Assignment 4

Exercise 1

Remember the VAR(p) model

$$\mathbf{y}_t = \sum_{j=1}^{p} \mathbf{A}_p \mathbf{y}_{t-j} + \mathbf{c} + \boldsymbol{\varepsilon}_t$$

where we implemented the independent NiW-prior with the following structure for the coefficients

$$\begin{aligned} p(\mathbf{A}) &\sim \mathcal{N}(\underline{\mathbf{A}}, \underline{\mathbf{V}}), \\ p(\boldsymbol{\Sigma}) &\sim iW(\underline{s}, \underline{\mathbf{S}}) \end{aligned}$$

with prior expectation and variance

$$\underline{\mathbf{A}} = \mathbb{E}[\mathbf{A}] = (\mathbf{I}_M, \mathbf{0}, \dots, \mathbf{0})$$

$$\underline{\mathbf{V}} = \mathbb{V}ar(\mathbf{A}) = \begin{cases} \left(\frac{\lambda_1}{k}\right)^2 & \text{for } i = j \text{ and the } k\text{-th lag and,} \\ \left(\frac{\sigma_i^2}{\sigma_j^2}\right)\left(\frac{\lambda_1 \lambda_2}{k}\right)^2 & \text{for } i \neq j \text{ and the } k\text{-th lag,} \\ \lambda_3 \sigma_i^2 & \text{for the deterministic part of the model,} \end{cases}$$

and set the hyperparameter for the inverse-Wishart prior accordingly.

Re-estimate the model for the `usmacro` dataset using different prior values for the prior variance (i.e. vary λ_1 and λ_2). Interpret changes in the various outputs of the model. In particular, discuss changes in the estimated autoregressive coefficients, impulse reponses, and forecasts — then explain how they may relate to the prior setup. Discuss why higher/lower values of λ_1 and λ_2 might have an impact on the shape of impulse responses. What could be a suitable way to alleviate hyperparameter choices?

Exercise 2

Read Kilian (2009), who discusses how to disentangle different oil shocks; focus on section II. Load the provided data by Kilian (2009), which contains a measure of change in oil production, a measure of real economic activity, and the real price of oil.

- Using the code for the Bayesian VAR, estimate the VAR described in section II.A.[1]
- Replicate figures 2 and 3 of Kilian, 2009 by recovering the structural form of the model by recursive ordering of variables.[2]
- Think of reasonable sign restrictions to identify the model at hand; discuss and implement them. Recreate figure 3 using these restrictions and discuss differences to the one identified by recursive ordering. Briefly discuss potential shortcomings of both identifcation schemes.
- Think of other variables that might be influenced by oil market shocks and collect data that fits the frequency and time period of the provided data. Transform the additional data appropriately and estimate the reduced form of a suitable VAR model. Identify the different shocks (using recursive ordering and sign restrictions), compute impulse responses and discuss your results.[3]

[1] Given the monthly frequency of the data and the large number of lags, the usual lag shrinkage of the Minnesota prior (which is set for quarterly or yearly data) might be too aggressive. Find a way to adjust for that.

[2] Note that in figure 3 the first column denotes the reponses of oil production, not the change in oil production. Hence, you will have to find a way to calculate *cumulative* impulse responses. Note also that the oil supply shock is a negative shock (i.e. lowering oil production), while the other two are positive ones.

[3] As an impulse, you could use again a stock market measure akin to Kilian & Park, 2009 as in the first assignment.