

Tauber Institute Symposium on *Frontiers in Operations*

May 15, 2025
Ross School
(Blau Building, Room B0560)

8:00-8:45 **Breakfast**

8:45-9:00 **Welcome remarks**

9:00-10:30 **Session 1: Queues, Markets, and Networks**

Electric Vehicle Fleet Sizing and Charging Infrastructure Planning
Sushil Varma, Department of Industrial and Operations Engineering

Greedy matching of impatient agents: The role of inventory
Angela Kohlenberg, Ross School of Business

Asymptotic Methods for Large-Scale Stochastic Systems
Lei Ying, Department of Electrical and Computer Engineering

10:30-11:00 **Break**

11:00-12:30 **Session 2: Data, Learning, and Decisions**

Design-Based Confidence Sequences: Stopping Experiments Earlier with Netflix
David Ham, Ross School of Business

Sequential Change Detection with Simulators
Shubanshu Shekhar, Department of Electrical and Computer Engineering

Managing Product Availability in Rental Subscriptions
Lennart Baardman, Ross School of Business

12:30-1:30 **Lunch**

1:30-3:00 **Session 3: Automation, Manufacturing, and Air Transportation**

From Dyadic to Multi-Agent Teams: Combining Empirical and Computational Approaches to Model Trust in Human-Autonomy Interaction
X. Jessie Yang, Department of Industrial and Operations Engineering

The Effect of U.S.-China Decoupling on Investment in High-Tech Manufacturing
Ran Zhuo, Ross School of Business

Air Transportation Operations Research and Management
Max Li, Department of Aerospace Engineering

3:00-3:15 **Break**

3:15-4:15 **Panel Discussion:**

Opportunities and Challenges for Research Collaboration

Ravi Anupindi, Ross School of Business

Saif Benjaafar, Department of Industrial and Operations Engineering

Brian Denton, Department of Industrial and Operations Engineering

Izak Duenyas, Ross School of Business

Joline Uichanco, Ross School of Business

4:15-5:00 **Concluding remarks & reception**

Abstracts and Bios

Electric Vehicle Fleet Sizing and Charging Infrastructure Planning

Speaker: Sushil Varma, Department of Industrial and Operations Engineering, <https://sites.google.com/view/sushil-varma/home>

Abstract: We analyze an optimal electric vehicle (EV) fleet and charging infrastructure capacity planning problem in a spatial setting. As customer requests arrive at rate λ , the system operator must determine the minimum number of vehicles and chargers for a given service level along with a matching and charging policy that maximizes the service level. We provide a sharp characterization of the fleet size and the charging infrastructure requirements as the demand grows. We show that an EV system has a fundamentally different scaling due to non-negligible charging times. In addition, we propose the Power-of-d dispatching policy, which achieves near-optimal performance by selecting the d closest vehicles to a trip request and choosing the one with the highest battery level. We conduct simulations on Chicago transportation data verifying our operational insights.

Bio: Sushil Varma is an incoming tenure-track assistant professor at the Industrial and Operations Engineering Department of the University of Michigan, Ann Arbor. He is currently pursuing a postdoc at INRIA Paris. His research interests include queueing theory and revenue management with applications in online marketplaces and electric vehicles. Sushil's thesis received the GT Sigma Xi Best Thesis Award and the SIGMETRICS Dissertation Award 2025. Sushil was also a finalist in the INFORMS Transportation Science and Logistics (TSL) Best Student Paper Award 2024.

Greedy matching of impatient agents: The role of inventory

Angela Kohlenberg, Ross School of Business, University of Michigan, <https://angelakohlenberg.github.io/>

Abstract: In this talk, I discuss dynamic matching with different types of demand and supply that arrive over time and abandon if not matched before their patience expires. A match consists of one supply unit and one compatible demand unit and yields a demand-dependent reward. At each moment, a controller decides whether to match and, if so, which types to match. There is a fundamental trade-off: greedy (immediate) matching ignores the benefit of holding inventory (waiting supply) for better future matches, while delayed matching risks abandonment of supply or demand. I find that a family of simple greedy policies, Restricted Greedy (RG), which immediately match each supply type with a fixed subset of its compatible demand, perform well in many cases. To explain this, I identify sufficient conditions under which RG is near-optimal, and prove that all RG policies can have arbitrarily bad performance when these conditions are not met. These conditions reveal key determinants of optimal match timing. Two questions determine RG's region of optimality: Can, and should, inventory be held? Closed-form expressions of parameters provide the answers. RG is suboptimal only when occasional matching delays result in exactly enough inventory so that abandonment of both supply and demand is costless (incurs no reward loss). This requires precise alignment of parameters, which may arise in settings where arrival rates can be adjusted. In all other cases, RG effectively balances the tension between immediate and delayed matching while retaining the simplicity of greedy matching.

