ISyE 7201 Production & Service Systems Engineering
Spring 2025

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Course Meeting Times: TuTh 3:30-4:45pm
Course Classroom: Groseclose 118
Instructor Office Hours: By appointment

Course Objectives

This course seeks to familiarize the students with some fundamental techniques and results coming from the theory of Stochastic Processes and its specialization in the modeling and the analysis of queueing systems. It also highlights the application of this material in the modeling, analysis and control of production and service systems.

The presentation of the aforementioned material takes place at a technical level that will (i) enable the student to use it effectively in research, (ii) refer to it with the necessary rigor in technical writings and presentations, and (iii) provide a base for the further expansion of the students' background in this area through personal reading and investigation.

Tentative Course Outline

1. Introduction: Course Objectives, Context, and Outline
   - Corporate strategy and its connection to operations
   - The organization as a resource allocation system (RAS)
   - The underlying RAS management problems and the need for understanding the impact of the underlying stochasticity
   - The basic course structure
2. Modeling and Analysis of Production and Service Systems through Stochastic Processes
3. An overview of Discrete-Time Markov Chain (DT-MC) theory
   - Characterizing the transient and the limiting behavior of DT-MCs
   - Analysis of the limiting behavior of DT-MCs with finite state space through the Perron-Frobenius theorem.
   - Bucket Brigades as another example of the application of the Perron-Frobenius theorem
4. The Exponential Distribution and the Poisson Process
5. Continuous-Time Markov Chains (CT-MCs)
6. Birth-Death Processes and the M/M/1 Queue
   - Transient Analysis
   - Steady State Analysis
7. Modeling more complex behavior through CT-MCs
   - Single station systems with multi-stage processing, finite resources and/or blocking effects
   - Open (Jackson) and Closed (Gordon-Newell) Queueing networks
8. Modeling and analysis of Production and Service Systems with non-Markovian behavior
   - Phase-type distributions and their role as approximating distributions
   - The M/G/1 queue
   - Priority Queues
   - The G/G/1 queue
   - The essence of "Factory Physics"

Course Prerequisites: Familiarity with Stochastic / Probabilistic Modeling and Deterministic Optimization at the respective levels of ISYE 6761 and ISYE 6669.

Course Reading Material

Textbook: *Fundamentals of Queueing Theory (4th ed.)*, by D. Gross, J. F. Shortle, J. M. Thompson and C. M. Harris, John Wiley & Sons, Inc., 2008.

The above text will function as a "base" for the presented developments. Additional supplementary material will be provided either in class, or through a course website accessed from the instructor homepage, or through the library electronic reserves (in case that copyright clearance is necessary).

Course Policies

Homework: I shall circulate "homework" for various parts of the course together with its solutions. This material intends to help the student internalize the course lectures, but many of the provided problems have significant theoretical interest, as they extend the basic theory covered in class.

Exams: There will be two midterms and a final exam. All exams will be take-home. The exact dates and the material to be covered by the midterm exams will be determined as the course progresses. The final exam will be comprehensive. Students are expected to observe the ***Georgia Tech Honor Code*** while taking the exams ***(and no collaboration or any other interactions will be allowed during the exams!)***

Grading:

- Homework: 0%
- Two Midterm Exams: 33% each
- Final Exam: 34%