PSTAT 120B

MATHEMATICAL STATISTICS, I
SUMMER SESSION A, 2024

Instructor: Ethan P. Marzban (he/him)

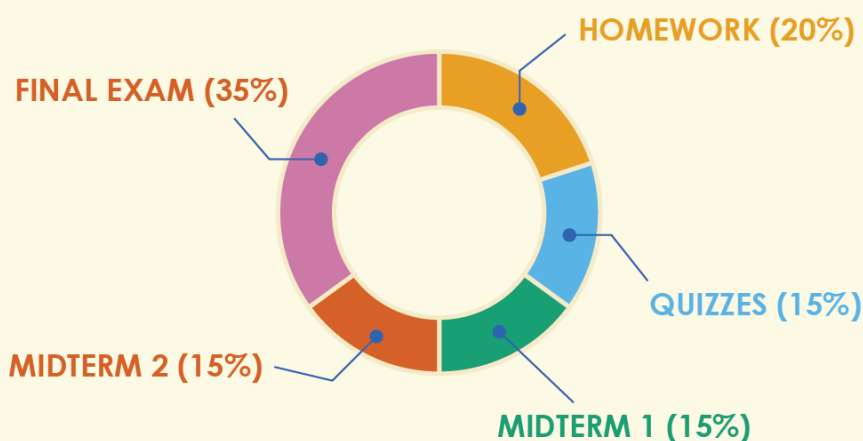**Course Site:** pstat120b.github.io

WEEKLY MEETINGS

M, T, W, Th, 12:30 - 1:35 pm in ILP 1302

TEACHING ASSISTANTS

- Jean (Hyuk) Choe (he/him)   2pm & 3pm Sections
- Minwoo Park (he/him)   4pm & 5pm Sections

TENTATIVE GRADE BREAKDOWN

HOMEWORK (20%)

FINAL EXAM (35%)

QUIZZES (15%)

MIDTERM 2 (15%)

MIDTERM 1 (15%)

Approximate Grade Cutoffs

- A^- – A^+: [90, 100]
- B^- – B^+: [80, 90)
- C^- – C^+: [70, 80)
- D^- – D^+: [60, 70)
- F: [0, 60)

Cutoffs may be adjusted at the end of the quarter, depending on class performance.

OVERVIEW OF REQUIRED ASSIGNMENTS

WE WANT YOU TO SUCCEED! To that end, we have designed a wide array of different assignment types which will be used to periodically check-in with you and your understanding of the course. These assignments are:

HOMEWORK ASSIGNMENTS

Designed to give you an opportunity to practice the material introduced in lecture and section.

QUIZZES

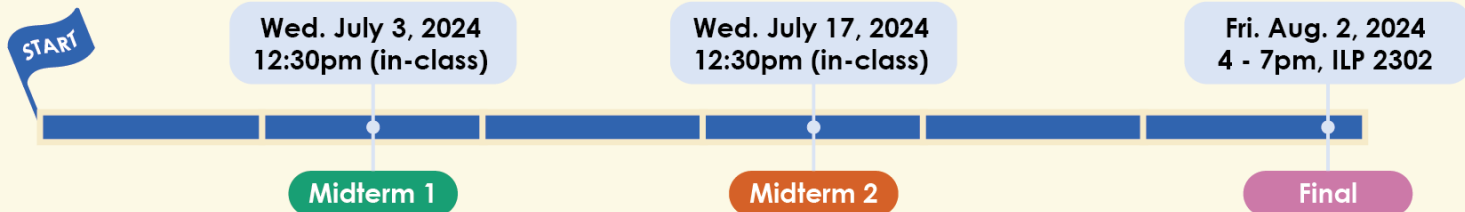Administered weekly in non-exam weeks; designed to assess your retention of course material.

MIDTERM EXAMS

Larger in scope than quizzes, and designed to assess your ability to connect course concepts.

FINAL EXAMINATION

Designed to check your retention of the entire course, and to assess your ability to proceed to more advanced PSTAT courses

START

Wed. July 3, 2024
12:30pm (in-class)

Wed. July 17, 2024
12:30pm (in-class)

Fri. Aug. 2, 2024
4 - 7pm, ILP 2302

Midterm 1

Midterm 2

Final

COURSE TOPICS

PROBABILITY

Conditional Distributions
Conditional Expectations

TRANSFORMATIONS

Univariate Transformations
Multivariate Transformations

SAMPLING DISTRIBUTIONS

Central Limit Theorem
Notions of Convergence

ESTIMATION

Properties of Estimators
Constructing Point Estimators
Confidence Intervals

H_0 HYPOTHESIS TESTING

Type I, II Errors
Level of Significance
Statistical Power

PREREQUISITES

PROBABILITY (PSTAT 120A)

We'll use using probability and calculus a LOT this quarter, so please make sure to brush up!

