social ties (IMST) and IT supplier selection and IT standardization. We find that: (1) A firm is more likely to use an IT vendor if the firm has more IMST with the IT vendor. (2) A firm with more IMST with its potential IT vendors uses more IT vendors. (3) More IT vendors is associated with lower IT standardization for the firm, and such relationship is strengthened when the firm has a greater number of IMST with its IT vendors.

3 - Latent Space Inference of Internet-Scale Networks
Junning Yin, University of Arizona, Department of MIS, Tucson, AZ, 85721, United States of America, junning@email.arizona.edu, Qirong Ho, Eric Xing
The rise of internet-scale networks with hundreds of millions to billions of nodes, presents new scientific opportunities, such as overlapping community detection to discover the structure of the internet. However, many existing models are difficult or impossible to deploy at these massive scales. We propose a scalable approach for overlapping community detection in internet-scale networks, and we demonstrate our method on real networks with up to 100 million nodes and 1000 communities.

2 - How Our Networks Shape Our Privacy
Yotam Shmargad, University of Arizona, 1515 E. First St., Tucson, United States of America, yotam@email.arizona.edu
In this study, I relate characteristics of people’s networks to the level of privacy they experience in their social environments. I analyze over half a million users with nearly 40 million connections on a social network site, and show that characteristics of users’ networks can be used to predict various behaviors on the site – including decisions to share and consume information. In particular, users with networks containing several distinct social groups are more active on the site.

4 - The Value of Live Chat in Online Purchase
Xue Tan, University of Washington, Seattle, WA, United States of America, Youwei Wang, Yong Tan
In today’s competitive online marketplace, adopting a live chat tool is widely considered by merchants as a way to conduct one-to-one selling like in physical store. By allowing customer representatives to talk to potential buyers, e-tailer can answer consumers’ questions and decrease the level of information asymmetry. This paper empirically examine the role of live chat in terms of purchase conversion.

2 - Dynamic Estimation of Peer Effects and Product Engagement
Daniel Rock, Doctoral Candidate, MIT Sloan School of Management, 30 Memorial Drive, Office 341, Cambridge, MA, 02142, United States of America, drock@mit.edu, Sinan Aral, Sean Taylor
After product adoption, consumers make decisions about continued use. These choices can be influenced by peer decisions in networks, but identifying causal peer influence effects is challenging. Using engagement data for Yahoo! Go, a mobile application, we apply a dynamic version of the Bramoullet et al. (Journal of Econometrics 2009) identification strategy to estimate usage peer effects. We compare the performance of a variety of prediction models for the instrumental variable “first stage”.

2 - Estimating Non-additive Value Functions with Active Learning in the Ordinal Classification Setting
Levent Eriskin, Middle East Technical University, Industrial Engineering Department, Ankara, Turkey, levent.eriskin@gmail.com, Gulser Koksal
Preference modeling is used to represent Decision Maker’s subjective preference structure. Preference structure having some kind of interaction among criteria is hard to model. In this study, we present results of analyses conducted for estimating non-additive value functions having interaction structure by utilizing active learning techniques in the ordinal classification setting.

3 - Information Technology and the Rise of the Power Law Economy
Guillaume Saint-Jacques, PhD Candidate, MIT Sloan School of Management, 100 Main St, E62-459, Cambridge, MA, 02142, United States of America, gsaaintj@mit.edu, Erik Brynjolfsson
We show that the dramatically increasing share of income going to top earners can be explained by the rise of the “power law economy” and argue this reflects increased digitization and networks. Specifically, tax data (1960-2008) show that more individual incomes are drawn from a power law, as opposed to the long-established log-normal distribution. We present a simple theoretical model to argue that the increased role of power laws is consistent with the growth of information technology.
4 - Bi-objective Route Planning for Unmanned Air Vehicles in Continuous Space
Dilechan Texcanner Ozturk, Dr., TED University, Industrial Engineering, Ankara, Turkey, dilechan.ozturk@tedu.edu.tr, Murat Koksalan
We consider the route planning problem of a single unmanned air vehicle visiting multiple targets in continuous space under two objectives: minimization of total distance traveled and minimization of total radar detection threat. We develop solution approaches to generate the nondominated frontier of this problem. We also develop an interactive algorithm that asks for comparison between solutions and progressively reduces the search area around the decision maker's most preferred solutions.

1 - Understanding, Replicating, and Leveraging Dynamics of Bidder Behavior in Combinatorial Auctions
Ali Mahdavi, Carlson School of Management, 321 19th Ave S, #3-365, Minneapolis, MN, 55455, United States of America, mahr0008@umn.edu
We use an agent-based modeling approach to simulate human bidder behaviors observed in continuous combinatorial auctions. After validating our bidding agents, we leverage them to simulate a wide variety of competition types (different compositions of bidder behavior) and demonstrate how different competition types affect auction outcomes, such as revenue and allocative efficiency.

2 - An Experimental Agent-based Approach for Intelligent Decision Making on Electricity Future Markets
Derck Koolen, Rotterdam School of Management, Erasmus University, Burgemeester Oudlaan 50, Rotterdam, 3062 PA, Netherlands, koolen@rsm.nl, Wolf Ketter, Liangfei Qiu, Ronald Huisman
We study the determinants of forward prices and hedging decisions on electricity future markets in an experimental agent-based setting. Faced with imperfect storability and depending on price expectations, the agent supports producers using different technologies with varying risks from fuel trading, emission prices and weather conditions. Presenting different information treatments, the decision making of wholesale market participants is assessed.

3 - Moral Hazard in Auctions: A Principal-agent Model of Bidding Firms
Martin Bichler, Professor, TU München, Boltzmannstr. 3, Germany, bichler@in.tum.de, Per Paulsen, Salman Fadaei
We model auctions where the bidders are firms consisting of a principal and an agent. The agent wants to win the package with the highest expected value. Bayesian Nash equilibrium strategies in sealed-bid auctions illustrate possibilities for profitable manipulation of agents. For small markets we prove a non-truthful ex-post Nash equilibrium. Sometimes it is impossible for the principal to set allowances such that the agent bids truthfully. In larger markets, there are multiple equilibria.

4 - An Auction Mechanism for Scheduling Electric Vehicle Charging
Konstantina Valogianni, Rotterdam School of Management, Erasmus University, Burgemeester Oudlaan 50, Rotterdam, Netherlands, kvalogianni@rsm.nl, Wolfgang Ketter, Soumya Sen, Alok Gupta, Eric Van Heck
We present an auction-based framework for scheduling electric vehicle charging. We account for individual arrival and departure preferences and aim to service as many customers as possible without suffering major delays regarding their departure time. We show how the payments need to be allocated to minimize the system's delay cost. We examine the effect of the presented mechanism to smart grid's stability and reliability.

5 - Dynamic Decision-making in Sequential B2B Auctions
Yixin Lu, Assistant Professor, VU University Amsterdam, Netherlands, y2lu@vum.nl, Eric Van Heck, Alok Gupta, Wolfgang Ketter
We develop a dynamic structural model of competitive bidding in sequential B2B auctions. Given that bidders often have multiple purchase opportunities in these auctions, we formulate the optimal bidding problem as a partially observable Markov decision process. We apply the model to a unique dataset from the world's largest flower wholesale market.
In this talk we present a model whose objective is to determine, within a given physical region, the near-optimal required number of technicians and their assigned home base locations in order to satisfy defined customer service levels. Ideally, the workload for each technician would be balanced and the total cost to meet the desired service level is minimized. Furthermore, we examine additional areas where this general technique could be applied.

### MC32

**Sponsored Session**

**Cluster:** Big Data Analytics in Computational Biology/Medicine  
**Sponsor:** Data Mining

**MC32**

32-Room 409, Marriott

**Statistical Innovations in Computational Biology and Genomics**

Chair: Mingyao Li, Statistical Innovations in Computational Biology and Genomics, University of Pennsylvania, 213 Blockley Hall, 423 Guardian Drive, Philadelphia, PA, 19104, United States of America, mingyao@mail.med.upenn.edu

1 - Prediction using Multinomial Inverse Regression in Microbiome Studies  
Hongze Li, Professor of Biostatistics, University of Pennsylvania, 215 Blockley Hall, Philadelphia, PA, United States of America, hongze@mel.med.upenn.edu

Next-generation sequencing technologies allow 16S rRNA gene surveys or metagenome shotgun sequencing in order to characterize taxonomic composition. The data can be summarized as k-mer counts. We consider the regression problem for such high dimensional in order to build a model for predicting the clinical outcomes based on microbiome data and demonstrate its applications.

2 - Computational Validation of NGS Variant Calls using Genotype Data  
Margaret Taub, Assistant Scientist, Johns Hopkins Department of Biostatistics, 615 N Wolfe St, E3527, Baltimore, MD, United States of America, mtaub@jh sph.edu, Suyash Shringarpure, Ingo Ruczinski, Rasika Mathias, Kathleen Barnes

We performed a comparison of different variant calling algorithms on 642 samples whole-genome sequenced to an average depth of 30x, focusing on characteristics of variants called by different subsets of callers. We developed a classifier which uses genotyping array data, often collected for all sequenced individuals, as a gold standard to improve calibration of variant calls. We found little difference in quality between single- and multi-sample calling methods at 30x coverage.

### MC33

33-Room 410, Marriott

**Topics in Health Systems**

Sponsor: Health Applications

**Sponsored Session**

**Chair:** Douglas King, University of Illinois at Urbana-Champaign, 117 Transportation Bldg., 104 S. Mathews Ave., MC-238, Urbana, IL, 61801, United States of America, dmking@illinois.edu

1 - Methods in Treatment Planning with Continuous Dose Delivery  
Kimia Ghabadi, Massachusetts Institute of Technology, 77 Massachusetts Ave, Cambridge, MA, United States of America, kinia@mit.edu, David Jaffray, Dionne Alferman, Caroline Chung

In this work we investigate continuous dose delivery models and algorithms for head-and-neck patients. We discuss the necessary changes and considerations in the optimization models and algorithms for different tumor sites. We will also present the clinical realization of the plans and compare the obtained clinical results with the simulated treatment plans.

2 - Optimal Timing of Living-donor Liver Transplantation under Risk-aversion  
Ozlem Cavus, Bilkent University, Department of Industrial Engineering, Ankara, 06800, Turkey, ozlem.cavus@bilkent.edu.tr, Umit Emre Kose, Oguzhan Alagoz, Andrew J. Schaefer

The timing of liver transplantation is crucial as it affects the quality and the length of the patients’ life. Previous studies used risk-neutral Markov Decision Processes to optimize the timing of the transplantation. In this study, we model the risk-averse behavior of the patients using coherent dynamic measures of risk. We obtain optimal policies for different patients and donated organs. We also derive the structural properties of the optimal policy. Supported by TUBITAK [Grant 213M442].
3 - Forecasting Outcomes of Donor Liver Allocation Policies Given Growing Disparities in Supply and Demand
Rachel Townsley, North Carolina State University, Industrial and Systems Engineering, Raleigh, NC, rmtownsley@ncsu.edu, Maria Mayorga

Health trends in the US general population point to a growing gap in the supply and demand of livers for transplantation. Obesity, diabetes, and an aging population are the cause of declining donor liver quality as well as the cause of growing transplant waitlists. We use UNOS data to develop agent-based simulation models and evaluate 30-year outcomes of liver allocation in the US in light of these trends.

4 - An Efficient Contiguity-enforcement Algorithm for Practical Geographic Districting Problems
Douglas King, University of Illinois at Urbana-Champaign, 117 Transportation Bldg., 104 S. Mathews Ave., MC-238, Urbana, IL, 61801, United States of America, dmking@illinois.edu, Sheldon Jacobson, Edward Sewell

Geographic districting applications include congressional districting, police districting, and deployment of emergency services. Often, these districts are required to be contiguous, imposing a substantial computational burden during optimization. By integrating assessment of district holes (i.e., enclaves), this talk presents efficient algorithms for enforcing contiguity when district composition is optimized with local search. Practical scaling properties of these algorithms will be discussed.

1 - Data-driven Decision Making at Triage: Toward Better Patient Streaming in the Emergency Department
Elham Torabi, University of Cincinnati, Cincinnati, OH, torabiem@mail.uc.edu, Craig Froehle, Christopher Miller

The inadequacy of the ESI triage system potentially contributes to suboptimal patient routing and ED congestion. Using partitioning methods, we define new prioritization policies to further stratify the ESI-3 patients who make 50% of all patients. We evaluate the performance of the system under new policy using queueing models.

2 - The Cost of Waiting in Healthcare and Hospitality Services
Craig Froehle, Professor, University of Cincinnati, Lindner College of Business, Lindner College of Business, Cincinnati, OH, 45221-0130, United States of America, froehlecm@ucmail.uc.edu, Rohit Verma

The perceived cost of waiting to patients and customers has proven difficult to measure. Using a set of experiments, we compare how waiting is perceived in the contexts of healthcare and hospitality services. We examine the perceptions of waiting as well as “sequence” effects — where the wait occurs within the service process — and draw preliminary conclusions about how healthcare and hospitality services might better approach the management and mitigation of customer and patient waiting.

3 - Impact of Inspection Outcomes on Nursing Home Care Quality - Role of Ownership and Affiliation
Rachna Shah, Professor, University of Minnesota, Minneapolis, MN, United States of America, shahx024@umn.edu, Gopalakrishnan Narayananmurthy, Anand G

Inspections and their impact on quality outcomes have been studied in many different settings. Surprisingly, this relationship has not been examined in the healthcare sector. In this study, we investigate the impact of inspection outcomes on future clinical (evidence-based) and experiential (patient-centered) quality in nursing homes using a unique secondary panel data.

4 - Addressing Challenges of Scheduling Providers at Major Teaching Hospitals
Brian Lemay, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, 48109, United States of America, blemay@umich.edu, Amy Cohn

When using optimization models for solving healthcare provider scheduling problems, multi-criteria objective functions are necessary, but often result in undesirable schedules. Additionally, it is frequently not possible to satisfy every scheduling preference, so compromises must be made to resolve the infeasible problem instances. We discuss our methods for overcoming these multi-criteria objective and infeasibility challenges for scheduling providers at two major teaching hospitals.

Practice-Based Research in Humanitarian Operations Management
Sponsor: Public Sector OR
Sponsored Session
Chair: Maria Besiou, Kuehne Logistics University, Grosser Grasbrook 17, Hamburg, Germany, Maria.Besiou@the-klu.org

1 - Fundraising for Operational Expenditures in International Humanitarian Aid
Laura Turriti, Köhne Logistics University, Großer Grasbrook 17, Hamburg, 20457, Germany, Laura.Turriti@the-klu.org, Maria Besiou, Joern Meissner

Effectiveness of humanitarian programs depends on funding. Based on the programs operational needs, international humanitarian organizations estimate the operational expenditures and then appeal for donations. Donations affect services and the number of beneficiaries they will be able to reach. In this paper, using multiple regression analysis, we aim to shed more light on the operational implications of fundraising and on possible improvements of fundraising strategies for humanitarian programs.

2 - Disaster Response Test Cases: Representing Real Disasters
Azrah Azlah, Graduate Student, George Washington University, 800, 22nd Street NW, Washington, DC, 20052, United States of America, azrah@gwu.edu, Erica Gralla

In the humanitarian logistics literature, algorithms and policies are recommended based on their performance in test problem instances. Therefore, it is important that these test problems are representative of real disasters. We study twenty-seven real disaster instances, identify their characteristics and compare them to test problems from the humanitarian literature.

3 - Transition to Practice of Access Restoration in Post-disaster Humanitarian Logistics
Fellipe Arro-Vera, Rensselaer Polytechnic Institute, Troy, NY, United States of America, arosvm2@rpi.edu, Jose Holguin-Veras

This presentation focuses on the technical challenges of the transition to practice of access restoration methodologies after disasters. It gives an overview of the integration of systems that provide: (1) initial assessment of transportation network conditions, (2) mathematical modeling, and (3) decision making process on the ground. The presentation builds on the implementation of access restoration models into the disaster response plans in the city of New York.

4 - Volunteer Management in Charity Storehouses
Maria Besiou, Kuehne Logistics University, Grosser Grasbrook 17, Hamburg, Germany, Maria.Besiou@the-klu.org, Alfonso Pedraza-Martinez

We study volunteer management at a large faith-based organization. The whole supply chain operates exclusively with volunteers (from supply to delivery). We focus our study on the preparation of the beneficiaries' orders by volunteers in a storehouse. There are different categories of volunteers; some are more experienced while others may work in the system for the first time. Using empirical data we build a model to explore the drivers of on-time order fulfillment at the storehouse level.
1 - Resource Allocation for Sustaining Interventions in the Education System
Donna Llewellyn, Executive Director, Boise State University, 1910 University Drive, ISDI - ACS 104, Boise, ID, 83725-1155, United States of America, donnallewellyn@boisestate.edu, Pratik Mital, Roxanne Moore

In this work, the Education System Intervention Modeling Framework (ESIM) is developed that can be used to analyze interventions in the K-12 education system. The framework aids in locating resources to the more important parts of the system such that probability of sustaining the intervention can be maximized and the cost of implementation remains within the budget constraints. The framework can also be extended to analyze other complex systems like Healthcare, Humanitarian aid etc.

2 - Blending Systems Thinking Approaches for Organisational Diagnosis: Child Protection in England
David Lane, Henley Business School, Reading, United Kingdom d.c.lane@henley.ac.uk

The Department for Education’s high-profile ‘Munro Review of Child Protection’ used a blend of systems thinking ideas. First, a compliance culture that had computational savings. The framework aids in allocating resources to the more important parts of the system such that probability of sustaining the intervention can be maximized and the cost of implementation remains within the budget constraints. The framework can also be extended to analyze other complex systems like Healthcare, Humanitarian aid etc.

3 - Multiple Resource Type Straddling a Standard with Applications in Election Resource Allocation
Theodore Allen, Associate Professor, The Ohio State University, 1971 Neil Avenue, 210 Baker Systems, Columbus, OH, 43221, United States of America, allen.515@osu.edu, Muer Yang

The challenge of guaranteeing that no one will wait over 30 minutes using simulation optimization is explored. Novel selection and ranking methods are proposed. Numerical results illustrate potential new guidelines and associated computational savings.

4 - Measures and Inference of Spatial Access to Pediatric Dental Care in Georgia
Monica Gentili, Georgia Tech, North Ave NW, Atlanta, GA, United States of America, mgentili3@mail.gatech.edu, Shanshan Cao, Nicola Serban, Susan Griffin

We develop a measurement and modeling framework to infer the impact of policy changes on disparities in spatial accessibility to pediatric dental care in Georgia. Our measurement models are based on optimization models that match need of service with supply under a series of user and provider system constraints. We compare the derived measures and evaluate the impact of policy interventions for two population groups (publicly insured and privately insured children) and for rural and urban areas.

5 - Intertemporal Decisions in Hospital Capacity Planning
Jorge Vera, Professor, Universidad Catolica de Chile, Dept. Industrial and System Engineering, Vicuna Mackenna 4860, Santiago, Chile, jvera@ing.puc.cl, Ana Batista

Correct planning of capacity in a hospital is crucial for high standards of service to patients. The problem is complex not only because of the different areas in a large hospital but also because of several uncertainties present in the system, like patient demand or length of stay. In this work we show how we could use an intertemporal hierarchical decisions modeling to address this problem. We present model alternatives as well as solution methods based on Stochastic Optimization and Simulation methods.

6 - Workload Balancing Problem in an Outpatient Center under Uncertainty
Kamil Ciftci, PhD Candidate, Lehigh University, H.S. Mohler Laboratory, 200 West Packer Ave., Bethlehem, PA, 18015, United States of America, kac208@lehigh.edu

Creating fair nurse workload in infusion center is a difficult task due to uncertainty in patient late cancelation and no-show while patient satisfaction is top priority for hospital. In this study, we propose two-stage stochastic program model to find best combination of nurse workload balancing schedule (NWBS) and patient waiting time (PWT) under different uncertainties. Computational results show that proposed methodology provides better NWBS and keeps average PWT under hospital goal.

2 - Conjugate Gradient Algorithms to Optimize RBE-weighted Dose in Intensity Modulated Proton Therapy
Guven Kaya, PhD Student, Industrial Engineering, University of Houston, E206 Engineering Bldg. 2, Houston, TX, 77204, United States of America, gkaya@central.uh.edu, Gino Lim

Intensity modulated proton therapy (IMPT) usually operates a constant relative biological effectiveness (RBE). In fact, RBE is not constant. RBE is described as a function of dose, linear energy transfer (LET) and tissue type in the structure of the linear-quadratic (LQ) model. We study the optimization of radiobiological effects (dose and rbe-weighted dose) in the context of LQ model by using two conjugate gradient algorithms. For results, we use data for head and neck cancer case.

3 - Robust Surgery Scheduling with Exception Analytics
Yoonneun Lee, The Pennsylvania State University, 236 Leonhard Building, University Park, PA, 16802, United States of America, yx5250@psu.edu, Vittalad Prabhu

In this study, we address a surgery scheduling problem with uncertain surgery duration where surgical procedure takes place in multiple operating rooms. We present a robust surgery scheduling model and study its performance using exception analytics approach. We perform numerical experiments to compare performances of various models including simple heuristics, and find out that the results illustrate that the robust models with exception analytics works well across different instances.

4 - Intermarket Decisions in Hospital Capacity Planning
Jorge Vera, Professor, Universidad Catolica de Chile, Dept. Industrial and System Engineering, Vicuna Mackenna 4860, Santiago, Chile, jvera@ing.puc.cl, Ana Batista

Correct planning of capacity in a hospital is crucial for high standards of service to patients. The problem is complex not only because of the different areas in a large hospital but also because of several uncertainties present in the system, like patient demand or length of stay. In this work we show how we could use an intertemporal hierarchical decisions modeling to address this problem. We present model alternatives as well as solution methods based on Stochastic Optimization and Simulation methods.

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3 - Dynamic Credit-collections Optimization
Naveed Chehrazi, Assistant Professor, McCombs School of Business, 2110 Speedway Stop B6300, Austin, TX, 78705.
United States of America, naveed.chehrazi@mccombs.utexas.edu,
Peter Glynn, Thomas Weber
We develop a dynamic model of consumer repayment behavior on delinquent credit-card loans using a marked point process. The intensity of this point process can be influenced by costly treatment actions. Both the type and the timing of the account-treatment actions are subject to optimization, leading to an optimal impulse control problem. Using the HJB equation, we obtain a quasi-closed form solution for this control problem.

4 - Complexity Estimates for Policy and Value Iteration Algorithms for Total-cost and Average-cost MDPs
Jefferson Huang, Stony Brook University, Dept. Applied Mathematics & Statistics, Stony Brook, NY, 11794-3600, United States of America, jefferson.huang@stonybrook.edu, Eugene Feinberg
We present two groups of results: an example showing that the value iteration algorithm and its modifications are not strongly polynomial for discounted MDPs, and reductions of certain total-cost and average-cost MDPs to discounted ones. Combining the latter with Yinyu Ye’s result on the strong polynomiality of the simplex method and policy iterations for discounted MDPs allows us to design strongly polynomial algorithms for important classes of total-cost and average-cost MDPs.

■ MC39
39-Room 100, CC
Branding and Bundling
Cluster: Operations/Marketing Interface
Invited Session
Chair: Kathy Stecke, UT Dallas, SM 30 JSOM, 800 W Campbell Rd, Richardson, TX, 75080, United States of America, kstecke@utdallas.edu
1 - Consumer Taste Uncertainty in the Context of Store Brand and National Brand Competition
Saibal Ray, Professor, McGill University, 1001 Sherbrooke Street West, Montreal, Canada, saibal.ray@mcgill.ca, Tamer Boyaci, Arcan Nalca
We focus on the uncertainty in consumer taste and study how a retailer can benefit from acquiring that taste information in the presence of competition between its store brand and a national brand. We also identify the optimal information sharing strategy of the retailer as well as the equilibrium product positioning and pricing of the brands. We generate insights as to when it is most valuable for the retailer to acquire taste information as well its value for the manufacturer.

2 - Retail Assortment and Price Competition when Consumers are Uncertain about Product Tastes
Steve Gilbert, Professor, University of Texas at Austin, 1 University Station, B6300, The University of Texas at Austin, Austin, TX, 78712, United States of America, steve.gilbert@mccombs.utexas.edu, Haoying Sun
For many products, at least some consumers may need to physically experience them in order to assess their valuations. For such products, we provide conditions under which there will be an equilibrium between two symmetric retailers in which one carries both products and the other carries only one. In addition, we find that the pricing strategy that should be adopted by each retailer differs substantially depending upon his rival's assortment.

3 - Demand Shaping through Bundling and Configuration: A Dynamic Multiproduct Inventory-pricing Model
Zhengliang Xue, IBM Research Center, Yorktown Heights, NY, United States of America, zxue@us.ibm.com, Jeannette Song
Motivated by the industrial practice of using product bundling to shape demand, we present a dynamic model to analyze the optimal joint inventory, pricing, and bundling decisions for a firm selling vertically differentiated bundles over a finite horizon. We study the factors driving the bundling strategy, and provide insights into when to change the bundling strategies. Such strategies have a broad application in practice such as pricing the configuration of server and accessories.

4 - Should a Retailer Consider Adding a Social Network Enabled Channel?
Gulver Karamemis, University of Florida, 355A STZ, Gainesville, FL, 32611, United States of America, gulver.karamemis@warrington.ufl.edu, Narendra Agrawal, Subhajyoti Bandopadhyay, Asok Vakharla
Social networks are one of the most exciting recent developments that have influenced the relationships between individuals and between individuals and organizations. However, due to its relative infancy as well as the myriad data and security related concerns of consumers, retailers have been slow to dive into social networks as a sales channel. Our research sheds light on the question of when retailers should consider adding a social network channel to their existing channel architecture.

■ MC40
40- Room 101, CC
Micro-Underpinnings of Mobility, Knowledge, and Performance in Groups and Organizations
Sponsor: Organization Science
Sponsored Session
Chair: Aimee Kane, Duquesne University, Pittsburgh, PA, kanea@duq.edu
Co-Chair: Gina Dokko, University of California, Davis, CA
1 - Managing Talent across Organizations: the Portability of Individual Performance
Gina Dokko, University of California, Davis, Davis, CA, Winnie Jiang
As individuals’ careers increasingly unfold in diverse ways, the question of what they carry with them as they cross organizational or institutional boundaries becomes increasingly important. In this essay, we review findings on the portability of individual performance and develop a framework for thinking about talent management in organizations that accounts for the movement of individuals in and out of organizations and the complexity of modern careers.

2 - Using What You Know: Inventor Mobility to Young Firms
Erin Fahrenkopf, Carnegie Mellon University, Pittsburgh, PA, efahrenkopf@gmail.com
The research addresses the conditions under which individuals at entrepreneurial firms exploit knowledge from prior organizational experiences. In particular, I examine the effect of engaging in collaborative work and organizational roles on individuals’ knowledge use at young firms. I study a sample of inventor movements, both founders and employees, in the US laser industry and provide implications for the study of entrepreneurship and knowledge transfer by employee movements.

3 - Overcoming Barriers to Team Receptivity to Newcomers
Aimee Kane, Duquesne University, Pittsburgh, PA, kanea@duq.edu, Floor Rink
Newcomers bring with them unique perspectives drawn from prior experience, but, due to social psychological barriers, there is a pervasive tendency for teams to push newcomers to assimilate to the team rather than utilize their valuable knowledge. This contribution draws on evidence from small group experiments and vignette studies to suggest ways of replacing this resistance with receptivity to newcomer's unique knowledge, which are also amendable to managerial, team, and newcomer intervention.

4 - Shady Characters: How Illicit Roles Contribute to Team Performance
Colleen Stuart, Johns Hopkins University, Baltimore, MD, cstuart@jhu.edu, Celia Moore
In this paper we theorize about illicit roles, roles that specialize in activity that contravens rules or regulations to support group goals. We use data on professional hockey teams to examine how team performance is disrupted when the enforcer, a player who specializes in the prohibited activity of fighting, is injured. We discuss how our understanding of illicit roles can be used to build theory about informal organizational roles and the implications of these roles for mobility in teams.
United States of America, songheek@marshall.usc.edu

Business, University of Southern California, Los Angeles, CA, dai@jhu.edu

on various contextual and situational factors. In this paper, we consider a patient panel and develop a new model of patient health classification performance.

