

Numerical Methods in Macroeconomics Estimation and Solution of DSGE Models

The course is based on techniques and applications and explores the example of frictional labor markets in macroeconomics using a variety of methodological tools. It is designed to develop and sharpen students' prior knowledge dynamic macroeconomics and econometrics with a mixture of lectures on state-of-the-art solution and estimation techniques for macroeconomic models and application of the techniques to search theory with standard software packages and models from the literature.

Course Outline

1. Introduction

Concepts/techniques:	Data filtering, DSGE linearized difference equations
Main readings:	King and Rebelo (1993), Shimer (2005), Uhlig (1997) sec. 3
Additional reading:	Hamilton (1994) ch. 1

2. Macroeconomic Search and Matching Model

Concepts/techniques:	Intertemporal optimization, search and matching
Reading:	Merz (1995)

2. Root Finding Methods, Linear Solution Methods

Concepts/techniques:	Bisection, Newton-based methods, eigenvalue methods
Reading:	Judd (1998) ch. 5, Uhlig (1997) sec. 6 and 7
Additional readings:	Fernández-Villaverde (2010) sec. 4.1, Fernandez-Villaverde, et al. (2016) sec. 4.2.1-4.2.4

3. State Space and Likelihood Function

Concepts/techniques:	Kalman filter, likelihood function
Main reading:	Fernández-Villaverde (2010) sec. 4.2, Fernandez-Villaverde, et al. (2016) sec. 10.1-10.2
Additional reading:	Hamilton (1994) ch. 13.2 and 13.4, Herbst and Schorfheide (2015) chap. 2

5. Estimation Methods and Model Analysis

Concepts/techniques:	Maximum likelihood, Bayesian methods, Markov Chain Monte Carlo, Diagnostics, Model Comparison
Main reading:	Fernández-Villaverde (2010) sec. 4 and 5, Fernandez-Villaverde, et al. (2016) sec. 12.1-12.2
Additional reading:	An and Schorfheide (2007) sec. 3 and 4, Herbst and Schorfheide (2015) chap. 3 and 4.1

6. Nonlinear Dynamic Methods

Concepts/techniques:	Perturbation, Particle Filter
Main reading:	Fernández-Villaverde (2010) sec. 4.2.2 and An and Schorfheide (2007) sec. 6
Additional readings:	Andreasen et al. (2018), Fernandez-Villaverde, et al. (2016) sec. 4.2, 4.4, and 10.3, Herbst and Schorfheide (2015) chap. 7 and 8.1-8.2 Lan and Meyer-Gohde (2013), Schmitt-Grohé and Uribe (2004)

Literature

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- DeJong, David N. with Chetan, Dave. *Structural Macroeconomics*. 2007.
- Fernández-Villaverde, Jesús (2010): "The Econometrics of DSGE Models," *SERIEs*, Spanish Economic Association, vol. 1(1), pages 3-49.
- Fernández-Villaverde, Jesús, Pablo Guerron-Quintana, and Juan F. Rubio-Ramirez (2010): "The New Macroeconometrics: A Bayesian Approach," in A. O'Hagan and M. West ,eds., *Handbook of Applied Bayesian Analysis*. 2010.
- Fernandez-Villaverde, Jesus, Juan Rubio-Ramirez, and Frank Schorfheide (2016): "Solution and Estimation Methods for DSGE Models" In: H. Uhlig and J. Taylor (eds.): *Handbook of Macroeconomics*, Vol 2, p.527-724, New York.
- Hamilton, James. *Time Series Analysis*. 1994.
- Herbst, Edward, and Frank Schorfheide. *Bayesian Estimation of DSGE Models*, Princeton. 2015.
- Judd, Kenneth. *Numerical Methods in Economics*. 1998.
- King, Robert G. and Rebelo, Sergio T. (1993): "Low frequency filtering and real business cycles," *Journal of Economic Dynamics and Control*, vol. 17(1-2), pages 207-231.
- Merz, Monika (1995): "Search in the Labor Market and the Real Business Cycle." *Journal of Monetary Economics*, 36(2): 269–300.

Shimer, Robert (2005): "The Cyclical Behavior of Equilibrium Unemployment and Vacancies." *American Economic Review*, 95(1): 25–49.

Uhlig, Harald (1997): "A Toolkit for Analyzing Nonlinear Dynamic Stochastic Models Easily," extended version:
<http://www2.wiwi.hu-berlin.de/institute/wpol/html/toolkit/toolkit.pdf>