Econometrics I [G31.2100]
Fall 1999

Instructor:
Professor C. Flinn
269 Mercer Street, Room 318
Phone: 998 8925
E-mail: christopher.flinn@nyu.edu

Time:
Monday 12:05-2:05 [Lecture]
Wednesday 12:05-2:05 [Lab]

Texts (Required):

- Arthur S. Goldberger. *A Course in Econometrics*. Cambridge, MA: Harvard University Press, 1991.
- Alexander Mood, Franklin Graybill, and Duane Boes. *Introduction to the Theory of Statistics, Third Edition*. New York: McGraw-Hill, 1974.

Course Objectives:

We will begin by reviewing probability and sampling theory using as our main source one of the more widely-used intermediate level mathematical statistics texts. We will then consider estimation theory and hypothesis testing, both from the vantage point of statisticians and econometricians. There are subtle and not so subtle differences between these two groups of researchers in terms of subject matter and methods. When performing multivariate analyses, statisticians tend to be interested in the estimation of the joint distribution of the random variables, while econometricians tend to focus their attention on estimating conditional distributions, and often just conditional moments. This difference is due to the fact that econometricians, who for the most part are trained as economists, are interested in estimating models. These models typically take the form of decision rules [or equilibrium mappings] which are functions of state variables [e.g., prices and income] and parameters which reflect preferences, technologies, etc. The decisions that agents take yield outcomes; using data on decisions and/or outcomes and the state variables, the econometrician attempts to retrieve

the parameters characterizing the economic environment. Comparative statics exercises can only be conducted when the applied economist has "good" estimates of these parameters.

If we call the state variables x and the choice or outcome variable y, the "economics" of the problem is in the conditional relationship $y = g(x)$. Often times, economic theory will have little or nothing to say about the distribution of x, so that the joint distribution $F(x, y)$ will be of little direct interest to economists. This is not generally the case for statisticians, for whom the conditional distribution $F(y|x)$ would be of no more interest than $F(x|y)$ - thus they tend to treat all random variables "symmetrically" and look at the joint distribution. From my perspective, econometrics is essentially the application of standard statistical tools to the analysis of conditional relationships between random variables. What distinguishes econometrics from statistics is the econometrician's objective to infer something about behavior from empirical relationships between variables. The mapping from an empirical relationship to an underlying behavioral model is what we refer to as the identification problem. For the most part, there is little discussion of identification problems in the statistics literature because statisticians don't work with behavioral models.

To be a competent applied econometrician, one needs to have a solid understanding of basic statistical theory, some familiarity with data, and a good knowledge of economic theory. The researcher typically begins with a theoretical model of a behavior of interest. S/he will then have to become familiar with data sets which contain the variables, or reasonable substitutes for them, that appear in the model. The identification step of the analysis is the determination of whether or not estimators can be found which can be used with the data that will allow the econometrician to completely or partially characterize the economic environment of the model. The "statistics" part of the enterprise really occurs contemporaneously with or after the identification step, and amounts to the investigation of the properties of the estimators which one proposes for the recovery of model parameters, and for hypothesis-testing types of exercises.

In this course, we will attempt to prepare the student for this kind of research enterprise by carefully covering most or all of the statistical theory [albeit at a basic level] they will need to do competent applied econometric analysis. Along the way we shall discuss identification issues when possible, though always in very simple contexts. We will also prepare the student for further study of econometrics by using the matrix programming language GAUSS in many of the homework assignments.

Course Requirements and Grading:

Students are expected to complete weekly problem sets. These problem sets will be distributed at the end of each lecture and collected at the beginning of the lecture in the following week. Each problem set will be graded and discussed in the lab session of the same week in which the problem set was collected. The average homework grade will be a component of the student's final grade. The average grade will be computed after dropping the two lowest homework scores received over the course of the semester. *No late homework assignments will be accepted under any circumstances.* Students will also take a midterm exam [during a class period] and a final [during finals week].

The final grade will be determined using the following weights:

Homework Average	.15
Midterm Exam	.40
Final Exam	.45

Lecture Schedule:

1. Introduction to Econometrics; Review of Basic Probability Theory (G:1;M:I)
2. Univariate Distribution Theory: Characterizations and Special Cases of Interest; Functions of Random Variables (M:II.1-3,III.2-3;G:2)
3. Moments of Random Variables; Chebyshev, Jensen, and Markov Inequalities; Characteristic and Moment Generating Functions; Prediction and Expectation (G:3;M:II.4)
4. Bivariate Distribution Theory; Characterization of Joint and Conditional Distributions; Distributions of Functions of Random Variables (G:4;M:IV.1-3)
5. Moments of Multivariate Distributions; Multivariate Normal Distributions; Mean Independence; Prediction and Expectation Revisited (G:5-7,18;M:IV.4-5,V)
6. Sampling Distributions: Univariate, Small Sample Case; Sampling from Normal Populations (G:8;M:VI.1,2,4)
7. Sampling Distributions: Multivariate Case; Asymptotic Theory; Order Statistics (G:9,10;M:VI.3,5;Theil (1973): Chapter 8)
8. **Midterm Exam** *(November 1)*
9. Parametric and Nonparametric Estimation: Classes of Commonly-Used Estimators; Small and Large Sample Distribution Theory (G:11; M:VII.1,2,XI.3,5)
10. Properties of Estimators: Unbiasedness, Consistency, Sufficiency, Efficiency; Exponential Families (G:12;M:VII.3-6,8,9)
11. Hypothesis Testing: Large and Small Sample Theory; LaGrange Multiplier, Wald, and Likelihood Ratio Tests (M:IX.1-6)
12. Estimating Conditional Relations; Simple Linear Models (G:13;M:X)
13. Multiple Regression Analysis: Introduction, Matrix Representations and Useful Equalities (G:14-16)
14. Linear Regression with Normally Distributed Disturbances: Distribution Theory and Hypothesis Testing (G:19-21)