

STAT 131-01
Introduction to Probability Theory
Winter, 2023

Course Meeting Times: Tuesday/Thursday 11:40 — 1:15

Location: Classroom Unit 001

Website: Through Canvas

Instructor: Prof. Zehang “Richard” Li

Office: E2 537B

Office Hours:

Tuesday 2:30 - 3:30 on Zoom

Thursday 2:30 - 3:30 at E2 537B

E-mail: lizehang@ucsc.edu

TA: Zach Horton

Sections: A, B, E

TA Office Hours: Monday 11:00 - 12:00 location TBD

E-mail: whorton@ucsc.edu

TA: Seokjun Choi

Sections: C, D, F

TA Office Hours: Friday 12:00 - 1:00 location TBD

E-mail: schoi90@ucsc.edu

Graders:

Jingkai Guo (jguo70@ucsc.edu)

Hayley Coyle (hacoyle@ucsc.edu)

Group Tutor:

Andrew Lee Hu (anlhu@ucsc.edu)

Tu/Th 9:30 - 11:00, location TBD

Priyesh Rajesh Vakharia (pvakhari@ucsc.edu)

M/W 9:30 - 11:00, on Zoom

Course Description:

This is an introductory course to probability theory and its applications. The course aims to introduce the basic ideas of probability, distribution theory, and their applications. The main goal is to develop basic mathematical tools to consider models incorporating uncertainty using a probabilistic framework. Some of the topics that will be covered include combinatorial analysis, axioms of probability and independence, conditional probability, Bayes’ theorem, random variables (discrete and continuous), joint probability distributions, properties of expectation, the central limit theorem, the law of large numbers, and Markov chains.

Prerequisites: Economics 11B or Mathematics 11B or 19B.

Learning outcomes:

- Be familiar with the basic approaches to the definition of probability.
- Understand basic theory to construct probability models for discrete and continuous random variables.
- Be able to use distribution functions.
- Be able to apply the meaning and the applications of joint probability and joint distribution functions.
- Be able to apply the concepts and expectations with respect to a given probability function.
- Understand the meaning and be able to apply the concept of conditional and marginal probability functions.
- Understand and be able to apply the central limit theorem, the law of large numbers, and the concept of Markov Chains.
- Simulate probability models by writing original computer code.

Textbook: Lectures are designed to supplement the textbook reading, not substitute for it. Please make sure you have access to the following materials to complete readings and homework:

- Joe Blitzstein and Jessica Hwang (2014). *Introduction to Probability*. Second Edition. Chapman & Hall. Link to PDF: <https://drive.google.com/file/d/1VmkAAG0YCT0Rq1wxSQqy255qLJjTNvBI/view>

Some useful additional references:

- M.H. DeGroot and M.J. Schervish (2002). *Probability and Statistics*. Fourth Edition. Addison Wesley.
- S. Ross (2010). *A First Course in Probability* (eighth edition). Prentice Hall
- Dekking, MA (2007). *Modern Introduction to Probability and Statistics: Understanding Why and How*.

Laptop or Desktop Computer: You will need a computer for labs. Students who need a laptop can make use of the library's borrow program: <https://library.ucsc.edu/services/computing/borrow-a-laptop>

You will need a computer with Zoom, Canvas, and Google Suite access. Zoom links will be posted in Canvas, when necessary. R and Rstudio installed in the computer recommended. <https://rstudio-education.github.io/hopr/starting.html>

Assessment and Grading:

- **Homework:** The best way to learn how to apply probability theory is by practicing. The homework is intended to give you more practice. Homework will be assigned, collected via Canvas, and graded by completion. You are encouraged to work together on homework. Just to remind you, you have to take quizzes individually, so the point of the homework is to learn and practice the material. Every time HW is due, TAs will do class calls to check the responses of each homework. If you cannot explain your HW, you won't get points for it.
- **Quizzes:** There will be short (generally 20 minutes) quizzes based on the textbook readings, given four times during the quarter via Canvas. You will have an open window of 12 hours to take the quiz, and you can choose to do it when it is more convenient for you. Each quiz will be based on material from the previous week (see course schedule for more info). Many questions will be based on class problems with small changes. The quizzes are open-book, and you may use a calculator, R, or your notes. Your lowest quiz score will be dropped when computing your quiz average, which is meant to account for nearly all reasons you might miss class, including illness. Just so you know, if you miss a quiz, there will not be any way to repeat it.
- **Labs:** Each TA will explain the labs during their discussion sessions for you to complete during the week. Each lab will be submitted using GradeScope. Please make sure to label your answers according to this video: <https://help.gradescope.com/article/ccbpppziu9-student-submit-work>. These labs are the most important part of your grade, so please make sure you are always in communication with your TA. Lab regrades: you have one week after the labs are graded to request a regrade. After that, you cannot request a regrade. Please take this into account.
- **Midterm and Final Exam:** we will have two in-person exams. It will include questions from quizzes and homework.