2 - Managing Office Revisit Intervals and Patient Panel Sizes in Primary Care

Hessam Bahafza, Assistant Professor, Wisconsin School of Business, Madison, WI, United States of America, hbahafza@bus.wisc.edu

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. In this paper, we consider a patient panel and develop a new model of patient health dynamics.

3 - Outpatient-clinic Capacity Management when Continuity of Care Matters

Yichuan Ding, UBC, 2053 Main Mall, Sauder School of Business, Vancouver, BC, V6T1Z2, Canada, daniel.ding@sauder.ubc.ca, Diwakar Gupta, Xiaoxu Tang

We study how to manage capacity in an outpatient clinic with the goal of maximizing service volume as well as maintaining high level of continuity of care (COC). We consider a simple strategy that doctors may use to improve COC — book a follow-up appointment (FUA) for a patient before she leaves the clinic. In order to encourage the doctor to use this strategy, the current fee-for-service mechanism must be revised to compensate doctors for FUAs that are no show or late cancelled.

4 - The Impact of Health Information Exchanges on Emergency Department Length of Stay

Jan Vlachy, PhD Student, Georgia Institute of Technology, 755 Ferst Drive, NW, Atlanta, GA, 30332, United States of America, vlachy@gatech.edu, Turgay Ayer, Mehmet Ayvaci, Zeynal Karaca

Electronic exchange of health information (HIE) is expected to improve coordination in emergency departments (ED). We empirically study the impact of HIEs on ED length of stay (LOS) using a large longitudinal dataset comprising about 5.8 million visits to 63 EDs over three years. Overall, we find that HIE adoption is associated with substantial reductions in LOS, but this impact depends on various contextual and situational factors.

1 - Efficient Spatial Allocation of Epidemic Intervention Resources with a Focus on Ebola in West Africa

Elke Nohdurf, Research Assistant, WHU - Otto Beisheim School of Management, Burgplatz 2, Vallendar, 56179, Germany, elke.nohdurf@whu.edu, Elisa Long, Stefan Spinder

The recent Ebola outbreak has shown that containment of an infectious disease relies on deployment and allocation of intervention resources. A model reducing the number of infections through improved allocation is proposed. Allocation decisions are based on a spatial compartmental epidemic model with a novel factor dynamically incorporating behavioral change in the population. Our approach could avoid up to 23% of the infections.

2 - Information Aggregation and Classification under Anchoring Bias: Application to Breast Imaging

Mehmet Eren Ahsen, Researcher, IBM Research, 1101 Route 134 Kitchawan RD #13-146C, Yorktown Heights, NY, 10598, United States of America, mahsen@us.ibm.com, Mehmet Ayvaci, Sriniivasan Raghunathan

We study optimal aggregation and subsequent classification for the case of two sources of information where the interpretation of the primary information (mammography) is biased by the secondary information (risk profile). We examine the relationship between bias, weights assigned, and the decision thresholds in the context of optimal utility or the optimal discriminative ability.

3 - Priority and Predictability

Jillian A Berry Jaeger, Assistant Professor, Boston University, 595 Commonwealth Avenue, Boston, MA, 02215, United States of America, jaeger@bu.edu

This study explores how patient admission characteristics (i.e. whether a patient is scheduled or emergent; medical or surgical) moderate the effects of high workload and demand. In particular, the probabilities of admission and discharge, by patient type are analyzed. The results of this study provide an estimation of the impact of predictability on patient flow.

4 - Decision Ambiguity and Conflicts of Interests in Interventional Cardiology Decision-Making

Tinglong Dai, Assistant Professor, Johns Hopkins University, 100 International Dr, Baltimore, MD, 21202, United States of America, dai@jhu.edu, Chao-wei Hwang, Xiaofang Wang

With the rapidly rising cost of health care, there is a renewed urgency for reducing inappropriate use of percutaneous coronary interventions (PCI). In this work, we provide a quantitative analytical model of clinical and non-clinical factors influencing PCI decision-making processes. Our model helps inform policy-makers designing guidelines to optimize the use of PCI.
3 - Selling Information in Oligopolies
Alireza Tahbaz-Salehi, Columbia Business School, 3022 Broadway, Uris Hall 418, New York, NY, 10023, United States of America, alirezat@columbia.edu, Kostas Bimpikis, Davide Crippa
This paper studies the strategic interaction between a monopolist seller of an information product and a set of potential buyers that compete in a downstream market. We argue that the nature of competition among the buyers largely determines the price and accuracy of the product that the monopolist decides to sell.

4 - Analysis of a Simple Cost Allocation Rule for Joint Replenishment
Xuan Wang, New York University, 44 West 4th Street, Suite 8-154, New York, NY, 10012, United States of America, xwang38@stern.nyu.edu, Jiawei Zhang, Sinal He, Jay Sethuraman
We consider the joint replenishment game in which the major setup cost is split equally among the retailers who place an order together. Each retailer pays his own holding and minor setup cost. Under this allocation rule each retailer determines, his replenishment policy to minimize his own cost anticipating the other retailers’ strategy. We show that a payoff dominant Nash equilibrium exists and quantify the efficiency loss of the non-cooperative outcome relative to the social optimum.

■ MC44
44-Room 103B, CC
Empirical and Data-Driven Research in Revenue Management and Pricing
Sponsor: Revenue Management and Pricing
Sponsored Session
Chair: Jun Li, Assistant Professor, Ross School of Business, University of Michigan, 701 Tappan St, Ann Arbor, 48103, United States of America, jliwli@umich.edu
Co-Chair: Serguei Netessine, Professor, INSEAD, 1 Ayer Rajah Avenue, Singapore, 138676, Singapore, Serguei.Netessine@insead.edu
1 - Interpreting “3 Seats Left”: An Empirical Analysis of Airline Inventory Announcements
Kate Ashley, UC Berkeley Haas School of Business, 2220 Piedmont Ave, Berkeley, CA, 94720, United States of America, kate_ashley@haas.berkeley.edu, Prinia Feldman, Jun Li
Does inventory announcement affect the timing of customer purchases? We estimate the impact of inventory announcement policy on purchases of airline tickets. We analyze the extent to which customers treat messages from the firm as cheap talk or credible information, and the extent to which firms use announcements strategically to influence demand.

2 - Contextual Treatment Selection and its Application to Pricing Optimization
Yan Zhao, MIT, 77 Mass Ave, 1-245, Cambridge, MA, United States of America, zhaoyan@mit.edu
With the rapid growth of e-commerce, the wealth of data makes it possible to exploit the heterogeneity among customer pricing sensitivity and maximize revenue. We develop a general framework for the customized pricing problem and propose a tree-based algorithm, which shows superior performance on both simulated data and real transaction data. Under mild regularity conditions we prove the upper bound of the difference of expected revenue between a simplified version of our algorithm and an oracle.

3 - Dynamic Pricing and Inventory Management: An Empirical Perspective
Yan Shang, PhD Student, Duke University, 845 Ivy Meadow Ln, Apt. 3D, Durham, NC, 27707, United States of America, yan.shang@duke.edu, Yiting Deng, Jing-Sheng Song
This paper applies structural modeling to study joint inventory and pricing management of perishable product, using fresh vegetable data from the largest state-owned supermarket chain in China. Demand of fresh vegetables depends not only on price but also freshness, and complementarity exists between items. We use a multiple continuous model to incorporate these factors. Based on demand estimates, optimal prices are solved, which achieves significant profit improvement and waste reduction.

■ MC45
45-Room 103C, CC
From Store to Omni-Channel: Choice-Driven Pricing Models
Sponsor: Revenue Management and Pricing
Sponsored Session
Chair: Stefanus Jasin, Stephen M. Ross School of Business, University of Michigan, Ann Arbor, MI, United States of America, sjasin@umich.edu
Co-Chair: Joline Uichanco, Asst. Professor, University of Michigan, Ross School of Business, 701 Tappan Ave, Ann Arbor, MI, 48109, United States of America, jolineu@umich.edu
1 - Drivers of Demand for Consumer Packaged Goods that Have Wide Variations in Price and Perceived Quality
Olga Pak, Student, University of South Carolina, 1014 Greene Street, Columbia, SC, 29208, United States of America, olga.pak@grad.moor.sc.edu, Mark Ferguson
In joint work with Oracle Retail, we identify the drivers of demand for consumer packaged goods that have wide variations in price and perceived quality. We investigate the problem with the use of hierarchical models on retail transaction data across multiple market and store locations to analyze the influence of prices, promotions and individual store effects.

2 - Integrated Lifecycle Price and Inventory Optimization in an Omni-channel Environment
Pavithra Harsha, IBM, 1101 Kitchawan Road, Room 34-225, Yorktown Heights, NY, 10598, United States of America, pharsha@us.ibm.com, Shivaram Subramanian, Joline Uichanco, Markus Ettl
In an online-channel environment, inventory is shared across channels through multiple fulfillment options (e.g. ship-from-store). Without accounting for this, existing pricing solutions take steep mark downs in stores. We present a tractable optimization model to determine optimal lifecycle channel prices, inventory allocations and partitions across channels that maximizes the total chain level profit. Our experiments show a 6-12% improvement in profit over multiple categories of a large retailer.

3 - Data-driven Learning in Dynamic Pricing using Adaptive Optimization
Phrode Vayanos, Assistant Professor, University of Southern California, 3551 Trousdale Pkwy, University Park, Los Angeles, CA, 90089, United States of America, pvayanos@usc.edu, Dimitris Bertsimas
We consider the pricing problem faced by a retailer endowed with a finite inventory of a product with unknown demand curve offered to price-sensitive customers. We formulate the seller’s problem as an adaptive optimization problem with decision-dependent uncertainty set and propose a tractable solution approach.

■ MC46
46-Room 104A, CC
Pricing and Strategic Behavior in Queuing Systems
Sponsor: Manufacturing & Service Oper Mgmt/Service Operations
Sponsored Session
Chair: Philipp Afche, Associate Professor, University of Toronto, 105 St. George Street, Toronto, ON, M5S3E6, Canada, afche@rothman.utoronto.ca
1 - Pricing, Diagnosis and Over-treatment in Expert Services
Senthil Veeraraghavan, Associate Professor, The Wharton School, 3730 Walnut St, Philadelphia, PA, 19104, United States of America, senthilv@wharton.upenn.edu
In many services, consumers must rely on advice of experts to identify the type of treatment/service they need. The information asymmetry between service provider and the consumers creates inefficiencies in the form of cheating and over-treatment. We show that congestion and waiting costs act as natural “fraud costs” which mitigate cheating, inducing honesty and increasing social welfare. We show the informational value of pricing in inducing either honesty or overtreatment.
2 - Value of Dynamic Pricing in Congestible Systems
Jeonghyun Kim, University of Southern California, Marshall School of Business, Bridge Hall 401, Los Angeles, CA, 90089, United States of America, jeonghyun.kim.2015@marshall.usc.edu, Ramandeep Randhawa
From UBER to express lanes on highways, dynamically changing the premium for access to limited resources based on congestion is prevalent. Our research question is: what is the value of dynamic pricing over static pricing in such systems? By modeling a firm that caters to price- and delay-sensitive customers, we analytically prove that the value can be significant and a simple dynamic scheme of using only two price points reaps most of this value.

3 - Price Competition with Customer Search in Congested Environments
Laurens Debo, Associate Professor, Dartmouth College, 100 Tuck Hall, Hanover NH 03755, United States of America, laurens.g.debo@tuck.dartmouth.edu, Varun Gupta, LuIy Yang
We study how firms compete in service rate when congestion-sensitive customer search, at some cost, for the firm with the shortest line. We find that decreasing search costs increases search and intensifies service rate competition, which reduces firms’ equilibrium profits. Firms can get around by inflicting random costs on customers.

4 - Learning and Earning for Congestion-prone Service Systems
Philipp Afeche, Associate Professor, University of Toronto, 103 St. George Street, Toronto, ON, M5S 3E6, Canada, afeche@rotman.utoronto.ca, Bora Keskin
We consider a firm that sells a service in a congestion-prone system to price- and delay-sensitive customers. The firm faces Bayesian uncertainty about the consumer demand for its service and can dynamically make noisy observations on the demand. We characterize the structure and performance of the myopic Bayesian policy and well-performing variants. Our results show that capacity constraints have an important effect on performance.

MC49
49-Room 105B, CC
Emerging Topics in Supply Chain Management
Sponsor: Manufacturing & Service Oper Mgmt/Sustainable Operations
Sponsored Session
Chair: Hakjin Chung, Stephen M. Ross School of Business, University of Michigan, Ann Arbor, MI, United States of America, hakjin@umich.edu
Co-Chair: Kun Soo Park, Assistant Professor, KAIST College of Business, 85 Hoegiro, Dongdaemun-gu, Seoul, 130722, Korea, Republic of, kunsoo@kaist.ac.kr
1 - The Newsvendor under Demand Ambiguity: Combining Data with Moment and Tail Information
Soroush Saghaifian, Harvard University, 79 JFK Street, Cambridge, MA, 02138, United States of America, Soroush.Saghaifian@asu.edu, Brian Tomlin
Data-driven approaches typically assume that the planner has no information beyond the evolving history of demand observations. The planner may, however, have partial information about the demand distribution in addition to demand observations. We propose a non-parametric, maximum-entropy based technique, termed SORME (Second Order Belief Maximum Entropy), which allows the planner to effectively combine demand observations with partial distributional information.

2 - Managing The Supply-demand Mismatch with Complementary Product Flow Options
Alexander Angelus, University of Texas, Jindal School of Management, Dallas, TX, United States of America, alexandar.angelus@utdallas.edu, Ozalp Ozer
To address the pervasive supply-demand mismatch in multi-stage supply chains with stochastic demand, we use the option to expedite shipments downstream to manage excess demand, and allow for returns of stock upstream to deal with excess inventory. We identify the optimal policy that decomposes this multi-dimensional problem into single-dimensional subproblems. Our numerical studies of supply chains with both expediting and returns of stock find those two product flow options to be complementary.

3 - Capacity Investment with Demand Learning
Anany Qi, Assistant Professor, University of Texas at Dallas, 800 W Campbell Rd, Richardson, TX, 75080, United States of America, axq140430@utdallas.edu, Amitabh Sinha
We study a firm’s strategy to adjust its capacity using information learned from observed demand. We characterize the firm's optimal policy and develop an easily-implementable and data-driven heuristic about when and by how much the firm should adjust its capacity. We also numerically validate the performance of our heuristic.

4 - Sequential Capacity Allocation under Order Manipulation: Efficiency and Fairness
Kun Soo Park, Assistant Professor, KAIST(Korea Advanced Institute of Science and Technology), 410 Supex Bldg, 85 Hoegiro, Dongdaemun-g, Seoul, Korea, Republic of, kunssoo/business.kiaist.ac.kr, Seyed Iravani, Bosung Kim
We analyze the strategic behavior of the supplier and manufactures in sequential capacity allocations when the manufacturers’ order strategy is not necessarily truthful to the supplier. We show how an allocation changes under order manipulation and consider two directions to improve sequential allocation mechanisms under order manipulation from the perspective of efficiency and fairness of an allocation.
Retail Supply Chain: From Demand Forecast to Order Fulfillment
Sponsor: Manufacturing & Service Operations Management
Sponsored Session
Chair: Santiago Gallino, Tuck School of Business, 100 Tuck Hall, Hanover, NH, United States of America, santiago.gallino@tuck.dartmouth.edu

1 - How an e-Retailer can Profit from the Right Free Shipping Policy: A Model and Evidence
Joseph (Jiaqi) Xu, The Wharton School, University of Pennsylvania, 3730 Walnut Street, Suite 500, Philadelphia, PA, United States of America, jiaqixu@wharton.upenn.edu, Gerard Cachon, Santiago Gallino
We present a model of online retail profitability when consumers purposely increase their order size to qualify for free shipping. While this behavior results in more sales, it also adds cost from less shipping revenue and more product returns. We find that free shipping threshold often decreases profitability and is effective only for retailers with high fulfillment cost relative to shipping revenue and with low probability of return. The model is applied to data from an online retailer.

2 - Can Supply Chain Flexibility Facilitate Information Sharing?
Mohammad M. Fazel-Zarandi, PhD Candidate, Rotman School of Management, 105 St George Street, Toronto, M5S 3E6, Canada, M.FazelZarandi10@Rotman.utoronto.ca, Oded Berman, Dmitry Krass
We attempt to provide an explanation for a long-standing observation in supply chain management: while simple contracts cannot induce credible forecast sharing between different supply chain parties, firms often use them in practice, and exchange information through unverifiable communication. Using a stylized supply chain model, we show that if the reporting firm is uncertain about the receiving firm’s reaction to its report, it may truthfully share its private information in equilibrium.

3 - Improving Color Trend Forecasting using Social Media Data
Yorun Fu, PhD Student, The Wharton School, 3730 Walnut St, Philadelphia, PA, United States of America, yorumluf@wharton.upenn.edu, Marshall Fisher
We partnered with a leading apparel retailer to investigate how to use social media data to improve fashion color trend forecasting. We find that using fine-grained Twitter data and a Google search volume index to predict style-color sales three months out reduces forecast error by 11% compared to conventional methods.

4 - Wisdom of Crowds: Forecasting using Prediction Markets
Ruomeng Cui, Assistant Professor, Indiana University, 309 E. Tenth Street, Bloomington, IN, 47401, United States of America, cui@indiana.edu, Achal Basamboo, Antonio Moreno-Garcia
Prediction markets are virtual markets created to aggregate predictions from the crowd. We examine data from a public prediction market and internal prediction markets run at three corporations. We study the efficiency of these markets in extracting information from participants. We show that the distribution forecasts, such as sales and commodity price predictions, generated by the crowds are perfectly calibrated. In addition, we run a field experiment to study drivers of forecast accuracy.

Dynamic Contracts in Operations Management
Sponsor: Manufacturing & Service Operations Management
Sponsored Session
Chair: Hao Zhang, Associate Professor, University of British Columbia, Sauder School of Business, Vancouver, BC, V6T1Z2, Canada, hao.zhang@sauder.ubc.ca

1 - Optimal Long-term Supply Contracts with Asymmetric Demand Information
Wengiang Xiao, Associate Professor, New York University, Stern School of Business, 44 West Fourth Street, 8-72, New York, NY, 10012, United States of America, wxiaoj@stern.nyu.edu, Ilan Lobel
We consider a manufacturer selling to a retailer with private demand information arising dynamically over an infinite time horizon. We show that the manufacturer's optimal dynamic long-term contract takes a simple form: in the first period, based on her private demand forecast, the retailer selects a wholesale price and pays an associated upfront fee, and, from then on, the two parties stick to a simple wholesale price contract with the retailer’s chosen price.

2 - Dynamic Mechanisms for Online Advertising
Hamid Nazeraezadeh, University of Southern California, Bridge Memorial Hall, 3670 Trousdale Parkway, Los Angeles, CA, 90089, United States of America, hamidn2@marshall.usc.edu, Vahab Mirrokni
I will discuss designing dynamic contracts for selling display advertising. I will show that under natural but rather restricted assumptions, the traditional reservation contracts can be revenue-optimal. I will also present the optimal mechanism in a general setting and discuss their practical implementations.

3 - Dynamic Short-term Contracts under Private Inventory Information and Backlogging
Lifei Sheng, PhD Candidate, University of British Columbia, 2053 Main Mall, Vancouver, BC, V6T1Z2, Canada, Fay.Sheng@sauder.ubc.ca, Mahesh Nagarajan, Hao Zhang
We study a setting where a supplier sells to a retailer facing random demand over multiple periods. At the beginning of each period, the retailer offers a one-period contract and the retailer decides his order quantity before the demand realizes. The retailer carries leftover inventory or backlogs unmet demand, which is unobservable by the supplier. We show interesting properties of the supplier’s optimal contract and study special cases when the problem is tractable.

4 - Structures of Optimal Dynamic Mechanisms
Alexandre Belloni, Professor Of Decision Sciences, Duke University, 100 Fuqua Drive, Duke University, Durham, NC, 27708, United States of America, abn5@duke.edu, Peng Sun, Bingyao Chen
Consider a principal procures up to one unit of a product/service in every period from an agent who is privately informed about its marginal production cost in each period. We identify regularity conditions on the distribution of private information under which the optimal contracts offer at most two different procurement levels depending on the newly reported cost. Our results rely on “dynamic virtual valuation,” a generalization of the Myersonian virtual valuation in the static setting.
3 - Request for Service Process (RFS) Process Reengineering for IBM Strategic Outsourcing (SO) Business
Pawan Chowdhary, Software Research, IBM Research, 650 Harry Road, San Jose, CA, 95120, United States of America, chowdhar@us.ibm.com, Jeanette Blomberg, Anca Chandra

RFS’s are small work items that were not covered in strategic SO contract and are highly profitable. For a typical contract there could be hundreds of RFS that needs to be executed. The traditional processes to manage these RFS’s were very cumbersome and often got delayed. In this talk, I will present the findings and the process reengineering work that IBM Research did to improve the performance of the RFS’s along with increased customer satisfaction.

■ MC53
53-Room 107B, CC
Opportunities and New Directions for Behavioral OM
Sponsor: Behavioral Operations Management
Sponsored Session
Chair: Stephen Leider, University of Michigan, 701 Tappan Ave R4486, Ann Arbor, MI, 48104, United States of America, leider@umich.edu

1 - Supply Chain Risk: Behavioral Research Opportunities
Brian Tomlin, Professor, Tuck School of Business, Dartmouth College, 100 Tuck Hall; Hanover, NH, United States of America, Brian.T.Tomlin@tuck.dartmouth.edu

I will give an overview of the theoretical research in supply chain risk and attempt to identify some interesting questions for behavioral research.

2 - Humans Versus Machines: Impact on Network Capacity
Jan Van Mieghem, Professor, Kellogg School of Management, 2001 Sheridan Road, 5th Floor, Evanston, IL, 60201, United States of America, vanneghem@kellogg.northwestern.edu, Itai Gurvich, Lu Wang

One of the fundamental questions in operations is to determine the maximal throughput or productivity of a process. Does it matter whether humans or machines execute the various steps in the process? If so, how do we incorporate this difference in our planning and performance evaluation? We propose some answers by discussing two examples: a theoretical analysis an empirical study.

3 - Sustainability: Challenges and Research Opportunities
Erica Plambeck, Professor, Stanford Graduate School of Business, 655 Knight Way, Stanford, CA, United States of America, elp@stanford.edu

Environmental sustainability requires profound changes in the production of goods and services. Behavioral OM researchers can guide and learn from those changes.

■ MC54
54-Room 108A, CC
Equilibrium Routing and its Paradoxes
Cluster: Tutorials
Invited Session
Chair: Asu Ozdaglar, Massachusetts Institute of Technology, 32 Vassar St, Cambridge, MA, United States of America, asuman@mit.edu

1 - Tutorial: Equilibrium Routing and its Paradoxes
Asu Ozdaglar, Massachusetts Institute of Technology, 32 Vassar St, Cambridge, MA, United States of America, asuman@mit.edu

We study equilibrium routing of flows in congested traffic and communication networks. We investigate efficiency implications of decentralized routing with and without prices and with different information structures. Despite the tractable nature of the models, both the equilibrium properties and the potential types of inefficiencies are rich and can sometimes change in unexpected directions in response to modifications in network and information structures.

■ MC55
55-Room 108B, CC
Efficiency in the Higher Education and Banking Sectors
Cluster: Data Envelopment Analysis
Invited Session
Chair: Jill Johnes, Professor, University of Huddersfield, The Business School Queensgate, Huddersfield, HD1 3HG United Kingdom j.johnes@hud.ac.uk

1 - Does Bank Performance and Corruption Matter for Economic Growth? An International Exploratory Study
Abdel Latef Anourou, Assistant Prod, Qatar University, College of Business and Economic-DMM, Doha, No, 2713, Qatar, a.anourou@qu.edu.qa

While previous economic development studies take into account the impact of financial sector performance on economic growth, the role of corruption as economic factors remain yet to be assessed. This paper integrates DEA and Structural Equation Modelling (SEM) to explore these relationships. Experimental experiences are reported on a sample of banks from different countries. The analytical results provide illustration on how to integrate DEA and SEM to examine and predict economic development.

2 - Bank Branch Operational Performance: A Robust Multivariate and Clustering Approach
Kostas Triantis, John Lawrence Professor, Virginia Tech, 7054 Haycock Rd, Room 428, Falls Church, VA, 22043, United States of America, triantis@vt.edu, Joseph Paradi, Haiyan Zhu, Oscar Herrera-Restrepo, William Seaver

We investigate bank branch operational performance by integrating robust techniques for clustering analysis and data envelopment analysis (DEA). By applying robust techniques based on principal component analysis, we look for the detection of branches exhibiting extreme operating behaviors (i.e., influential), and the clustering of branches based on operating characteristics. Our premise is that influential branches affect both the clustering and the determination of efficiency performance.

3 - Costs and Efficiency in the English Higher Education Sector: Latent Class Stochastic Frontier Models
Jill Johnes, Professor, University of Huddersfield, The Business School Queensgate, Huddersfield, HD1 3HG United Kingdom j.johnes@hud.ac.uk, Geraint Johnes

Using panel data from 2002/03 to 2010/11 we estimate a cost function for English higher education institutions (HEIs) using the latent class variant of the stochastic frontier model. We are able to identify clusters of institutions based on the data; evaluate the parameters of the cost function for each cluster; estimate economies of scope and of scale within each cluster; measure efficiency of each institution relative to all HEIs and other HEIs in the same cluster.

■ MC56
56-Room 109A, CC
Location Analytics
Sponsor: Location Analysis
Sponsored Session
Chair: Alan Murray, Professor, Drexel University, 3141 Chestnut Street, Philadelphia, PA, 19104, United States of America, amurray@drexel.edu

1 - Locating Units in a Data Network with Full Reliability and Redundancy
Sergio García Quiles, Lecturer In Operational Research, University of Edinburgh, James Clerk Maxwell Building, Peter Guthrie Tait Road, Edinburgh, EH9 3FD, United Kingdom, sergio.garcia-qui@ed.ac.uk, Lukas Schaefer, Andreas Mitschke, Vassili Sritthamavan

We study the problem of designing a data network that has to fulfil some restrictions while being optimal under certain criteria. Some data flows must be sent between certain units to be located and there must be full reliability and redundancy. A network is fully reliable if the probability of any given function failing is less than a given safety threshold. Full redundancy means that no single failure leads to the loss of any function. This problem is motivated by a real application.
2 - A Maximal Conditional Covering Location Problem to Relocate Emergency Response Enterprise Units
Brian Lunday, Assistant Professor Of Operations Research, Department of Operational Sciences, Grad. Sch. of Engr. & Mgmt., Air Force Institute of Technology, Wright Patterson AFB, OH, 45433, United States of America, Brian.Lunday@afit.edu, Nicholas Paul, Sarah Nurre
We analyze the collective effectiveness of three hierarchical tiers within an existing enterprise of Department of Defense units designated to respond to a large-scale emergency (e.g., a chemical, biological, or radiological attack), and we identify their optimal locations via a maximal conditional covering problem formulation with side constraints. Acknowledging fiscal and political restrictions on facility relocations, we apply a multiobjective approach to identify Pareto optimal solutions.

3 - Location of Milk Collection Points for the Blended Milk Collection Problem
Vladimir Maríanov, Pontificia Universidad Católica de Chile, vicuña Mackenna 4860, Macul, Santiago, Chile, marianov@ing.puc.cl, Armin Löer Villagra, Germán Paredes - Belmar, Andrés Bronfman
Different qualities of milk are collected from farms, using a heterogeneous truck fleet. Each farm produces single quality milk. Milk can be blended in the trucks, if convenient. The blend takes the quality of its lower quality component. Collection points are located for farthest farms to bring their milk. Trucks visit some of the farms and the collection points. A model is presented and solved using Branch and Cut for small instances. A heuristic is presented to solve a real problem.

