STRATHMORE INSTITUTE OF MATHEMATICAL SCIENCES (SIMS)
MASTER OF SCIENCE IN STATISTICAL SCIENCES
END OF SEMESTER EXAMINATION
STA 8203: TIME SERIES AND FORECASTING

DATE: 15th April 2019 Time: 2 Hours

Instructions

1. This examination consists of **FOUR** questions.
2. Answer **Question ONE (COMPULSORY)** and any other **TWO** questions.

Question One

1.1. What is a white noise process and state its importance in time series application? (2 marks)

1.3. Consider the following ARMA (2,2) model. Establish if there are redundant parameters and whether the reduced model is stationary and invertible (8 marks).

$$X_t - 0.4X_{t-1} - 0.45X_{t-2} \quad = w_t + 0.3w_{t-1} + 0.25w_{t-2}$$

1.4. Consider a model: $(1 - B)\,(1 - B^4)\,(1 - 0.43B^4)\,X_t = (1 + 0.22B)\,(1 + 0.88B^4)\,w_t$. Identify different components of the model and write the ARIMA form of the model. **(5 marks)**

1.5. Explain three components of time series data (3 marks)

1.6. Explain the difference between autocorrelation function and partial autocorrelation functions (2 marks)

Question Two

2.1. Consider first-order moving average process of the form;

$$Y_t = \varepsilon_t + b\varepsilon_{t-1}$$

Where ε_t is a white noise series distributed with mean zero and constant variance δ_ε^2. Show that autocorrelation $\rho(k) = 0 \;\; for\ all \;\; k > 1$ (6 marks)

2.2. Explain how the sample ACF and PACF can be used to specify the orders p and q of a stationary ARMA (p, q) process. (4 marks)

2.3. The following parameter estimates were computed for the AR (2) model based on the differenced data. Use the results to answer the questions that follow.

Parameter	Estimate	Std. error	95% CI
Intercept	-0.005	0.0119	
AR(1)	-0.4064	0.0419	(-0.4884, -0.3243)
AR(2)	-0.1649	0.0419	(-0.2469, -0.0829)

(a) Write the presented autoregressive model in the form of ARIMA and determine whether or not the AR parameters are significant (2 mark)

(b) Express the model in terms of the original data, X_t, rather than the differenced data, Y_t. (4marks)

Question Three

3.1 Explain the different parameters of the cosine model as used in frequency domain analysis approach to time series (5 marks)

3.2 The following cosine function can be used to model the seasonal pattern that might exist in the data.

$$f(t) = \alpha \times cos\left[\left(\frac{2\pi t}{T}\right) - \theta\right]$$

Show how the model can be represented by both sine and cosine. (5 marks)

3.3 The following data represent monthly average temperature of Nairobi city for a period of one year. Use the data to develop a cosine model of the form y = A cos (bt + c) + d and interpret the results (10 marks).

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature	85	85	81	72	65	59	58	61	65	72	77	83

Question Four

4.1 State and explain both the variables and parameters in the general regression model for interrupted time series (ITS) (10 marks)

4.2 The cotton yield after the intervention can be evaluated using an ARIMA (1,2,1) model of intervention. The final model is given as;

$$Y_t' = \frac{104}{1 + 0.18B} B^2 I_t + \frac{1 - 0.11B}{1 - 0.71B} \varepsilon_t$$

Identify the delay and impact parameters from the model. Give Y_t' in its original form and give the presentation of the model (10 marks)