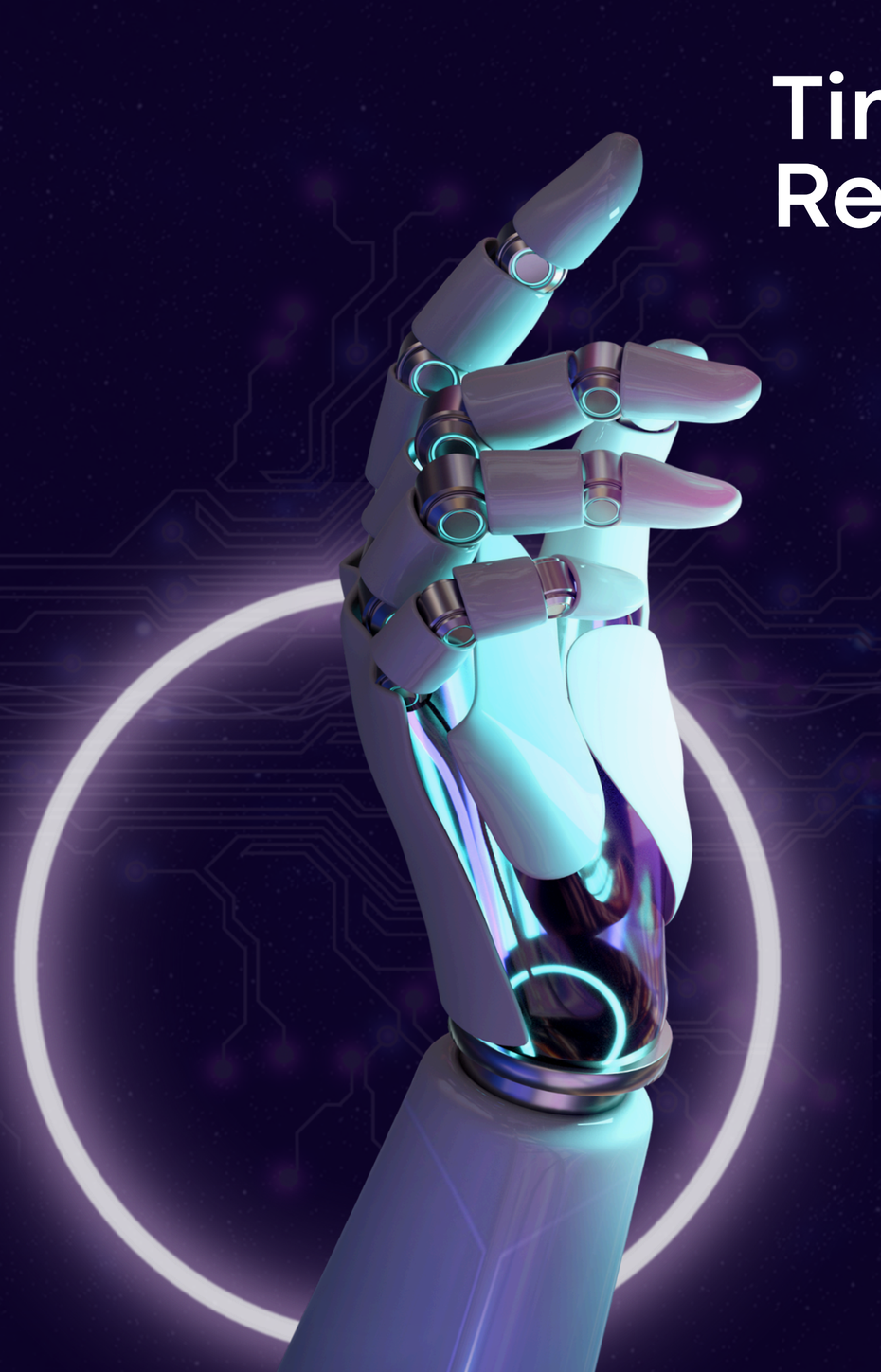
Demand Forcasting for Retail Store using Time series Technique

Problem Statement

Demand forecasting is a critical aspect of inventory management and operational planning in retail stores. Accurate demand forecasting helps in optimizing stock levels, reducing inventory costs, improving customer satisfaction by minimizing stockouts, and enhancing overall operational efficiency. This project aims to develop a robust demand forecasting model for a retail store using time series techniques. The model will predict future sales based on historical sales data, seasonal patterns, and other relevant factors.



Time Series verses Regression

In Simple Regression, the causal relationship between the response and Explanatory variable is significant but this is not very important in a time-series data.

In the time-series data, the sequence of the data is considered important because each data is dependent on the time instance.

Methodology

Data Collection

Gather relevant data from diverse sources.

Preprocessing

Clean, normalize, and engineer data.

