



# Product Demand Analysis

Predicting product demand is crucial to optimize inventory management and production planning for businesses. Our project uses machine learning models to forecast product demand based on historical sales data.

# Problem Statement

## Goal

Create a machine learning model that forecasts product demand based on historical sales and external factors.

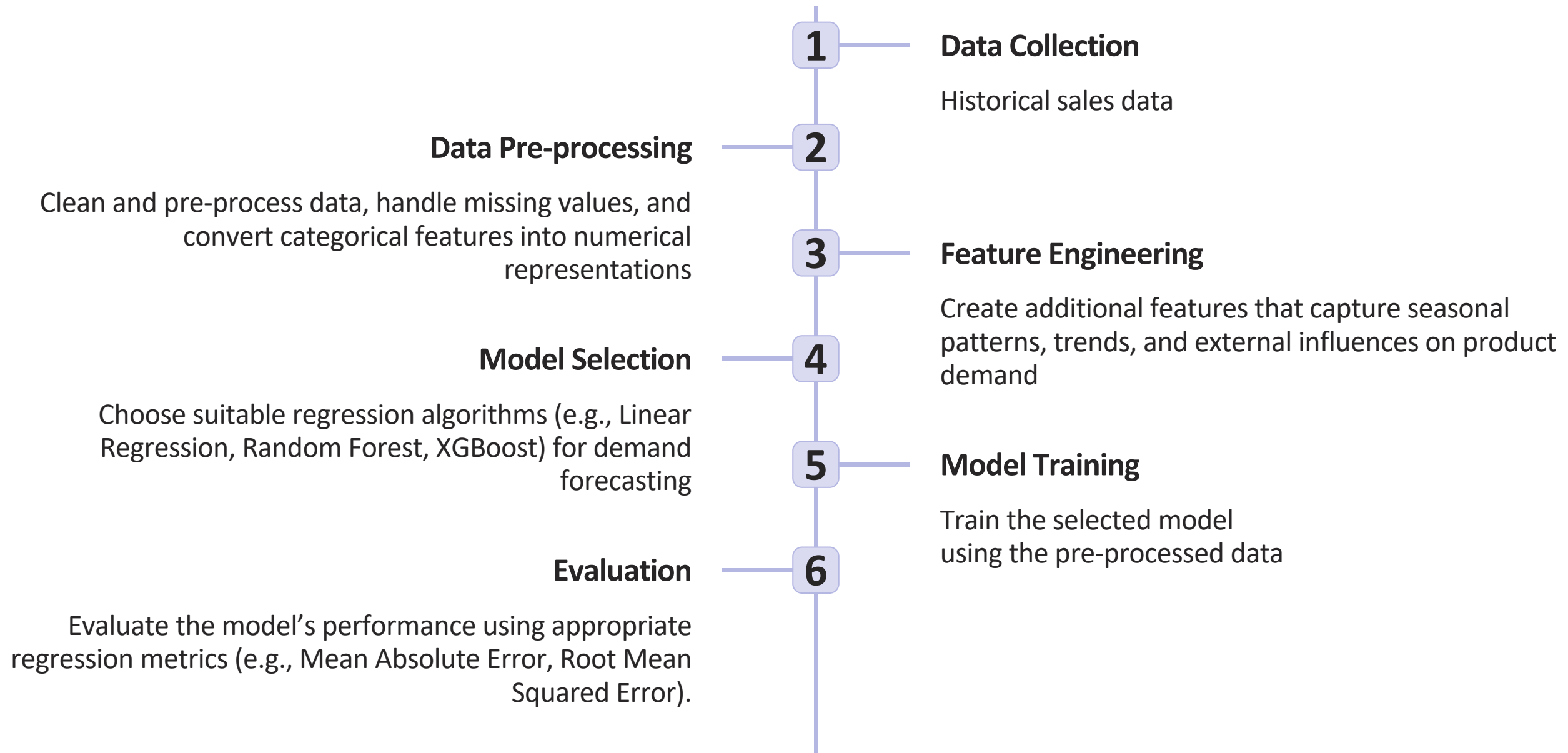
## Objective

Help businesses optimize inventory management and production planning to meet customer needs efficiently

