Math 541B, Graduate Mathematical Statistics II, Fall 2023

Exterior Course Website: http://www.stevenheilman.org/~heilman/541bf23.html
Prerequisite: Math 541A
Course Content: Hypotheses testing, Neyman-Pearson lemma, generalized likelihood ratio procedures, confidence intervals, consistency, power, jackknife and bootstrap. Monte Carlo Markov chain methods, hidden Markov models.

Lecture Meeting Time/Location: Mondays, Wednesdays, and Fridays, 11AM-1150AM KAP 140
Instructor: Steven Heilman, stevenmheilman@gmail.com
Office Hours: Tuesdays, 9AM-11AM, on zoom [link posted on blackboard]
TA: Xinze Du, xinzedu@usc.edu
TA Office Hours:
Recommended Textbook: Cassella and Berger, Statistical Inference, 2nd Edition.
Other Textbooks: (not required): Lehmann and Romano, Testing Statistics Hypotheses.
Ferguson, A Course in Large Sample Theory.
Shao and Tu, The jackknife and bootstrap.
McLachlan and Krishnan, The EM Algorithm and Extensions.
Robert and Casella, Monte Carlo and Statistical Applications.
Haggstrom, Finite Markov Chains and Algorithmic Applications.
Levin and Peres, Markov Chains and Mixing Times.
First Midterm: Friday, September 29, 11AM-1150AM KAP 140
Second Midterm: Monday, October 30 , 11AM-1150AM KAP 140
Final Exam: Wednesday, December 6, 11AM-1PM, KAP 140

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

Exam Resources: Here is a page containing USC Stats B Qual Exams with solutions.

Other Resources: An introduction to mathematical arguments

Homework Policy:

- Homeworks are due roughly every other week, at **9AM Fridays**.

- 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 use whatever resources you want to do the homework, including computers, textbooks, friends, the TA, etc. However, I would discourage any over-reliance on search technology such as Google, since its overuse could degrade your learning experience. By the end of the quarter, you should be able to do the entire homework on your own, without any external help.

- 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.

Grading Policy:

- The final course grade is weighted as the larger of the following two schemes. Scheme 1: homework (25%), the first midterm (20%), the second midterm (25%), and the final (30%). Scheme 2: homework (25%), largest midterm grade (35%), final (40%). The grade for the semester will be curved. However, 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.

- You must attend the final exam to pass the 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.

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

Week	Monday	Tuesday	Wednesday	Thursday	Friday
1	Aug 21: 8.1, Hypothesis Testing	Aug 22	Aug 23: 8.1, Hypothesis Testing	Aug 24	Aug 25: 8.2, Likelihood Ratio Tests
2	Aug 28: 8.3.1, Neyman-Pearson Lemma	Aug 29	Aug 30: 8.3.2, Karlin-Rubin Theorem	Aug 31	Sep 1: Homework 1 due. 8.3, Exponential Families
3	Sep 4: No class	Sep 5	Sep 6: 8.3, Unbiasedness	Sep 7	Sep 8: 8.3.4, p-values
4	Sep 11: 8.3.5, Loss Function Optimality	Sep 12	Sep 13: 9.1, Confidence Intervals	Sep 14	Sep 15: Homework 2 due, 9.2, Test Inversion
5	Sep 18: 9.2.2, Pivotal Method	Sep 19	Sep 20: 9.2.3, Pivoting CDF	Sep 21	Sep 22: 9.2.4, Bayesian Intervals
6	Sep 25: 9.3.4, Loss Function and CI	Sep 26	Sep 27: 10.3, Asymptotics of Likelihood Ratio	Sep 28:	Sep 29: Exam 1
7	Oct 2: 10.3, Asymptotics of GLR	Oct 3	Oct 4: 10.3, Asymptotics of GLR	Oct 5	Oct 6: Homework 3 due, Jackknife
8	Oct 9: Jackknife	Oct 10	Oct 11: Bootstrap	Oct 12: No class	Oct 13: No class
9	Oct 16: Bootstrap	Oct 17	Oct 18: Consistency of Jackknife	Oct 19	Oct 20: Homework 4 due, Bootstrap/Jackknife Relationship
10	Oct 23: EM Algorithm	Oct 24	Oct 25: EM Algorithm	Oct 26:	Oct 27: EM Algorithm
11	Oct 30: Exam 2	Oct 31	Nov 1: EM Algorithm Convergence	Nov 2:	Nov 3: EM Algorithm Convergence
12	Nov 6: Monte Carlo	Nov 7	Nov 8: Rejection Sampling	Nov 9:	Nov 10: No class
13	Nov 13: Importance Sampling	Nov 14	Nov 15: Markov Chains	Nov 16:	Nov 17: Homework 5 due, Markov Chains
14	Nov 20: Metropolis-Hastings	Nov 21	Nov 22: No class	Nov 23: No class	Nov 24: No class
15	Nov 27: Markov Chain Monte Carlo	Nov 28	Nov 29: Review of Course	Nov 30:	Dec 1: Homework 6 due, Review of Course