Model Selection

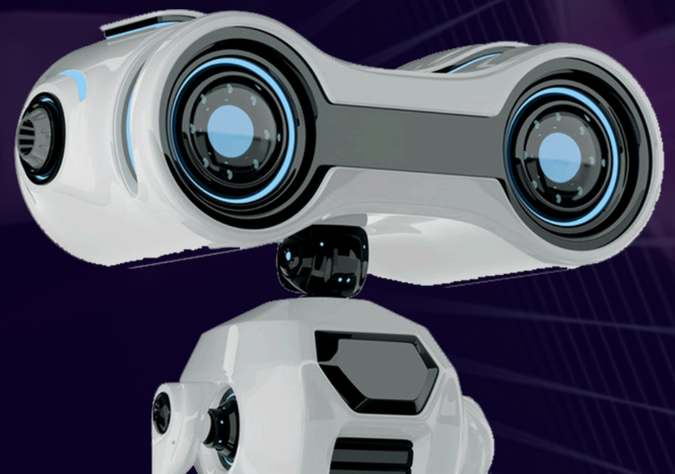
Choose and train ML/DL algorithms for peak performance.

Model Evaluation

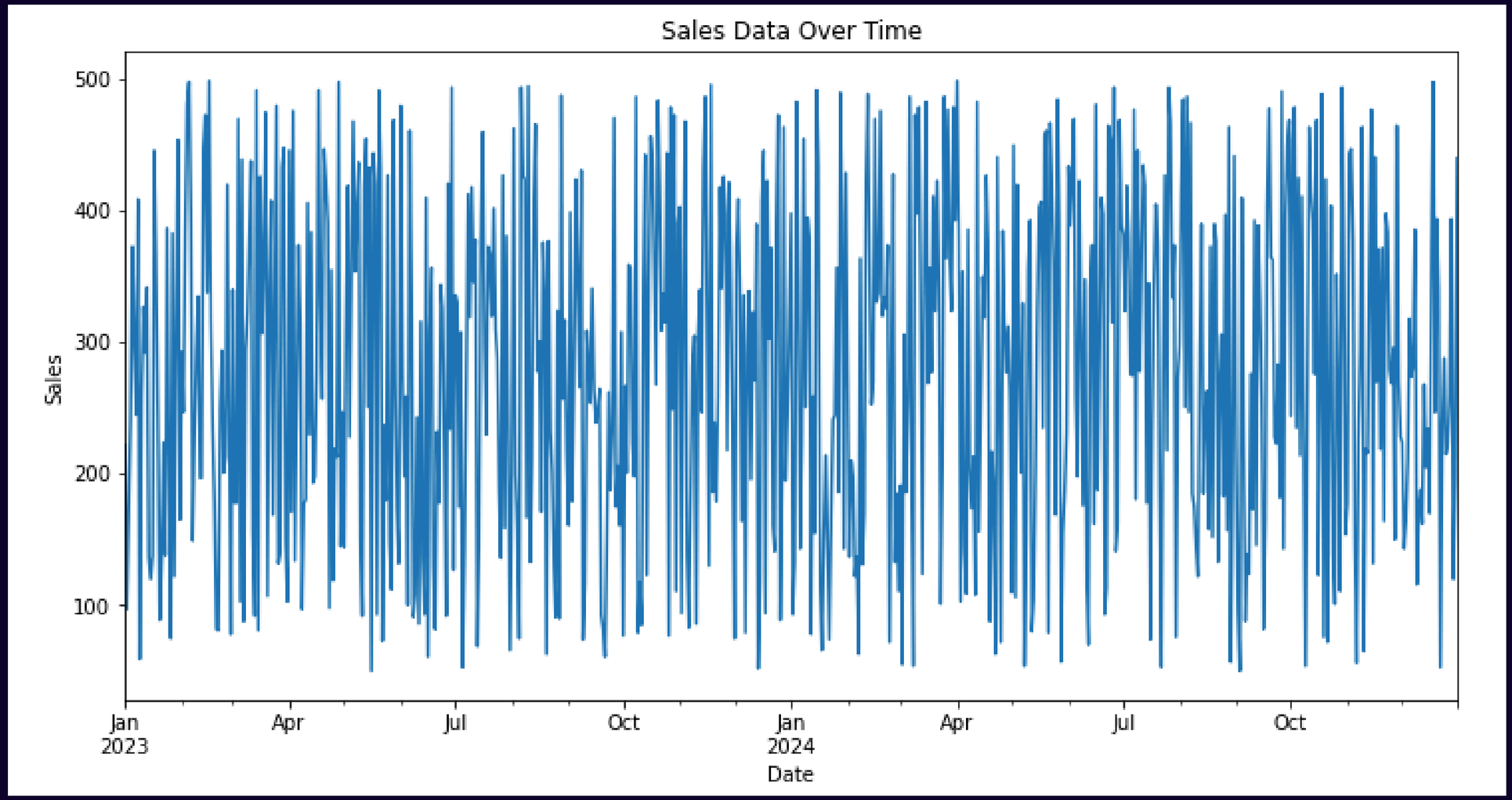
Based of diffrent Error parameters like RMSE and MAPE

