**PhD course “Time Series Analysis by State Space Methods”**

Siem Jan Koopman  
Vrije Universiteit Amsterdam, CREATEs, Tinbergen Institute  

CREATEs, Aarhus University, 11-13 October 2016

**Lecturers**

Prof. Dr. Siem Jan Koopman [SJK email: s.j.koopman@vu.nl]

**Contact person**

Martin Thyrgaard [MT email: thyrgaard@econ.au.dk]

**Organisation**

On each of the three days, the main lecture is presented by SJK. In the afternoon, students will work on assignments (partly written exercises and partly computer work).

**Contents**

The course is organised around the book “Time Series Analysis by State Space Methods” of Durbin and Koopman (Second Edition, 2012, OUP). A set of articles will complement the material for the course. Each day covers a range of topics that are grouped around three themes, they are:

- Local level model, unobserved components models, statistical properties, reduced form ARMA representations. introducing the Kalman filter and signal extraction methods, linear Gaussian state space models.
- General derivation of Kalman filter, missing observations, forecasting, maximum likelihood estimation, initialisation, multivariate extensions, dynamic factor models, collapsing methods, quasi-maximum likelihood methods.
- Nonlinear and non-Gaussian models in economics and finance, introduction to simulation-based state space methods for estimation, signal extraction and forecasting, including importance sampling and particle filtering, observation-driven alternatives, score-driven time-varying parameter models.

The aim of the course is that students get a good overview of state space time series analysis together with a solid understanding of some key derivations of the main results and a hands-on training for the implementation of various methods on the computer. Data sets will be provided.

**Schedule**

**Tuesday 11 October**

10.00-11.30 Lecture (S530)  
11.30-13.00 Lunch  
13.00-14.30 Lecture (M103)  
14.30-15.00 Break  
15.00-16.30 Lecture/Exercises (M103)
**Wednesday 12 October**
10.00-11.30 Lecture (S530)
11.30-13.00 Lunch
13.00-14.30 Lecture (M208)
14.30-15.00 Break
15.00-16.30 Lecture/Exercises (M208)

**Thursday 13 October**
09.00-10.30 Lecture (M211)
10.30-11.00 Break
11.00-12.30 Lecture (M211)
12.30-15.00 Lunch / CREATE seminar
15.00-16.30 Lecture/Exercises (M202)

**Reading list**

Time Series Analysis by State Space Methods, Second Edition,
by James Durbin and SJK,

Likelihood-based Dynamic Factor Analysis for Measurement and Forecasting,
by Borus Jungbacker and SJK,

Forecasting Macroeconomic Variables using Collapsed Dynamic Factor Analysis,
by Falk Brauning and SJK,

Numerically Accelerated Importance Sampling for Nonlinear Non-Gaussian State Space Models,
by SJK, Andre Lucas and Marcel Scharth,

Generalized Autoregressive Score Models with Applications,
by Drew Creal, SJK and Andre Lucas,

Predicting time-varying parameters with parameter-driven and observation-driven models
by SJK, Andre Lucas and Marcel Scharth