Grading Policy:

- Homework 8%: 4 assignments via Canvas, checked by completeness, open 1 week from Wednesday to Wednesday. Calls during Discussion Sections to check answers. Late assignments will lose 1 point per day.
- Quizzes 12%: 4 in total, online on Friday, from 12:00 - 24:00. One lowest score dropped, no retakes are possible.
- Labs 30%: 7 in total, due on Tuesday from next week. One lowest score dropped.

- Midterm Exam 15%: in person, **Tuesday Feb 14th** during class time. If you cannot make it because of illness, you will be given one makeup opportunity one week after the original date.
- Midterm Exam wrapper 5%: due a week after midterm grades are posted.
- Final Lab 10%: one final lab, due the Tuesday in the finals week.
- Final Exam 20%: in person, **Monday, Mar 20th** from 8:00 am to 11:00 am in our usual classroom.

Extra points: There will be extra credit opportunities. Extra credit is a way to help you through any difficulty that you might encounter and to support you in case you miss some assignments. Note, however, there will be no curves, no rounding, no extra assignments, and no changes when the final grades are posted.

- SETs 2% if more than 75% of the class completes them before the deadline.
- Quiz 0 1% a questionnaire to complete during the first week of classes
- Syllabus Quiz 1% a quiz about the syllabus
- Mid Quarter Survey 2% a survey to see what's working and what's not
- Extra Credit Question 4% two questions assigned during lectures

Grades Timeline:

- Deadline for lab regrades (via gradescope): one week after grades are posted
- Deadline for final lab regrades (via gradescope): March 22th, 11:59PM
- Any other questions about grades are accepted before March 27th, 11:59PM
- Grades will be posted on the system early on March 28th. I cannot modify any grades after that.

Course Letter Grade: We will use the following letter grade conversion table. It may be slightly adjusted at the end of the course.

Letter	Score	Letter	Score
A+	[100, 110]	C+	[70, 75)
A	[95, 100)	C	[65, 70)
A-	[90, 95)	C-	[60, 65)
B+	[85, 90)	D	[50, 60)
B	[80, 85)	F	[0, 50)
B-	[75, 80)		
P	[65, 110]	NP	[0, 65]

Student Hours: This is a 5-unit course. It will require 3 hours of lecture, 5 hours of reading, 1 hour of section, and 6 hours of homework per week.

Instructor Feedback: The graders will provide direct comments and feedback on the discussion sections assignments. Homework will be graded by completion, but you can always use office hours to clarify any answers. Exams will be graded by the TAs and the instructor.

Student Feedback: At the end of the quarter you will be asked to complete a Student Experience of Teaching survey for this course. SETs provide an opportunity for you to give valuable feedback on your learning that is honest and constructive. This anonymous feedback will help me consider modifications to the course that will help future students learn more effectively.

Tips to Succeed in This Course:

- Read the suggested chapters from the textbook every week.
- Attend class, and be an active participant during lectures and discussion sessions.
- Read the syllabus and understand the evaluation of the class.
- Work on the HW problems and labs weekly; this will make studying for the quizzes very easy. Find a study group and commit to it; this will make the work easier. Learning is always better with a learning community.
- Work on your formula sheet every week. Include theorems, definitions, formulas, and properties discussed in each class.
- Don't leave questions about the material unanswered; you have office hours from the TAs and the instructor to ask them.
- If you feel like you are getting lost in the class, attend the MSI tutoring sessions: <https://lss.ucsc.edu/lss-tutor-hub/index.html>

Week-by-week Schedule:

The reading chapters refer to the Blitzstein & Hwang textbook. Weekly suggested exercises are omitted from the schedule below and will be posted on Canvas. Homework and Lab listed in a given week refers to them being released that week and due the following week.

