

**Software.** The subsequent problems can be solved using the software provided in *MATLAB-PF.zip*.

**Problem 1.** The goal of this exercise is to replicate some of the particle filter results for the small-scale DSGE model in Chapter 8 of Herbst and Schorfheide (2015). We will generate output from the Kalman filter and the particle filter.

1. Familiarize yourself with the structure of the MATLAB programs
2. Closely examine the procedure PF\_lik.m and compare it to the description of the particle filter in the lecture notes.
3. Run the programs: you can choose between two parameter vectors and two versions of the particle filter (what are they? why does it make a difference?)
4. Change the number of particles and explore the effect on the accuracy of the likelihood approximation. Does the choice of sampler matter?
5. Turn off the resampling step. What happens?
6. Modify one of the observations to create an extreme outlier, e.g., a “Great Recession.” What happens to the estimated state? What happens to the Effective Sample Size? Does it matter which filter you use?

**Problem 2.** Implement the tempered particle filter in Herbst and Schorfheide (2017) and use it to approximate the likelihood function of the small-scale New Keynesian DSGE model. Change the number of particles and the targeted inefficiency ratio and study how the performance of the filter changes.

**References:**

- Herbst, Edward and Frank Schorfheide (2015): *Bayesian Estimation of DSGE Models*, Princeton University Press.
- Herbst, Edward and Frank Schorfheide (2015): “Tempered Particle Filtering,” *NBER Working Paper*, **23448**.