1. Let $Y_t = (IP_t, r_t, \pi_t)'$, where IP is industrial production growth, r interest rate and π inflation, measured at a quarterly frequency. Suppose you estimated the following model for Y_t :

$$\begin{aligned} Y_t &= \varepsilon_t + \begin{pmatrix} 1 & -.05 & -.5 \\ 0 & 1 & .4 \\ .1 & -.9 & 1 \end{pmatrix} \varepsilon_{t-1} + \begin{pmatrix} 1 & -.01 & -.1 \\ .2 & 1 & .7 \\ 0 & -.2 & 1 \end{pmatrix} \varepsilon_{t-2}, \ \varepsilon_t \ iid(0, \Omega), \text{ where} \\ \Omega &= \begin{pmatrix} 1 & 0 & .3 \\ 0 & 1 & .1 \\ .3 & .1 & 1 \end{pmatrix} \end{aligned}$$

   (a) What is the effect of a one-unit shock to interest rate on inflation 1-, 2- and 3-quarters ahead?

   (b) Does your answer to point a. represent how you would revise your future inflation expectations after learning new information about output and the interest rate today? Why or why not?

   (c) What is the effect of a one-unit shock to interest rate on industrial production growth one-quarter ahead?

2. Let x_t = log of output m_t = log of money supply u_{st} = iid supply shock u_{mt} = iid money shock. Consider the SVAR(1)

$$\begin{aligned} A_0 Y_t &= A_1 Y_{t-1} + u_t, \ E u_t u_t' = \Omega_u \qquad (1) \\ Y_t &= \begin{pmatrix} \Delta x_t \\ \Delta m_t \end{pmatrix} \ u_t = \begin{pmatrix} u_{st} \\ u_{mt} \end{pmatrix} \end{aligned}$$

   and the corresponding reduced-form VAR(1)

$$Y_t = \Phi Y_{t-1} + \varepsilon_t, \ E\varepsilon_t \varepsilon_t' = \Omega_\varepsilon \qquad (2)$$

   (a) Explain how you would test that money does not Granger-cause output in the model

   (b) In general, how many restrictions do you need to identify the structural parameters in (1) if you know the reduced-form parameters?

   (c) Suppose that Ω_u is diagonal and that the estimation of (2) yields reduced-form parameters $\Phi = \begin{pmatrix} .4 & -.4 \\ .1 & .7 \end{pmatrix}$, $\Omega_\varepsilon = \begin{pmatrix} 16 & 4 \\ 4 & 26 \end{pmatrix}$. Under the assumption that money does not contemporaneously affect output, derive the structural parameters in (1).

(d) Using the identifying assumption in point c), how would you compute the impulse response function (IRF) of both output and money to a supply shock? The IRF of output and money to a money shock?

3. The files hours.txt and realgdp.txt respectively contain quarterly data on average weekly hours worked and real GDP from 1964:2 to 2007:3. Compute the logarithmic growth rate of hours and of productivity (obtained as the GDP/Hours ratio).

   (a) Estimate a VAR(1) model for the productivity growth and the hours growth. Which model is selected by BIC? Which by AIC?[1] In each case, test whether the residuals of the model(s) selected by each information criterion are serially correlated.

   (b) For the model (or models) selected in question a., compute the impulse-response functions for all variables and all shocks, up to 10 quarters, with asymptotic confidence intervals (Eviews and Stata gives you the option). What is the effect of a shock to hours growth on productivity growth? How long does it take to die out?

   (c) For the model (or models) selected in question a., test whether the residuals are normally distributed. What are the implications for the use of an asymptotic confidence interval for the impulse-response function (IFR)?

   (d) For the model (or models) selected in question a., compute confidence intervals for the IRF that are based on re sling methods (in Eviews, you can do this by selecting the "Monte Carlo" standard errors option). Do your results change?

4. Download the series x1.txt, x2.txt, x3.txt. Do the following analysis in Eviews:

   (a) Test for a unit root in the three time series

   (b) Regress x1 on x2 and report the R^2 and significance of the regression coefficient. What do you conclude?

   (c) Plot the autocorrelogram of the residuals from the regression in point b. and do a unit root test on the residuals. What do you conclude?

   (d) Take first differences of x1 and x2 and repeat the analysis in point b. and c. for the first differences

   (e) Test whether x1 and x2 are cointegrated

   (f) Test whether x1, x2 and x3 are cointegrated find the number of cointegrating relationships and the cointegrating vectors.

   (g) Let $\beta = (\beta_1, \beta_2, \beta_3)$ be the cointegrating vector estimated in point f. above (if there are more than one, just choose one). Construct a new variable as $Y_t = \beta_1 x1 + \beta_2 x2 + \beta_3 x3$ and test whether it has a unit root

[1] In Stata, use the comand "varsoc". Eviews does it automatically for you by clicking on view-lag structure-lag length criteria.