Methods of TimeSeries Analysis II

Course Summary 1990

1. This course looks at some of the practical aspects of identification and estimation of time-series models. Univariate time-series analysis owes many of its practical aspects to Box and Jenkins who proposed a methodology of model identification which was based on their interpretation of the profiles of the autocorrelation functions and partial autocorrelation functions of various ARMA and ARIMA models. In deference to the conventional practices, we ought to understand their methodology and to be able to tell a story about an empirical autocorrelation function and partial autocorrelation function

2. In my opinion, a much more effective way of identifying an underlying model is to look at the periodogram of the time series which can be subjected to varying degrees of smoothing. It is important to understand why smoothing is necessary and to know what the effects on model identification might be if we apply too much or too little of it. This seems to provide a superior means of model identification. bigskip
3. Box and Jenkins were also concerned with the question of predicting a time series. In fact, they caused a great stir amongst econometricians in the 1970's by demonstrating that simple unconditional methods of prediction usually performed much better than methods based on complicated econometric regression equations or on fully-fledged econometric models. The reasons for this are obvious. The univariate methods are ideally suited to the purpose of capturing the linear and angular momentum of time series (i.e. trends and cycles). By contrast, the typical econometric model fails to express adequately the dynamic properties of the times series

4. Time series analysis became practical in the 1970's largely because of the availability of computing technology and the development of procedures for non-linear optimisation which enable analysts to estimate time-series models by optimising complicated non-linear criteria functions which correspond to sums of squares of the residuals of the fitted models or to the likelihood functions of the samples. The algorithm which is used more than any other in this connection is the Gauss–Newton procedure. It transpires that the Gauss–Newton procedure is very closely related to the Newton–Raphson procedure. In fact, in many applications it is equivalent to the classical method of calculating the maximum-likelihood estimates which is known as Fisher's method of scoring which is derived by replacing the second-order partial derivatives of the Newton–Raphson procedure by an expression which corresponds to their expected value (expressed as a function of the unknown parameters which are to be estimated).

5. In effect, we only described one method for fitting what we called an RTM. This was the method of prewhitening which was also advocated by Box and Jenkins. The limitation of this method is that it assumes that the signal x(t), ie the explanatory series, can be represented as an AR process which is not always possible.

6. We ought to have spent more time discussing the practical effects of linear filtering. This is a fascinating subject which has a wide range of practical applications in signal processing an other branches of engineering (eg. the processing of transatlantic telephone calls, the enhancement of digital sound recordings, the elimination of vibrations from mechanical structures etc.). All that we managed to do was to apply some of the ideas of linear filtering to the problem of eliminating seasonal fluctuations from economic time series