The aim of the course is to develop familiarity with a wide range of statistical and econometric techniques that have proved to be useful in applied contexts. Theoretical results will be developed as necessary and in order to allow students to apply general principles to their own research problems. Primary emphasis, however, is placed upon applicability, on the ability to understand the techniques in use in the literature, and on acquiring a minimal acquaintance with econometric computing. The material discussed is a reasonable definition of the minimum that a well-trained economics Ph.D. should know. For those of you who are primarily interested in economic theory, the course should give you some idea of the way in which economists attempt to confront theory and evidence.

Prerequisites

Economics 707 or equivalent. Familiarity with calculus, linear (matrix) algebra and basic mathematical statistics is expected. I shall also assume that students are familiar with the general linear regression model, its algebra, and estimation and inference within that framework. (Students for whom this last assumption is not true will have a hard time very quickly and should review the material at once.)

Grading

The course grade will be based on a mid-term (30%) and a final (50%) and 4-5 problem sets (20%). The final will be a 2 hour exam and will cover all material. Parts of the problem sets can be asked in the mid-term or final exams.

Academic Conduct

Students should know and understand the GRS Academic Conduct Code, see http://www.bu.edu/cas/students/graduate/forms-policies-procedures/academic-discipline-procedures/. Any suspected academic misconduct will be reported to the Dean's Office.

Texts and Notes

Good texts to review the basic notions of probability and statistics useful for this course are:


There is no required text, which we will follow closely. The course is based on a set of lecture notes. However, it is strongly recommended that you complement these notes with one or more of the following textbooks:


You are also encouraged to supplement the material discussed in class with a good introductory level book that gives an intuitive explanation of the use of the various methods. The one I recommend is:


Other useful books are:


At a more advanced and theoretical level, the following books are very useful:


An interesting book with economic applications is:

COURSE OUTLINE

1. **A Brief Review of Linear Models & Asymptotics** (least squares projection, LLN, CLT, CMT)

2. **Instrumental Variables** (instruments and estimator, two-stage interpretation, weak identification, Hausman-Wu test).

3. **Generalized Method of Moments** (moment restrictions, identification, asymptotic theory, and specification tests)

4. **Linear Panel Data Models** (random effects estimator, fixed effects estimator, incidental parameter problem, and dynamic panel data models)

5. **Maximum Likelihood Estimation** (the principle of MLE, sufficient statistics, the Cramer-Rao lower bound, asymptotic distribution of the MLE, an information matrix equality, the MLE in the standard linear model, consistent estimates of the information matrix).

6. **Numerical Optimization** (basic results, numerical optimization).

7. **Limited Dependent Variable Models** (Logit, probit, multinomial choice)

8. **Resampling Methods** (Bootstrap, subsampling, and others)

9. **The Trinity of Test Procedures Revisited** (LR, Wald and LM tests, asymptotic distribution, geometric interpretation, when are LM, LR and Wald tests the same? the LM test in least-squares problems).

10. **Misspecified Models** (basic issues of the quasi-MLE, the Kullback-Leibler divergence, asymptotic distribution of the quasi-MLE, hypothesis testing with potential misspecification, the information matrix test for misspecification, simplification of the information matrix test).

11. **Vector Autoregression** (VAR and VMA representations, variance decomposition, impulse response function)

12. **Unit Roots, Cointegration and Spurious Regressions** (an example, unit roots, differenced versus trend stationary models, testing for a unit root, spurious regression, cointegration, error correction models, testing for cointegration).

**Selected Readings.**

1. **The Basic Linear Model; Asymptotic Results:** Wooldridge, ch. 4.1-4.2;


2. **Instrumental Variables:** Wooldridge, ch. 5;


3. **Generalized Method of Moments:** Hayashi, ch. 3;


4. **Linear Panel Data:** Wooldridge, ch. 10;


5. **Maximum Likelihood Estimation:** Wooldridge, ch. 12.1-3, 13;


6. **Numerical Optimization:** Hayashi, ch.7.5;


7. **Limited Dependent Variable Models:** Wooldridge, ch. 15, 16.1-2.


9. The Trinity of Test Procedures revisited: DM, ch. 4.1-4.5, 10.6;


10. Misspecified Models


11. Vector Autoregression Models: Hayashi, ch. 6.4-6.6, Hamilton, ch. 11


12. Unit Roots and Spurious Regressions: Hayashi, ch. 9, Hamilton, ch. 17