SOME POTENTIALLY USEFUL RESOURCES

i DISABLED STUDENTS PROGRAM (DSP): https://dsp.sa.ucsb.edu/

If you require accommodations for lectures, in-class assessments, or assignments in general, DSP is a great office to consult in order to get you those accommodations. The DSP office also handles short-term accommodations, for example due to a sprained wrist.

i CAMPUS LEARNING ASSISTANCE SERVICES (CLAS): https://clas.sa.ucsb.edu/

Though CLAS does not have a designated resource for PSTAT 100, they do offer extensive support relating to many PSTAT classes (including PSTAT 120A), and can be a great resource to get additional help from outside the course staff.

i COUNSELING AND PSYCHOLOGICAL SERVICES (CAPS): https://caps.sa.ucsb.edu/

College can be stressful! CAPS is here to help you navigate that stress, and try and help you navigate the complexities of being a student. In addition to various counseling services, they also have a selection of "egg-chairs" which can provide a nice physical break from the daily grind.

i TECHNOLOGY NEEDS: https://basicneeds.ucsb.edu/resources/technology-resources

As a part of this course, you will be asked to program using the language "R". This will necessitate that you have access to a laptop, which we understand is not the case for everyone. Please consult the link above for information on how to obtain a loaner laptop and other technological needs.
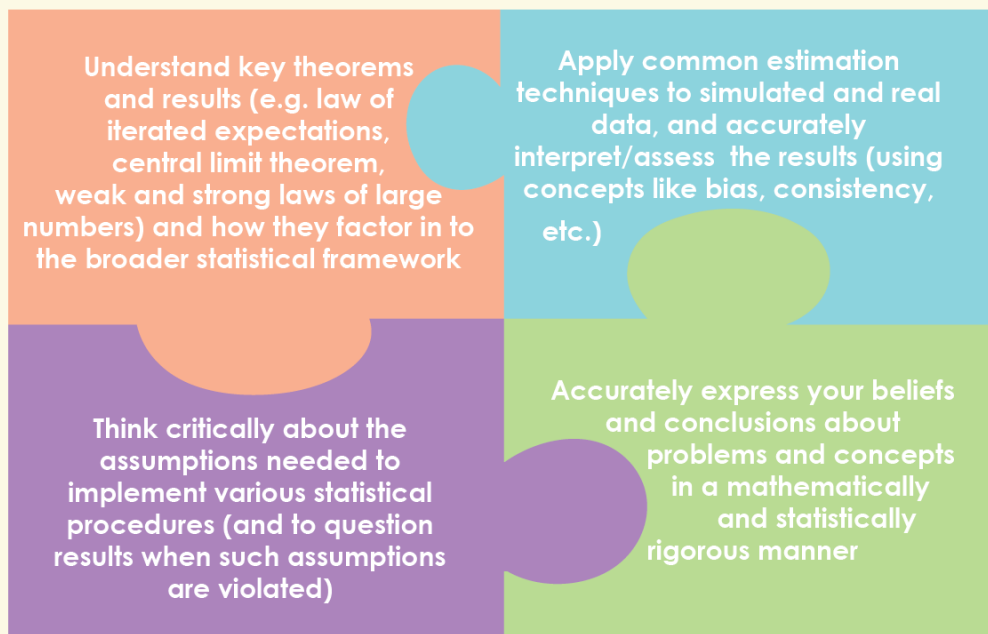
LEARNING OUTCOMES

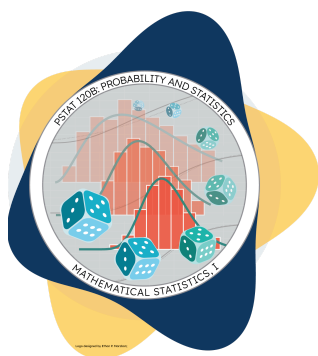*At the end of this course, it is my hope that you will be able to:*

Understand key theorems and results (e.g. law of iterated expectations, central limit theorem, weak and strong laws of large numbers) and how they factor in to the broader statistical framework

Apply common estimation techniques to simulated and real data, and accurately interpret/assess the results (using concepts like bias, consistency, etc.)

