**Course: Time Series Analysis**

**Course code: 21VBB7D501**

**Answer any 4 of the following questions (5M x 4Q = 20)**

**SET 1 - Questions**

| **Sl. No.** | **QUESTION** | **UNIT No.** | **CO MAPPING** | **BTL** |
| --- | --- | --- | --- | --- |
| 1 | You are an analyst at a retail company. Your manager has asked you to analyze the sales trends.  Based on your understanding of time series analysis, describe how you would apply univariate analysis to identify trends in sales data.  **(No need to use any data)** | 1 | CO1 | 3 |
| 2 | You are working for a logistics company and need to forecast future trends.  Describe the steps you would take to preprocess and forecast the time series data. How would you ensure the accuracy of your forecast? | 2 | CO1 | 3 |
| 3 | You are analyzing data to identify seasonal patterns.  Explain how you would apply the classical decomposition model to the data to identify and interpret seasonal patterns. | 3 | CO2 | 3 |
| 4 | A supply chain manager needs to forecast future trends.  Apply simple forecasting techniques such as naive forecasting and moving average forecasting to estimate future trends. Discuss the pros and cons of each technique.   | | **Month** | **Sales** | | --- | --- |  | Jan 2023 | 120 | | --- | --- |  | Feb 2023 | 135 | | --- | --- |  | Mar 2023 | 150 | | --- | --- |  | Apr 2023 | 160 | | --- | --- |  | May 2023 | 145 | | --- | --- |  | Jun 2023 | 155 | | --- | --- |  | Jul 2023 | 170 | | --- | --- |  | Aug 2023 | 165 | | --- | --- |  | Sep 2023 | 180 | | --- | --- |  | Oct 2023 | 175 | | --- | --- |  | Nov 2023 | 190 | | --- | --- |  | Dec 2023 | 200 | | --- | --- | | | **Month** | **Sales** | | --- | --- |  | Jan 2023 | 120 | | --- | --- |  | Feb 2023 | 135 | | --- | --- |  | Mar 2023 | 150 | | --- | --- |  | Apr 2023 | 160 | | --- | --- |  | May 2023 | 145 | | --- | --- |  | Jun 2023 | 155 | | --- | --- |  | Jul 2023 | 170 | | --- | --- |  | Aug 2023 | 165 | | --- | --- |  | Sep 2023 | 180 | | --- | --- |  | Oct 2023 | 175 | | --- | --- |  | Nov 2023 | 190 | | --- | --- |  | Dec 2023 | 200 | | --- | --- | | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | 4 | CO2 | 5 |
| 5 | A company is using decomposition-based forecasting to predict future trends.  Describe how you would implement forecasting with decomposition to estimate future trends. What specific steps would you take to ensure the accuracy of your forecast? | 5 | CO3 | 3 |
| 6 | You are developing a custom forecasting solution for a healthcare organization to predict patient admissions.  Create a detailed implementation plan for a decomposition-based forecasting algorithm in Python. Outline the steps, tools, and techniques you would use and justify your approach for ensuring accurate and reliable forecasts. | 6 | CO3 | 6 |

**SET 2 – Questions**

| **Sl. No.** | **QUESTION** | **UNIT No.** | **CO MAPPING** | **BTL** |
| --- | --- | --- | --- | --- |
| 1 | A financial analyst is tasked with examining the historical performance of a company.  Analyze the differences between univariate and multivariate time series analysis in the context of performance analysis and explain which method would be more appropriate for this scenario. | 1 | CO1 | 4 |
| 2 | A marketing team wants to understand the impact of their campaigns over time.  Analyze the components of time series data that would be most relevant for assessing the impact of marketing campaigns. Justify your selection of components. | 2 | CO1 | 4 |
| 3 | A researcher is studying the effect of certain events on consumption patterns using historical data.  Analyze the differences between the additive and multiplicative decomposition models in this context. Which model would be more appropriate and why? | 3 | CO2 | 4 |
| 4 | A company is validating its forecasting models.  Evaluate the measures of forecast accuracy (e.g., MAE, RMSE) and their relevance in validating forecasting models. Which measure would you recommend and why? | 4 | CO2 | 5 |
| 5 | An economist is forecasting future trends using historical data and decomposition methods.  Analyze the benefits and challenges of using decomposition methods for forecasting. How would you address the challenges to improve forecast reliability? | 5 | CO3 | 4 |
| 6 | A climatologist is decomposing temperature data to study long-term climate trends.  Evaluate the strengths and weaknesses of using the additive model versus the multiplicative model for decomposing temperature data. Which model provides more meaningful insights and why? | 6 | CO3 | 5 |

