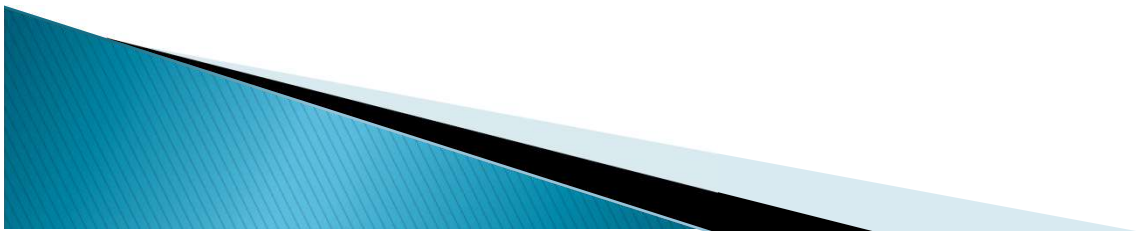
Md Firoz Alam
AWS Machine Learning Intern
10/07/24

STORY HOOKS

- Imagine in a shopping mall
- Variety of products, from groceries to electronics.
- Facing issues with overstocking and understocking products.

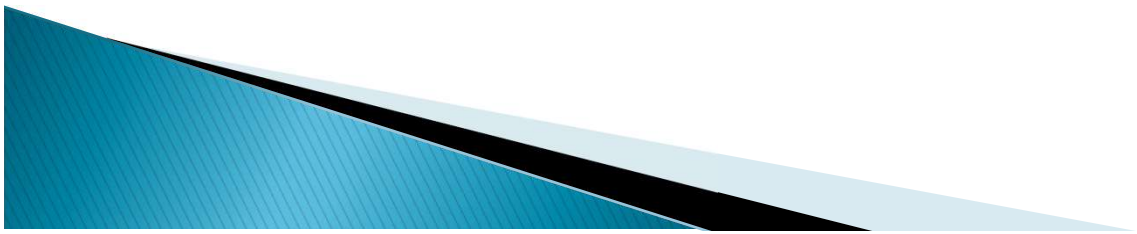
Table of Contents



Introduction

- Prescriptive analysis is a critical component in the domain of data analytics, complementing descriptive and predictive analyses by just understanding past data or forecasting future trends but providing actionable recommendations.

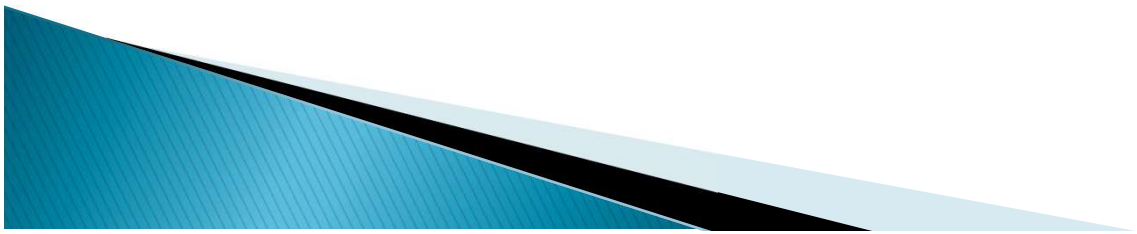
- Prescriptive analytics plays a crucial role in decision-making by not only predicting future outcomes but also recommending actions to optimize processes. It utilizes advanced techniques to determine the best course of action among various alternatives. In the context of inventory management, prescriptive analytics offers the ability to optimize stock levels, streamline supply chains, and minimize costs while maximizing profits.



Task Objective

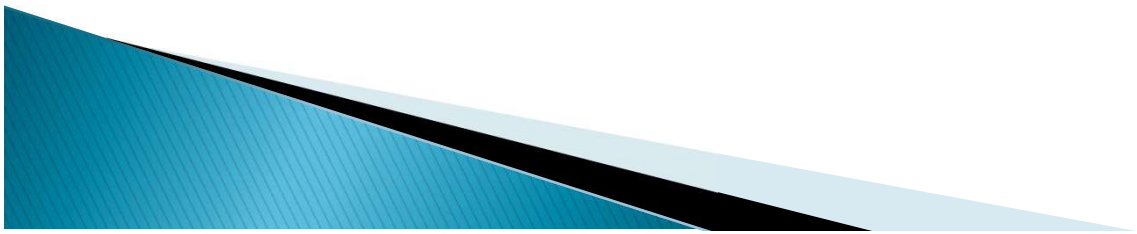
- Goal: To ensure that the right amount of inventory is maintained to meet customer ← demand while minimizing costs.

