U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

January / February 2025 Semester End Main Examinations

Programme: B.E. **Semester: V**

Branch: CSE(DS)/AI & DS **Duration: 3 hrs.**

Course Code: 23DS5PCTSA **Max Marks: 100**

Course: Time Series Analysis

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

			UNIT - I	*CO*	*PO*	Marks
1	a)		Explain decomposition of time series and elaborate on types of decomposition of times series data with appropriate mathematical equations.	*CO1*	*PO 1*	**5**
	b)		Compare and contrast at least two database applications supporting time series data. Also list out advantages and disadvantages of the same.	*CO2*	*PO2*	**5**
	c)		A time series is composed of several components that capture different patterns in the data. I. Describe the key components of a time series. II. Provide an example in R to illustrate each component. III. Explain how they can be identified in a given time series dataset. IV. write an R script to decompose a time series dataset into its components.	*CO1, CO2*	*PO1, PO2, PO3*	**10**
			OR			
2	a)		Consider a time series of the number of visitors to a park over 10 days: X = {45, 47, 46, 48, 50, 52, 51, 53, 54, 55}. I. Calculate the autocorrelation at lag 1 and lag 2. II. Highlight the role of autocorrelation in identifying trends and seasonality, and explain what the calculated values suggest about visitor patterns.	*CO2*	*PO2*	**5**
	b)		Explain the concept of stationarity in time series analysis, Discuss its importance in modeling, Describe key features that help identify a stationary time series.	*CO1*	*PO1*	**5**
	c)		Compare and contrast the graphic method and the semi-averages method for measuring the trend in a time series. For each method, discuss the advantages and disadvantages in terms of their accuracy, ease of use, and applicability to real-world datasets.	*CO2*	*PO1, PO2*	**10**

