



# **MAASAI MARA UNIVERSITY**

**REGULAR UNIVERSITY EXAMINATIONS  
2023/2024 ACADEMIC YEAR  
SECOND YEAR SECOND SEMESTER**

**SCHOOL OF PURE, APPLIED AND HEALTH  
SCIENCES  
BACHELOR OF APPLIED STATISTICS WITH  
COMPUTING**

**COURSE CODE: STA 2218-1  
COURSE TITLE: INTRODUCTION TO TIME SERIES  
ANALYSIS**

**DATE: 16/4/2024**

**TIME: 1430-1630 HRS**

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## **INSTRUCTIONS TO CANDIDATES**

### **INSTRUCTIONS**

- i) Answer Question **One** and **any Two** Questions
- ii) Show all the workings clearly
- iii) Do not write on the question paper

**Question One –( 20 Marks)**

a) Describe the three steps in model building in time series. **(4 Marks)**

b) Consider the process

$$x_t = 15 + 0.6x_{t-1} + e_t$$

where  $\sigma_e^2 = 4$ .

i) Is this process stationary? **(1 Mark)**

ii) Calculate the autocorrelation function of the process. **(4 Marks)**

c) Consider the MA(1) process given by

$$x_t = 6 + e_t + 0.2e_{t-1}$$

Where  $\sigma_e^2 = 3$ .

i) Is the process stationary? **(1 Mark)**

ii) Is the process invertible? If so, express the process in autoregressive form. **(4 Marks)**

d) Explain the main stages in setting up a Box-Jenkins forecasting model. **(4 Marks)**

e) Define spectrometer or periodogram. **(2 Marks)**

**Question Two – (15 Marks)**

a) Consider the set of independent and identically distributed random variables  $\{e_t\}$  such that  $E(e_t) = 0$  and  $Var(e_t) = \sigma_e^2$ . Let the process  $X_t$  be given by  $X_t = \theta e_{t-1} + e_t$  where  $\theta$  is a constant. Show that  $X_t$  is stationary. **(8 Marks)**

b) Consider a process given as

$$X_t = e_1 + e_2 + \dots + e_t$$

Where the variables  $\{e_t\}$  are as in (a) above. Show that  $X_t$  is not stationary. **(3 Marks)**

c) Name and describe the components of a time series. **(4 Marks)**

**Question Three (15 Marks)**

a. Explain the objective of time series analysis **(4marks)**

b. Given the following data, use the method of semi – average to:

Year	1997	1998	1999	2000	2001	2002	2003
Sales in thousand	102	105	114	108	116	112	120

- i) Fit the trend line (4marks)  
ii) Tabulate the trend values (2marks)

c. The first order autoregressive process AR(1) is the Markov process defined by the 1<sup>st</sup> order stochastic differential equation;

$$X_t = \alpha_1 X_{t-1} + \ell_t \text{ where } |\alpha| < 1.$$

Show that this process is stationary by proving that the expectation

$$E(X_t) = 0 \quad (5marks)$$

**Question Four (15marks)**

- a) State the component of time series that influence the following observed time series (3marks)
- i) The rate of inflation in Kenya's economy is high during electioneering period.
  - ii) The business activities dropped at the coastal region after unpredicted Tsunami devastations.
  - iii) The experience of high turns up of passengers during end months.
- b) State the importance of the time series analysis (4marks)
- c) The export of a certain commodity in millions of ksh during 2001-2006 is given below

Year	2001	2002	2003	2004	2005	2006
Amount	100	107	128	140	181	192

- i. Fit a parabola  $Y = a + bX + cX^2$  to the data. (4marks)
- ii. Estimate the price of the commodity for the year 2007. (2marks)
- iii. Plot the actual and the trend values on the graph( sketch) (2marks)

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