

SELLER-SIDE DEMAND FORECASTING AND ANALYSIS USING MACHINE LEARNING

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Abstract—Seller-side demand forecasting and analysis are essential for supermarket platforms to optimize their operations and meet customer needs efficiently. One common technique used in seller-side demand forecasting is time series analysis. This involves analyzing sales data over time to identify trends and seasonality. Time series analysis can help sellers identify periods of high and low demand and adjust their operations accordingly. Machine learning provides powerful tools for analyzing sales data, identifying trends, and making accurate demand predictions. Using machine learning algorithm, such as random forests, sellers can identify patterns in sales data and make predictions based on historical trends. These algorithms can analyse a variety of factors, such as customer demographics, product features, and seasonality, to make more accurate predictions. Moreover, machine learning algorithms can help sellers identify products that are likely to be popular, optimize pricing strategies, and manage inventory more efficiently. By accurately forecasting demand, sellers can ensure they have the right products in stock, reduce waste, and improve customer satisfaction. Overall, using machine learning for seller-side demand forecasting and analysis is a powerful way for supermarket platforms to improve their operations, reduce costs, and stay competitive. Machine learning algorithms can help sellers identify which products are likely to be popular in the future, allowing them to focus their marketing efforts and increase sales. They can also optimize pricing strategies by identifying the ideal price point for a particular product.

Keywords—component, Product Demand, Shop, Forecasting, Machine Learning.

I. INTRODUCTION

Seller-side demand forecasting and analysis is a critical aspect of e-commerce platforms. It involves predicting future sales data to optimize inventory management, pricing strategies, and customer satisfaction. The goal of seller-side demand forecasting and analysis is to help sellers make data-driven decisions that drive growth and success. In today's rapidly changing marketplace, sellers face many challenges in predicting and meeting customer demand. Seasonal fluctuations, changing consumer preferences, and unexpected events such as natural disasters or global pandemics can all impact sales. To address these challenges, sellers need accurate and timely information about customer demand and trends. This is where seller-side demand forecasting and analysis using machine learning comes in. Machine learning algorithms can analyse large amounts of sales data and identify patterns and trends that are difficult for humans to discern. These algorithms can also incorporate external factors such as weather, social media trends, and economic indicators to make more accurate predictions. Seller-side demand forecasting and analysis using machine learning can help supermarket platforms optimize their operations, reduce costs, and improve customer satisfaction. By accurately predicting future demand, sellers can ensure they have the right products in stock, reduce waste, and improve efficiency. Additionally, machine learning algorithms can help sellers identify new growth opportunities and optimize pricing strategies to increase sales. In summary, seller-side demand forecasting and analysis using machine learning is a powerful tool for supermarket platforms. It allows sellers to stay ahead of their competition, improve customer satisfaction, and make data-driven decisions that drive growth and success.

A. Accurately predict future demand:

The primary objective of seller-side demand forecasting and analysis is to accurately predict future demand for products. By analysing sales data and identifying patterns and trends, machine learning algorithms can help sellers forecast future demand with greater accuracy.

B. Optimize inventory management:

Accurate demand forecasting can help sellers optimize their inventory management by ensuring they have the right products in stock at the right time. This can help reduce waste, improve efficiency, and reduce costs.

c. Identify growth opportunities:

Machine learning algorithms can help sellers identify new growth opportunities by analysing sales data and identifying products that are likely to be popular in the future. This can help sellers focus their marketing efforts and increase sales.

II. LITERATURE SURVEY

The literature survey shows that seller-side demand forecasting and analysis using machine learning is a rapidly growing field with many applications in e-commerce. The studies reviewed demonstrate the effectiveness of machine learning algorithms for accurately predicting future demand, optimizing inventory management, and increasing sales. However, challenges such as the need for accurate data and interpretability of machine learning models remain important areas for future research.

Demand forecasting is a basic component of production planning and supply chain management, impacting competitiveness and profitability, providing critical information for purchasing decisions, production, stock levels, logistics, finance and marketing. Exploratory research provides an overview and approximation on a theme, constituting the first stage of a broader investigation, allowing the definition of the theme, delimitation of the research scope, formulation of hypotheses or discovery of a new approach. In the context of the fast-moving consumer goods (FMCG) industry, most of the papers from this research investigation show that Machine Learning results in better demand predictability than the use of traditional models. One of the benefits obtained from this better sales forecast accuracy is an improvement in inventory management due to better decisions on production and distribution. The decrease in the occurrence of stockouts, which cause a shortage of items in stores, is also mentioned, as well as the greater availability of products at the points of sale, thus increasing revenue and customer satisfaction.