Think critically about the assumptions needed to implement various statistical procedures (and to question results when such assumptions are violated)

Accurately express your beliefs and conclusions about problems and concepts in a mathematically and statistically rigorous manner

FOR ADDITIONAL INFORMATION ON POLICIES, COURSE STAFF CONTACT INFORMATION, AND A WEEKLY BREAKDOWN OF TOPICS AND LECTURES, PLEASE CONSULT THE MAIN COURSE SITE. THANKS!

PSTAT 120B: Mathematical Statistics
Summer Session A, 2024

Course Policies and Syllabus

Welcome to PSTAT 120B! I am very excited to be your instructor this quarter. Our journey together will take us through the wonders of mathematical statistics, which seeks to form a logically and rigorously sound framework to discuss more advanced statistical topics. Looking forward to a great quarter with y'all!   – Ethan

LECTURE INFORMATION

M, T, W, R;   12:30 - 1:35 pm, in the Interactive Learning Pavillion (ILP), Room 1302

COURSE STAFF

Instructor: Ethan P. Marzban (He/Him)
Email: epmarzban@pstat.ucsb.edu (please reserve for emergencies)

TA: Jean (Hyuk) Choe (He/Him)   **TA:** Minwoo Park (He/Him)
Email: hchoe@umail.ucsb.edu   **Email:** minwoo@umail.ucsb.edu
Sections: 2 - 2:50 pm and 3 - 3:50 pm   **Sections:** 4 - 4:50 pm and 5 - 5:50 pm

COURSE DESCRIPTION

The official description of this course, from the UCSB Course Catalog, is:

Distribution of sample mean and sample variance; t, chi-squared and F distributions; summarizing data by statistics and graphs; estimation theory for single samples: sufficiency, efficiency, consistency, method of moments, maximum likelihood; hypothesis testing: likelihood ratio test; confidence intervals.

This quarter, we will also discuss conditional expectations, to set you up for success in your future PSTAT courses (like PSTAT 160A/B, 131/231, 174/274, etc.)

PREREQUISITES

The only prerequisite for this course is a grade of C or higher in PSTAT 120A (Calculus-based probability). We will be using probability *extensively* this quarter, so please make sure to brush up on your probability knowledge before starting this course. (I've also provided some review material on our Course Website which you are welcome to use.)

TEXTBOOK

There is only one required textbook for this course:

- *Mathematical Statistics with Applications*, 7th edition, by Dennis Wackerly, William Mendenhall, Richard L. Scheaffer.

We will (roughly) cover chapters 6 - 10 and parts of Chapter 14. Readings will be assigned; I ask that you please complete the readings before lecture.

Please note: though the lecture notes I post to the course website are designed to be largely self-contained, studies have shown great benefit to seeing material presented in several different ways. This is why textbooks are very useful, and an integral part of the learning process!

COURSE COMPONENTS

- **Homework:** there will be one homework assignment due per week, on either Tuesday or Wednesday (please see the tentative schedule below). These will be submitted on Gradescope.

- **Quizzes:** there will be 3 quizzes this quarter, administered once per non-exam week. Quizzes will be administered **synchronously and in-person**, at the start of Thursday Discussion Sections, and will last for 20 minutes.

- **Exams:** there will be a total of three exams this quarter: two midterms, and one final exam. The dates and locations for the exams are:

  - **Midterm 1:** Wednesday, July 3, 2024 during Lecture, in the Lecture Hall
  - **Midterm 2:** Wednesday, July 17, 2024 during Lecture, in the Lecture Hall
  - **Final Exam:** Friday, August 2, 2024; **4 - 7pm in ILP 2302**

LATE WORK

We have adopted the following policies when it comes to late work:

- **Homework:** You may submit up to 2 (two) homework assignments late (within 48 hours of the originally-posted deadline), as long as you email **your TA** before the original due date.
- **Quizzes and Exams:** Unfortunately, we will **not be offering any make-up quizzes or exams**, except for conflicts due to university-sanctioned sports. (If you have a conflict with a quiz or exam due to a university-sanctioned sporting event, please reach out to Ethan ASAP to coordinate.)

Please also note that our Final Exam is scheduled to take place on the final *Friday* of the quarter. If this Final Exam time conflicts with another Final Exam you are taking, please reach out to me (Ethan) ASAP to coordinate.

COURSE GRADES

Your final grade in the course will be computed according to the following scheme:

Homework	Quizzes	Midterms	Final Exam
20%	15%	15% each	35%

Furthermore, your final letter grade will be computed according the the following scheme:

A⁻ – A⁺: [90, 100]   B⁻ – B⁺: [80, 90)   C⁻ – C⁺: [70, 80)

D⁻ – D⁺ : [60 - 70)   F: [0, 60)

Cutoffs between plusses and minuses will be determined at the end of the quarter.

