Bayesian estimation and computation in time series models

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Course overview

The main aim of this course is to help students develop an understanding of Bayesian methods in the analysis of financial and macroeconomic time series. The emphasis throughout this course is on Bayesian estimation and computation, and specification of flexible models. Several topics will be covered including static and dynamic factor models, Bayesian shrinkage priors, multivariate stochastic volatility, vector autoregressions, panel vector autoregressions, and estimation of multivariate models for Big Data.

This short course will introduce a very large spectrum of time series models used in macroeconomics and finance. Instead of focusing on the theoretical time-series properties of these popular models, we will delve deeply into estimation issues which are of practical importance for PhD students and applied researchers.

As an illustration, students will learn how to estimate Bayesian linear static factor models for the mean of a time series, as well as univariate stochastic volatility models using the Gibbs sampler. Then enough guidance and hints will be given so that students can independently combine this knowledge to estimate state-of-the-art econometric models such as the factor stochastic volatility model to test Asset Pricing Theory.

The focus of this course will be on estimation and computation. We focus on the Gibbs sampler which allows us to estimate a large class of models (e.g. Markov Switching models, time-varying parameter VARs, dynamic factor models, stochastic volatility models). I also make references to estimation of Bayesian DSGE models using Metropolis-Hastings algorithm without, however, getting into details (this is a separater topic that can't be covered in detial in this course).

Who should attend this course

Students should be familiar with the concept of linear regression models, the least squares estimator, and the definition of the likelihood function. Basic knowledge of time series (e.g. understanding basic properties of autoregressions and vector autoregressions) is probably necessary as, for example, I will not have time to explain what an impulse response function is, rather I will only demonstrate how to use the Markov Chain Monte Carlo output from a Bayesian VAR to calculate impulse responses. Good knowledge of basics of computational statistics (Monte Carlo, Bootstrap) would also be beneficial.

We will need to rely heavily on distributions such as the Normal, Bernoulli, Gamma, and Wishart so students should be familiar with the concept of a p.d.f., a c.d.f, and their basic functional forms.

Computations are in MATLAB. I will provide all the code in a very accessible form, so that even students with no knowledge of programming can attend this class. Nevertheless, students who are serious about using Bayesian econometrics are expected to have some basic MATLAB skills (e.g. know how to estimate a VAR with OLS using basic commands, i.e. " >> beta_OLS = X/Y ").

Readings and resources

Bauwens, L. and Korobilis, D. (2013). "*Bayesian Methods*", in Handbook of Research Methods and Applications on Empirical Macroeconomics.

Koop, G. and Korobilis, D. (2010). "Bayesian Multivariate Time Series Methods for Empirical Macroeconomics", *Foundations and Trends in Econometrics*, 3, pp. 267-358.

Koop, Gary (2003) *Bayesian Econometrics*, Wiley.

Koop, G., Poirier, D. and Tobias, J. (2007) *Bayesian Econometric Exercises*, Cambridge University Press

Further references will be given during the course

Lecture Outline

Lecture I: Introduction to Bayesian Inference; Bayesian computation; Bayesian linear regression (2 hrs); Bayesian VARs (1 hr)

Lab I: Bayesian computation, and regression basics; the Bayesian LASSO (2 hrs)

Lecture II: State-space models and Bayesian filtering; Dynamic Factor Model; Multivariate Stochastic Volatility models; Generic estimation of DSGE systems (2 hrs); extensions of Bayesian VAR: panel VARs, FAVARs etc (1 hr)

Lab II: Bayesian VARs (2 hrs)

Lecture III: Special Topics: VARs with time-varying parameters; VARs for Big Data (3hrs)

Lab III: Bayesian VARs with time-varying coefficients and stochastic volatility (2 hrs)