Math 408, Mathematical Statistics, Fall 2023

Exterior Course Website: http://www.stevenheilman.org/~heilman/408f23.html
Prerequisite: Math 407, Probability Theory.
Course Content: Principles for testing hypotheses and estimation, confidence intervals, methods of moments, maximum likelihood, information inequality, likelihood ratio tests, goodness of fit and nonparametric methods.

Lecture Meeting Time/Location: Mondays, Wednesdays, and Fridays, 1PM-150PM KAP 156
Instructor: Steven Heilman, stevenmheilman@gmail.com
Office Hours: Tuesdays, 9AM-11AM, on zoom [link posted on blackboard]
TA: Tianle Liu, tianleli@usc.edu
TA Office Hours:
Discussion Session Meeting Time/Location:

- 39436, Tuesdays and Thursdays, 12PM-1250PM, KAP 167
- 39437, Tuesdays and Thursdays, 1PM-150PM, KAP 148

Textbook: The following textbook is recommended but **not required**: Rice. Mathematical Statistics & Data Analysis.
Exam 1: Wednesday, September 27, 1PM-150PM, KAP 156
Exam 2: Friday, November 3, 1PM-150PM, KAP 156
Final Exam: Wednesday, December 13, 11AM-1PM, Location TBD

Email Policy:

- My email address for this course is stevenmheilman@gmail.com.
- It is your responsibility to make sure you are receiving emails from stevenmheilman@gmail.com, and they are not being sent to your spam folder.
- Do NOT email me with questions that can be answered from this document.

Exam Procedures: Students must bring their USCID cards to the midterms and to the final exam. Phones must be turned off. Cheating on an exam results in a score of zero on that exam. Exams can be regraded at most 15 days after the date of the exam. This policy extends to homeworks as well. All students are expected to be familiar with the USC Student Conduct Code. (See also here.)

Student Conduct: Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the Office of Equity and Diversity http://equity.usc.edu/or to the Department of Public Safety http://capsnet.usc.edu/department/department-public-safety/online-forms/contact-us. This is important for the safety whole USC community. Another member of the university community - such as a friend, classmate, advisor, or faculty member - can help initiate the report, or can initiate the report on behalf of another person. The

Center for Women and Men http://www.usc.edu/student-affairs/cwm/ provides 24/7 confidential support, and the sexual assault resource center webpage sarc@usc.edu describes reporting options and other resources.

Accessibility Services: If you are registered with accessibility services, I would be happy to discuss this at the beginning of the course. Any student requesting accommodations based on a disability is required to register with Accessibility Services and Programs (OSAS) each semester. A letter of verification for approved accommodations can be obtained from OSAS. Please be sure the letter is delivered to me as early in the semester as possible. OSAS is located in 301 STU and is open 8:30am-5:00pm, Monday through Friday.
https://osas.usc.edu
213-740-0776 (phone)
213-740-6948 (TDD only)
213-740-8216 (fax)
OSASFrontDesk@usc.edu

Other Resources: An introduction to mathematical arguments

Homework Policy:

- Homeworks are due roughly every other week, at **12PM noon Thursdays**, i.e. at the beginning of the first discussion session on Thursdays.
- Homeworks are submitted in blackboard, under the "Assignments" tab. You are allowed unlimited submission "attempts" for an assignment, but only the last submission will be graded. To avoid internet issues, I recommend making your first submission of an assignment well in advance of the deadline. (Note that phone tethering can also give you an internet connection to a computer.)
- Homeworks should be submitted as single PDF documents. One way to create a PDF document from paper homework assignments is the freely available Adode Scan App.
- Late homework is not accepted.
- If you still want to turn in late homework, then the number of minutes late, divided by ten, will be deducted from the score. (The time estimate is not guaranteed to be accurate.)
- **Do not submit homework via email.**
- The **single lowest** homework score will be dropped. This policy is meant to account for illnesses, emergencies, dropped internet connections, etc.
- You may not use the internet to try to find answers to homework problems.
- A random subset of the homework problems will be graded each week. However, it is strongly recommended that you try to complete the entire homework assignment.
- All homework assignments must be **written by you**, i.e. you cannot copy someone else's solution verbatim. However, collaboration on homeworks is allowed and encouraged.

- Homework solutions will be posted a few days after the homework is turned in.

Quiz Policy:

- There will be several quizzes throughout the semester, as listed in the schedule below, roughly every other week. One week before the quiz occurs, a list of quiz problems will be posted on the course website. The quiz will have a few problems similar or identical to the posted list of problems.
- The **single lowest** quiz grade will be dropped. This policy is meant to account for illnesses, emergencies, etc.
- Quizzes will be administered in your discussion section on Thursdays. Each quiz should last about 15 minutes.
- No notes, no books, no calculators, etc. will be allowed during the quizzes.