## Process

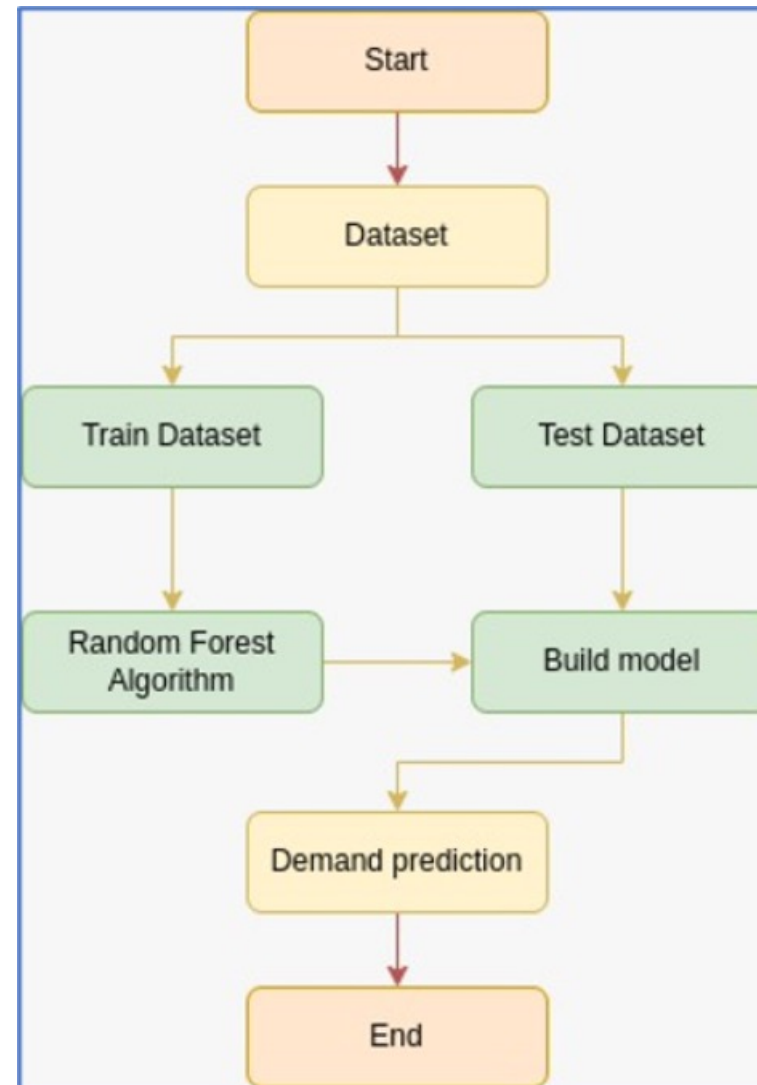
This involves data collection, data pre-processing, feature engineering, model selection, training, and evaluation.

# Design



The project aims to train a predictive model for product demand forecasting using various machine learning algorithms. Once the model is trained, it can be used to predict the product's demand at different pricing points. This information can then be used to set the optimal price for the product during the holiday season.

# Flow chart for product demand prediction



Determine product demand based on historical sales data and offer optimal price at which the product can outperform its competitors in the market.

Train a predictive model that can forecast the product's demand under various pricing scenarios.

Analyze dataset containing historical sales data based on different price points and identify the price point at which the product is perceived to be a better deal compared to competitors.

# Dataset Information

Product ID	Each product has a unique identifier to distinguish between different items.
Store ID	Identifies the specific store or location where the product was sold, helping in understanding regional variations in the demand
Total Price	The actual price at which the product was sold to customers during the sales transaction, including any discounts or promotions applied.
Base Price	The original or standard price at which the product is typically sold before any discounts or promotions are applied.
Units Sold (Quantity Demanded)	The quantity of the product sold at a given price point, reflecting the demand for the product at that particular price.

