Statistical Analysis: Econ 8300

Course Syllabus

Instructor : Dong-Hyuk Kim (dong-hyuk.kim@vanderbilt.edu)
Lectures : Tuesday and Thursday 11:00 am ~ 12:15 pm, Calhoun Hall 209
Office Hours : Tuesday 4:00 pm ~ 5:00 pm, Calhoun Hall 403

Teaching Assistant : Ying Zheng (ying.zheng.1@vanderbilt.edu)
Review Session : Friday, 2:30 pm ~ 3:30 pm, Calhoun Hall 203
TA Office Hours : Friday, 3:30 pm ~ 4:30 pm, Calhoun Hall 203

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 and for applications of probability theory in other parts of economics.

Prerequisites:
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 be comfortable reading and writing 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 the notes written by Guido Imbens and updated by Keisuke Hirano. I thank Keisuke Hirano for permission to adapt his material for this course.

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 Exams 40%: The (in-class) midterm will be held on October 8 (regular class time). No makeup will be given.

• Final Exam 50%: The final exam will be cumulative. No makeup will be given. The final exam will be on December 17 (3 pm).
Computer Software:

Most of the homeworks will involve analytic exercises, but some assignments will also require you to do some programming. We will use the matrix programming language Matlab. I will provide notes on how to use Matlab later in the semester. An alternative to Matlab is the program Octave. This software is freely available under the GNU Public License at [http://www.octave.org](http://www.octave.org). It has essentially the same syntax as Matlab. This is a good choice if you wish to be able to run the programs on your own computer.

Course Outline: (may be revised as semester progresses)

1. 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)

2. 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)
   - 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)