In this era of technological advancement, business intelligence plays a pivotal role in decision aspects of the company related to future endeavors. Business intelligence (BI) termed as the methods technique and concepts having a positive impact on the decision for business by excursing the support of fact-based systems. It is the architecture and technology that transforms raw and disparate data into meaningful full informative data. This informative data assists in establishing new strategies, enable operational excellence, tactical insights, and firm decision making for future aspects of the company. Business Intelligence (BI) is set up to play a decisive role in almost all kinds of business in the modern era and in the near future. Business Intelligence (BI) is inevitable for analytics and strong decision making for all sorts of businesses ranging up to all sectors. It is not only

improving the efficiency and effectiveness of enterprise organizations, but it also reduces the cost and losses. It helps in retaining and attracting the customer, improving sales, and many other significant benefits. Business Intelligence (BI) predicts the future trends of the market. Machine Learning is used as one tool and technology another tool to implement a business intelligence concept using demand forecasting for a particular business.

III. NATURE OF RETAIL SHOP

Normally, a super shop contains different kinds of products with a large number. They always bring a huge number of products to enhance their stock. Daily needed products, grocery products, and occasionally needed items are available in these kinds of shops. In our country, the trend of urban people is purchasing daily needed items on that day. Again, the people who live in the city buy their products weekly basis or monthly basis. Therefore, product demand is different in different locations. Local retailer, always look on their inventory, when inventory product gets low, they refill it. However, in a super shop or city market, they refill products monthly or weekly. It needs a established database and information controlling technology to keep a record of the sale and purchase of different kinds of products. The total amount of buy and sale of different products necessitates an optimum forecasting system. In a super shop and city shop, a wide verity of products sold every day, so forecasting is very difficult. Again, local shops never maintain e database. They use their experience and memory to calculate the demand that is why maximum time their forecasting is wrong.

PROBLEMS IN DEMAND FORECASTING

Super shops face problems in terms of the number of store level, storehouse inability, promotional activity, and price change. The established demand patterns for a fixed item prove that shops can be restocked insufficient time to cope with consumer demand change. The modern demand prediction system gives us new opportunities to improve retail performance. Deterministic demand prediction of an individual product is now replaced with technology. Machine learning and deep learning can predict anything based on a training data set. The point of this controls the large scale data, manages it and using it for future client demand and their actions.

This study identified various demand influencing factors for using in forecasting model, such as,

1. Demand varies in two portions of the month. Demand remains higher in the first portion of the month and low in the last portion of the month.
2. Promotional offers affect customer demand.
3. Demand remains higher in a weekend, holidays.
4. Festivals has a vital impact on demand.
5. Weather conditions also affect the customer's demand.
6. Product and market pattern.
7. Available items on a shelf.
8. Brand category.
9. Consumption rate.

Past data is very essential while predicting the customer's demand. These data can create a demand pattern for the individual product. The demand for the product in a shop is nonlinear because there are varying influencing variables against product demand.

IV. METHODOLOGY

This section describes how we implement our theoretical knowledge for making the model.

A. Data Collection

Working with machine learning and deep learning, data collection is the most important task. First, we need to fix that which data will have an impact on prediction. Then find out who can give us those data and where should we go. Then collect the required data, we need to process data. Because data processing is a vital issue in prediction. A misbehavior of a single data may change the output of our prediction model. We collected data from both a super shop and verities shop of ten different products. Product data collection is a difficult issue because the retailer looks for profit; they do not maintain a database. We collect their previous paper, calculated some numbers and then finally we found the sale and demand data of our selected ten items. Here, some numbers mean the sale number of the previous month and the current number of products in-store. In our study we able to find out the demand quantity which is a continuous value. Randomly the demand value is changing that is why we count it as a continuous value.

B. FEATURE EXTRACTION

all data transforms are applied simultaneously to raw input data and combined to create one huge dataset, feature extraction techniques play a critical role in improving the correctness of the data. How to enhance model performance for a typical classification dataset over a baseline using the feature extraction method for data preparation. In order to create a single, sizable dataset from which a model can be fitted and assessed; preparation techniques are applied to the raw data in parallel. The most relevant features that have the greatest impact on sales demand need to be identified. This can be done using statistical methods, domain expertise, or feature importance measures provided by the Random Forest Regressor algorithm.

C. DATASET ACQUISITION

Data acquisition is the process of acquiring relevant business information, translating it into the necessary format, and transferring it to the intended system. A data acquisition defines data extraction, data transformation, and data loading. Collecting data from Kaggle and putting it in the database is done in the dataset acquisition module.