Data Collection and Preprocessing

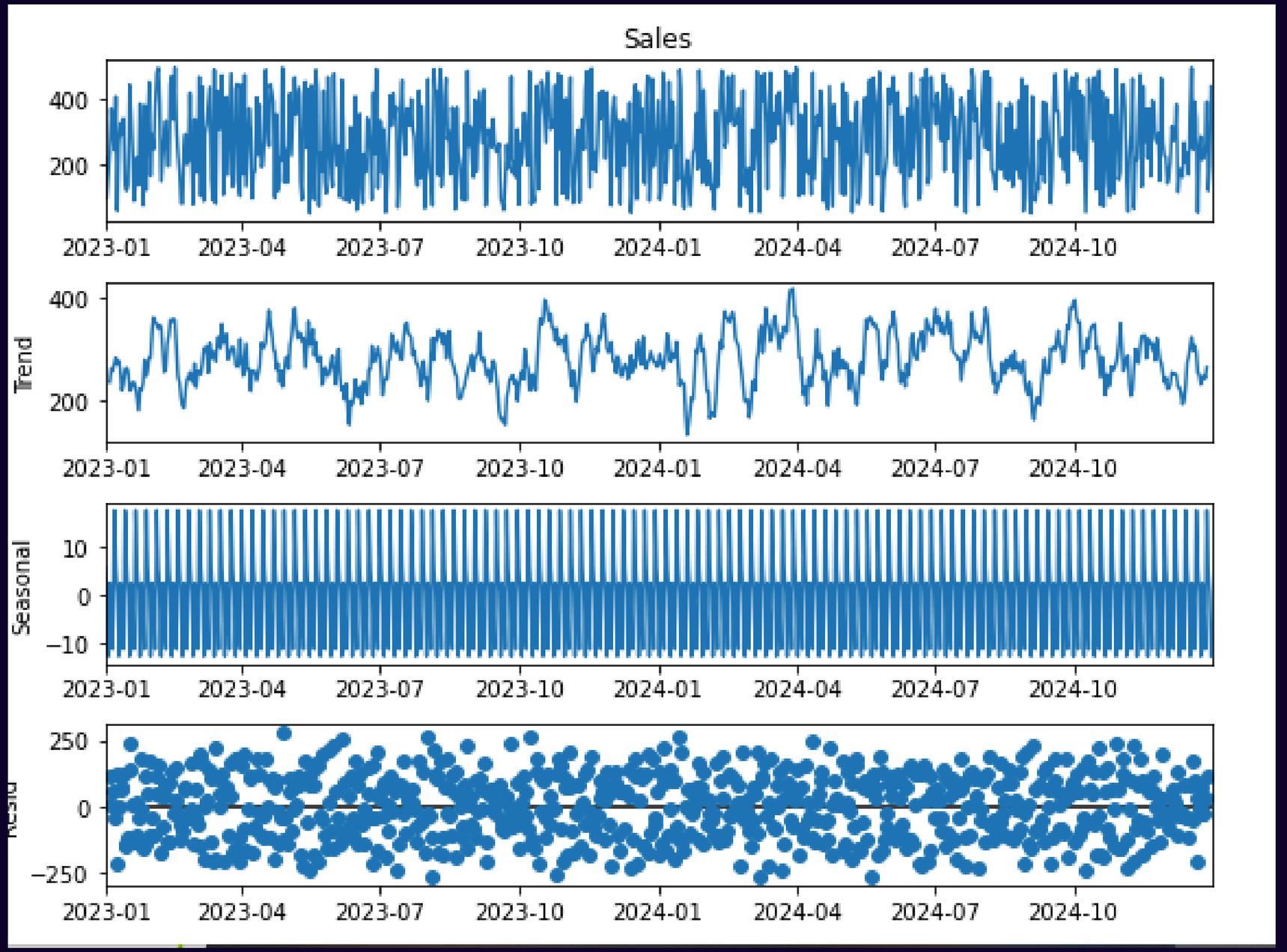
We gather relevant datasets from various sources and clean, normalize, and preprocess the data to ensure its quality and consistency which basically involves ,finding missing values and outlier treatment.This step is crucial for training accurate and reliable AI models.



