Unique Paper Code : 32377905

Name of the Paper : Time Series Analysis (DSE-1(i))

Name of the Course : B.Sc. (Hons.) Statistics under CBCS

Semester : V

Duration : 3 hours

Maximum Marks : 75 Marks

Instruction for Candidates

Attempt any *four* questions. All questions carry equal marks. Use of a calculator is allowed.

1. State the conditions under which the Moving Average method can be recommended for trend analysis? How will you determine the period of the moving average? Calculate the 4-yearly moving average of the following data relating to sales in a departmental store:

Year	2000	2001	2002	2003	2004	2005	2006	2007
Sales (in crores of Rs.)	960	976	974	996	1024	1040	1688	1128

Year	2008	2009	2010	2011	2012	2013	2014	2015
Sales (in crores of Rs.)	1144	1120	1140	1168	1196	1212	1200	1180

Further show that centered moving average values of period 4 are same as the weighted moving average value of period 5 with weights 1,2,2,2,1.

2. Explain what is meant by seasonal fluctuations of a time series. A company manufactures bicycles. Given the quarterly production figures of the company for the last 4 years, explain

the procedure to compute seasonal indices by the 'link relatives' method. Use link- relatives method to compute seasonal indices from the recorded production figures given below:

YEAR	Q1	Q2	Q3	Q4
2016	420	414	502	365
2017	491	456	516	337
2018	463	365	478	310
2019	502	487	536	404

3. Describe the method for the estimation of the variance of the random component of a time series. For large samples, how will you check for the homogeneity of two successive estimates of variances? If ε_t is a random series, show that the correlation between successive items of $\Delta^k \varepsilon_t$ for long series is $\frac{-k}{k+1}$ and hence tends to -1 as k increases.

4. Explain what is meant by a weakly (or second-order) stationary process and define the autocorrelation function, ρ_u for such a process. Show that the ac.f of the stationary second order AR process

$$X_t = \frac{1}{12}X_{t-1} + \frac{1}{12}X_{t-2} + Z_t$$

is given by

$$\rho_k = \frac{45}{77}\left(\frac{1}{3}\right)^{|k|} + \frac{32}{77}\left(-\frac{1}{4}\right)^{|k|} ; k = 0, \pm 1, \pm 2, \ldots$$

Under what conditions is a second order MA process stationary?

5. Explain clearly the steps involved in Box-Jenkins approach to forecasting. For the model $(1-B)(1-0.2B)y_t = (1-0.5B)\varepsilon_t$ classify the model as an $ARIMA(p,d,q)$ process. Determine whether the process is stationary and invertible. Evaluate the first three ψ weights of the model when expressed as an $MA(\infty)$ model. For the given ARIMA model, find the forecasts for one- and two-steps-ahead and show that a recursive expression for forecasts three or more steps ahead is given by

$$\hat{y}_n(h) = 1.2\hat{y}_n(h-1) - 0.2\hat{y}_n(h-2)$$

6. When is Simple Exponential Smoothing procedure an optimal method to use? What values can the smoothing constant take on? What is the impact of various

values of the smoothing constant on the smoothed time series? The table below shows the temperature (degrees C), at 11 p.m., over the last ten days:

Day	1	2	3	4	5	6	7	8	9	10
Temperature	1.5	2.3	3.7	3.0	1.4	-1.3	-2.4	-3.7	-0.5	1.3

Calculate a three-day moving average forecast for the temperature at 11 p.m. on day 11? Apply exponential smoothing with a smoothing constant of 0.8 to derive a forecast for the temperature at 11 p.m. Which of the two forecasts for the temperature at 11 p.m. on day 11 do you prefer and why?