Econ 506: Advanced Economic Statistics

Fall 2017
Rutgers University
Department of Economics

Instructor

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Class Meetings

Lecture: Tuesdays& Fridays 9:50 am- 11:10 am, Scott Hall 104
Recitation: Wednesdays 9:50am-11:10am, Scott Hall 119

- The recitation session will be spent in answering questions about problem sets.
- Occasionally I will hold lectures during the recitation session (Wednesday mornings) due to traveling on the scheduled lecture days. I will announce in advance.

Office Hour

Tuesdays 3:00 PM - 4:00 PM or by appointment.

Course Overview

This course is the first course in the core econometrics sequence. The main purpose is to introduce you to basic probability and statistical inference topics that you will find helpful as you pursue a graduate education in Economics. At the end of this course, you should be familiar with basic concepts in probability theory, commonly used univariate and multivariate distributions, different types of convergence and estimation methods, and general principles of constructing confidence intervals.

Textbook

1. Bickel, P. and Doksum, K. (2006) *Mathematical Statistics, Basic Ideas and Selected Topics*, Vol. 1, Pearson (2nd Edition).
2. Casella, G. and Berger, R. (2001) *Statistical Inference*, Cengage Learning (2nd edition).

- Both books are excellent introduction to Mathematical Statistics, which I used when I was a first-year graduate student in the Department of Statistics at Northwestern University. Casella and Berger (2001) has more emphasis on Bayesian aspects and decision theories, while Bickel and Doksum (2006) is more about conventional mathematical statistics. You are encouraged to have either one of them.
- However, the books were written for graduate students in statistics, and neither is completely suitable for our course. I will provide more economic intuitions and examples. So it is important that students attend classes and follow my notes.
- Examples of economic applications: Markowitz's modern portfolio theory, Testing capital asset pricing models, Multiple choice models, Nonparametric instrumental variables, Tests of exogeneity and Missing data.

Course Evaluation

The final grade will be determined by your performance in regular homework assignments, a mid-term exam and the final exam. The breakdown of weight given to each component is as follows:

Assignments: 30%
Mid-term exam: 30%
Final exam: 40%

- There will be one midterm. The date will be announced at least two weeks ahead.
- Homework is usually due in a week.
- The exams will be in class. Students are allowed to bring a formula sheet.

Topics to be Covered

1. Review of Probability and Distribution Theories
    - Basic Set Theory
    - Random Variables
    - Expectation of a random variable
    - Joint, Marginal and Conditional Distributions
    - Transformations of random variables
    - Some common univariate and multivariate distributions
    - Some useful inequalities
2. Large Sample Theory for Independent Data
    - Convergences in Probability and in Distribution
    - Law of Large Numbers
    - Central Limit Theorem

- Delta method

3. Mathematical Statistics

   - Identification
   - Sufficiency and Completeness
   - Maximum Likelihood Estimations (MLE) and Efficiency
   - Fisher's Information Matrix and Its Estimations
   - Computation: Newton-Raphson Iteration, Coordinate Descent

4. Hypothesis Testing

   - Wald, Likelihood Ratio, and Score Tests
   - Power Functions and Local Alternatives
   - Hausman's Specification Test
   - Neyman-Pearson Lemma

5. Confidence Intervals

   - Large Sample Confidence Intervals
   - Duality between Testing and Confidence Sets
   - Partial Identification Approach for Confidence Sets