

Sales & Demand Forecasting using Machine Learning

1. Introduction

Sales forecasting plays a critical role in helping businesses make informed operational and financial decisions. Accurate demand predictions allow companies to optimize inventory, manage staffing levels, and plan budgets effectively.

This project focuses on building a machine learning model to forecast future sales using historical retail data. The objective is not only to generate predictions but also to present insights in a clear, business-friendly manner.

2. Problem Statement

Businesses need accurate sales forecasts to:

- Plan inventory levels
- Manage cash flow
- Schedule workforce efficiently
- Avoid overstocking or stock shortages

Without forecasting, companies may experience financial losses due to poor planning. This project aims to develop a predictive model that analyses historical sales data and forecasts future demand to support better business decision-making.

3. Dataset Overview

The dataset contains historical daily sales records, including:

- Date
- Store number
- Product family
- Sales amount
- Promotion information

The data spans multiple years, allowing the model to capture long-term trends and patterns.

4. Data Preparation & Feature Engineering

To prepare the dataset for forecasting, the following steps were performed:

- Converted the date column to datetime format
- Aggregated total daily sales
- Sorted data chronologically
- Created a time-based feature (Time index)
- Split the dataset into training and testing sets (last 90 days used for testing)

These steps ensured the data was properly structured for time-series forecasting.

5. Model Used

A **Linear Regression** model was applied to predict future sales trends.

Linear Regression was selected because:

- It effectively captures overall growth trends
- It is simple and interpretable
- It provides a strong baseline forecasting approach

Model Evaluation Metrics:

- **Mean Absolute Error (MAE):** 157,340
- **Root Mean Squared Error (RMSE):** 180,406

These values indicate that while the model does not perfectly capture daily fluctuations, it successfully models the overall sales trend.

6. Forecast Results

Sales Forecast vs Actual

The comparison between actual and predicted sales shows that:

- The model follows the general upward trend in sales
- Predictions remain reasonably close to actual values
- Some short-term variations are not perfectly captured

Future 30-Day Sales Forecast

The forecast indicates:

- A continuing upward sales trend
- Stable growth over the next 30 days
- Predictable demand behaviour based on historical patterns

This demonstrates that the model can be used for short-term business planning.

7. Business Impact & Applications

This forecasting model can help businesses in the following ways:

1. Inventory Planning

Ensures optimal stock levels, reducing both shortages and excess inventory.

2. Workforce Scheduling

Allows managers to plan staffing during peak and slow demand periods.

3. Budget & Revenue Forecasting

Helps estimate future income and manage working capital efficiently.

4. Marketing Strategy

Identifies slower sales periods where promotions or discounts can be applied.

8. Conclusion

This project demonstrates how Machine Learning can support real-world business decisions. By analysing historical sales data and applying a forecasting model, businesses can make proactive decisions instead of reactive ones.

The model captures overall sales growth effectively and provides actionable insights for short-term planning.

This solution reflects how data-driven forecasting improves operational efficiency and financial stability in modern businesses.