I have elected to adopt an uncurved grading scheme to eliminate any sense of "competition" among students; I highly encourage you all to collaborate with and uplift each other! Furthermore, I will certainly consider adjusting the cutoffs at the end of the quarter if necessary. (I will, however, not be able to tell if or how such adjustments will be made until the end of the quarter.) **Please note:** failure to take any of the three exams without first making prior arrangements with the Course Staff will result in an automatic grade of 'F'.

ACADEMIC INTEGRITY

As a member of the UCSB community, it is expected that you will act with academic integrity. This means, among other things, that the work you submit should be entirely your own and not copied from any external sources. Collaboration on homework assignments is perfectly acceptable (even encouraged) but the work you submit should still be your own; you can't have someone else write up solutions for you, nor can you consult sites like Chegg, CourseHero, ChatGPT, etc. Anyone found guilty of academic misconduct will be reported to the Academic Senate, and will receive *at minimum* a failing grade on the assignment in question; actions may also include failing the course, and marks being made on permanent records. Depending on the severity of the infraction, expulsion is also a possibility.

Basically, don't cheat- please! If you're ever struggling with course material, please come talk to me or the TAs. We are truly here for you, and want only the best for you!

DISABLED STUDENTS PROGRAM (DSP)

If you have a disability, or otherwise require accommodations for the exams and/or quizzes please reach out to the Disabled Students Program (DSP) ASAP to ensure your request(s) for accommodation can be processed. Please note that we cannot honor any requests for accommodations unless they come to us from DSP directly.

SECTIONS

Though we will not be tracking Section attendance this quarter, I *highly* encourage you to attend Section. During Section, you will work through a series of problems that are designed to help you learn the course material.

COMMUNICATION

Please note that we (the course staff) request you refrain from emailing us except in case of extreme emergency (it is up to you to decide what is an 'emergency'). Please bring all of your questions to the course staff during either Office Hours or after Lecture/Section. We also encourage you to make use of our **Discord** Server.

Topic	Redirect to…
Checking answers	Office hours or Discord
Clarifying assignment content	Office hours or Discord
Assignment submission	Gradescope
Re-evaluation request	Gradescope
Question about missing grades	Fill Out This Form

COURSE RESOURCES/SITES

There are a couple of important sites you should be aware of for this course:

- **Main Course Site:** https://pstat120b.github.io
  This is the main site for this course this quarter - lecture, section, etc. material will be posted here. Please note that you do not need any special login to access this site - it is publicly accessible from anywhere that has internet access.

- **Gradescope:** https://www.gradescope.com/courses/769316
  Please use Gradescope for all homework submissions.

- **Canvas:** https://ucsb.instructure.com/courses/20787
  We will primarily be using Canvas for grading purposes, and announcements - course material will not, in general, be posted to Canvas.

SECTION SWITCHING

If you want to switch sections unofficially (we do not have the ability to switch your official enrollment through GOLD), please follow the steps at this link. Any requests to switch sections that do not adhere to the guidelines posted at that link will be ignored.

MODALITY

Please note that this course is **fully in-person and synchronous**; there will not be any lecture recordings made or posted, nor will Sections be recorded or offered over Zoom. Please make every effort to attend lectures and Sections!

DISCLAIMER

The instructor reserves the right to modify this syllabus if he deems such modifications academically advisable. Such modifications, should they occur, will be announced publicly.

FACULTY MENTORS

The faculty mentors for this course are Dr. Drew Carter (he/him) and Dr. Jack Miller (they/them)., and can be reached at carter@pstat.ucsb.edu and jbmiller@pstat.ucsb.edu, respectively. Please note that neither Dr. Carter nor Dr. Miller will be able to authorize regrades, accommodations/extensions for the course, or modifications for the course policies - for such inquiries, please communicate with the course staff (Instructor and/or Teaching Assistants).

