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REDEEMER'S UNIVERSITY

PMB 230 Ede, Osun State, Nigeria



FACULTY:	Natural Sciences
DEPARTMENT:	Mathematical Sciences
COURSE CODE /TITLE:	STA 413/ Time Series
COURSE UNIT:	3 unit
SESSION/SEMESTER:	2020/2021 /First Semester
INSTRUCTIONS:	Attempt any Four questions
TIME ALLOWED	2½hrs

Question One

- (a). State the two types of Time Series Models.
- (b). Sixteen successive observations of a given time series are as follows: 1.2, 0.6, 0.8, 1.6, 0.8, 1.2, 0.5, 0.9, 1.1, 1.1, 0.6, 1.5, 0.8, 0.9, 1.2, and 0.5.
- Obtain the time-plot of the observation.
 - Calculate r_1 and r_2 .

Question Two

- (a). Suppose $Y_t = 5 + 2t + X_t$, where $\{X_t\}$ is a zero-mean stationary series with ACF γ_k ,
- Find the mean function for $\{Y_t\}$.
 - Find the Autocorrelation function (ACF) for $\{Y_t\}$.
 - Is $\{Y_t\}$ Stationary? Why or why not?
- (b). State three properties of duality between autoregressive and moving average processes.
- (c). If $X_t = (a + b_t)S_t + e_t$ where a, b, are constants, $S_t = S_{t12}$ and e_t is a white noise process. Show that $\nabla_{12}^2 X_t$ is a stationary process.

Question Three

- (a). Define Correlogram and state three of its main components.
- (b). The data below shows the quarterly sales for ShopRite shop in Ibadan for the years 2015 to 2020. The sales are reported in million's of naira. Determine a quarterly seasonal index using the ratio-to-moving-average method.

Years	Quarters			
	1	2	3	4
2015	6.7	4.6	10.0	12.7
2016	6.5	4.6	9.8	13.6
2017	6.9	5.0	10.4	14.1
2018	7.0	5.5	10.8	15.0
2019	7.1	5.7	11.1	14.5
2020	8.0	6.2	11.4	14.9

Question Four

- (a). Define the following terms:
- (i). Discrete time series (ii). Continuous time series.
- (b). Give a simple equation to show how a time series may be represented by
- (i). an additive decomposition (ii). a multiplicative decomposition
- (c). The sales of Alayande Foods, a small grocery chain located in Oluyole extension Ibadan, since 2011 to 2020 are:

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Sales	7	10	9	11	13	12	15	18	17	21

Fit a linear regression to the data and forecast sales in 2021.

Question Five

- (a). State three main components into which a time series is usually decomposed for analysis. Explain what each component represents.
- (b). Show that the second order AR process:

$X_t = \frac{3}{4}X_{t-1} - \frac{1}{8}X_{t-2} + \varepsilon_t$ is stationary. Hence or otherwise, show that the autocorrelation function is given by $\rho_k = \frac{17}{21}\left(\frac{1}{2}\right)^{|k|} + \frac{4}{21}\left(\frac{1}{4}\right)^{|k|}$

Question Six

- (a). Describe, in details, steps in forecasting ARIMA models.
- (b). Consider an AR process of order 2, i.e AR(2): $X_t = \phi_1 X_{t-1} + \phi_2 X_{t-2} + \varepsilon_t$
- (i). State the stationary condition of X_t .
- (ii). Obtain the estimate of ρ_1 and ρ_2