SYLLABUS FOR STAT 210B
THEORETICAL STATISTICS

Spring 2024

University of California, Berkeley

- Instructor: Nikita Zhivotovskiy

- Lectures: TuTh, 11:00AM-12:30PM - 155 - Anthro/Art Practice Bldg.

- Office hours: 315 Evans, Tuesday 2:00 PM - 4:00 PM

- TA: Drew Nguyen

- TA office hours: Thursday 10:00 AM - 11:00 AM (Cafe Strada), Friday 2:00 PM - 3:00 PM (Evans 444)

Means of communication. Please, email Instructor and GSI only for emergencies. General questions should be asked here: `https://edstem.org/us/courses/52628/discussion/4105584`.

Description and Topics. This is an advanced, fast-paced graduate course focused on non-asymptotic techniques in high-dimensional statistics. List of topics:

1. Concentration of measure inequalities.

2. Uniform law of large number. Metric entropy and chaining.

3. Non-asymptotic analysis of random matrices.

4. Localization and fast rates. Non-parametric least squares.

5. Lower-tail inequalities, sub-Gaussian estimators.

6. Selected questions on sparse recovery.

7. Information-theoretic upper bounds for density estimation and regression.

Textbooks. Two primary references:

- Martin J. Wainwright. *High-dimensional statistics: A non-asymptotic viewpoint.* Cambridge University Press, Volume 48, 2019.

- Roman Vershynin. *High-dimensional probability: An introduction with applications in data science.* Cambridge University Press, Volume 47, 2018.

Some topics will be taken from other textbooks including:

- Stéphane Boucheron, Gábor Lugosi, and Pascal Massart. *Concentration Inequalities - A Nonasymptotic Theory of Independence.* 2013.

- Aad van der Vaart and Jon A. Wellner. *Weak Convergence and Empirical Processes: With Applications to Statistics* Springer, 2023.

- Yury Polyanskiy and Yihong Wu. *Information Theory: From Coding to Learning.* Cambridge University Press, Expected 2023+ (book draft).

- Evarist Giné and Richard Nickl. *Mathematical Foundations of Infinite-Dimensional Statistical Models.* Cambridge University Press, 2021.

- Tong Zhang. *Mathematical Analysis of Machine Learning Algorithms.* Cambridge University Press, 2023.

Additional useful references:

- Aditya Guntuboyina, *Spring 2018 Statistics 210B*.

- Alexander Rakhlin, *Mathematical Statistics: A Non-Asymptotic Approach*

- Ramon van Handel, *Probability in High Dimension*.

- Shahar Mendelson. *Geometric Aspects of Statistical Learning Theory*.

- Matthieu Lerasle, *Selected Topics on Robust Statistical Learning Theory*.

- Joel A. Tropp. *Probability Theory & Computational Mathematics*

Preliminaries. Stat 210A or an equivalent graduate course. Strong background in probability and real analysis.

Home Assignments. Four home assignments submitted in Gradescope, Latex-made Pdf. No evaluation for late (after 11:59 PM) submissions except for emergencies.

While students are permitted to discuss homework assignments with peers, each student is required to independently write up their own work. Additionally, students must specify the names of any classmates with whom they discussed the homework problems.

Grading. Class attendance is strongly encouraged. No video lectures/recordings. No midterm.

- HW×35% + Scribe ×5% + Final×60%.

Each participant in the course will be responsible for creating a scribe of the lecture. One student will compile the materials, while another student will be in charge of proofreading them. The submission deadline for scribes from Tuesday and Thursday lectures is the following week's Wednesday at 11:59 PM. Draft texts provided by the instructor, along with discussions during office hours, will assist in the preparation of these scribes.

Final exam date: TODO

Academic Integrity. The high academic standard at the University of California, Berkeley, is reflected in each degree awarded. Every student is expected to maintain this high standard by ensuring that all academic work reflects unique ideas or properly attributes the ideas to the original sources. These are some basic expectations of students with regards to academic integrity: Any work submitted should be your own individual thoughts, and should not have been submitted for credit in another course unless you have prior written permission to re-use it in this course from this instructor.

Disability Accommodations. If you need an accommodation for a disability, if you have information your wish to share with the instructor about a medical emergency, or if you need special arrangements if the building needs to be evacuated, please inform the instructor as soon as possible. If you are not currently listed with DSP (the Disabled Students' Program) and believe you might benefit from their support, please apply online at `https://dsp.berkeley.edu`.