Syllabus

OIDD 9300 - STOCHASTIC MODELS I

Fall 2022 - Q2

Draft 8/9/2022; Updates to be posted online

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Lectures: Tuesday, Thursday 10:15 a.m.-11:45 p.m., JMHH F92

Office hours: TBD

Evaluation: homework assignments (40%);
participation (20%);
final exam (40%)

Prerequisites: Calculus (including differential equations), linear algebra, probability
(no measure theory required)

Resources: Main text (required):

- Ross *Stochastic Processes,* 2nd edt, Wiley

Secondary texts:

- Karlin and Taylor *A First Course in Stochastic Processes,* 2nd edt., 1975, Academic Press
- Ross *Introduction to Probability Models,* 11th edt, Elsevier

You are encouraged to find the right text for your level. I will give an overview of the rich literature in this field in Lecture 1. The required text will also be used in OIDD 931.

Additional materials: Class handouts, lecture slides and assignments will be made available on the course website.

Website:

We will be using a Canvas website that facilitates information sharing, course logistics and assignments. To access your Canvas sites, go to https://canvas.upenn.edu/courses/xxxxx. Log in with your PENN username & password. Please, check the Canvas website frequently during the semester for up to date information, assignments, and class handouts.

Course Description:

Mathematical models based on probability theory prove to be extremely useful in describing and analyzing complex systems that exhibit random behavior over time. The goal of this course is to introduce important classes of stochastic processes, to analyze their behavior over a finite or infinite time horizon and to provide the student with probabilistic intuition and insight into the modeling process. The theory of stochastic processes will be developed based on elementary probability theory and calculus; measure theory is not required. Applications of stochastic models will be presented in a variety of areas including operations management, finance, marketing, health care as well as computer/communication systems. Computational aspects and solution techniques that complement the theory will also be addressed.
This course, Stochastic *Models I,* is part of the Stochastic Model course sequence and covers the Poisson process as well as Markov chains in discrete and continuous time. A separate course, *OIDD 931 Stochastic Models II,* offered in Q3, will focus on computational methods, time reversibility, renewal theory, and Brownian motion.

Course Topics:

A tentative course outline follows (with the number of lectures on each topic in parenthesis). Content and focus may vary based on student background and interest.

1. Introduction to Stochastic Processes (1)
2. Review of Probability Concepts (1)
3. Generating Functions and Transforms (1)
4. The Poisson Process (3)
5. Discrete Time Markov Chains (4)
6. Continuous Time Markov Chains (4)

Homework:

Assignments will be given on a weekly/biweekly basis. Please, submit your solutions on Canvas by the due date listed. If you can't make the deadline due to extenuating circumstances, please ask the instructor before the due-date for a possible extension. Unless otherwise stated, homework is to be done individually. You are encouraged to discuss the problems (and any of the material covered in class) with your class mates; yet the work that you submit must be your own. If you benefited from discussions with a peer, please do acknowledge the collaboration. Students are expected to refrain from soliciting solutions from other sources (e.g. internet, previous years' classes, etc). If you do use outside information, academic honesty requires you to state such sources.

Participation:

This is a Ph.D. level course, assuming students' serious commitment to learning. Our class sessions are meant to provide an environment that involves all participants. I am always open for questions, both during scheduled class sessions and during office hours. Students are expected to come prepared to class, ask relevant questions, and actively participate in classroom discussions.

Assessment and Exams:

There will be frequent opportunities for you to actively engage in this class. My assessment of your participation will be based on your level of engagement in these activities, the degree of your preparedness for class sessions, and your in-class presentation of a stochastic modeling paper. There will be an open book final exam according to the University schedule. Logistical details will be discussed in the first week of classes.