1. What is probability
 - Reading: 1.1 – 1.6, Appendix A.
 - Tasks: Surveys. Syllabus quiz. Math review. Installing R. HW 1 (Ch 1).
2. Conditional probability
 - Reading: 2.1 – 2.8, Appendix B.
 - Tasks: Lab 1 (Appendix A)
3. Random variables and their distributions
 - Reading: 3.1 – 3.8
 - Tasks: Quiz 1 (Ch 1 and 2). Lab 2 (Ch 1 and 2)
4. Expectation and Continuous random variables
 - Reading: 4.1 – 4.8, 5.1 – 5.4
 - Tasks: HW 2 (Ch 3 and 4). Lab 3 (Ch 3 and 4)
5. Continuous random variables and moments
 - Reading: 5.5 – 5.7, 6.1 – 6.6
 - Tasks: HW 3 (Ch 5 and 6)
6. Joint distributions
 - Reading: 7.1
 - Tasks: **Midterm (Ch 1 to 5.4)**, Lab 4 (Ch 5 and 6)
7. Joint distributions
 - Reading: 7.2 – 7.5
 - Tasks: Midterm exam wrapper. Quiz 2 (Ch 5 and 6). Lab 5 (Ch 7)
8. Transformations
 - Reading: 8.1 – 8.6
 - Tasks: Homework 4 (Ch 7 and 8). Lab 6 (Ch 8)
9. Conditional expectations and limit theorems
 - Reading: 9.1 – 9.6, 10.1 – 10.4
 - Tasks: Quiz 3 (Ch 7 and 8). Lab 7 (Ch 9 and 10)
10. Markov Chains
 - Reading: 11.1 – 11.4
 - Tasks: Quiz 4 (Ch 9 and 10). Final Lab (Ch 11). SETs.

Academic Integrity

All members of the UCSC community benefit from an environment of trust, honesty, fairness, respect, and responsibility. You are expected to present your own work and acknowledge the work of others in order to preserve the integrity of scholarship.

Academic integrity includes:

- Following exam rules
- Using only permitted materials during an exam
- Viewing exam materials only when permitted by your instructor
- Keeping what you know about an exam to yourself
- Incorporating proper citation of all sources of information
- Submitting your own original work

Academic misconduct includes, but is not limited to, the following:

- Disclosing exam content during or after you have taken an exam
- Accessing exam materials without permission
- Copying/purchasing any material from another student, or from another source, that is submitted for grading as your own
- Plagiarism, including use of Internet material without proper citation
- Using cell phones or other electronics to obtain outside information during an exam without explicit permission from the instructor
- Submitting your own work in one class that was completed for another class (self-plagiarism) without prior permission from the instructor.
- Violations of the Academic Integrity policy can result in dismissal from the university and a permanent notation on a student's transcript. For the full policy and disciplinary procedures on academic dishonesty, students and instructors should refer to the Academic Misconduct page at the Division of Undergraduate Education.

Accessibility

UC Santa Cruz is committed to creating an academic environment that supports its diverse student body. If you are a student with a disability who requires accommodations to achieve equal access in this course, please submit your Accommodation Authorization Letter from the Disability Resource Center (DRC) to me privately during my office hours or by email, preferably within the first two weeks of the quarter. At this time, I would like us to discuss ways we can ensure your full participation in the course. I encourage all students who may benefit from learning more about DRC services to contact the DRC by phone at 831-459-2089 or by email at drc@ucsc.edu.

Intellectual Property

The materials in this course are the intellectual property of their creators. As a student, you have access to many of the materials in the course for the purpose of learning, engaging with your peers in the course, completing assignments, and so on. You have a moral and legal obligation to respect the rights of others by only using course materials for purposes associated with the course. For instance, you are not permitted to share, upload, stream, sell, republish, share the login information for, or otherwise disseminate any of the course materials, such as: video and audio files, assignment prompts, slides, notes, syllabus, simulations, datasets, discussion threads. Conversely, any materials created solely by you (for example, your videos, essays, images, audio files, annotations, notes) are your intellectual property and you may use them as you wish.

Religious Accommodation

UC Santa Cruz welcomes diversity of religious beliefs and practices, recognizing the contributions differing experiences and viewpoints can bring to the community. There may be times when an academic requirement conflicts with religious observances and practices. If that happens, students may request reasonable accommodation for religious practices. The instructor will review the situation in an effort to provide a reasonable accommodation without penalty. You should first discuss the conflict and your requested accommodation with your instructor early in the term. You or your instructor may also seek assistance from the Dean of Students office.

All-gender restrooms

UC Santa Cruz is committed to the well-being of all students and cares about all students feeling safe and welcome, regardless of their gender identity, expression, and/or embodiment. The Lionel Cantú Queer Center has worked with students and campus staff to create more safe and accessible restrooms for transgender and genderqueer students, staff, faculty, alumni, and UCSC visitors. A complete list of all-gender restrooms on campus was compiled and is maintained by the Cantú Queer Center: <https://genderinclusive.ucsc.edu/inclusive%20facilities/images/gif-list-5-17-17.pdf>

Principles of Community

The University of California, Santa Cruz expressly prohibits students from engaging in conduct constituting unlawful discrimination, harassment or bias. More here. I am committed to providing an atmosphere for learning that respects diversity and supports inclusivity. We need to work together to build this community of learning. I ask all members of this class to:

- be open to and interested in the views of others
- consider the possibility that your views may change over the course of the term
- be aware that this course asks you to reconsider some “common sense” notions you may hold
- honor the unique life experiences of your colleagues

- appreciate the opportunity that we have to learn from each other
- listen to each other's opinions and communicate in a respectful manner
- keep confidential discussions that the community has of a personal (or professional) nature
- ground your comments in the texts we are studying. Refer frequently to the texts and make them the focus of your questions, comments, and arguments. This is the single most effective way to ensure respectful discussion and to create a space where we are all learning together.

