Economics 520: Theory of Quantitative Methods, Fall 2014

Course Syllabus

Last Revised: September 9, 2014

- Lectures: MW, 2:00–3:15 PM, McClelland Hall 401KK
- Instructor: Keisuke Hirano (hirano@u.arizona.edu)
- Instructor Office Hours: Tuesdays, 2:00–3:15 PM (or by appointment)
- Teaching Assistant: Max Rosenthal (rosenthm@email.arizona.edu)
- TA Office Hours: Wednesdays, 12:30–2:00 PM
- Discussion Section: Tuesdays, 8:00–9:00 AM, McClelland 126

Course Description:

This course serves as an introduction to probability theory and statistical inference for graduate studies in economics and related fields. It is particularly intended to prepare students for graduate econometrics courses (522A and 522B) and for applications of probability theory in other graduate economics courses.

Pre- and Co-requisites:

Unless you receive an exception from the instructor, you are required to have taken the Economics PhD “Math Camp” which starts at the beginning of August, and to concurrently enroll in Economics 519. More specifically, you are expected to be familiar with multivariable calculus (including optimization and Taylor expansions), basic real analysis (set operations, open and closed sets, compact sets, limits, etc.), linear algebra (matrix operations, determinants, etc.), and mathematical proofs.

Textbook:


The textbook by Casella and Berger (hereafter CB) is required for the course. I will also provide written lecture notes. These are based on notes written by Guido Imbens, and I thank him for permission to adapt his material for this course. You may find it useful to consult other textbooks as you learn this material. I recommend:

- Silvey, D., Statistical Inference, Chapman and Hall.
- Wasserman, L., All of Statistics, Springer.

Assessment:

- **Homework Assignments** 10%: There will be homework assignments nearly every week. They are intended primarily to help you prepare for the exams, and will be graded on a pass/no pass basis. Because of the frequency of the
assignments, I will not accept late homeworks for any reason. However, I will drop the lowest homework score when calculating your overall grade in the course. You are allowed to work in groups on the homework, but you must write up your own solutions in your own words.

- **Midterm Exam** 40%: The (in-class) midterm will be held on **Monday, October 27**.
- **Final Exam** 50%: **Friday, December 12, 2014, 1:00–3:00 PM.** The final exam will be cumulative.

**Computer Software:**

Most of the homeworks will involve analytic exercises, but some assignments will also require you to do some programming. We will use **R**, a system for statistical computing. It is freely available from [http://www.r-project.org/](http://www.r-project.org/). I will distribute notes on using R, and additional resources are available from the R Project website.

**Course Web Site:**

[http://www.u.arizona.edu/~hirano/520_2014.html](http://www.u.arizona.edu/~hirano/520_2014.html)

I will post lecture notes, homework assignments, and other supplementary material for the course here.

**Outline: (may be revised as semester progresses)**

**Probability Theory**

- Elementary Probability Theory and Combinatorics (CB 1.1–1.2)
- Conditional Probability and Independence (CB 1.3)
- Functions of Random Variables (CB 1.4–1.6, 2.1)
- Expectations (CB 2.2–2.3)
- Common Distributions (CB 3.1–3.3)
- Joint distributions, Conditional Distributions, (CB 4.1–4.2, 4.6)
- Random vectors, multivariate normal distribution (notes)
- Stochastic processes (notes)
- Convergence, Laws of Large Numbers, Central Limit Theorem (CB 5.1–5.3, 5.5)

**Statistical Inference:**

- Point Estimation: Method of Moments and Maximum Likelihood (CB 7.1, 7.2.1, 7.2.2)
- Bayesian Point Estimation (CB 7.2.3)
- Evaluating Point Estimators (CB 7.3, 6.1–6.2)
- The Cramer-Rao Bound (CB 7.3)
- Large Sample Properties of Maximum Likelihood Estimators (CB 10.1.1–10.1.3)
- Hypothesis Testing (CB 8.1, 8.3.1–8.3.2)
- Most Powerful Tests (CB 8.3.2–8.3.3)
- Large Sample Tests (CB 10.3)
- Confidence Intervals (CB 9.1–9.2, 10.4)