

Keck School of Medicine of USC

PM 522A: introduction to the theory of Statistics

Units: 3 units

Term–Day–Time: Fall 2020, Mon 1:00 PM-4:00 PM

Location: TBA

Course Coordinator(s):

Name: Paul Marjoram Contact: pmarjora@usc.edu

Office: Office Hours: By Appointment

Course Instructor(s):

Teaching Assistant(s):

Course Description

This course is a rigorous non-measure theoretic introduction to probability theory with an emphasis on the results and methods that are most relevant to statistical inference. PM522a and PM522b are to be taken in sequence; PM522a covers probability and PM522b covers statistical inference. These two courses form the core statistical-theory of the Biostatistics program, providing a sound theoretical basis for understanding applied statistical methods and pursuing more advanced Theory. The sequence PM522a-b is required for all the Biostatistics PhD tracks and it is also open to quantitatively oriented students in Epidemiology and other population-based sciences. A detailed list of the topics is given below.

Learning Objectives

Course objectives

1. • To acquire skill in the basic computations involving probabilities and to develop probabilistic thinking • To gain intuition and understanding of probabilistic concepts with the aid of computer-based simulation and visualization. • To become familiar with common parametric families of distributions and their applications. • To understand the key probability theory results that are fundamental to statistical inference.

Prerequisite(s):

Co-Requisite(s):

Concurrent Enrollment:

Recommended Preparation:

Teaching & Assessment Methods

Teaching Methods

- Online lecture
- Assigned reading/writing (texts)
- Classroom lecture
- Small group discussion
- Polling questions

Assessment Methods

- Short answer
- Quiz

Course Notes

Unlike most courses you will be taking here, this course will be taught using the “flipped classroom” style. This means that students will be expected to study the relevant textbook sections, and work through the exercises for that chapter, ahead of each session. There will be a 30-minute ‘quiz’ at the start of each week’s class. This quiz will in part cover the basics of the material read for that week, but will also include one or two of the text-book exercises from the material from the previous week of class. These quizzes will count (25%) towards final grading. Much of the class time will then be used as an opportunity to ask for clarifications, or further discussion of parts of the material that were unclear, ask questions about exercises you struggled with, go through more examples or exercises, have group discussions of related issues, review important concepts, and so on. Please see the course schedule below to see what you are expected to have completed before arriving for that week’s class. (And note that the nature of the course means that there are things you are expected to have completed before week 1’s class!). **You are expected to read sections 1.1-1.5 of chapter 1 of the Blitzstein book before attending the first class, but there will be no quiz on week 1.**

Communication

Technological Proficiency and Hardware/Software Required

Required Materials

- Introduction to Probability, by Joseph Blitzstein and Jessica Hwang, Chapman & Hall/CRC Texts in Statistical Science [Referred to as BH below]. Available at bookstore and Amazon. Get the second edition. A free online version of the second edition of the book is available at <http://probabilitybook.net>

Optional Materials

Description and Assessment of Assignments

Weekly quiz.

Grading Breakdown

Weekly 'in class' quiz: 25%;
Biweekly homework assignments: 20%;
A midterm exam: 25%;
A final exam: 30%;

Assignment	% of Grade
Weekly 'in class' quiz	25
Biweekly homework assignments	20
midterm exam:	25
Final	30
Total	100

Grading Scale

Course final grades will be determined using the following scale.

A	95-100
A-	90-94
B+	87-89
B	83-86
B-	80-82
C+	77-79
C	73-76

C-	70-72
D+	67-69
D	63-66
D-	60-62
F	59 and below

Course-specific Policies

Assignment Submission

Via Blackboard

Grading Timeline

within a week or two

Late work

Technology in the classroom

Academic integrity

A grade of zero will be applied to submitted work that does not comply with the USC standards of academic conduct. Such work may not be resubmitted for a new grade. Academic integrity is included at the end of the syllabus.

Attendance

Classroom norms

Expectations on Student Engagement

Course evaluation

Mid-term exam + final exam.

Policy on Learning & Assessment Feedback (LAF)

Feedback on examinations will be provided using the following methods. Please indicate which method(s) you will use in the course.

- Complete examination will be returned and a key will be made available

Course Schedule: A Weekly Breakdown

Date	Topic	Lecturer
Mon 08/17/20 01:00p - 04:00p	[Sections 1.1-1.5 of BH] Probability and Counting; “Pebble” spaces; Probability on Finite Sample Spaces; Basic set theory. Story Proofs. Assignment 1 out. Work you are expected to complete before attending class: Read through and study Sections 1.1-1.5 of the course text, Blitzstein and Hwang [BH hereafter]. Attempt many of the exercises in that section. Optional: Watch lectures 1, 2 and 3 of the course on Youtube, (you can skip over the first 15 minutes of lecture 1, which is general chit-chat). You can find that via this link: https://projects.iq.harvard.edu/stat110/youtube	Paul Marjoram
Mon 08/24/20 01:00p - 04:00p	[Sections 1.6-2.4 of BH]. Non-naïve Definition of Probability, Bayes’ Rule, Conditional Probability. Work you are expected to complete before attending class: Read through and study Sections 1.6-2.4 of BH. Attempt many of the exercises in that section. Optional: Watch lectures 4 and 5 of the Youtube course.	Paul Marjoram
Mon 08/31/20 01:00p - 04:00p	[Sections 2.5-2.10 of BH]. Independence, Coherency of Bayes’ Rule, Conditioning as a Problem Solving Tool. Work you are expected to complete before attending class: Read through and study Sections 2.5-2.10 of BH. Attempt many of the exercises in that section. Optional: Watch lectures 6 and 7 .	Paul Marjoram
Mon 09/14/20 01:00p - 04:00p	[Chapter 3 of BH]. Random Variables and Their Distributions, Classic Discrete Distributions, Probability Mass Functions, Cumulative Distribution Functions, functions of Random Variables. Work you are expected to complete before attending class: Read through and study Chapter 3 of BH. Attempt many of the exercises in that section. Assignment 1 Due. Assignment 2 out. Optional: Watch lecture 8.	Paul Marjoram
Mon 09/21/20 01:00p - 04:00p	[Chapter 4 of BH]. Expectation. Properties of Expectation. Geometric and Negative Binomials, Indicator Variables, Variance, Poisson and	Paul Marjoram

