BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF COMMERCE

DEPARTMENT OF ECONOMICS

MSc ECONOMICS

JUN 2025

ECONOMETRIC PRINCIPLES AND DATA ANALYSIS 2 (MEC 536) (2)

EXAMINATION DURATION: 3 HOURS TOTAL MARKS: 100

INSTRUCTIONS TO CANDIDATES

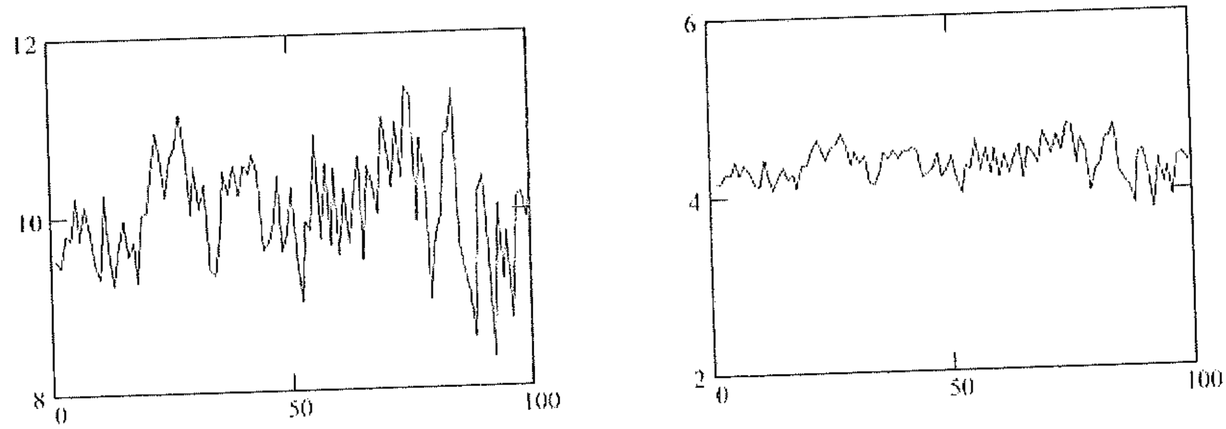
1. Answer question 1 in Section A and any other three questions from Section B.
2. Question 1 carries 40 marks.
3. All the questions in Section B carry equal marks of 20 each.
4. Cell-phones are not allowed into the examination room.

SECTION A (COMPULSORY)

Question 1

a) The graphs below represent two different time series plots.

(a) (b)



i) Which of the two plots reresents a stationary series and why? **(5 marks)**

ii) Assign random ordinal values to differentiate the standard deviations of the two plots. **(3 marks)**

iii) Explain the Box-Cox transformation with reference to the above plots. **(4 marks)**

b) with the aid of graphs explain each of the following terms as applied in time series econometrics:

i) White noise process. **(5 marks)**

ii) Random Walk. **(5 marks)**

iii) A deterministic trend process. **(5 marks)**

c) Assume the following AR(1) model,

$x_t = px_{t-1} + \varepsilon_t$,

where εt~NID(0,σ2),

i) Explain the differences of performing inference on the estimated p, when p <1.0 and when p=1.0. **(6 marks)**

d) i) Explain what is meant by an impluse response function in the context of VAR models. **(4 marks)**

ii) What is the purpose of variance dcomposition in VAR models? **(3 marks)**

[40 marks]

SECTION B (ANSWER ANY THREE QUESTIONS)

Question 2

a) Detail the Box-Jenkins model selection process. **(11 marks)**

b) Sketch the autocorrelation and partial autocorrelation functions for the following stochastic processes:

i. stationary

ii. an ARMA (3,2). **(6 marks)**

c) Why is stationarity a useful property in ARIMA model estimation? **(3 marks)**

[20 marks]

Question 3

a) Birdi and Dunne (2001) consider a log linear relationship based upon a simple Cobb Douglas model: $q = a + \alpha k + \beta l + \gamma m$

