UNIVERSITY OF EMBU

2016/2017 ACADEMIC YEAR

SECOND SEMESTER EXAMINATION

SECOND YEAR EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE STATISTICS

STA 222: TIME SERIES ANALYSIS I

DATE: APRIL 12, 2017 **TIME: 11:00 AM-1:00 PM**

INSTRUCTIONS:

Answer Question ONE and ANY Other TWO Questions.

QUESTION ONE (30 MARKS)

a) State and explain main objectives in analysing a time series. [4 Marks]

b) Define a time series and give two examples. [4 Marks]

c) Explain four phases that can exist in a business cycle. [4 Marks]

d) The monthly sales of life insurance cover by a certain company in a given year are as shown in the table below.

Month	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
No. of policies	52	38	43	45	40	38	32	38	41	34	22	24

Compute a five-month moving average and describe the trend. [5 Marks]

e) Describe Holt-Winters smoothing procedure. [5 Marks]

f) Explain the forecasting procedure based on exponential smoothing. [5 Marks]

g) Give three purposes of decomposition of a time series. [3 Marks]

QUESTION TWO (20 MARKS)

a) Give the steps used in calculating the seasonal indices by the method of ratio to trend. [5 Marks]

b) Calculate the quarterly seasonal indices in respect to the following data by using the ratio to trend method and comment on the results. [15 Marks]

Year	Q1	Q2	Q3	Q4
1996	71	68	79	71
1997	76	69	82	74
1998	74	66	84	80
1999	76	73	84	78
2000	78	74	86	82

QUESTION THREE (20 MARKS)

a) The following data can be fitted by the model $y_t = ab^t$

Year	1951	1961	1971	1981	1991	2001	2011
Production in (000) tones	25	25.1	27.9	31.9	36.1	43.9	54.7

Determine the values of a, b and hence forecast the production for the year 2027 [10 Marks]

b) If $X_t = \mu + Z_t + \beta Z_{t-1}$, where μ is a constant, show that the autocorrelation function does not depend on . [5 Marks]

c) Derive the least-squares estimates for a first-order AR process having mean μ. [5 Marks]

QUESTION FOUR (20 MARKS)

a) Define the following processes,

(i) A random walk. [2 Marks]

(ii) A strictly stationary process [2 Marks]

b) Consider the AR(2) process $X_t = 1.1X_{t-1} - 0.18X_{t-2} + Z_t$ where $\{Z_t\}$ is a series of white noise with mean 0 and variance ,

(i) Please show that this series is stationary. [5 Marks]

(ii) Please derive the first two partial autocorrelation functions. [6 Marks]

c) Derive the Yule-Walker equations satisfied by the a.c.f of an AR(p) process. [5 Marks]

QUESTION FIVE (20 MARKS)

a) Given the following exponential curve $x_t = a + bc^t$show how you can estimate the values of a, b and c using the method of three selected points. [8 Marks]

b) Consider the ARIMA (1, 1) process $X_t = \theta_0 + \theta_1 X_{t-1} + Z_t + \theta_2 Z_{t-1}$, where $\{Z_t\}$a series of white noise with mean 0 is and variance.

i. For what values of θ_0, θ_1, and θ_2 is this series stationary and invertible? Show detailed derivation. [5 Marks]

ii. Derive by the method of moments the estimators of θ_0, θ_1 and θ_2 [5 Marks]

c) Give the difference between a stochastic time series which is stationary in the strict sense and the one that is stationary in the weak sense. [2 Marks]

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