Mathematical Statistics

With the recent advances in powerful computing and the availability of massive sets of data, the tools of statistics, data science, and analytics have become indispensable in the applied sciences and in industry. This course focuses on the mathematical underpinnings that provide the foundations to modern day data analysis and statistics.

The contents of the course will depend in part on the background, preparation, and interest of the students, thus making the list of topics below somewhat flexible.

Instructor:

- Larry Goldstein, University of Southern California, Los Angeles, USA

Course content will be drawn from:

- Parametric models, linear models
- Estimation, criteria and construction of estimators, maximum likelihood, the information inequality, asymptotics
- Non parametric models, empirical distribution functions, bootstrap
- Hypothesis testing, uniformly most powerful tests, multiple hypotheses testing, family wise error, false discovery rate
- Density and regression estimation, regularization and smoothing
- Classification methods, Vapnik Chervonenkis (VC) dimension
- Variable selection, the lasso and matrix completion

Course Prerequisite: Students should have at least one mathematically rigorous course in probability, and some basic statistics. It will be assumed that students are familiar with the first five chapters of the course text, All of Statistics: A concise course in Statistical Inference, by Larry Wasserman. Students should review these chapters and study any material new to them before starting the course. It is also strongly suggested that students read Chapter 6; this material will be covered in more depth during the course.
Evaluation;

- Midterm, 30%, Final Exam, 40%, Course participation, 30%

Course Text, and four additional references:

- All of Statistics: A concise course in Statistical Inference, by Larry Wasserman.
- Mathematical Statistics: Basic Ideas and Selected Topics, by Peter Bickel and Kjell Doksum
- A Course in Large Sample Theory, by Thomas Ferguson
- Statistical Inference, by Casella and Berger
- Theoretical Statistics: Topics for a Core Course, by Keener