LEARNING OUTCOMES

My main (and somewhat broad) goal for this course is:
- To help introduce you to the theoretical underpinnings of mathematical statistics and the statistical way of thinking/writing

To this end, I have devised the following learning outcomes. By the end of this course, you should be able to:
- Understand key theorems and results (e.g. law of iterated expectations, central limit theorem, weak and strong laws of large numbers) and how they factor in to the broader statistical framework
- Apply common estimation techniques to simulated and real data, and accurately interpret/assess the results (using concepts like bias, consistency, etc.)
- Think critically about the assumptions needed to implement various statistical procedures (and to question results when such assumptions are violated)
- Accurately express your beliefs and conclusions about problems and concepts in a mathematically and statistically rigorous manner

AFFIRMATIONS

I firmly believe that each and every one of you belongs here, at this university, in your major, and in this course. As such, I am committed to fostering a sense of inclusivity, tolerance, and respect; I ask that you please join me in this commitment. This includes things like: arriving to class and sections on time (or arriving/departing quietly if you need to arrive late/leave early), refraining from using derogatory or other hurtful language, and respecting your classmates' lived names and pronouns.

You can update your preferred name and pronouns using UCSB's Identity Services Directory Editor, and read more about how UCSB uses Lived and Legal Names at this link. I am committed to using everyone's preferred names and pronouns, so please don't hesitate to correct me if I accidentally misidentify you.

SOME GENERAL TIPS FOR SUCCESS

Form study groups
Statistics is not meant to be a lonely field! There is much we can learn from one another, and it can be an incredibly enlightening experience to discuss problems and ideas with one another. (Just make sure you don't violate any of the Academic Integrity points listed above)

Be mindful of <u>how</u> you're solving problems
It's tempting to start a problem, get about halfway through, and then default to looking at the solutions or a similar worked-out example. This is **not** an effective way to learn! Rather, start by working through them *fully* and *without* looking at similar worked-out problems or solutions. Then you can compare your answers, and identify any areas for potential further study. Finally, return to the problem after a few days and see if you still get stuck in the same places as you did the first time.

Start things early!
Make sure you're giving yourself enough time to complete the homework assignments, study for quizzes/exams, and process the course material. I'd recommend creating a weekly schedule for yourself, and allocating time each day for PSTAT 120B material (whether that be working through the homework, studying for a quiz, or just reading lecture slides/the textbook).

Attend office hours (TA and Instructor) regularly
Even if you don't have a specific question, you're always more than welcome to sit in on Office Hours and listen to other people's questions. (Sometimes, doing so will help you formulate your own questions!)

Attend lectures and Discussion Sections.
It's true that we do <u>not</u> have an attendance policy, but please don't let yourselves skimp on attendance. Studies show that regular exposure is the best way to learn material, and there really is no substitute for going to Section and Lecture. Also, while you're in Lecture, **take your own notes!** Even the act of writing things down and having to synthesize what you think is important information can help you process and learn the material in real time.

Don't be too hard on yourself!
Though a *little* stress can be a good motivating factor for some, please don't stress yourself out too much. Your performance in this course is **not** an evaluation of who you are as a person!

SCHEDULE

Please note that this schedule is only tentative, and may change at the discretion of the instructor (and also according to how quickly we run through the material this quarter).

Week	Date	Lecture Topic	Anything Due?
1	Mon, June 24, 2024	Conditional Distributions	
	Tues, June 25, 2024	Conditional Expectations	
	Wed, June 26, 2024	Transformations	**HW01 Due**
	Thurs, June 27, 2024	Transformations	**Quiz 01**
2	Mon, July 1, 2024	Transformations	**HW02 Due**
	Tues, July 2, 2024	Review/Catch-Up	
	Wed, July 3, 2024	**Midterm Exam 01**	
	Thurs, July 4, 2024	**No Class; Fourth of July**	
3	Mon, July 8, 2024	Sampling Distributions	
	Tues, July 9, 2024	Sampling Distributions	
	Wed, July 10, 2024	Estimation	**HW03 Due**
	Thurs, July 11, 2024	Estimation	**Quiz 02**
4	Mon, July 15, 2024	Estimation	**HW04 Due**
	Tues, July 16, 2024	Review/Catch-Up	
	Wed, July 17, 2024	**Midterm Exam 02**	
	Thurs, July 18, 2024	Estimation	
5	Mon, July 22, 2024	Sufficiency	
	Tues, July 23, 2024	Hypothesis Testing	
	Wed, July 24, 2024	Hypothesis Testing	**HW05 Due**
	Thurs, July 25, 2024	Hypothesis Testing	**Quiz 03**
6	Mon, July 29, 2024	Hypothesis Testing	
	Tues, July 30, 2024	χ^2-Based Tests	
	Wed, July 31, 2024	χ^2-Based Tests	**HW06 Due**
	Thurs, August 1, 2024	Review/Catch-Up	
	Fri, August 2, 2024	**Final Examination**	