Norges Bank

Inference in Macro Models: Forecasting with Big Data, BVARs and SVARs

OSLO, MAY 9 – 13, 2022

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General description of the course

This course covers methods designed to deal with univariate and multivariate prediction with "big data" in macroeconomics, and to conduct semi-structural analysis. The three main subjects of the course are: (i) predictive regressions with big data; (ii) Bayesian Vector Autoregressions (BVARs), as a popular example of big data multivariate models, which also represent a bridge between reduced-form and structural models; (iii) Structural VARs, which have become the most popular tool for structural shock identification. We will also touch upon several other topics, such as state-space models, Monte Carlo methods, model comparison and model choice. Along the way, we will discuss applications to forecasting economic activity and prices with large datasets, scenario and counterfactual analysis. In the practical sessions, we will provide and go over Matlab codes for inference in predictive regressions with big data, and scenario and counterfactual analysis with BVARs.

What follows is a more detailed plan of the course. Our recommendation would be to follow all the lectures. In fact, although we will make every reasonable attempt to make them self contained, there is a fair amount of continuity in our covering of the material. In addition, the neat separation of the topics into the five days of the course will only be approximate.

1. Plan of the course: **Day 1**

Lecture 1: Big data and the curse of dimensionality in macroeconomics: Sympthoms and "classical" cures, such as principal components and penalized regressions (Ridge regression and Lasso). Multivariate models: Dynamic factor models and their connection with principal components. Applications in macroeconomics.

Practical session: *Point* forecasting of economic activity and prices with large information sets.

Some references for day 1: Lawley and Maxwell (1963); Leamer (1973); Tibshirani (1996); Hastie et al. (2001); Stock and Watson (2002); Doz et al. (2012); Hastie et al. (2015); Stock and Watson (2016); Carrasco and Rossi (2016); Bok et al. (2017).

2. Plan of the course: **Day 2**

Lecture 2: Introduction to Bayesian inference. Priors and their connection with big data, regularization and shrinkage techniques. Selection of the informativeness of the priors and the degree of shrinkage. Bayesian Ridge, Bayesian Lasso, Bayesian Model Averaging.

Practical session: *Point* and *density* forecasting of economic activity and prices with large information sets.

Some references for day 2: Geweke (2005); Park and Casella (2008); De Mol et al. (2008); Giannone et al. (2021).

3. Plan of the course: **Day 3**

Lecture 3: Multivariate models: VARs and Bayesian VARs. Minnesota prior and hyper-parameter selection. Applications in macroeconomics.

Some references for day 3: Hamilton (1994); Doan et al. (1984); Sims and Zha (1998); Banbura et al. (2010); Del Negro and Schorfheide (2011); Karlsson (2013); Giannone et al. (2015).

4. Plan of the course: **Day 4**

Lecture 4: Recent and more advanced priors. Discussion of data transformations.

Practical session: Using (large) BVARs for unconditional and conditional forecasts, and scenario analysis. Joint density prediction of inflation, economic activity. Financial condition index.

Some references for day 3: Sims and Zha (1998); Banbura et al. (2015); Giannone et al. (2015); Giannone et al. (2019); Crump et al. (2021).

5. Plan of the course: **Day 5**

Lecture 5: Shock identification and Structural VARs. Traditional identification strategies (short-run, long-run and sign restrictions) and newest developments (identification through heteroskedasticity, narrative restrictions, proxy VARs).

Some references for day 5: Blanchard and Quah (1989); Christiano et al. (1999); King et al. (1991); Gali (1999); Rigobon (2003); Uhlig (2005); Rubio-Ramirez et al. (2010); Mertens and Ravn (2013); Antolin-Diaz and Rubio-Ramirez (2018); Arias et al. (2019); Caldara and Herbst (2019); Brunnermeier et al. (2021); Arias et al. (2021).

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