# Linear Regression

## Algorithm

A simple but effective algorithm that models the relationship between the product price and units sold.

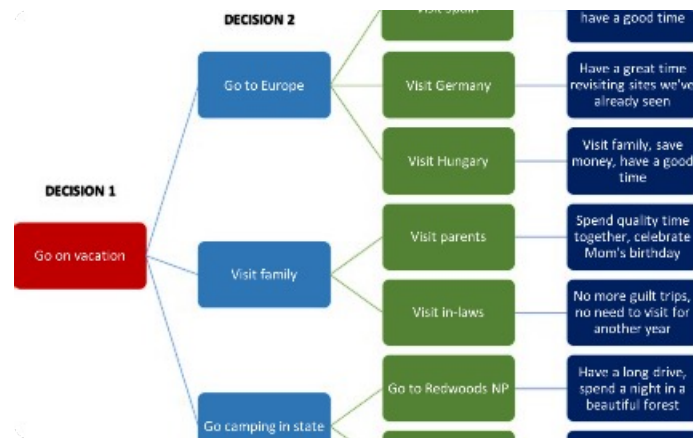
## Process

Through this algorithm, we can identify the price bracket that leads to an increase in demand, eventually leading to an increase in production planning, and inventory management.

## Benefits

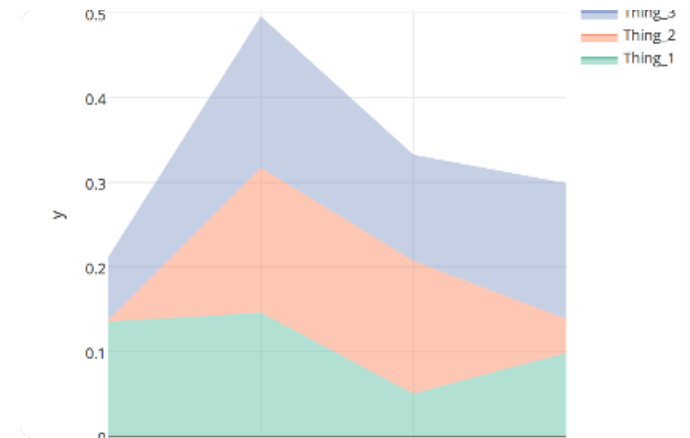
This algorithm is straightforward and can analyze and predict demand based on one independent variable.

# Decision Trees



## Algorithm

The decision tree algorithm can learn complex relationships between the features in the dataset and the target variable(units sold).



