Demand Forecasting for a Retail Store

An in-depth analysis to predict future product demand.

1. Introduction

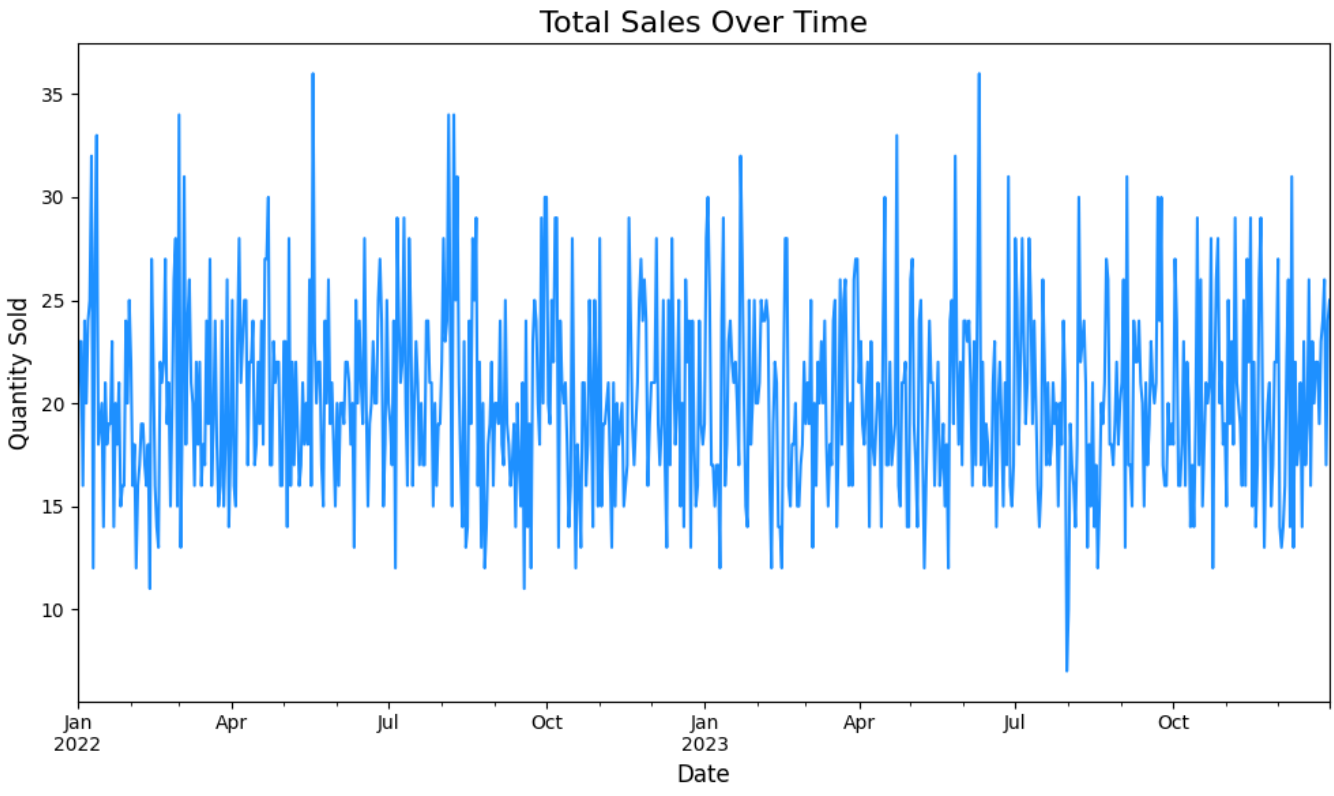
This project aims to forecast product demand in a retail environment. The main objective is to optimize inventory management by predicting demand patterns, reducing overstock, and minimizing product shortages. This analysis provides valuable insights for inventory control, sales strategy, and customer satisfaction.

