[This question paper contains 2 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 2043 **L**

Unique Paper Code : 2372012403

Name of the Paper : Time Series Analysis

Name of the Course : **B.Sc. (Honours) Statistics, NEP-UGCF**

Semester : IV

Duration : 3 Hours Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **five** questions in all.
3. Use of a non-programmable scientific Calculator is allowed.

1. (a) Define the concept of trend in a time series. Describe the various methods used to estimate the trend. Discuss the merits and demerits of each method.

   (b) What are seasonal fluctuations in time series data? Compare the ratio-to-trend and ratio-to-moving-average methods for measuring seasonal indices, clearly stating their assumptions, advantages, and limitations.

(9,9)

2. A polynomial of degree $p = 2n$ is fitted to $m = 2k + 1$ consecutive points in a time series. Obtain the normal equations for estimating the trend value.
   (i) Show that the trend value corresponding to the $(k + 1)$th point of the set can be obtained as a weighted average of the observed values. How does the fact that the weights are independent of the part of the series taken utilized in estimating the trend?
   (ii) Show that the formula obtained in (i) is good enough for estimating trend when $p = 2n + 1$.
   (iii) Further, if $p = 2$ and $k = 6$, obtain the formula [13,2].

(18)

3. (a) Explain the cyclical component of a time series. Describe the method of periodogram analysis. Discuss the relationship between periodogram and correlogram.

   (b) Suppose a time series $\{y_t\}$ consists of trend, cyclical (oscillatory), and random components. Discuss the impact of removing the trend component on the remaining components of the series.

(9,9)

P.T.O.

4. (a) Explain the concept of stationarity in time series analysis. Distinguish between strict stationarity and weak (second-order) stationarity, with suitable examples.

   (b) Define an autoregressive process of order p, $AR(p)$. Derive and discuss the stationarity conditions for an $AR(1)$ model.

(9,9)

5. (a) Express the parameters of an autoregressive process of order p in terms of its autocorrelation function (ACF). Show that for the model
   $y_t = \phi_1 y_{t-1} + \epsilon_t$;
   $\phi_1 = \rho_1$, and ρ_1 is the lag-1 autocorrelation coefficient.

   (b) For each of the following models:

   (i) $y_t = 0.3\, y_{t-1} + \epsilon_t$
   (ii) $y_t = \epsilon_t - 1.3\, \epsilon_{t-1} + 0.4\, \epsilon_{t-2}$
   (iii) $y_t = 0.5\, y_{t-1} + \epsilon_t - 1.3\, \epsilon_{t-1} + 0.4\, \epsilon_{t-2}$

   Express each model using the backshift operator B. Determine whether each model is stationary and/or invertible.

(9,9)

6. (a) State the basic principles of forecasting in time series analysis. Describe the exponential smoothing technique and explain how it is used for forecasting.

   (b) Define a non-stationary time series. What does the "I" component represent in an ARIMA model?
   For the SARIMA $(0,0,1) \times (1,1,0)_{12}$ model, find forecasts at time N for up to 12 steps ahead in terms of observations and estimated residuals up to time N.

(9,9)

7 Write short notes on any three of the following:

   (a) Estimation of Seasonal variation under changing patterns
   (b) Variate difference method
   (c) Non-linear Time Series Models
   (d) Box–Jenkins Approach to Forecasting

(6,6,6)

(1000)