4 - Sensor Location Problems: Open Locating-dominating Sets
Robin Givens, College of William & Mary, Computer Science Department, McGlothlin 126, Williamsburg, VA, 23185, United States of America, rmgivens@cs.wm.edu, Gexin Yu, Rex Kicincaid
We consider the problem of fault location via sensors in parallel and multiprocessor networks with the goal of minimizing the number of sensors required throughout the system. We prove the lower bound of the minimum open locating-dominating set size for two different circulant graphs using two proof techniques, the discharging method and Hall’s Theorem. We also provide constructions for the upper bound at the same size.

3 - A Natural Gas Model for North America: Impact of Cross-border Flows of Natural Gas with Mexico.
Felipe Feijoo, Postdoctoral Fellow, Johns Hopkins University Whiting School of Engineering, 3400 N Charles St, Baltimore, MD, 21218, United States of America, fiejoo@jhu.edu, Sauleh Siddiqui, Daniel Huppmann, Larissa Sakiyama
Natural gas is becoming an important energy source due to its low environmental impact and price. New regulations in Mexico and Canada will highly affect the North American natural gas market. We present a long-term dynamic partial-equilibrium model that incorporates a range of regulatory measures to study impacts of various policies, assess the costs and benefits from cross-border flows of natural gas and electricity, and quantify the emissions avoided in Mexico through a switch to natural gas.

3 - Inventory and Maintenance Optimization in Oil and Gas Production System
Farnaz Ghazi Nezami, Assistant Professor, Kettering University, 1700 University Ave, Flint, MI, 48504, United States of America, fghazinezami@kettering.edu, Prasanna Tamilselvan
This research is aiming at developing an optimal spare provisioning policy for an offshore oil and gas production facility to jointly optimize the production system availability and maintenance cost. The proposed policy minimizes the downtime which is a function of subsea intervention equipment lead time and spare parts availability.

3 - Oil Supply Chain Risk Identification in Saudi Arabia
Julio Daza, Universidad de Valencia, Valencia, Spain, julio.daza@uv.es, Mario Ferrer, Ricardo Santa, Alvaro Sierra, Daniel Romero-Rodriguez
This investigation has a twofold purpose: to operationalize the constructs of the oil Supply-Chain-Risk-Management (SCRM), Supply-Chain-Resilience (SCR) and Supply-Chain-Vulnerability (SCV), and to quantitatively test the nature as well as the strength of the relationship between these three constructs within the context of the oil-industry in the Kingdom of Saudi Arabia.

2 - Environment and Economic Performance of Stochastic Market Clearing under High Wind Penetration
Ali Daraeepour, PhD Student, Duke University, Box 90328, Duke University, Durham, NC, 27707, United States of America, a.daraeepour@duke.edu, Xin Li, Dalia Patino-Echeverri
Using a scaled version of PJM, and generated wind scenarios and demand data from BPA data, this paper explores a comparison of the performance between stochastic and deterministic models for market clearing in terms of total operational costs, wind curtailment, and air emissions. Operating reserves in the deterministic-day-ahead model and Value of Lost Load in the Stochastic-day-ahead model are chosen so that both result in commitments that have the same expected reliability.

2 - Risk and Return under Renewable Support Mechanisms – Towards a Coherent Framework
Christoph Weber, Prof., University Duisburg-Essen, Universitaetstr. 11, Essen, 45117, Germany, Christoph.weber@uni-duisburg-essen.de, Lena Kitzing
Risk exposure resulting from renewable support mechanisms such as feed-in tariffs impacts the incentives for investors. We consider multi-stage decision making, including regulatory settings, financing and investment decisions and operations. Both systematic and unsystematic risks are included in a stochastic cash flow approach. The model is applied to a wind park in Germany. Feed-in-tariffs are found to require lower support levels than other support schemes but transfer more risk to society.
2 - Agglomeration Economies and the Geographic Dimension of Firm Boundaries
Juan Alcacer, Harvard Business School, Soldiers Field, Boston, MA, United States of America, jalcacer@hbs.edu, Jasmina Chauvin
We provide new insights into firm boundary decisions by comparing location strategies of multi-business and single-business firms in the same industry. We find that establishments belonging to multi-business firms agglomerate more, and the difference is related to the potential for sharing of labor resources. Our results suggest that strategic decisions about the geographic and product boundaries of the firm are intimately related, and that resource sharing is implicated in both decision processes.

2 - Ethnic Communities, Informal Institutions, and Foreign Location Choice
Exequiel Hernandez, University of Pennsylvania, Wharton School of Management, Philadelphia, PA, United States of America, exequiel@wharton.upenn.edu
This study examines the institutional role of transnational ethnic communities in MNEs’ location choice. We propose that ethnic communities fulfill a governance function by facilitating entry into locations that present high transaction hazards for foreign firms. We test our ideas using a unique dataset on the location choices of Korean banks across Chinese provinces during 1992-2013, taking advantage of a historical event that created a quasi-random distribution of Koreans across provinces.

3 - Vertical Scope and Location Decisions: Evidence from us Manufacturers in Mexico
Octavio Martínez, INCAE, Montecristo, Managua, Nicaragua, Octavio.Martinez@Rotman.Utonto.ca, Joanne Oxley
We explore how vertical integration affects firms’ propensity to locate in dense industrial clusters. We argue that since vertically-integrated firms are less dependent on external economies they benefit less from locating within a dense cluster, and thus may opt for lower-cost locations away from the cluster, particularly in the face of high congestion costs. Analysis of location data on new US-owned plants established in Mexico after NAFTA generates evidence consistent with our claims.

4 - Community and Capital in Entrepreneurship and Economic Growth
Olav Sorenson, Yale University, School of Management, New Haven, CT, United States of America, olav.sorenson@yale.edu, Sampsam Samila
We argue that social and financial capital have a complementary relationship in fostering innovation, entrepreneurial and economic growth. Using panel data on metropolitan areas in the US, our analyses reveal that social integration – in the microgeography of residential patterns – moderates the effect of venture capital, with more integrated regions benefiting more from expansions in the supply of financial capital.

2 - Bank Service Simulation using ProModel
Palaniappa Krishnan, Associate Professor, University of Delaware, 212 Townsend Hall, 531 S. College Avenue, Newark, DE, 19711, United States of America, baba@udel.edu, Guang Xiao
The problem on hand was to simulate the queueing service of a local branch of a national bank “XYZ” on a Saturday. The students in the graduate simulation class collected data of the customers coming into the branch and leaving the branch. The students calculated the inter arrival data and the service time of the tellers. They then set up the (M/M/c) queueing model. The students used ProModel to conduct the simulation process. During this project, the students learned first hand the importance of collecting good data. The students also worked with different “what-if” scenarios in their simulation model.

3 - Math and the Mouse: Explorations of Math and Science at Walt Disney World
Kevin Hutson, Associate Professor of Mathematics, Furman University, 330 Poinsett Hwy, Greenville, SC, 29613, United States of America, kevin.hutson@furman.edu, Liz Bouzarth, John Harris
We developed an immersive, three-week May course providing students the opportunity to see applications of mathematics and science at Walt Disney World. The course focused on typical problems faced by not only Disney professionals but also the consumer who visits the theme parks. In this talk, we will discuss various experiences and projects in which students engaged in the areas of scheduling, touring, and queueing.

2 - Convex Hull Pricing: Rigorous Analysis and Implementation Challenges
Chair: Antonio Conejo, Professor, The Ohio State University, 1971 Neil Avenue, Columbus, OH, 43210, United States of America, conejovanavarro.1@osu.edu
We developed an immersive, three-week May course providing students the opportunity to see applications of mathematics and science at Walt Disney World. The course focused on typical problems faced by not only Disney professionals but also the consumer who visits the theme parks. In this talk, we will discuss various experiences and projects in which students engaged in the areas of scheduling, touring, and queueing.
4 - The Trade-off Between Market Efficiency and Compensation
Payments in Unit Commitment Problems
Daniel Ruppmann, Postdoctoral Fellow, Johns Hopkins University, German Institute for Economic Research (DIW Berlin), 3400 N. Charles St., Baltimore, MD, 21218, United States of America, dhi@dergobelaslon.at, Sauleh Siddiqui
We apply an exact solution method for binary equilibrium problems to a large-scale power market unit commitment problem based on a realistic dataset. We illustrate the trade-off between efficient market operations (least-cost dispatch) against the budget required for compensation payments to guarantee incentive-compatibility of all market participants. The results are contrasted with prices and dispatch according to the current practice in market operation.

■ MC62
62-Room 112A, CC
Operations Management with Carbon Restrictions
Environmental Concerns
Sponsor: ENRE – Environment I – Environment and Sustainability
Sponsored Session
Chair: Ulku Gurler, Professor, Ilhsan Dogramaci Bilkent University, Industrial Engineering Department, Ankara, 06800, Turkey, ulku@bilkent.edu.tr
Co-Chair: Emre Berk, Bilkent University, Management Faculty, 06800 Bilkent, Ankara, Turkey, eberk@bilkent.edu.tr
1 - Supply Chain Coordination with Resource Constraints:
Analysis of Buyback and Target Rebate Contracts
A. Serdar Sinrogi, Cornell ORIE, 282 Rhodes Hall, Ithaca, NY, 14853, United States of America, as2899@cornell.edu, Ulku Gurler, Malek Ebadi
We analyze certain supply chain contracts under resource constraints such as carbon emission or cash constraints. We consider a setting where both the manufacturer and the retailer can trade with their available resources in the marketplace after they decide the order quantities and analyze the range of buyback and target rebate contract parameters that would achieve coordination and the resulting profit share structure. We also provide extensive numerical analysis to study some practical cases.

2 - Multiple Input Newsvendor Problem with Environment
Concious Customers
Ulku Gurler, Professor, Ihsan Dogramaci Bilkent University, Industrial Engineering Department, Ankara, 06800, Turkey, ulku@bilkent.edu.tr, Nazli Sonmez
In this work the inventory replenishment problem of a newsvendor with multiple inputs is considered when the customers have environmental concerns. In particular, it is assumed that the carbon emission of the final product is a function of the carbon emissions of the inputs and the customer demand decreases with the product's carbon emissions. The optimal order quantity of the newsvendor is investigated and some numerical results are provided.

3 - Technology Selection for Production Firms in a Carbon Economy
Emre Berk, Bilkent University, Management Faculty, 06800 Bilkent, Ankara, Turkey, eberk@bilkent.edu.tr, Onurcan Ayas
In this study, we address public policy structures and their implications on technology selection decisions for product design and pollution abatement in the presence of carbon emission restrictions and carbon markets. We consider a number of demand/utility functions to capture the firm behavior. We model technology primarily as a knowledge-based input in a multi-input setting. We provide some analytical results on technology enhancement conditions and illustrative numerical examples.

4 - How to use Data Analytics for Smarter Energy Management
Ozge Islegen, Assistant Professor, Northwestern University, Kellogg School of Management, 2001 Sheridan Road, Evanston, IL, 60208, United States of America, o.islegen@kellogg.northwestern.edu
The electricity industry has recently enjoyed the influx of “big data”. Through smart grid technologies, many firms now have access to the consumption behavior of their customers. This talk demonstrates how firms use this data to design effective demand side management programs to change the consumption behavior of their customers.
3 - Stimulating the Creation of More and Better Alternatives using Objectives
Ralph L. Keeney, Fuqua School of Business, Duke University, 101 Lombard Street, #704W, San Francisco, CA, 94111, United States of America, KeeneyR@aol.com, Johannes Siebert
The quality of alternatives considered, perhaps more than the quality of the decisions made, influences the desirability of the subsequent consequences. Several experiments investigated the implications of different procedures to create alternatives. From the results, we developed guidelines to effectively create better alternatives for decisions with incomplete sets of alternatives.

4 - Proving the Effectiveness of an Online-course on Decision-making
Johannes Siebert, University of Bayreuth, Bayreuth, D-95440, Germany, Johannes.Siebert@uni-bayreuth.de, Reinhard Kunz
We use the proactive decision-making (PDM) scale before and after an online-course on decision-making to prove its positive impact on its participants. In line with our hypotheses, the four proactive cognitive skills systematic identification of objectives, systematic search for information, systematic identification of alternatives, and using a `decision radar’ improved significantly while the two proactive personality traits showing initiative and striving for improvement remain stable.

**MC66**

65-Room 113B, CC

**Joint Session DAS/MAS: Game Theory, Decision Analysis, and Homeland Security, Part A**

**Sponsor: Decision Analysis**

**Sponsored Session**

Chair: Jun Zhuang, University at Buffalo, SUNY, 317 Bell Hall, Buffalo, NY, 14221, United States of America, jzhuang@buffalo.edu

1 - Deterrence and Risk Preferences in A Sequential Attacker-defender Game with Continuous Defense Effort
Vineet Madasseri Payyappall, PhD Student, University at Buffalo, 305 Winspear Avenue (Upper), Buffalo, NY, 14215, United States of America, vineetma@buffalo.edu, Jun Zhuang, Victor Richmond Jose

Most attacker-defender games consider players as risk-neutral, whereas in reality, attackers and defenders may be risk-seeking or risk-averse. We study the impact of player’s risk preferences on their equilibrium behavior and their impact on the notion of deterrence. We present analytic results, numerical illustration, and discussion which provide insights that could be used by policy analysts and decision makers involved in investment decisions in security and safety.

2 - Dynamic Modeling of Bombing Attack Threat Based on Time-series Process and Intervention Analysis
Shuying Li, Tsinghua University, 1017, Building Liujing, Tsinghua Unii., Beijing, China, 474042502@qq.com, Jun Zhuang, Shifel Shen

In the recent years, various kinds of terrorist attacks occurred frequently. Among all tactics of attacks, bombing attack is the highest threat, followed by armed assault. A model for analyzing and predicting bombing attack threat based on time-series process is developed. The model is validated by using terrorist attack data from the Global Terrorism Database between 2004 and 2014. Intervention analysis is used to analyze the sudden increase in the process.

3 - Identifying and Structuring the Objectives of ISIL and its Followers
Richard John, Associate Professor, University of Southern California, 3620 McClintock Ave., Dept. of Psychology, MC-1061, Los Angeles, CA, 90266–1061, United States of America, richard@usc.edu, Detlof Von Winterfeldt, Johannes Siebert

This study addresses three questions: (1) What are the objectives of the leaders of ISIL? (2) What are the objectives of the followers of ISIL? (3) How are the two sets of objectives related? We analyzed the transcripts of interviews and presentations of 59 subject matter experts (SMEs) and conducted a separate analysis of speeches of ISIL leaders and internet sources. In both efforts we identified and structured the strategic, fundamental, and means objectives of ISIL and its followers.

4 - A Robust Resolution of Newcomb’s Paradox
Thomas Weber, Associate Professor, EPFL, CDM-ODY 3.01, Station 5, Lausanne, YD, 1015, Switzerland, thomas.weber@epfl.ch

Newcomb’s problem is viewed as a dynamic game. Depending on whether or not a risk-neutral agent’s belief about the move order exceeds a threshold, one obtains the one-box outcome or the two-box outcome, respectively. The findings extend to an agent with arbitrary increasing utility, featuring in general two thresholds. All solutions require only minimal assumptions about the being’s payoffs and it is always sure to predict the agent’s choice in equilibrium. Some practical settings are discussed.

**MC65**

66-Room 113C, CC

**Ongoing Challenges in Airline Operations Planning**

**Sponsor: Aviation Applications**

**Sponsored Session**

Chair: Norbert Lingaya, Manager Of Optimization Technologies, Krotos Incorporated, 3353 Queen Mary Road, Suite 300, Montreal, QC H3V 1H8, Canada, nlingaya@kronos.com

1 - Broadening the Manpower Planning Horizon with Altitude Insight
Luc Charest, Operations Research Specialist, AD OPT, A Krotos Division, 3353 chemin Queen-Mary Ouest, Montréal, QC, H3V 1H8, Canada, luc.charest@kronos.com, Alain Marcotte

AD OPT’s Altitude Insight addresses crew manpower planning for airline operations by producing optimized staffing plans that satisfy expected company requirements. In the short and medium term, Insight identifies position openings to be assigned and scheduled as trainings to crew members. As the horizon widens, the focus shifts to budgetary objectives with constraints on asymmetric distributions. In this talk, we present some long-term manpower planning concepts and their related challenges.

2 - Improving Branching in Airline Crew Pairing Problem with Base Constraints
Frederic Quesnel, GERAD, 2900 Boulevard Edouard-Montpetit, Montreal, Canada, frederic.quesnel@gerad.ca, François Soumis, Guy Desaulniers

In the context of crew pairing, many of the real-world crew pairing solvers consider restrictions on the total number of working time at each crew base. These base constraints have not been often studied academically. We propose a Danzig-Wolfe decomposition formulation for crew pairing problem that includes base constraints. We show how they degrade the resolution of the problem. We propose different branching schemes to improve the computational time and the objective value of our instances.

3 - Simultaneous Airline Crew Recovery Problem
Atoosa Kasirzadeh, GERAD & Ecole Polytechnique de Montreal, Andrés-Aisenstadt Building, 2920, Chemin de la Tour, 4th Floor, Montreal, Canada, atoosa.kasirzadeh@gerad.ca, François Soumis

Different sources of unpredicted disturbances such as adverse weather conditions may affect the planned schedules for airline crew members. These disruptions may result in delayed or canceled flights and affect the crew schedules. Due to delay propagation, robust crew recovery problem will be very significant. We study the simultaneous cockpit recovery problem where the planned schedules are constructed using personalized scheduling approach.

4 - Airline Fleet Assignment with Stochastic Demand and Limited Re-fleeting Recourse Actions
Guy Desaulniers, Polytechnique Montreal and GERAD, 2900 Boulevard Edouard-Montpetit, Montreal, Canada, guy.desaulniers@gerad.ca, David Lasalle Ialongo

We introduce a new fleet assignment model that considers a stochastic demand and the possibility to perform re-fleeting on pre-computed chains of flights as recourse actions. This integer model is solved by the Cplex MIP solver and embedded in a loop with a passenger assignment model to compute the revenues. We report computational results on data sets derived from a North American carrier schedule involving more than 5,000 flights over a week and 20,000 passenger itineraries.
1 - Vehicle Routing with Mileage Bands
Maciek Nowak, Loyola University Chicago, Chicago, IL, United States of America, mnowak4@luc.edu, Michael Hewitt
A gap in vehicle routing research is the use of mileage bands as a basis for determining travel costs. While the trucking industry regularly uses mileage bands to price routes, research has widely ignored this pricing structure. In this research, we develop a methodology for shippers to create routes that minimize cost based on mileage bands and for carriers to create bands that maximize profits.

2 - Solving the Fleet Size and Mix Vehicle Routing Problem with Backhauls: A Successive Approximation Approach
Javier Bellosso, Spain, javier.bellosso@unavarra.es, Javier Faulin, Adrian Serrano, Angel A. Juan
The Fleet Mixed Vehicle Routing Problem with Backhauls (FSMVRPB) is a variant of the vehicle routing problems where delivery and pick-up customers are served from a central depot and the fleet of vehicles is unlimited and heterogeneous. The proposed algorithm utilizes a successive approximation approach that obtains a heterogeneous solution by iteratively solving homogeneous problems. The method combines three randomized criteria to improve the greedy behavior of the base heuristic applied to solve each particular problem. An ILP is presented for the FSMVRPB considering both fix and variable costs. Benchmark instances for the FSMVRPB have been selected in order to assess the efficiency of our approach, and results show that our approach is able to provide promising solutions by improving some of the best solutions reported in the literature.

3 - Inventory Routing in a Two-Echelon Supply Chain with Cross-Docks
Forough Pourhossein, University of Waterloo, Waterloo, ON, Canada, jpourhossein@uwaterloo.ca, Hossein Abouee Mehrizi, James Bookbinder
Consider a supply chain whose suppliers serve multiple customers, each ordering several product types. Products are shipped to cross-docks from the suppliers, and several customers are served by each route from a cross-dock; multiple routes can originate from a single cross-dock. We design optimal routes considering the total transportation, inventory carrying, and pipeline inventory costs. We restructure the model as a set-covering problem and develop a column generation algorithm to solve it.

4 - Periodic Vehicle Routing with Inventory Considerations
Blupesh Shetty, University of Iowa, Iowa City, IA, United States of America, blupesh-shetty@uiowa.edu, Jeffrey Ohlmann
We study the problem of designing the inbound supply routes for a manufacturing plant to minimize transportation and inventory costs. We consider a routing plan that is periodic and supports pickup amounts that are proportional to the amount of time between visits. We develop a heuristic and present computational results to demonstrate the effect of inventory holding costs on the routing plans.

1 - G-Network Models for Relief Activity Coordination at Disaster Sites
Merve Ozen, University of Wisconsin, Madison, WI, United States of America, mozen@wisc.edu, Ananth Krishnamurthy
We use generalized queuing networks (G-network) to model relief item distribution and activity coordination following a major disaster. The models capture key aspects of victim behavior including changing needs for relief items and variability in staffing. We investigate the existence of product form solution for the queuing network models and develop theoretical approximations to estimate performance measures. We analyze the developed networks under various conditions and provide insights.

2 - Hierarchical Emergency Shelter Location Optimization
Brett Decker, University of Connecticut, 261 Glenbrook Rd, Unit 3037, Storrs, CT, 06269, United States of America, brett.decker@uconn.edu, Nicholas Lownes
Many jurisdictions use only qualitative methods of locating emergency shelters and supply hubs. A hierarchical capacitated emergency shelter location problem is presented. The tradeoffs between local access and economies of scale are investigated. The model is applied to a case study along the southern shore of Connecticut.

3 - Reliable Supply Chain Design with Expedited Shipments
Meng Zhao, Harbin Institute of Technology, Harbin Institute of Technology, Harbin, China, 14b332001@hit.edu.cn, Xiaoping Li, Jianxun Cui, Molsen Parsalar
This study proposes a reliable location-inventory model that considers expedited shipments under probabilistic supplier disruptions. This model allows a facility to be reassigned to backup suppliers when its primary supplier disrupts. A customized algorithm is developed and numerical examples are conducted to test the algorithm and draw managerial insights.

4 - Humanitarian Facility Location and Supply Prepositioning Considering Road Vulnerability
Melih Celik, Middle East Technical University, ODTU Kampusi Endustri Muhendisligi, Oda 219 Cankaya, Ankara, 06800, Turkey, cmelili@metu.edu.tr, Ece Aslan
An important challenge in relief item and service delivery in the aftermath of a disaster is that roads may become unusable. In this study, we consider the problem of locating distribution centers and prepositioning supplies in the pre-disaster stage, and routing of deliveries in the aftermath. Given the uncertainty of various aspects of the disaster, we develop a two-stage stochastic programming model and propose heuristics, which we test on real-life disaster scenarios for Istanbul, Turkey.

1 - Performance Analysis of Vehicle-based Order-pick Systems with Dual-command Cycles
Kaveh Azadeh, PhD Candidate, Rotterdam School of Management Erasmus University, Burgemeester Oudlaan 50, Maastricht University Building 709-41, Rotterdam, 3062PA, Netherlands, azadeh@rsm.nl, Debjit Roy, Rene De Koster
In the new generation of vehicle-based order-pick systems, vehicles travel in both horizontal and vertical direction using the racking structure to access all storage positions within an aisle. We develop queuing models to evaluate the performance measures and analyze the performance trade-offs with other vehicle-based goods-to-picker systems.

2 - A Conceptual Model for Operational Control in Discrete Event Logistics Systems (DELS)
Timothy Sprock, Georgia Tech, 755 Fert Dr NW, Atlanta, GA, 30332, United States of America, tsprock3@gatech.edu, Leon McGinnis
To support design of smart operational controllers, this paper proposes a conceptual model capable of integrating a description of the control activities with a description of the physical system and an explicit interface to optimal-control analyses. These smart operational control mechanisms must not only integrate real-time data from system operations, but also formulate and solve a wide variety of optimal-control analyses efficiently and then translate the results into executable commands.

3 - Effects of Multiple Docks on Expected Distance Traveled in a Unit Load Warehouse with a Cross-aisle
Mahmut Tutam, PhD Student, University of Arkansas, 1617 N. Evening Shade Dr., Fayetteville AR, 72703, United States of America, mutam@uark.edu, John A. White
The warehouse configuration that minimizes expected travel distance is obtained for a unit load warehouse with a cross-aisle and multiple docks. Single- and dual-command operations are considered. Continuous and discrete formulations are employed. Considering multiple docks and their locations yields more general formulations than found in the research literature. Cases treated include receiving from an adjacent production area and external suppliers and the use of multiple docks for shipping.
4 - Optimizing Space Utilization in Block Stacking Warehouses
Shahab Derhami, PhD Student, Auburn University, 3301 Shelby Center, Auburn University, Auburn, AL, 36849, United States of America, sderhami@auburn.edu, Kevin R. Gie, Jeffrey S. Smith

Block stacking storage systems are unit load storage systems which are widely used in manufacturing facilities. However, determining the optimal lane depth in this storage system under the finite production rate constraint has not been adequately addressed in the literature. In this research, we propose mathematical models to obtain the optimal lane depth for a single and multiple SKUs where the pallet production rates are finite.

**MC70**

7D-Room 202A, CC  
**International Rail Freight**  
Sponsor: Railway Applications  
Sponsored Session  

Chair: Steven Harrod, Associate Professor, Technical University of Denmark, Building 116B, Niels Koppel Allé, Kgs. Lyngby, 2800, Denmark, stehar@transport.dtu.dk  

1 - Growth Potential for Rail Freight in Short Distance Markets
Steven Harrod, Associate Professor, Technical University of Denmark, Building 116B, Niels Koppel Allé, Kgs. Lyngby, 2800, Denmark, stehar@transport.dtu.dk, Matthias Schett

The Scandinavian countries have traditionally been maritime economies, dependent on sea shipping. Recent bridge and tunnel links now connect Scandinavia to the European continent, but a large volume of freight still moves by sea. This presentation discusses the successful short distance intermodal shuttles operating in Scandinavia, and their potential for expansion. Examples from Sweden and Denmark are presented.

2 - Freight Operations from a North American Perspective
Marc Meketon, Oliver Wyman, 1 University Square, Princeton, NJ, 08540, United States of America, Marc.Meketon@oliverwyman.com, Carl Van Dyke

Freight operations in Europe differ in many respects to those in North America for reasons including regulatory, physical differences, IT systems (especially wagon ordering systems) and interactions with passenger trains. This talk will describe freight operations in several European countries, and also contrast them to North American operations.

3 - An Integrated Model for Locomotive Routing and Fueling Facility Locating
Gongyuan Lu, Southwest Jiaotong University, 111 Erhuan Road, Bei yi Duan, Chengdu, China, lugongyuan@qq.com, Xuesong Zhou

In this presentation, we will present a 3-dimensional time-space network which adds the resource dimension to the traditional TS network. Via this method, the problem formulation can be simplified tremendously. Meanwhile, the Lagrangian relaxation associated with Dynamic Programming is applied to solve this model efficiently.

**MC71**

71-Room 202B, CC  
**Shared Mobility Analysis and Optimization**  
Sponsor: TSL/Urban Transportation  
Sponsored Session  

Chair: Wei Lu, Texas A&M University, CE/TTI Building, Room 601-D, 3136 TAMU, College Station, TX, 77843-3136, United States of America, luwei.blues@gmail.com  

1 - Optimizing Ridesharing Services
Wei Lu, Texas A&M University, CE/TTI Building, Room 601-D, 3136 TAMU, College Station, TX, 77843-3136, United States of America, luwei.blues@gmail.com, Luca Quadrifoglio

Ridesharing services, which aim to bring together travelers with similar itineraries, may provide substantial societal and environmental benefits. We study the most generalized setting of ridesharing problems – given a set of travelers and their origins/destinations, we aim to simultaneously make optimal decisions on driver/taxi role assignment, customer partition and route planning, with the goal of minimizing/maximizing the system-wide total vehicle-miles/ridesharing value.

