

**General Info**

*Instructor:* Professor David Grant, grant@colorado.edu

*Office Hours:* M 12:30-1:30, W 2:30-3:30, (or by appointment), in Math 303 (x2-7208).

*Class Meetings:* MWF 9-9:50 PM in MUEN E417.

*Text:* S. Ross, A First Course in Probability (Pearson, 10th Edition) We will cover most of Chapters 1 through 7, and as much of Chapter 8 as we can. The book is one of the recommended texts for Actuarial Exam P.

**Prerequisites.**

Multivariable calculus and linear algebra (MATH 2400 or APPM 2350 and MATH 2130 or 3130 or MATH 2135 or 3135).

**About the course: A topical outline.**

Roughly speaking, probability is the mathematics of *chance*. In particular, probability is a powerful tool for understanding and making sense of the chances that an outcome (or set of outcomes) of a particular experiment will occur.

The easiest case to consider is when an experiment has a finite set of outcomes, and this will occupy our attention for Chapters 1-4. If all outcomes are equally likely, finding the probability of a set of outcomes occurring comes down to counting the size of the set, and we will learn about counting strategies in Chapter 1 as we cover 1.1-1.5.

In Chapter 2 we'll learn the axioms of probability so we can analyze the more general case when not all outcomes are equally likely. The set of all outcomes and their probabilities of occurring is called a *sample space*, and we'll cover 2.1-2.5.

In Chapter 3 we will learn how to modify probabilities of outcomes when we are provided with additional information. This is called *conditional probability* and we'll cover sections 3.1-3.4

In Chapter 4 we study *random variables*, which are functions on sample spaces, for example, the sum of the values you get when you roll two fair dice is a random variable. In particular we'll study the notion of the *expected value* of a random variable (for the sum of the two dice, it's 7) and the *variance* of a random variable, which measures how likely the values of the random variable are to be close to the expected value. We'll cover sections 4.1-4.8, which includes discussions of *distributions* of random variables, and important distributions like the *binomial* and *Poisson* distributions.

In chapter 5 we'll revisit all these notions for *continuous random variables*, which now have an infinite number of outcomes. For example, if you throw a dart at a dart board, there are infinitely many places it can hit, but you can still make sense of the probability of hitting a bull's-eye or of the expected number of points one would get on each throw. We'll cover sections 5.1-5.5 and 5.7, which includes discussions of the *uniform* and ubiquitous *normal* distributions (among others).

In chapter 6 we will study *jointly distributed* random variables, where we model the many real-life situations when we're concerned simultaneously with the outcomes of more than one experiment. We'll cover sections 6.1-6.5.

In Chapter 7 we will cover sections 7.1-7.7, which will introduce the important notions of *covariance* and *correlation* of a pair of random variables, and the magical tool of *moment generating functions*, which we will use in chapter 8.

Finally in Chapter 8, we will develop the mathematical tools to state and prove the main theoretical results in the course, including the *Central Limit Theorem*, which says that the distribution of the average of  $n$  identically distributed variables approaches the normal distribution as  $n \rightarrow \infty$ , and the *Weak and Strong Laws of Large Numbers*, which says that the average of identically distributed random variables converges to their common mean. This is probably most people's intuitive notion of what probability is.

### **Class meetings.**

This course will meet three days a week. This course will employ aspects of *active learning*, a technique that has proven more successful for student learning than just listening to lecturing in a course. Students spend classtime working on problems, both alone and with a partner, and then sharing ideas with the class. I will therefore not lecture all the time and have you each actively working the rest of the time.

For this reason, attendance will be mandatory. Also, I will not lecture on everything in the book, so you will be responsible for reading the material in the book before classtime — I will answer questions on the material and go over the main points and do some examples. (The book is excellent and very comprehensible.)

