

MACROECONOMETRICS, Spring 2024

Homework 4. Due Wednesday February 28.

1. Write an alternative state-space representation for the ARMA-model on page 2 of the handout (make it less compact, then it should be much simpler to do).
 - 2a. Assume that a data series is the sum of a random walk and a first order moving average. Write down the process and its difference.
 - 2b. Put the process in state-space form.
3. Download as long a series as you can find for real quarterly U.S. GDP per capita. (I assume you would go the Bureau of Economic Analysis or maybe FRED.)
 3. Assume that the log of the data follows the process described in part 1. Use the Kalman Filter to estimate the three parameters of the model from the difference of log data. NOTE: I realized that year the initialization was wrong. Correct this (I would suggest doing 10–20 steps of the updating equations, starting from an identity matrix...if you have the time, see how closely that fits into the Riccati equation). I have code for ARMA too if you prefer to estimate that instead. Or you can download something else (and, likely, there are a lot of state space representations out there, but always check.)
5. Use the Kalman Smoother to extract the random random walk and moving average components. You can adapt the posted Matlab code or download code from somewhere else, but it has to be in a matrix language and not a canned program where you “write ‘Kalman’ and out it comes.”

You can do the coding together if you wish, but make sure to understand the code (even if you are not yet fully comfortable with the theory). The Kalman Filter has a lot of applications so you may well need it in the future.