LAIKIPIA UNIVERSITY

UNIVERSITY EXAMINATIONS

FIRST SEMESTER 2025/2026 ACADEMIC YEAR

FOURTH YEAR EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE (STATISTICS) AND BACHELOR OF SCIENCE (ECOMICS & STATISTICS)

STAT 411: APPLIED TIME SERIES ANALYSIS

STREAM: R ***TIME: 2 HRS***

DAY: MONDAY [8.30 – 10.30 A.M] ***DATE: 02/02/2026***

THIS QUESTION PAPER CONSISTS OF FIVE (5) PAGES

PLEASE DO NOT OPEN UNTIL THE INVIGILATOR SAYS SO.

Instructions: Answer Question <u>ONE</u> (compulsory) and any Other <u>TWO</u> questions

<u>QUESTION ONE (30 MARKS)</u>

a) Consider the following Autocorrelation function of time series depicted in figure 1

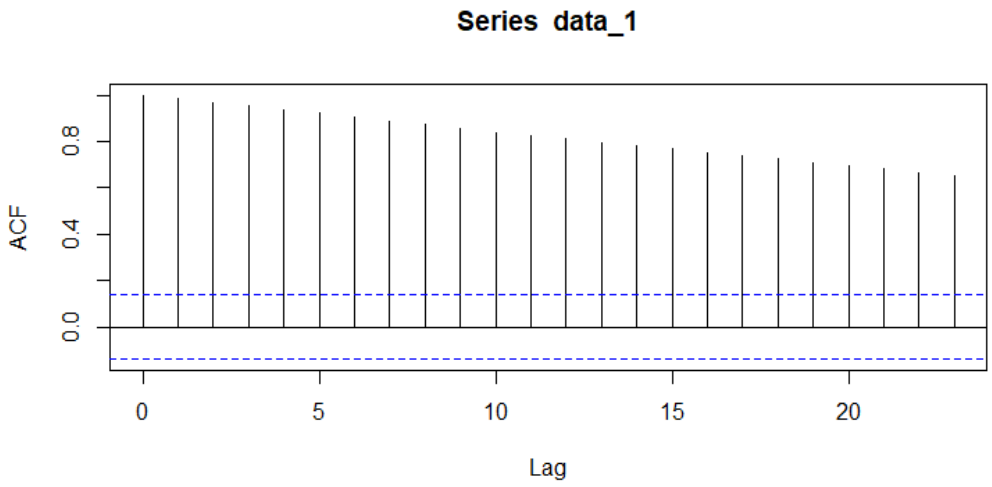

Figure1

i) Is the series stationary or not? Why? **(2 Marks)**

ii) What kind of transformation is required to make it stationary **(2 Marks)**

b) Consider the following ACF depicted in the Figure 2 below.

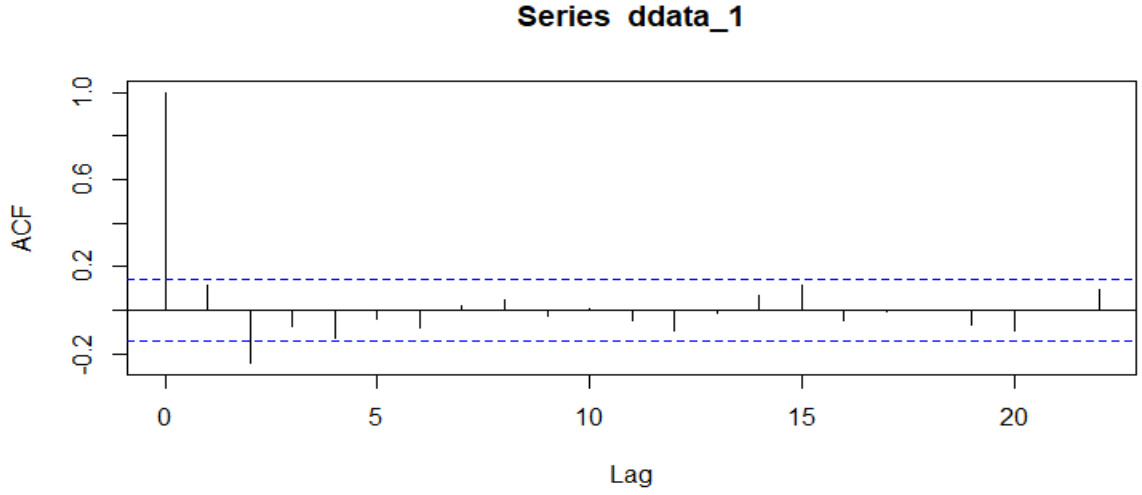

Figure2

i) State the lags of ACF which are significant from the figure 2. **(2 Marks)**

ii) Which are the possible models for the acf depicted above? **(2 Marks)**

C) Consider the PACF given in figure 3.

