Syllabus: Statistics 210A (Fall 2021)

Will Fithian

Course Information

Instructor: Will Fithian, Evans 301. OH TBD

GSI: Dohyeong Ki. OH TBD

Lectures: TuTh 9:30-11, VLSB 2060.

Final exam: Tuesday December 14, 3-6pm

Announcements and handouts at bCourses (`https://bcourses.berkeley.edu/`)

Assignments on course website at `http://www.stat.berkeley.edu/~wfithian/courses/stat210a/`

Email policy: You can email me (`wfithian@berkeley.edu`) or the GSIs about administrative questions, with [Stat 210A] in the subject line. **No math** over email, please.

Piazza for technical questions (no homework spoilers!)

Gradescope for turning in homework

Content

Stat 210A is Berkeley's introductory Ph.D.-level course on theoretical statistics. It is a fast-paced and demanding course intended to prepare students for research careers in statistics.

Topics: Statistical decision theory (frequentist and Bayesian), exponential families, point estimation, hypothesis testing, resampling methods, estimating equations and maximum likelihood, empirical Bayes, large-sample theory, high-dimensional testing, multiple testing and selective inference.

Prerequisites: Linear algebra, real analysis, one year of probability and statistics

Main text: Keener, *Theoretical Statistics: Topics for a Core Course*, Springer 2010.

Supplementary texts: (see course web site for additional resources)

- Lehmann and Casella, *Theory of Point Estimation*, Springer 1998.
- Lehmann and Romano, *Testing Statistical Hypotheses*, Springer 2005.

All texts are available online from Springer Link (linked from course website).

Grading

Your final grade is based on weekly problem sets (50%) and a final exam (50%).

Lateness policy: Homework must be submitted to Gradescope at midnight on Wednesday nights. Late problem sets will not be accepted, but we will drop your lowest 2 grades.

Collaboration policy: For homework, you are welcome to work with each other or consult articles or textbooks online, with the following caveats:

- You must write up your solution by yourself.
- You may **NOT** consult any solutions from previous iterations of this course.
- If you collaborate or use any resources other than course texts, you must **acknowledge** your collaborators and the resources you used.

Academic integrity: You are expected to abide by the Berkeley honor code. Violating the collaboration policy, or cheating in any other way, will result in a failing grade for the semester and you will be reported to the University Office of Student Conduct.

Accommodations

Students with disabilities: Please see me as soon as possible if you need particular accommodations, and we will work out the necessary arrangements.

Scheduling conflicts: Please notify me in writing by the **second week of the term** about any known or potential extracurricular conflicts (such as religious observances, graduate or medical school interviews, or team activities). I will try my best to help you with making accommodations, but cannot promise them in all cases. In the event there is no mutually-workable solution, you may be dropped from the class.

Lecture schedule

Date	Reading	Topics
Aug. 26	Chap. 1 and Sec. 3.1 of Keener	Probability models and risk
Aug. 31	Chap. 2 of Keener	Exponential families
Sep. 2	Chap. 2 and Sec. 3.2 of Keener	Sufficient statistics
Sep. 7	Secs. 3.4, 3.5, and 3.6 of Keener	Minimal sufficiency and completeness
Sep. 9	Secs. 3.6 and 4.1 of Keener	Rao-Blackwell theorem
Sep. 14	Secs. 4.1 and 4.2 of Keener	UMVU estimation
Sep. 16	Secs. 4.5 and 4.6 of Keener	Information inequality
Sep. 21	Secs. 7.1 and 7.2 of Keener	Bayesian estimation
Sep. 23	Secs. 7.1 and 7.2 of Keener	Conjugate priors
Sep. 28	Secs. 7.2 and 11.1 of Keener	More on Bayes
Sep. 30	Secs. 7.2 and 11.1 of Keener	Hierarchical priors, empirical Bayes
Oct. 5	Secs. 11.1, 11.2 and 9.4 of Keener	James-Stein paradox, confidence intervals
Oct. 7	Secs. 5.1 and 5.2 of Lehmann-Casella	Minimaxity and admissibility
Oct. 12	Secs. 12.1, 12.2, 12.3 and 12.4 of Keener	Hypothesis testing, Neyman-Pearson lemma
Oct. 14	Secs. 12.3, 12.4, 12.5, 12.6 and 12.7 of Keener	UMP tests
Oct. 19	Secs. 13.1, 13.2, and 13.3 of Keener	Testing with nuisance parameters
Oct. 21	Secs. 13.1, 13.2, and 13.3 of Keener	UMP unbiased tests
Oct. 26	Secs. 13.1, 13.2, and 13.3 of Keener	UMP unbiased tests
Oct. 28	Secs. 14.1, 14.2, 14.4, 14.5, and 14.7 of Keener	Linear models
Nov. 2	Secs. 8.1, 8.2, and 8.3 of Keener	Asymptotic concepts
Nov. 4	Secs. 8.3 and 8.4 of Keener	Maximum likelihood estimation
Nov. 9	Secs. 8.5, 9.1, and 9.2 of Keener	Relative efficiency
Nov. 11	Secs. 9.1, 9.2, and 9.3 of Keener	Consistency of the MLE
Nov. 16	Secs. 9.1, 9.2, and 9.3 of Keener	Asymptotic normality of MLE
Nov. 18	Secs. 9.5 and 9.7 of Keener	Trio of asymptotic likelihood-based tests and CIs
Nov. 23	Secs. 19.1-19.3 of Keener	Bootstrap and permutation tests
Nov. 25		No class (Thanksgiving)
Nov. 30	15.1-15.4 of Lehmann-Romano	Bootstrap theory
Dec. 2	Lecs. 2, 3 of Candes	Testing in high dimensions
Dec. 7	Lec. 6 of Candes	Multiple testing
Dec. 9	Lecs. 8 and 9 of Candes	Multiple testing