

# A Two-Day Course on Bayesian Macroeconometrics at the Deutsche Bundesbank

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## Syllabus

**Course Description:** Bayesian econometric methods are increasingly popular in empirical macroeconomics. In particular, nonlinear models that allow for time variation in coefficients and volatility are now routinely used among macroeconomists. The overarching purpose of this short course is to quickly bring the participants to the research frontier so that they are prepared to do research in Bayesian macroeconometrics and empirical macroeconomics.

This course will cover both Bayesian theory and computations. We will also discuss various empirical applications to illustrate the models and estimation techniques. Since high-dimensional models—which are inherently computationally intensive—are now commonly used, we will investigate a range of strategies and algorithms to speed up computations.

We will start with an overview of Bayesian theory and computations. We will then give a brief review of the linear regression and the Gibbs sampler. Some flexible variants of the linear regression will then be introduced, along with various more sophisticated Markov chain Monte Carlo algorithms to estimate them.

We will then dive into a few state-of-the-art macroeconomic models, including unobserved components models, dynamic factor models and stochastic volatility models. Lastly, we will cover a range of vector autoregressions, including time-varying parameter VARs and large VARs with stochastic volatility and non-Gaussian errors.

Throughout the course we will demonstrate the estimation methods using the programming environment MATLAB. Some working knowledge of programming in MATLAB, R or Python would be advantageous.

**Course notes:** This course is based on the set of notes titled **Bayesian Macroeconomics: Methods and Applications**, which will be available to the participants (as well as the data and code). I also recommend the textbook **Bayesian Econometric Methods** (Second Edition), by Chan, Koop, Poirier and Tobias, 2019.

**Course outline:** The course is divided into four modules. The outline of each module is given below.

Module 1: Overview of Bayesian econometrics

- Bayesian theory and computations
- standard linear regressions; Gibbs sampler

- more flexible regressions:  $t$  errors, moving average errors; independence-chain Metropolis-Hastings, Griddy-Gibbs

#### Module 2: Linear state space models

- unobserved components models, dynamic factor models; precision-based samplers
- applications: models for trend inflation and output gap

#### Module 3: Nonlinear state space models and introduction to vector autoregressions

- stochastic volatility models; auxiliary mixture sampler
- standard VARs, time-varying VARs
- natural conjugate prior, independent normal and inverse-Wishart priors

#### Module 4: Large vector autoregressions and hierarchical shrinkage priors

- the Minnesota prior and its many extensions
- computation strategies for large VARs
- recent research on large Bayesian VARs with stochastic volatility