

SYLLABUS - EE 512 (Fall 2020)

STOCHASTIC PROCESSES

Lecture Information:

Location: Virtual

Time: Friday 1730h – 2020h

Instructor: Dr. Osonde Osoba (osondeos@usc.edu)

Office Hours: Virtual/Friday 1630h - 1730h

TA: Yixian Zhu (yixian@usc.edu)

Office Hours: TBD

Course Summary: The course is an exploration of the theory and applications of stochastic processes with a special focus on computation. This entails a mastery of the underlying probability theory and statistics as well as familiarity with a programming language. Recommended languages: Python or R. MATLAB or Java acceptable. There will be two midterms, a final exam and a final simulation project.

Recommended pre-requisite: 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:

- Gubner, J. A., *Probability and Random Processes for Electrical and Computer Engineers*, Cambridge University Press, 2006.
- Hsu, H. P. *Schaum's outline of theory and problems of probability, random variables, and random processes*. 2nd Ed. McGraw-Hill, 2014.
- Glasserman, P. *Monte Carlo methods in financial engineering*. Springer, 2013.
- Ross, S. M. *Simulation*. Academic Press, 2013.
- G. Grimmett and D. Stirzaker. *Probability and Random Processes*, 3rd ed., OUP, 2001

COURSE OUTLINE

AUG 28: Overview of Stochastic Processes. Probability spaces.

SEP 04: Joint Descriptions. Expectations. Random Sequences. Random Walks.

SEP 11: Martingales. Probabilistic Limit Laws.

SEP 18: Monte Carlo. Variance Reduction. Importance sampling.

SEP 25: Markov Chains. Kolmogorov Equations. Ergodicity. MCMC.

OCT 02: **[Midterm I]** Markov Chain Applications: Hidden Markov Models. EM.

OCT 09: Linear Time-Invariant Systems. Mean-squared Calculus.

OCT 16: Poisson Processes and Variations. Compound Poisson.

OCT 23: Brownian Motion and Variations. Levy Processes. Stochastic integrals.

OCT 30: Stochastic Differential Equations. Ito Diffusions. Ito's Lemma.

NOV 06: **[Midterm II/Project Proposals Due]**. Numerical Simulation for SDE/SP.

NOV 13: Geometric BM. Black-Scholes. Girsanov Change of Measure.

NOV 20: Financial Applications. Monte Carlo Techniques in Finance. Review.

DEC 04: **[FINAL EXAM]** (1630h-1830h). Projects due.

GRADING PROCEDURE

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:** Instructor must approve an original computational project involving random processes. Worth 10 points.
5. **Course Grade.** 100 points possible in course.
 - A if 90 - 100 points
 - B if 80 - 89 points
 - C if 70 - 79 points
 - D if 60 - 69 points
 - F if 0 - 59 points .
6. **Cheating.** Not tolerated on homework or exams. Penalty ranges from F on exam to F in course to recommended expulsion.
7. **Statement for Students with Disabilities.** Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m.–5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.
8. **Statement on Academic Integrity.** USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. Scampus, the Student Guidebook, contains the Student Conduct Code in Section 11.00, while the recommended sanctions are located in Appendix A:
<http://www.usc.edu/dept/publications/SCAMPUS/gov/>. Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at: <http://www.usc.edu/student-affairs/SJACS/>.
9. **Academic Conduct**
Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Section 11, Behavior Violating University Standards <https://scampus.usc.edu/1100-behavior->

[violating-university-standards-and-appropriate-sanctions](#). Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, <http://policy.usc.edu/scientific-misconduct>.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the Office of Equity and Diversity <http://equity.usc.edu> or to the Department of Public Safety <http://capsnet.usc.edu/department/department-public-safety/online-forms/contact-us>.

This is important for the safety of the whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. The Center for Women and Men <http://www.usc.edu/student-affairs/cwm/> provides 24/7 confidential support, and the sexual assault resource center webpage <http://sarc.usc.edu> describes reporting options and other resources.

10. Support Systems

A number of USC's schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the American Language Institute <http://dornsife.usc.edu/ali>, which sponsors courses and workshops specifically for international graduate students. The Office of Disability Services and Programs http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, USC Emergency Information <http://emergency.usc.edu> will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.