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<tr><td></td><td></td><td></td><td>UNIT - II</td><td></td><td></td><td></td></tr>
<tr><td></td><td>3</td><td>a)</td><td>Analyze and interpret an ergodic time series and how it differs from a stationary series. Discuss the significance of the variance function in a stationary time series model.</td><td>CO2</td><td>PO2, PO4</td><td>5</td></tr>
<tr><td></td><td></td><td>b)</td><td>Using the AirPassengers dataset in R, plot a correlogram and interpret the results. Highlight any observed patterns, such as seasonality or trends, based on the autocorrelation at different lags.</td><td>CO2</td><td>PO2</td><td>5</td></tr>
<tr><td></td><td></td><td>c)</td><td>The table below shows monthly sales data (in thousands of units) for a product over three years:
<table>
<tr><th>Month</th><th>Year 1</th><th>Year 2</th><th>Year 3</th></tr>
<tr><td>January</td><td>18</td><td>22</td><td>24</td></tr>
<tr><td>February</td><td>20</td><td>23</td><td>25</td></tr>
<tr><td>March</td><td>25</td><td>30</td><td>33</td></tr>
<tr><td>April</td><td>27</td><td>32</td><td>35</td></tr>
<tr><td>May</td><td>30</td><td>35</td><td>38</td></tr>
<tr><td>June</td><td>35</td><td>40</td><td>42</td></tr>
</table>
I. Using the ratio-to-trend method, calculate the seasonal indices for each month based on the provided sales data.
II. Based on the seasonal indices, discuss any observable seasonal patterns across the months.
III. Analyze which months exhibit higher or lower sales and explain the potential reasons behind these seasonal variations.</td><td>CO3</td><td>PO2, PO4</td><td>10</td></tr>
<tr><td></td><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td></td><td>4</td><td>a)</td><td>Elaborate on the Methods for Measuring Cyclical Variations.</td><td>CO2</td><td>PO2</td><td>5</td></tr>
<tr><td></td><td></td><td>b)</td><td>Compare and contrast seasonal variations and cyclical fluctuations. How would you measure secular trend in any given data?</td><td>CO2</td><td>PO2</td><td>5</td></tr>
<tr><td></td><td></td><td>c)</td><td>Calculate the seasonal indices using the ratio to moving average method for the following data:
<table>
<tr><th>Year</th><th>1st Quarter</th><th>2nd Quarter</th><th>3rd Quarter</th><th>4th Quarter</th></tr>
<tr><td>2005</td><td>68</td><td>62</td><td>61</td><td>63</td></tr>
<tr><td>2006</td><td>65</td><td>58</td><td>66</td><td>61</td></tr>
<tr><td>2007</td><td>68</td><td>63</td><td>63</td><td>67</td></tr>
</table></td><td>CO2</td><td>PO2</td><td>10</td></tr>
<tr><td></td><td></td><td></td><td>UNIT - III</td><td></td><td></td><td></td></tr>
<tr><td></td><td>5</td><td>a)</td><td>Interpret the Possible Errors in Construction of Cost-of-Living Index Numbers. Elaborate on approaches in forecasting strategies with examples in R.</td><td>CO2</td><td>PO2</td><td>10</td></tr>
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<table>
<tr><td></td><td></td><td>b)</td><td>Calculate the chain index number with 2015 prices as the base year using the following data for average wholesale prices of commodities X, Y, and Z from 2015 to 2018:
<table><tr><th>Commodity</th><th>2015</th><th>2016</th><th>2017</th><th>2018</th></tr><tr><td>X</td><td>5</td><td>6</td><td>7</td><td>8</td></tr><tr><td>Y</td><td>12</td><td>14</td><td>16</td><td>18</td></tr><tr><td>Z</td><td>3</td><td>4</td><td>5</td><td>6</td></tr></table></td><td>CO3</td><td>PO2</td><td>10</td></tr>
<tr><td></td><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td></td><td>6</td><td>a)</td><td>Elaborate on the following with examples:
I. Exponential Smoothing
II. Holt-Winters method</td><td>CO2</td><td>PO2</td><td>10</td></tr>
<tr><td></td><td></td><td>b)</td><td>From the following data for the year 2020 with 2018 as the base year, compute the price index by supplying the weighted average of price method using:
I. Arithmetic mean
II. Geometric mean
<table><tr><th>Commodity</th><th>Weights</th><th>Price in 2018 (Rs.)</th><th>Price in 2020 (Rs.)</th></tr><tr><td>X</td><td>60</td><td>15</td><td>20</td></tr><tr><td>Y</td><td>25</td><td>8</td><td>12</td></tr><tr><td>Z</td><td>15</td><td>5</td><td>10</td></tr></table></td><td>CO3</td><td>PO2</td><td>10</td></tr>
<tr><td></td><td></td><td></td><td>UNIT - IV</td><td></td><td></td><td></td></tr>
<tr><td></td><td>7</td><td>a)</td><td>Derive the mean and variance of a random walk process.</td><td>CO2</td><td>PO2</td><td>10</td></tr>
<tr><td></td><td></td><td>b)</td><td>Identify and address practical challenges in analyzing any given time series dataset. Suggest methods to resolve missing data and detect trends using suitable examples.</td><td>CO2</td><td>PO2</td><td>10</td></tr>
<tr><td></td><td></td><td></td><td>OR</td><td></td><td></td><td></td></tr>
<tr><td></td><td>8</td><td>a)</td><td>Explain generalized least square (GLS) model and elaborate on steps in GLS Model in time series analysis. List out the Advantages of GLS.</td><td>CO1</td><td>PO1</td><td>10</td></tr>
<tr><td></td><td></td><td>b)</td><td>Elaborate on the methods used to transform a non-stationary series into a stationary series in time series analysis with suitable examples in R. Interpret the need for converting a non-stationary series to stationary series.</td><td>CO2</td><td>PO2</td><td>10</td></tr>
<tr><td></td><td></td><td></td><td>UNIT - V</td><td></td><td></td><td></td></tr>
<tr><td></td><td>9</td><td>a)</td><td>Explain how fitted MA models are used in time series forecasting with an example R Script.</td><td>CO1</td><td>PO1</td><td>5</td></tr>
<tr><td></td><td></td><td>b)</td><td>Provide a clear interpretation of partial autocorrelation in the context of time series analysis? Analyze its role in identifying AR terms in a time series.</td><td>CO2</td><td>PO2, PO4</td><td>5</td></tr>
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		c)	Elaborate on the process of building a non-seasonal ***ARIMA*** model. Interpret the steps involved in identifying the order of the ***ARIMA*** model?	*CO2*	*PO2*	**10**
			OR			
	10	a)	Analyze and interpret ***ARCH*** model and explain its application in financial time series data.	*CO2*	*PO2, PO4*	**5**
		b)	With proper justification interpret how ***GARCH*** extend the ***ARCH*** model.	*CO2*	*PO2*	**5**
		c)	Discuss how differential equations are used in time series analysis. Provide an example of how they model the behavior of time series processes.	*CO2*	*PO2*	**10**

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