Course Information

18.600: Probability and Random Variables
Fall 2020

1 Instructors

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2 Basic Course Information

Course Website: http://course.mit.edu/18.600

Other Websites:
Piazza: piazza.com/mit/fall2020/18600
Gradescope: https://www.gradescope.com/courses/179128

Lectures: MWF 10:00–11:00
Lectures will be asynchronous and posted by the usual class time. In addition, I will run a Zoom session during the Friday lecture times (starting 9/11) to work through examples and answer questions. These sessions will be recorded and accessible through the course website.

Recitations: Recitations will be on Thursdays (starting 9/10). They are optional but strongly encouraged. You can go to any recitation, but it would help with load balancing for you to attend the one to which you are assigned.

Prerequisites: 18.02 or permission of the instructor

3 Course Description

This course introduces the mathematical framework of probability and random variables. It aims to provide a rigorous axiomatic development of the theory while, at the same time, building intuition and problem solving skills.

Some of the topics that we shall cover include: probability spaces; discrete and continuous random variables; distribution functions; conditional probabilities; Bayes' rule; joint distributions; expectations, variances, and higher moments; uniform, binomial, geometric, Poisson, exponential and Gaussian distributions; Markov, Chebyshev, and Chernoff inequalities; the law of large numbers and the central limit theorem; Markov chains; and the probabilistic method.

4 Textbook

The textbook for this class is *A First Course in Probability, 9th Edition*, by Sheldon Ross. Since I know that textbooks are expensive and earlier editions are often available much more cheaply, I will do my best to support the 6th, 7th, and 8th editions too.

5 Grading

Problem Sets (30%) There will be 9 problem sets, handed out approximately once a week and due on Gradescope by the beginning of lecture on Fridays. (See the course web page for the precise dates.)

- Collaboration on homeworks is encouraged. However, you should think about the problems yourself before discussing them with others. Furthermore, **you must write up your solutions by yourself and understand anything that you hand in**. If you do collaborate, you must acknowledge your collaborators in your write-up.
- Use of outside sources is strongly discouraged. If, however, you do use an outside source, you must reference it in your solution. **Use of course bibles or materials from previous semesters is absolutely not allowed.**
- For each question on the problem set, please write a list of everyone with whom you collaborated on that problem. If you did not collaborate with anyone, please explicitly write, "No collaborators."
- Late homeworks will be accepted up until 11:59pm (EDT) on the Monday directly after the problem set is due. However, there will be a 10% late penalty. For anything later than that, you will need to make specific arrangements with the course staff or have a note from the Dean's Office.
- **All assignments are required and no grades are dropped.** Please turn in every problem set, as averaging a zero into your problem set score significantly decreases your grade.

Two Quizzes (20% each) We will have two quizzes. Quiz #1 will be on October 9th, and Quiz #2 will be on November 6th.

Final Exam (30%) There will be a final exam during Finals Week.

6 Schedule

The following is rough breakdown of how long we will spend on the different topics in the class, along with the portions of the textbook to which they correspond:

- *Chapters 1 and 2:* Introduction, background, axioms and basic properties of probability, and combinatorial analysis (6 lectures)
- *Chapter 3:* Conditional probability, independence, and Bayes' rule (3 lectures)
- *Chapter 4:* Discrete random variables, expectation and variance, Bernoulli, Poisson, binomial, and geometric random variables (4 lectures)
- *Chapter 5:* Continuous random variables and their expectations and variances, uniform, normal, and exponential random variables (4 lectures)

- *Chapter 6:* Joint distributions, independent random variables, and conditional distributions (3 lectures)
- *Chapter 7:* Properties of expectation: linearity of expectation, correlation, conditional expectation and variance, moment generating functions, and joint distributions of normal random variables (6 lectures)
- *Chapter 8:* Limit theorems, Markov, Chebyshev and Chernoff bounds, the weak and strong laws of large numbers, and the central limit theorem (4 lectures)
- *Chapters 9, 10, and beyond:* Additional topics determined by student interest and time remaining. Likely possibilities include Markov processes, simulation, and the probabilistic method (4 lectures)