2 - Ride-Matching Problem in Peer-to-Peer Multi-Hop Ridesharing Systems with Stochastic Demand
Neda Masoud, University of California, Irvine, CA, United States of America, R. Jayakrishnan

We propose a stochastic program with recourse to formulate the peer-to-peer multi-hop ride-matching problem with stochastic demand. We propose an algorithm to efficiently generate a set of scenarios that can be used to formulate and solve the IP equivalence of the stochastic program, and solve it using an L-shaped algorithm.

**MC72**

72-Room 203A, CC  
**Panel Discussion on “Publishing in Quality and Reliability: The Editor’s Perspective”**  
Sponsor: Quality, Statistics and Reliability  
Sponsored Session  

Chair: Huili Yang, Associate Professor, Pennsylvania State University, 310 Leonhard Building, Industrial and Manufacturing Eng., State College, PA, 16801, United States of America, huy25@psu.edu  

1 - Panel Discussion on “Publishing in Quality and Reliability: The Editor’s Perspective”
Moderator: Huili Yang, Associate Professor, Pennsylvania State University, 310 Leonhard Building, Industrial and Manufacturing Eng., State College, PA, 16801, United States of America, huy25@psu.edu, Panelists: Trevor Craney, Jianjun Shi, Douglas Montgomery, Peihua Qiu, Peter Parker, Fugee Tsung

This panel brings journal editors to share their perspectives and experiences with the audience and answer questions pertaining to publication in Quality and Reliability Data Sciences. Panelists are: Dr. Jianjun Shi, Dr. Trevor Craney, Dr. Douglas Montgomery, Dr. Peihua Qiu, Dr. Fugee Tsung.

**MC73**

73-Room 203B, CC  
**Modeling and Analysis of Data with Quantitative and Qualitative Variables**  
Sponsor: Quality, Statistics and Reliability  
Sponsored Session  

Chair: Xinwei Deng, Assistant Professor, Department of Statistics, Virginia Tech, 211 Hutchenson Hall, Blacksburg, VA, United States of America, xndeng@vt.edu  

Co-Chair: Ran Jin, Virginia Tech, Grado Department of Industrial and Systems Engineering, Blacksburg, VA, 24061, United States of America, jran5@vt.edu  

1 - Bayesian Hierarchical Models for Quantitative and Qualitative Responses
Lulu Kang, Assistant Professor, Illinois Institute of Technology, 10 W 32nd Street, E1-208, Chicago, IL, 60615, United States of America, lkang2@iit.edu, Xinwei Deng

In many engineering systems both quantitative and qualitative output measurements are collected. If modeled separately, the important relationship between the two type of responses is ignored. In this paper we propose a Bayesian hierarchical modeling framework to jointly model a continuous and a binary response. Both simulation and real case studies are shown to illustrate the proposed method.

2 - A Latent Process Approach to Modeling and Analysis of Mixed-type Observations
Shuyu Chu, Virginia Tech, 1210 University City Blvd, J113, Blacksburg, VA, 24060, United States of America, e.shuyu@vt.edu, Xinwei Deng

In many applications, mixed-type observations are commonly present. To analyze the data with mixed-type observations, one key challenge is to quantify the hidden association among them. In this work, we proposed a latent process approach to jointly modeling the mixed observations. The proposed method adopts the combined Discrete Particle Filter and Sequential Monte Carlo algorithm for parameter estimation and Bayesian inference.
3 - Quantitative and Qualitative Evaluation of Printed Electronics Based on Microscopic Images

Hongyue Sun, Virginia Tech., Grado Department of Industrial and Systems Engineering, Blacksburg, VA, 24061, United States of America, hongyue@vt.edu, Yifu Li, Chuck Zhang, Ran Jin, Kan Wang

Aerosol jet printing is an additive manufacturing technology to fabricate printed electronics. Although various types of machine vision sensors are used to take images for qualitative evaluation, no methods have been reported to use image features to quantitatively characterize the quality of electronics. This work uses a quantitative method to model the correlation of image features and quality variables. A case study to fabricate silver conducting wires is used to evaluate the performance.

4 - On the Asymptotics of Pairwise Modeling for Multivariate Gaussian Process

Yongxiang Li, Research Assistant, City University of Hong Kong, Department of SEEM, 83 Tat Chee Avenue, Kowloon, Hong Kong - PRC, novern.li@gmail.com, Qiang Zhou

Multivariate Gaussian process is a popular method for emulating computer models with multiple outputs. But its complexity poses significant challenges to parameter estimation due to high dimensionality and huge computational burden. A pairwise modeling approach is proposed to solve the issue. The asymptotic normality for parameter estimation is studied. Simulation studies are conducted and the pairwise method is applied to model the low-E glass data for such purposes as quality control.

MC74  INFORMS Philadelphia – 2015

74-Room 204A, CC

Modern Monitoring Applications

Sponsor: Quality, Statistics and Reliability

Sponsored Session

Chair: Irad Ben-Gal, Professor, Tel Aviv University, Tel Aviv, Israel, bengal@tauex.tau.ac.il

1 - An Application of Sensor Selection Based on Information Theoretic Measurements for Change Detection

Marcelo Bacher, PhD Candidate, Tel Aviv University, Ramat Aviv, Tel Aviv, Israel, mbacher@post.tau.ac.il, Ira Ben-Gal

Feature selection based on Information Theoretic measurements has been used with great success in Machine Learning applications in special for classification tasks. Nevertheless, less effort has been applied to process monitoring. In this work we propose a framework that aims at finding the most significant subset of features for change detection and bouded false alarm rate when monitoring a process.

2 - Correlated Gamma-based Hidden Markov Model for Asthma Control Status Diagnosis

Junbo Son, PhD Candidate, University of Wisconsin-Madison, 1513 University Avenue, Madison, WI, 53706, United States of America, jsong9@wisc.edu, Patricia Brennan, Shiyu Zhou

To effectively manage the asthma as a chronic disease, a statistical model based on the everyday patient monitoring is crucial. Taking advantages from the remote patient monitoring system, we propose a data-driven diagnostic tool for assessing underlying asthma condition of a patient based on Hidden Markov model (HMM). The proposed correlated gamma-based HMM can visualize the asthma progression to aid therapeutic decision making. Its promising features are shown in both simulation and case study.

3 - Project Management Monitoring

Irad Ben-Gal, Professor, Tel Aviv University, Tel Aviv, Israel, bengal@tauex.tau.ac.il

We consider the monitoring of large projects (software/hardware) and propose an analytical approach for identifying the optimal project monitoring points by using concepts from the Information Theory. The methodology used is based on simulation-optimization scheme - selecting the monitoring points that provide the highest potential information gain on the project duration. (joint work with Shiva Kashi-Cohen and Shay Rozanes)

4 - Leveraging Analytics to Support Health-monitoring and Management of Infrastructure Facilities

Pablo Durango-Cohen, Associate Professor, Northwestern University, 2145 Sheridan Road, A332, Evanston, IL, 60208, United States of America, pdc@northwestern.edu, Yikai Chen

Motivated by recent technological advances, we describe the development and validation of a statistical framework to support health-monitoring and management of transportation infrastructure. The framework consists of formulation of structural time-series models to explain, predict, and control for common-cause variation, and use of multivariate control charts to detect special-cause variation. We present several examples from an in-service bridge to validate the framework.

MC75

75-Room 204B, CC

Innovations in Healthcare Products and Services

Cluster: New Product Development

Invited Session

Chair: Nitin Joglekar, Boston University, Questrom School of Business, Boston, MA, United States of America, joglekar@bu.edu

1 - Healthtech Platforms: Barriers to Innovation

Edward Anderson, Professor, McCombs School of Business, The University of Texas at Austin, 1 University Station B6500, Austin, TX, 78712-1277, United States of America, Edward.Anderson@mccombs.utexas.edu, Shi Ying Lim

The state of mobile and digital health is far behind that of other platform industries, such as travel, retail, and even banking. Using qualitative analysis, we present some of the more important barriers to healthtech startup success (and, but extension, health tech in general) and outline some initial suggestions to create an ecosystem to counter them.

2 - Platform Innovations in Healthcare Delivery

Geoffrey Parker, Professor, Tulane University, 7 McAlister Drive, New Orleans, LA, 70118, United States of America, ggparker@tulane.edu

Network platform systems have reshaped the computer and telecommunications industries and are now transforming other industries such as transportation, lodging, and contract labor. The shift to platforms is slower in highly regulated industries, but changes are coming quickly. We survey likely mechanisms and entry points for a platform shift in healthcare.

3 - Patient, Heal Thyself! A Learning Algorithm to Predict How Telemedicine Affects Patient Activation

Kellas Cameron, PhD Student, Boston University, Questrom School of Business, Boston, MA, 02215, United States of America, kellas@bu.edu, Carrie Queenan, Nitin Joglekar

The Patient Activation Measure (PAM) assesses an individual's knowledge and confidence for managing one's health. This paper proposes a learning algorithm to predict a patient's PAM with data from a controlled telemedicine study, accounting for social and technology effects. The algorithm allows for the analysis of Type I and II errors and learning versus testing tradeoffs. Implications of this study create opportunities for operational improvements to reduce patient readmission rates.

MC76

76-Room 204C, CC

Accounting for Input Uncertainty in Stochastic Simulations

Sponsor: Simulation

Sponsored Session

Chair: Canan Gunes Corlu, Assistant Professor, Boston University, 808 Commonwealth Avenue, Boston, MA, 02215, United States of America, canan@bu.edu

1 - A Sequential Experiment Design for Input Uncertainty Quantification in Stochastic Simulation

Xie Wei, Assistant Professor, Rensselaer Polytechnic Institute, 400 McGhnesey Ave. Ext. 5-9, Troy, NY, United States of America, xiwei3@rpi.edu

When we use simulations to estimate the performance of a stochastic system, simulations are often driven by input distributions that are estimated from real-world data. Non-parametric bootstrap could be used to quantify both input model and parameter uncertainty. A sequential experiment design is proposed to efficiently propagate the input uncertainty to output mean and deliver a percentile confidence interval to quantify the impact of input uncertainty on the system performance estimate.

2 - Input Uncertainty in Stochastic Simulations: Dependent Input Variables of Mixed Types

Alp Akcay, Eindhoven University of Technology, Department of Industrial Engineering, Netherlands, A.E.Akcay@tue.nl, Bahar Biler

We consider stochastic simulations with correlated input random variables having NORmal-To-Anything (NORTA) distributions. We assume that the marginal distribution functions and the NORTA base correlation matrix are unknown. Given that the dependent input variables can take discrete and continuous values, we develop a Bayesian procedure that decouples the input model estimation into two stages. We investigate the role of the corresponding input uncertainty in simulation output data analysis.

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3 - Norata Random Vector Generation with Deterministic Constraints
Kalyani Nagaraj, Department of Statistics, Purdue University,
250 N University Street, West Lafayette, IN, 47907, United States of America,
kalyanin@purdue.edu, Raghu Pasupathy,
Soumyadip Ghosh, Jie Xu
We consider the problem of a Norata random vector generation with given
deterministic constraints. This question is of relevance in settings such as CVAR
estimation in finance, and estimation of expected penalties in large-scale service
systems. We propose a Weibull-like importance sampling twist to Norata that is
easily implemented and frequently achieves surprising reductions in variance. We
will discuss the asymptotic optimality of the proposed estimator with an
implementable sampler.

■ MC77
77-Room 300, CC
Supply Chain Management VII
Contributed Session
Chair: Sang Won Kim, Assistant Professor, CUHK Business School,
Shatin, N.T., HK, Hong Kong - PRC, skim@cuhk.edu.hk
1 - Competition under Power Structure in a Two-echelon
Supply Chain
Abhishek Chakraborty, XLRI, Jamshedpur, 831001, India,
abhishekcxlri.ac.in
In this work we bring the importance of power in decision making in a two
echelon supply chain in which a single manufacturer sells to multiple retailers.
We analyzed the role of differential power structure within the retailers in
affecting the supply chain performance in a Manufacturer-Stackelberg case where
the retailers compete on quantity. Further, we bring in the countervailing nature
of the same where the benefits from the fringe retailers are passed on to the final
customers.

2 - Revenue Management in a Manufacturing Supply Chain
Almut Oezkul, Associate Professor Of Management, University of New
Haven, 14 Wellington Dr, Orange, CT, 06477, United States
of America, aozkul@newhaven.edu, Mehmet Barut
In this paper, we take the yield/revenue management problem in a capacity
restrained manufacturing company, and put it in a supply chain framework
integrating customer order acceptance decisions with the supplier end in a
manufacturing supply chain. A conceptual model is presented.

3 - How Joint Ventures Business Environment and Vertical Partnering
Relationship Influence Performance
Weixi Han, University of Southampton, Building 2 Highfield
Campus, Southampton, SO17 1BJ, United Kingdom,
Weiz12@sooton.ac.uk
There is a paucity of research regarding vertical partnering relationship played in
a cross-border setting. This study focus on the dyadic relationships as the unit of
analysis, using a qualitative case study and interview in the Chinese automotive
industry, shows how relationship played is performance by both partners and suppliers, and how it is critical when viewing the different nationalities joint
ventures backgrounds.

4 - A Study on Supply Chain Sustainability Impact Factors and
Related Empirical Analysis
Zhiduan Xu, Professor, School of Management,
Xiamen University, 422 Siming South Road, Xiamen, China,
zhiduanx@xmu.edu.cn, Danxia Guo
This paper mainly discusses the impact factors of supply chain sustainability. The
empirical results showed that supply chain context has a significant positive effect
on learning and development ability of the supply chain, and the learning and
development ability has a significant positive effect on supply chain sustainability. Some of the cases in the enterprises have a significant effect on its supply chain context, learning and development ability, and supply chain sustainability.

5 - Supplier Development in Competitive Supply Chains
Sang Won Kim, Assistant Professor, CUHK Business School,
Shatin, N.T., HK, Hong Kong - PRC, skim@cuhk.edu.hk,
Yannan Jin, Qiying Hu, Sean Zhou
We study manufacturers’ decisions on supplier integration and supplier development in a competitive environment, considering two key factors: manufacturers’ capabilities and the supply structure. We find the efficiency improvement via supplier integration outweighs the negative impact of increased competition for the more capable manufacturer, and the reverse for the less capable. Also, the shared supply structure lowers market competition and strengthens the benefits of supplier integration.

■ MC78
78-Room 301, CC
Integer Programming Applications in Energy
Contributed Session
Chair: Mohsen Rahmani, Research Scientist, Carnegie Mellon
University, 5000 Forbes Ave, BH 131, Pittsburgh, PA,
United States of America, rahmani@andrew.cmu.edu
1 - Supply Chain Network Optimization for Biomass Generation
Qiu Dong, Huazhong University of Science and Technology,
School of Management, 1037 Luyou Road, Wuhan, 430074,
China, 304520244@qq.com, Liu Zhixue
This paper focuses on supply chain design for biomass generation. A new
biomass supply mode with purchasing station is proposed. An integer
programming model about facility location-allocation is build. And a genetic
algorithm is design for the model. A case study of Xinneng Company, one of
the biggest biomass generation companies of China, is used as an application of the
proposed model. In addition, sensitivity analysis is conducted to provide deeper
understanding of the proposed model.

2 - Mathematical Optimization Techniques for Selective Catalytic
Reduction for a Fleet of Power Plants
Antonio Alanis, University of Texas at Arlington, Box 19017
Arlington, TX, 76019, United States of America,
antonio.alanis pena@mavs.uta.edu, Jay Rosenberger, Anoop Ade
Selective Catalytic Reduction (SCR) reduces emissions of oxides of nitrogen (NOx) in coal-fired power plants. With a given set of scheduled outages for a fleet of power plants, we use a multi-commodity flow problem with schedule elimination constraints from the literature and a modified knapsack problem to create an SCR management plan, which minimizes the total SCR operational cost of the entire fleet of power plants and maintains NOx emissions below a desired target.

3 - A Search Space Reduction Strategy for Security Constrained Unit
Commitment Problem
Mohsen Rahmani, Research Scientist, Carnegie Mellon
University, 5000 Forbes Ave, BH 131, Pittsburgh, PA,
United States of America, rahmani@andrew.cmu.edu
We proposed a special heuristic algorithm to reduce the number of variables and
constraints in the day-ahead security constrained unit commitment (SCUC) problem.
SCUC is a mixed integer linear programming problem (MIP) in which a
least cost combination of generators are defined to follow the next day electricity
demand while considering transmission and generator’s temporal and thermal
constraints. The size of the SCUC is thus reduced, and it becomes tractable by
the MIP solvers.

4 - Strategic Trading in a Multi-leader Multi-follower Framework
Chiara Lo Prete, Assistant Professor Of Energy Economics, The
Pennsylvania State University, 213 Hosler Building,
University Park, PA, 16802, United States of America,
chiaraolprete@psu.edu
Enforcement actions in regard to allegations of electricity price manipulation by
financial players have been the source of a great deal of controversy in recent
years. We focus on one type of manipulation strategy (placing unprofitable virtual
bids to enhance the value of related PFR positions) and construct examples of
equilibrium manipulation in the context of a multi-leader multi-follower game
played by generators and financial players.

■ MC79
79-Room 302, CC
Software Demonstration
Cluster: Software Demonstrations
Invited Session
1 - AIMMS - Experience Optimization Modeling in Real Time
Deanne Zhang, AIMMS Optimization Specialist
What can you do in 45 minutes? Attend a lecture? Watch a TED Talk online?
Maybe go on a 5-mile run? There is a lot that can be accomplished in 45 minutes
that can provide both a sense of achievement and generates new ideas. We invite
you to experience this same kind of feeling in a 45-minute journey with AIMMS!
We are going to build an optimization model in real time and publish it on
AIMMS PRO, an enterprise level app store. This 45-minute software demo will
provide you with a fresh view of how AIMMS delivers broader usage and greater
benefits for business users.
2 - MOSEK ApS - using MOSEK at its Best
Andrea Cassioli, Product Manager, MOSEK ApS
MOSEK provides high-quality software for conic optimization. The software tutorial focuses on: 1) the key features and benefits of our object-oriented API called FUSION API, speed, expressiveness and simplicity; 2) modeling issues and best practices that may be helpful in many cases; 3) insight on the upcoming new release will be presented. Customer inspired examples will be used to show how to use MOSEK at its best.

Monday, 4:30pm - 6:00pm

■ MD01
01-Room 301, Marriott
Military Applications Society Awards
Sponsor: Military Applications
Sponsored Session
Chair: Andrew Hall, COL, U.S. Army, 4760 40th St N, Arlington, Va, United States of America, AndrewOscaH@aol.com

■ MD02
02-Room 302, Marriott
Cyber Security
Cluster: Homeland Security Invited Session
Chair: Laura Mclay, Associate Professor, University of Wisconsin, 1513 University Ave, ISYE Department, Madison, WI, 53706, United States of America, lmclay@wisc.edu
1 - Data-driven Markov Decision Processes Applied to Cyber Vulnerability Maintenance
Theodore Allen, Associate Professor, The Ohio State University, 1971 Neil Avenue, 210 Baker Systems, Columbus, OH, 43221, United States of America, allen.515@osu.edu, Chengjun Hou
Issues relating to parametric uncertainty in Markov decision processes are described. Recent methods and results are over-viewed including relating to partially observable Markov decision processes. The application to cyber vulnerability maintenance is described using real world data.
2 - A Supply Chain Game Theory Framework for Cybersecurity Investments under Network Vulnerability
Shivani Shukla, PhD Candidate, Isenberg School of Management, University of Massachusetts, 121 Presidents Dr., Amherst, MA, 01003, United States of America, sshukla@som.umass.edu, Ladimier Nagurney, Anna Nagurney
We develop a supply chain game theory framework consisting of retailers and consumers who engage in electronic transactions via the Internet and, hence, may be susceptible to cyberattacks. The retailers compete noncooperatively in order to maximize their expected profits by determining their optimal product transactions as well as cybersecurity investments in the presence of network vulnerability. Theoretical and computational results are given.
3 - Budgeted Maximum Multiple Coverage Problem and its Extensions
Kaiyue Zheng, Industrial & Systems Engineering Department, University of Wisconsin-Madison, 1513 University Avenue, Madison, WI, United States of America, kzheng238@wisc.edu, Laura Mclay
This talk will discuss a cyber-security planning application for securing global information technology (IT) supply chain from the myriad of cyber-security risks and vulnerabilities that exist. We propose a budgeted maximum multiple coverage problem for selecting mitigations and discuss its multiple extensions. We examine the problem structures and introduce integer programming and greedy approximation algorithms for identifying optimal and near-optimal solutions.

■ MD03
03-Room 303, Marriott
Scheduling with Applications
Cluster: Scheduling and Project Management
Invited Session
Chair: Hui-Chih Hung, Assistant Professor, National Chiao Tung University, 1001 University Rd., Hsinchu, Taiwan - ROC, hhc@cc.nctu.edu.tw
1 - Job Shop Scheduling with Task Similarity and Knowledge Transfer
Huan Jin, University of Iowa, S210 Pappajohn Business Building, The University of Iowa, Iowa City, IA, 52242, United States of America, huan-jin@uiowa.edu, Michael Hewitt, Barrett Thomas
We consider job shop scheduling problem in which workers improve through experience, both from repeatedly working the same task but also through working similar tasks. In addition, we incorporate knowledge gained through transfer from co-located employees. We demonstrate how we linearly reformulated the problem to overcome the nonlinearity of the learning curves. The reformulation adds many additional variables. We present solution methods as well as insights gained from solutions.
2 - A Simple and Effective Appointment Sequencing Heuristic Algorithm Based on the First Half Rule
Boray Huang, National University of Singapore, 1 Engineering Drive 2, Singapore, Singapore, borayhuang@msn.com, Ahmad Reza Pourghaderi
We propose a simple and effective heuristic algorithm for appointment sequencing that could find solutions with about 60% lower total waiting time compare to the smallest variance first and the shortest expected processing time first rules. This heuristic method is inspired by a new appointment sequencing rule, the first half rule, which implies that the customer with stochastically smaller excess service time must be scheduled in the first half of the available appointment slots.
3 - Appointment Scheduling with Uncertain Patient Arrivals
Mabel C. Chou, National University of Singapore, Mochtar Riady Building, 15 Kent Ridge Dr, BIIZ #8-66, Singapore, 119245, mabelchou@nus.edu.sg, Cheng-han Yu, Hui-Chih Hung
We consider a single class patient appointment scheduling problem with uncertain patient arrival times and seek to determine the optimal appointment schedule for patient arrivals. We study the trade-off between the expected patient waiting time and the expected makespan of the doctor's working hours. “Passing” occurs when a patient is seen earlier than another patient whose appointment is earlier. We study the problem under no-passing, one-passing, and infinite-passing scenarios analytically.
4 - Order Scheduling with Preemptive Jobs on Fully Flexible Machines to Minimize Number of Late Orders
Hui-Chih Hung, Assistant Professor, National Chiao Tung University, 1001 University Rd., Hsinchu, Taiwan - ROC, lhc@cc.nctu.edu.tw, Jun-min Wei
We consider order scheduling problem with preemptive jobs on fully flexible machine environment. The objective is to minimize number of late orders. It is noted as PFi | pmn, pk | Ji, which is shown to be NP-hard. Integer programming models are prepared for rational and real processing time problems. Traditional heuristics of forward arrangement is considered, but unbounded in worst case. By backward arrangement, we build a tight lower bound and propose a heuristic bounded in worst case.
The purpose of this study is to investigate the value of Facebook data in predicting individual customer behavior. In addition, we study the importance of different online engagement variables such as likes, answers to event rsvp’s, and group memberships in predicting acquisition and defection. The results indicate that customer acquisition can be predicted very accurately using Facebook data. In addition Facebook data significantly improve defection prediction over and above customer data.
1 - Storage Valuation

Long Zhao, PhD Student, UT McCombs Bussiness School, 2110 Speedway Ste B6500, CBA 5.202, Austin, TX, 78712-1277, United States of America, zhao.long.soul@gmail.com, Sthathis Tompaidis, Kumar Muthuraman

We use moving boundary method to approach the valuation problem of storage with transaction costs. If the storage facility is a price taker and price follows a mean-reverting process with seasonality, we are able to find the optimal strategy of injection and withdraw. Because of discounting, we may hold even price is super cheap. We may choose to hold instead of injection when the price is low because high selling transaction costs prevent us from selling in the future.

2 - Predictable Forward Mean Variance Preferences

Xiao Han, PhD Student/Teaching Assistant, The University of Texas at Austin, 7802 Lecompte Rd., Austin, TX, 78717, United States of America, xiao.han@utexas.edu, Thalia Zarpipoulou

The classical mean variance preference poses a serious challenge when applied in the context of long term portfolio management. In the spirit of the forward utility preference of Musiela and Zariphopoulou, we propose a dynamic, self generating, mean variance preference that is flexible with both horizon and the associated model/parameter uncertainties. We will show that the new preference generates a much higher Sharpe ratio in a market with uncertain, time varying risk premium.

3 - Modelling of Electricity Supply Curves under Correlated Plant Behavior

Vishwakant Malladi, Doctoral Student, UT Austin, Austin, TX, 78703, United States of America, Vishwakant.Malladi@phd.mccombs.utexas.edu, Rafael Mendoza-arriaga, Sthathis Tompaidis

We present a framework where the electricity plants in a region are modeled as subordinated Markov Chains. We also develop a factor model for Markov chain generators to separate both the idiosyncratic and correlated behavior of the plants. Calibration shows that supply curves are bent resulting in lower generation capacity available at higher reliability levels.

4 - Modeling Electricity Prices: A Time Change Approach

Rafael Mendoza-Arriaga, McCombs School of Business, 1 University Station, Austin, TX, 78712, United States of America, rafael.mendoza-arriaga@mccombs.utexas.edu, Lingfei Li, Daniel Mitchell

We develop a new framework for modeling electricity spot prices by time changing the basic affine jump diffusion, which successfully captures seasonal spikes. Our model is easy to estimate from data and it is tractable for pricing electricity derivatives.

2 - Empirical Analysis of the Effectiveness of Mobile Channels

Marcel Goic, Assistant Professor Or Marketing, University of Chile, Republica #701, Santiago B3704J38, Chile, mgoic@di.uchile.cl, Jose Gualardo

The continuously growing use of mobile devices provides the opportunity to use this new channel to complement the value proposition that companies offer to their customer. However, the nature of customer responses to these initiatives remains largely unexplored. We empirically investigate the drivers of effectiveness in managing a mobile transactional channel and how to use location-based information to interact with consumers.

3 - Nudging Mobile Advertising with Offline Social Contexts

Beibei Li, Assistant Professor, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, beibei@andrew.cmu.edu, Anindya Ghose, Siyuqiu Liu

We conducted a large-scale field experiment in a major shopping mall in Aisa for three weeks in 2015 based on a total of 52,500 unique user responses. Our results allow us to examine how offline social context would affect the effectiveness of mobile advertising.

4 - Evaluating Consumer M-Health Services for Promoting Healthy Eating: A Randomized Field Experiment

Vibhanshu Abhishek, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, vib@andrew.cmu.edu, Rema Padman, Y-chin Lin, Julie Downs

In this paper we provide a systematic study on the effectiveness of using mHealth to promote healthy eating. We examine the effects of an mHealth app on food choices in a 4-month randomized field experiment. Mixed models showed that the mobile-based visual diary might be effective in increasing engagement. Results also showed strong evidence that dietitian support significantly improves consumer engagement in self-monitoring, and this effect was mediated by consumers’ intention.

