Statistics 25300/31700, Winter 2014

Introduction to Probability Models

— An introduction to applied stochastic processes

Time: MWF 11:30-12:20 am, Eck117

Prerequisites: Equivalent of STAT24400 or STAT25100 or Consent of Instructor

People

	Name	Office	E-mail
Instructor	Yibi Huang	Eck 7 (in the basement)	yibih@uchicago.edu
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Textbook: *Introduction to Probability Models* (2010, 10th edition) by S. Ross.

Other Commonly Used Textbooks (a partial list; recommended but not required)

- *An Introduction to Probability Theory and Its Applications*, (Wiley, 1968, 3rd ed.) by W. Feller
- *An Introduction to Stochastic Modeling*, (1998, 3rd ed.) by Karlin and Taylor
- *Introduction to Stochastic Processes*, (Chapman & Hall, 2006, 2nd ed.) by G. Lawler
- *Stochastic Processes*, (1995, 2nd ed.) by S. Ross.

Course Outline

This course introduces stochastic processes as models for a variety of phenomena in sciences. Following a brief review of basic concepts in probability the course will introduce stochastic processes that are popular in scientific applications, such as discrete time Markov chains, the Poisson process, continuous time Markov processes, renewal processes, queuing models, and Brownian motion.

Grade Components

- **Daily** Homework (40%)
- Midterm (30%)
- Final (30%)

Homework Policy

- Due 7 days from the day it is assigned, in class
- Resubmission is welcomed, can get 50% of the points back
- Late homework **within one week** will be taken 50% off
- Late homework **beyond one week** will NOT be accepted
- The course assistant will be available during his office hours (or by appointment) to discuss questions you may have about the homework.
- Homework should be handed in stapled with **your name** and **date** clearly marked.
- Collaboration: Discussion is allowed but you should write your homework independently

Wk	Date	Lecture	Content	Textbook Sections
	01/06 M	-	Severe weather, class canceled	-
1	01/08 W	1	definitions of Markov chains, transition probabilities	4.1
			Ehrenfest diffusion models, discrete queueing models	
	01/10 F	2	Chapman-Kolmogorov Equation	4.2
	01/13 M	3	classification of states (recurrent, transient)	4.3
			recurrence and transience of simple random walks	
2	01/15 W	4	limiting distribution I	4.4
	01/17 F	5	limiting distribution II	4.4
	01/20 M	-	Martin Luther Kings' Day, No Class	-
3	01/22 W	6	backward Markov chain, time reversibility, detailed balanced equation	4.8
	01/24 F	7	Branching Processes	4.7
	01/27 M	8	Generating Functions	
4	01/29 W	9	exponential distributions, memoryless property, definitions of Poisson processes	5.2 - 5.3
	01/31 F	10	interarrival times of a Poisson process, conditional distribution of interarrival times	5.3
	02/03 M	11	thinning, superposition, "converse" of thinning and superposition, generalization of Poisson processes	5.3-5.4
5	02/05 W	12	definitions of continuous-time Markov chains, birth and death processes, Chapman-Kolmogorov equation, forward equation, backward equation	6.2 - 6.4
	02/07 F	13	limiting probabilities, time reversibility	6.5 - 6.6
	02/10 M	14	definition of renewal processes, renewal function, renewal equation	7.2
6	02/12 W	15	limit theorems, stopping time, Wald's equation, elementary renewal theorem	7.3
	02/14 F	-	College Break, No Class	-
	02/17 M	16	limit theorems, CLT for renewal processes	7.3
7	02/19 W	17	renewal reward processes	7.4
			alternating renewal processes	7.5.1
	02/21 F	18	the inspection paradox	7.7
			queueing models	8.1
	02/24 M	19	Little's formula, cost identity	8.2.1
			birth-death queueing models	8.3
8	02/26 W	20	PASTA principle	8.2.2
			A Markov chain embedded in $M/G/1$	8.5
	02/28 F	21	A Markov chain embedded in $G/M/1$	8.7
			$G/M/k$, $M/G/k$	8.9.3-8.9.4
			Gaussian processes, definition of Brownian motion	
	03/03 M	22	Brownian motion as a limit of random walk, conditional distribution	10.1
			hitting times, maximum, reflection principle	10.2
9	03/05 W	23	Arcsine law, zero set of Brownian motion	
	03/07 F	24	Wald's identities for Brownian motion	
	03/10 M	25	more applications of Wald's identities	
10	03/12 W	26	quadratic variation	
	03/14 F	-	Reading Period, No Class	-
11	03/21 F	-	Final Exam, 10:30-12:30pm, Room TBA	-