Title:
Large-Scale Service Networks with Time-Varying Demand: Performance Forecasting and Staffing Control

Speaker:
Yunan Liu, Assistant Professor, Department of Industrial and Systems Engineering, North Carolina State University

Abstract:
Motivated by the need for tools of forecasting and control in real service systems, we consider queueing networks with time-varying arrivals, customer abandonment, non-exponential service and patience distributions, and two types of routing policies: the conventional Markovian routing and the prescribed deterministic paths. We develop the many-server heavy-traffic fluid and diffusion limits. These limits have strong engineering relevance: First, they provide useful approximating formulas (in terms of the model input data) for the means, variances and distributions of important performance metrics, such as the waiting time and queue length. Second, these limits provide theoretic bases for developing efficient policies for staffing recommendations (in terms of the number of servers) so that the time-varying effect of the nonstationary demand can be reduced and controlled; we show that appropriate staffing methods can make nonstationary systems almost stationary.

Biography:
Yunan Liu is currently an Assistant Professor at the Department of Industrial and Systems Engineering, North Carolina State University. He received the B.E. degree in Electrical Engineering from Tsinghua University, Beijing, China, and the M.S. and Ph.D. degrees in Operations Research from Columbia University, New York. His current research interests include Stochastic Modeling and Analysis, Applied Probability, Queueing Theory and Operations Management, with applications in service systems including customer contact centers, health care and manufacturing systems.

Title:
Models and Insights for Hospital Inpatient Flow Management

Speaker:
Pengyi Shi, Assistant Professor, Krannert School of Management, Purdue University

Abstract:
Emergency department (ED) overcrowding negatively impacts patient safety and public health, and hence, has become one of the most challenging problems facing healthcare delivery systems worldwide. It is well known that prolonged waiting time for admission to inpatient beds, i.e., ED boarding, is a key contributor to ED overcrowding. Our research aims on gaining insights into effective inpatient flow management to reduce this waiting time, and eventually, to reduce ED overcrowding. In this talk, I will first introduce a new class of stochastic network models that are built based on an extensive empirical study and can capture the empirical time-varying waiting time performance. One important feature of these models is that the service times are no longer exogenous, iid random variables. Then, I will introduce a two-time-scale framework to analyze these models. These analyses help us identify operational policies
such as inpatient discharge timing that can reduce ED boarding and eliminate the excessively long waiting times for patients requesting beds in the morning. This talk is based on joint works with Jim Dai at Cornell University.

Biography:
Pengyi Shi joined Purdue University as an Assistant Professor in January 2014. She received her Ph.D. degree from Georgia Institute of Technology before joining Purdue. Her research interests include healthcare operations and stochastic modeling, with a focus on hospital patient flow management. She has collaborations with practitioners and faculty members from different healthcare organizations, including major hospitals in the US and Singapore.

Title:
The Quest for Exact Simulation of the Stationary Distribution of Generalized Jackson Networks of Queues

Speaker:
Karl Sigman, Professor, Department of Industrial Engineering & Operations Research, Columbia University

Abstract:
In an attempt at deriving an exact simulation algorithm for the stationary distribution of generalized Jackson networks of queues (we will go over that carefully), we stumble across a simple variation of the FIFO M/G/1 queueing model, one for which the service time of the $n$th customer, $S_n$, depends on the length $T_{n-1} = t_n - t_{n-1}$ of the previous interarrival time (here, $t_n$ denotes the arrival time of the $n$th customer). In particular, $S_n$ and delay $D_n$ (in line) of this $n$th customer are now dependent (through $T_{n-1}$). Applications could include situations where a customer’s service is lengthened (or shortened) if they arrive late. Although a seemingly simple modification of the classic M/G/1 model, we illustrate how in fact it is surprisingly complicated to analyze. For example, classic Weiner-Hopf factorization does not hold because now the underlying random walk increments are not iid. But we also explain how and why this kind of generalization can offer a solution to our original problem.

Biography:
Professor Karl Sigman joined Columbia University’s Industrial Engineering and Operations Research Department in 1987; having received his Ph.D. from the University of California at Berkeley. Professor Sigman was the recipient of a Presidential Young Investigator Award from the NSF, and the recipient of the Distinguished Faculty Teaching Award both in 1998 and in 2002 from Columbia University. He is the Director of Columbia's Center for Applied Probability. He teaches courses in stochastic models, stochastic simulation, financial engineering, and queueing theory. Professor Sigman is currently the Director of Undergraduate Programs. Professor Karl Sigman’s research interests include queueing theory, stochastic networks, point processes, insurance risk, economics and political science (USA Presidential Election modeling). He has published in numerous journals including Stochastic Processes and Their Applications, Queueing Systems, Journal of Applied Probability, and Mathematics of Operations Research.

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