Economics 520: Theory of Quantitative Methods
Fall Semester 2005
Course Syllabus

Lectures: TTh 12:30-1:45 pm, McClelland 401KK

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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 parts of economics.

Prerequisites: You are expected to have taken Economics 519 or be comfortable with the material covered in that course. Information about Economics 519 can be found at:

`http://www.u.arizona.edu/~dreiley/econ519/syllabus.html`

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 be comfortable reading and writing mathematical proofs.

Textbook:

- Casella, G., and Berger, R.L., *Statistical Inference*, 2nd edition, Duxbury Press.

The textbook by Casella and Berger (hereafter CB) is required for the course. We will mostly follow CB, but we will skip some topics, and add some other topics, such as a brief section on Markov chains and stochastic processes.

I will also provide written lecture notes. These are based on notes written by Guido Imbens, and I thank him for permission to use his material in this course.

You may find it useful to consult other textbooks as you learn this material. Some useful resources are:

- DeGroot, M., and Schervish, M., *Probability and Statistics*, Addison-Wesley.
- Hogg, R., and Craig, A., *Introduction to Mathematical Statistics*, Prentice Hall.
- Silvey, D., *Statistical Inference*, Chapman and Hall.
- Lehmann, E., *Testing Statistical Hypotheses*, Springer.
- Lehmann, E., and Casella, G., *Theory of Point Estimation*, 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 is tentatively scheduled for October 13. We will finalize the date of the midterm during the first week of classes.
- Final Exam **50%**: 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 the matrix programming language Matlab. This is available on the university u-system. For instructions on how to set up your u-system account, see: `http://www.u.arizona.edu/` 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`. 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 Web Site: Lecture notes, homeworks, and other course materials will be made available at: `http://www.u.arizona.edu/~hirano/520.html`

Outline: (may be revised as semester progresses)

1. Probability Theory
   (a) Elementary Probability Theory and Combinatorics (CB 1.1-1.2)
   (b) Conditional Probability and Independence (CB 1.3)
   (c) Functions of Random Variables (CB 1.4-1.6, 2.1)
   (d) Expectations (CB 2.2-2.3)
   (e) Common Distributions (CB 3.1-3.3)
   (f) Joint distributions, Conditional Distributions, (CB 4.1-4.2, 4.6)
   (g) Stochastic processes and Markov chains (lecture notes)
   (h) Convergence, Laws of Large Numbers, Central Limit Theorem (CB 5.1-5.3, 5.5)
2. Statistical Inference:
   (a) Point Estimation: Method of Moments and Maximum Likelihood (CB 7.1, 7.2.1, 7.2.2)
   (b) Bayesian Point Estimation (CB 7.2.3)
   (c) Evaluating Point Estimators (CB 7.3, 6.1-6.2)
   (d) The Cramer-Rao Bound
   (e) Large Sample Properties of Maximum Likelihood Estimators (CB 10.1.1-10.1.3)
   (f) Hypothesis Testing (CB 8.1, 8.3.1-8.3.2)
   (g) Most Powerful Tests (CB 8.3.2-8.3.3)
   (h) Large Sample Tests (CB 10.3)
   (i) Confidence Intervals (CB 9.1-9.2, 10.4)