■ MD08

08-Room 308, Marriott

Mobile-Based Business Model Innovations

Cluster: Business Model Innovation

Invited Session

Chair: Vibhanshu Abhishek, Carnegie Mellon University, 5000 Forbes Avenue, Pittsburgh, PA, 15213, United States of America, vib@andrew.cmu.edu

1 - Big Data Business Analytics from Mobile Marketing Innovation Perspectives

Xueming Luo, Temple University, 1801 Liacouras Walk, Philadelphia, PA, United States of America, Xueming.Luo@temple.edu

Xueming Luo will address big data business analytics from mobile marketing innovation perspectives. Over 3.6 billion people worldwide are deeply engaged with smartphone devices, machine-to-machine connected solutions, wearables, Internet-of-things technologies. As marketers can send ads to smartphone users, anywhere they are, marketing discipline now faces tremendous opportunities of coming up with new theory and industry practices for manager and consumer insights. Xueming will explore how mobile technologies and connected smart devices affect advertising, promotions, marketing ROI, and omni-channel targeting effectiveness.


Wael Jabr, Assistant Professor, Georgia State University, 35 Broad Street, Robinson College of Business, Atlanta, GA, 30303, United States of America, wjabr@gsu.edu, Radha Mookerjee, Vilay Mookerjee

User forums are a popular alternative to traditional support channels. To understand the dynamics of problem resolution there, we analyze the delay incurred by users waiting for a solution. Using datasets from support forums we find that users who initiate threads suffer a shorter delay than those who join later on. We explain this counter-intuitive result with queuing theory. We use the empirical findings to devise a policy for firm involvement aiming at minimizing overall delay.

■ MD10

10-Room 310, Marriott

IT-Enabled Competitive Strategies

Cluster: Business Model Innovation

Invited Session

Chair: Hong Guo, University of Notre Dame, 356 Mendoza College of Business, Notre Dame, IN, 46556, United States of America, hguo@nd.edu


Wael Jabr, Assistant Professor, Georgia State University, 35 Broad Street, Robinson College of Business, Atlanta, GA, 30303, United States of America, wjabr@gsu.edu, Radha Mookerjee, Vilay Mookerjee

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2 - Has Production Interdependence Been Changed with Information Technology?
Fengmei Gong, Assistant Professor Of Information Technology, University of La Verne, La Verne, CA, 91750, United States of America, fgong@laverne.edu, Barrie R. Nault, Zhuo (june) Cheng
Industries have become increasingly integrated with their suppliers’ business processes such as purchasing and Just-in-time (JIT) production; however, whether industries in a supply chain have become more interdependent remains an open question. We examine the impact of an industry’s IT investment on its production interdependence with upstream suppliers, where we measure interdependence as direct backward linkage (DBL).

3 - New Platform Announcement Strategies: A Duopoly of Two-sided Platforms
Rajiv Mukherjee, Assistant Professor, Southern Methodist University, Dallas, TX, United States of America, rmukherjee@mail.smu.edu, Rammath Chellappa
We study a duopoly where two firms that are horizontally differentiated in their two-sided platform offerings evaluate their release strategies for a new version. The firms chose between two release strategies: I) Formal release whereby the firms commit to their future offering, II) Informal release whereby the firms employ rumor or other seeding mechanisms to announce to the market.

4 - Social Interactions and Product Sales in Social Shopping: An Experimental Approach
Annibale Sodero, Assistant Professor, University of Arkansas, Sam M. Walton College of Business, Fayetteville, AR, 72701, United States of America, ASodero@walton.uark.edu, Elliot Rabinovich, Bin Gu
Social shopping revolves around deeply discounted deals that are offered for a limited time through social networking websites. In this study, we investigate the effect of social interactions on product sales and the contingencies surrounding the interactions. Using an experimental approach, we investigate five social interaction mechanisms and find that three mechanisms act in tandem to accelerate a deal’s demand: opinion leadership, network integration, and boundary spanning of early buyers.

MD12
12-Franklin 2, Marriott
Surrogate-Based and Derivative-Free Optimization II
Sponsor: Optimization/Mixed Integer Nonlinear Optimization and Global Optimization
Sponsored Session
Chair: Rommel Regis, Saint Joseph’s University, Mathematics Department, 5600 City Avenue, Philadelphia, PA, 19131, United States of America, rregis@sju.edu
1 - A DFO-based Approach to Computer-aided Mixture Design
Nick Austin, Graduate Student, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15213, United States of America, ndaustin@andrew.cmu.edu, Nikolaos Sahinidis, Daniel Trahan
Computer-Aided Mixture Design (CAMD) relies on complex physicochemical simulation models to design a blend of components. We present a novel approach to CAMD that relies on the use of derivative-free optimization (DFO). We present comparative results from the application of 27 DFO solvers to this challenging problem.

2 - Surrogate-based Optimization for Oral Solid Drug Product Manufacturing
Zilong Wang, Graduate Research Assistant, Rutgers University, 98 Brett Rd, Chemical and Biochemical Engineering, Piscataway, NJ, 08854, United States of America, wzlpublic@gmail.com, M. Sebastian Escotetespinoza, Ravendra Singh, Fernando J. Muzzio, Mariathian Ierapetritou
Surrogate-based optimization is used to solve computationally expensive simulation models and to optimize functions when the model is not available. However the applicability of such methods can be limited due to the high dimensionality of problem variables. In this presentation we focus on solving high-dimensional design problems in pharmaceutical manufacturing using RBF-based surrogate modeling strategies. Case studies will be used to illustrate the applicability of the proposed approaches.

3 - Applied Results from the Techno-economic Optimization of a High-flux Solar Thermal Receiver
Michael Wagner, Mechanical Engineer, National Renewable Energy Lab, 15013 Denver West Parkway, Golden, CO, 80401, United States of America, Michael.Wagner@nrel.gov, Alexandra Newman, Robert Braun
We optimize a novel concentrating solar power tower receiver technology by choosing the 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. Nonlinear constraints are incorporated via Lagrangian terms. We present results that guide the applied technology configuration.

4 - Applications of Surrogate-based Optimization
Cameron Turner, Associate Professor Of Mechanical Engineering, Colorado School of Mines, 1500 Illinois St., Department of Mechanical Engineering, Golden, CO, 80401, United States of America, ctturner@mines.edu
Many engineering design problems are characterized by nonlinear behaviors, mixed discrete-continuous variables, multiple objective functions, & uncertain or limited precision data about the problem. What data that exists is often derived from empirical measurements, experimental studies, or models & simulations, each with errors, limited precision & data collection costs. We focus on the use of the techniques, tradeoffs and decisions necessary to employ surrogates in optimization.
MD13

13-Franklin 3, Marriott

Stochastic Integer Programming
Sponsor: Optimization/Optimization Under Uncertainty
Sponsored Session

Chair: Kibaek Kim, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL, 60439, United States of America, kimk@anl.gov

1 - A Scalable Approach to Solving Multi-stage Stochastic Integer Programs
Osman Ozalp, Assistant Professor, North Carolina State University, Raleigh, NC, United States of America, oyzalp@ncsu.edu, Burhaneddin Sandi'eki

Despite being a flexible modeling framework, multi-stage SPs are not widely adopted in practice, mostly due to their unbearable size. Moreover, incorporating integer variables renders multi-stage SPs even less tractable. We propose a bounding-based solution approach, which does not assume convexity but rather relies on scenario decomposition and is inherently parallelizable. Our results demonstrate that the proposed method scales nicely with problem size and produces high quality solutions.

2 - On Solving General Two-stage Stochastic Programs
Manish Bansal, Postdoctoral Fellow, Department of Industrial Engineering and Management Science, Northwestern University, 2145 Sheridan Road, Evanston, IL, 60208, United States of America, manish.bansal@northwestern.edu, Sanjay Mehrota

We study general two-stage stochastic programs (TSSPs) and present conditions under which the second stage programs can be convexified. This generalizes the results of Bansal et al. (2015) for two-stage stochastic mixed integer programs. We present finitely convergent decomposition algorithms to solve many classes of TSSPs including TSSP with some non-convex program in the second stage. We computationally evaluate our convexification approach by solving two-stage stochastic lot-sizing problems.

3 - Algorithmic Innovations and Software for the Dual Decomposition Method Applied to SMIP
Kibaek Kim, Argonne National Laboratory, 9700 South Cass Avenue, Argonne, IL, 60439, United States of America, kimk@anl.gov, Victor M. Zavala

We develop algorithmic innovations for the dual decomposition method to address two-stage stochastic programs with mixed-integer recourse and provide a parallel software implementation. Our innovations include the derivation of valid inequalities that tighten Lagrangian subproblems and the stabilization of dual variables by solving the master problem with a primal-dual interior point method and provide termination criteria that guarantee finite termination of the algorithm.

4 - Updates to PIPS-SBB: A Parallel Distributed Memory Stochastic Mip Solver
Geoff Oxberry, Lawrence Livermore National Laboratory, P.O. Box 808, L-792, Livermore, CA, United States of America, oxberry1@llnl.gov, Deepak Rajan, Thomas Edmunds, Pedro Sotorrio, Lluís Miquel Munués, Cosmin Petra

Deterministic equivalent formulations of stochastic MIPs from applications such as unit commitment (UC) can exceed available memory on a single workstation. To overcome this limitation, we have developed PIPS-SBB, a parallel distributed memory stochastic MIP solver based on the distributed memory stochastic LP solver PIPS-S. Here, we discuss ongoing work on PIPS-SBB, with a focus on parallel implementations of B&B techniques. We also present a path forward to solving large UC problem instances.

MD14

14-Franklin 4, Marriott

Robust Optimization in Radiation Therapy Planning
Sponsor: Optimization/Optimization Under Uncertainty
Sponsored Session

Chair: Wei Liu, Assistant Professor, Mayo Clinic Arizona, 5777 E Mayo Blvd., Phoenix, AZ, 85054, United States of America, liuwei@mayo.edu

1 - Scenario-based Radiotherapy Margins: Handling Tissue Inhomogeneity, Range Errors, and Organ Motion
Rasmus Bokrantz, RaySearch Laboratories, Sveavägen 44, Stockholm, 111 34, Sweden, rasmus.bokrantz@raysearchlabs.com, Albin Fredriksson

We consider a scenario-based optimization formulation to handle the effects of errors in radiotherapy planning. The formulation coincides with margin-based planning if the implicit assumptions made when the margins are delineated are valid, but also generalizes to more difficult situations such as irradiation of inhomogeneous tissue or irradiation with proton fields. We extend the model to account for tissue inhomogeneity, proton range errors, and organ motion.

2 - Robust Optimization Methods for Breast Cancer Radiation Therapy
Houra Mahmassi, University of Toronto, Toronto ON, Canada, houra@mie.utoronto.ca, Timothy Chan, Thomas Purdie

We explore robust optimization methods for improving the quality of treatment in left-sided breast cancer radiation therapy. Our robust models take into account breathing uncertainty and minimize the dose to the organs at risk while meeting the clinical dose-volume limits on the cancerous target. We use clinical data from several breast cancer patients and compare the outcomes of our robust models with those of the current clinical methods.

3 - Chance-constrained Robust Optimization in Proton Therapy to Account for Beam Delivery Uncertainties
Yu An, Mayo Clinic, 5777 East Mayo Blvd., Phoenix, AZ, 85054, United States of America, an.yu@mayo.edu, Jianming Liang, Wei Liu

We propose a chance-constrained model in intensity-modulated proton therapy treatment planning by explicitly accounting for range and patient setup uncertainties in optimization algorithm. Decomposition methods are applied to render the large-scale optimization problems tractable and achieve the best trade-off between plan quality and robustness. The results are then checked by patient population study to demonstrate the statistically significant advantages of our planning method.

4 - Robust Spatiotemporally Integrated Fractionation in Radiotherapy
Archis Ghate, University of Washington, Industrial & Systems Engineering, University of Washington Box 352650, Seattle, United States of America, archis@uw.edu, Ali Ajdari

Feasibility of the fluence-maps in the spatiotemporally integrated fractionation problem crucially depends on the linear-quadratic dose-response parameters of the organs-at-risk. We present a robust formulation of this problem whereby the resulting dosing schedule remains feasible as long as the dose-response parameters vary within a known range. This robust model is non-convex and high-dimensional. We discuss approximate solution techniques rooted in convex programming.

MD15

15-Franklin 5, Marriott

Distributed Convex Optimization
Sponsor: Optimization/Nonlinear Programming
Sponsored Session

Chair: Necdet Serhat Aybat, Assistant Professor, Industrial Engineering Dept., Penn State University, University Park, PA, United States of America, ns10@engr.psu.edu

1 - A New Globally Convergent Incremental Newton Method
Mert Gurbuzbalaban, Massachusetts Institute of Technology, 32 Vassar St, Cambridge, MA, United States of America, mertg@mit.edu, Asu Ozdaglar, Pablo Parrilo

We develop and analyze a new globally convergent incremental Newton method for minimizing the sum of strongly convex functions, motivated by machine learning problems over large data sets and distributed optimization over networks. We discuss its convergence rate and prove its linear convergence under some assumptions.

2 - Multiagent Distributed Admm: Rate of Convergence
Ali Makhdoumi, Massachusetts Institute of Technology, 32 Vassar St, Cambridge, MA, 02139, United States of America, makhdoumi@mit.edu, Asu Ozdaglar

We consider a multi agent optimization problem where a network of agents collectively solves a global optimization problem with the objective function given by the sum of locally known convex functions. This problem arises in many applications in large-scale distributed statistical estimation. We propose a fully distributed ADMM algorithm and characterize its rate of convergence as well as its dependence on the network structure.

3 - An Asynchronous Distributed Proximal Method for Composite Convex Optimization
Zi Wang, Penn State University, 1400 Martin St Apt. 2112, State College, PA, 16803, United States of America, zwx212@psu.edu, Necdet Serhat Aybat, Garud Iyengar

We propose an asynchronous distributed first-order augmented Lagrangian (DFAL) algorithm to minimize sum of composite convex functions, where each term is a private function to one node, and only nodes connected by an edge can communicate. We show any limit point of iterates is optimal, an eps-optimal and eps-feasible solution can be computed with probability at least 1-p within O(1/eps log(1/p)) communications. We demonstrate the efficiency of DFAL on large scale sparse-group LASSO problems.
2 - Impact of Sub-networks on the Diffusion of Innovation
Xu Dong, Research Assistant, University of Miami, 1251 Memorial Drive, Coral Gables, FL, 33146, United States of America, x.dong3@miami.edu, Nazril Shalikh

Recent research shows that the structural properties of social networks influence the diffusion of innovation; however, these studies assume that the network is one giant cluster. Networks can have disconnected clusters (sub-networks) that introduce discontinuities in the diffusion pathways. Our research provides an understanding of the impact of discontinuities on diffusion.

3 - Identifying High Value Customers in a Network: Individual Characteristics Versus Social Influence
Sang-Uk Jung, Assistant Professor, Hankuk University of Foreign Studies, Imunro 102, Dongdaemun-gu, Seoul, 130-791, Korea, sanguk.jung@hufs.ac.kr, Jin-Kyu Park, Gary Russell

Firms are interested in identifying customers who generate the highest revenues. In a social network setting, customer interactions can play an important role in purchase behavior. This study proposes a spatial autoregressive model that explicitly shows how network effects and individual characteristics interact in generating firm revenue. Using model outputs, we develop a method of identifying individuals whose purchase behavior most impacts the total revenues in the network.

Modeling Social Influence in Networks

17-Franklin 7, Marriott

Sponsor: Optimization/Network Optimization

Chair: Vladimir Boginski, University of Florida, 303 Weil Hall, Gainesville, FL, United States of America, boginski@reef.ufl.edu

1 - Fashion Supply Chain Network Competition with Ecolabelling
Min Yu, Assistant Professor, University of Portland, 5000 N. Willamette Blvd., Portland, OR, 97203, United States of America, yu@up.edu, Jonas Floden, Anna Nagurney

We develop a competitive supply chain network model for fashion that incorporates ecolabelling. We capture the individual profit-maximizing behavior of the fashion firms which incur ecolabelling costs with information associated with the carbon footprints of their supply chains revealed to the consumers. Consumers, in turn, reflect their preferences for the branded products of the fashion firms through their demand price functions, which include the carbon emission information.

2 - Automatic Sequence Extraction for Sequence Alignment in Text Mining
Michelle Seref, Virginia Tech, Pamplin 1007, 0235, Blacksburg, VA, 24061, United States of America, mmhsselef@vt.edu, Onur Seref

We illustrate novel methods to automatically extract sequences from pre-labeled text in order to apply sequence alignment for classifying text. Sequences are initially generated using n-gram approaches and then aggregated into semantically unique sequences. Sequence alignment uses these sequences to detect semantically equivalent text with either exact word or synonym matches. We demonstrate our method on several text domains.

Methodologies in Text Mining for Big Data

18-Franklin 8, Marriott

Sponsor: Optimization/Linear and Conic Optimization

Chair: Michel Gendreau, École Polytechnique de Montréal, Montréal, QC, Canada, michel.gendreau@polymtl.ca, Marco Morabito, Stavros Athanasopoulos, Paolo Tadei

1 - A Novel Method for Forecasting Forecasted Results
Xiao Wang, Assistant Professor, University of Florida, 303 Weil Hall, Gainesville, FL, United States of America, xiaowang@ufl.edu, Andrew Nash, W. Scott Bryson

We present a novel method for forecasting forecasted results. Our method is based on the idea that forecast errors are random variables with certain properties. We develop a model that takes into account these properties and uses them to forecast forecasted results.

2 - Automatic Sequence Extraction for Sequence Alignment in Text Mining
Michelle Seref, Virginia Tech, Pamplin 1007, 0235, Blacksburg, VA, 24061, United States of America, mmhsselef@vt.edu, Onur Seref

We illustrate novel methods to automatically extract sequences from pre-labeled text in order to apply sequence alignment for classifying text. Sequences are initially generated using n-gram approaches and then aggregated into semantically unique sequences. Sequence alignment uses these sequences to detect semantically equivalent text with either exact word or synonym matches. We demonstrate our method on several text domains.
1 - State of Optimization in Advanced Process Control
Rishi Amrit, Shell International, Houston, TX, United States of America, R.Amrit@shell.com

Process Control forms the backbone as well as the driving agent for almost all of process industries today. Smart algorithms combined with superior computational capabilities allow us to automate processes in a controlled fashion while optimizing environmental, safety and economic performance. This talk discusses recent advances in commercial Advanced Process Control technology by harnessing the latest developments in the optimization community along with the challenges going forward.

2 - Modeling Recursive Formulae in Xpress using Variable Eliminations
Libin Varghese, Lead Modeling Developer, FICO, 1500 Broadway, Suite 1101, New York, NY, 10036, United States of America, LibinVarghese@fico.com

Modeling a deposit pricing problem, that optimizes rates for a multiyear period, involves handling of various recursive formulae that link each time period to the next. We shall focus on how we modeled the problem in the Mosel modeling language using the new variable elimination feature of Xpress-Nonlinear and the performance improvements achieved.

3 - A New Optimality Measure for Sequential Linear Programming Methods
Zsolt Csizmadia, Principal Engineer, FICO, FICO House, Starley Way, Birmingham, B37 7GN, United Kingdom, zsolt.csizmadia@gmail.com

The KKT conditions are regarded as the definite first order optimality conditions for nonlinear programming though regularity conditions relatively rarely hold in practice. The convergence of nonlinear optimization algorithms based on first order approximations often focus on the progress made rather than the solution properties. We introduce a new optimality measure derived from the KKT conditions and explore the connection between the convergence of first order methods and the new measure.

21 - Franklin 11, Marriott

Stochastic Models in Healthcare
Sponsor: Health Applications
Sponsored Session
Chair: Sait Tunc, UW-Madison, 3233 Mechanical Engineering Building, 1513 University Avenue, Madison, WI, 53706, United States of America, stunc@wisc.edu
Co-Chair: Oguzhan Alagöz, UW-Madison, 3242 Mechanical Engineering Building, 1513 University Avenue, Madison, WI, 53706, United States of America, alagoz@engr.wisc.edu

1 - Robustness of Markov Decision Processes for Medical Treatment Decisions
Lauren Steimle, University of Michigan, 1205 Beal Avenue, Ann Arbor, MI, 48109-2117, United States of America, steimle@umich.edu, Brian Denton

Markov decision process (MDP) models are frequently used to study optimal policies for treatment of patients with chronic diseases. However, these models can be sensitive to estimates of transition probabilities and rewards. We discuss an approach for quantifying robustness of MDP-based policies with respect to parameter uncertainty. We illustrate our findings based on a model for optimal treatment of blood pressure and cholesterol in patients with type 2 diabetes.

2 - Ambulance Emergency Response Optimization in Dhaka, Bangladesh
Justin Boutilier, University of Toronto, 5 King’s College Road, Toronto, ON, M5S 3G8, Canada, j.boutilier@mail.utoronto.ca, Moinul Hossain, Timothy Chan

Dhaka, the capital city of Bangladesh and the tenth largest city in the world, does not currently have a centralized emergency medical service (EMS) system or 9-1-1 type number. As a result, patients experience restricted access to healthcare. To address this problem, we have developed a novel data-driven robust location-routing model that can be applied to Dhaka and other developing urban centers. The model uses traffic data collected via GPS to construct an uncertainty set for travel times.

3 - Score Based Anticipative Transfer Requests in the Intensive Care Units
Yasin Ulukus, University of Pittsburgh, Pittsburgh PA, United States of America, myu1@pitt.edu, Gilles Clermont, Guodong Pang, Andrew J. Schaefer

The efficient operation and management of ICUs is critical to providing high quality of care while managing costs. We construct a new Transfer Score to estimate readmission and death probabilities. We further show that an anticipative transfer request policy combined with effective use of clinical markers can significantly decrease transfer delays without increasing the capacity. We present a Markov Decision Process (MDP) model for the transfer request problem and solve it via approximations.

4 - Optimal Breast Cancer Diagnostic Decisions under the Consideration of Overdiagnosis
Sait Tunc, UW-Madison, 3233 Mechanical Engineering Building, 1513 University Avenue, Madison, WI, 53706, United States of America, stunc@wisc.edu, Oguzhan Alagöz, Elizabeth Burns

Breast cancer over-diagnosis issue becomes more severe every year, a recent study approximates the annual cost of overdiagnosis to the United States as $243 million. We propose a large-scale MDP model to determine the optimal diagnostic strategy under the consideration of overdiagnosis by incorporating cytologic grade into the traditional breast cancer diagnostic decision problem.
complex health data.

Support. We developed sparse, nonnegative tensor factorization models to obtain phenotypes with minimal human supervision. Results on real EHRs demonstrate the effectiveness of our models to extract medically interpretable concepts from complex health data.

MD22

Joint Session Prize/CPMs: 2015 Informal Prize Winner Cluster: 2015 INFORMS Prize Presentation Invited Session
Chair: Peter Buczkowski, Manager, Workforce Management, Disney Parks & Resorts, P.O. Box 10005, Lake Buena Vista, FL, 32830, United States of America, peter.s.buczkowski@disney.com

1 - 2015 Informal Prize Presentation by Chevron
Margery Connor, Chevron, 6001 Bollinger Canyon, P-2080, San Ramon, CA, 94583, MHCO@chevron.com, Bill Klimack, Wen Chen

Chevron, 2015 Informal Prize Winner for excellence in analytics and operations research, will present their long and innovative history of applying analytics and operations research across their worldwide energy company. Highlighted projects include: Petro: Chevron’s refinery refinery planning tool • Workforce forecasting to ensure the right people on the right projects • genOpt: Optimization model to maximize oil and gas production. Chevron will also share their journey applying decision analysis.

MD23

Markov Lecture
Sponsor: Applied Probability
Sponsored Session
Chair: Tolga Tezcan, Associate Professor, London Business School, Regent’s Park, London NW145A, United Kingdom, tezcan@london.edu
Co-Chair: Neil Walton, University of Amsterdam, Science Park 904, Amsterdam, Netherlands, n.s.walton@uva.nl

1 - Risk Analytics
David D. Yao, Industrial University, Department of Industrial Engineering, 500 West 120 St, New York, NY, 10027-6699, United States of America, yao@columbia.edu, Jose Blanchet, Paul Glasserman

This year’s Markov lecture and discussions will provide a survey of risk analytics as a fundamental tool in operations research. While the focus of business analytics is on issues of productivity and efficiency: cost savings and revenue/profit optimization, risk analytics address the complementary issues of sustainability and resiliency: risk-return tradeoff and related resource allocation decisions and mitigation strategies. Some of the applications to be highlighted include: resilient urban infrastructures, production planning with risk hedging, financial systemic risk, and securitized insurance products.

MD24

Latent Variable Models in Biomedical Informatics
Sponsor: Artificial Intelligence
Sponsored Session
Chair: Madeleine Udell, Postdoctoral Fellow, Caltech, CMS, Mail Code 9-94, Pasadena, CA, 91125, United States of America, madeleine.udell@gmail.com

1 - Computational Phenotyping from Electronic Health Records using Tensor Factorization
Joyce Ho, University of Texas at Austin, 1 University Station C0803, Austin, TX, 78712, United States of America, joyceho@utexas.edu, Jimeng Sun, Joydeep Ghosh

A computational phenotype (a set of clinical features or clinical condition) can enable cohort identification, allow decision-makers to identify patients for interventions, and be integrated with systems for real-time clinical decision support. We developed sparse, nonnegative tensor factorization models to obtain phenotypes with minimal human supervision. Results on real EHRs demonstrate the effectiveness of our models to extract medically interpretable concepts from complex health data.

INFORMS Philadelphia – 2015 MD25

12-Franklin 12, Marriott

Economics of IS & OM
Sponsor: Information Systems
Sponsored Session
Chair: Lin Hao, University of Notre Dame, 351 Mendoza College of Business, Notre Dame, IN, United States of America, lhao@nd.edu

1 - Exploring a New Marketing Platform of Credit Card Companies
Soohyun Cho, University of Florida, 355F STZ, Gainesville, FL, United States of America, soohyun.cho@warrington.ufl.edu, Subhajyoti Bandyopadhyay, Liangfei Qiu

Some credit card companies (CCs) and partner merchants have launched an exclusive marketing platform for their cardholders. The platform provides either public promotion through Social Network Services (SNS) or targeted promotion through their websites. We examine which promotion is more profitable to CCs and to competitive partner merchants.

2 - Bundling of Digital Products in Music Industry: An Empirical Study
Kyuungsun Rhee, PhD Student, University of Washington, University of Washington, Seattle, WA, 98105, United States of America, ksr22@uw.edu, Yong Tan, Jiaping Peng

It is becoming increasingly competitive for music websites nowadays. Due to highly heterogeneous demand, offering music bundles is a popular strategy to attract consumers. In this work, we examine the effectiveness of various bundling strategies using a unique dataset from a music mobile application which contains variables such as music downloads, ringtone purchase logs and user behavior in monthly subscription.

3 - E-book Platform Competition in the Presence of Two-sided Network Externalities
Yabling Jiang, Florida Gulf Coast University, 10501 FGCU Blvd, Fort Myers, FL, United States of America, yjiang@fgcu.edu

The success of the Kindle e-book platform and the increased popularity of e-books among readers have attracted extensive competition in the e-book market. We model the direct competition in the e-book platform market through a two-sided network externality model and show that publishers can influence consumers’ e-book platform adoption decisions and the total e-book sales by strategically deciding the size of contents available on each platform.

