

University of Bergamo/Georgia Institute of Technology

Fall 2017 Workshop

Groseclose Advisory Boardroom, Room 402

28 August – 1 September 2017

Workshop Program

Monday 28 August 2017, Supply Chain Management

Workshop Chair: Anton Kleywegt

1. Time: 9:00 – 10:25
Speaker: Anton Kleywegt
Title: Revenue Management
Abstract: This tutorial gives an overview of revenue management models and methods. Some of the classical models and methods will be briefly discussed. Then we will cover some of the more modern models and methods, such as assortment optimization and pricing with various discrete choice models.
2. Time: 10:35 – 12:00
Speaker: He Wang
Title: Online Learning and Bandit Problems in Supply Chain and Revenue Management
Abstract:
3. Time: 12:00 – 13:30
Lunch
4. Time: 13:30 – 14:00
Speaker: Satya Malladi
Title: Dynamic Mobile Capacity Logistics and Inventory Control
Abstract: We investigate the problem of dynamically planning inventory and capacity logistics for a mobile modular production system. Faced with state and action space explosion, we identify upper and lower bounds on the optimal cost function and propose rollout based heuristics that overcome the computational hurdle and determine near-optimal decisions. Through a systematic computational study, we quantify the value addition of mobile modular production systems over traditional fixed production systems.

5. Time: 14:00 – 15:00

Speaker: Roberto Pinto

Title: Title: Rationing problems in the supply chain

Abstract: In many business scenarios where companies face uncertain demand and building extra capacity does not represent a viable option, the available production capacity or amount of stock might not be sufficient to fulfill every possible demand realization. Therefore, it is necessary to devise proper rules to distribute the availability and maximize the expected results. In this talk, the inventory rationing problem in a vertically integrated distribution system is discussed, providing solution procedures under different objectives.

6. Time: 15:15 – 16:00

Speaker: Hongzhang Shao

Title: Demand Estimation with Unobserved Stockouts

Abstract: Stockouts of some products are quite common for typical snack vending machines. These stockout events are not observed — it is only observed that a product had stocked out at some stage when the products in the vending machine are replenished. This causes a challenge when estimating choice models for vending machines, because the choice sets available to different customers were different, and we do not observe what fraction of customers faced each possible choice set. We developed a demand estimation model that works on such incomplete sales data, and took both unobserved stock-outs and unobserved customer arrivals into consideration. We also introduced a transformation of the likelihood function that simplifies the computations and improve the algorithms performance. Numerical test results are presented.

7. Time: 16:00 – 16:30

Speaker: Fabien Caspani and Jye-Chyi Lu

Title: Dynamic Category Planning With Forecast Updates and Space Constraint – Applications Include Pop-Up Store Assortment Decision

Abstract: In a pop-up store items sharing similar characteristics are grouped into categories. Retailers procurement decision for a given category is made once during the planning horizon for maximizing the expected profit from sales. The sequence of procurement decisions and space allocations for each category are not known in advance, and are dynamically made to benefit from forecast updates over the course of the planning horizon. The number of possible sequences exponentially increases with the number of categories. This study shares some similarities with the multi-item newsvendor problem where a capacity constraint is imposed (e.g., Turken et al., 2012), but extends their static decision process to a dynamic situation with updates of advance information about category demands. The study also extends separate optimizations about sequencing and allocation decisions (e.g., Wang et al, 2012; Papier, 2016) to a dynamic joint decision process. We propose a tractable solution method that first determines the sequence of procurement decisions made in the subsequent periods by using an approximation of the allocation problem. The optimal allocation is then found by using this sequence. Strength and weakness of a few developed algorithms are compared with a considerable number of simulation experiments designed

for mimicking various real-life market conditions. Limited analytical studies provide partial-ordering of procurements for solving sequence decision problems.

8. Time: 16:30 – 17:00

Speaker: Yi Zhang

Title: A Comparison of Resource Exchange and Free-Sell Seller Alliances

Abstract: Alliances between sellers are important in many industries, such as airline and ocean shipping. Two popular models of seller alliances are resource exchange or hard block alliances and free-sell or soft block alliances. It is of interest to understand how these alliance structures compare in terms of performance and stability (instability of alliances seems to be a perpetual problem in many industries). Intuition indicates that free-sell alliances provide more flexibility to adapt to unpredictable variations in demand. What is less intuitive is how these alliance structures compare in terms of predictability and stability of equilibria. We study models of simple alliances to compare them in terms of performance, predictability and stability of equilibria.

