Syllabus

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Course: Bayesian macroeconometrics
Professor:

FIRST SEMESTER, 2026

PROGRAM

This course provides an introduction to modern macroeconometrics using Bayesian techniques. We will discuss the estimation, inference, and evaluation of Bayesian vector autoregressive models (BVARs) and linearized dynamic stochastic general equilibrium (DSGE) models. Therefore, the course discusses the computation of the likelihood via the Kalman filter and posterior simulation via standard Markov Chain Monte Carlo (MCMC) methods. The course will present some theoretical foundations of Bayesian estimation and focus on applications and implementation issues in macroeconomics.

Previous knowledge of time-series econometrics and advanced macroeconomic theory on DSGE models is required. In the applications, some basic knowledge of programming is necessary.

Most applications related to BVARs will the done in MATLAB, while the ones related to DSGE will use Dynare. Some of the classes will include lab sessions where students will have the opportunity to estimate BVARs and small-scale DSGE models.

BIBLIOGRAPHY

Books:

[DS] Del Negro, Marco and Schorfheide, Frank (2011): “Bayesian Macroeconometrics," in: The Oxford Handbook of Bayesian Econometrics, p.293-389.

[HS] Herbst, Edward and Schorfheide, Frank (2016): Bayesian Estimation of DSGE Models, Princeton University Press.

[KK] Koop and Korobilis (2009): Bayesian Multivariate Time Series Methods for Empirical Macroeconomics Foundations and Trends in Econometrics Vol. 3, No. 4,267–358

[K] Koop (2003) Bayesian Econometrics, John Wiley & Sons Inc.

[KN] Kim and Nelson (1999) State-Space Models with Regime Switching Classical and Gibbs-Sampling Approaches with Applications, The MIT Press.

[BM] Blake, Andrew and Mumtaz, Haroon (2017) Applied Bayesian econometrics for central bankers, Centre for Central Banking Studies.

[H] Hamilton (1994) Time Series Analysis. Princeton University Press.
[Z] Zellner, A. (1971), An Introduction to Bayesian Inference in Econometrics, John Wiley & Sons.

Introduction to Bayesian econometrics
[HS] Sec. 3.1-3.2, [K] Ch. 2-3, [H] ch. 12, [Z] ch. 2-3, [HS] ch. 3

Numerical integration and Markov Chain Monte Carlo (MCMC) methods: Direct sampling, importance sampling, Gibbs sampling and Metropolis-Hastings
[BM] ch.1, [BM] ch.5, [HS] ch.2,

Metropolis-Hastings algorithm.
[HS] ch. 4
Siddhartha Chib & Edward Greenberg (1995) Understanding the Metropolis-Hastings Algorithm, The American Statistician, 49:4, 327-335
Chib, S., I. Jeliazkov (2001), 'Marginal Likelihood from the Metropolis-Hastings Output,' *Journal of the American Statistical Association*, 96, 270–281.

Reduced-Form Bayesian VARs.
[DS] ch. 2.1-2.2. [HS] ch.2, [H] ch. 12, [BM] ch.1
Kadiyala, K. R. and Karlsson, S. (1997), `Numerical methods for estimation and inference in bayesian var-models', Journal of Applied Econometrics 12, 99-132.
Giannone, D., Lenza, M. and Primiceri, G. E. (2015), Prior selection for vector autoregressions, The Review of Economics and Statistics 97:2, 436-451
Domenico Giannone, Michele Lenza & Giorgio E. Primiceri (2019) Priors for the Long Run, Journal of the American Statistical Association, 114:526, 565-580.

Bayesian Structural VARs
[DS] Sec. 2.4-2.5.
Sims, Christopher, and Tao Zha, 1998, Bayesian Methods for Dynamic Multivariate Models, International Economic Review 39(4), 949—68.
Waggoner, D. F. and Zha, T. (2003a), `A Gibbs sampler for structural vector autoregressions', Journal of Economic Dynamics & Control 28, 349-366.
Rubio-Ramirez, J. F., Waggoner, D. F. and Zha, T. (2010), `Structural vector autoregressions: Theory of identification and algorithms for inference', The Review of Economic Studies 77, 665-696.
Uhlig, H. (2005): "What Are the Effects of Monetary Policy on Output? Results From an Agnostic Identification Procedure," Journal of Monetary Economics, 52(2), 381–419.

Topics in Bayesian VARs
Time-varying parameters: [KK] ch. 3, [BM] ch. 3
Stochastic volatility: [KK] ch. 4,
Uhlig, H. (1997): "Bayesian Vector Autoregressions with Stochastic Volatility," Econometrica, 65(1), 59–73.

Time-varying parameters and Stochastic volatility: [DS] ch. 5,
Primiceri, G. (2005). Time Varying Structural Vector Autoregressions and Monetary Policy. The Review of Economic Studies, 72(3), 821-852

Markov switching: [BM] ch. 4
Sims, Christopher, A., and Tao Zha. 2006. "Were There Regime Switches in U.S. Monetary Policy?" American Economic Review, 96 (1): 54-81.

Factor Augmented VAR: [BM] ch. 3
Bernanke, Ben S., Jean Boivin and Piotr Eliasz. "Measuring The Effects Of Monetary Policy: A Factor-Augmented Vector Autoregressive (FAVAR) Approach," Quarterly Journal of Economics, 2005, v120(1,Feb), 387-422.

State-space models

Kalman filter:
[H] ch.13
Gibbs sampler:
[KN] ch. 8, [BM] ch.3
Carter, C. K., and R. Kohn. "On Gibbs Sampling for State Space Models." Biometrika, vol. 81, no. 3, 1994, pp. 541–553.

