# Exercises Accompanying Session
# *State-space models and the Kalman filter*

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**Problem 1**

Consider the following time-varying regression for UK inflation

$$\pi_t = sv2_t + sv1_t \pi_{t-1} + e_t$$

$$\begin{pmatrix} sv1_t \\ sv2_t \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix} + \begin{pmatrix} 0.95 & 0 \\ 0 & 0.95 \end{pmatrix} \begin{pmatrix} sv1_{t-1} \\ sv2_{t-1} \end{pmatrix} + \begin{pmatrix} v_{1t} \\ v_{2t} \end{pmatrix}$$

where:

- $VAR(\varepsilon_t) = 0.6$
- $VAR\begin{pmatrix} v_{1t} \\ v_{2t} \end{pmatrix} = \begin{pmatrix} 0.001 & 0 \\ 0 & 0.006 \end{pmatrix}$

A. Use Eviews to find the filtered and smoothed estimates of the state vector
B. Use Eviews and attempt to estimate *R* and *Q* via maximum likelihood
C. Use Eviews to estimate elements of the transition matrix *F*

**NOTE**: Set $\beta_{0\backslash 0} = (0, 0)'$ and $P_{0\backslash 0} = \begin{pmatrix} 100 & 0 \\ 0 & 100 \end{pmatrix}$. Data is provided in spreadsheet *data.xls*.

**Problem 2: A Time-varying parameter model for exchange rate pass-through**

Consider the following time-varying parameter regression

$$\Delta p_t = c_t + B_t \Delta e_t + \rho_t \Delta p_{t-1} + v_t$$

$$\begin{pmatrix} c_t \\ B_t \\ \rho_t \end{pmatrix} = \begin{pmatrix} c_{t-1} \\ B_{t-1} \\ \rho_{t-1} \end{pmatrix} + z_t$$

Where:

- $v_t \sim N(0, R)$
- $z_t \sim N(0, Q)$

The data in Eviews format is in *exercise.wf1* (note growth rates have already been taken, i.e. p and e in the file correspond to $\Delta p_t$ and $\Delta e_t$ above and no further modification is necessary)

A. Estimate the model by maximum likelihood in Eviews. Use a starting value of -2 for $lnR$ and the three elements of $lnQ$. Can you reproduce the results (for the smoothed estimates) below

## Problem 2: Results to replicate

***Figure 2.A.i FX Pass Through (Eviews)***

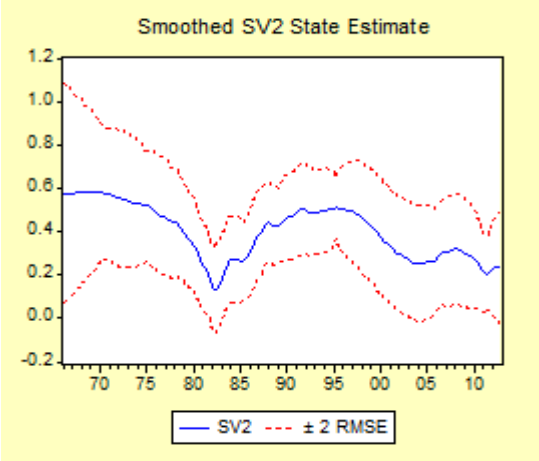



***Figure 2.A.ii AR(1) Coefficient (Eviews)***

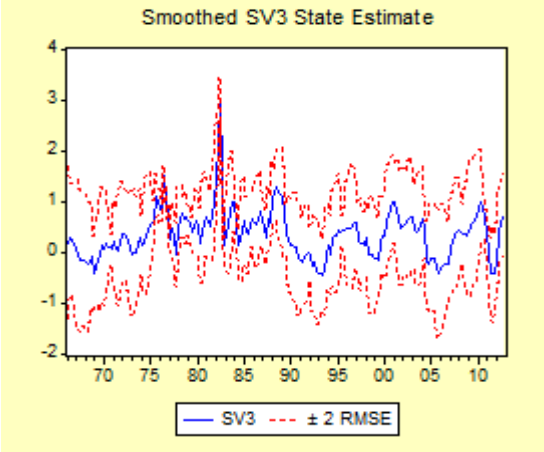
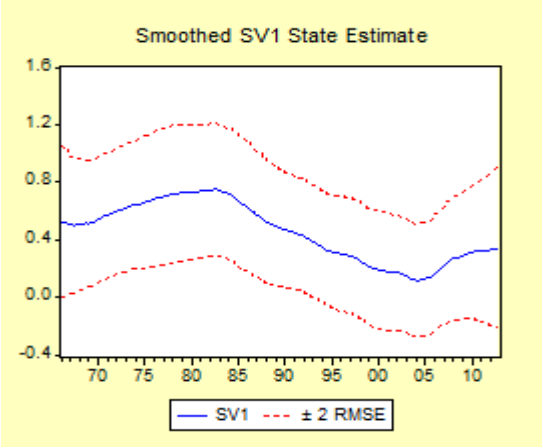



***Figure 2.A.iii Constant (Eviews)***



**Problem 3**

**A model for trend inflation in the US**

Consider the following state-space model

$$\pi_t = T_t + C_t$$

$$\begin{pmatrix} T_t \\ C_t \end{pmatrix} = \begin{pmatrix} \theta_1 \\ 0 \end{pmatrix} + \begin{pmatrix} 1 & 0 \\ 0 & \theta_2 \end{pmatrix} \begin{pmatrix} T_{t-1} \\ C_{t-1} \end{pmatrix} + \begin{pmatrix} v_{1t} \\ v_{2t} \end{pmatrix}$$

Where $v_t \sim N(0, R)$ and *R* is a diagonal matrix.

A. Use the provided data on US inflation $\pi_t$ and compute estimates of trend CPI inflation in Eviews.
B. Try re-estimating the model of problem 1 on the new data.