



Strathmore
UNIVERSITY

INSTITUTE OF MATHEMATICAL SCIENCES (IMS)
MASTER OF SCIENCE IN STATISTICAL SCIENCES
END OF SEMESTER EXAMINATION - MARKING GUIDE
STA 8203: TIME SERIES AND FORECASTING

DATE: 4th September 2020

Time: 3 Hours

Instructions

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

Question One

1.1. State three conditions of weak stationarity for a time series process in lay language?

(3 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).

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

1.4. Consider a model: $(1 - B)(1 - B^{12})(1 - 0.43B^{12})X_t = (1 + 0.22B)(1 + 0.88B^{12})w_t$. Identify different components of the model and write the ARIMA form of the model. **(5 marks)**

1.5. Explain the difference between autocorrelation function (ACF) and partial autocorrelation function (PACF) and state their use in time series analysis

(4 marks)

Question Two

2.1. Consider first-order moving average process of the form $Y_t = \varepsilon_t + 0.75\varepsilon_{t-1}$, where ε_t is a white noise series distributed with mean zero and constant variance $\delta_\varepsilon^2 = 0.12$. Determine the autocorrelation at lag 1, $\rho(1)$

(6 marks)

2.2. State four major steps of developing ARMA (p, q) model and explain each step.

(4 marks)

2.3. The following parameter estimates were computed for seasonal ARIMA model based on the original data. Use the results to answer the questions that follow.

```
ele.arima<-arima(eletricity, order=c(1,0,0), seasonal = list(order=c(2,1,0), period =12))
```

Parameter	Estimate	Std. error
AR (1)	0.2856	0.0642
SAR (1)	-0.8598	0.0639
SAR (2)	-0.2963	0.0667

(a) Write the presented autoregressive model in the form of ARIMA (p, d, q) (P, D, Q) s

(4 marks)

(b) Write down an explicit expression for the fitted model

(6marks)

Question Three

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

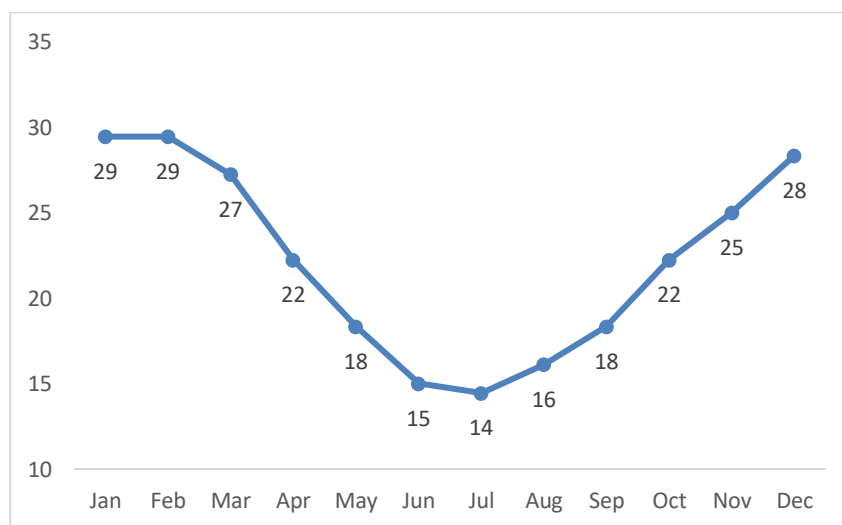
3.2 The following cosine function can be used to model the seasonal pattern that might exist in the data.

$$f(t) = \alpha \times \cos[(\omega t) - \theta]$$

Show how the model can be represented by both sine and cosine.

(5 marks)

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



Question Four

4.1 Let a time series process

$$X_t = \begin{cases} Y_t & \text{if } t \text{ is even} \\ Y_t + 1, & \text{if } t \text{ is odd} \end{cases}$$

Where Y_t is a stationary time series, is X_t stationary? Justify your answer **(5 marks)**

4.2 Consider a random walk with a drift

$$Y_t = \delta + Y_{t-1} + W_t$$

For $t=1, 2, 3, \dots$ and $Y_0 = 0$ and W_t is a white noise with variance σ_w^2

- a) Is Y_t stationary process? **(5 marks)**
- b) Suggest a transformation to make the series stationary and prove that the transformed series is stationary. **(10 marks)**