Where q is output, k is capital, l is labour and m is military spending, all in logs and all constant prices. Treating this within a VAR estimation framework within Microfit 4.1 (Pesaran and Pesaran, 1997) and starting from an order 4 VAR we get a VAR (2) as the optimal lag length. The order of the VAR is found to be 2 and unrestricted intercepts and no trends gives one cointegrating vector:

$$qm = 1.32\,k - 1.53\,l + 0.50\,m$$
$$(0.7) \quad (2.1) \quad (0.5)$$

The underlying ECM model is:

$$\Delta qm_t = 1.96 + 0.55\,\Delta qm_{t-1} + 1.23\,\Delta k_{t-1} - 0.84\,\Delta l_{t-1} - 0.08\,\Delta m_{t-1} + 0.16\,ECM_{t-1} - 0.04\,DS$$
$$(1.7) \quad (3.6) \quad (2.0) \quad (1.6) \quad (1.3) \quad (1.6) \quad (2.3)$$

i) What is the short run effect of military spending on growth. **(3 marks)**

ii) Explain what they have done and why this approach might be an improvement over simply estimating the aggregate production function? **(8 marks)**

iii) Interpret and critically evaluate the results. **(6 marks)**

iv) Give an interpretation for the error correction term. **(3 marks)**

[20 marks]

Question 4

b) An analyst is examining two annual time series, x and z runs two tests in STATA using data from 1901 to 2000 (n=100) as follows.

```
. dfuller d.x,regress

Dickey-Fuller test for unit root                   Number of obs   =        98

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)            -15.168            -3.513            -2.892            -2.581
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

------------------------------------------------------------------------------
        D2.x |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           x |
         LD. |  -1.409368   .0929198   -15.17   0.000    -1.593812   -1.224923
             |
       _cons |   16.46793   8.227766     2.00   0.048     .1359444    32.79992
------------------------------------------------------------------------------

. egranger x z,regress
Replacing variable _egresid...

Engle-Granger test for cointegration              N (1st step)  =        100
                                                  N (test)      =         99
------------------------------------------------------------------------------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -9.422            -4.009            -3.399            -3.088

Critical values from MacKinnon (1990, 2010)
------------------------------------------------------------------------------
Engle-Granger 1st-step regression
------------------------------------------------------------------------------
           x |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           z |   .9409922   .0177354    53.06   0.000     .9057969    .9761875
       _cons |  -670.0667   210.5659    -3.18   0.002    -1087.928   -252.2055
------------------------------------------------------------------------------
Engle-Granger test regression
------------------------------------------------------------------------------
  D._egresid |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    _egresid |
         L1. |  -.9496467   .1007855    -9.42   0.000    -1.149652   -.7496412
------------------------------------------------------------------------------
```

a) What is the purpose of performing the Dickey-Fuller test in this scenario?

(5 marks)

b) What does the Dickey-Fuller test conclude? Refer to the output when justifying your answer. **(5 marks)**

c) Explain why he used the Engle-Granger test for cointegration and detail an alternative method which was not relevant in this instance. **(5 marks)**

d) Interpret the results of the cointegration test. **(5 marks)**

[20 marks]

Question 5

a) What is Realized Variance and why is it useful in ARCH and GARCH model estimation? **(4 marks)**

b) Suppose we model log-prices at time t, written p_t, as an ARCH(1) process:

$$p_t|\mathcal{F}_{t-1} \sim N(p_{t-1}, \sigma_t^2),$$

where $\mathcal{F}_t$ denotes the information up to and including time t and

$$\sigma_t^2 = \alpha + \beta(p_{t-1} - p_{t-2})^2$$

i) What is meant by an ARCH(1) model? **(3 marks)**

Is p_t a martingale? Why or why not? **(5 marks)**

ii) How can the ARCH(1) model be generalized to better capture the variance dynamics of asset prices? **(4 marks)**

iii) In the ARCH(1) case, what can you say about the properties of

$$p_{t+s}|\mathcal{F}_{t-1} \text{ ,}$$

for s > 0, i.e., the multi-step ahead forecast of prices? **(4 marks)**

[20 marks]

END OF PAPER