D. PREPROCESSING

The store's revenue may be predicted using this method, which is the most crucial phase in the manipulation and modification of datasets process. Successful application leads to better outcomes and increased accuracy rates. The dataset is extracted from the Kaggle dataset using the threshold approach. Analyzing the missing values in the dataset that was obtained. Data that is noisy has no meaning and cannot be understood by computers. It may be produced as a result of poor data gathering, incorrect data entry, etc. There may be a lot of useless information and gaps in the data. Data cleansing is completed to address this issue.

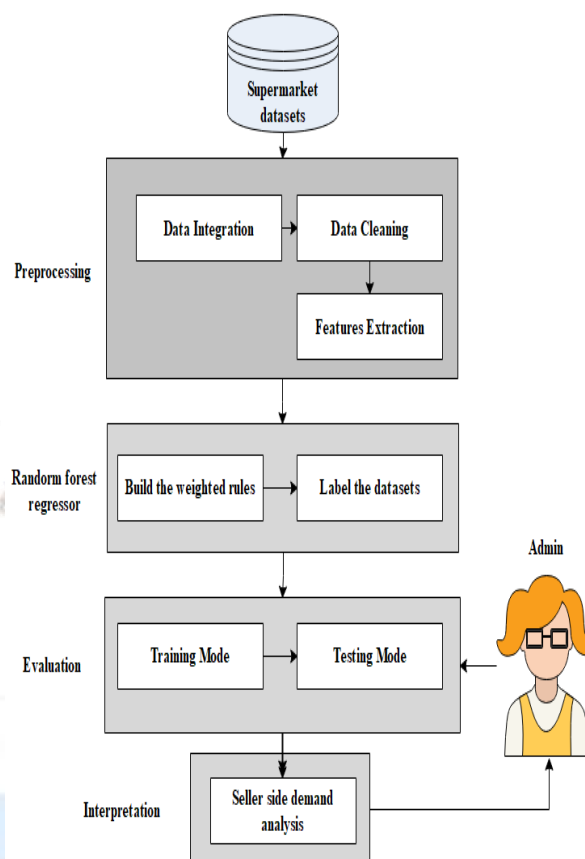


Fig. 1. Prediction Analysis Plan

E. CLASSIFICATION

Utilizing machine learning methods in this module. One of the most often used Machine learning algorithms, within the category of Supervised Learning, is Random Forest Regressor Using a predetermined set of independent factors, it is used to predict the categorical dependent variable. In a categorical dependent variable, the output is predicted via Random Forest Regressor. Consequently, the result must be a discrete or categorical value. The Random Forest Regressor algorithm can be applied to train a model that can predict future sales demand based on the historical data and selected features. The model can be tuned using hyperparameters such as the number of trees, the maximum depth of each tree, and the minimum number of samples required to split a node. The model needs to be validated using a holdout dataset or cross-validation techniques to ensure that it is performing accurately. This involves comparing the predicted values with the actual values and calculating performance metrics such as mean absolute error, root mean squared error, and coefficient of determination. The forecasts provided by the model can be used to optimize inventory management and improve sales performance. The model can be integrated into the existing systems and processes of the supermarket, and can be used by managers and analysts to make data-driven decisions.