4 - The Effect of Online “Following” on Contributions to Open Source Communities
Mohammadmahdi Mogri, University of Florida, 299 Diamond Blvd, Apt. 5, Gainesville, United States of America, mohdi.mogri@warrington.ufl.edu, Liangfei Qiu, Subhajyoti Bandyopadhyay, Ira Horowitz

Although numerous studies have examined members’ motivation to contribute to online communities, the positive effect of social factors has not been unanimously confirmed in different settings. In this study, we estimate the effect of social factors on members’ contributions in an open source software (OSS) community, using a large scale dataset of 4 million online members. The results have implications for online community designers and OSS scholars.
3 - Key Challenges and Meta-choices in Designing Spatial Multi-criteria Evaluations
Gilberto Montibeller, London School of Economics, Houghton Street, London WC2A 2AE, London, United Kingdom, G.Montibeller@lse.ac.uk, Valentina Ferretti
Spatial multi-criteria decision analysis is increasingly employed in environmental decision-making and in related fields. However, there are key challenges when designing such evaluations, which impose important meta-choices to decision analysts, as they may lead to different contents of the evaluation model and to distinctive outcomes of the analysis. In this paper we provide a systematic and comprehensive discussion of these key challenges and the associated meta-choices.
**MD29**

29-Room 406, Marriott

**Joint Session Analytics/CPMS: 2015 Innovative Applications in Analytics Award Winner Reprise**

Sponsor: Analytics
Sponsored Session

Chair: Pooja Dewan, BNSF Railway, Fort Worth, TX, 76092, United States of America, Pooja.Dewan@bnsf.com

1 - Intelligent Surgical Scheduling System

Kalyan Pasupathy, Associate Professor, Mayo Clinic, 200 First Street SW, HA 2-43, Rochester, MN, 55905, United States of America, Pasupathy.Kalyan@mayo.edu, Narges Hosseini, Jeanne Huddleston, Paul Huddleston, Yariv Marmor, Thomas Rohleder

Orthopedic Surgery was facing highly fluctuating utilization of their operating rooms due to inaccurate estimation and scheduling of procedures. The existing scheduling optimization problems in literature were insufficient with just a single "optimal" solution. The team conducted descriptive research of clinical and operational factors, developed predictive models for surgical durations, and a prescriptive scheduling algorithm. Implementation results exhibit improvement in key metrics.

2 - Solving the Airline Pilot Manpower Planning Problem.

Chair: Stefan Karisch, Digital Aviation Optimization & Value Strategy, Boeing Commercial Aviation Services, 55 Inverness Drive East, Englewood, CO, 80112, United States of America, Stefan.Karisch@ge.com

Sponsor: Health Applications

The pilot manpower planning problem consists of the long term planning of recruitment and promotion to meet the forecasted crew need. Complicating this are strict seniority promotion rules and limited training resources. We further consider movable activities such as vacation and overtime distribution as well as required recurrent training. We will present a high level description of the mixed integer model, the heuristic solution process and successful applications.

**MD30**

30-Room 407, Marriott

**Practice Presentations by INFORMS Roundtable Companies III**

Sponsor: INFORMS Practice
Sponsored Session

Chair: Stefan Karisch, Digital Aviation Optimization & Value Strategy, Boeing Commercial Aviation Services, 55 Inverness Drive East, Englewood, CO, 80112, United States of America, Stefan.Karisch@ge.com

1 - Xpress-mosel: New Modeling Features for Distributed and Cloud Computing

Susanne Heipcke, FICO Xpress Optimization, FICO House, Starley Way, Birmingham, B37 7GN, United Kingdom, susanne.heipcke@fico.com

A major concern when deploying optimization models in distributed computing environments are questions related to security for the transmission and storing of data, and the protection of the model itself - we show examples how these are addressed by the new Mosel module mmosel. We further discuss the new concept of model annotations, metadata that can be used to configure optimization applications, and touch on new interfaces (HTTP, XML, JSON, Hadoop, R).

2 - Solving the Airline Pilot Manpower Planning Problem.

Per Sjogren, Jeppesen Systems AB, Odsingsatan 9, Gothenburg, 41311, Sweden, per.sjogren@jeppesen.com

The pilot manpower planning problem consists of the long term planning of recruitment and promotion to meet the forecasted crew need. Complicating factors are strict seniority promotion rules and limited training resources. We further consider movable activities such as vacation and overtime distribution as well as required recurrent training. We will present a high level description of the mixed integer model, the heuristic solution process and successful applications.

3 - Prescriptive Analytics on the Cloud with Python

Vincent Beraudier, Architect And Program Manager, IBM ILOG CPLEX, Porte Neuve, Bat A, 4 Av Alphonse Morel, Grasse, Al, 06130, France, vincent.beraudier@fr.ibm.com, Philippe Courronne

Python’s scipy provides tools for large-scale predictive/prescriptive analysis for manipulating, cleaning, and crunching data, and publication-quality graphics. The use of these web based tools with both state-of-the-art OR solvers and cloud computing will allow new users to enter the world of OR. Users with few development skills can leverage state-of-the-art solvers to develop, tune and publish their results without installing software. Come and discover these scientific python pillars.

4 - A Mixed Integer Programming Model for Optimizing Wheel Tru Operations for a Locomotive

Rajeev Namboothiri, GE Global Research, John F Welch Technology Centre, Bangalore, India, Rajeev.Namboothiri@ge.com, Srinivas Bollapragada, Rajeev Mathew, Mark Smith

FRA regulations mandate tolerance limits on locomotive wheel measurements for safe locomotive operations. The wheel tru machine operator needs to decide the amount of material to be trued from each wheel, and the wheels that need to be replaced with inventory wheels, in order to comply with FRA regulations. In this talk, we will present a novel MIP formulation for automating this complex decision, which minimizes the total cost of the wheel tru operation, thereby enhancing locomotive wheel life.

**MD32**

32-Room 409, Marriott

**Big Biological Data: Computational and Analytical Challenges**

Cluster: Big Data Analytics in Computational Biology/Medicine
Invited Session

Chair: Jian Peng, Assistant Professor, University of Illinois, 2118 Siebel Center, 201 N Goodwin Ave, Urbana, IL, 61801, United States of America, jianpeng@illinois.edu

1 - Reconciling of Species Histories using Genomic Data

Siavash Mirarab, UCSDS, Jacobs Hall, EBU1, 2nd Floor, University of California, San Diego, San Diego, CA, 92093, United States of America, smirarab@gmail.com, Shamsuzzoha Bayzid, Bastien Boussau, Tandy Warnow

Reconstructing phylogenies, trees that show evolutionary histories of species, can be now attempted using genomic data. Building these species trees is complicated by potential differences between evolutionary histories across the genome. In this talk, we introduce two new methods used to infer whole-genome phylogenies of 48 birds and 103 plants. These new algorithms can analyze datasets with thousands of genes and species with high accuracy, and can account for weak signal across the genome.

2 - Entropy-Scaling Search of Massive Biological Data Sets

Noah Daniels, MIT, 32 Vassar St., 32G-572, Cambridge, MA, 02139, United States of America, ndaniels@csai.mit.edu

Recently, we have seen an exponential increase in biological data, outpacing advances in computing power. Extracting new science from these massive datasets requires algorithms that scale sublinearly in the size of the datasets. We present a novel entropy-scaling data structure for similarity search. Applying this data structure provides massive acceleration of several standard tools in three biological domains: genomics, high-throughput drug screening, and protein structure search.

**MD33**

33-Room 410, Marriott

**Radiation Therapy Optimization: Algorithms and Biological Effects**

Sponsor: Health Applications

Sponsored Session

Chair: Gino Lim, Department Chair, Hari And Anjali Agrawal Faculty Fellow, Associate Professor, University of Houston, E206, Engr. Bldg 2, Houston, TX, 77204, United States of America, ginolin@central.uh.edu

1 - Benders Decomposition and an LP-based Heuristic for Selecting IMRT Treatment Beam Angles

Siying Lin, The University of Texas at Austin, 1 University Station C2200, Austin, TX, 78712, United States of America, sifenglin@utexas.edu, Jonathan Bard, Gino Lim

This talk presents two Benders decomposition algorithms and a novel two-stage integer programming-based heuristic to optimize the beam angle and fluence map in Intensity Modulated Radiation Therapy planning. The results indicated that implementing Benders using the lazy constraint usually led to better feasible solutions than the traditional approach. Moreover, the LP rounding heuristic can generate good solutions quickly, with further improvement obtained with the local branching search.

2 - Robust Optimization for Craniospinal Irradiation using Intensity Modulated Proton Therapy

Li Liao, Research Assistant, University of Houston, 4800 Calhoun Rd, Houston, TX, 77004, United States of America, lliao5@uh.edu, Gino Lim, Xiaodong Zhang

Conventional passive scattering proton therapy (PSPPT) is an extremely complex technique for craniospinal irradiation (CSI). In this study, we proposed a robust intensity modulated proton therapy (IMPT) for CSI. A small dose deviation can be achieved when ±3 mm mis-alignment errors were applied on field junction for the robust IMPT plans, whereas this index was more than 40% for PSPPT plans. A simplified dose model was introduced to predict dose deviation in different field arrangement situation.
A chance constrained programming (CCP) framework is developed to handle set-up uncertainties in radiation treatment planning. By allowing some degree of violations of constraints, the proposed approach optimizes the treatment plan while satisfying the planner's tolerance level on the constraint violation in a probabilistic environment. Linear deterministic equivalences of the chance constraints are derived under distributional assumptions on uncertainties.

1 - Modeling Comorbidity in Women with Diabetes
Nisha Nataraj, PhD Student, North Carolina State University, 111 Lampe Drive, Campus Box 7906, Raleigh, NC, 27695, United States of America, nnatara@ncsu.edu

Comorbidity is the presence of two or more concurrently existing conditions in an individual. A 2012 CDC report estimates that one in four US adults have comorbid conditions, contributing heavily to healthcare spending. Our focus is on diabetes since it is associated with significant comorbidity. Using National Inpatient Sample data (2006-2011), we build a modeling framework that helps evaluate how comorbidity impacts prognosis and outcomes for women with diabetes at a population level.

2 - Using Simulation to Determine a Balance between Cost and Quality of Care for Critically Ill Infants
Emily Lada, Principal Operations Research Specialist, SAS Institute Inc., SAS Campus Drive, Cary, NC, United States of America, Emily.Lada@sas.com, Chris Dertienzo, David Tanaka, Phillip Meanor

Discrete-event simulation techniques are used to assess the relationship between cost, average length of stay, and patient outcomes in a neonatal intensive care unit (NICU). The model represents a general method that can be applied to any NICU, thereby providing clinicians and administrators with a tool to quantitatively support staffing decisions. Over time, the use of the model could lead to significant benefits in both patient safety and operational efficiency.

3 - A Bayesian Markov Decision Process to Evaluate Mode of Delivery for Laboring Women
Karen Hicklin, PhD Student, North Carolina State University, 111 Lampe Drive, Campus Box 7906, Raleigh, NC, 27695, United States of America, kihickli@ncsu.edu, Fay Cobb Payton, Vidyadhar Kulkarni, Meera Viswanathan, Evan Myers, Julie Ivy

Laboring women will deliver through one of two ways: successful trial of labor or C-section. We combine Bayesian updating into a Markov decision process to determine under what circumstances it is appropriate to gather more information before making a decision regarding mode of delivery. The goal is to maximize the utility of health outcomes for the mother and child as a function of the belief that the woman will have a safe vaginal delivery as a function of cervical dilation progression.

MD35
35-Room 412, Marriott
Joint Session PPSN/Analytics: Pro Bono Analytics Panel Discussion
Sponsor: Public Sector OR
Sponsored Session
Chair: David Hunt, Manager, Oliver Wyman, One University Square, Suite 100, Princeton, NJ, 08540, United States of America, David.Hunt@oliverwyman.com

1 - Pro Bono Analytics Panel Discussion
Moderator: David Hunt, Manager, Oliver Wyman, One University Square, Suite 100, Princeton, NJ, 08540, United States of America, David.Hunt@oliverwyman.com, Panelists: Evan Fieldston, Joel Zarrow

Pro Bono Analytics (PBA) is a new initiative within INFORMS to match members willing to volunteer their skills with non-profit organizations working in underserved and developing communities. To launch PBA, representatives from prominent Philadelphia area non-profit organizations will participate in a panel discussion exploring the types of problems they face and ways that analytics/OR methods can help. Please join us to learn about the types of analytical problems at non-profits, and about PBA.

MD36
36-Room 413, Marriott
Modeling Broader Policy Impacts at the Local Scale
Sponsor: Public Sector OR
Sponsored Session
Chair: Ronald McGarvey, Indus. & Manuf. Systems Engineering; Truman School Of Public Affairs, University of Missouri, 225 Engineering Building North, Columbia, MO, 65211, United States of America, mcgarvey@missouri.edu

1 - Using Big Data to Inform Mental Health Policies
Maryam Alsadat Andalib, PhD Student, Virginia Tech, 536F Whittmore Hall, 1185 Perry Street, Blacksburg, VA, 24061, United States of America, maryam7@vt.edu, Vida Abedi, Arash Baghaei Lakeh, Ramin Zand, Navid Ghaffarzadegan, Niyousha Hosseinichimeh, Grant Hughes

The U.S. Environmental Protection Agency (EPA) has proposed a rule that aims to reduce carbon emissions from coal-fired power plants. We develop an MILP model to identify nim-cost approaches for satisfying these proposed standards via biopower generation subject to spatially-explicit biomass constraints. We next propose a robust optimization model to address parameter uncertainty, and compare the two models’ results to illustrate the impact of data uncertainty on overall cost and emissions.

2 - Robust Optimization for Biopower Generation
Bayram Dundar, University of Missouri-Columbia, 200 Engineering Building North, Columbia, MO, 65211, United States of America, bd52c@mail.missouri.edu, Ronald McGarvey, Francisco Xavier Aguilera

Community Health Centers (CHC) are for-profit health care corporations which provide comprehensive medical and dental care for their communities regardless of the individual's insurance coverage or ability to pay. For a CHC in rural Montana, there are unique challenges related to recruitment and retention of highly qualified, mission-driven employees. We identify and address these challenges using a system dynamics modeling approach.

3 - Modeling the Recruitment and Retention of Employees at a Rural Montana Community Health Center
Andreas Thorsen, Assistant Professor Of Management, Montana State University, 330 Jabs Hall, Bozeman, MT, 59717, United States of America, holger3000@gmail.com, Don Greer, Laura Black, Edward Gamble

Community Health Centers (CHC) are non-profit health care corporations which provide comprehensive medical and dental care for their communities regardless of the individual's insurance coverage or ability to pay. For a CHC in rural Montana, there are unique challenges related to recruitment and retention of highly qualified, mission-driven employees. We identify and address these challenges using a system dynamics modeling approach.

4 - Technoeconomic and Policy Considerations for Large-scale Solar Deployment in India
Ainmee Curtright, Senior Physical Scientist, RAND Corporation, 4570 Fifth Ave, Suite 600, Pittsburgh, PA, 15213, United States of America, acurtrig@rand.org, Zhimin Mao, Oluwatobi Oluwatola, Mridula Dixit Bhardwaj

The SERIUS consortium aims to develop and assess PV and CSP solar technologies that can support India's ambitious solar deployment goals, recently increased to a target of 100 GW by 2022. RAND and CSTEP are collaborating to conduct techno-economic and policy analyses to support the SERIUS consortium. This presentation will discuss recent and ongoing work, including progress made by U.S.-based PARDEC RAND students during their visiting internships at CSTEP in India.
1 - Improving Surgical Instrument Delivery using Optimization and Process Flow Modeling

Rama Wmnesi, Center for Healthcare Engineering and Patient Safety, University of Michigan, IOE Building, 1205 Real Avenue, Ann Arbor, MI, 48109-2117, United States of America, Rmwnes@umich.edu, Joseph Derosier, James Bagian, Shawn Murphy, Amy Cohen

Efficiency in surgical instrument reprocessing is a key challenge for high-volume surgical centers. Insufficiently cleaned or maintained instruments adversely impact patient safety and surgical outcomes. This study examines how i) instrument cleanliness and ii) instrument configuration impact efficiencies in reprocessing as well as quality of care and costs of delivery. We evaluate process flow variations in the delivery of instruments and present optimization-based models for improvement.

2 - A Queueing Model of Critical Care Outreach Team in Hospitals

Ali Haji Vahabzadeh, PhD Student, The University of Auckland, Private Bag 92019, Auckland, 1142, New Zealand, a.vahabzadeh@auckland.ac.nz, Valery Pavlov

The considerable evidence of failed CCO T implementations in hospitals demonstrate a lack of genuine understanding of the CCO T roles and capabilities. Such an evidence suggests that many times implementations follow, in effect, trial and error approach. To allow hospitals making better informed decisions this research proposes a queueing model for understanding the effectiveness of the CCO T on the intensive care unit performance and patient outcomes.

3 - Optimal Incentives for HIV Prevention Funds Allocation under Asymmetric Information

Monali Malvankar, Assistant Professor, Western University, St. Joseph’s Hospital, 268 Grosvenor St., London, ON, N6A 4V2, Canada, mmalvann@uwo.ca, Gregory Zaric, Xinghao Yan

Resource allocation models often require cost and effectiveness data on the outcomes of an intervention. However, these data may not be available in practice due to several reasons. We model information asymmetry in a multi-level HIV/AIDS resource allocation process with an attempt to answer the following questions: What is the impact of incentives if the preferences and infections prevented at the lower level are unknown at the upper level?

4 - Elective Surgery Scheduling for Multiple Operating Rooms Considering Patient Health Condition

Jooonyup Eun, PhD Candidate, Purdue University, 315 N. Grant Street, West Lafayette, IN, 47907-2023, United States of America, ejuni@purdue.edu, Sang-phik Kim, Yuehwhyn Yih

This research is motivated by the fact that surgery scheduling considering patient condition can contribute to improving patient safety. Surgeons and patients may want to schedule their surgeries early in order to escape from the risk of worsening patient condition. However, the resource limitation on surgeons, operating rooms, etc., forces surgical schedulers to prioritize surgeries. This research suggests a systematic mathematical model to consider patient condition in surgery scheduling.

5 - Who is the Right Kid for the Next Service? A Real Time Access Control Policy in the Pediatric Clinic

Yunzhe Qiu, Peking University, No. 298 Chengfu Road, Haidian District, Beijing, China, qiyunzhe92@163.com, Zekun Liu, Jie Song

This paper develops a real-time appointment scheduling policy considering both the difference and fairness of waiting time among heterogeneous patients. We use the utility theory to measure service satisfaction, which is integrated with CTMDP model. A myopic policy considering heterogeneous patients’ waiting patience is provided to minimize the overall dissatisfaction. A case based on the collaborated hospital is investigated, where the results confirm the effectiveness of the policy.
For diversity and self-expression, and have mitigating effects on diversity that result in positive economic growth. The results imply that leadership in more diverse environments is key to making positive structural shifts around inequality and participation.

1 - Can Female Leaders Mitigate the Negative Effects of Racial Diversity? National Leaders and Structural Shifts
Susan Perkins, Northwestern University, Evanston, IL, s-perkins@kellogg.northwestern.edu

Using a multi-method research design we study the effects of inequality and exclusion on productivity. We find that female leaders are expected improve economic outcomes more than male leaders; are associated with greater tolerance for diversity and self-expression, and have mitigating effects on diversity that resulted in positive economic growth. The results imply that leadership in more diverse environments is key to making positive structural shifts around inequality and participation.

2 - Online Decision-making with High-dimensional Covariates
Hamsa Bastani, Graduate Student, Stanford University, Stanford, CA, United States of America, hsridhar@stanford.edu, Molshen Bayati

Big data has enabled decision-makers to tailor choices at the individual-level. However, this involves learning a model of decision rewards on millions of individual-specific covariates, which are often high-dimensional. We present an efficient method to solve this problem in an online setting and a corresponding regret analysis. Unlike previous methods whose regret scales with the cube of the covariate's dimension, our method's regret scales linearly with the number of sparse features.
3 - A Low-cost Method for Multiple Disease Prediction
Mohsen Bayati, Assistant Professor, Stanford Graduate School of Business, 635 Knight Way, Stanford, CA, United States of America, bayati@stanford.edu, Andrea Montanari, Sonia Bhaskar

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 and require a low-cost screening to detect individuals with a high risk of developing such diseases. We offer a multiple disease prediction procedure that maximizes the predictive power while minimizing the screening cost. Our method is based on multi-task learning from machine learning.

MD42
42-Room 102B, CC
Joint Session MSOM-Health/HAS: Operations Research/Management for Public Health: Data-Driven and Dynamic Decision-Making
Sponsor: Manufacturing & Service Operations Management
Sponsored Session
Chair: Soroush Saghaian, Harvard University, 79 JFK Street, Cambridge, MA, 02138, United States of America, Soroush.Saghaian@asu.edu

1 - New Data-driven Approach to Safety and Risk Management in ICUs
Retsel Levi, J. Spencer Standish (1945) Professor of Operations Management, Sloan School of Management, MIT, 100 Main Street, BDG E62-562, Cambridge, MA, 02142, United States of America, retsel@mit.edu, Patricia Folcarelli, Yiqun Hu, Jeffrey Adam Traina, Daniel Talmon

We develop an innovative system approach to safety in ICUs. The approach is based on the innovative concept of risk drivers, which are states of the ICU, its environment and its staff that affect the likelihood of harms, as well as an innovative aggregated measure of the ‘burden of harm’. Using real data we develop statistical models that identify risky states in the ICUs of a major academic medical center.

2 - Developing Optimal Biomarker-Based Prostate Cancer Screening Policies
Christine Barnett, University of Michigan, 1205 Beal Ave., Ann Arbor, MI, United States of America, christinebarnett@umich.edu, Brian Denton, James Montie

Recent advances in the development of new biomarker tests, which physicians use for the early detection of cancer, have the potential to improve patient survival by catching cancer at an early stage. We develop a partially observable Markov decision process (POMDP) to compute near optimal prostate cancer screening strategies. We present results based on Monte Carlo simulation to compare the policies developed using our approximated POMDP methods with those recommended in the medical literature.

3 - Optimizing Hepatitis C Screening and Treatment Allocation Strategy
Yuankun Li, University of Washington, Seattle, WA, United States of America, yuankunl@uw.edu, Zelda Zabinsky, Hao Huang, Shun Liu

Chronic hepatitis C (HCV) is a significant public health problem affecting 2.7-3.9 million Americans. The U.S. healthcare systems are ramping up combined HCV screening and treatment efforts, but screening and treatment programs are very costly. We design the optimal HCV screening and treatment allocation strategies in the next 10 years under yearly budget constraint from a national perspective. The method includes simulation optimization using adaptive probabilistic branch and bound.

4 - A Robust POMDP Framework for the Management of Post-transplant Medications
Allieza Boolori, PhD Student Of Industrial Engineering, Arizona State University, 699 S Mill Avenue, Office # 313, Tempe, AZ, 85282, United States of America, abooloori@asu.edu, Curtis B. Cook, Soroush Saghaian, Harini A. Chakkera

Patients after organ transplants receive high dosages of immunosuppressive drugs (e.g., tacrolimus) to reduce the risk of organ rejection. However, this practice has been shown to increase the risk of New-Onset Diabetes After Transplantation (NODAT). We propose a robust POMDP framework to generate effective medication management strategies for tacrolimus and insulin. Our approach increases the patient’s quality of life while reducing the effect of transition probability estimation errors.

MD43
43-Room 103A, CC
Empirical Revenue Management
Sponsor: Revenue Management and Pricing
Sponsored Session
Chair: Dan Zhang, University of Colorado at Boulder, 995 Regent Dr, Boulder, United States of America, Dan.Zhang@colorado.edu

1 - Would You Like to Upgrade to a Premium Room? An Empirical Analysis on Standby Upgrades
Ovunc Yilmaz, PhD Student, University of South Carolina, 1014 Greene St, Columbia, SC, 29208, United States of America, oyilmaz@email.sc.edu, Mark Ferguson, Pelin Pekgun

Standby upgrades, where the guest is only charged if the upgrade is available at the time of arrival, is one technique that has become increasingly popular in the hotel industry. Working on a data set from a major hotel chain, we analyze the linkage between guest attributes, hotel characteristics and guest decision-making for standby upgrades through an empirical study.

2 - Analytics for an Online Retailer – Demand Forecasting and Price Optimization at Rue La La
Kris Johnson Ferreze, Harvard Business School, Morgan Hall 492, Boston, MA, 02163, United States of America, kferreze@hbs.edu, David Simchi-Levi, Bin Hong Alex Lee

We present our work with Rue La La, an online retailer who offers limited-time discounts on designer apparel. One of their main challenges is revenue management for new products. We use machine learning to build a demand prediction model, the structure of which poses challenges on creating a pricing policy. We develop theory around multi-product price optimization and use this to create and implement a pricing decision support tool. Field experiment results show significant increases in revenue.

3 - A Model to Estimate Individual Preferences using Panel Data
Gustavo Vulcano, NYU, 44 West Fourth St, Suite 8-76, New York, NY, 10012, United States of America, gvulcano@stern.nyu.edu, Srikanth Jagabathula

In a retail operation, customer choices may be affected by stockout and promotion events. Given panel data with the transaction history of each customer, we use a general nonparametric framework in which we represent customers by partial orders of preferences. Numerical experiments on real-world panel data show that our approach allows more accurate, fine-grained predictions for individual purchase behavior compared to state-of-the-art existing methods.

4 - Estimation of Arrival Rates and Choice Model with Censored Data
Anton Kleywegt, Georgia Tech, 733 Ferst Drive NW, Atlanta, GA, 30332, United States of America, anton@isye.gatech.edu

Revenue management models with customer choice behavior include two types of parameters: (1) customer arrival rates and (2) choice parameters. Revenue managers usually have censored arrival data only, because no-purchase data are not observed. For both homogeneous and nonhomogeneous Poison arrivals we give necessary and sufficient conditions for the arrival rates and choice parameters to be identifiable with such censored data, and we give algorithms for parameter estimation, with numerical results with airline data.

MD44
44-Room 103B, CC
Pricing and Information in Innovative Business Models
Sponsor: Revenue Management and Pricing
Sponsored Session
Chair: Jose Guajardo, University of California Berkeley, 545 Student Services Bldg #1900, Berkeley, CA, 94720-1900, United States of America, iguajardo@berkeley.edu

1 - Information Provision Policies in Developing Countries: Heterogeneous Farmers and Market Selection
Chen-Nan Liao, National Taiwan University, No.1,Sec. 4, Roosevelt Rd., Taipei City, Taiwan - ROC, chennan@berkeley.edu, Ying-ju Chen, Chris Tang

We examine the impact of information provision policies on farmer welfare in developing countries where heterogeneous farmers lack relevant information for making market (or crop) selection. We show that the optimal information provision policy may call for limited dissemination, and the government can implement it while overcoming perceived unfairness by providing information to all farmers at a nominal fee. We also examine issues including information dissemination via a for-profit company.
2 - Pay-as-You-go Business Models for Energy Technology Innovations in Developing Economies
Jose Guajardo, University of California Berkeley, 545 Student Services Bldg #1900, Berkeley, CA, 94720-1900, United States of America, jguajardo@berkeley.edu
Pay-As-You-Go business models have become widespread for the diffusion of energy technology innovations in developing economies, yet not much is known about this recent phenomenon. In this research, we analyze central aspects of consumer behavior and contract design in these novel markets.

3 - Selling Freemium Products to Loss Averse Consumers
Sami Najafi-Asadolahi, Santa Clara University, 500 El Camino Real, Santa Clara, CA, United States of America, snajali@scu.edu, Nishant Mishra, Andy Tsay
We consider a firm selling two versions of a single product, a freemium for free and a premium at a regular price, to consumers who are loss-averse. Each consumer first uses the freemium, and after using it, decides whether to buy the premium. We find that when consumers become slightly dissatisfied from the freemium’s valuation they, counter-intuitively, become more willing to purchase the premium, thereby increasing the firm’s revenue.

4 - Product Recommendations via Geometric-based Adaptive Choice Conjoint Analysis
Denis Saure, University of Chile, Republica 701, Santiago, Chile dsauerre@gmail.com, Juan Pablo Vielma
Aiming to obtain individualized estimates of consumer preferences in the context of product recommendations, we study the construction of adaptive conjoint choice designs under a Bayesian framework. By adopting a geometric interpretation of the problem, we construct near-optimal designs when the number of questions is small, and also give a precise interpretation of efficiency criteria and design methods used in extant research, which we show result in suboptimal designs.

2 - Dynamic Pricing and Learning in Spread Betting
Adam Schultz, PhD Student, University of Chicago Booth School of Business, 5807 S Woodlawn Ave., Chicago, IL, 60637, United States of America, adam.schultz@chicagobooth.edu, John Birge, Bora Keskin
We develop a model in which a sportsbook dynamically prices the point spread for a sporting event. In our model, bettors maximize their expected profits by timing their bets, while the sportsbook follows an easily implementable policy to update the point spread. To analyze the decisions of the betting market, we introduce a mean-field approximation. Using data from online sportsbooks, we reveal insights about the betting market.