Bio: Angela Kohlenberg is joining the Ross School of Business as an Assistant Professor of Technology and Operations in July 2025. She is currently a PhD candidate in Operations Management at the Kellogg School of Management, Northwestern University, advised by Professor Itai Gurvich. Her research examines how impatience impacts the performance and optimal control of dynamic matching markets, such as organ exchange programs, ride-hailing platforms, and perishable inventory systems like blood and food banks.

She holds a bachelor's degree in Operations Management from the University of Alberta (Edmonton, Canada) and an MBA from the Schulich School of Business, York University (Toronto, Canada).

Asymptotic Methods for Large-Scale Stochastic Systems

Lei Ying, Department of Electrical and Computer Engineering, <https://leiying.engin.umich.edu/>

Abstract: Large-scale stochastic systems are ubiquitous in practical applications, including foundational models, cloud computing centers, ride-sharing systems, and more. However, design, control, and analysis of these systems are often challenging due to the curse of dimensionality. In this talk, I will present asymptotic methods for analyzing and optimizing large-scale stochastic systems.

Bio: Lei Ying is a Professor at the Electrical Engineering and Computer Science Department of the University of Michigan, Ann Arbor. His research is broadly in the interplay of complex stochastic systems and big data, including reinforcement learning, large-scale communication/computing systems for big-data processing, private data marketplaces, and large-scale graph mining.

Managing Product Availability in Rental Subscriptions

Lennart Baardman, Ross School of Business, <https://baardman.github.io/>

Abstract: Rental subscription firms, from fashion to furniture, often struggle with customer churn. Frequently, customers will sign up and cancel their subscription in the span of a few months. Collaborating with a clothing rental subscription firm, we identify the key drivers of their customer churn and develop policies to address these. Applying machine learning methods to customer cancellation comments, we observe that product variety and limited availability is a major reason for cancellation. To manage product availability, we develop three simple yet effective inventory policies that decide which clothing styles to display and which items should fulfill which orders. Our approach improves availability significantly, with only a small tradeoff in service levels, ultimately reducing expected churn.

Bio: Lennart Baardman is an Assistant Professor of Technology & Operations at the Ross School of Business, University of Michigan. His research focuses on data-driven decision-making in retail, using predictive and prescriptive analytics tools from mathematical optimization, statistics, and machine learning. He studies problems in revenue management and supply chain management, often in collaboration with industry partners including Adobe, Amazon Fresh, Hungryroot, Johnson & Johnson, Oracle, and others.

Sequential Change Detection with Simulators

Speaker: Shubanshu Shekhar, Department of Electrical and Computer Engineering, statml.engin.umich.edu

Abstract: In this talk, I will discuss the problem of sequential change detection with simulators for the pre- and post-change distributions. Specifically, we consider a stream of observations $(U_t, V_t, X_t)_{t \geq 1}$, where $(U_t)_{t \geq 1}$ and $(V_t)_{t \geq 1}$ are generated by the simulators, and $(X_t)_{t \geq 1}$ represents the actual data sequence. Our goal is to develop an efficient strategy for detecting when the distribution of X_t shifts from an unknown distribution P_0 to another unknown distribution $P_1 \neq P_0$ at an unknown time T . Additionally, we know that $U_t \sim Q_0$ and $V_t \sim Q_1$, where $Q_0 \approx P_0$ and $Q_1 \approx P_1$. I'll discuss how this problem can be reduced to that of detecting changes in the sign of the mean of the observation stream. This reduction allows us to leverage recent advancements in sequential anytime-valid methods for estimation and uncertainty quantification, leading to powerful change detection techniques.

Bio: Shubanshu Shekhar is an assistant professor in the Department of Electrical Engineering and Computer Science (EECS) at the University of Michigan, Ann Arbor. Before this, he was a postdoctoral

researcher in the Department of Statistics and Data Science at Carnegie Mellon University. He earned his PhD in Electrical Engineering from the University of California, San Diego. His research interests lie broadly in the areas of statistics and machine learning theory.

