

Homework 2

Due date: Wednesday, 10 June 2026, 15:30

1. Question 1

(a) Give the state-space representation of the following models:

i. Unobserved component model with a stochastic drift

$$\begin{aligned}y_t &= \tau_t + c_t, \\ \tau_t &= g_{t-1} + \tau_{t-1} + v_t, \quad v_t \sim iid N(0, \sigma_v^2) \\ g_t &= g_{t-1} + w_t, \quad w_t \sim iid N(0, \sigma_w^2) \\ c_t &= \phi_1 c_{t-1} + \phi_2 c_{t-2} + e_t, \quad e_t \sim iid N(0, \sigma_e^2).\end{aligned}$$

Note that in this model, the stochastic trend, τ_t , has a drift term (g_t) modeled as a random walk.

ii. Time-varying parameter model

$$\begin{aligned}y_t &= x_{1,t}\beta_{1,t} + x_{2,t}\beta_{2,t} + u_t, \quad u_t \sim iid N(0, \sigma^2), \\ \beta_{i,t} &= \beta_{i,t-1} + v_{i,t}, \quad v_{i,t} \sim iid N(0, \sigma_i^2).\end{aligned}$$

(b) Briefly discuss how you would estimate a model given in a state space form using maximum likelihood.

2. Question 2: Sims (1980) for Poland

Using the sample code from the website estimate a 3×3 VAR model for growth rate of real GDP per capita, short-term interest rate, and CPI in the model with short-run restrictions for Poland.

- Find and download the data for Poland (starting from 1998Q1). Use WIBOR-3M as the short term interest rate. Convert both interest rate and the CPI to quarterly data. Explain how you choose to convert your data to the quarterly frequency.
- The inflation target in Poland was set to $2.5\% \pm 1\%$ only in 2004. Consider 2004Q1 as starting point.
- Set the time/date indicator with `tsset`.
- Generate the CPI inflation rate and the rate of growth of real GDP per capita.
- Write down the VAR model you want to estimate. What do you assume about the contemporaneous effects of the variables in that model? What are your short run restrictions?

- (f) Check the stationarity of all variables you want to use in your model for the 2004Q1-2025Q2 sample.
- (g) Estimate a VAR model with short-run restrictions as in Sims (1980) and produce IRF's. Comment on the results.
- (h) Change the order of the variables in the VAR vector. What are the new short run restrictions you are imposing? How are your results changing?
- (i) Using the original ordering estimate the SVAR model on the entire sample (i.e. starting from 1998Q1). Are the results different?
- (j) Using the original ordering estimate the SVAR model until the beginning the COVID-19. Are the results (IRFs) different? What can we say about these results?