6 ECTS

14E026

Advanced Econometric Methods III

Overview and Objectives

This is an advanced course in time series econometrics. We examine the models and statistical techniques used to study time series data in economics. The course is intended to fulfill two needs: (1) to provide students with applied interests with up-to-date techniques used in empirical time series analysis, and (2) to introduce students with more theoretical inclinations and those who are likely to use time series in they Ph.D. work to the tools that are used to derive some of the more interesting results. The first block of the course presents the theory of univariate stationary time series processes. The second block focuses on univariate non-stationary models, VAR modeling, state space models and Bayesian econometrics.

Course Outline

Part I: Univariate time series models
Univariate, stationary time series
Estimation, inference and forecasting with univariate models
Frequency domain
Unit roots
Part II: Multivariate time series models
Covariance stationary vector time series
Cointegration
Part III: Topics
Time series models for higher moments and transition data
State space modeling and the Kalman filter
Time varying parameters and structural breaks
Bootstrap methods for time series

Prerequisites

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Advanced Econometrics I and II do not constitute prerequisites for this course. However, you should have previous knowledge of probability and statistics and familiarity with concepts such as modes of convergence, law of large numbers, central limit theorem is required. Also, please review Appendix A of Hamilton (1994).

Required Activities

The course comprises four hours of lecture each week. In addition, students will complete weekly problem sets and hand them in before the TA-sessions. The problem sets will have a theoretical component and an applied component. For the applied part students will need to use Matlab. Students are also required to read the required chapters and papers marked by (*).

Evaluation

Grades will be based on the problem sets (40%) and the final exam (60%)

Materials

Textbook: Hamilton, J. D. (1994) Time Series Analysis, Princeton University Press, New Jersey. I will follow Hamilton's book rather closely. I will provide additional references for specific topics. Additional readings for each topic can be found at the end of this document.

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Course Outline:

TOPIC 1: INTRODUCTION TO UNIVARIATE, STATIONARY TIME SERIES (H2, H3)

- Preliminary Concepts:
  - Lag Operators
  - White noise, martingales and martingale difference sequences
  - Autocovariances and autocorrelations
  - Stationarity:
    - Weak stationarity
    - Strong stationarity
  - Ergodicity and the Ergodic Theorem
- ARMA models: (H3)
  - MA, AR, and ARMA models
  - Wold representation theorem

TOPIC 2: ESTIMATION, INFERENCE AND FORECASTING (H4, H5)

- The Method of Maximum Likelihood (H5)
  - Consistency
  - Asymptotic Normality
- MLE for ARMA models
  - AR ML: exact versus conditional likelihood
  - MA ML: exact versus conditional likelihood
  - ARMA ML
- Statistical Inference
  - Wald, Likelihood Ratio and Lagrange Multiplier principles
  - Liung-Box and Box-Pierce statistics.
- Forecasting (H4)
  - MSE and optimal forecasts
  - Updating rule
  - Forecasting with ARMA models
- Comparing Predictive Accuracy
  - Diebold and Mariano test for Predictive Accuracy

TOPIC 3: UNIT ROOTS (H15, H16, H17)

- Detrending Methods: deterministic vs. stochastic trends
- Asymptotic distribution of the simple trend model
- Unit Roots
  - Preliminaries: Brownian motion
  - Functional central limit theorem:
    - Convergence in law of random functions
    - Convergence in probability of random functions
  - Continuous mapping theorem
  - The Dickey-Fuller distribution
    - Functional central limit theorem for dependent processes
    - The augmented Dickey-Fuller test: derivation
    - The Phillips-Perron test: derivation

TOPIC 4: COVARIANCE STATIONARY VECTOR TIME SERIES (H10, H11)

- The VAR(p)
  - Presentation
  - Stationarity
  - Wold's theorem and the VMA representation
- Heteroskedasticity and Autocorrelation Variance Estimation
  - Newey-West estimator
- Granger causality and exogeneity
- MLE of vector processes
- Structural interpretation of VARs
  - The impulse response function
  - The variance decomposition
  - Identification and Interpretation
- Inference in VARs

TOPIC 5: COINTEGRATION (H19, H20)

- Motivation: spurious regressions
- Definition:
  - Properties
  - Error correction representation
  - Granger representation theorem
  - Phillips triangular representation
  - Stock-Watson common trends representation
- Testing
  - Engle-Granger 2-step cointegration test
    - Corrections for serial correlation
- Full Information Maximum Likelihood analysis of cointegrated systems
  - Preliminaries: canonical correlations
  - Johansen's test
  - Concentrating the likelihood
  - Hypothesis testing

TOPIC 6: TIME SERIES MODELS FOR HIGHER MOMENTS AND TRANSITION DATA (H21)

- ARCH models
  - Relation to ARMA
  - MLE – GARCH
  - Testing for ARCH
  - Extensions
- ACD models
  - Specification
  - Estimation
- ACH models
  - Relation to ACD
  - Estimation
- ACM models
  - Presentation

  - Relation to ACD
  - Estimation

TOPIC 7: TIME VARYING PARAMETERS AND STRUCTURAL BREAKS (H15, H16, H17)

- Functional central limit theorem (once more)
- Overview of TVP topics
  - Models
  - Testing
  - Estimation
- Testing Problems
- Tests

TOPIC 8: STATE SPACE MODELING AND THE KALMAN FILTER

- State Space Representation
- Kalman Filter
  - Overview
  - Algorithm
  - Forecasting
- MLE with the Kalman filter
- Asymptotic properties of MLE/QMLE

TOPIC 9: BOOTSTRAP METHODS IN ECONOMETRICS

- Introduction to Bootstrap
- Bootstrap for Time Series
- Block Bootstrap
- Non stationary Bootstrap