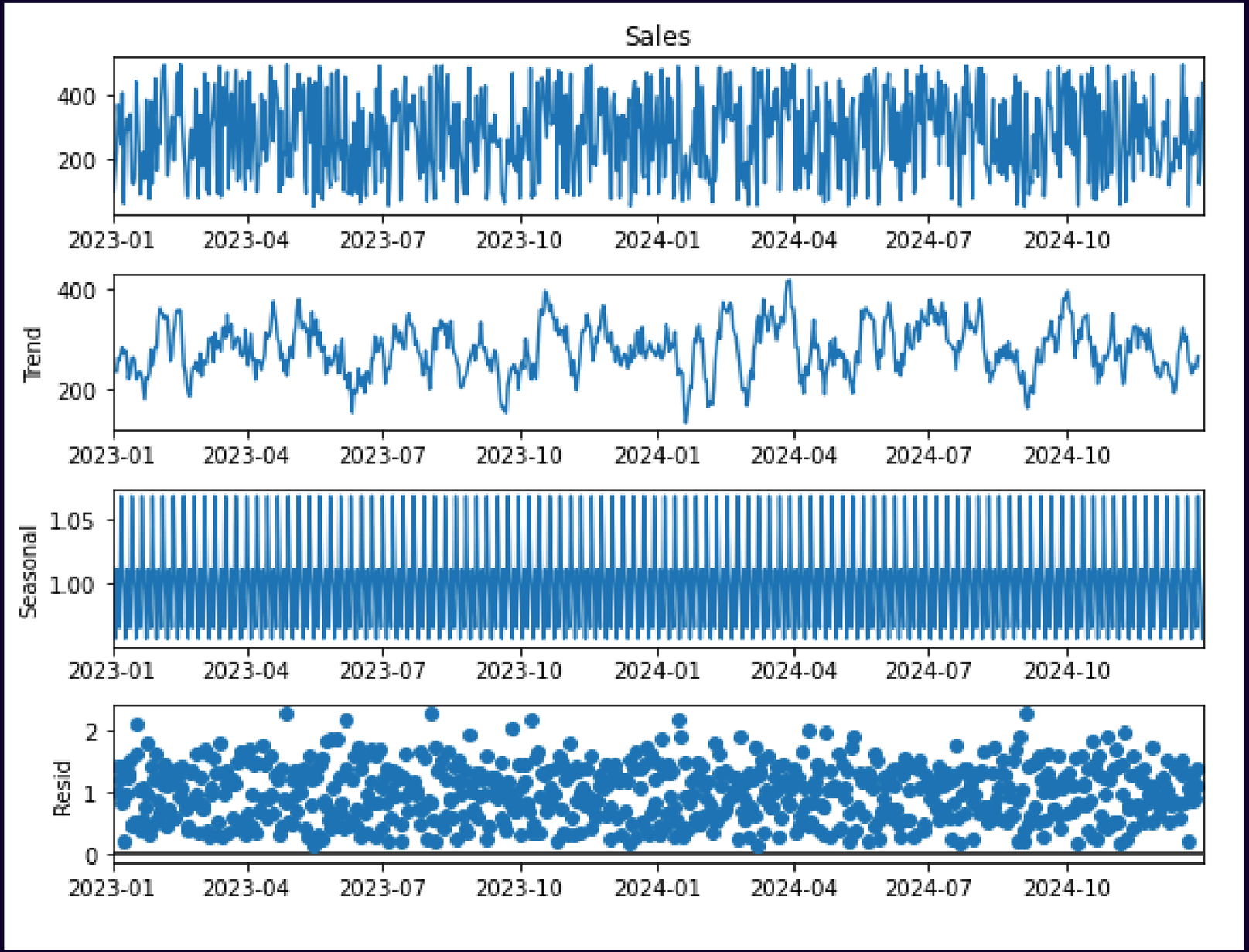
Data Preprocessing



Additive Seasonal Decomposition

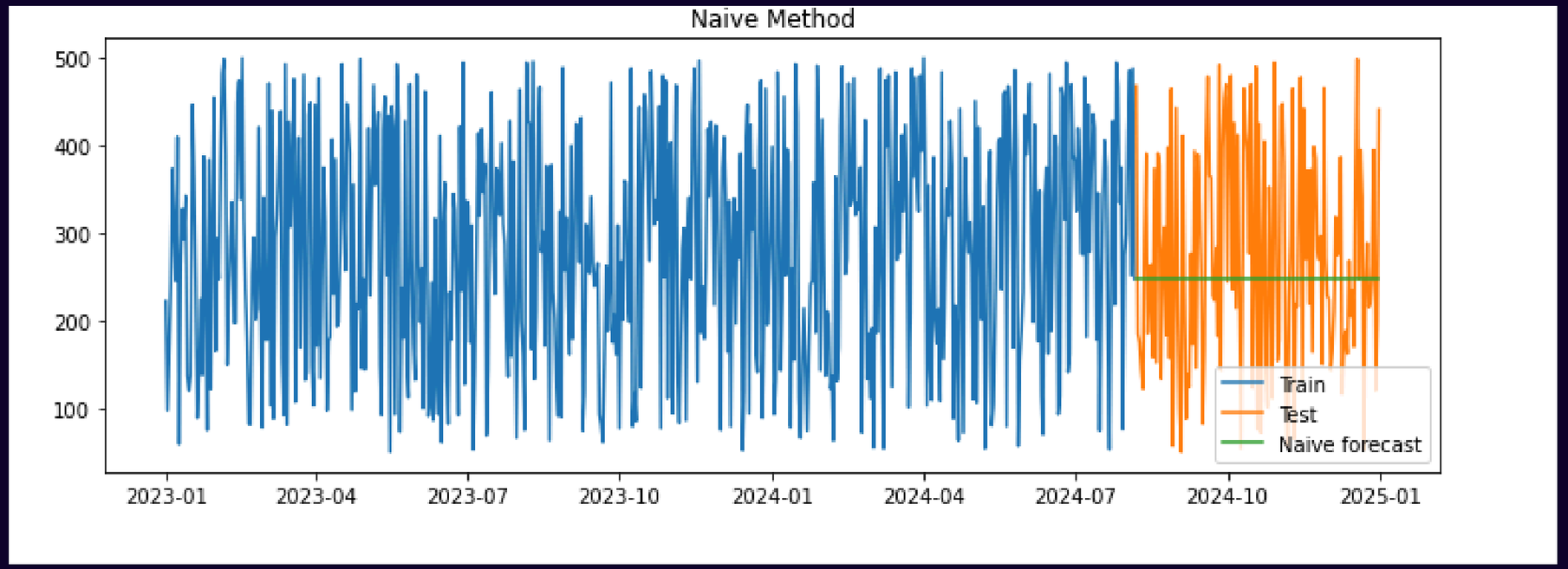


