Fall 2023

EE503

Probability for Electrical and Computer Engineers

Lecture: TuTh 10:00 - 11:50am, OHE 122
Discussion: F 10:00 - 10:50am, OHE 122

Course Description

Probabilistic tools are among the most useful for modelling real systems and doing performance analysis. This course provides a solid basis of probability theory and related topics for graduate students in Electrical Engineering, Computer Engineering and Computer Science, and prepares the students for many of the graduate classes that require a strong understanding of probability. The course covers the material from first principles in a more rigorous manner than is typically found in undergraduate probability classes in Engineering. Major topics covered include but are not limited to discrete and continuous random variables, expectation and moments, functions of multiple random variables, covariance and correlation, conditional probability and expectation, limit theorems, discrete and continuous time Markov chains, and a brief introduction to queueing theory. Examples using probability in a variety of applications are provided, including in computer communications, gambling, machine learning, search engines, server farms/data centers and computer networks.

Instructor

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Teaching Assistants

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Graders

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Grader hours: contact graders using their emails to setup a meeting if needed

Grading

- Homework 25%
- Midterm 30%
- Final 45%
- 5-min quizzes: 5% extra credit towards the midterm and final exam score.

Topics

- Sets, sigma algebras, probability axioms
- Combinatorics
- Discrete and continuous random variables
- Expectation and moments
- Functions of multiple random variables
- Covariance and correlation
- Conditional probability and expectation
- Limit theorems
- Estimation and entropy
- Stochastic Processes
- Discrete and continuous time Markov chains
- Introduction to queueing theory

Course textbooks

There are three textbooks and you can use any combination that you wish. The detailed schedule will denote for each topic the corresponding chapters and sections from each book.

1. Introduction to Probability Models, 10th edition or later, Sheldon M. Ross
2. Probability and Random Processes for Electrical Engineering, 3rd edition, Alberto Leon-Garcia
3. Probability and Random Processes for Electrical and Computer Engineers, John A. Gubner

The book from Ross reviews basic probability relatively fast and focuses on Markov Chains and Queueing theory, and, more general, in modeling. It is particularly suited for the second part of the class. The book from Leon-Garcia covers almost all the material in reasonable depth but it is not as modeling-oriented as Ross's book though it is relatively easy to read and covers the first part of the class in detail. The book from Gubner tends to be more rigorous/mathematical than the other two but is not modelling oriented. Between the three, the Ross book is likely the better fit overall.

Additional textbooks:

1. For those of you who are particularly interested in the performance and design of computer systems, I recommend:
   - Performance Modeling and Design of Computer Systems: Queueing Theory in Action, Mor Harchol-Balter

2. If you are weak in probability and need an undergrad level book to consult especially during the first month of the semester, consider the following two:
   - Introduction to Probability, Dimitri P. Bertsekas and John N. Tsitsiklis
   - A first course in probability, Sheldon M. Ross

Exams

Midterm: Tuesday 10/24, 10am-11:50am in-class (tentative, to be finalized soon)
Final: Tuesday 12/12, 8am-10am, per university schedule

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.

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/.