

# DOCTORAL PROGRAMME IN ECONOMICS AND BUSINESS 2024/25

Course: Bayesian VAR for Macroeconomic Analysis Lecturer: Professor Dan Zhu (Monash University, Australia)

#### **Course Description**

Bayesian econometric methods have become an essential tool in empirical macroeconomics, particularly for modeling nonlinear dynamics, time-varying relationships, and stochastic volatility. These methods are now widely adopted for macroeconomic forecasting and policy analysis. This short course is designed to equip participants with the skills needed to apply cutting-edge Bayesian techniques, enabling them to effectively estimate and analyze modern macroeconomic models. By the end of the course, participants will be well-prepared to engage with the latest research in Bayesian macroeconometrics and apply these methods to real-world macroeconomic and policy challenges.

This intensive course particular focuses on the computational implementation of Bayesian Vector Autoregression (BVAR) techniques for macroeconomic forecasting and policy analysis. The course provides a rigorous yet practical introduction to both fundamental and advanced topics, emphasizing efficient Bayesian estimation, inference, and forecasting methods that are directly applicable to central banking tasks. Participants will explore key applications of BVAR models in monetary policy, risk assessment, and macroeconomic forecasting, with topics covering standard VAR formulation, time-varying parameter and stochastic volatility extensions, advanced Bayesian sampling methods (such as MCMC algorithms), and computational strategies for handling large-scale models.

A key strength of this course is its hands-on approach, featuring real-world monetary policy maker relevant applications and coding exercises in MATLAB. By the end of the course, participants will have both a deep theoretical understanding and practical implementation skills, enabling them to effectively use BVAR models for forecasting, scenario analysis, and policy evaluation in a central banking environment.

### **Course Outline**

- Day 1: Basic VAR Formulation
- Introduction to VAR models in macroeconomics

- Frequentist vs Bayesian approaches
- Bayesian prior distributions for VAR models
- Minnesota Prior, Normal-Wishart Prior
- Posterior computation in Bayesian VARs
- Empirical applications using macroeconomic data
- Day 2 Stochastic Volatility, Time-Varying Parameters (TVP-VAR) and Mixed Frequency
- Why stochastic volatility? Motivation and estimation techniques
- filtering and state-space models
- Why TVP? Motivation and estimation techniques for TVP models
- Combine them: TVP-SV
- Mixed Frequency Data, State-space vs MIDAS
- Applications: Macro uncertainty, monetary policy regimes
- Day 3: Forecasting and Structural Analysis
- Density forecasting with Bayesian VARs
- Evaluating predictive performance
- Forecast error variance decomposition (FEVD)
- Structural VAR Identification
- Impulse response analysis in Bayesian settings
- Applications to monetary policy
- Day 4: Markov Chain Monte Carlo (MCMC) Algorithms
- Introduction to Monte-Carlo Method
- Gibbs Sampling for BVARs
- Metropolis-Hastings Algorithm
- Computational considerations and diagnostics
- Day 5: Computational Tricks and Practical Implementation
- Efficient posterior simulation techniques
- Handling large-dimensional BVARs
- Computation Methods Beyond BVAR
- Case study and hands-on empirical exercise

### **Course Requirements**

• Participants should have some understanding of statistics and probability, particularly in the context of time series analysis and econometrics. Prior exposure to Bayesian methods is beneficial but not required.

• The course will be highly computational and involve hands-on coding exercises in MATLAB, with a focus on implementing Bayesian estimation techniques for macroeconomic

forecasting and policy analysis. Familiarity with MATLAB is recommended, though essential programming concepts will be introduced as needed.

## References

• Chan, Joshua, et al. Bayesian econometric methods. Vol. 7. Cambridge University Press, 2019.

• Chib, Siddhartha. "Markov chain Monte Carlo methods: computation and inference." Handbook of econometrics 5 (2001): 3569-3649.

• Del Negro, M. & Schorfheide, F. (2011). Bayesian Macroeconometrics.

• Primiceri, Giorgio E. "Time varying structural vector autoregressions and monetary policy." The Review of Economic Studies 72.3 (2005): 821-852

## Exam (for students who wish to be awarded 4 ECTS credits)

Upon completing all course activities (attendance throughout the course and doing the assignment), participants will be awarded 4 ECTS credits.