International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 06 | June 2020 www.irjet.net p-ISSN: 2395-0072

FOOD DEMAND PREDICTION USING MACHINE LEARNING

K.Aishwarya[1], Aishwarya.N.Rao[2], Nikita Kumari[3], Akshit Mishra[4], Mrs.Rashmi M R[5]

K Aishwarya, Dept. of Computer Science & Engineering, NIE College, Mysore, Karnataka, India
Aishwarya N Rao, Dept. of Computer Science & Engineering, NIE College, Mysore, Karnataka, India
Nikita Kumari, Dept. of Computer Science & Engineering, NIE College, Mysore, Karnataka, India
Akshit Mishra, Dept. of Computer Science & Engineering, NIE College, Mysore, Karnataka, India
Mrs. Rashmi MR, Assistant Professor, Dept. of Computer Science & Engineering, NIE College, Mysore, Karnataka, India

---

Abstract - *Demand forecasting is the process in which historical data is used to estimate the quantity of product customer will purchase. This prediction activity is used in many fields like retailing, food industry etc. In Restaurants, prediction play a vital role as most of the basic ingredients have short-shelf life. The demands depend upon many explicit and hidden context such as season, region etc. In this paper, number of order is used to forecast stock of items, using machine learning with internal and external data. In this we provide an appropriate algorithm for demand forecasting which is capable of overpowering the wastage of short life items. Proposed algorithm like Bayesian Linear Regression, LASSO, XGBoost algorithm are used that considerably improves the forecasting performance.*

1. INTRODUCTION

The success of a restaurant not only depends on taste, ambience but also on service. The most important part among the services is serving fresh food. In order to provide this, the restaurants need to prepare food daily, this requires buying some of fresh self life food products every day. The major task that one would face in this will be predicting the quantity of products to be bought and prepared. It is very difficult to predict the number of orders in a given restaurant on a given day. A wrong prediction may end up purchasing and preparing less amount of food which will cause shortage or purchasing and preparing more which will lead to wastage of food. So, predicting the exact demand is a challenge because of uncertainty and fluctuations in consumer demand [1]. These variations ad fluctuations in demand may be because of price change, promotions, change in customer's preferences and weather changes. All these factors imply that some dishes are sold mostly during limited period of time. Although we know that some regular seasonal pattern is expected, the features that predict these seasons are not directly observed. Thus, drops and rises in orders because of these seasonal changes are difficult to predict. In order to solve such problems, we are researching how to predict the demand [1]. Here we are researching food demand forecasting methods using internal data such as number of orders.

This paper describes the approach for forecasting methods using machine learning and statistical analytics**.**

2. FORECASTING METHOD

In this research, the number of customers is forecasted using machine learning and statistical analysis method with internal data and external data in the ubiquitous environment. Bayesian Linear Regression, Boosted Decision Tree Regression, and Decision Forest Regression are used for machine learning, Stepwise method is used for statistical analysis method. We used Jupyter Notebook as a machine learning tool.

2.1 Linear Regression

It is way technique which uses a Bayesian network for the aim of machine learning. We formulate linear regression using probability distributions instead of point estimates. The anticipated value of the variable is completed by the very best probability value of distribution of unobserved variables against observed variables. The conditional dependencies are often expressed in sort of a graph or data structure using this probabilistic model. It's mainly defined by three variables: conditional probability, variate variable and conditional dependency condition between random variables.

2.1.1 Bayesian Linear Regression

Bayesian Linear Regression (Bayesian) may be a method of applying Bayesian network to machine learning. The Bayesian network may be a probabilistic model during which conditional dependencies among multiple random variables are expressed employing a graph structure and dependency relationships between random variables are expressed by conditional probabilities [2]. The Bayesian network is defined by three variables: variate variable, conditional dependency condition between random variables, and conditional probability [3]. By using the Bayesian network, the probability distribution of unobserved variables is calculated using observed some variables and therefore the value with the very best probability value is obtained because the predicted value of that variable.

2.1.2 Random Forest

It is a way which may be used for both classification and regression and deploys multiple decision tress to construct a forest and accumulates all the training results from each tree. It works well with both linear also as non -linear data, hence it relies on number of decision trees and uses mean prediction for the ultimate value [8].

2.1.3 Support Vector Machine (SVM)

SVM may be a popular technique used for classification and builds a hyper plane to extract the data patterns. For SVM model to possess high accuracy, the training data must have top quality and relevant features, otherwise the performance would be very poor and would end in low accuracy [9]. Users can complete the training tasks on non-linear distributions of coaching data by changing the kernel function of SVM.

2.1.4 LASS0

In statistics and machine learning, lasso could also be a multivariate analysis method that performs both variable selection and regularization so on reinforce, the prediction accuracy and interpretability of the statistical model it produces. Lasso regression could also be a kind of linear regression that uses shrinkage. Shrinkage is where data values are shrunk towards a central point, a bit like the mean [7]. The lasso procedure encourages simple, sparse models [7]. This particular kind of regression is well-suited once we would like to automate certain parts of model selection, like variable selection/parameter elimination.

