U.S.N.										

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

Autonomous Institute Affiliated to VTU

June 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.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	*CO*	*PO*	Marks
1	a)	Summarize the following with example of and R Code: I. Smoothing. II. Decomposition of Time series data.	*CO2*	*PO 2*	**5**
	b)	Given a simple time series data-set with daily stock prices for 10 days: X = {120, 122, 119, 118, 121, 123, 124, 125, 126, 128}, I. Calculate the auto-correlation at lag 1 and lag 2. II. Explain the significance of auto-correlation in time series analysis and discuss how auto-correlation at these lags might inform predictions about stock price behavior.	*CO2*	*PO1, PO2*	**5**
	c)	Analyze and interpret on the following: I. Key components of Time series data with suitable examples for each. II. The process of decomposition in time series analysis. III. With clear justification using R on how the decomposition is applied to any time series dataset.	*CO2*	*PO2*	**10**
		OR			
2	a)	With proper justification interpret the main objective of time series analysis and elaborate on the nature of times series.	*CO2*	*PO1*	**5**
	b)	A data-set of monthly rainfall (in mm) for the past 10 months is provided: X = {78, 82, 80, 79, 85, 90, 87, 88, 92, 95}. I. Determine the auto-correlation coefficients at lag 1 and lag 2.	*CO2*	*PO2*	**5**

<table>
<tr><td></td><td></td><td></td><td>II. Explain the importance of auto-correlation in forecasting, and interpret how the identified patterns at these lags could be used to predict future rainfall.</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td>c)</td><td>Explain 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.</td><td>CO1</td><td>PO1, PO2</td><td>10</td></tr>
<tr><td></td><td></td><td></td><td>UNIT - II</td><td></td><td></td><td></td></tr>
<tr><td>3</td><td></td><td>a)</td><td>Briefly describe the relative merits and demerits of the ratio to trend and ratio to moving average methods.</td><td>CO1</td><td>PO1</td><td>5</td></tr>
<tr><td></td><td></td><td>b)</td><td>Discuss the following methods in time series analysis:
I. The method of simple averages and its application.
II. The ratio-to-trend method and its application.</td><td>CO2</td><td>PO2</td><td>5</td></tr>
<tr><td></td><td></td><td>c)</td><td>Using the Link Relative method to calculate the seasonal indices for the following data:
<table>
<tr><th>Quarter</th><th>2015</th><th>2016</th><th>2017</th><th>2018</th><th>2019</th></tr>
<tr><td>I</td><td>5.6</td><td>5.8</td><td>6.2</td><td>6.4</td><td>6.1</td></tr>
<tr><td>II</td><td>6.4</td><td>6.7</td><td>6.9</td><td>7.0</td><td>7.2</td></tr>
<tr><td>III</td><td>7.3</td><td>7.6</td><td>7.9</td><td>8.1</td><td>8.0</td></tr>
<tr><td>IV</td><td>8.0</td><td>8.1</td><td>8.3</td><td>8.6</td><td>8.5</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>4</td><td></td><td>a)</td><td>Briefly describe the relative merits and demerits of the ratio to trend and ratio to moving average methods.</td><td>CO1</td><td>PO1</td><td>5</td></tr>
<tr><td></td><td></td><td>b)</td><td>With an example interpret de-seasonalization and elaborate on models used for the same with examples.</td><td>CO2</td><td>PO1</td><td>5</td></tr>
<tr><td></td><td></td><td>c)</td><td>Consider the following quarterly sales data (in thousands of units) for a product over two years:
<table>
<tr><td>Quarter</td><td>Year 1</td><td>Year 2</td></tr>
<tr><td>Q1</td><td>120</td><td>125</td></tr>
<tr><td>Q2</td><td>150</td><td>155</td></tr>
<tr><td>Q3</td><td>170</td><td>175</td></tr>
<tr><td>Q4</td><td>200</td><td>205</td></tr>
</table>
I. Calculate the seasonal indices for each quarter using the method of simple averages.
II. Based on the calculated seasonal indices, discuss the trends in production levels across quarters.
III. Evaluate the effectiveness of the simple averages method for identifying seasonality patterns in this dataset.</td><td>CO3</td><td>3</td><td>10</td></tr>
</table>