3 - Rental System Revenue Management Problem with Totally Unimodular Constraints
Ali Cem Randa, University of Chicago Booth School of Business, 5807 Woodlawn Ave., Chicago, IL, 60637, United States of America, randa@chicagobooth.edu, John Birge, Baris Ata
We analyze the example of a renter which has finite number of identical units that can be loaned for durations of days. The renter has to determine its booking limits for a planning horizon of finite duration which is considerably far in the future. We assume that all permutations of consecutive days in the planning horizon define a different product. The capacity constraints formed by these products are totally unimodular. We solve a multi-stage stochastic program exploiting this structure.
1 - Compete vs. Cooperate? A Strategic Game Behind the EV Standards War
Ni Fang, HEC Paris, 1, Rue de la Libération, HEC Paris, Jouy en Josas, DI, 78351, France, nl.fang@hec.edu, Marco Cecchinelli
In the light of the standards war currently staged in electric vehicle (EV) industry, this paper examines the strategic choice facing the two EV manufacturers as to compete vs. cooperate for the development of an extensive charging infrastructure, a key complementary asset mitigating EV range anxiety. In doing so, this paper demonstrates how EV manufacturers’ incentives towards standardization and shows how standardization affects EV diffusion rate and firm’s performance.

2 - Food, Energy and Environment Trilemma: Land use Configuration for Biofuel Industry Development
Michael Lim, University of Illinois, 1206 S. 6th Street, Champaign, IL, 61822, United States of America, mlim@illinois.edu, Yanfeng Ouyang, Xing Wang
We address the negative side effects of the rapid development of the biofuel industry, which has caused extensive competition among food, energy, and the environment in agricultural land use. Taking into account interactions among multiple stakeholders (e.g., farmers, bioenergy firms, food industry, government), we develop policy guidelines for coordinating subsidy and mandates to better achieve sustainable development of this emerging bio-economy.

3 - Socially Responsible Business Models for Off-grid Energy Access
Serguei Netessine, Professor, INSEAD, 1 Ayer Rajah Avenue, Singapore, 138676, Singapore, Serguei.Netessine@insead.edu, Bhavani Shanker Upadhy, Ioana Popescu
One fifth of the humankind does not have access to electricity. They are mainly poor and rely on unhealthy solid fuels (kerosene etc.) for lighting. Even though cheaper rechargeable lighting technologies are available, their adoption is low and some consumers still use kerosene. We propose a model which explains this preference for kerosene and explore various business models which could alter this preference.

4 - Technology Sharing in Two-sided Markets
Ozge Yapor, Doctoral Candidate, University of Pennsylvania, Wharton School, Operations and Information Management, Philadelphia, PA, 19104, United States of America, yapor@wharton.upenn.edu, Lorin Hitt, Ruben Lobel
This paper investigates the drivers behind Tesla’s decision to make its patents freely available to other electric car manufacturers. The two sides of this market, car owners and potential charging stations, rely on each other to increase the value of their investment. We show under what conditions subsidizing the competitors can be profitable. By sharing technology, Tesla may be able to improve the charging station network and increase its own profit from car sales.

2 - Systematic Risk and Mass Layoffs in the U.S. Manufacturing
Nikolay Osadchiy, Emory University, 1300 Clifton Rd NE, Atlanta, GA, 30322, United States of America, nikolay.osadchiy@emory.edu, Suresh Daniari, Peyush Taoiiri, Srdihar Seshadri
We study the role of systematic risk in job relocation decisions of manufacturers. Using the mass layoff data in the U.S. manufacturing sector for the period from 2002 to 2010, we explore the view voiced by a number of manufacturers that in addition to cheap labor, systematic risk is also an important input in their production decisions.

3 - Risk or Margin: The Role of Trade Credit in Competition
Helikki Peura, London Business School, Regent’s Park, London, United Kingdom, hpeura@london.edu, S. Alex Yang, Guoming Lai
We analyze horizontal competition with and without trade credit under the classic Bertrand framework. We find that when the competing firms are financially constrained, trade credit allows them to soften price competition. We further investigate the relationship between firms’ financial strength and their physical production capacity, finding that with trade credit, financial constraints are a partial substitute for the role that physical capacity plays in price competition.

4 - Mental Cost Ratios and the Beer Game
Maximiliano Udenio, Technical University of Eindhoven, Eindhoven, Netherlands, M.Udenio@tue.nl, Vishal Gaur, Jan Fransoo
In this study we investigate the underlying behavior of beer-game players through a series of experiments. We argue that players make decisions partly, on a dynamic mental cost-ratio that fluctuates following multiple factors. We use a structural estimation model to quantify the mental weighing of underage and overage costs, and discuss several factors driving the decision making.

2 - Using Retailer Order Commitments to Improve Supply Chain Performance
Nagesh Gavirneni, Cornell University, Ithaca, NY, United States of America, sg337@cornell.edu, Nagesh Gavirneni
We establish that retailer order commitment strategies improve the efficiency of decentralized distribution supply chains whenever the supplier’s cost is at least 29.3% of the total supply chain cost. The effectiveness increases as the supplier’s share of the total supply chain cost increases. We establish the robustness of these results for settings with non-normal demand distributions, backlogging at the supplier, and positive lead times between the supplier and the retailers.

2 - Can a Zero-margin Demand Stream Increase Profits?
Shaokuan Chen, The University of Texas at Dallas, 800 W Campbell Road, Richardson, TX, 75080, United States of America, shaokuan.chen@utdallas.edu, Ganesh Janakiram, Alp Muharremoglu
We consider a firm selling a non-perishable product in its primary market over time with uncertain demand. Suppose a new opportunity arises from a secondary market where the firm’s product can only be sold at a zero-margin. Moreover, the firm is required to give priority to the demand from the secondary market. We explore the following question: Can such a zero-margin opportunity increase the firm’s profit, and if so, when?

3 - Mitigating Supply Chain Disruptive Risks: A Two-stage Robust Optimization Approach
Peter Yun Zhang, Massachusetts Institute of Technology, 77 Massachusetts Avenue, Building E40-261, Cambridge, MA, 02139, United States of America, pyzhang@mit.edu, Nikolaos Trichakis, David Simchi-Levi
We present a model that captures two sets of decisions a supply chain risk manager faces: the placement of inventory in preparation for supply disruption and demand uncertainty, and the recourse decisions that coordinate capacity and inventory allocation after the uncertain events unfold. We take a worst-case perspective and analyze the problem via its Affinely Adjustable Robust Counterpart.
4 - Package Size and Pricing Decisions with a Bulk Sale Option
Ismail Kirici, PhD Student, University Of Texas at Dallas, 800 W. Campbell Road, Richardson, TX, 75080, United States of America, isk130330@utdallas.edu, Alp Mitharremoglu, Dorothee Nonhoff
In this study we investigate package size and pricing decisions of a retailer for a perishable product. The retailer has the option of bulk sale, which is defined as selling the product in a container that allows customers to buy as much or as little as they want.

■ MD50
50-Room 106A, CC
Procurement, Auction, and Pricing
Sponsor: Manufacturing & Service Operations Management
Sponsored Session
Chair: Zhili Tian, Assistant Professor, Florida International University, 11200 S.W. 8th Street, Miami, FL, United States of America, ztian@fiu.edu
1 - Optimal Descending Mechanisms for Constrained Procurement
Shivam Gupta, PhD Candidate, UT Dallas, NJ School of Management, 800 W. Campbell Rd., Richardson, TX, 75080, United States of America, sxg104920@utdallas.edu, Milind Dawande, Ganesh Janakiraman, Wei Chen
We propose optimal descending mechanisms for procurement under two practically-relevant feasibility constraints. We then show that both mechanisms belong to a larger class of descending mechanisms that are optimal for procurement under polymatroid feasibility constraints.

2 - Dual Sourcing Auctions for Unreliable Suppliers: with or Without Cost Distribution Information
He Huang, Professor, Chongqing University, School of Economics and Business Admin., Chongqing, China, huanghe@cqu.edu.cn, Zhigeng Li, Hongyan Xu
This paper examines dual-sourcing auctions for risk mitigation when a buyer faces uncertain demand and multiple unreliable suppliers with private cost information. Two scenarios involving three auction formats are considered, Generalized First-price Auction, Generalized English Auction and Optimal Auction with Learning. We separately design the above dual-sourcing auctions and then examine the buyer's strategic choice.

3 - Using Procurement Service Providers in Supplier Screening
Zhixi Wan, Assistant Professor, University of Oregon, Eugene, OR, United States of America, zwan@uoregon.edu, Sriipad Devalkar
A buyer engages a procurement service provider (PSP) to short-list pre-screened suppliers for final selection. The PSP can exert costly effort to include promising candidates that have a higher probability to be deemed qualified by the buyer. We solve the buyer's joint optimization about the short-list size and the performance bonus.

4 - Dynamic Pricing with Product Returns
Xing Hu, Assistant Professor, University of Oregon, Eugene, OR, United States of America, xingh@uoregon.edu
We consider a monopolist's dynamic pricing problem when the customers may stochastically return the purchased products. We study how the customers' return speed and return probability affect the optimal pricing decisions.

■ MD51
51-Room 106B, CC
Applications of Operations Management to Pharmaceutical and Healthcare Industry
Sponsor: Manufacturing & Service Operations Management
Sponsored Session
Chair: Zhili Tian, Assistant Professor, Florida International University, 11200 S.W. 8th Street, Miami, FL, United States of America, ztian@fiu.edu
1 - Process Flexibility with Inventory
Yang Wang, UC Berkeley, IEOR Dept., Berkeley, CA, 48109, United States of America, yangwang0803@berkeley.edu, Phillip Kaminsky
Motivated by a capacity planning project undertaken with a biopharmaceutical firm, we explore the benefits of combining process flexibility with inventory to better respond to demand uncertainty. We consider a multi-plant multi-product multi-period supply chain model in which each plant is capable of producing multiple products as well as holding inventory, and characterize conditions under which inventory, flexibility, or a combination of the two are most beneficial.

2 - Optimal Investment in Support of Existing Drug and Development of New Drug
Zhili Tian, Assistant Professor, Florida International University, 11200 S.W. 8th Street, Miami, FL, United States of America, ztian@fiu.edu
Firms invest in the support of existing drug and R&D of new drug. While the investment fund comes from the net sales of the existing drug, a firm has to balance the investment in the two types of competing projects. We determine the optimal resource allocation between the marketing support of the existing product and developing a new product. We estimate the demand as function of investment in marketing. We derive the optimal investment policy for the above two types of investment.

3 - Nurse Staffing Decision in Nursing Homes
Min Chen, Florida International University, 10200 SW 8th St. Miami, FL, 33199, United States of America, mchen2@fiu.edu
Staffing is the dominant input in the production of nursing home services. This paper examined how skilled nursing facilities responded to the minimum nursing hours per resident day regulations. Panel data analyses of facility-level nursing inputs and outputs revealed that nursing homes strategically reallocated their staffing levels and skill mix, which could have important implications for quality management.
4 - The Effect of Supply Base on Ordering Behavior
Haresh Gurnani, Professor, Wake Forest University, School of Business and Center for Retail, Winston Salem, NC, 27106, United States of America, gurnanih@wfu.edu, Karthik Ramachandran, Saibal Ray, Yusen Xia

Previous experimental research in newsvendor problem has mostly focused on ordering from a single supplier; we investigate how the availability of multiple suppliers would influence the order size and allocation decisions with uncertain demand. We also study how the supply base impacts behavioral insights developed under a single supplier setting.

MD54

54-Room 108A, CC
Computational Optimization and Statistical Methods for Big Data Analytics: Applications in Neuroimaging
Cluster: Tutorials
Invited Session
Chair: W. Art Chaovalitwongse, University of Washington - Seattle 3900 Northeast Stevens Way, Mechanical Engineering Building, Room G6, Seattle, WA, United States of America, arthao@uw.edu

1 - Computational Optimization and Statistical Methods for Big Data Analytics: Applications in Neuroimaging
W. Art Chaovalitwongse, University of Washington - Seattle, 3900 Northeast Stevens Way, Mechanical Engineering Building, Seattle, WA, United States of America, arthao@uw.edu, Shuai Huang

This tutorial describes recent advances in computational optimization and statistical methodologies in the emerging research area of Big Data analytics, with a focus on classification, regression and feature selection. We discuss the mathematical and statistical modeling of these problems and provide an application to brain imaging. Analyses of neuroimaging data can provide a unique and often complementary characterization of the underlying neurophysiological process that may be useful in clinical diagnosis of brain diseases.

MD55

55-Room 108B, CC
Environmental Application and Computational Aspects of Efficiency and Productivity Analysis
Cluster: Data Envelopment Analysis
Invited Session
Chair: Herbert Lewis, Associate Professor, Stony Brook University, College of Business, Stony Brook, NY, 11794-3775, United States of America, herbert.lewis@stonybrook.edu

1 - An Algebraic Modeling Language Package for Solving Large-Scale Data Envelopment Analysis Problems
Wen-Chih Chen, National Chiao Tung University, 1001 Ta Hsueh Rd., Hsinchu, Taiwan - ROC, wenchih@faculty.nctu.edu.tw, Yueh-shan Chung

Algebraic modeling languages for mathematical programming provide a flexible and powerful tool for DEA computation. This talk introduces an algebraic modeling language package for solving large-scale DEA problems. While taking the advantage of flexibility and powerful solvers from a modeling language, this package can solve larger-scale DEA problems without limitation on constraints and variables, and with better computational performance.

2 - Frontier Estimation via Penalized Concave Regression
Abolghaz Keshvari, Dr., Aalto University School of Business, Ruoholahtiinkatu 22-24, Helsinki, 00100, Finland, abolghaz.keshvari@aalto.fi

Concave regression is an important tool in estimating a productive efficiency frontier. However, computing this estimator is a very difficult and time consuming task. The computational burden rises very quickly with increasing numbers of observations. We develop an unconstrained quadratic programming (QP) problem to the (monotonic) concave regression, which outperforms the conventional constrained QP problem. Using our approach, we solve a problem with hundreds of observations in some seconds.

3 - Productivity Growth and Environmental Efficiency: A Global Malmquist-Luenberger Index Analysis
Jayanthi Ananda, Dr., Central Queensland University, 120 Spencer Street, Melbourne, 3000, Australia, j.ananda@eq.edu.au, Benjamin Hampf

The paper analyses the productivity of the urban water sector using the global Malmquist-Luenberger index while incorporating an undesirable output – greenhouse gas emissions. Findings indicate that the productivity growth of the sector has declined in cumulative terms. The water source, the level of wastewater treatment and production density showed a statistically significant influence on the relative efficiency of urban water utilities.

4 - Saving Water in California: using DEA to Allocate Usage Reductions
Herbert Lewis, Associate Professor, Stony Brook University, College of Business, Stony Brook, NY, 11794-3775, United States of America, herbert.lewis@stonybrook.edu, Diana Hagedorn, Thomas Sexton

Governor Brown of California has directed the State Water Resources Control Board to implement mandatory urban water reductions of 25%. In this paper, we use DEA in 5 of the 9 water use categories, comprising 95% of the state’s water usage, to identify the reductions possible in each county through the elimination of inefficiency. Where the elimination of inefficiency is insufficient to meet the goal, we use a second linear programming model to allocate additional cuts in an equitable manner.

MD56

56-Room 109A, CC
Spatial Analysis
Sponsor: Location Analysis
Sponsored Session
Chair: Alan Murray, Professor, Drexel University, 3141 Chestnut Street, Philadelphia, PA, 19104, United States of America, amurray@drexel.edu

1 - Transmax 2: An Expanded Transit Route Covering Model
Richard Church, Professor, University of California, Santa Barbara, Santa Barbara, CA, 93106, United States of America, rick.church@ucsb.edu, Timothy Niblett

Current et al. (1984, 1985) were the first to suggest a routing problem to minimize distance and maximize demand coverage. This problem characterizes the principal goals of transit route design. Since that time there have been a number of formulations, involving elements like route extension and multiple route design. We discuss the TRANSMax model of Carin and Bibe (2011) and based upon that propose a new, expanded formulation called TRANSMax 2, which allows for greater flexibility.

2 - Max Flow with Buyout: Identifying The Minimum Number of Facilities/personnel Required to Meet Demand
Blair Swieqart, Operations Research Analyst, US Coast Guard, 216 Maryland Ave, Norfolk, VA, 23504, United States of America, dbswiegart@email.wm.edu

The USCG needs to identify deployability of personnel and mission impact. This reduces to a facility location problem: mission demands are demand nodes, personnel are potential facilities, arc capacities are time requirements. Objectives are: determine min. number of personnel needed to meet demand; ID if a person is critical. If not, ID the tradeoff cost. This is a modification of a max-flow algorithm that pushes excess out of the network intelligently to minimize the required number of personnel.
technologies. In this paper, we discuss distributed approaches, all based on

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1 - Optimal Portfolio Investment and Coordinated Scheduling of an Energy Storage Merchant in the Energy
Roderick Go, Johns Hopkins University, 3400 N. Charles St.,
Ames Hall 313, Baltimore, MD, 21218, United States of America,
go1@jhu.edu, Anya Castillo, Deneice F. Gayme, Sonja Wogrin

We assess strategic behavior of a merchant energy storage provider in the bulk power market through a bilevel model to represent sequential decisions in investment and operations. We model optimal portfolio investments based on siting, sizing, and technology mix, and explore the effect of strategic operations, such as coordinated scheduling, on decisions. We transform this model into a math program with equilibrium constraints (MPEC), and approximate and solve as a mixed integer program (MIP).

2 - Proactive Transmission Planning: A Case Study of the Eastern Interconnection
Evangelia Spyrou, PhD Student, Johns Hopkins University, 3400 N Charles Street, Dept of Geography, Johns Hopkins University, Baltimore, MD, 21218, United States of America,
elina.spirou@gmail.com, Benjamin Hobbs, Jonathan Ho, Randell Johnson, James Mc Calley

Traditional transmission planning procedures are being challenged by renewable integration due to their reactive character. Meanwhile academic literature proposes the concept of proactive transmission planning. A mixed integer linear program is applied to estimate the impacts of proactively considering response by generation investments to transmission investments. We attempt to examine features of planning procedures that could impede or facilitate optimal planning.

3 - Unit Commitment Approximations in Generation and Transmission Planning: Efficiency & Accuracy
Benjamin Hobbs, Professor, The Johns Hopkins University, 3400 North Charles Street, Baltimore, MD, United States of America, bhobbs@jhu.edu, Saamrat Kasina, Jonathan Ho, Sonja Wogrin

Alternative tight relaxations of unit commitment problems that enable large planning models to be solved with operating subproblems that capture ramp, start-up, and min limits and costs. We examine their performance in the context of generation and transmission expansion models, including a stochastic programming analysis of the western interconnection of North America.

4 - Reserve Determination Methods for Variable Generation
Robert Entriken, EPRI, 3420 Hillview Avenue, Palo Alto, CA, United States of America, rentrike@epri.com

We present results of a survey of existing practices in certain power system operators for determining operating reserve requirements for system operators faced with growing penetrations of variable renewables, such as wind or solar generators. Building on existing practices, we review methods proposed for planning and integration studies, as well as in academia, which may become useful as renewable penetrations increase.

1 - Distributed State Estimation and Energy Management in Smart Grids
Soumya Kar, Assistant Research Professor, Carnegie Mellon University, Electrical and Computer Engineering, CMU, Pittsburgh, PA, 15232, United States of America, soumyak@andrew.cmu.edu

Generally, it is expected that the grid of the future would differ from the current system by the increased integration of distributed generation, distributed storage, demand response, power electronics, and communications and sensing technologies. In this paper, we discuss distributed approaches, all based on consensus+innovations, for two common energy management functions: state estimation and economic dispatch.

2 - Computational Look-ahead SCOPF via ADMM
Sambuddha Chakrabarti, Graduate Student, UT Austin, 1616 Guadalupe Street, Austin, TX, 78705, United States of America, sambuddha.chakrabarti@gmail.com, Matt Kraning, Ross Baldick, Eric Chu, Stephen Boyd

We present computational scheme and results of the ADMM based Proximal Message Passing as applied to solve the look ahead SCOPF or limit post fault line temperature and current to safe values wit next set of outages.

3 - Adaptive Bidding Strategies of a Load Serving Entity with Distributed Energy Resources
Jhi-Young Joo, Assistant Professor, Missouri University of Science and Technology, 301 W. 16th St, 235 Emerson Electric Co. Hall, Rolla, MO, 65409, United States of America, joojhi@msi.edu

This talk concerns two problems solved by an agent, a load serving entity (LSE), within a large-scale energy system. An LSE with different types of demand and energy resources optimizes energy schedule by mathematical programming. On the other hand, to optimize bids into the markets, a learning algorithm is used to adapt to the uncertain market conditions and rewards. The interdependencies between these two problems within an agent and among multiple agents are examined.

4 - Active Distribution Grid Operation: A System of Systems Framework
Amin Kargarin, Carnegie Mellon University, 5000 Forbes Ave, Pittsburgh, PA, 15232, United States of America, amin.kargarin@gmail.com

A system of systems framework is presented to operate an active distribution grid composed of several independent entities. The grid structure includes two layers where the distribution company is in upper layer and microgrids are in lower layer. A hierarchical optimization algorithm is presented to optimally operate the entire active distribution grid.

Forest & Timber Management
Sponsor: ENRE – Environment II – Forestry
Sponsored Session
Chair: Nick Kullman, Masters Student, University of Washington, 360 Blended Hall, Seattle, WA, United States of America, nick.kullman@gmail.com

1 - A Joint Model of Strategic Forest Management, Capacity Expansion and Logistics
Eldon Gunn, Dalhousie University, Halifax, NS, B3H 4R2
Eldon.Gunn@Dal.Ca

This paper presents a mixed integer programming model that enables the integrated analysis of strategic forest management, forest industry capacity and the transport logistics that connect them. Some insights that arise from this model are discussed.

2 - Route Selection in Forest Transportation
Patrik Flisberg, Creative Optimization, Tokai, 7945 Cape Town, South Africa, pafl@web.co.za, Mikael Ronqvist, Gunnar Svensson

Determining the best route for logging trucks is difficult as many road features need to be considered. We describe a system called Calibrated Route Finder that is used to evaluate about 50% of all 2 million forest transports done annually in Sweden. This system has gradually been developed based on reporting and requests from the users. Recently, we have included detailed description on stops, acceleration and breaking to describe emissions and times. We report on detailed testing and analysis.

3 - Joint Production of Timber and Sitka Deer Habitat Capability on the Tongass National Forest
Michael Bevers, Dalhousie University, Halifax, NS, B3H 4R2
beversm@gmail.com, Curt Flather, Yu Wei, Greg Hayward, Mary Friberg, Thomas Hanley, Ben Case

The Tongass NF uses the FRESH model to estimate Sitka deer habitat capability measured in deer-days based on digestible dry matter and protein from hundreds of forage species occurring in dozens of vegetative communities potentially affected by timber harvests. Landscape effects on deer DE accounted for using a moving window analysis. We developed a MILP formulation incorporating FRESH calculations into a whole-stand timber harvest scheduling model for spatially optimizing joint production of timber and deer habitat capability on management units of the Tongass NF.
MD60
60-Room 111A, CC
Panel Discussion: Encouraging Professionalism in the Classroom
Sponsor: INFORMS ED
Sponsored Session
Chair: Cliff Ragsdale, Bank of America Professor, Virginia Tech, Dept. of Business Information Technology, Pamplin Hall, Room 1007, Blacksburg, VA, 24061, United States of America, Cliff.Ragsdale@vt.edu

1 - Encouraging Professionalism in the Classroom
Moderator: Cliff Ragsdale, Bank of America Professor, Virginia Tech, Dept. of Business Information Technology, Pamplin Hall, Room 1007, Blacksburg, VA, 24061, United States of America, Cliff.Ragsdale@vt.edu, Panelists: James Cochran, Ronald Klimberg, Kevin Scheibe

One of a professor's roles as an educator is to prepare students for the professional workplace. The panelists in this session will share ideas related to how we might treat various aspects of our courses and classrooms as simulators of the professional workplace. Open discussion of these ideas with the audience is encouraged.

MD61
61-Room 111B, CC
Multilevel Optimization Problems in Energy
Sponsor: ENRE – Energy II – Other (e.g., Policy, Natural Gas, Climate Change)
Sponsored Session
Chair: Sauleh Siddiqui, Assistant Professor, Johns Hopkins University, 3400 N. Charles St. Latrobe 205, Baltimore, MD, 21218, United States of America, siddiqui@jhu.edu

1 - Strategic Bidding in Multi-unit Auctions with Storage of Electric Energy
Chia Lo Prete, Assistant Professor Of Energy Economics, The Pennsylvania State University, 213 Hosler Building, University Park, PA, 16802, United States of America, chialoprete@psu.edu, Uday Shanbhag

Increased supply variability due to the integration of renewables has raised interest in energy storage resources providing flexibility in the operation of electricity systems. One of the key issues to be addressed by market operators relates to the participation of these resources in wholesale energy markets. We develop a theoretical framework to analyze how the inclusion of storage affects incentives and opportunities for strategic bidding behavior in electricity markets.

2 - An Exact Solution Method for Binary Equilibrium Problems and the Power Market Uplift Problem
Daniel Huppmann, Postdoctoral Fellow, Johns Hopkins University, German Institute for Economic Research (DIW Berlin), 3400 N. Charles St., Baltimore, MD, 21218, United States of America, dh@dergelbesalan.at, Sauleh Siddiqui

We propose a novel method to find Nash equilibria in games with binary decision variables by including compensation and incentive-compatibility directly into an optimization framework in lieu of using a linearization, or relaxation of integrality conditions. The method endogenizes the trade-off between efficiency and compensation payments necessary to align incentives of players. We provide existence results and conditions under which this problem can be solved as a mixed-binary linear program.

3 - How Proactive Transmission Investments Can Incentivize Social Welfare Improving Gencos Investments?
Enzo Sauma, Pontificia Universidad Catolica de Chile, Santiago, Chile, esuma@ing.puc.cl, David Pozo, Javier Contreras

We propose a proactive three-level equilibrium model for power transmission and generation expansion. The lower level models the market outcome; the intermediate level models the equilibrium in generation capacity expansion; and the upper level models the transmission expansion. The second and third levels are modeled as an Equilibrium Problem with Equilibrium Constraints. We study how proactive transmission investments can incentivize generation investments that improve social welfare.

4 - The Impact of Withholding Flexibility: An Application to Ramp Bidding in Electricity Markets
Ekaterina Moisseeva, KTH Royal Institute of Technology, SE-100 44, Stockholm, Sweden, moisseeva@kth.se, Mohammad Reza Hesamzadeh, Sonja Wogrin

We compare a one-level and a bilevel equilibrium game in which firms’ flexibility is either: decided at the same time as their production decisions, or sequentially. We analyze the impact that different market structures have on the equilibrium outcomes. Our findings are applied to the ramp bidding game in electricity markets. It is observed that electricity producers may strategically declare a lower ramp rate if they expect such decision to maximize their profit in the production stage.

MD62
62-Room 112A, CC
Spatial Optimization and Conservation Reserve Design
Sponsor: ENRE – Environment I – Environment and Sustainability
Sponsored Session
Chair: Bistra Dilkina, Assistant Professor, Georgia Institute of Technology, Klaus Bldg 1304, Atlanta, GA, 30332-0765, United States of America, bdilkina@cc.gatech.edu

1 - Land Development Uncertainties in the Dynamic Reserve Network Design Problem
Nahid Jafari, Postdoctoral Research Associate, University of Georgia, 180 East Green St., Warnell School of Forestry and Natural R, Athens, GA, 30602, United States of America, nahid.jafari@uga.edu, Clinton Moore

The (conservation) reserve network design problem is a challenge to solve because of the spatial and temporal nature of the problem, stochastic action costs and dynamic land markets. To plan cost-effective conservation over time under stochastic uncertainties, we propose multi-period MIP models for the budget-constrained selection of fully connected sites. The objective is to maximize a summed conservation value for a subset of site availability scenarios at the end of the planning time horizon.