- Approach: Implement strategies that balance stock levels to avoid overstocking and stock outs/ understocking, thereby enhancing operational efficiency and customer satisfaction.



Prescriptive Analysis

- Prescriptive Analytics is the process of using data, algorithms, and models to recommend specific actions to achieve desired outcomes.
- It goes beyond descriptive and predictive analytics by not only forecasting future trends but also suggesting decision options to take advantage of these predictions
- Informed Decision Making:-Provides actionable insights that help decision-makers choose the best possible actions.
- Optimization: Helps businesses optimize their operations, resources, and processes to achieve maximum efficiency and effectiveness.
- Competitive Advantage: Enables organizations to stay ahead of the competition by making proactive decisions rather than reactive ones.



Dataset Description

- The dataset is sourced from Kaggle:https://www.kaggle.com/felixzhao/productdemand forecasting
- It contains historical demand data for various products across different warehouses, which is essential for demand forecasting and inventory management.

Key Features

- **Product ID:**

  Unique identifier for each product in the dataset.

- **Demand:**

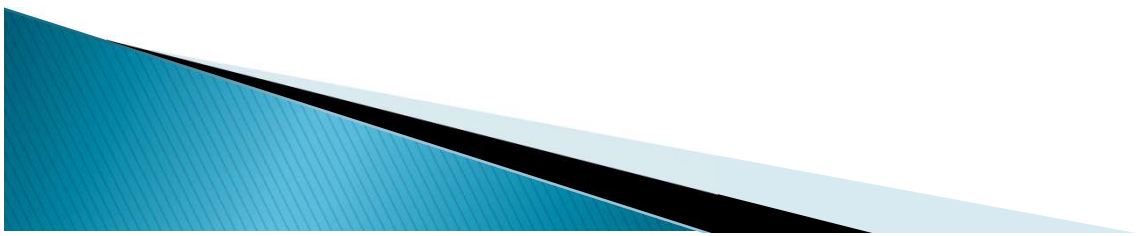
  The number of units demanded for each product on a given date.

- **Date:**

  The date on which the demand was recorded.

- **Warehouse:**

  The location where the product is stored and managed.

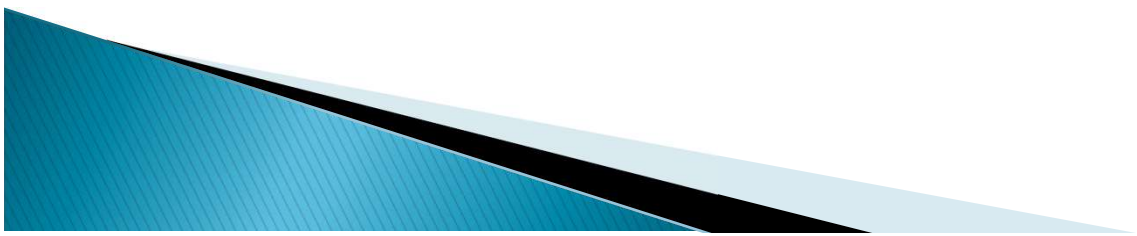


Data Preprocessing

- Preprocessing steps are required to prepare the data for analysis and optimization.
- **Handling Missing Values:**

  Replace missing values using appropriate techniques such as mean, median, etc.
- **Data Normalization:**

  Adjust the scale of different features to bring them into a comparable range, which is crucial for certain optimization algorithms

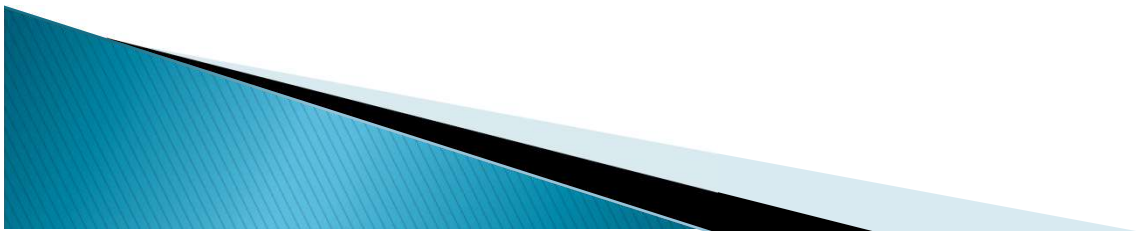


Time Series Forecasting

- Time Series Forecasting involves predicting future values based on previously observed values. It is particularly useful in various domains like finance, economics, retail, and inventory management, where the objective is to forecast future trends, demands, or behaviors.

