

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

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Vrije Universiteit Amsterdam, CREATES, Tinbergen Institute

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## Lecturers

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

## Contact person

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## 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 / CREATES seminar  
15.00-16.30 Lecture/Exercises (M202)

Reading list

Time Series Analysis by State Space Methods, Second Edition,  
by James Durbin and SJK,  
Oxford University Press, 2012.

Likelihood-based Dynamic Factor Analysis for Measurement and Forecasting,  
by Borus Jungbacker and SJK,  
Econometrics Journal, 2015, Volume 18, p. C1-C21.

Forecasting Macroeconomic Variables using Collapsed Dynamic Factor Analysis,  
by Falk Brauning and SJK,  
International Journal of Forecasting, 2014, Volume 30, p. 572-584.

Numerically Accelerated Importance Sampling for Nonlinear Non-Gaussian State Space Models,  
by SJK, Andre Lucas and Marcel Scharth,  
Journal of Business and Economic Statistics, 2015, Volume 33, p. 114-127.

Generalized Autoregressive Score Models with Applications,  
by Drew Creal, SJK and Andre Lucas,  
Journal of Applied Econometrics, 2013, Volume 28, p. 777-795.

Predicting time-varying parameters with parameter-driven and observation-driven models  
by SJK, Andre Lucas and Marcel Scharth  
Review of Economics and Statistics, 2016, Volume 98, p. 97-110.