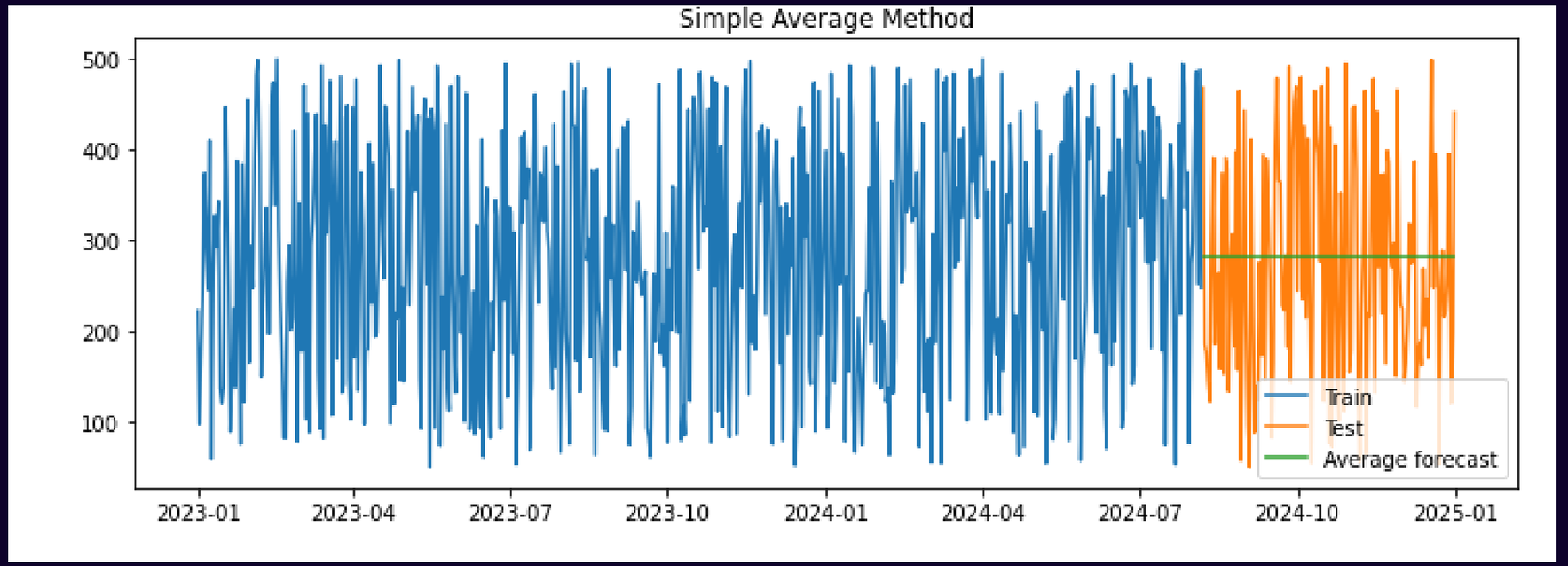
Multiplicative Seasonal Decomposition

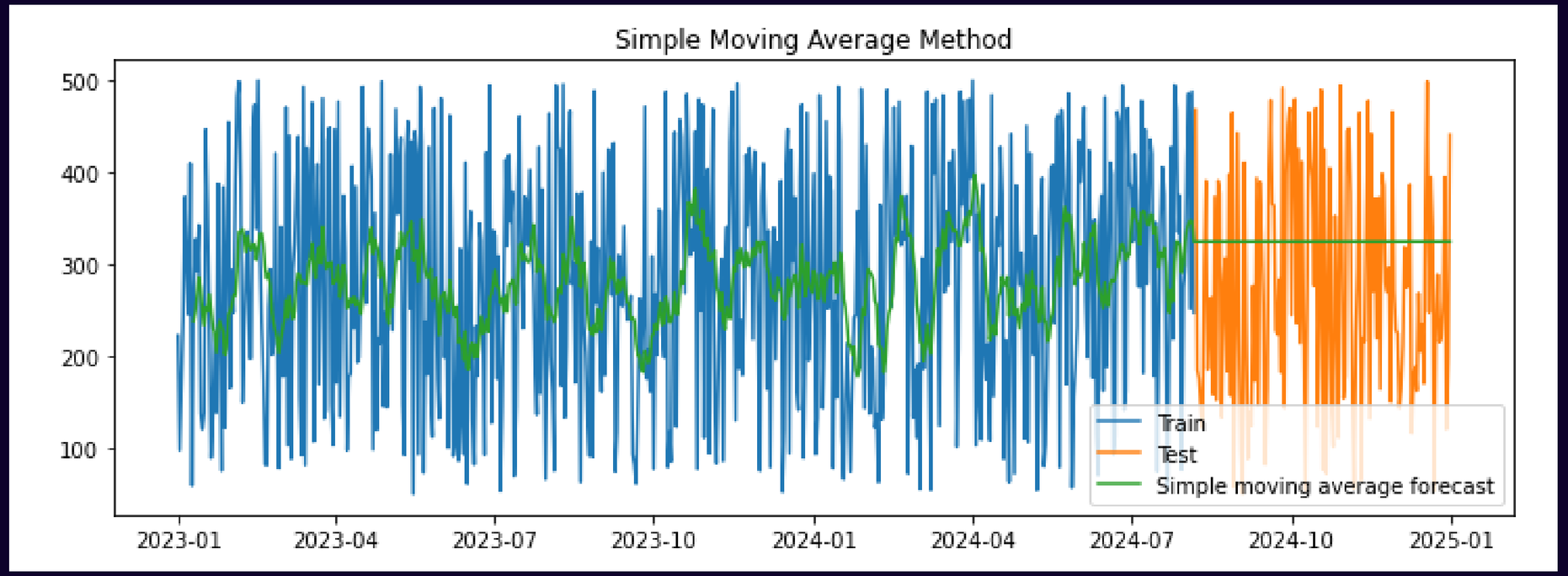