Title IX/CARE Advisory

UC Santa Cruz is committed to providing a safe learning environment that is free of all forms of gender discrimination and sexual harassment, which are explicitly prohibited under Title IX. If you have experienced any form of sexual harassment, sexual assault, domestic violence, dating violence, or stalking, know that you are not alone. The Title IX Office, the Campus Advocacy, Resources & Education (CARE) office, and Counseling & Psychological Services (CAPS) are all resources that you can rely on for support.

Please be aware that if you tell me about a situation involving Title IX misconduct, I am required to share this information with the Title IX Coordinator. This reporting responsibility also applies to course TAs and tutors (as well to all UCSC employees who are not designated as "confidential" employees, which is a special designation granted to counselors and CARE advocates). Although I have to make that notification, you will control how your case will be handled, including whether or not you wish to pursue a formal complaint. The goal is to make sure that you are aware of the range of options available to you and that you have access to the resources you need.

Confidential resources are available through CARE. Confidentiality means CARE advocates will not share any information with Title IX, the police, parents, or anyone else without explicit permission. CARE advocates are trained to support you in understanding your rights and options, accessing health and counseling services, providing academic and housing accommodations, helping with legal protective orders, and more. You can contact CARE at (831) 502-2273 or care@ucsc.edu.

In addition to CARE, these resources are available to you:

- If you need help figuring out what resources you or someone else might need, visit the Sexual Violence Prevention & Response (SAFE) website, which provides information and resources for different situations.
- Counseling & Psychological Services (CAPS) can provide confidential counseling support. Call them at (831) 459-2628.
- You can also report gender discrimination and sexual harassment and violence directly to the University's Title IX Office, by calling (831) 459-2462 or by using their online reporting tool.

- Reports to law enforcement can be made to the UC Police Department, (831) 459-2231 ext. 1.
- For emergencies, call 911.

Report an Incident of Hate or Bias

The University of California, Santa Cruz is committed to maintaining an objective, civil, diverse and supportive community, free of coercion, bias, hate, intimidation, dehumanization or exploitation. The Hate/Bias Response Team is a group of administrators who support and guide students seeking assistance in determining how to handle a bias incident involving another student, a staff member, or a faculty member. To report an incident of hate or bias, please use the following form: Hate/Bias Report Form.

Counseling and Psychological Services

Many students at UCSC face personal challenges or have psychological needs that may interfere with their academic progress, social development, or emotional well-being. The university offers a variety of confidential services to help you through difficult times, including individual and group counseling, crisis intervention, consultations, online chats, and mental health screenings. These services are provided by staff who welcome all students and embrace a philosophy respectful of clients' cultural and religious backgrounds, and sensitive to differences in race, ability, gender identity and sexual orientation.

Student Success and Engagement Hub

The Division of Student Success provides campus-wide coordination and leadership for student success programs and activities across departments, divisions, the colleges, and administrative units.

Slug Support Program

College can be a challenging time for students and during times of stress it is not always easy to find the help you need. Slug Support can give help with everything from basic needs (housing, food, or financial insecurity) to getting the technology you need during remote instruction. To get started with SLUG Support, please contact the Dean of Students Office at 831-459-4446 or you may send us an email at deanofstudents@ucsc.edu.

Slug Help/Technology

The ITS Support Center is your single point of contact for all issues, problems or questions related to technology services and computing at UC Santa Cruz. To get technological help, simply email help@ucsc.edu.

On-Campus Emergency Contacts

Slug Help/Emergency Services. For all other help and support, including the health center and emergency services, start here (<https://www.ucsc.edu/help/>). Always dial 9-1-1 in the case of an emergency.

Tutoring

There is tutoring available for this class, provided by Learning Support Services (LSS)! Learning Support Services Tutors are an important part of the teaching team and are here to help you be successful. Large Group Tutoring is for everyone and open to all students in class to get extra practice on the things you already know or the things you want to know better. Your tutor(s) is an undergraduate student who took the class, did well, and received extensive training on how to help you learn! Sessions are one-hour long, available several days a week and attendance is voluntary; however, students who attend sessions weekly tend to earn a higher final grade than students who do not participate. Ask your tutor for more information about session times, visit our website, or visit us in person at the ARCenter or remotely at our Virtual Front Desk, M-F 9am-6pm. You can also view your Tutor's schedule on The Tutor Hub.