The Wharton School, University of Pennsylvania
Course Syllabus

OIDD 931 - STOCHASTIC MODELS II

Q3, Jan 21 - March 9, 2021
Status: January 15, 2021

Instructor: Professor Maria Rieders
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Lectures: Tuesday, Thursday 10:30-11:50 am, synchronous via zoom
Office hours: Wednesday 5-6 pm, and by appointment

Evaluation: Weekly/biweekly homework assignments (40%);
participation (10%);
final exam (50%)

Prerequisites: Calculus (including differential equations), linear algebra, probability (no measure theory required), stochastic models as in OIDD 930

Texts:
- Ross *Stochastic Processes,* 2nd edt, Wiley (required)
- Karlin and Taylor *A First Course in Stochastic Processes,* 2nd edt., 1975, Academic Press (recommended)
- Some relevant texts have been put on reserve; see Canvas
- Class handouts and assignments will be made available on Canvas

Course Description:
This is the second part of our Stochastic Models course sequence. We start by revisiting continuous time Markov chains, with a special focus on computational methods and time reversibility. Markov chains will also form the foundation for Monte Carlo methods which is an important tool in simulating stochastic systems. Building on the elementary counting processes presented in Stochastic Models I, we now study the more general theory of renewal processes. Of particular interest are limiting results such as the Key Renewal Theorem that enable us to calculate long run performance measures of interest. We then introduce martingales which provide a basic approach for studying applied probability models. Martingales will prove particularly useful in analyzing Brownian motion processes. Besides presenting general results on Brownian motion, we will look at applications including some financial models of interest.

Course Topics:
A tentative course outline follows. Content and focus may vary based on student background and interest.

	Topics	Sessions
Topic 1	Continuous Markov Chains – Applications and Computations	1-2
Topic 2	Time Reversibility	3-4
Topic 3	Markov Chain Monte Carlo Methods	5
Topic 4	Renewal Processes – Basic Results	6
Topic 5	Renewal Processes - Key Renewal Theorem	7-8
Topic 6	Renewal Theory - Related Processes	9-10
Topic 7	Martingales	11
Topic 8	Brownian Motion	12-13
	Final Exam	**14: Tu 3/9**

Website:
We will be using a Canvas website that facilitates information sharing, course logistics and assignments. Please, check the Canvas website frequently during the semester for up to date information, assignments, and class handouts.

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 each other; yet the work that you submit must be your own. If you significantly 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. Our class sessions are meant to provide a learning environment that involves all participants. I am always open for questions, both during our sessions and during office hours. Students are expected to come prepared to class, ask relevant questions, and actively participate in classroom discussions.

Exams:
There will be an open book final exam during the last session on March 9th.