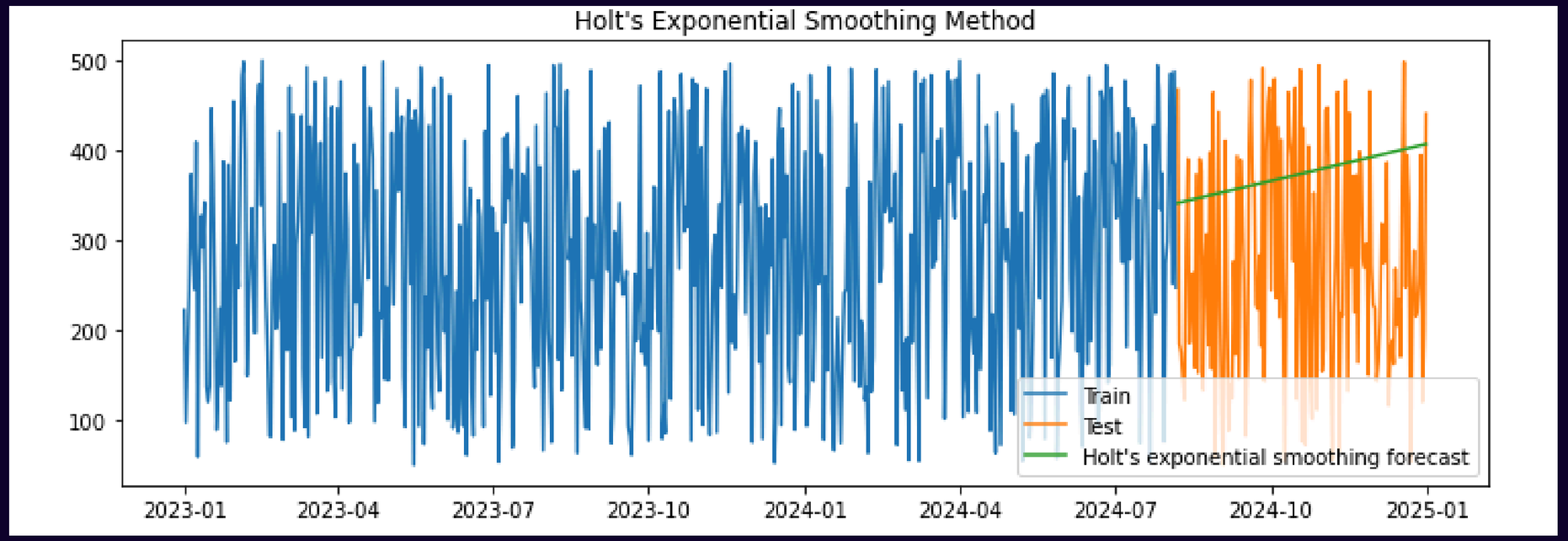
Model Development

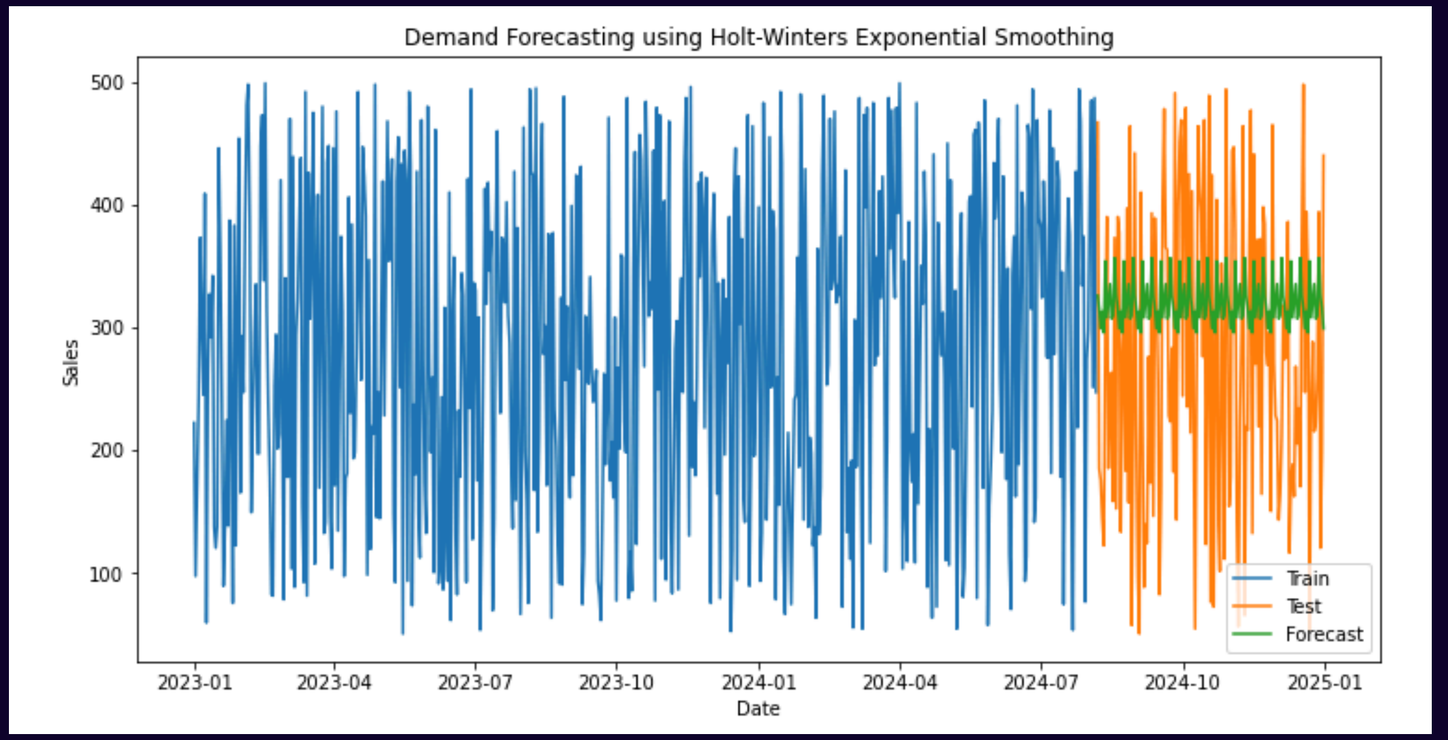
1. Simple Time Series Naive Method
2. Simple Average Method
3. Simple Moving Average
4. Exponential smoothing methods
5. Holt Winters' additive method with trend and seasonality