Tuesday 29 August 2017, Health and Humanitarian Systems

Workshop Chair: Pinar Keskinocak

1. Time: 9:00 – 10:15

Speaker: Joel Sokol

Title: Transplant Analytics

Abstract: The waiting list for organ transplants in the United States continues to get longer and longer, with severe consequences: on average, a person is added to the waiting list every 10 minutes, and an average of about 22 people die per day while waiting for a transplant. In this tutorial, we describe how analytics — statistics, optimization, machine learning, etc. — can be used to address a variety of transplant-system questions, all with the goal of increasing both the number of life-saving transplants and the quality of their medical outcomes.

2. Time: 10:15 – 10:45

Break

3. Time: 10:45 – 12:00

Speaker: Dave Goldsman

Title: Simulating Healthcare Systems

Abstract: Simulation has emerged as a valuable modeling and analysis tool in the healthcare space. This talk describes a variety of healthcare research problems in which simulation has found great applicability. We provide examples ranging from traditional hospital operations to pandemic disease propagation to disease surveillance.

4. Time: 12:00 – 13:15

Lunch

5. Time: 13:15 – 14:00

Speaker: Turgay Ayer

Title: Prioritizing Hepatitis C Treatment in U.S. Prisons

Abstract: About one out of six inmates in the United States (U.S.) is infected with hepatitis C virus (HCV). HCV prevalence in prison systems is ten times higher than the general population, and hence prison systems offer a unique opportunity to control the HCV epidemic. New HCV treatment drugs are very effective, but providing treatment to all inmates is prohibitively expensive, which precludes universal HCV treatment in prison systems. As such, current practice recommends prioritizing treatment based on clinical and incarceration-related factors, including disease staging, remaining sentence length, and injection drug use (IDU) status. However, there is controversy about how these factors should be incorporated because of the complicated tradeoffs. In this study, we propose a restless bandit modeling framework to support hepatitis C treatment prioritization decisions in U.S. prisons. We first prove indexability for our problem and derive several structural properties of the well-known Whittle's index, based on which, we derive a closed-form expression of the Whittle's index for patients with advanced liver disease. From the interpretation of this closed-form expression, we anticipate

that the performance of the Whittle's index would degrade as the treatment capacity increases; and to address this limitation, we propose a capacity-adjusted closed-form index policy. We parameterize and validate our model using real-world data from Georgia state prison system and published studies. We test the performance of our proposed policy using a detailed, clinically-realistic simulation model and show that our proposed policy can significantly improve the overall effectiveness of the hepatitis C treatment programs in prisons compared with the current practice and other benchmark policies, including the commonly used Whittle's index policy. Our results also shed light on several controversial health policy issues in hepatitis C treatment prioritization in the prison setting and have important policy implications including: 1) prioritization based on only liver health status, a commonly practiced policy, is suboptimal compared with many other policies we consider. Further, considering remaining sentence length of inmates and IDU status in addition to liver health status in prioritization decisions can lead to a significant performance improvement; 2) the decision of whether to prioritize patients with shorter or longer remaining sentence lengths depends on the treatment capacities inside and outside the prison system, and prioritizing patients with shorter remaining sentence lengths may be preferable in some cases, especially if the treatment capacity inside the prison system is not very tight and linkage-to-care level outside prison system is low; and 3) among patients with advanced liver disease, IDUs should not be prioritized unless their reinfection is very well controlled.

6. Time: 14:00 – 14:45

Speaker: Eva Lee

Title: Saving Lives: Building Capacities, Capabilities, and Real-Time Operations

Abstract: Its a terrifying doomsday scenario: A novel infectious disease is sweeping through the worlds population, and health officials have only a day or two to stop its deadly spread. While this may sound like the plot of a movie thriller, health officials argue that an event of this kind could become a reality sometime in the near future. According to epidemiology experts, new drug-resistant infectious diseases are appearing more frequently and are spreading faster than ever before. With the ability to strike anywhere in the world at any given time, these pathogens are not only a major threat to public health, but they also place a substantial burden on the global economy. In order to best address the next outbreak, the U.S. Centers for Disease Control and Prevention (CDC) partnered with Dr. Eva Lee, a math/OR professor at Georgia Institute of Technology, to produce a modeling tool to help health personnel with the challenge of population protection in an emergency. The software, known as RealOpt[®], has decision support capabilities for modeling and optimizing the public health infrastructure for hazardous emergency response. It is designed for use in biological and radiological preparedness, for disease outbreak planning and response, and for natural disaster planning. RealOpt helps officials plan for dispensing facility locations, to ensure optimal facility staffing and allocation of resources, including routing of the population and dispensing modalities. The program sifts through massive amounts of data to better optimize decision-making during the event of an emergency scenario especially in the case of a deadly outbreak. In this talk, Lee will share her experience

