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RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B.Sc. (General) Degree
Third Year - Semester I Examination – September / October 2019

MAT 3208 – TIME SERIES

Time: 02 hours

- **Answer All Questions.**
- **Calculators will be provided.**

1.

a) Define a time series. Explain its main components. **(20 marks)**

b) What are the advantages and disadvantages of the graphical method and least square method in trend analysis? **(20 marks)**

c) The production data on mobile phones in a factory during the past 8 years are given below:

Year	2010	2011	2012	2013	2014	2015	2016	2017
Production (in '000 units)	80	90	92	83	94	99	92	104

i. Fit a straight line trend and tabulate the trend values.

ii. Plot the actual and trend values on the graph.

iii. What is the expected production in the year 2020 on the basis of trend?

(60 marks)

Continued

2.

a) Define weak- stationarity of a time series. **(10 marks)**

b) Write down the properties of the Auto Correlation Function. **(10 marks)**

c) Give an example of a non-stationary process.
(Make sure to state the property of the process that varies through time)
(10 marks)

d)

i. Find Auto Correlation Function (ACF) for MA (1) process.

ii. Suppose x is $\rho(1)$ and θ_1 is a real number. Using the answer obtained in Part(i), show that: $x\theta_1^2 - \theta_1 + x = 0$.

Find MA(q) representation for the stationary process with acf

$$\rho(h) = \begin{cases} 1 & \text{if } h = 0, \\ 0.3 & \text{if } |h| = 1, \\ 0 & \text{if } |h| > 1. \end{cases}$$

(70 marks)

3.

a) State the required conditions for the stationarity and invertibility in relation to an ARMA(p,q)) process. **(20 marks)**

b) Define the term *causality*. **(05 marks)**

c) Consider the second order AR process : $x_t = 0.8x_{t-1} + Z_t$, where $Z_t \sim WN(0,\sigma^2)$.

Determine whether the model is causal or not. **(15 marks)**

d) Consider the process $x_t = x_{t-1} + \frac{1}{4}Z_{t-1} + Z_t$, where Z_t is a white noise process.

i. Express the model in B (Backward shift operator) notation.

ii. Is the process invertible?

Continued

iii. Is the process stationary?

iv. Is the first difference of the process, $y_t = x_t - x_{t-1}$ stationary?

(60 marks)

4.

a) Distinguish between Moving Average Method and Semi Average Method. **(10 marks)**

b) Measure the trend by the **Method of Semi Averages** by using the table given below. Also write the equation of the trend line with **1984-1985** taken as the origin.

Years	Profit in Million
1984-1985	18.6
1985-1986	22.6
1986-1987	38.1
1987-1988	40.9
1988-1989	41.4
1989-1990	40.1
1990-1991	46.60
1991-1992	60.7
1992-1993	57.2
1993-1994	53.4

(60 marks)

b)

i. Find the Yule-Walker equations for the AR(2) process :

$$X_t = \frac{1}{3}X_{t-1} + \frac{2}{9}X_{t-2} + \epsilon_t.$$

(Hint : $\rho_k = A\lambda^k$)

Continued

ii. Hence, show that it has Autocorrelation Function :

$$\rho_k = \frac{16}{21}\left(\frac{2}{3}\right)^{|k|} + \frac{5}{21}\left(-\frac{1}{3}\right)^{|k|}, \text{ where } k \in Z.$$

(30 marks)

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