	connections with Binomial. Work you are expected to complete before attending class: Read through and study Chapter 4 of BH. Attempt many of the exercises in that chapter. Optional: Watch lectures 9-11	
Mon 09/28/20 01:00p - 04:00p	[Chapter 5 of BH] Continuous r.v.s, PDFs, Common continuous r.v.s, Poisson Processes, symmetry of r.v.s. Work you are expected to complete before attending class: Read through and study chapter 5 of BH. Attempt many of the exercises in that chapter. Optional: Watch lectures 12-14 & 16 of the course. Assignment 2 Due. Assignment 3 out.	Paul Marjoram
Mon 10/05/20 01:00p - 04:00p	Mid-term Mid-term exam. This will cover chapters 1-5 of BH.	
Mon 10/12/20 01:00p - 04:00p	[Chapter 6 of BH]. Moments as a summary of distributions, Interpretation, Sample Moments, MGFs and their uses. Work you are expected to complete before attending class: Read through and study chapter 6 of BH. Assignment 2 Due. Assignment 3 out. Attempt many of the exercises in that chapter. Optional: Watch lectures 17 & 18 of the course. Assignment 3 Due. Assignment 4 out.	Paul Marjoram
Mon 10/19/20 01:00p - 04:00p	[Chapter 7 of BH]. Joint Probability Distributions Function; Covariance and correlation. Multinomials and Multivariate Normals. Work you are expected to complete before attending class: Read through and study chapter 7 of BH. Attempt many of the exercises in that chapter. Optional: Watch lectures 19-21 of the course.	Paul Marjoram
Mon 10/26/20 01:00p - 04:00p	[Chapter 8 of BH] Transformations. Change of Variables, Convolutions, Betas and Gammas and their unearthy offspring, Order Statistics Work you are expected to complete before attending class: Read through and study chapter 8 of BH. Attempt many of the exercises in that chapter. Optional: Watch lectures 22-25 of the course. Assignment 4 Due. Assignment 5 out.	Paul Marjoram
Mon 11/02/20 01:00p - 04:00p	[Chapter 9 of BH] Conditional Expectation given events and r.v.s, Properties, Conditional Variance, Read and study chapter 9 of BH]. Attempt many of the exercises in that chapter. Watch lectures 26 & 27 of the course.	Paul Marjoram
Mon 11/09/20 01:00p - 04:00p	[Chapter 10 of BH]. Inequalities and Limit Theorems, Law of Large Numbers, Central Limit Theorem; Chi-Square and Student-t. Read and study chapter 10 of BH. Attempt many of the exercises in that chapter. Optional: Watch lectures 28-30 of the course.	Paul Marjoram

Statement on Academic Conduct and Support Systems

Academic Conduct:

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Part B, Section 11, “Behavior Violating University Standards” policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, <http://policy.usc.edu/scientific-misconduct>.

Support Systems:

Student Counseling Services (SCS) – (213) 740-7711 – 24/7 on call

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention. engemannshc.usc.edu/counseling

National Suicide Prevention Lifeline – 1 (800) 273-8255

Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week. www.suicidepreventionlifeline.org

Relationship and Sexual Violence Prevention Services (RSVP) – (213) 740-4900 – 24/7 on call

Free and confidential therapy services, workshops, and training for situations related to gender-based harm. engemannshc.usc.edu/rsvp

Sexual Assault Resource Center

For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website: sarc.usc.edu

Office of Equity and Diversity (OED)/Title IX Compliance – (213) 740-5086

Works with faculty, staff, visitors, applicants, and students around issues of protected class. equity.usc.edu

Bias Assessment Response and Support

Incidents of bias, hate crimes and microaggressions need to be reported allowing for appropriate investigation and response. studentaffairs.usc.edu/bias-assessment-response-support

The Office of Disability Services and Programs

Provides certification for students with disabilities and helps arrange relevant accommodations. dsp.usc.edu

Student Support and Advocacy – (213) 821-4710

Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic. studentaffairs.usc.edu/ssa

Diversity at USC

Information on events, programs and training, the Diversity Task Force (including representatives for each school), chronology, participation, and various resources for students. diversity.usc.edu

USC Emergency Information

Provides safety and other updates, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible. emergency.usc.edu

USC Department of Public Safety – UPC: (213) 740-4321 – HSC: (323) 442-1000 – 24-hour emergency or to report a crime.

Provides overall safety to USC community. dps.usc.edu