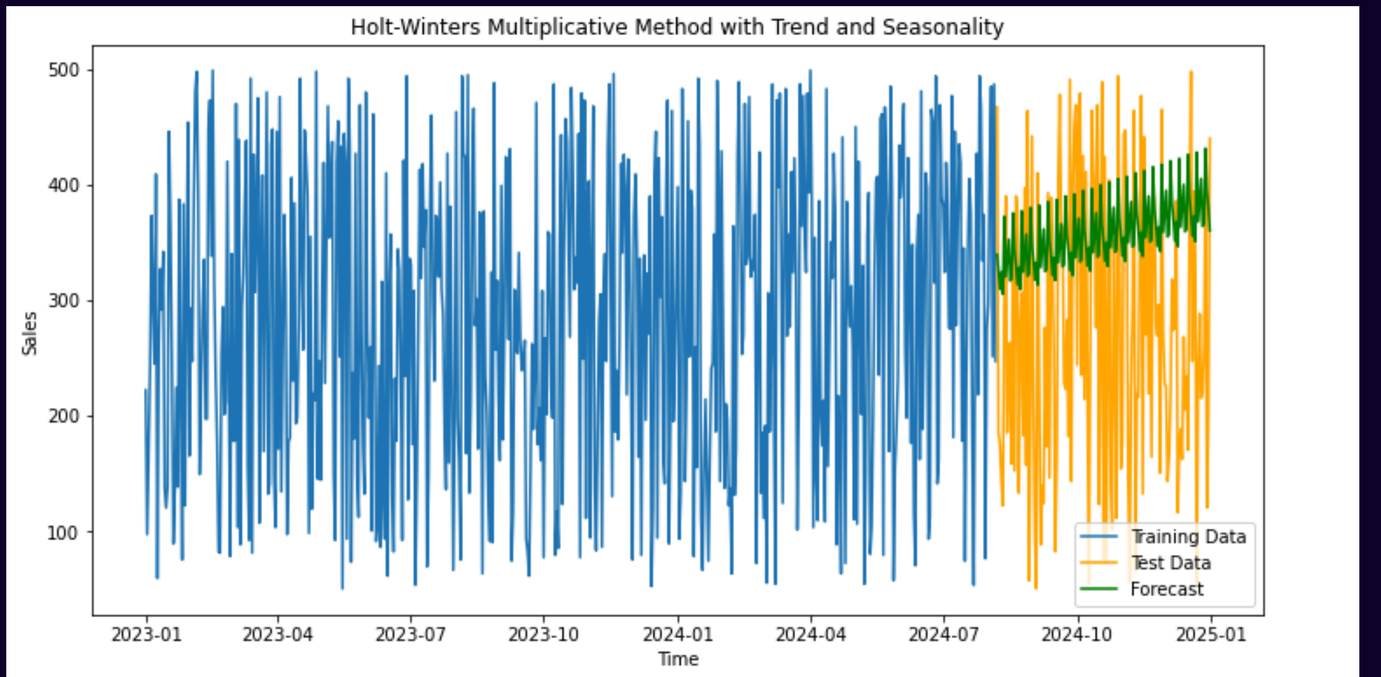

Naive Method
500
400
300
200
100
2023-01
2023-04
2023-07
2023-10
2024-01
2024-04
2024-07
2024-10
2025-01
Train
Test
Naive forecast


Simple Average Method
500
400
300
200
100
2023-01
2023-04
2023-07
2023-10
2024-01
2024-04
2024-07
2024-10
2025-01
Train
Test
Average forecast


Simple Moving Average Method
500
400
300
200
100
2023-01
2023-04
2023-07
2023-10
2024-01
2024-04
2024-07
2024-10
2025-01
Train
Test
Simple moving average forecast


Holt's Exponential Smoothing Method
500
400
300
200
100
2023-01
2023-04
2023-07
2023-10
2024-01
2024-04
2024-07
2024-10
2025-01
Train
Test
Holt's exponential smoothing forecast


Demand Forecasting using Holt-Winters Exponential Smoothing
Sales
Date
Train
Test
Forecast
500
400
300
200
100
2023-01
2023-04
2023-07
2023-10
2024-01
2024-04
2024-07
2024-10
2025-01


Holt-Winters Multiplicative Method with Trend and Seasonality
Sales
Time
Training Data
Test Data
Forecast
500
400
300
200
100
2023-01
2023-04
2023-07
2023-10
2024-01
2024-04
2024-07
2024-10
2025-01

Evaluation Metrics

We define appropriate metrics to assess the performance of our AI models, such as RMSE and MAPE. These metrics help us quantify the effectiveness of our solutions.

	Method	RMSE	MAPE
0	Naive method	127.03	54.85
0	Simple average method	124.54	62.83
0	Simple moving average forecast	134.34	76.21
0	Holt's exponential smoothing method	160.73	92.95

we found the best model is Holt Winters' additive method with trend and seasonality giving RMSE is 132.18 and MAPE is 74.086.


Thank You!