Topics in Time Series Analysis

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This course reviews some recent developments in the analysis of time series data in economics, with a special emphasis on their use for forecasting and macroeconomic applications. The focus will be both on the theoretical underpinnings of the techniques and on their empirical implementation.

The techniques will be illustrated with several empirical applications, mostly implemented in Gauss or Matlab. Students can use any other programming software.

The final grade will be given by an average of the grades in three assignments (75%) and final exam (25%). The assignments will contain mostly empirical questions, the final exam mostly theoretical questions.

The topics that will be covered include:

1. Review of linear models

a) Review of the three approaches to analyze stationary processes: the Wold Theorem, the Autocovariance function, the Spectrum
b) Review of estimation and inference for stationary and non-stationary processes
c) Model selection by information criteria
d) Forecasting
e) Example: AR vs Leading indicator forecasts for euro area GDP and inflation (Forecast robustness)
f) Example: Country specific vs euro area forecasts for euro area IP, inflation and unemployment (Forecasting the aggregate vs aggregating the forecasts)
g) Example: h-step ahead forecasts for US macro variables (Multi-step estimation vs iterated formulae for h-step ahead forecasting)

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2. Time-varying and nonlinear models

a) Smooth transition and threshold autoregressive models
b) Neural networks
c) Markov switching models
d) ARCH and stochastic volatility models
e) Example: comparison of several forecasting models for euro area and US macro variables (Forecasting with nonlinear models)
f) Example: a multivariate TAR model for forecasting GDP growth (Time-varying VARs and international shock transmission)
g) Example: a multivariate MS-ECM of the UK labour market (Impulse response functions in nonlinear models)
h) Example: the great moderation in the US (SV and Bayesian time-varying models)

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3. The Kalman Filter

a) State space representation of dynamic linear models
b) Structural time series models
c) Derivation of the Kalman filter
d) Forecasting
e) Maximum likelihood estimation
f) Example: the Stock-Watson coincident index for the US (Small scale factor model)
g) Example: the Mariano-Murasawa coincident index for the US (Mixed frequency data)
h) Example: the Kim-Yoo coincident index for the US (Markov switching factor model)
i) Example: Ireland's sticky price model (MLE of a DSGE model)

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4. Methods for the analysis of large datasets

a) Factor models: representation and principal component based estimation
b) Shrinkage estimators and Bayesian methods
c) Reduced rank regressions
d) Variable selection: information criteria, LASSO and Boosting
e) Example: factor based forecasts of euro area, US and UK macro variables
f) Example: factor based interpolation, backdating, and nowcasting
g) Example: the role of factors in Taylor rules and monetary VARs for the euro area and the US
h) Example: factor augmented error correction models
i) Example: forecast comparison of alternative methods

References

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