2.1.5 XGBoost

It is a recently new technique in field of machine learning which is predicted on the thought of gradient boosting. It uses decision tree method to supply high performance with very less computation time, leading to better performances with real data [10]. The amount of incorrect predictions is increased to enhance the accuracy of the training model. XGBoost is an implementation of gradient boosted decision trees which is designed for speed and performance. XGBoost stands for eXtreme Gradient Boosting. It runs on one machine, also due to the distributed processing frameworks. It's many silent features such as-

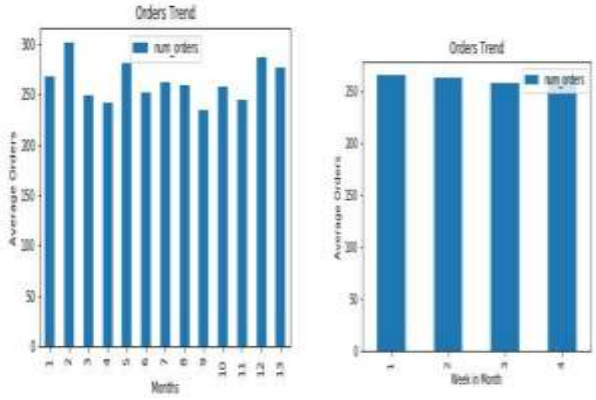
- Clever penalization of treesDF.
- A proportional shrinking of leaf nodes.
- Newton Boosting.
- Extra randomization parameter

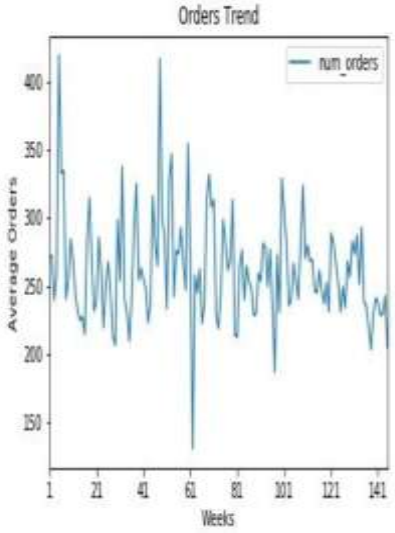
3. FORECASTING OF NUMBER OF CUSTOMERS

3.1 On track variable

The meal delivery restaurant which is the client wants to forecast the orders for upcoming weeks. This is often a basic regression problem where model must predict the amount of orders for a specific week for a particular fulfilment center. For this, we can use extensive set of algorithms such as XGBoost to solve the problem. Hence, if we observe weekly and monthly trends, we find that-

- Week 5 and 48 had the highest number of orders, while week 62 has the lowest orders.
- It was also noticed that usually the first and last week of the month had highest number of orders as compared to other weeks.



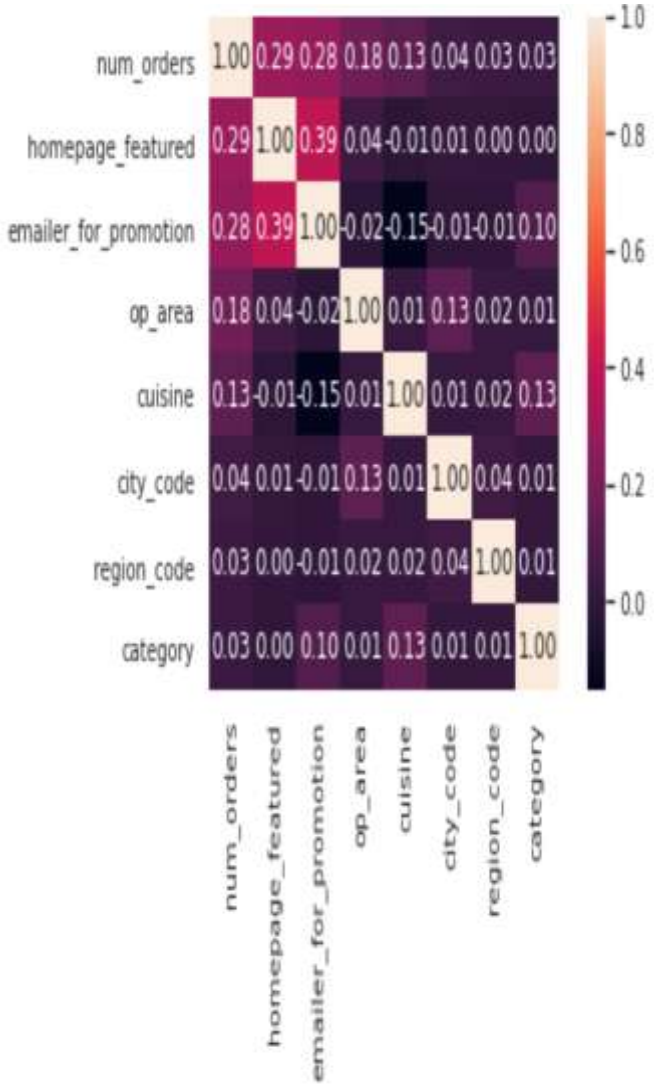


3.2 Forecasting Method

- Numbers of orders have a slight positive correlation with homepage featured and mailer used for promotion.

