ECONOMETRIC THEORY: 1993/4

Lecturer : D.S.G. Pollock

This course lays the groundwork for an understanding of the theory and practice of modern econometrics. A relatively simple level of mathematics is employed throughout the course. The topics include the simple regression model and its estimation by least squares, maximum likelihood and the method of moments. The classical simultaneous-equation model, the errors-in-variables model, and a variety of models with limited and qualitative dependent variables are also considered. The latter part of the course introduces the concepts of linear vector spaces and matrix algebra and uses them in a thoroughgoing analysis of the k-variable linear regression model. The lectures are accompanied by a series of printed chapters. The topics are as follows:

Principles of Estimation
- Probability Limits and Consistent Estimators
- The Method of Moments
- The Method of Least Squares
- The Method of Maximum Likelihood

The Simple Regression Model
- Conditional Expectations and Lines of Regression
- Estimation by the Method of Moments
- Estimation by Least Squares
- Estimation by Maximum Likelihood
- Example: The Inconsistent Estimation of the Consumption Function by Ordinary Least-Squares Regression

The Errors-in-Variables Model
- Estimation by the Method of Moments
- Estimation by Least Squares
- Estimation by Maximum Likelihood
- The Simple Regression Model as a Limiting Case of the Errors-in-Variables Model
- The Classical Simultaneous-Equation Model of Econometrics and the Errors-in-Variables Model
- Example: Friedman's Permanent Income Hypothesis
- Example: Estimation of a Demand Function

Models with Limited Dependent Variables
- Probit and Logit
- The Solution of Nonlinear Estimating Equations: The Newton–Raphson Procedure
- Example: The Mortality of Locusts
- Censored and Truncated Models: Tobit Model
- Example: the New Jersey Negative Income-Tax Experiment

Appendix: Plane Geometry
- Inner Products, Distances and the Law of Cosines
- The Least-Squares Derivation of the Estimating Equations of the Errors-in-Variables Model
- The Equation of a Line and the Distance of a Point from a Line

Interlude: Linear Spaces Vectors and Matrices
- Abstract Vector Spaces and Cartesian Spaces
- Linear Combinations, Inner Products and Orthogonality
- Linear Transformations and Matrices, Projections, Rotations and Reflections
- Eigenvectors, Eigenvalues and the Factorisation of a Positive-Definite Matrix

The Classical Linear Regression Model
- Multiple Regression and the Ordinary Least-Squares Estimator
- The Moments of the OLS estimator: the Gauss–Markov Theorem
- The Geometric Representations of the Model
- The Restricted Regression Model
- Computational Aspects of Ordinary Least-Squares Regression and Restricted Least-Squares Regression. Computation via the Q–R Decomposition
- Generalised Least-Squares Regression

Hypothesis Testing and Confidence Intervals for the Classical Linear Regression Model
- Cochran's Theorem and the Decomposition of a Chi-Square Variate
- Hypotheses Concerning Subsets of the Regression Parameters
- The Testing of Linear Restrictions in General
- Joint Tests, Separate Tests and Nested Test Procedures.

Books

The principal text for the course is our own text, POLLOCK, *A Course of Econometrics*, instalments of which are placed in the intensive-use collection in the Library as the course progresses.

There are many published texts of econometric theory. The best-selling text, and therefore one of the cheapest, is *Econometric Methods: third edition* by J. JOHNSTON. McGraw–Hill (1984). A recent text with a considerable coverage is W. GREENE, *Econometric Analysis*, Macmillan (1990). Another new book which is both accessible and brief is *Econometrics* by JON STEWART, Philip Allan (1991). An older and well-established book is JAN KMENTA, *Elements of Econometrics: second edition*. Finally a book which provides a good background in Statistic and Matrix Algebra as well treating some basic econometric topics is AMEMIYA. *Introduction to Statistics and Econometrics*, Harvard University Press (1994).

Books will be referenced, when appropriate, at various stages in the course. Students are advised to purchase a book which is on the same level as JOHNSTON or STEWART. Further advice on the matter can be sought from the lecturer.