in assisting with the U.S. response to the earthquake in Haiti, in Japan for the Tohoku earthquake and tsunami and the Fukushima radiological emergency response, the 2014 Ebola outbreak in West Africa, and the recent Zika virus in the Americans and within United States. She will discuss the system capabilities and the technical challenges.

7. Time: 14:45 – 15:00

Break

8. Time: 15:00 – 15:30

Speaker: Ethan Mark

Title: Using Machine Learning and Simulation to Help Patients Decide Whether to Accept a High Risk Kidney or Remain on the Waiting List.

Abstract: In 2012, over 10% of organ donors in the U.S were labelled “Increased Risk” (IR). With an organ shortage that has been increasing every year, many patients are faced with a decision: should patients offered an IR organ accept it, or remain on the waiting list for non IR organ? Using machine learning and simulation, we built an interactive tool to help patients make this decision. We will discuss our model building process and show some interesting results from our simulation. We find that in a large number of cases, patients would have a higher benefit for accepting the “increased risk” organ. In this talk, we will focus on the Kidney, and organs coming from donors with either HBV, HCV or HIV.

9. Time: 15:30 – 16:00

Speaker: Seyma Guven-Kocak

Title: Dynamically Consistent Home Health Care Routing and Scheduling

Abstract: This work addresses a real-world home health care routing and scheduling problem (HHCRSP) faced by a home care agency in the United States. In home health care scheduling, there is a desire to retain consistency with respect to the HHA servicing each patient, which is referred to as continuity of care. In order to handle this consistency requirement, we propose a dynamic approach and introduce the dynamically consistent home health care routing and scheduling problem (D-Con-HHCRSP). We present two different constructive methods to solve HHCRSP on a daily basis: an integer programming-based method with approximations and a variant of a petal heuristic. We present adjustments on these methods to address D-Con-HHCRSP, where the goal is to be able to quantify and control the deviation from the existing schedule in place, so that some of the existing assignments may be retained in the new schedule that is produced. We discuss the performance and computational efficiency of these methods.

10. Time: 16:00 – 16:30

Speaker: Zihao Li

Title: Value of Inventory Information

Abstract: We evaluate the value of dynamic availability of vaccine inventory information during an influenza pandemic, with the goal of efficiently effectively allocating limited vaccine supplies to reduce the number of infections and to improve public health outcomes. We adapt an agent-based simulation model to predict the spread of

the disease both geographically and temporally. We study a vaccine inventory allocation strategy considering population and inventory information when uptake rates vary geographically, and compare it to the commonly used pro-rata allocation strategy. The simulation model is run using detailed population and work-related commuting data from the state of Georgia, and is flexible to be run with data from other locations. The proposed vaccine inventory allocation strategy, when compared to the pro-rata allocation strategy, reduces the infection attack rate from 23.4% to 22.4%, decreases the amount of leftover inventory from 827 to 152 thousand, and maintains or increases the percentage of vaccinated population. In addition, the proposed allocation strategy maintains fairness, i.e., the percentage of vaccinated population remain the same or increases in all the locations, compared to the pro-rata strategy. Our results indicate the need for greater vaccine inventory visibility in public health supply chains, especially when the supply is limited and uptake rates vary geographically. Such visibility has a potential to decrease the number of infections, help identify locations with low uptake rates and to motivate public awareness efforts.

Wednesday 30 August 2017, Logistics, Transportation and Warehousing

Workshop Chair: Alan Erera

1. Time: 9:00 – 10:30

Speaker: Alan Erera

Title: Tutorial: "Challenges and Opportunities in Last-mile Logistics"

Abstract: The exponential growth of eCommerce has made it even more critical for organizations to manage profitability alongside an increasing demand from individual consumers to receive product within days using non-traditional delivery methods. In this session, we will discuss modern last mile logistics (LML) and the changing landscape and complexities that drive research into different approaches and methodologies. We will cover some of the basics of LML organization and optimization as well as recent advancements and approaches to same-day and urban delivery.