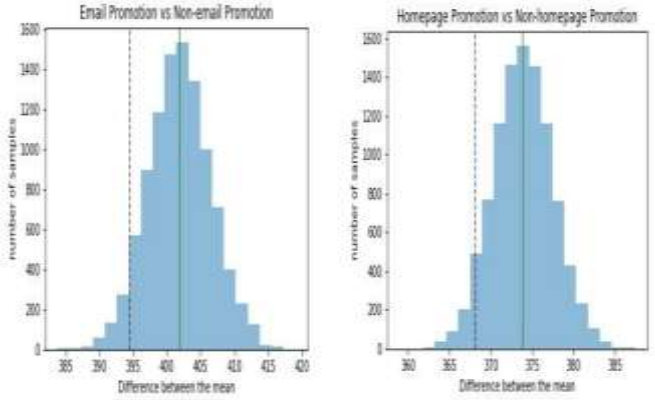
- Number of orders also depends directly on cuisine and area.
- Area and cuisine have negative correlation with homepage it is featured in and mailer used for promotion.
- There are many features which have neutral relationship.

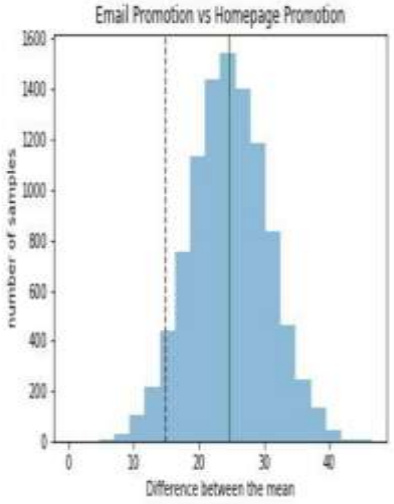
There are several irrelevant features which can be merged with the help of feature engineering. Feature engineering basically makes data analysis easier and compatible for analyzing by preparing a proper dataset. Also, it enhances the performance of the training model. Label encoding can be used for categorical data to convert them into numeric format and enables them to group the categorical data without losing any vital information.



It is also seen that with Bayesian Linear Regression and LASSO have very low accuracy with respect to KNN and Decision tree.

XGBoost algorithm has given the highest accuracy and thus gives us better performance with respect to other models.





4. CONCLUSION AND FUTURE WORK

In this paper, we are using external and internal data for the prediction consisting of different factors like region ID, week etc. Food demand prediction is an important and challenging problem. In this paper we presented penalized regression method, Bayesian Linear Regression K-nearest Neighbor, Decision tree approach as a food demand method. As we go through different algorithm for prediction the accuracy rate keeps on improving. There was not big difference other than precision rate of forecasting. XGboost is a decision-based boosting algorithm which is used for increasing the accuracy rate.

This evaluation is used practically for restaurants. Furthermore, in future more refined prediction can be done based on many other factors like cultural habits, religious holiday, consumer preferences etc. In future, this method can be used for predicting work force requirement, automated food ordering based on forecasting results.

REFERENCES

[1] Patrick Meulstee and Mykola Pechenizkiy," Food Sales Prediction: "If Only It Knew What We Know"" 2008 IEEE International Conference on Data Mining Workshop.

[2] Yoichi Motomura, Baysian network, Technical Report of IEICE, Vol.103, No.285, pp.25-30, 2003.

[3] Yoichi Motomura, Baysian Network Softwares, Journal of the Japanese Society for Artificial Intelligence, Vol.17 No.5, pp.1-6, 2002.

[4] D. Adebanjo and R. Mann. Identifying problems in forecast-ing consumer demand within the fast paced commodity sector. Benchmarking: An International Journal, 7(3):223– 230, 2000.

[5] Bohdan M. Pavlyshenko," Machine-Learning Models for Sales Time Series Forecasting", 2018 IEEE Second International Conference on Data Stream Mining & Processing (DSMP), Lviv, Ukraine, 21–25 August 2018.

[6] İrem İşlek and Şule Gündüz Öğüdücü," A Retail Demand Forecasting Model Based on Data Mining Techniques".

[7] https://statisticshowto.com/lasso/regression

[8] https://en.wikipedia.org/wiki/Random_forest

[9]https://towardsdatascience.com/supportvector-machines-svm-c9ef22815589

[10] https://towardsdatascience.com/httpsmedium-com-vishalmorde-xgboost-algorithmlong-she-may-rein-edd9f99be63d.