

## **1. Introduction to Time Series Analysis**

Time series analysis involves methods for analyzing time series data to extract meaningful statistics and other characteristics. The primary goal is to predict future values based on previously observed values.

Key components

Trend: The long-term progression of the series.

Seasonality: Seasonal variations, or cyclical patterns.

Noise: Random variations in the data.

Stationarity: The property of a series whose statistical properties, such as mean and variance, are constant over time.

## **2. Model Selection Criteria**

The selection of an appropriate model for time series forecasting is crucial. The key criteria considered were:

Accuracy: The model should provide accurate forecasts.

Scalability: The model should handle large datasets efficiently.

Flexibility: The model should adapt to different patterns in the data, including trends and seasonality.

Ease of Use: The model should be easy to implement and interpret.

## **3. Evaluation of Time Series Models**

Several models were considered for this task, including:

ARIMA (AutoRegressive Integrated Moving Average): A widely used model for time series forecasting. It combines autoregression, differencing (to make the series stationary), and moving average.

SARIMA (Seasonal ARIMA): Extends ARIMA to handle seasonality.

Exponential Smoothing (ETS): Uses weighted averages of past observations for forecasting.

Prophet: Developed by Facebook, designed for forecasting time series data with daily observations that display patterns on different time scales.

## **4. Introduction to Prophet**

Prophet is an open-source tool developed by Facebook for producing high-quality forecasts for time series data. It is robust to missing data and shifts in the trend, and typically handles outliers well.

### **Features of Prophet:**

Automatic detection of change points: It automatically identifies points where the time series changes its behavior.

Handling seasonality: It can model daily, weekly, and yearly seasonality.

Incorporation of holidays: It allows users to include custom seasonal effects, like holidays.

Scalability: It can handle large datasets efficiently.

### **5. Why Prophet was Selected**

Given the nature of the dummy sales data, which likely includes seasonal effects (e.g., increased sales during holiday periods) and potential trend shifts (e.g., new product launches), Prophet was selected for the following reasons:

1. **Seasonality Handling:** Prophet excels in capturing daily, weekly, and yearly seasonality, making it suitable for sales data that may have such patterns.
2. **Automatic Change Point Detection:** The model's ability to detect changes in trends is beneficial for capturing shifts in sales patterns.
3. **Scalability and Robustness:** It is efficient with large datasets and robust to missing data and outliers, which are common in real-world sales data.
4. **Ease of Use:** Prophet's API is user-friendly, allowing for quick implementation and interpretation.