<table>
<tr><td></td><td></td><td></td><td colspan="3">UNIT - III</td><td></td><td></td><td></td></tr>
<tr><td></td><td>5</td><td>a)</td><td>Explain the key forecasting methods used for time series data that account for trends and seasonality, and how they differ in their approach?</td><td></td><td></td><td>CO1</td><td>PO1</td><td>5</td></tr>
<tr><td></td><td></td><td>b)</td><td>Analyze and interpret the significance and uses of cost-of-living index numbers.</td><td></td><td></td><td>CO2</td><td>PO2, PO4</td><td>5</td></tr>
<tr><td></td><td></td><td>c)</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></td><td></td><td>CO3</td><td>PO2</td><td>10</td></tr>
<tr><td></td><td></td><td></td><td colspan="3">OR</td><td></td><td></td><td></td></tr>
<tr><td></td><td>6</td><td>a)</td><td>With clear justification interpret the shortcomings of Laspeyres and Paasche indices with examples for each.</td><td></td><td></td><td>CO2</td><td>PO1, PO2</td><td>5</td></tr>
<tr><td></td><td></td><td>b)</td><td>Summarize aggregate expenditure method and elaborate on the steps involved in calculating the Consumer Price Index using the Aggregate Expenditure Method.</td><td></td><td></td><td>CO2</td><td>PO2</td><td>5</td></tr>
<tr><td></td><td></td><td>c)</td><td>From the following data for the year 2023 with 2019 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 2019 (Rs.)</th><th>Price in 2023 (Rs.)</th></tr>
<tr><td>A</td><td>45</td><td>12</td><td>14</td></tr>
<tr><td>B</td><td>35</td><td>6</td><td>8</td></tr>
<tr><td>C</td><td>15</td><td>10</td><td>13</td></tr>
<tr><td>D</td><td>5</td><td>20</td><td>25</td></tr>
</table></td><td></td><td></td><td>CO3</td><td>PO2, PO4</td><td>10</td></tr>
<tr><td></td><td></td><td></td><td colspan="3">UNIT - IV</td><td></td><td></td><td></td></tr>
<tr><td></td><td>7</td><td>a)</td><td>Provide a clear interpretation of white noise in the context of time series analysis. Elaborate on Second-Order Properties of White Noise.</td><td></td><td></td><td>CO2</td><td>PO1</td><td>5</td></tr>
<tr><td></td><td></td><td>b)</td><td>Analyze the significance of diagnostic plots, and how are they used in time series modeling?</td><td></td><td></td><td>CO2</td><td>PO2, PO4</td><td>5</td></tr>
</table>

		c)	Given any time series data with a drift component, fit a random walk with a drift model and interpret the results with ACF Plots.	*CO3*	*PO2*	**10**
			OR			
	8	a)	Differentiate between stationary and non-stationary autoregressive processes with examples.	*CO2*	*PO2*	**5**
		b)	How would you conduct exploratory data analysis (EDA) for a time series dataset? Provide a brief outline.	*CO3*	*PO2*	**5**
		c)	Apply the concepts of stochastic trends and deterministic trends to classify components of a given time series dataset.	*CO3*	*PO2*	**10**
			UNIT - V			
	9	a)	Interpret the ***ARIMA*** model with its components and briefly describe each.	*CO2*	*PO1, PO2*	**5**
		b)	Compare and contrast stationary and non-stationary time series. Provide an example of each.	*CO2*	*PO2*	**5**
		c)	Define the autocorrelation function (***ACF***) and partial autocorrelation function (***PACF***). Discuss how they are used to identify the order of **AR** and **MA** models.	*CO2*	*PO2*	**10**
			OR			
	10	a)	Analyze and interpret partial autocorrelation and its role in identifying AR terms in a time series.	*CO2*	*PO2, PO4*	**5**
		b)	Write an R example to fit a ***non-seasonal ARIMA*** model to any times series datasets.	*CO3*	*PO2*	**5**
		c)	Outline the procedure for forecasting using an ***ARIMA*** model. Discuss how parameter estimation is carried out in ***ARIMA*** models	*CO2*	*PO2*	**10**

****