JOMO KENYATTA UNIVERSITY

OF

AGRICULTURE AND TECHNOLOGY

UNIVERSITY EXAMINATIONS 2018/2019

THIRD/FOURTH YEAR SECOND SEMESTER EXAMINATIONS FOR THE DEGREE OF

BACHELOR OF SCIENCE IN ACTUARIAL SCIENCE, BACHELOR OF SCIENCE IN FINANCIAL ENGINEERING, BACHELOR OF SCIENCE IN PHYSICAL SCIENCES AND MATHEMATICS AND COMPUTER SCIENCE

STA 2401: TIME SERIES ANALYSIS

DATE: APRIL 2019   TIME: 2 HOURS

INSTRUCTIONS TO CANDIDATES:

1. Answer questions ONE (section A) and any two questions in section B
2. Be neat and show all your workings
3. All questions except question one carry equal marks

This paper consists of 3 printed pages

STACS Examination board 2018/2019

SECTION A
QUESTION ONE (30 MARKS)

a) Differentiate the following terms used in time series analysis   (4 marks)
   i) Purely random process and Random walk process
   ii) Deterministic time series and Stochastic time series

b) Define a moving average process and state the importance of invertibility condition in a moving average process. Hence investigate invertibility of the following process
   $X_t = Z_t + 0.7Z_{t-1} - 0.2Z_{t-2}$ where $\{Z_t\}$ is a white noise process.   (5 marks)

c) State the model concerned in the Box-Jenkins forecasting and give a reason why stationarity of the process is irrelevant in this procedure.   (1 marks)

d) Consider the process $Y_t = X_t + X_{t-1} + X_{t-2}$ where $\{X_t\}$ is a purely random process with mean 0 and variance 4. Obtain the Normalized spectral density function of this process.
                                                                                        (5 marks)

e) Define stationarity of a time series in weak sense. Hence investigate whether the following time series is stationary in weak sense $Y_t = \frac{1}{6}Y_{t-1} + Z_t$ where $\{Z_t\}$ is a white noise process with mean zero and variance 16.   (5 marks)

f) State the components of a time series applicable in the following cases
   i) Terrorists attacks in Kenya.
   ii) Decrease of infant mortality in developing countries due to development of science and technology.
   iii) Increase of teachers salaries by Kenyan government.
   iv) Volatility of the price of petrol in Kenya.   (4 marks)

g) Fit a growth curve $Y_t = ab^{c^t} + e_t$ to obtain the trend values.   (6 marks)

SECTION B
QUESTION TWO (20 MARKS)

a) Obtain the spectral density function of the following process   (10 marks)
   i) A white noise process $Z_t = e_t$
   ii) A process $X_t = Z_t + Z_{t-1} + Z_{t-2} + Z_{t-3}$ where $\{Z_t\}$ is a purely random process

b) State the prediction theory in finding the optimal forecast of a given time series. (2 marks)

c) Consider a process $Y_t = 0.25Y_{t-1} + Z_t$ where $\{Z_t\}$ is a purely random process. Use the prediction theory in (b) above to forecast Y_{n+3} and hence obtain the mean squared error of the forecast.   (8 marks)

QUESTION THREE (20 MARKS)

The price of a commodity during 2000 – 2005 is given below

Year	2000	2001	2002	2003	2004	2005
Price	100	107	128	140	181	192

i) Fit a second degree polynomial using the least squares method and tabulate the trend values.
ii) Estimate the price of the commodity in the year 2008.
iii) Eliminate the trend and find out the components left.

QUESTION FOUR (20 MARKS)

a) Consider a process given by $Y_t = 0.8Y_{t-1} - 0.64Y_{t-2} + X_t$ where $\{X_t\}$ is a purely random process with mean zero and variance σ^2. Show that the process is stationary and hence obtain its A.C.F   (10 marks)

b) Establish invertibility of the following MA process $X_t = Z_t + 0.8Z_{t-1} - 0.2Z_{t-2}$ where $\{Z_t\}$ is a purely random process with mean zero and variance σ^2. Also obtain its A.C.F   (10 marks)