Math 281A: Mathematical Statistics

- Instructor: Wenxin Zhou <wez243@ucsd.edu>
- Lectures: 2pm–3:20pm TuTh, AP&M 5402
- Office hours: 1pm–2pm TuTh (AP&M 6131) or another time upon email appointment
- Teaching Assistant(s):
  - Xiaoou Pan <xip024@ucsd.edu>
    Office hours: 5pm–7pm Wednesday (AP&M 1121)

Overview This course blends classical asymptotic statistics and nonasymptotic statistics. Specifically, we will offer an introduction to asymptotic analysis in the classical literature and nonasymptotic analysis which guarantees finite sample performance. The goal is to review classical statistical philosophy with a focus on asymptotic inference (central limit theorems, confidence intervals, p-values, etc.), present measure concentration tools which will be illustrated on several problems in statistics and machine learning such as regression, matrix estimation and principal component analysis (PCA) when asymptotic analysis does not (always) apply.

Required background Mathematical/real analysis and linear algebra at an undergraduate level; advanced probability theory at a graduate level. Students who haven't yet taken any graduate-level probability course are STRONGLY encouraged to take Math 280A concurrently.

Structure This course covers the following contents:

- *Convergence of random variables and linear statistics*
- *Delta method for nonlinear statistics*
- *M-estimation: consistency, asymptotic normality, confidence construction and relative efficiency*
- *Maximum likelihood estimator and logistic regression*
- *Topics in hypothesis testing*
- *A glance at the empirical process theory*
- *U-statistics* (optional)

Course references

- Asymptotic Statistics (by A. W. van der Vaart) [Link]
- Theory of Point Estimation (by E. L. Lehmann & George Casella) [Link]

Grading Homework (60%) and final exam (40%).

Homework Homework must be turned in by the end of the class every Thursday, starting Week 2. We encourage electronic submissions, for example, typing the solutions in LaTeX. Late homework will not be accepted unless there is a reasonable justification. Although it is acceptable for students to discuss the homework assignments with one another, each student must write up his/her homework on an individual basis.