### **Course requirements and grading.**

Homework will be assigned daily, and will be due the following Wednesday. All the assignments will appear on the website: [euclid.colorado.edu/~grant/courses/4510/](http://euclid.colorado.edu/~grant/courses/4510/), as will the daily outline of the course. Note that the book has three types of problems for each chapter: (1) Problems (some have answers in the back); (2) Theoretical Exercises; and (3) Self-Test Problems and Exercises (solutions in the back). Homeworks will consist of problems from (1) and (2), but (3) are useful for you to work through each week (and to study for tests).

There will be three hour exams during our regular class time and in our usual room. The first will be on Friday, September 20, the second will be on Friday, October 18, and the third on Friday, November 15. There will be a final exam, in our regular classroom, from 1:30 p.m. till 4 p.m. on Wednesday, December 18. Your final grade in this course will be determined by your total score out of 600 possible points. These points are broken down as follows: Homeworks count for a total of 100 points, the three hour exams will each be worth 100 points, and the final exam will make up the remaining 200 points. The final will, unlike the hour exams, be cumulative, with an emphasis on the material covered after the third exam.

You are allowed (even encouraged) to work together on homework assignments, but each of you must write up the solutions separately. In good academic fashion, if you do work with someone on a problem, just be sure to say on your homework who you worked with. Likewise, if you accidentally come across a similar problem online, just make sure to say so, and write the solution up yourself. Copying anyone else's solution or failing to say who you worked with or where you got help, will be considered a violation of the Honor

Code and will be dealt with as such. Such behavior also always becomes readily apparent on test performance.

Students enrolled in the graduate Math 5510 version of the course will have to do extra “in-depth” homework problems (which must be submitted on a separate page) or learn and then do problems from sections we skip in class. MATH 5510 students will also have some different problems on the tests.

### **Et Cetera:**

The last day to drop a course for a 100% refund (but \$200 fee) and without a “W” on your transcript is September 11. See <https://www.colorado.edu/registrar/students/withdraw> for costs associated to withdrawals after that date.

### **Required Syllabus Statements**

**ACCOMMODATION FOR DISABILITIES** If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to me in a timely manner so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the Disability Services website. Contact Disability Services at 303-492-8671 or [dsinfo@colorado.edu](mailto:dsinfo@colorado.edu) for further assistance. If you have a temporary medical condition or injury, see Temporary Medical Conditions under the Students tab on the Disability Services website.

**CLASSROOM BEHAVIOR** Students and faculty each have responsibility for maintaining an appropriate learning environment. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. Class rosters are provided to the instructor with the student’s legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records. For more information, see the policies on classroom behavior and the Student Code of Conduct.

**HONOR CODE** All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the Honor Code. Violations of the policy may include: plagiarism, cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, submitting the same or similar work in more than one course without permission from all course instructors involved, and aiding academic dishonesty. All incidents of academic misconduct will be reported to the Honor Code ([honor@colorado.edu](mailto:honor@colorado.edu); 303-492-5550). Students who are found responsible for violating the academic integrity policy will be subject to nonacademic sanctions from the Honor Code as well as academic sanctions from the faculty member. Additional information regarding

the Honor Code academic integrity policy can be found at the Honor Code Office website. I will expect each student to sign the pledge of the honor code on each exam.

**SEXUAL MISCONDUCT, DISCRIMINATION, HARASSMENT AND/OR RELATED RETALIATION** The University of Colorado Boulder (CU Boulder) is committed to fostering a positive and welcoming learning, working, and living environment. CU Boulder will not tolerate acts of sexual misconduct intimate partner abuse (including dating or domestic violence), stalking, protected-class discrimination or harassment by members of our community. Individuals who believe they have been subject to misconduct or retaliatory actions for reporting a concern should contact the Office of Institutional Equity and Compliance (OIEC) at 303-492-2127 or [cureport@colorado.edu](mailto:cureport@colorado.edu). Information about the OIEC, university policies, anonymous reporting, and the campus resources can be found on the OIEC website. Please know that faculty and instructors have a responsibility to inform OIEC when made aware of incidents of sexual misconduct, discrimination, harassment and/or related retaliation, to ensure that individuals impacted receive information about options for reporting and support resources.