Design-Based Confidence Sequences: Stopping Experiments Earlier with Netflix
David Ham, Ross School of Business, <https://www.daewoongham.com/>

Abstract: Randomized experiments have become the standard method for companies to evaluate the performance of new products or services. In addition to augmenting managers' decision-making, experimentation mitigates risk by limiting the proportion of customers exposed to innovation. Since many experiments are on customers arriving sequentially, a potential solution is to allow managers to "peek" at the results when new data becomes available and stop the test if the results are statistically significant. Unfortunately, peeking invalidates the statistical guarantees for standard statistical analysis and leads to uncontrolled type-1 error. Our paper provides valid design-based confidence sequences, sequences of confidence intervals with uniform type-1 error guarantees over time for various sequential experiments in an assumption-light manner. In particular, we focus on finite-sample estimands defined on the study participants as a direct measure of the incurred risks by companies. Our proposed confidence sequences are valid for a large class of experiments, including multi-arm bandits, time series, and panel experiments. We further provide a variance reduction technique incorporating modeling assumptions and covariates. Finally, we demonstrate the effectiveness of our proposed approach through a simulation study and three real-world applications from Netflix. Our results show that by using our confidence sequence, harmful experiments could be stopped after only observing a handful of units; for instance, an experiment that Netflix ran on its sign-up page on 30,000 potential customers would have been stopped by our method on the first day before 100 observations

Bio: David Ham conducts research at the intersection of causal inference and business/social science applications. A lot of his research is motivated by an existing problem in real practice without a feasible or appropriate existing solution. At a high level, he is a causal inference researcher. Specifically, He is interested in experimentation, adaptive and sequential inference, Difference-in-Difference and Matching, randomization inference (Fisher-Based Testing), design-based causal inference, and non-parametric statistics. Though he is in the operations department, he has obtained his Ph.D. from the Harvard Statistics Department and plans to continue to do methodological work in statistics.

From Dyadic to Multi-Agent Teams: Combining Empirical and Computational Approaches to Model Trust in Human-Autonomy Interaction

X. Jessie Yang, Department of Industrial and Operations Engineering, <https://icrl.engin.umich.edu/index.php/xi-jessie-yang/>

Abstract: Trust has been identified as one central factor in effective human-autonomy interaction. In this talk, I will first present the results of two studies examining trust dynamics in human-autonomy interaction in both dyadic and multi-agent settings. In study 1, I will present a study that identifies three properties of trust dynamics, namely continuity, negativity bias, and stabilization. The three properties characterize a human agent's trust formation and evolution process de facto. In study 2, we propose a computational model of trust dynamics that adheres to the three properties and evaluate the computational model against existing trust inference models.

The Effect of U.S.-China Decoupling on Investment in High-Tech Manufacturing

Ran Zhuo, Ross School of Business, <https://ranzhuo17.github.io/>

Abstract: High-tech manufacturing is often characterized by rapid technology turnover, frequent and substantial investment, and significant economies of scale. Recent national policies emphasizing domestic self-reliance in the U.S. and China highlight potential interactions between these industry characteristics and national security considerations. In this paper, we study the effect of U.S.-China decoupling on investments in contract manufacturing capacity for semiconductor chips. Our unique dataset combines a comprehensive sample of worldwide plant-level capacity investments and a representative sample of global contract manufacturing orders for semiconductors on a quarterly basis from 2004 to 2015. We use these data to estimate key parameters in a structural model of contracting between manufacturers and their clients, as well as manufacturers' capacity investment decisions. Based on the estimated parameters and using counterfactuals, we explore a large global semiconductor manufacturer's potential responses to geographically specific national policies affecting investment incentives.

Short bio: Ran Zhuo is an Assistant Professor in the Technology and Operations department at the University of Michigan's Ross School of Business. She received her Ph.D. in Business Economics from Harvard University in May 2023. She has broad research interests at the intersection of economics of innovation, technology, digitization, and industrial organization. Her published papers have examined digital markets, privacy regulations, and open source software. Her current and future research will broadly look at allocation of innovation resources and investment in new technologies in organizations. She uses a variety of methods, including reduced-form analysis, machine learning, and structural estimation of empirical decision models.

Air Transportation Operations Research and Management

Max Li, Department of Aerospace Engineering, <https://aero.engin.umich.edu/people/li-max/>

Abstract: I will provide a brief, broad overview of current and recently completed research projects within the Laboratory for Air Transportation, Infrastructure, and Connected Environments (LATTICE) here at the University of Michigan. I will then dive into some projects in more depth: Distributionally robust optimization for air traffic management; congestion pricing in Urban Air Mobility operations; Spaceport facility location planning; as well as exploration-exploitation drone routing problems—with the goal of emphasizing potential collaborative opportunities between technology/operations management and aerospace engineering.

Bio: Max Li is an Assistant Professor of Aerospace Engineering at the University of Michigan, Ann Arbor. He also has courtesy appointments in Civil and Environmental Engineering as well as Industrial and Operations Engineering. Max received his PhD in Aerospace Engineering from the Massachusetts Institute of Technology in 2021. He received his MSE in Systems Engineering and BSE in Electrical Engineering and Mathematics, both from the University of Pennsylvania, in 2018. Max's research and teaching interests include air transportation systems, airport and airline operations, Advanced Air Mobility, networked systems, as well as optimization and control.