ECONOMETRIC THEORY 1995/96

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This course lays the groundwork for an understanding of the theory and practice of modern econometrics. Relatively simple mathematics are employed throughout the course.

The course begins by establishing some fundamental results which relate minimum-mean-square-error predictors to conditional expectations. Conditional expectations provide a basis for developing the simple regression model which expresses the predicted value of a variable y as a linear function of another variable x on which there is a prior observation. The analysis of conditional expectations is generalised to the case where both y and x are vectors.

By pursuing the estimation technique known as the method of moments, estimating equations can be derived for the parameters of the regression model. These equations are identical to those which are derived subsequently, under different assumptions, via the principle of least squares.

The principle of least squares is a major theme in the next part of the course which presents a thorough analysis of the classical linear regression model wherein a single dependent variable y is related to a set of k explanatory variables $x_1, \ldots, x_k$. The tests of the common hypotheses regarding the regression parameters are derived in a rigorous manner; and an intuitive explanation of their structure is provided which deals in terms of the underlying geometry of the regression model.

The next topic of the course is introduced via an analysis of the recursive least-squares algorithm which takes the point of view of Bayesian statistical analysis. The derivation of the algorithm makes use of the results concerning conditional expectations which have been established at the start of the course. Various generalisations of the algorithm are considered including the rolling regression and the discounted least-squares algorithms. This section of the course ends with a brief account of the Kalman filter.

The remainder of the course is devoted to the topic of dynamic econometric regression equations. At first, the classical linear regression model is elaborated by replacing the sequence of independently and identically distributed disturbances by a serially correlated sequence generated by a first-order autoregressive process. Thereafter, a variety of models incorporating lagged dependent variables and distributed lag schemes in the explanatory variables are considered. Care is taken to establish a firm understanding of the dynamic properties of such models under the assumption that the sequences of explanatory variables are generated by stationary stochastic processes.

The course concludes by describing the models and the methods of inference which are appropriate when some of all of the explanatory variables follow nonstationary time trends. It has been recognised, in recent years, that many nonstationary econometric series are connected to each other via long-term relationships of proportionality. This has given rise to the theory of cointegrated

time series which is the principal theme of this section of the course. There are a variety of mechanisms which might be at work in preserving such proportionality. However, the simplest of these is the so-called error-correction mechanism which can be depicted as a natural adjunct of a linear cointegrating relationship. We shall examine the inferential problems associated with such simple linear models, and we shall endeavour to assess the limits of their applicability.

The Topics

1. The Bivariate Normal Distribution and Conditional Expectations,
2. Minimum-Mean-Square-Error Prediction and Conditional Expectations,
3. Empirical Regression in the Bivariate Case,
4. Moments of a Multivariate Distribution,
5. The Classical Linear Regression Model: Least-Squares Estimation,
6. The Classical Linear Regression Model: Tests of Hypotheses,
7. The Recursive Least-Squares Regression Algorithm,
8. The Rolling Regression, Discounted Least Squares and the Kalman Filter,
9. Serially Correlated Regression Disturbances,
10. Lagged Dependent Variables, Distributed Lags and Autoregressive Residuals,
11. Dynamic Responses, the Impulse Response the Step Response and the Median Lag,
12. Nonstationary Time Series and Cointegrated Econometric Variables.

Books

The principal texts for the course are our own texts, POLLOCK, *Lectures in Introductory Econometrics* and *A Course of Econometrics,* instalments of which will be distributed 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 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.* A book which provides a good background in Statistic and Matrix Algebra as well treating some basic econometric topics is *Introduction to Statistics and Econometrics,* by T. AMEMIYA, Harvard University Press (1994). Finally, an introductory book to which it might be useful to refer in the first instance is *Introduction to Econometrics: second edition* by G.S. MADDALA, Macmillan, (1992).