DSGE Solution methods

Perturbation methods
Wouter's lecture notes (http://www.wouterdenhaan.com/numerical/perturbation.pdf)
Schmitt-Grohé and Uribe (2004) Solving dynamic general equilibrium models using a second-order approximation to the policy function. Journal of Economic Dynamics and Control Volume 28, Issue 4, January 2004, Pages 755-775

Solution methods for linear rational expectation models
[HS] ch. 2
Blanchard, O. J., and C. M. Kahn (1980), "The Solution of Linear Difference Models under Rational Expectations," Econometrica, 48(5), 1305–1312
Klein, P. (2000), "Using the Generalized Schur Form to Solve a Multivariate Linear Rational Expectations Model," Journal of Economic Dynamics and Control, 24(10), 1405–1423
Sims, Christopher A., 2002, Solving Linear Rational Expectations Models, Computational Economics 20(1), 1—20.

From DSGE solution to the data: forming likelihood from Kalman filter

Guerrón-Quintana, P. and J. Nason (2013),"Bayesian Estimation of DSGE Models" ch 21 in Hashimzade, N. and M. Thornton (eds.), Handbook of Research Methods and Applications in Empirical Macroeconomics.

Estimating a DSGE Model

Likelihood**:** [HS] ch.2, [DS] ch. 4.1-4.2.

Choosing priors:
Del Negro M, Schorfheide F (2008) Forming priors for DSGE models (and how it affects the assessment of nominal rigidities). J Monet Econ 55:1191–1208

Metropolis-hastings
[HS] ch. 3.5, 4.1 - 4.2, [DS] ch. 4.3,

Surveys/aplications covering the bayesian estimation
An, Sungbae and Frank Schorfheide, 2007, Bayesian Analysis of DSGE Models, Econometric Reviews 26(2-4), 113—172.
Guerrón-Quintana, P. and J. Nason (2013),"Bayesian Estimation of DSGE Models" ch 21 in Hashimzade, N. and M. Thornton (eds.), Handbook of Research Methods and Applications in Empirical Macroeconomics.

Some applications
Fernández-Villaverde, J., and J. F. Rubio-Ramírez (2004), "Comparing Dynamic Equilibrium Models to Data: a Bayesian Approach," Journal of Econometrics, 123(1), 153 – 187
Rabanal, P. and J. F. Rubio-Ramírez (2005), "Comparing New Keynesian Models of the Business Cycle: A Bayesian Approach", Journal of Monetary Economics 52 (2005) 1151–1166
Smets, Frank, and Rafael Wouters. 2007. "Shocks and Frictions in US Business Cycles: A Bayesian DSGE Approach." American Economic Review, 97 (3): 586-606.
Adolfson, M., S. Laséen, J. Lindé, and M. Villani, (2007), 'Bayesian estimation of an open economy DSGE model with incomplete pass-through,' Journal of International Economics, 72(2), 481–511.
Del Negro, M., F. Schorfheide, F. Smets, R. Wouters (2007), 'On the Fit and Forecasting Performance of New Keynesian Models,' Journal of Business and Economic Statistics, 25 (2),123–162.

DSGE Model Evaluation.
[DS] ch. 4.7.
Geweke, J. (1999), `Using simulation methods for bayesian econometric models: Inference, development and communication', Econometric Reviews 18, 1-126.

DSGE-VAR Methodology
Theory:
[DS] ch. 4.7.
Ingram, B., and C. Whiteman (1994): "Supplanting the Minnesota Prior- Forecasting Macroeconomic Time Series Using Real Business Cycle Model Priors,"Journal of Monetary Economics, 49(4), 1131–1159.
Del Negro, M., and F. Schorfheide (2004), "Priors from General Equilibrium Models for VARs," International Economic Review, 45(2), 643 – 673

Applications:
Adolfson, M., S. Laséen, J. Lindé and M. Villani (2008), "Evaluating an Estimated New Keynesian Small Open Economy Model", Journal of Economic Dynamics and Control, 32(8), 2690-2721

Ghent, A. (2009), "Comparing DSGE-VAR forecasting models: How big are the differences?", Journal of Economic Dynamics and Control, 33(4), 864-882

Cole, S., and F. Milani (2017), "The Misspecification of Expectations in New Keynesian Models: A DSGE-VAR Approach", Macroeconomic Dynamics, 1-34

Advanced MCMC methods:

Tailored Random Block MH (TaRBMH) algorithm

Chib, Siddhartha & Ramamurthy, Srikanth. (2010). Tailored randomized block MCMC methods with application to DSGE models. Journal of Econometrics. 155. 19-38.

Sequential Monte Carlo Methods

[HS] ch. 5

Herbst, E., and F. Schorfheide (2014): ''Sequential Monte Carlo Sampling for DSGE Models,'' Journal of Applied Econometrics, 19(7), 1073–1098.

GRADING

Problem sets (50%)
Paper replication (50%)

PROFESSOR - EMAIL

DETAILED PROGRAM

1	Introduction to Bayesian econometrics
2	Introduction to Bayesian econometrics
3	Monte Carlo methods
4	Reduced-form BVAR: Prior and Likelihood
5	Reduced-form BVAR: Monte carlo
6	Structural BVAR
7	State-Space models
8	DSGE and state-space models
9	DSGE: Prior and Likelihood
10	DSGE: estimating via Metropolis-Hastings
11	DSGE: estimating via Metropolis-Hastings
12	Dynare
13	DSGE: convergence diagnostics and model evaluation
14	DSGE-VAR methodology