Grading Policy:

- The final course grade is weighted as the larger of the following two schemes:
- Scheme 1: class participation (3%), homework (11%), quizzes (11%), the first midterm (20%), the second midterm (20%), and the final (35%).
- Scheme 2: class participation (3%), homework (11%), quizzes (11%), the largest midterm grade (30%), and the final (45%).
- The grade for the semester will be curved. However, I do not "curve down" since anyone who exceeds my expectations in the class by showing A-level performance on the exams and homeworks will receive an A for the class.
- If you cannot attend one of the exams, you must notify me within the first two weeks of the start of the quarter. Later requests for rescheduling will most likely be denied.
- Class participation is not the same as attendance. I will never explicitly take attendance, but I will notice if someone is frequently absent. Things that increase your class participation grade include: asking good questions, paying attention in class, showing up on time or early to class, etc. Things that decrease your class participation grade include: excessive talking or disruptions during class, frequent absences, excessive texting/smartphone usage in class, frequent tardiness, etc.
- You must take the final exam to pass the course.

Tentative Schedule: (This schedule may change slightly during the course.)

Week	Monday	Tuesday	Wednesday	Thursday	Friday
1	Aug 21: Review of Probability	Aug 22	Aug 23: 5.3, Review of Probability	Aug 24: Homework 1 due	Aug 25: 6.2, 6.3, Review of Probability
2	Aug 28: 7.3, Review of Probability	Aug 29	Aug 30: 8.1, 8.2, Parameter Estimation	Aug 31: Quiz 1	Sep 1: 8.3, Parameter Estimation
3	Sep 4: No class	Sep 5	Sep 6: 8.4, Method of Moments	Sep 7: Homework 2 due	Sep 8: 8.5, Maximum Likelihood Estimation
4	Sep 11: 8.6, Efficiency, Cramer-Rao	Sep 12	Sep 13: 8.7, Sufficiency, Rao-Blackwell	Sep 14: Quiz 2	Sep 15: 9.1, 9.2, Hypothesis Testing
5	Sep 18: 9.3, Neyman-Pearson Lemma	Sep 19	Sep 20: 9.4, Confidence Intervals	Sep 21: Homework 3 due	Sep 22: 9.5, 9.6, Likelihood Ratio Tests
6	Sep 25: 9.4, Confidence Regions /Hypothesis Tests	Sep 26	Sep 27: Exam 1	Sep 28: No homework due	Sep 29: 9.4, p-values
7	Oct 2: 9.5, Generalized Likelihood Ratio Test	Oct 3	Oct 4: 8.2, Case Study: Alpha Particles, Contingency Tables	Oct 5: Quiz 3	Oct 6: 8.2, Case Study: Alpha Particles, Contingency Tables
8	Oct 9: 8.2, Case Study: Alpha Particles, Contingency Tables	Oct 10	Oct 11: 11.2, Comparing Independent Gaussians	Oct 12: Homework 4 due, No class	Oct 13: No class
9	Oct 16: 11.2, Comparing Independent Samples	Oct 17	Oct 18: 11.2, Comparing Independent Samples	Oct 19: Quiz 4	Oct 20: 11.3, Comparing Dependent Samples
10	Oct 23: 12.2, Analysis of Variance	Oct 24	Oct 25: 12.2, Analysis of Variance	Oct 26: Homework 5 due	Oct 27: 14.2, Linear Regression
11	Oct 30: 14.2, Linear Regression	Oct 31	Nov 1: 14.2, Linear Regression	Nov 2: No homework due	Nov 3: Exam 2
12	Nov 6: 14.3, 14.4, Least Squares	Nov 7	Nov 8: 14.4, Least Squares	Nov 9: Quiz 5	Nov 10: No class
13	Nov 13: Leeway	Nov 14	Nov 15: Leeway	Nov 16: Homework 6	Nov 17: Leeway
14	Nov 20: Leeway	Nov 21	Nov 22: No class	Nov 23: No class	Nov 24: No class
15	Nov 27: Review of course	Nov 28	Nov 29: Review of Course	Nov 30: Quiz 6	Dec 1: Review of Course

Advice on succeeding in a math class:

- Review the relevant course material **before** you come to lecture. Consider reviewing course material a week or two before the semester starts.
- When reading mathematics, use a pencil and paper to sketch the calculations that are performed by the author.

- Come to class with questions, so you can get more out of the lecture. Also, finish your homework at least **two days** before it is due, to alleviate deadline stress.
- Write a rough draft and a separate final draft for your homework. This procedure will help you catch mistakes. Also, I would very much recommend typesetting your homework. Learning LaTeX is a very important skill to have for doing mathematics. Here is a template .tex file if you want to get started typesetting.
- If you are having difficulty with the material or a particular homework problem, review Polya's Problem Solving Strategies, and come to office hours.