

The Wharton School, University of Pennsylvania  
Course Syllabus

OIDD 9310 - STOCHASTIC MODELS II

Q3, Jan 18 – February 29, 2024

Status: January 5, 2024

**Instructor:** Professor Maria Rieders  
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**Lectures:** Tuesday, Thursday 10:15-11:45 am, room JMHH F94

**Office hours:** Thursdays 1:30-2:30 pm, 517 JMHH (in person),  
Mondays 5:00-6:00 pm, via zoom  
and always by email and/or 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 9300

**Texts:**

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

**Website:** <https://canvas.upenn.edu/courses/xxxxx>  
Please, check the Canvas website frequently during the semester for up to date information, assignments, and class handouts.

**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. 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.

Sessions	Topics	Due Dates
1 Th 1/18	<b>Topic 1</b> Markov Chains – Computations and Applications	
2 Tu 1/23		
3 Th 1/25	<b>Topic 2</b> Time Reversibility	<b>Tu 1/30</b> Hw1
4 Tu 1/30		
5 Th 2/1	<b>Topic 3</b> Renewal Processes – Basic Results	
6 Tu 2/6	<b>Topic 4</b> Renewal Processes - Key Renewal Theorem	<b>Tu 2/6</b> Hw2
7 Th 2/8		
8 Tu 2/13	<b>Topic 5</b> Renewal Theory - Related Processes	<b>Tu 2/13</b> Hw3
9 Th 2/15		
10 Tu 2/20	<b>Topic 6</b> Martingales	<b>Tu 2/20</b> Hw4
11 Th 2/22	<b>Topic 7</b> Brownian Motion	
12 Tu 2/27		
13 Th 2/29	<b>Final Exam</b>	

**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; some group work may be assigned as well. 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 **February 29**.