



**MASINDE MULIRO UNIVERSITY OF  
SCIENCE AND TECHNOLOGY  
(MMUST)**

**MAIN**

**UNIVERSITY EXAMINATIONS**

**2021/2022 ACADEMIC YEAR**

**MAIN CAMPUS**

**SECOND YEAR SECOND SEMESTER EXAMINATIONS**

**FOR THE DEGREE**

**OF**

**BACHELOR OF MATHEMATICS AND IT**

**COURSE CODE: STA 244**

**COURSE TITLE: INTRODUCTION TO TIME SERIES AND  
FORECASTING**

**DATE: 25/04/2022 TIME: 12:00 – 2:00 PM**

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**INSTRUCTIONS TO CANDIDATES:**

Answer Question one and any other two questions.

**TIME: 2 HOURS**

**QUESTION ONE (30 Marks)**

a) The monthly production of crude petroleum in Canada during 1989 is shown below.

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
crude	5886	5485	6269	5776	6109	5867	6196	6045	5839	6180	6192	6362

- i. Calculate the four-month centered moving averages for the time series (5marks)
- ii. Compute the exponentially smoothed time series with  $w = .2$  for the data

(5marks)

b) Below are given figure of production (kg tones) of a sugar factory

Year	2004	2005	2006	2007	2008	2009
production	77	88	95	114	119	1127

Fit a trend  $Y = ab^x$  to this data and tabulate the trend values (10marks)

c) Calculate the autocorrelation coefficient of the following set of data

9, 8, 12, 9, 12, 11, 7, 13, 9, 11, 10

(10marks)

**QUESTION TWO (20 MARKS)**

a) In 2000, two forecasting models were used to predict annual sales for the period 2000–2004. The forecasts and actual sales are listed below.

Year	Sales in millions	Model I	Model II
2000	53	49	60
2001	70	63	68
2002	82	78	75
2003	85	75	82
2004	95	80	85

For each model, calculate mean absolute deviation (MAD) and sum of squared error (SSE) to determine which model worked best for the Period 2000–2004. (10marks)

b) Below are given the annual production figures (in thousand tonnes) of a fertilizer factory:

Year	2003	2004	2005	2006	2007	2008	2009
Production	70	75	90	91	95	98	100

(i) Fit a straight line trend by the method of least squares and tabulate the trend values (7marks)

(ii) Convert your annual trend equation into a monthly trend equation (3marks)

**QUESTION THREE (20 MARKS)**

- a) Define the following terms used in time series
- (i) Stationary time series
  - (ii) Forecast error
  - (iii) Forecast horizon
  - (iv) Forecast interval
  - (v) Non-stationary

- b) Consider the AR(3) process

$$X_t = \frac{1}{3}X_{t-1} + \frac{1}{4}X_{t-2} + \frac{1}{12}X_{t-3} + \varepsilon_t ; \{\varepsilon_t\} \sim WN(0, \sigma^2).$$

Determine the autocorrelation function for the process. (15marks)

**QUESTION FOUR (20 MARKS)**

The data below shows the sales of a toy robot over the last 11 months.

Month	1	2	3	4	5	6	7	8	9	10	11
Sales	3651	4015	3874	3501	3307	3105	2986	3100	3209	3450	3507

- (i) Calculate a four month moving average for each month. What would be your forecast for the sales in month 12? (7marks)
- (ii) Apply exponential smoothing with a smoothing constant of 0.9 to derive a forecast for the sales in month 12. (7marks)
- (iii) Which of the two forecasts for month 12 do you prefer and why? (6marks)

**QUESTION FIVE (20 MARKS)**

- a) Calculate seasonal index numbers from the following data  
RATIO OF OBSERVED TO TREND VALUES (%)

Year	I	II	III	IV
2004	108	130	107	93
2005	86	120	110	91
2006	92	118	104	88
2007	78	100	94	78
2008	82	110	98	86
2009	106	118	105	98

If the sales of goods X by a firm in the first quarter of 2009 are worth Ksh 20000, determine how much worth of the goods should be kept in stock by the firm to meet the demand in each of the remaining three quarters of 2009 by using the seasonal index numbers calculated. (10marks)

b) Fit a parabolic trend to the following time-series data and estimate the production in 2014.

(10marks)

Year	2003	2004	2005	2006	2007	2008	2009
Production	42	49	62	75	92	122	158