2 - Wildlife Corridors in Harvest Scheduling Models: A Case Study in Northern Sweden
Rachel St. John, University of Washington, Box 352650, Seattle, WA, 98195-2650, United States of America, rachelstjohn1@gmail.com, Sandor Toth

In northern Sweden, commercial forestry and reindeer husbandry compete for forest resources. The former relies on timber - the latter on lichen. We present a new model for maximizing net timber revenues while maintaining a high quality corridor system for reindeer. The model can control such geometric characteristics as corridor length and width by incorporating path finding technology in a mixed integer programming framework. We illustrate the model with a case study in Sweden.

3 - Spatial Considerations and Optimum Reserve Design for Multiple Species
Hayri Oral, University of Illinois, Urbana IL 61801, United States of America, h oral@illinois.edu, Yicheng Wang

We present a linear MIP model for designing a conservation reserve system for multiple species where compactness and connectivity of the reserves are imposed at species level. We consider both structural connectivity and functional connectivity of the selected sites. An empirical application to the protection of ten state endangered bird species in Illinois will be presented.

4 - Optimal Design of Nature Reserves Considering Connectivity and Buffer Zones
Eduardo Alvarez-miranda, Universidad de Talca, Merced 437, Curicó, Chile, ealvarez@utalca.cl, Ivana Ljubic, Markus Sinnl, Marcos Goycoolea

In this talk we present general ILP models, which address two spatial requirements of nature reserves: connectivity to avoid spatial fragmentation; and the presence of buffer zones surrounding so-called core areas. Extensive experimental results on synthetic and realistic instances show the effectiveness of a specially tailored algorithm in providing optimal solutions in short computing times. Other desired spatial properties, such as compactness, are also discussed.
The ability to better predict how different individuals will respond to vaccination and to understand what best protects individuals from infection greatly facilitates developing next-generation vaccines. We present a general-purpose, machine-learning framework for discovering gene signatures that can predict vaccine immunity and efficacy. Our models offer unique features not found in other models simultaneously. We will describe the implemented results for yellow fever and influenza vaccines, and highlight their implications for public health and precision medicine.

The Decision Analysis Society Awards Session

1 - Machine Learning Framework for Predicting Vaccine Immunogenicity
Eva Lee, Georgia Institute of Technology, Atlanta, GA, United States of America, eva.lee@gatech.edu

The ability to better predict how different individuals will respond to vaccination and to understand what best protects individuals from infection greatly facilitates developing next-generation vaccines. We present a general-purpose, machine-learning framework for discovering gene signatures that can predict vaccine immunity and efficacy. Our models offer unique features not found in other models simultaneously. We will describe the implemented results for yellow fever and influenza vaccines, and highlight their implications for public health and precision medicine.

2 - Container Terminals
Mohammad Torkjazi, PhD Student, University of South Carolina, 620 Heidt St Apt 1, Columbia SC 29205, United States of America, torkjazi@email.sc.edu

Overcapacity and pressure on margins are keeping the container shipping industry’s environment challenging. This has led carriers to enter vessel sharing agreements and alliances, resulting in a quasi-consolidation. To address the investment problem in an industry that has moved to a more cooperative setting, we develop a cooperative game theory simulation model. We assess impact of competitive intensity and investment heuristics on industry capacity, alliance stability, and carrier financials.

3 - How Drayage Schedule Affect the Gate Appointment System at Container Terminals
Mohammad Torkjazi, PhD Student, University of South Carolina, 620 Heidt St Apt 1, Columbia SC 29205, United States of America, torkjazi@email.sc.edu, Nathan Huynh

The lack of good communication between drayage companies and container terminals is one of the contributing causes for long queues at the terminal gates. To improve the communication process, a comprehensive model of this process is required. This study proposes a mathematical formulation which reflects the process of communication from the view of both sides in detail. Also, a three-step algorithm is proposed to solve the model and tested on hypothetical problems of different sizes.

4 - Practice Award
Frank Koch, Consultant, 2510 Cleveland St, Eugene, OR, 97405, United States of America, Frank@kochdecisions.com

The Decision Analysis Practice Award is awarded to the best example of decision analysis practice as judged by the Decision Analysis Practice Award Committee. The purpose of the award is to publicize and encourage outstanding applications of decision analysis practice. We will present the finalists and this year’s winner.

5 - Ramsey Medal Award
Eric Bickel, Associate Professor & Director, OR/IE, U. of Texas at Austin, ETC 5.128C, Austin, TX, United States of America, ebickel@utexas.edu

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 2015 Ramsey Medal winner, followed by a presentation by the winner.
**MD66**
66-Room 113C, CC

### Aviation Applications Section: Keynote Presentation

**Sponsor:** Aviation Applications  
**Sponsored Session**

**Chair:** Senay Solak, University of Massachusetts Amherst, Isenberg School of Management, Amherst, MA, 01003, United States of America, solak@isenberg.umass.edu

**1 - FAA’s Modernized Terminal Area Forecast**  
Dipasis Bhadra, Economist, FAA, 800 Independence Avenue, SW, Washington, DC, 20591, United States of America, dipasis.bhadra@faa.gov

The Terminal Area Forecast tool is designed to view local, national and international flow of activities and capture effects of socioeconomic and technological factors on aviation. The tool is used to understand airports, passenger routing, and aircraft network impact of NEXTGEN development. It also provides projections for future air transport activity through time using future passengers by origin and destination (O&D) market routes and networks (i.e., segment flows), aircraft operations by markets and network routes; and integrates operations and plans. It is run through the National Airspace System (NAS) network. The forecasting tool is used to help understand the policies, procedures, and environmental regulations.

**MD67**
67-Room 201A, CC

### Integrated Vehicle Routing Problems II

**Sponsor:** TSL/Freight Transportation & Logistics  
**Sponsored Session**

**Chair:** Wei Hong Hu, Georgia Tech, Atlanta, GA, United States of America, weihongh@gatech.edu

**1 - Heuristics for an Integrated Inventory Routing and Freight Consolidation Problem of Perishable Goods**  
Wei Hong Hu, Georgia Tech, Atlanta, GA, United States of America, weihongh@gatech.edu, Alejandro Toriello, Maged Dessouky

We study a novel mixed integer programming model that integrates freight consolidation and inventory routing of perishable goods. We propose an iterative framework that combines a decomposition procedure involving three subproblems and an optimization-based local search scheme. Experiments based on empirical distributions of real data demonstrate the effectiveness of both solution approaches for small to medium size problem instances. We further extend the approach for larger problem instances.

**2 - Reoptimization Capabilities of Benders Decomposition for the Stochastic Production Routing Problem**  
Yossiri Adulyasak, HEC, Canada, yossiri.adulyasak@hec.ca, Jean-Francois Cordeau, Raf Jans

We present two approaches that exploit the reoptimization capabilities to speed up the Benders decomposition algorithms for the the production routing problem (PRP), which is a generalization of the inventory routing problem (IRP), under demand uncertainty. The first approach is applied to the two-stage stochastic PRP in the context of a sample average approximation (SAA) method. The second approach is embedded into a rollout algorithm for the multi-period stochastic PRP. Computational results are presented.

**3 - Resource-Constrained Dynamic Programming with “Hot-Starting” for the Elementary Shortest**  
Ahmad Jarrah, George Washington University, Washington, DC, United States of America, jarrah@gwu.edu, Luis Novoa, Xinhui Zhang, Jonathan Bard

We develop the complete theory for designing a dynamic program (DP) for solving elementary shortest path problems with idle time cost. This is integrated with bidirectional extensions, decremental state-space relaxation, 2-cycle elimination and sharpest-to-date restricted sets of unreachable nodes. We describe new hot-starting procedures to significantly improve the DP’s run time. The approach can be used in solution algorithms for the capacitated VRPTW problem with idle time cost.

**MD68**
68-Room 201B, CC

### Joint Session TSL/Public Sector: Resilience in Transportation Infrastructure Systems

**Sponsor:** Transportation, Science and Logistics  
**Sponsored Session**

**Chair:** Lili Du, Assistant Professor, Illinois Institute of Technology, 3201 S. Dearborn Street, Chicago, IL, United States of America, ldu3@iit.edu

**1 - A System-of-Systems Approach toward a Resilient, Dynamically Interdependent Transportation Network**  
Elise Miller-Hooks, Professor, University of Maryland, College Park, MD, elishmh@umd.edu, Neza Vodopivec

A transportation network’s vulnerability to damage depends on the vulnerabilities of other critical systems (i.e., energy, telecommunications, building infrastructure). In a disaster, interdependencies both within a system and between different systems are reshaped dynamically as people take adaptive actions to mitigate impact and repair networks. We explore the interactions between changes in network structures and the evolution of interdependencies between systems.

**2 - Infrastructure Investment Decisions in Multimodal Intercity Transportation Networks**  
Bo Zou, University of Illinois at Chicago, 2095 Engineering Research Facility, 842 W. Taylor Street (M/C 246), Chicago, IL, 60607-7023, United States of America, bzou@ucic.edu, Lili Du, Mohamadhossein Noruzi

Infrastructure investment in multimodal intercity transportation networks involves maintaining existing capacity and adding new capacity to infrastructure facilities. To achieve maximum returns, the infrastructure planner should understand the behavior of players in the network, especially their responses to investment. We develop a bi-level framework to model the decision process, where the upper level pursues social welfare maximization subject to lower-level supply-demand equilibrium.

**3 - Optimal Location and Operation of Railroad First-response Resources**  
Siyang Xie, PhD Student, University of Illinois at Urbana-Champaign, Urbana, IL, United States of America, sxie13@illinois.edu, Yanfeng Ouyang

Railroad incidents such as derailments often seriously impact a large region and block traffic in nearby highway networks, which in turn hinders efficiency of first response efforts. In this paper, we develop a reliable optimization model to characterize and guide positioning and utilization of railroad first-responder resources. Customized solution techniques are employed to effectively solve the model and to provide decision support.

**4 - Hazmat Network Design using Time-dependent Consecutive Road Closures Considering Intermediate Stops**  
Tolou Esfandeh, University at Buffalo, SUNY, Department of Industrial & Systems Eng., 339A Bell Hall, Buffalo, NY, 14260, United States of America, tolous@buffalo.edu, Changhyun Kwon, Rajan Batta

we analyze the regulator’s problem of identifying the sections of the network and their corresponding times that should be closed to hazmat transportation in a time varying network. We assume that the closure of a section is consecutive in time and the hazmat carriers are allowed to stop in the middle of their trip. We develop a column generation algorithm that accounts for routing and scheduling alternatives which not only reduce the risk but also accounts for drivers’ cost perspectives.
1 - Multi-task Learning for Joint Prediction of Failure Time and Failure Types of Train Wheels
Weixin Wang, University at Buffalo, 1357 Millersport Hwy Apt A, Buffalo, NY, 14221, United States of America, weixinw@buffalo.edu, Zhiguo Li, Qing He

The failures of train wheels account for half of all train derailments. Both failure time and failure types of wheels are critical for wheel maintenance. Failure time prediction is a regression task, whereas failure type is a classification task. In this work, we propose a multi-task learning approach to jointly predict these two tasks by using a common input space to achieve more desirable results.

2 - Diagnostic Method to Measure the Impact of Railway Traffic Heterogeneity from Field Operations Data
Meh-Cheng Shih, University of Illinois, U-C, 205 North Mathews Ave, Urbana, IL, 61801, United States of America, mshih2@illinois.edu, C. Tyler Dick

Growing demand for freight rail transportation of crude oil and domestic intermodal traffic has increased both the volume and disparity in types of trains operated on many mainlines. Differences in train characteristics and priority has become one of the major causes of congestion. Based on actual train operations data from a Class 1 railroad, this study develops two indices that help railroads measure the degree to which traffic heterogeneity impacts observed operating performance.

3 - Evaluating Track Maintenance Aggregation in Extended Work Windows on Freight Railroad Lines
Alexander Lovett, Graduate Research Assistant, University of Illinois at Urbana-Champaign, 205 N Mathews Ave, B118 Newmark Lab, Urbana, IL, 61801, United States of America, alovetti2@illinois.edu, Christopher Barkan, C. Tyler Dick

Combining track maintenance activities into extended work windows can improve maintenance efficiency. Efficiencies come from reduced set-up time and efforts common to multiple activities at the cost of being more disruptive to train operations. Aggregating activities requires adjusting maintenance cycles which may increase accident risk or maintenance frequency. A methodology for evaluating the costs of aggregating track maintenance into an extended work window is presented.

MD69
Arc Routing Problems and Applications
Chair: Mehmet Basdere, Northwestern University, 2145 Sheridan Road, Tech Institute C210, Evanston, IL, 60208, United States of America, mehmetbasdere2016@u.northwestern.edu

1 - The Windy Rural Postman Problem with a Time-dependent Zigzag Option
Rui Zhang, University of Maryland, College Park, MD, ruizhang@rsmith.umd.edu, Erwin Pesch, Jenny Nossack, Bruce Golden
We focus on the windy rural postman problem with an additional zigzag option. It combines two classes of arc routing problems known before: those with zigzag options and those with time dependencies. We present two MIP formulations and suggest exact solution approaches. Furthermore, we analyze the effects of zigzag and time window options on the objective value.

2 - Arc Routing Problems to Restore Connectivity of a Road Network after a Disaster
Vahid Akbari, Koc University, College of Engineering, Sariyer, Istanbul, 34450, Turkey, vakbari@hakokolaei@ku.tr, Sibel Salman
Routes should be generated to reconnect a disconnected road network in the shortest time by opening blocked roads. We study two versions: 1) minimize the time to reconnect the network, 2) maximize the total prize of components reconnected within a time limit. We develop MIP formulations and heuristic algorithms.

3 - Arc Routing, Vehicle Routing and Turn Penalties
Thibault Vidal, Professor, Pontifícia Universidade Católica do Rio de Janeiro, R. Marquês de São Vicente, 225 - Gávea, Rio de Janeiro, 22451-900, Brazil, vidalt@inf.puc-rio.br
We introduce a structural decomposition for arc routing problems, in which all decisions about driving lanes, turns, edge traversal and service orientations are addressed via dynamic programming. We show that a neighborhood based on moves on the sequences of services with optimal traversal decisions can be explored in (1) per move. The approach is integrated into two classical metaheuristic frameworks, leading to remarkable results for many arc routing variants, with possible turn penalties.

4 - The Lock Free Arc Touring Problem with an Application to Marathon Course Design
Mehmet Basdere, Northwestern University, 2145 Sheridan Road, Tech Institute C210, Evanston, IL, 60208, United States of America, mehmetbasdere2016@u.northwestern.edu, Karen Smilowitz, Sanjay Mehrotra
In this talk, we present a new type of arc routing problem in the marathon course design setting. The aim is to find a valid marathon course that minimizes the average distance to the medical facilities within the region of interest without preventing the public access to those facilities while visiting a predetermined subset of landmark streets. A novel solution approach which utilizes visit restrictions and new valid inequalities are introduced.

MD70
Railway Analytics
Chair: Qing He, Assistant Professor, SUNY Buffalo, 313 Bell Hall, Buffalo, NY, 14051, United States of America, qinghe@buffalo.edu

1 - Multi-task Learning for Joint Prediction of Failure Time and Failure Types of Train Wheels
Weixin Wang, University at Buffalo, 1357 Millersport Hwy Apt A, Buffalo, NY, 14221, United States of America, weixinw@buffalo.edu, Zhiguo Li, Qing He

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When the route-choice behavior of network users are uncertain, the notion of bounded rationality has been used to allow users to choose sub-optimal routes whose length is within a certain bound. In this paper, we provide another framework to explain such bounded rationality assuming that network users make perfectly rational route decisions, but with perception error in link costs. By showing that some cases of the perception error model are equivalent to the bounded rationality models, we establish the notion of generalized bounded rationality. We demonstrate how the notion of generalized bounded rationality can be used for robust multi-commodity network design problems and provide computable optimization frameworks based on both links and paths. We illustrate our approaches in the context of hazardous materials transportation.

## MD72

**Panel Discussion on Big Data Science – Opportunities and Challenges**
Sponsor: Quality, Statistics and Reliability
Sponsored Session

Chair: Hui Yang, Associate Professor, Pennsylvania State University, 310 Leonhard Building, Industrial and Manufacturing Eng., State College, PA, 16801, United States of America, huy25@psu.edu

### 1 - Panel Discussion on Big Data Science - Opportunities and Challenges
Moderator: Hui Yang, Associate Professor, Pennsylvania State University, 310 Leonhard Building, Industrial and Manufacturing Eng., State College, PA, 16801, United States of America, huy25@psu.edu; Panelists: Soundar Kumara, Liying Cui, Yan Xu, Andrew Kusiak

This panel brings experts from academia and industry to discuss the opportunities and challenges in big data science. The panelists are: Dr. Andrew Kusiak, Professor and Chair, The University of Iowa; Dr. Soundar Kumara, Professor, The Pennsylvania State University; Dr. Yan Xu, Senior Manager, Big data optimization group, SAS Institute; Dr. Liying Cui, network improvement manager, Starbucks;...

## MD73

**Data Analytics in Manufacturing and Service Industries**
Sponsor: Quality, Statistics and Reliability
Sponsored Session

Chair: Nan Chen, National University of Singapore, 117576, Singapore, iseccn@nus.edu.sg
Co-Chair: Kaibo Liu, Associate Professor, Tsinghua University, Department of Industrial Engineering, Beijing, China, kbwang@tsinghua.edu.cn

### 1 - Modeling Air Quality Data based on Physical Dispersion Processes
Xiaol Liu, IIBM, Singapore, liuxiao@sg.ibm.com

In this paper, we investigate a statistical modeling approach based on a commonly used physical dispersion model, called the scalar transport equation. The relationship between the proposed spatial-temporal model and the physical model is well established. The model describes the pollutant concentration by a non-stationary random field with a space-time non-separable and anisotropic covariance structure.

### 2 - Remaining Useful Life Prediction using Mixed Effects Model with Mixture Prior Distributions
Raqiq Al Kontar, UW Madison, Eagle Heights 301J, Madison, WI, United States of America, alkontar@wisc.edu, Junbo Sun, Shiyu Zhou

In modern engineering systems, pre-mature failure has become quite rare. Thus, degradation signals used for prognosis are often imbalanced. Such imbalanced data may hinder accurate remaining useful life prediction especially in terms of detecting pre-mature failures as early as possible. We propose a degradation signal based RUL prediction method to address the imbalance in data. This method captures the characteristics of different groups and provides real time updating of an in-service unit
INFORMS Philadelphia – 2015

4 - Joint Burn-in and Imperfect Condition-based Maintenance for N-subpopulations
Yisha Xiang, Assistant Professor, Lamar University, 2626 Cherry Engineering Building, Beaumont, TX, 77710, United States of America, yxiang@lamar.edu, David Colt
For some engineering design and manufacturing applications, particularly for evolving and new technologies, some populations of manufactured parts or devices are heterogeneous and consist of a small number of different subpopulations. In this study, we propose a joint burn-in and imperfect condition-based maintenance model with consideration of random effects within subpopulations. Numerical examples are provided to illustrate the proposed procedure.

MD75
75-Room 204B, CC
Deep Dive on Open Innovation – Papers and Discussants
Cluster: New Product Development
Invited Session
Chair: Jeremy Hutchison-Krupat, Professor, University of Virginia, Charlottesville, VA 22901, United States of America, KrupatJ@darden.virginia.edu
1 - Optimal Shapes of Innovation Pipelines
Joel Wooten, University of South Carolina, Columbia, SC, United States of America, joel.wooten@moores.sc.edu, Srinam Venkataraman
New product introductions often occur via R&D pipelines. We explore the optimal number of innovation options to pursue in this complex managerial process. A stylized game simulation of the Pharma industry provides additional evidence for our problem.

2 - Discussant
Sanjiv Erat, UCSD, Gilman Drive, La Jolla, CA, United States of America, serat@ucsd.edu
This talk will offer a discussion/critique of the paper titled “Optimal Shapes Of Innovation Pipelines.

3 - How Much Better is Open Innovation?
Sebastian Fixson, Babson College, Tomasso Hall 226, Babson Park, MA, 02457, United States of America, sfixson@babson.edu, Tucker Marion
Over the past 15 years research has emerged that describes many advantages of open innovation, such as unearthing ideas that better match customer needs and/or problem specifications. In this paper, we study in detail the new product development process of a single organization that makes extensive use of external actors throughout its process, and explore the corresponding performance implications.

4 - Discussant
Yi Xu, Associate Professor, Smith School of Business, University of Maryland, College Park, MD, 20742, United States of America, yxu@rhsmith.umd.edu
This talk will offer a discussion/critique of the paper titled “How Much Better Is Open Innovation?”

MD76
76-Room 204C, CC
Simulation in Healthcare
Sponsor: Simulation
Sponsored Session
Chair: Tahir Ekin, Assistant Professor, Texas State University, 01 University Dr. McCoy Hall 411, San Marcos, TX, 78666, United States of America, larry.fulton@tsu.edu, Nathaniel Bastian
MedModel was used to provide decision support for a hospital’s outpatient clinic organization. Variables of interest included cost, capitation rate, utilization, and throughput. Outpatient areas evaluated included primary care clinics, OB/GYN, pediatrics, internal medicine, same-day surgery, orthopedics, psychology / psychiatry, social work service, and physical therapy / occupational therapy. The modeling demonstrates the usefulness of healthcare simulation for organizational change.

2 - The Use of Lindley’s Entropy in Dynamic Sampling Decisions
Rasim Muzaffer Musal, Associate Professor, Texas State University, 601 University Dr., McCoy Hall 411, San Marcos, TX, 78666, United States of America, rm84@txstate.edu, Tahir Ekin
Neyman Allocation (NA) is used to stratify Medicare payments to create relatively homogeneous strata. These strata are assumed to provide a relatively more homogeneous over-payment sub-populations. We suggest an extension to NA by the use of Lindley’s expected information gain measure to make efficient sampling decisions. In doing so a novel application is presented under simulated scenarios. A comparison between alternative methods is illustrated.

3 - Using Markov Chain Monte Carlo for Input Models of Surgery Duration in a Multi-specialty Department
Louis Luangkesorn, Research Assistant Professor, University of Pittsburgh, 1048 Benedum Hall, Department of Industrial Engineering, Pittsburgh, PA, 15261, United States of America, l0l11@pitt.edu, Zeynep Filiz Eren Dogu
The variety of procedures in a surgery suite means that even with several years of data many surgical cases will have little or no historical data for use in predicting case duration. Parameterizing duration is needed for other procedures such as stochastic optimization. We combine expert judgement, expert classification of procedures by complexity category and historical data in a Markov Chain Monte Carlo (MCMC) model to parameterize cases and test the result against other methods.

MD77
77-Room 300, CC
Supply Chain Management VIII
Contributed Session
Chair: Marcus Bellamy, Assistant Professor, Boston University Questrom School of Business, 595 Commonwealth Avenue, Boston, MA, 02215, United States of America, bellamym@bu.edu
1 - R and D Modes of Manufacturers’ Cost Reduction:
How to Invest in Supply Chains
Jing Hu, PhD Student, Fudan University, 670 Guoshun Road, Yangpu District, Shanghai, China, jinghu13@fudan.edu.cn, Qiyung Hu
Inspired by the Chinese mobile phone industry, we find four R&D modes between vertical firms: two collaborative modes (R&D cartel and R&D joint venture) and two non-collaborative modes (manufacturer-R&D and retailer-R&D). A three-stage game model is considered to explain why these modes coexist. We find that firms prefer the R&D cartel if and only if they have comparable channel powers. When collaboration is impossible, only the firm with sufficiently smaller cost factor prefers R&D by itself.

2 - The Role of Customer Flexibility in Achieving Supply Chain Agility
Vahid Ghomi, PhD Student, University of Mississippi, Marketing Department, School of Business Administration, Oxford, MS, 38655, United States of America, vghomi@bus.olemiss.edu, Bahram Alidadi
A firm’s supply chain agility (SCA) is a critical factor affecting its overall competitiveness. To create SCA, most research concentrate on exploring manufacturing flexibility, supply side flexibility, and logistics capabilities. However, there are variety of settings where demand side flexibility (DSF) can be achieved. The purpose of this research is to present, (1) a comprehensive literature review of DSF, (2) research directions as how SCA can be achieved by exploring DSF.
The operating model of battery swapping stations supports the adequate charging infrastructure. Battery swapping stations are positioned to reduce inventory cost. The seller on the other hand, offers a buyback rate to induce higher orders from the buyer. The model suggests that in a decentralized SC under purchasing postponement, a buyback rate can be arrived at such that the SC profits are maximized and SC coordination is established.

Impact of Supply Relationship Dynamics on Firm Performance: A Multilevel Empirical Analysis

Marcus Bellamy, Assistant Professor, Boston University Questrom School of Business, 595 Commonwealth Avenue, Boston, MA, 02215, United States of America, bellamym@bu.edu, Soumen Ghosh, Manpreet Hora

We develop an empirical model to examine supply relationship dynamics as drivers of firm performance. We use supply chain relationship and financial data from the Bloomberg database. Our unique dataset allows us to investigate manufacturing firms both as customers and suppliers. We use a multilevel mixed-effects model combining firm and dyad level effects.

Logistics Performance Improvement from Information Integration

Sung-tae Kim, Assistant Professor, SollBridge International School of Business, 128 Uam-ro, Dong-gu, Daejeon, 300-814, Korea, Republic of, stkim@sollbridge.ac.kr, Gi-eyun Seo

This study examines the moderating effects of strategic and operational information integration on the relationships between logistics performance and organizational performance. This study measures logistics performance, in terms of effectiveness, efficiency, and differentiation. Organizational performances are classified as operational, financial, and market performances. The data from 321 manufacturing firms are evaluated using moderated hierarchical regression analysis.

Decentralized N-V Model with Stochastic Demand

Sourabh Bhattacharya, Professor, Institute of Management Technology, Hyderabad, India, 38, Cherlaguda Village, Shamshabad, Hyderabad, TS, 500048, India, sbhattacharya@imthyderabad.edu.in

We determine the buyback price for a seller in a purchasing postponement environment. Under stochastic demand a buyer postpones its purchasing decision to reduce inventory cost. The seller on the other hand, offers a buyback rate to induce higher orders from the buyer. Our model suggests that in a decentralized SC under purchasing postponement, a buyback rate can be arrived at such that the SC profits are maximized and SC coordination is established.

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Decentralized N-V Model with Stochastic Demand

Sourabh Bhattacharya, Professor, Institute of Management Technology, Hyderabad, India, 38, Cherlaguda Village, Shamshabad, Hyderabad, TS, 500048, India, sbhattacharya@imthyderabad.edu.in

We determine the buyback price for a seller in a purchasing postponement environment. Under stochastic demand a buyer postpones its purchasing decision to reduce inventory cost. The seller on the other hand, offers a buyback rate to induce higher orders from the buyer. Our model suggests that in a decentralized SC under purchasing postponement, a buyback rate can be arrived at such that the SC profits are maximized and SC coordination is established.

Impact of Supply Relationship Dynamics on Firm Performance: A Multilevel Empirical Analysis

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We develop an empirical model to examine supply relationship dynamics as drivers of firm performance. We use supply chain relationship and financial data from the Bloomberg database. Our unique dataset allows us to investigate manufacturing firms both as customers and suppliers. We use a multilevel mixed-effects model combining firm and dyad level effects.

Logistics Performance Improvement from Information Integration

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This study examines the moderating effects of strategic and operational information integration on the relationships between logistics performance and organizational performance. This study measures logistics performance, in terms of effectiveness, efficiency, and differentiation. Organizational performances are classified as operational, financial, and market performances. The data from 321 manufacturing firms are evaluated using moderated hierarchical regression analysis.

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