**SET 3 - Questions**

| **Sl. No.** | **QUESTION** | **UNIT No.** | **CO MAPPING** | **BTL** |
| --- | --- | --- | --- | --- |
| 1 | An economist is studying economic growth patterns using historical data.  Evaluate the different types of time series data and their applications in economic growth analysis. Which type of data would provide the most accurate insights and why? | 1 | CO1 | 6 |
| 2 | You are developing a new forecasting model for an e-commerce company.  Create a detailed process for forecasting, including the steps for preprocessing, identifying components of the time series, and ensuring the robustness of your forecast. | 2 | CO1 | 6 |
| 3 | A forecasting team is using time series decomposition to improve their predictions.  Evaluate the effectiveness of STL decomposition compared to classical decomposition models in improving forecast accuracy. Provide examples to support your evaluation. | 3 | CO2 | 5 |
| 4 | A financial analyst is tasked with forecasting future earnings for a company.  Analyze the factors to consider when choosing a forecast range and the implications of different forecast ranges on the accuracy of predictions. | 4 | CO2 | 4 |
| 5 | You are creating a new forecasting algorithm for a fintech company.  Develop a detailed plan for implementing and validating a decomposition-based forecasting algorithm. Explain your approach and how it enhances the accuracy and robustness of predictions. | 5 | CO3 | 6 |
| 6 | You are designing a new software tool for time series decomposition tailored to the needs of small businesses.  Create a conceptual framework for your software tool, detailing the decomposition methods it would include and how it would help businesses analyze their time series data effectively. | 6 | CO3 | 6 |

**SET 4 - Questions**

| **Sl. No.** | **QUESTION** | **UNIT No.** | **CO MAPPING** | **BTL** |
| --- | --- | --- | --- | --- |
| 1 | Explain the concept of forecasting in time series analysis. Why is forecasting important in business and economics? Discuss different types of data and how time series analysis can be applied in various industries. | 1 | CO1 | 3 |
| 2 | Analyse the steps involved in forecasting time series data. Explain the key components of time series data and the significance of pre-processing in time series analysis. | 2 | CO2 | 4 |
| 3 | Analyse the difference between the Additive and Multiplicative models of the classical decomposition method. Provide examples of when each model is used and how moving averages are integrated into the decomposition process. | 3 | CO2 | 4 |
| 4 | Evaluate the effectiveness of simple forecasting techniques such as Naive Forecasting, Average Forecasting, and Moving Average Forecasting. How can model validation be performed, and what are the key measures of forecast accuracy? | 4 | CO3 | 5 |
| 5 | Analyze the importance of autocorrelation and partial autocorrelation in time series analysis. How can autocorrelation plots help in identifying patterns in data, especially with seasonality? | 8 | CO3 | 4 |
| 6 | Explain the concept of exponential smoothing. Compare and contrast simple exponential, double exponential, and exponential smoothing with seasonality. Provide an example of when the Holt-Winters model should be used. | 6 | CO2 | 4 |

**SET 5 - Questions**

| **Sl. No.** | **QUESTION** | **UNIT No.** | **CO MAPPING** | **BTL** |
| --- | --- | --- | --- | --- |
| 1 | Evaluate the effectiveness of univariate and multivariate time series analysis in predicting future trends. How do these methods impact decision-making in industries like finance and retail? | 1 | CO1 | 5 |
| 2 | Analyze the key rules for time series forecasting and how pre-processing affects the accuracy of forecasts. What are the implications of neglecting pre-processing steps on the forecast outcome? | 2 | CO2 | 4 |
| 3 | Apply STL decomposition to a time series dataset. Evaluate its ability to handle complex seasonality patterns compared to classical decomposition models. | 3 | CO2 | 5 |
| 4 | Evaluate the role of model validation and forecast accuracy measures when using Naive, Average, and Moving Average techniques. How do these methods differ in terms of long-term forecast reliability? | 4 | CO3 | 5 |
| 5 | Apply decomposition-based forecasting in Python to predict sales for a business. Analyze the forecast accuracy and suggest improvements to the model. | 5 | CO3 | 6 |
| 6 | Analyze the influence of seasonality when using exponential smoothing techniques. How does the Holt-Winters model adjust for trends and seasonality in time series data? | 6 | CO2 | 4 |