Econ 506: Advanced Economic Statistics

Fall 2018
Rutgers University
Department of Economics

Instructor

Yuan Liao
New Jersey Hall, Office 201B
75 Hamilton St
New Brunswick, NJ 08901
yuan.liao@rutgers.edu

Class Meetings

Lecture: Tuesdays Scott Hall 105 & Fridays Scott Hall 101 2:50 - 4:10 pm,
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

Thursdays 2:00 PM - 3:00 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 (and some advanced) 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. In addition, some advanced topics will also be discussed in this class, including empirical process and minimax theories.

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

    - Probability space
    - Distributions
    - Application: Markowitz's Modern Portfolio Theory

- Some useful inequalities

2. Large Sample Theory: Elementary

   - Convergences in Probability and in Distribution
   - Law of Large Numbers
   - Central Limit Theorem
   - Delta method

3. Mathematical Statistics

   - Identification and completeness
   - Maximum Likelihood Estimations (MLE) and Efficiency

4. Computations

   - Newton Raphson
   - Coordinate descent
   - Gradient descent
   - The Lasso as an example

5. Statistical Inference

   - Trinity tests
   - Neyman-Pearson lemma
   - Confidence regions
   - Partial identification

6. Large Sample Theory: Empirical Process

   - Symmetrization
   - ϵ-cover and packing
   - Chaining and peeling device
   - P-Donsker
   - Functional delta method

7. Minimaxity

   - Shannon's information theory
   - Fano's inequality
   - Normal models