Department of Economics
University of Washington

Econ 582
Midterm Exam

This is an open book exam. You have 1 hour and 30 minutes to complete the exam. Please write short answers to each question.

Time Series Models

1. Consider the following model for observed real GDP, y_t, as a function of consumption, c_t, and saving, s_t:

$$
\begin{aligned}
&y_t = c_t + s_t \\
&c_t = \mu + c_{t-1} + v_t, \ c_0 \text{ is a fixed constant} \\
&s_t = u_t \\
&\begin{pmatrix} v_t \\ u_t \end{pmatrix} \sim iid \ N\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_v^2 & 0 \\ 0 & \sigma_u^2 \end{pmatrix} \right)
\end{aligned}
$$

a. Is y_t covariance stationary? Justify your answer.

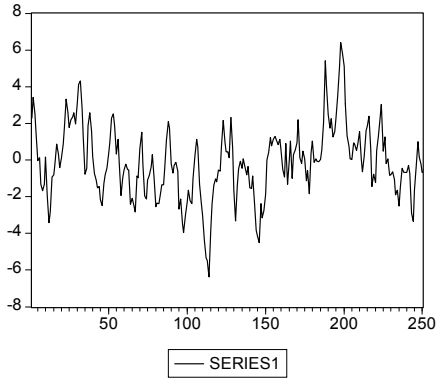
Consider the first difference of y_t:

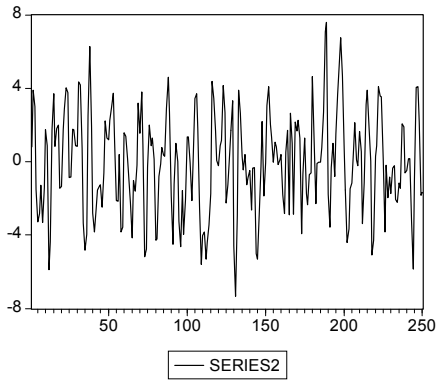
$$\Delta y_t = \Delta c_t + \Delta s_t = (\mu + v_t) + (u_t - u_{t-1}).$$

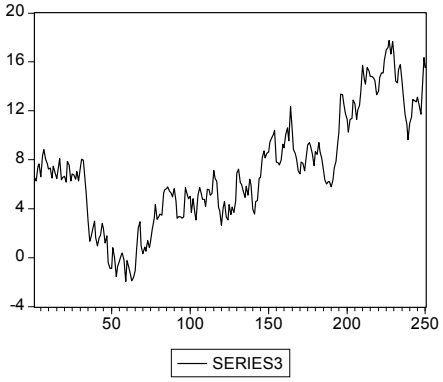
b. Compute $E[\Delta y_t], \text{var}(\Delta y_t)$ and $\text{cov}(\Delta y_t, \Delta y_{t-j})$ for $j = 1, 2, \ldots$. Based on your computations, is Δy_t covariance stationary?

c. Based on your computations above, what ARMA(p,q) model describes the behavior of Δy_t?

2. Below are plots of some simulated time series and the corresponding sample autocovariance functions.







a. What ARMA(p,q) models would you choose to describe the above 3 series? Justify your answers.

Panel Data

Consider the following gasoline demand equation:

$$\ln\left(\frac{Gas}{Car}\right)_{it} = \beta_0 + \beta_1 \ln\left(\frac{Y}{N}\right)_{it} + \beta_2 \ln\left(\frac{P_{MG}}{P_{GDP}}\right)_{it} + \beta_3 \ln\left(\frac{Car}{N}\right)_{it} + \varepsilon_{it}$$

where *Gas/Car* is motor gasoline consumption pear auto, *Y/N* is real per capita income, P_{MG}/P_{GDP} is real motor gasoline price and *Car/N* denotes the stock of cars per capita. The panel data set consists of annual observations across 18 OECD countries ($i = 1,\ldots,18$) covering the period 1960 – 1978 ($t = 1,\ldots,19$).

a. Under what conditions is the random effects (RE) estimator appropriate?
b. Briefly describe how you would compute the RE estimator. (Hint: You can give an analytic answer or you can describe how you would compute the estimator in Eviews)
c. Under what conditions is the fixed effects (FE) estimator appropriate?
d. Briefly describe how you would compute the FE estimator. (Hint: You can give an analytic answer or you can describe how you would compute the estimator in Eviews)
e. For the above application, which estimator would you use? Justify your answer.

Multi-Equation GMM

Consider the multi-equation investment model

$$\begin{aligned} y_{it} &= \delta_{i0} + \delta_{i1} F_{it} + \delta_{i2} C_{it} + \varepsilon_{it} \\ &= \mathbf{z}_{it}' \boldsymbol{\delta}_i + \varepsilon_{it}, \ (i = 1,\ldots,N; t = 1,\ldots,T) \end{aligned}$$

where

y_{it} = gross investment of firm i in year t
F_{it} = denotes market value of firm i at the end of the previous year t
C_{it} = value of the stock of plant and equipment for firm i at the end of the previous year t.

a. Write the system of equations as a "big giant regression" of the form

$$\boldsymbol{y} = \underline{\mathbf{Z}}\boldsymbol{\delta} + \boldsymbol{\varepsilon}$$

Suppose that z_{im} is predetermined for every equation ($E[z_{it}\varepsilon_{js}] = 0 \ \forall \ i, j, t, s$) and that the errors are contemporaneously correlated across equations.

b. What estimator would you use if you think that the errors are not conditionally homoskedastic? Briefly describe how you would compute this estimator. (Hint: You can give an analytic answer or you can describe how you would compute the estimator in Eviews)
c. What estimator would you use if you think that the errors are conditionally homoskedastic? Briefly describe how you would compute this estimator. (Hint: You can give an analytic answer or you can describe how you would compute the estimator in Eviews)
d. Suppose the errors are conditionally homoskedastic. Consider testing the hypothesis that the coefficients are the same across equations:

$$H_0 : \delta_1 = \ldots = \delta_M$$

Describe how you would test this hypothesis. (Hint: You can give an analytic answer or you can describe how you would compute the test in Eviews)