Fig: 2 Mean Absolute Percentage Error

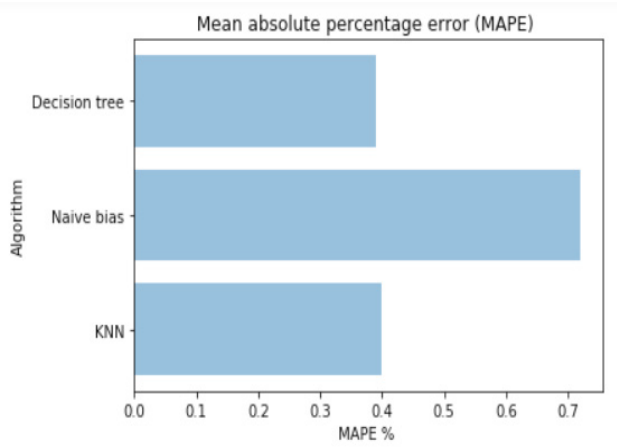


Fig: 6 Demand Visualizing

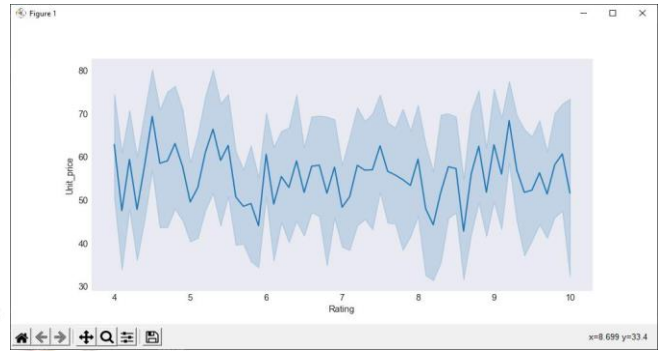
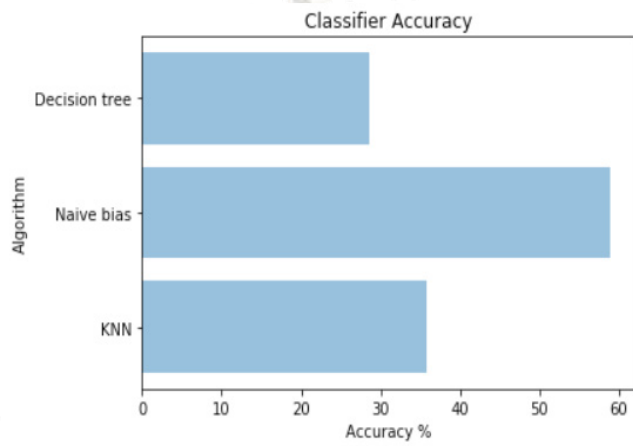


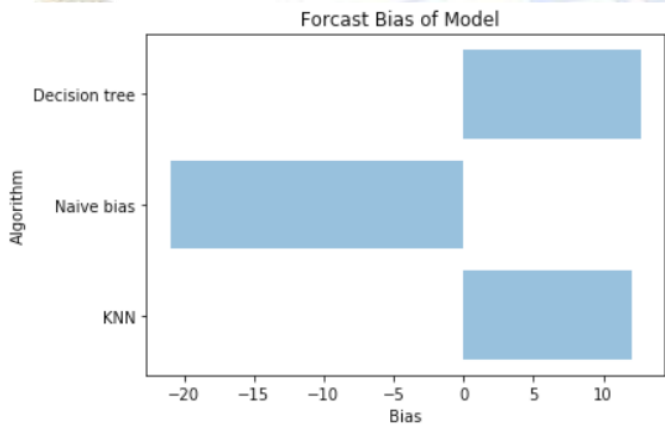
Fig: 3 Accuracy of Various Algorithms



V. FUTURE ENHANCEMENT

While historical sales data is important, incorporating external data such as economic indicators, weather, and social media trends can improve the accuracy of the forecasting model. The performance of Random Forest algorithm can be further optimized by fine-tuning the hyperparameters such as the number of trees, maximum depth, and minimum sample split. This can help achieve even better accuracy.

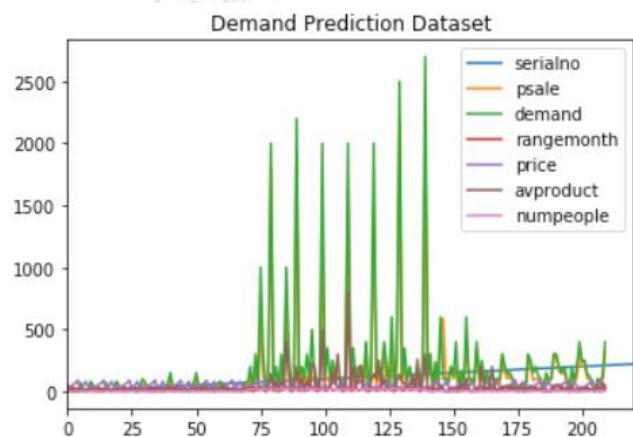
Fig: 4 Bias of Different Model



VI. CONCLUSION.

In conclusion, the Random Forest algorithm is a powerful tool for sales forecasting on the seller side. It is a machine learning technique that is effective in handling complex data and generating accurate predictions. By leveraging historical sales data and other relevant features, the algorithm can build a model that is able to predict future sales with a high degree of accuracy. The model can also identify important variables that contribute significantly to sales performance, allowing sellers to make informed decisions about product pricing, inventory management, and marketing strategies. Overall, the Random Forest algorithm is a valuable tool for sellers looking to optimize their sales forecasting process and improve their business outcomes. With the ability to generate accurate predictions and identify key drivers of sales performance, it can help sellers stay ahead of the competition and achieve their revenue goals.

Fig: 5 Data Visualization



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