

Math 541A, Graduate Mathematical Statistics, Spring 2022

Exterior Course Website: <http://www.stevenheilman.org/~heilman/541as22.html>

Prerequisite: 1 from (Math 505A or Math 407 or Math 408). Note: once you complete 541A, you cannot take 505A for credit.

Course Content: Parametric families of distributions, sufficiency. Estimation: methods of moments, maximum likelihood, unbiased estimation. Comparison of estimators, optimality, information inequality, asymptotic efficiency. EM algorithm, jackknife and bootstrap.

Lecture Meeting Time/Location: Mondays, Wednesdays, and Fridays, 11AM-1150AM THH 114

Instructor: Steven Heilman, stevenmheilman@gmail.com

Office Hours: Tuesdays, 9AM-12PM, on zoom [link posted on blackboard]

TA: Maria Allayioti, allayiot@usc.edu

TA Office Hours:

Recommended Textbook: Cassella and Berger, *Statistical Inference*, 2nd Edition.

Other Textbook: (not required): Keener, *Theoretical Statistics*.

First Midterm: Friday, February 25, 11AM-1150AM THH 114

Second Midterm: Wednesday, Apr 6, 11AM-1150AM THH 114

Final Exam: Wednesday, May 4, 11AM-1PM, THH 114

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 A Qual Exams with solutions. The exams from the last time I taught this class appear here: [Exam 1](#) [Exam 2](#) [Final](#)

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.

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

Week	Monday	Tu	Wednesday	Th	Friday
1	Jan 10: 1.1-1.6, Review of Probability		Jan 12: 1.1-1.6, Review of Probability		Jan 14: 2.1-2.4, Review of Probability
2	Jan 17: No class (MLK Day)		Jan 19: 2.1-2.4, Review of Probability		Jan 21: Homework 1 due. 3.1-3.6, Review of Probability
3	Jan 24: 3.4, Exponential Families		Jan 26: 3.4, Exponential Families		Jan 28: 4.1-4.7, Review of Probability
4	Jan 31: 4.1-4.7, Review of Probability		Feb 2: 4.1-4.7, Review of Probability		Feb 4: Homework 2 due. 5.1 Random Sample
5	Feb 7: 5.2, Sums of Random Variables		Feb 9: 5.3, Sampling from the Normal		Feb 11: 5.4, Order Statistics
6	Feb 14: 5.4, Order Statistics		Feb 16: 5.5, Modes of Convergence		Feb 18: Homework 3 due. 5.5, Delta Method
7	Feb 21: No class		Feb 23: 5.6, Generating a Random Sample		Feb 25: Midterm 1
8	Feb 28: 5.6, Generating a Random Sample		Mar 2: 6.2, Sufficiency		Mar 4: 6.2, Sufficiency
9	Mar 7: 6.2.4, Completeness		Mar 9: 6.3, Likelihood		Mar 11: Homework 4 due. 6.4, Equivariance
10	Mar 14: No class (spring break)		Mar 16: No class (spring break)		Mar 18: No class (spring break)
11	Mar 21: 7.2, Point Estimation		Mar 23: 7.2.1, Method of Moments		Mar 25: Homework 5 due. 7.2.2, Maximum Likelihood Estimators
12	Mar 28: 7.2.2, Maximum Likelihood Estimators		Mar 30: 7.2.2, Maximum Likelihood Estimators		Apr 1: 7.2.3, Bayes Estimator
13	Apr 4: 7.2.4, EM Algorithm		Apr 6: Midterm 2		Apr 8: 7.3, Comparison of Estimators
14	Apr 11: 7.3.2, Unbiased Estimators		Apr 13: 7.3.2, Unbiased Estimators		Apr 15: Homework 6 due. 7.3.3, Sufficiency and Unbiasedness
15	Apr 25: 7.66, Jackknife Resampling		Apr 27: 10.1.4, Bootstrapping		Apr 29: Homework 7 due. Review of course (last day of class)

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.