ECONOMETRICS II; 1996

Lecturer: D.S.G. Pollock

The Timetable

The following are the times for this lecture course:

1/4–3/4: 1400–1530

(4/4–9/4 Easter break)

10/4–12/4: 1100–1230 and (except 12/4 Friday) 1400–1530

15/4–19/4 and 22/4–26/4: 1100–1230

16/4–18/4 and 23/4–25/4: 1400–1530 (i.e. not Monday and Friday)

These amount altogether to 22 units. Note that 4/4 to 9/4 is the official Easter break. There may be some minor variations in this schedule; but they will be subject to negotiations with the participants. The Lectures will all take palce in the room HS/II.

A Preamble

The courses *Probability Theory and Statistical Inference* and *Econometrics I* have laid a secure foundation on which to base an account of some the methods of econometrics which find widespread use nowadays.

The present course will focus on the methods of multivariate statistical analysis which are used in the econometric analysis of dynamic systems and in other associated areas. The account will be a discursive one, which is unavoidable in view of the variety of the subject matter. We shall attempt to give it some order by referring to the content of the two previous courses.

The lectures will be supported by a variety of printed material which comes from other courses which the lecturer has delivered and from some of his published papers which have been written with a didactic purpose. The level of this material is quite variable and occasionally it is advanced. The first offering is a booklet titled *Lectures in Introductory Econometrics* which is the text for a compulsory course given to undergraduates at Queen Mary College, University of London. This at approximately the level of *Econometrics I,* albeit that it represents a less formal approach. It will be used mainly for reference and for revision. We will discover the appropriate level for the lectures by a speedy process of adaptation.

The Topics

Classical Regression Analysis and Recursive Regression. The method of moments, the method of least squares and the principle of maximum-likelihood represent the means of generating estimates of statistical parameters in a wide variety of contexts. We shall review these methods in the context of the simple classical regression model. The concept of a structural model, which is central to much of econometric methodology, will be examined. The algebra associated

with the first-order and second-order moments of a multivariate normal distribution will be expounded in detail. This will provide a basis many of the subsequent developments. Its immediate use will be in developing the recursive algorithm for least-squares regression which allows us to treat a variety of flexible and adaptive regression procedures such as rolling regression and discounted least-squares regression. The Kalman filter will also be developed. The opportunity will be taken to reveal various geometric aspects of least-squares regression in relation to the account given in *Econometrics I.*

The Errors-in-Variables Model and the Simultaneous-Equation Model. The errors-in-variables model is a device which can be used for expounding the methods with are central both to the classical simultaneous-equation model of econometrics and to the factor-analysis model. The latter has found its principle application in the realms of psychometrics. However, factor analysis has recently become an important method in connection with dynamic econometric models of cointegrated nonstationary processes. We shall begin our treatment of the classical simultaneous-equation model by using the method of moments to derive the limited-information maximum-likelihood (LIML) estimating equations. The familiar two-stage least-squares (2SLS) estimator can be derived as a specialisation of the LIML estimator. We shall also show how it was derived originally by Basmann and by Theil who represented it as a modified least-squares regression estimator.

System of Linear Equations. The estimators of multi-equation linear econometric models depend upon the algebra of Kronecker products. We shall develop this algebra in the context of systems of seemingly unrelated regression equations (SURE). The classical simultaneous-equation econometric model can be envisaged as an elaboration of the SURE model. The full-information maximum-likelihood (FIML) and the three-stage least-squares (3SLS) methods of system-wide estimation are the system analogues of the LIML and 2SLS methods respectively. In fact, they are related to each other in the same was as LIML and 2SLS are related.

Time-Series Methods and Dynamic Models. The foregoing topics concern methods which, in the main, pay little attention to the dynamic aspects of econometric relationships. We shall begin our account of dynamic econometrics in the context of regression models embodying simple transfer-function relationships mapping from a single input variable to a single output. The concepts of the impulse response, the step response, the steady-state gain etc. will be expounded. A brief account of these can be found in *Lectures in Introductory Econometrics.* Autoregressive moving-average (ARMA) models will also be dealt with briefly. The application of dynamic regression models to cointegrated nonstationary series will be discussed in this section.

Dynamic Econometric Systems. The final section will deal with vector autoregressive moving-average (VARMA) models . It will be show how a dynamic version of the classical simultaneous-equation model can be obtained by specialising a VARMA model. VARMA models will also be applied to cointegrated nonstationary time series.