Probability and Risk Analysis for Engineers

IEOR 172

Fall 2017

Course Description

This is an introductory course in probability designed to develop a good understanding of uncertain phenomena and the mathematical tools used to model and analyze it. Applications will be given in such areas as reliability theory, risk theory, inventory theory, financial models, and computer science, among others. To complement the theory, the course also covers the basics of stochastic simulation.

Contact Information

Instructor:

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Graduate Student Instructors:

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Prerequisites

Students should have a solid knowledge of calculus, including multiple variable integration, as well as programming experience in Matlab or Python.

Lectures and Office Hours

Lectures: Tuesdays and Thursdays, 2:00 pm - 3:30 pm, LeConte 2

Instructor's Office Hours:
Mondays and Thursdays 11:00 am - 12:00 pm, Etcheverry 4125

Teaching Assistant's Office Hours:

Rebi Daldal: Wednesdays 4:00 pm - 5:00 pm, Etcheverry 4176B
Anran Hu: Tuesdays 4:00 pm - 5:00 pm, Etcheverry 4176A

Discussion

There will be a weekly discussion to cover additional examples and programming techniques for the simulation content of the course.

Schedule: Mondays, 2:00 pm - 3:00 pm, Etcheverry 3109

Fridays, 3:00 pm - 4:00 pm, Etcheverry 3111 (as needed)

Textbooks

D.P. Bertsekas and J.N. Tsitsiklis. *Introduction to Probability*. 2nd Ed., Athena Scientific, 2008. **(Required)**

S. Ross. *Simulation*. 5th Ed., Academic Press, 2013. **(Recommended)**

S. Ross. *A First Course in Probability*. 8th Ed., Prentice Hall, 2009. **(Recommended)**

Homework

There will be weekly assignments due every Friday before 8:00 pm, which will need to be submitted through Gradescope. (*http://www.gradescope.com.* Use the entry code MX338G.) Students are encouraged to collaborate with other students in the class, as long as each person writes his/her own solutions. Copying homework from another student (past or present) is forbidden.

There will be no regrading of any homework two weeks after the day the assignment was graded, so please make sure you revise your graded homework within this time.

Exams

There will be two midterm exams, on the dates indicated below, and one final exam, on the date determined by the Registrar's Office. The exams will be open book/notes/homework; you will be able to use a calculator if needed, but no lending/borrowing of calculators will be allowed. You may not use laptops or smartphones during the exams.

First midterm: Thursday, September 28th, in class.
Second midterm: Thursday, November 2nd, in class.
Final: Monday, December 11, 2017.

Grading

- 20% Homework
- 20% First midterm
- 20% Second midterm
- 40% Final

Course Topics

- Sample spaces and events
  - Sets
  - Probabilistic models
  - Trees and conditional probability
  - Total probability and Bayes' rule
  - Independence
  - Counting
- Discrete random variables
  - Probability mass functions
  - Expectation, mean and variance
  - Joint PMFs of multiple random variables
  - Conditioning
  - Independence
  - Simulation of discrete random variables
    - Inverse transform, acceptance-rejection, and composition methods
    - Ad hoc methods (Binomial, Poisson)
- General random variables
  - Continuous random variables and PDFs
  - CDFs
  - Normal random variables
  - Conditioning
  - Multiple continuous random variables
  - Derived distributions
  - Simulation of continuous random variables
    - Inverse transform, acceptance-rejection, and composition methods
    - Ad hoc methods (Polar method for normal random variables, multivariate normal)
- Further topics on random variables
  - Tranforms
  - Sums of independent random variables
  - More on conditional expectation and variance
  - Sums of a random number of independent rv's
  - Covariance and correlation
- Limit theorems

- Markov and Chebyshev inequalities
- Central limit theorem
- Limit theorems and simulation
  - Rates of convergence
  - Constructing confidence intervals
  - The impact of dependence