Time Series Analysis and Forecasting - Course Outline

Objectives. Time series econometrics provides a set of statistical tools appropriate for estimating relations among variables that are observed over time. The sequential ordering of observations through time is the essential characteristic of time series variables that provides both challenges for modeling and information to be exploited (e.g. for forecasting). In this course we address three fundamental goals of time series econometrics: (1) to understand the nature of the series' dependence over time (e.g. trends, seasonality); (2) to model dynamic relations among functionally related time series; and (3) to generate statistically based forecasts incorporating forecast uncertainty.

Prerequisite is the Applied Econometrics course or its equivalent, including familiarity with EViews basics: workfiles, objects (series, equations, groups) and various Views, Procs for manipulating and displaying these objects.

Day 1

I. Time series regressions.

A. Special issues and opportunities with time series regressions

B. Autocorrelation: traditional & modern approaches

C. Application to demand for gasoline model, aggregate production function

II. Univariate time series analysis

A. Why perform univariate analysis?

B. White noise, autoregressive (AR) and moving average (MA) processes

1. descriptive statistics

2. definitions of AR, MA, ARMA processes

3. simulation program to generate representative series

4. concepts of stationary, non-stationary series

5. correlogam: concept and use to identify underlying data generation process.

C. Construction and forecasting with univariate models

1. Construction of univariate models for stationary series; application to economic, financial time series (inflation, unemployment); specification, diagnostic checking, and hypothesis testing.

2. Forecasting with univariate models: use of holdout sample; stochastic forecasting; forecast evaluation.

III. Unit roots

A. Concepts: alternative types of non-stationarity.

B. Unit root tests:

1. Construction of Dickey-Fuller equation; specification issues, deterministic components, lag length criteria.

2. Dickey-Fuller tests: null, alternative hypotheses; issue of power (application to economic, financial time series)

3. DF-GLS test: theory behind GLS de-trending; power advantage (application to economic, financial time series)

Day 2

IV. Multivariate models

A. Autoregressive distributed lag (ADL) models

1. Definition, specification of ADL models; application to economic, financial time series (leading indicators and GDP growth); estimation (issue of non-stationary series), diagnostic checking, and hypothesis testing.

2. Granger causality

B. Vector autoregressions (VARs)

1. Motivation, definition of VAR

2. Specification, estimation, diagnostic checking

3. Dynamic Analysis 1. Granger causality

4. Stochastic forecasting with VAR; forecast evaluation

5. Dynamic factor VARs

6. Dynamic analysis 2: impulse response functions; issue of contemporaneous correlations

Day 3

V. Cointegration and error correction models (ECMs)

A. Concepts, definitions

1. Stationary linear combination among non-stationary series

2. Correspondence between cointegration and ECM

B. Engle-Granger (least squares) approach to cointegration testing, modeling

C. Cointegration testing with ECM (autoregressive distributed lag model approach)

D. Vector ECM Dynamic Analysis: Granger causality, impulse response functions

E. Stochastic forecasting with vector ECM

VI. Johansen's (maximum likelihood) approach to cointegration testing & modeling

A. mathematic structure

B. testing procedure; treatment of deterministic components

C. application to monetary model

D. Hypothesis testing within Johansen model

E. Comments on Granger-causality, impulse response functions in VECMs

F. Concluding remarks on cointegration