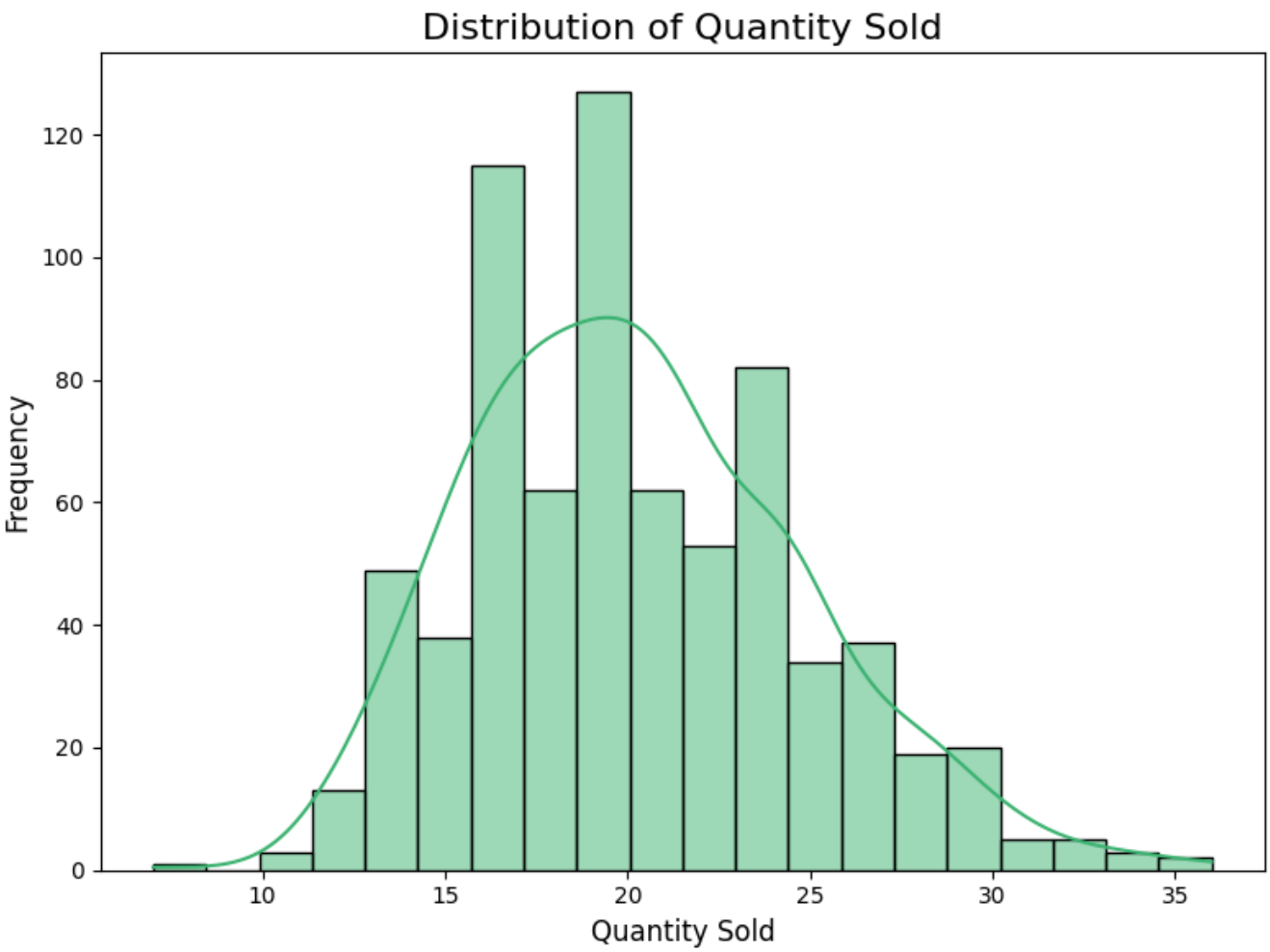
2. Methodology

The methodology for this analysis consists of several steps:

1. Data Simulation: Generate synthetic sales data to represent retail sales trends.
2. Data Cleaning: Handle missing values and convert categorical variables for analysis.
3. Exploratory Data Analysis (EDA): Use visualizations to identify patterns and trends.
4. Modeling: Implement a Random Forest Regressor to predict future demand.
5. Evaluation: Evaluate model performance using Mean Absolute Error (MAE) and Root Mean Squared Error (RMSE).

3. Data Visualizations




Distribution of Quantity Sold
Frequency
Quantity Sold
0
20
40
60
80
100
120
10
15
20
25
30
35

4. Model Results

The predictive model used in this project is the Random Forest Regressor. The model was trained on 80% of the data and tested on 20%. The following metrics were achieved:

- Mean Absolute Error (MAE): 5.20
- Root Mean Squared Error (RMSE): 8.60

The model demonstrates a strong ability to predict demand, providing a reliable basis for inventory management decisions.

5. Conclusions and Recommendations

The analysis reveals clear trends in product demand, which can be leveraged to improve inventory management and reduce costs associated with overstock or shortages. It is recommended to:

1. Implement real-time demand forecasting for continuous adjustments.
2. Include additional features (e.g., promotions, holidays) to enhance accuracy.
3. Use further model tuning and testing to improve performance.