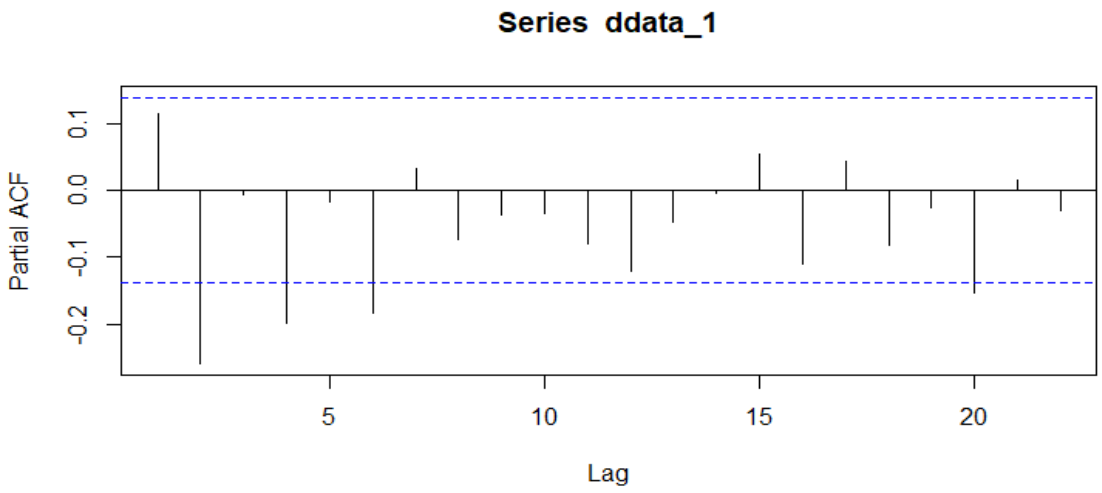

Figure 3

i) Which PACF(s) are significant **(2 Marks)**
ii) Which models are represented by the ACF given Figure 3 **(2 Marks)**

d)The data below shows quarterly sales ('000) of Sea Company from 2015 to 2017.

Year	Quarte1	Quarter 2	Quarter3	Quarter 4
2015	230	430	100	150
2016	250	480	110	175
2017	290	520	119	208

i) Compute the trend of the series. Comment on its shape. **(3 Marks)**
ii) Compute the seasonal variations **(4 Marks)**
iii) Forecast sales values for 2018 **(4 Marks)**

e) State and verify four properties of the autocovariance function. **(7 Marks)**

QUESTION TWO (20) MARKS)

a) With the aid of an example, define explain what is meant by time series **(4 Marks)**

b) State and explain how forecasting can be applied in three specific business functional areas

(6 Marks)

c)_Given AR(1) process $X_t = \phi X_{t-1} + e_t$

Find

i) An optimal one-step-ahead forecast **(3 Marks)**

ii) the one step ahead forecast error **(2 Marks)**

iii) An optimal two-steps-ahead forecast **(3 Marks)**

iv) The two steps ahead forecast error **(2 Marks)**

QUESTION THREE (20 MARKS)

a) Consider the AR(2) process $X_t = X_{t-1} - 0.25X_{t-2} + e_t$

i) Obtain the difference equation for autocorrelation functionACF (ρ_k) **(4 Marks)**

ii) Calculate the values for autocorrelation function ρ_k, $for\ \ k = 1,\ 2,\ 3,\ldots,10$ **(5 Marks)**

iii) Compute the partial autocorrelation for lags 1,2,3. **(5 Marks)**

iv) What do you expect to be the partial autocorrelation function for lags greater than three? **(2 Marks)**

v)

vi) What does the values of ACF and PACF signify about the order the model? **(4 Marks)**

QUESTION FOUR (20 MARKS)

a) Describe the steps in time series model identification process. **(12 Marks)**

b) Determine whether the following series is stationary or invertible.

$$x_t = 0.8x_{t-1} + 0.48x_{t-2} + 0.3e_{t-1} - 0.18e_{t-2} + e_t$$ **(8 Marks)**

QUESTION 5 (20 MARKS)

a) Explain the **three** main stages in time series analysis **(4 Marks)**

b) Consider the following data whose time series plot is given in Figure 5 below

t	1	2	3	4	5	6	7	8	9	10	11	12

Xt	110	112	122	135	133	119	122	134	132	122	125	141

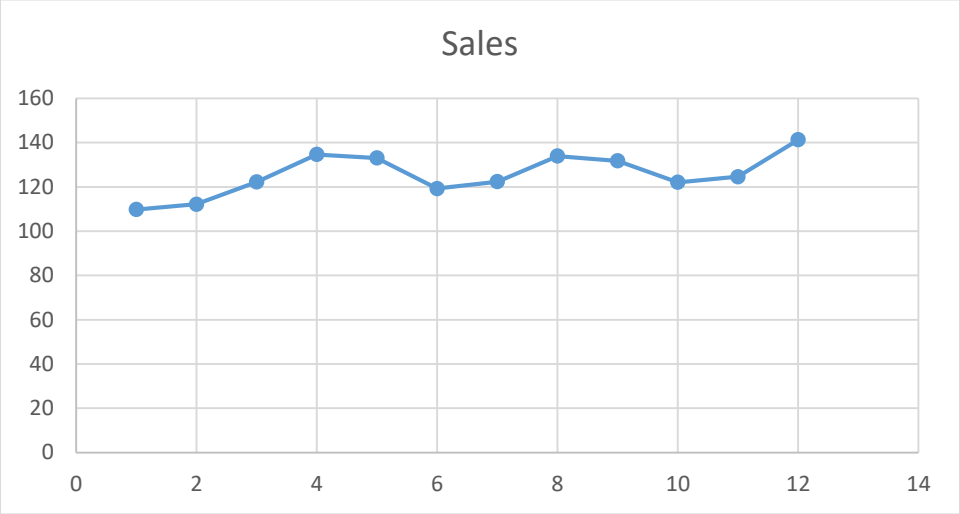

Figure 5

i) Perform an appropriate transformation to make the data stationary. Let the new series be W_t

(4 Marks)

ii) Plot Wt and state whether it is stationary or not **(2 Marks)**

iii) Compute the autocorrelation function (ACF) and partial autocorrelation function (PACF) of W_t

(8 Marks)

iv) Determine the ACF which are significant, using an appropriate confidence interval. **(2 Marks)**