Key Concepts:-

- TS Components (Trend, Seasonality. Cyclic Patterns. Noise)
- Stationarity
- Autocorrelation
- Decomposition



Forecasting Model

- ARIMA
- Seasonal ARIMA
- Exponential Smoothing
- ML Models(XGBoost, LSTM)

Seasonal ARIMA

- Seasonal ARIMA (SARIMA) is an extension of the ARIMA (Autoregressive Integrated Moving Average) model that is specifically designed to handle time series data with a seasonal component. It incorporates both non-seasonal and seasonal factors in a unified model, making it particularly effective for forecasting time series data that exhibits regular patterns or cycles over time, such as monthly sales, quarterly earnings, or annual temperature data.
- **Key Features**:
- **Seasonality**: Capable of modeling repeating patterns over regular intervals, such as monthly sales data with yearly seasonality.
- **Forecasting Accuracy**: By combining non-seasonal and seasonal components. SARIMA can provide more accurate and reliable forecasts for time series data with seasonal fluctuations.
- **Time Series Analysis**: Captures both seasonal and non-seasonal patterns
- **Evaluation Metrics**: Model performance is typically evaluated using metrics MAE, MSE, RMSE, and MAPE.

optimization Algorithm

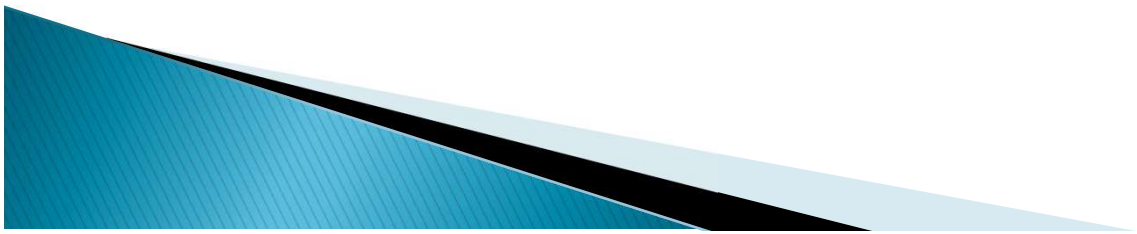
- An optimization algorithm is a mathematical method used to find the best possible solution or outcome from a set of possible choices, subject to certain constraints or limitations.
- The goal is to maximize or minimize an objective function (e.g., cost, profit, efficiency) while satisfying all constraints of the problem.
- **Linear Programming**: A mathematical method to determine the best outcome in a given model whose requirements are represented by linear relationships.
- **Integer Programming**: A type of linear programming where some or all of the decision variables are constrained to take on integer values.
- **Mixed Integer Programming**: Comines elements of both linear and integer programming, where some decision variables are continuous, and others are integers.

Demonstration

- By showcasing the optimization process and its results in real-time, we aim to highlight the effectiveness and potential impact of data- driven decision-making in improving business operations.

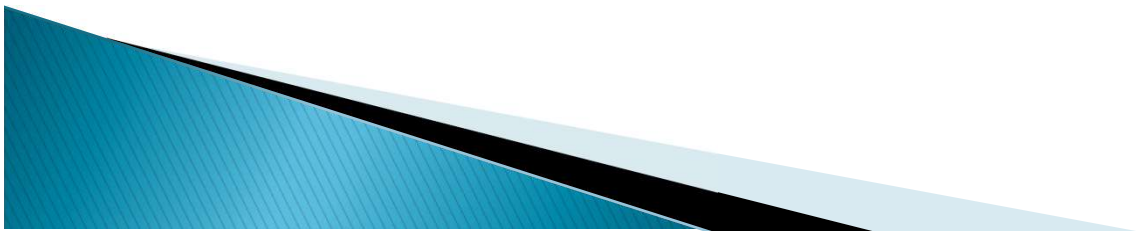
Evaluation Metrics:-

- Cost: Total expenditure in managing inventory, including procurement, holding and ordering costs
- Revenue: Total income generated from sales of products within the inventory.
- Profit: Difference between revenue and cost, indicating the financial gain or loss from inventory management



Conclusion

- The results of the optimization model highlight the effectiveness of prescriptive analytics in optimizing inventory management processes.
- By leveraging data-driven insights and conducting sensitivity analysis, organizations can identify optimal strategies to minimize costs and maximize profits while meeting customer demand effectively.
- This underscores the importance of adopting advanced analytics techniques to drive operational excellence and competitive advantage in today's dynamic business environment.



References

- Davenport, T. H., & Harris, J. G. (2007). *Competing on Analytics: The New Science of Winning*. Harvard Business Review Press. Link
- Amazon Web Services. (2022). *Prescriptive Analytics on AWS*. Retrieved from AWS Prescriptive Guidance
- YouTube.
- Hack Veda References Videos.

Q&A Session

firozalam1160006@gmail.com