



# MAASAI MARA UNIVERSITY

REGULAR UNIVERSITY EXAMINATIONS  
2021/2022 ACADEMIC YEAR  
FOURTH YEAR FIRST SEMESTER

SCHOOL OF PURE, APPLIED AND HEALTH SCIENCES

BACHELOR OF SCIENCE IN APPLIED STATISTICS WITH  
COMPUTING

COURSE CODE: STA 4135

COURSE TITLE: APPLIED TIME SERIES ANALYSIS

DATE: 1<sup>ST</sup> APRIL, 2022

TIME: 0830-1030

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## INSTRUCTIONS TO CANDIDATES

1. Answer **ALL** questions from section A and any **TWO** from section B.
2. Use of sketch diagrams where necessary and brief illustrations are encouraged.
3. Read the instructions on the answer booklet keenly and adhere to them.

*This paper consists of **four** printed pages. Please turn over.*

**SECTION A**

**QUESTION ONE (30 MARKS)**

- a) Explain the following terms.
- i) Time series analysis [1mk]
  - ii) Additive model [1mk]
  - iii) Multiplicative model [1mk]
- b) Define the following as used in time series analysis. [4mks]
- i. Random variations
  - ii. Cyclic variations
  - iii. Secular trend
  - iv. Seasonal variations
- c) Explain briefly the following methods of measuring trend?
- i) The geographical or free hand method [2mks]
  - ii) The principal of least squares [2mks]
  - iii) The method of curve fitting [2mks]
  - iv) The method of moving average [2mks]
- d) State the limitation of using geographical or free hand method in measuring trend. [1mk]
- e) The sales of a company in (Ksh.) for the year 2009-2015 are given as follows

Year	2009	2010	2011	2012	2013	2014	2015
Sales (tons)	30	45	63	90	130	188	273

Estimate the sales figures for the year 2018 using the equation of the form

$$y = ab^x, \text{ where } x = \text{years and } y = \text{sales}.$$

[5mks]

- f) Calculate the seasonal indices for the data given below for the average quarterly prices of a commodity for four years.

[6mks]

Years	Quarter I	Quarter II	Quarter III	Quarter IV
2009	554	590	616	653
2010	472	501	521	552
2011	501	531	553	595
2012	403	448	460	480

- g) Plot the following data and ascertain trend by the method of semi averages.

[3mks]

Year	1999	2000	2001	2002	2003	2004	2005
Sales (tons)	110	130	105	115	118	112	122

**SECTION B (40 MARKS)**

Answer any TWO Questions

**QUESTION TWO (20 MARKS)**

- a) Given AR(1) process as  $X_t = aX_{t-1} + e_t$ . Find
- i) An optimal one-step-ahead forecast [2mks]
  - ii) An optimal two-steps-ahead forecast [2mks]
- b) The table shows the profit made by a company between 2001 and 2009

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009
Profit	10.1	12.7	12.4	11.9	12.5	13.0	14.9	16.5	18.7

- i) Fit the above data in a least square equation and hence find the trend values. [6mks]
  - ii) Estimate the trend value for the year 2012 [3mks]
- c) Using the method of least squares, find the weights of a cubic polynomial  $U_t = a_0 + a_1t + a_2t^2 + a_3t^3$  by method of moving average to set of 5 points. [7mks]

**QUESTION THREE (20 MARKS)**

- a) The price in Kshs of a commodity during 1999-2005 is given below.

Year	1999	2000	2001	2002	2003	2004
price	200	207	228	240	281	292

Fit a parabola  $y = a_0 + a_1x + a_2x^2$  to this data. Estimate the price of the commodity for the year 2006. [5mks]

- b) Consider an autoregressive process of order 1 (AR (1)) given by  $X_t = aX_{t-1} + e_t$  where  $a$  is a constant. If  $|a| < 1$ , show that  $X_t$  may be expressed as infinite order of a MA process. [5mks]

- c) Let  $X_t = a + bt + ct^2 + e_t$ . Find  $Y_t = \Delta X_t$  [3mks]

- d) Calculate the 5-yearly and 7-yearly moving averages for the following data of a number of commercial industrial failures in a country during 1981-1996. [7mks]

Year	No. of failure	Year	No of failure
1981	24	1989	10
1982	27	1990	14
1993	29	1991	12
1984	33	1992	15
1985	21	1993	13
1986	13	1994	10

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1987	13	1995	4
1988	11	1996	2

**QUESTION FOUR (20 MARKS)**

- a) Calculate the seasonal indices for the data given below by the method of ratio to moving averages.

[5mks]

Year	Output of salt in millions tons			
	I	II	III	IV
1995	70	64	63	65
1996	67	60	58	63
1997	70	65	65	69
1998	72	61	58	64
1999	62	57	53	60

- b) Find  $\Delta X_t$  in  $X_t = e^{i\lambda t}$  by differencing? What is the effect of differencing?

[5mks]

- c) Use the following data and calculate the deseasonalised values  $T * C * I$ . Use the values to estimate the trend line.

[6mks]

Years	Quarter I	Quarter II	Quarter III	Quarter IV
2002	289	241	273	232
2003	336	294	363	274
2004	297	270	263	198
2005	291	209	243	187

- d) Given a quadratic function  $U_x = a_0 + a_1x + a_2x^2$ . Find the first, second and third order difference.

[4mks]

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