Statistics 416: Stochastic Modeling  
Spring 2014

Instructor: Matthew Reimherr  
Department of Statistics  
411 Thomas Building  
mreimherr@psu.edu

Prerequisites: STAT 318 or 414 (Probability)  
MATH 230 (Multivariate Calculus)

Class Schedule: MWF 1:25-2:15, 267 Willard Building

Office Hours: Monday and Tuesday 3:30-4:30


Webpage: Available through ANGEL, check regularly for updates.

Course Topics:
1. Probability Models (Chapters 1-2)  
2. Conditional Probability (Chapter 3)  
3. Discrete Time/State Markov Chains (Chapter 4)  
4. The Poisson Process (Chapter 5)  
5. Continuous Time Markov Chains (Chapter 6)  
6. Brownian Motion (Chapter 10)

Learning Objectives:
Below are learning objectives organized by course topic. For each item listed, expect to gain experience working with, computing, and interpreting said item.

1. It is assumed that students have familiarity with the concept of probability and many common probabilistic models. Therefore, only a brief overview will be given to refresh the following concepts: discrete and continuous probability distributions; compute and interpret expected values and variances; joint distributions.

2. While students are expected to have some familiarity with conditional probability, a longer overview will be presented due to the importance it plays in later chapters. In particular, students will gain an understanding of what conditional probability and expected value mean, and how to work with and compute conditional probabilities and expectations.

3. Students will be introduced to Markov chains, starting with discrete space and time models. Students will learn about the transition probability matrix and Chapman-Kolmogorov equations. Students will learn to compute multi step probabilities, and limiting and stationary behavior of Markov chains.
4. Students will expand on the previous chapter by learning about a continuous-time/discrete space Markov chain called the Poisson point process. Students will learn about the connection between the Poisson process and exponential waiting times, and explore generalizations of the Poisson process.

5. We will then examine a more general framework for continuous time stochastic processes. We will consider different examples, define the transition probability function, the generalization of the Chapman-Kolmogorov equations, and limiting and stationary behavior.

6. We conclude by discussing continuous time and continuous state stochastic processes, and, in particular, Brownian motion. We will define Brownian motion, discuss its construction, and its various properties. As time permits, we will learn about variations of Brownian motion, give a very basic introduction to stochastic integration, Gaussian processes, and harmonic analysis of stationary processes

**Grading:**
Homework: 30%
Midterm Exam #1: 20%
Midterm Exam #2: 20%
Comprehensive Final Exam: 30%

**Homework:**
Homework will be assigned most Wednesdays and will be due a week later. All homework must be turned in by Wednesday, either to me personally in class or before class through ANGEL. No late homework will be accepted. The lowest homework grade of the semester will be dropped. You are encouraged to work together on homework, but each student must turn in their own write up and answers.

**Exams:** Below is a list of exam dates. All students must take exams during these times. Conflicts should be discussed with the instructor well in advance. The final exam date will be announced by the Registrar late in the semester. If you have three or more final exams on one day, be sure to ask the Registrar about moving one of them.
Midterm Exam #1: TBA
Midterm Exam #2: TBA
Comprehensive Final Exam: TBA
**Academic Integrity:**
Academic integrity is the pursuit of scholarly activity free from fraud and deception and is an educational objective of this institution. All University policies regarding academic integrity apply to this course. Academic dishonesty includes, but is not limited to, cheating, plagiarizing, fabricating of information or citations, facilitating acts of academic dishonesty by others, having unauthorized possession of examinations, submitting work of another person or work previously used without informing the instructor, or tampering with the academic work of other students. All exam answers must be your own, and you must not provide any assistance to other students during exams.

**Disability Services:**
Penn State welcomes students with disabilities into the University's educational programs. If you have a disability-related need for reasonable academic adjustments in this course, contact the Office for Disability Services (ODS) at 814-863-1807 (V/TTY). For further information regarding ODS, please visit the Office for Disability Services Web site at http://equity.psu.edu/ods/. In order to receive consideration for course accommodations, you must contact ODS and provide documentation. If the documentation supports the need for academic adjustments, ODS will provide a letter identifying appropriate academic adjustments. Please share this letter and discuss the adjustments with your instructor as early in the course as possible.