Econometrics 3 (Topics in Time Series Analysis) – Spring 2021

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This course reviews classical methods and some recent developments for the analysis of time series data in economics, with a special emphasis on their use for macroeconomic applications and forecasting. 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 Matlab. Students can use any other programming software.

The final grade will be given by an average of the grades in three take home assignments (75%, 25% each) and a final closed book exam with theoretical questions (25%).

The topics that will be covered include:

1. Linear models

a) Three approaches to analyze stationary processes: the Wold Theorem, the Autocovariance function, the Spectrum
b) Central limit theorems for MDS and estimation of dynamic (AR) models
c) Functional central limit theorems and estimation and inference for non-stationary processes (unit roots and cointegration)
d) Bayesian VARs (Basics)
e) Forecasting
f) Example: h-step ahead forecasts for US macro variables (Multi-step estimation vs iterated formulae for h-step ahead forecasting) and h-step projections for impulse response functions
g) Example: path confidence regions (measures of forecast uncertainty)
h) Example: BVAR forecasts of US macro variables (role of model/prior specification)

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Watson, M.W. (2007), “How Accurate Are Real-Time Estimates of Output Trends and Gaps?”, *Federal Reserve Bank of Richmond Economic Quarterly*, 93, 143-161.

2. <u>Time-varying and nonlinear models</u>

a) Smooth transition and threshold autoregressive models
b) Markov switching models
c) ARCH and stochastic volatility models
d) Example: a multivariate TAR model for modelling GDP growth (Time-varying VARs and international shock transmission)
e) Example: a multivariate MS-ECM of the UK labour market (Impulse response functions in nonlinear models)
f) Example: a large Bayesian VAR with (common) stochastic volatility (Role of volatility for density forecasting)
g) Example: a Bayesian VAR model with stochastic volatility for the term structure (imposing theory based restrictions on VARs)

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3. <u>The Kalman Filter</u>

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: Ireland’s sticky price model (MLE of a DSGE model)
g) Example: the Stock-Watson coincident index for the US (Small scale factor model)
h) Example: the Mariano-Murasawa coincident index for the US (Mixed frequency data)
i) Example: the Kim-Yoo coincident index for the US (Markov switching factor model)
h) Example: MIDAS models vs mixed frequency VAR (alternative approaches for mixed data)
i) Example: the great moderation and the great crisis in the US (SV and Bayesian time-varying models)

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4. <u>Methods for the analysis of large datasets</u> <u>(if there is enough time)</u>

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: time-varying factor models and the transmission of financial shocks
f) Example: structural analysis with factor augmented error correction models
g) Example: the role of factors in Taylor rules and monetary VARs for the euro area and the US

References

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Deadlines:

PS-1: 15 April – due: 28 April

PS-2: 29 April – due: 12 May

PS-3: 13 May – due: 26 May

Exam: 3 June, 10.00 – 13.00

PS: Problem sets

Problem sets should be done by groups of two students. Please note that in case of evidence of "collaboration" in the solutions of the PS of different groups, all the involved groups will take an F grade.

All the material for the course can be found on the course page in the Bocconi BlackBoard.

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Office Hours:
Please consult the agenda