EE 512 - STOCHASTIC PROCESSES

Fall 2021 - Syllabus

Lecture Information:

Location: OHE 132
Time: Friday 1730h – 2020h
Discussions: Tuesday 1730h – 1820h

Instructor: Dr. Osonde Osoba (osondeos@usc.edu)
Office Hours: Virtual/Friday 1630h - 1730h & after class

TA: Yixian Zhu (yixian@usc.edu)
Office Hours: TBD

Course Summary: The course explores the theory and applications of stochastic processes with a focus on computational simulation. Our first step will be to shore up our mastery of the language of probability theory and statistics. Then we will build our understanding of stochastic processes using Markov processes as the default organizing principle. The last third of the course will focus on stochastic calculus. Simulation exercises will help us reinforce these concepts. These computational exercises require familiarity with a programming language; Python or R are recommended.

Pre-requisite: EE 503 – Probability for ECEs
Recommended: EE 518 – Tools for Financial Engineering

Recommended texts:
There is no required textbook for this class. But the following textbooks are highly recommended. They are listed in order of priority for this course:

- [Stochastic Calculus]: Mikosch, T. *Elementary Stochastic Calculus with Finance in View*. World scientific, 1998.
- [Probability]: Gubner, J. A., *Probability and Random Processes for Electrical and Computer Engineers*, Cambridge University Press, 2006.
- [Exercises & Worked Examples]: Hsu, H. P. *Schaum's Outline of Theory and Problems of Probability, Random Variables, and Random Processes.* 2nd Ed. McGraw-Hill, 2014.
- [Monte Carlo Simulation]: Glasserman, P. *Monte Carlo methods in financial engineering*. Springer, 2013.

Grading:
There will be two midterms, a final exam, and a final simulation project.
1. **Midterms**. Two midterms. Each worth 25 points. Closed book.
2. **Final exam**: Worth 30 points. Closed book.
3. **Homework**. Worth 10 points.
4. **Project:** Worth 10 points.

COURSE OUTLINE		
Date	**Topics**	**Chapter ref.**
AUG 27	Overview of Probability Theory: Single Variable Case.	Gubner 1-5 Hsu 1-2
SEP 03	Joint Descriptions. Random Sequences. Random Walks. Expectations & Moments	Gubner 7-10 Hsu 3-4
SEP 10	Stochastic Processes: Introduction. Probabilistic Limit Laws. Martingales.	Gubner 14 Hsu 4.9
SEP 17	Markov Chains: Theory. Kolmogorov Equations. Ergodicity.	Gubner 12 Hsu 5.5
SEP 24	Markov Chain: Applications. Hidden Markov Models.	Gubner 12
OCT 01	**[Midterm I]** Monte Carlo. Variance Reduction. MCMC Concepts.	Glasserman 1.1
OCT 08	Moment Characterization of Stochastic Processes	Gubner 10 Hsu 5.3
OCT 15	Poisson Processes and its Variants. Compound Poisson.	Gubner 11 Hsu 5.6
OCT 22	Brownian Motion and its Variants. Levy Processes. Stochastic integrals.	Mikosch 1.3 Hsu 5.7
OCT 29	Stochastic Differential Equations. Ito Diffusions. Ito's Lemma.	Mikosch 2-3
NOV 05	**[Midterm II]** Numerical Simulation for SDE/SP.	Glasserman 6.1
NOV 12	Ito Calculus cont'd. Geometric BM. Black-Scholes.	Mikosch 4.1 Glasserman 3.2
NOV 19	Financial Applications. Monte Carlo Techniques for Finance.	Mikosch 4 Glasserman 3
NOV 26	**[Thanksgiving Break; No class]**	
DEC 03	Review Session. Last day of the course	
DEC 10	**[FINAL EXAM]** (1630h-1830h). Projects due.	