STAT 4300: Probability
Sections 003 and 004
Fall 2023 syllabus (version 2, Aug. 27)

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Classes:	Section 003: TR 3:30–5:00 pm, JMHH 270 Section 004: TR 5:15–6:45 pm, JMHH 270
Office hours:	To be announced

Prerequisite

Multivariable calculus (for example, MATH 1080, 1410, 1510, or 1610).

Required textbook

Joseph K. Blitzstein and Jessica Hwang, *Introduction to Probability*, Second Edition (2019)

- You can buy or rent the book from Penn Bookstore, Amazon, or other sellers, or you can view a free online version at `http://probabilitybook.net`.
- Another option (if you'd like to read the book on paper but find the 2nd edition too expensive to buy or rent) is to get a used copy of the 1st (2014) edition. The two editions are very similar, so the 1st edition is fine for studying the material. But you'll still need to consult the free online version of the 2nd edition to make sure you're working on the right homework problems (otherwise, you'll get zero credit for solving the wrong problem).

- Regardless of whether you use a hardcopy or online version, I recommend always having a pen(cil) and paper handy. Mathematical books at this level often leave out steps, assuming you can fill in the steps on your own. When I read books on probability or statistics, I usually need to scribble notes in the margins or on scratch paper (figuring out missing steps, trying out simple examples or diagrams, etc.). You don't need to fill in every missing step on your own (I'll help with some of them in class), but you're likely to learn more if you nudge yourself to *try* to fill in some steps. (You may be pleasantly surprised to find that you can fill in more than you expected.)
- You don't need to follow every line and example in the book (my lectures and slides will cover the concepts required for our course), but I strongly recommend at least attempting to study it. My slides are mostly based on the book and are meant to help you understand the main ideas, but they're not a substitute for it.
- Joe Blitzstein's website `https://stat110.net` has links to many helpful resources, including lecture videos and animations. These are optional, but some of you may find them helpful (and the animations are very cute!).

Class recordings and attendance policy

Recordings of all classes will be available on Canvas for all students. Feel free to watch either the 003 or the 004 class recordings, regardless of which section you're enrolled in.

Attendance in lecture isn't required, so you don't need my permission to miss a regular class. If you miss class, I recommend that you watch one of the recordings, study the textbook, or both. (See my comments below about the "news.pdf" file, which will list the relevant book sections.) My lecture slides don't include everything I cover in class (I use the whiteboard a lot).

Attendance *is* required for our two in-class midterm exams. Please mark the dates (Sept. 28 and Nov. 2) in your calendar.

Other resources on Canvas

Lecture slides, problem sets, solutions, and announcements will be posted on Canvas. I'll also post a file called "news.pdf" explaining which portions of the textbook you should be reading, which slides were covered in class, and so on. I'll add a new entry after each lecture (either that evening or the next morning). Following the "news" file is a good way to keep up to date with the course.

Requirements and grading

First midterm exam (Thurs., Sept. 28, in class) : 27%

Second midterm exam (Thurs., Nov. 2, in class): 33%

Final exam: 35%

- The university will announce final exam dates in late September or early October. In the meantime, please avoid scheduling travel during exam period (I won't give exams early).

Problem sets (dropping the two lowest scores): 5%

- Problem sets will be due Fridays at 5 pm (with exceptions such as the first two weeks and the weeks of exams) and should be submitted electronically on Gradescope.
  The first problem set will be due Friday, Sept. 15, and will be posted a week earlier.
  We'll post information about how to submit your work.
- You're encouraged to discuss problem sets with classmates (this can be a good way to learn), but you must write your solutions independently and in your own words.
  If you discuss a problem set with other students, please write an acknowledgment listing their names.
- Copying solutions (from other students, artificial intelligence tools, or other resources) is prohibited. It's okay to get help, but you need to learn something in the process and understand your own answers. Again, you must write your solutions in your own words. Also, please acknowledge anyone who helped you or discussed the problem set with you (other than the instructor and TAs), as well as any written resources or AI tools you consulted (other than the textbook and other resources on Canvas). The acknowledgment for an AI tool should be specific, giving the name and version of the tool and explaining how you used it.
- At this time, even the best AI tools aren't reliable for solving our homework problems (but they always *sound* intelligent!). If you need help, I recommend coming to office hours instead of consulting AI tools. Our TAs and I are happy to help students with homework problems and concepts. (Also, some students have made friends at office hours.)
- Late problem sets won't be accepted unless there are extenuating circumstances (e.g., an illness or family emergency). As mentioned above, we'll drop your two lowest scores. So, although you'll receive a score of zero for any late homework that we don't accept, that score will be dropped unless you already have two or more zeros.

Electronic device policy

It's okay to use tablets (iPads, etc.) to take notes in class. Please keep them flat on the table and use them only for note-taking.

I prefer that students not use phones or laptops in class, because these can be distracting for all of us.[1] Exceptions will be made if you need to use a laptop because of a disability or other reason (feel free to let me know).

(My phone will be in airplane mode during class. If it looks like I'm using my phone, I'm just turning off an alarm that I set to keep myself from running overtime.)

Email

Emails are fine for some administrative questions and very straightforward conceptual questions (e.g., when you think there's a typo in a homework problem). When you have conceptual questions that require more explanation, it's better to talk (during class, at office hours, or by appointment).

Also, we won't always be able to answer emails immediately, so please anticipate that it may take us a day or so to reply.

Outline

This is just an outline of our main topics. (We won't cover every section of these chapters. In the "news.pdf" file on Canvas, I'll give more specific advice on what to read.)

- Probability and counting (Ch. 1): Review of set theory and combinatorics. Sample spaces and events. "Naive" definition of probability (equally likely outcomes). "Non-naive" (axiomatic) definition of probability. Inclusion–exclusion principle.
- Conditional probability (Ch. 2): Definition. Bayes' rule. Law of total probability. Independence of events.
- Random variables and their distributions, with a focus on the discrete case (Ch. 3): Definition. Probability mass functions. Binomial and hypergeometric distributions. Cumulative distribution functions. Functions of random variables. Independence of random variables.
- Expectation (Ch. 4): Definition. Linearity. Geometric, negative binomial, and Poisson distributions. Variance and standard deviation.

[1] The economist Susan Dynarski gave a thoughtful discussion of research on how students' use of laptops in class may affect their own and their classmates' learning:
www.brookings.edu/research/for-better-learning-in-college-lectures-lay-down-the-laptop-and-pick-up-a-pen

- Continuous random variables (Ch. 5): Probability density functions. Continuous uniform, normal, and exponential distributions. "Universality of the uniform" (probability integral transform and its inverse).
- Moment generating functions (Ch. 6).
- Joint distributions (Ch. 7): Joint, marginal, and conditional distributions. Covariance and correlation. Multivariate normal distribution.
- Transformations (Ch. 8): Change of variables. Convolutions.
- Conditional expectation (Ch. 9): Conditional expectation given an event. Conditional expectation given a random variable. Law of iterated expectations ("Adam's law"). Conditional variance and law of total variance ("Eve's law").
- Inequalities and limit theorems (Ch. 10): Markov's and Chebyshev's inequalities. Laws of large numbers. Central limit theorem.