2. Time: 11:00 – 12:00

Speaker: Benoit Montreuil

Title: Tutorial: "The Physical Internet Concept"

Abstract: We provide a tutorial on the Physical Internet concept.

3. Time: 12:00 – 13:00

Lunch

4. Time: 13:00 – 13:30

Speaker: Damian Reyes

Title: Optimization algorithms for meal delivery operations

Abstract: The rise and consolidation of on-demand meal-ordering platforms (e.g. GrubHub, Yelp-Eat24, Uber Eats, and Amazon Restaurants) has fueled the emergence of large-scale meal delivery networks. Arguably the ultimate last-mile delivery challenge, these systems face complex capacity planning problems and increasingly large dynamic pickup and delivery problems, with high dynamism and urgency levels in delivery requests. In this talk, we introduce optimization algorithms tailored to solve the driver assignment (near real-time vehicle routing) and capacity management (offline shift scheduling) problems in meal delivery. Computational results illustrate the practical value of our approach.

5. Time: 13:35 – 14:05

Speaker: Felipe Lagos

Title: The Continuous Time Inventory Routing Problem

Abstract: Recently, Boland et al (2017) introduced a novel methodology for solving time-dependent problems, the dynamic discretization discovery (DDD) algorithm. In time-dependent problems the goal is to find optimal (start) times for activities. These problems have been shown to be difficult to solve optimally using standard methods. We explore whether the DDD algorithm can be used to solve instances of the Continuous Time Inventory Routing Problem (CIRP). In the CIRP, a company supplies

a homogeneous product to a geographically distributed set of customers from a single depot. Customers have a storage capacity and a constant product consumption rate. A fleet of homogeneous vehicles is available to serve customers. The goal is to find a minimum cost delivery plan such that no customer runs out of product.

6. Time: 14:10 – 14:40

Speaker: Alejandro Toriello

Title: Order Acceptance Mechanisms for Same-day Delivery

Abstract: We study same-day delivery by formulating the Dynamic Dispatch Waves Problem with Immediate Acceptance that models integrated request management and order distribution decision-making where delivery requests arise dynamically throughout the day. When a request arises, a decision is made immediately to accept (offer service) or reject (with a penalty). All accepted requests are included in dynamically-updated dispatch plans that serve each request by the end of the day. We provide computational experiments that estimate a cost increase of 4.4% when imposing immediate order acceptance.

Thursday 31 August 2017, Environment and Sustainability

Workshop Chair: Valerie Thomas

1. Time: 9:00 – 10:00
Speaker: Valerie Thomas
Title: Tutorial on Life Cycle Analysis and Greenhouse Gas Emissions Accounting
2. Time: 10:00 – 11:00
Speaker: Matthew Realff
Title: Tutorial on Environment and Sustainability
3. Time: 11:00 – 12:00
Speaker: Marilyn Brown (invited)
Title: Tutorial on the National Energy Modeling System
4. Time: 12:00 – 13:30
Lunch
5. Time: 13:30 – 14:00
Speaker: Yassine Ridouane, PhD student, ISYE, Georgia Tech
Title: Electricity System Development in Sub-Saharan Africa
6. Time: 14:00 – 14:30
Speaker: Boukouvala, Fani, Assistant Professor, Chemical and Biomolecular Engineering, Georgia Tech (invited)
Title: Carbon Capture and Storage System Planning
7. Time: 14:45 – 15:15
Speaker: Ibrahim Al Gunaibet, PhD student, ISYE, Georgia Tech
Title: Developing policy models as mixed-complementarity problems
8. Time: 15:15 – 15:45
Speaker: Johnson Kakeu, Assistant Professor, Morehouse College
Title: Triple Bottom Line Business and Profitability
9. Time: 16:00 – 16:30
Speaker: Bistra Dilkina, Assistant Professor, Georgia Tech School of Computational Science and Engineering
Title: Optimization for Wildlife Conservation
10. Time: 16:30 – 17:00
Speaker: Basak Kalkanci, Assistant Professor, Georgia Tech School of Business
Title: Are Transparency Commitments Effective at Promoting Supply Chain Social and Environmental Responsibility?

Friday 1 September 2017, Energy and Electricity Markets

Workshop Chair: Andy Sun

1. Time: 9:00 – 10:25
Speaker:
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2. Time: 10:35 – 12:00
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3. Time: 12:00 – 13:30
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