## Process

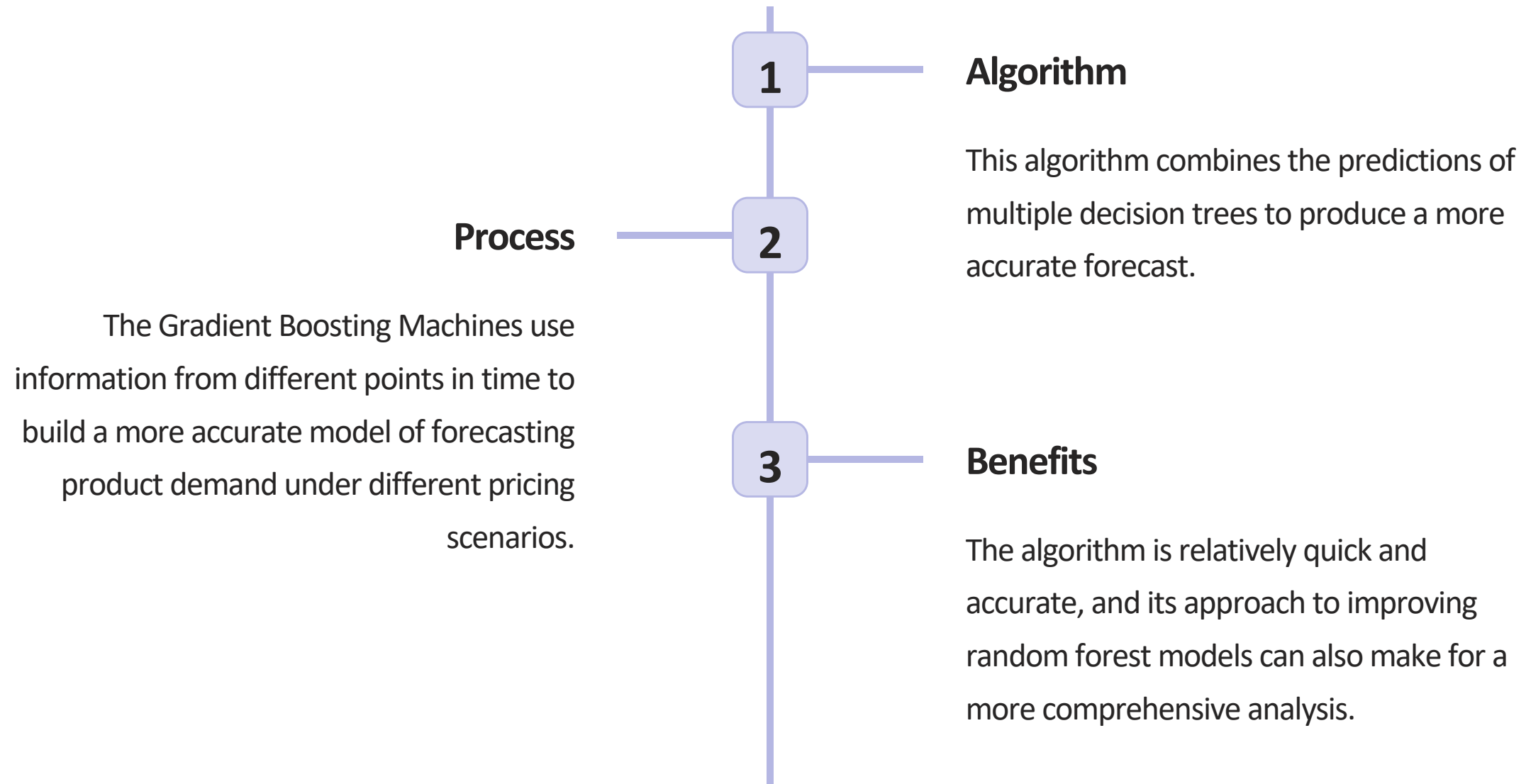
This algorithm generates prediction models and can provide health check-ups on existing models, analyzing granular data across independent variables.



## Benefits

Some benefits of Decision Trees include the ease of interpretation and the ability to identify the factors that lead to product demand fluctuations in retrospect.

# Gradient Boosting Machines





# Random Forests

1

## Algorithm

Similar to Gradient Boosting Machines, Random Forests use multiple trees to increase the accuracy of forecasts; however, it uses a different method for constructing decision trees.

2

## Process

The algorithm creates an ensemble of Decision Trees from training data samples to predict data values for unseen data. With each successive decision tree, the model averages across the decision trees and reduces variance and overfitting.

3

## Benefits

The main benefit of Random Forests is that it can work on standard and categorical data with little data preparation and use an averaging method to reduce variance and improve accuracy.

# Benefits of Using Machine Learning for Product Demand Prediction

- **Accuracy:** Machine learning models can produce highly accurate demand predictions, especially when trained on large datasets of historical sales data.
- **Speed:** Machine learning models can make predictions very quickly, leading to informed pricing decisions in real-time that can help businesses remain competitive in crowded markets.
- **Flexibility:** Machine learning models can be adapted to account for changes in market conditions and consumer preferences.

Using machine learning to forecast product demand can give a business a competitive advantage in the market. By setting the optimal price for its products, the company can boost sales and improve in-store performance.



# Conclusion

Product Demand Prediction brings a multitude of learning algorithms to the trend analysis stage on sales data. It is a diagnostic process that looks for patterns to help make pricing data-driven decisions with precision and speed, leading to customer satisfaction, reduced costs, and overall profitability.

