

Food Demand Prediction using Deep Learning

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Abstract- The population in various part of the world are growing with high rate which results high demand of food but the availability of food is not sufficient or overstocked to fulfill the requirements. This problem leads to unbalanced production of food but one of the major problem arises in demand of food requirements that is the major threat to merchants. By early detection of these food demand requirements can help suppliers to prevent the food wastage and also prevent their financial losses. In this project, we train a Deep Learning model to forecast different food demand requirements that are affecting suppliers adversely. Organization will be able to detect these food requirements at early stage of production and can take various measures to prevent the losses. We have used datasets of 4,56,548 rows and various features of different demand categories. Our model achieves an accuracy of 94.36% upon training these datasets. We have used the web application which will predict the demand of particular product in various areas.

I. INTRODUCTION

With the expanding population growth over recent decades in various part of the world causing high demand of food items, which results in large expansion of farming. In order to fulfill these requirements of these high demands of food, biomass and several other products, the management of food must be handled efficiently amid these rising population by 2050 to its double speed. This can only be achieved if crop production enhance by 2.4% each year and managed efficiently but it is hardly able to reach up to 1.3% per year.

In India, Agriculture is one of the important section which plays a vital role in contribution of economic development. There is very wastage of food items in our society and country due to improper management of the products. The person sometime get the required product on time while someone didn't get the product on time due to shortage of product. As an

engineer, we need to take an optimized approach to fulfill the requirements of the product. With the help of various advanced technology, we can help the society for it's betterment. The productivity of the product should be utilized and satisfy the demand of the particular product at particular place.

In recent times, many countries came up with different modern and advanced technologies that are able to forecast the demand of product with high accuracy. These tools and techniques helps and modern agriculture and society. But they are not very much cost effective and also time consuming. In modern days Machine Learning Algorithms and Deep Learning algorithm growing rapidly in helping people to resolve their issues at shorter period of time by predicting the demand of products with high accuracy. The requirements of product might varies in several characteristics with varying locations. All these patterns can be easily recognized by Machine Learning model by analysing various numbers of records of different location. Later these trained model can be used to some device that can easily augur the requirements of products. These trained models will help a lot to merchants and farmers in order to get rid of these food requirements and to optimize higher productivity. In fact the result we will get is more accurate at a very less period of time. The growth of these technologies i.e. Machine Learning and Deep Learning increasing rapidly day by day and proving its importance in every sector of the world.

In this study, we will learn about how Machine learning algorithms able to identify the demand of products. Deep learning is a class of Machine Learning algorithms used to evaluate complex patterns in datasets using various hidden layers and activation functions. This study three important stages to follow: Collection of datasets, preprocessing of datasets and model building. The dataset is collected from multiple source that it contains 4,56,548 rows of different categories of various

requirements of product i.e., Beverages, Soup, Salad, Rice Bowl, Sandwich, Pasta, etc. Then some preprocessing are done over the datasets like data processing, data cleaning, data augmentation etc. Model building is done basically in 3 layers input layer, hidden layer and output layer. Input layer contains the data on which the model will train in with the various datasets. Output layer receives an input from previous hidden layers and return an output representing the model’s prediction.

II. OBJECTIVE AND METHODOLOGY

OBJECTIVE

Our aim is to prevent the wastage of food as it needs lot of effort to grow crop and wastage of food never worth it. It will also help the merchants and owners to prevent from unconditional financial losses. As the accessibility to reach the correct solution to analyze the requirements in the food demand is very limited, so we will help merchants and owner to find the

optimized solution by their own. It will definitely deal with the problem of food insecurity and wastage of it in the country. The better accuracy of forecasting of food is our primary aim with our best working model.

METHODOLOGY

1. Dataset Discussion

We have collected the various datasets features like id, week, center_id, meal_id, checkout_price, base_price, emailer_for_promotion, homepage_features, num_orders from the online platform and classified the dataset. After that we will use train the dataset with different models. We will use machine learning algorithms to work with the large datasets and predict the accurate results. Dataset consists of 4,56,548rows and various features of different demand categories. It is also openly available on the internet. Some of the example of the dataset are as follows:

id	Week	Center_id	Meal_id	Checkout_price	Base_price	Homepage_feature d	Num_order
1379560	1	55	1885	136.83	149.98	0	177
1466964	1	24	1993	145.24	155.34	1	270
1346989	1	11	2539	198.68	225.29	0	189
1338232	1	55	2139	142.36	152.30	0	54
1448490	1	55	2631	178.25	195.14	0	40
1270037	1	24	1248	169.35	186.45	1	28
1191377	1	11	1778	176.34	189.76	1	190
1499955	1	11	1062	185.24	203.51	0	391
1025244	1	11	2707	198.36	226.28	0	472

2. MACHINE LEARNING ALGORITHMS

Deep Learning is the part of Machine Learning that also uses complex algorithms to model complex patterns in datasets. There is highly demand of deep learning in almost every field from banking for fraud detection to mobile phones, AI proctored examinations, speech and video analysis, forecasting, etc.

a) XBRRegressor

It is the one of the machine learning algorithm which is classifies the various features according to it’s importance used for prediction. A benefit of using the gradient boosting is that after the boosted trees are

constructed, it is relatively straightforward to retrieve importance scores for each attribute among the various features.

b) LINEAR REGRESSION

It is the machine learning algorithm which is used to train the continuous datasets with reference with the other variable in the features of the datasets. The variable which is being predicted are called dependent variable while other are called independent variable.

c) LASSO

The aim of lasso regression is to obtain the subset of predictors that minimizes prediction error for the

quantitative response variable. The lasso does the subset of predictors by imposing the constraint on the model parameters that causes regression coefficients for some variables to shrink toward zero.

d) ELASTIC NET

In terms of handling bias in the model, Elastic Net is considered better than Ridge and Lasso regression, Small bias leads to the varied disturbance of prediction as it is dependent on the variable. The elastic net algorithm uses a weighted combination of L1 and L2 regularization for giving the result.

e) DECISION TREE REGRESSOR

Decision tree builds regression or classification models in the form of tree structure to reach the output. It breaks down the datasets into smaller and smaller subsets while at the same time an associated decision tree is incrementally developed to classify the features. The final result is the tree with decision nodes and leaf nodes.

f) KNEIGHBOURS REGRESSOR

KNN regression is the non-parametric method that, in an intuitive manner, approximates the association between independent variables and continuous result by averaging the observations in the same neighbourhood of the datasets. The k-nearest neighbors (KNN) algorithm is the simple, supervised machine learning algorithm that can be used to solve both classification and regression problems. It is easy to implement and understand, but has a major drawback of becoming significantly slower as the size of that data in use grows.

g) GRADIENT BOOSTING REGRESSOR

Gradient boosting Regression measures the difference between the current prediction and the known correct target value. This difference is known as residual. After that Gradient boosting Regression trains the weak model that maps features to that residual. It can be used for regression and classification problems as well.

III. METHODOLOGY STEP BY STEP

The multiple steps are followed with preparing the model to predict the food demand prediction with various situations, some of the steps are as follows:

1. Dataset acquisition or collection

Collection of the datasets related to food demand such as historical sales data, demographics, market trends, weather conditions, etc which will be used to train the model.

2. Data Pre-processing

Preprocessing of the data by cleaning, filtering, and transforming it to remove any inconsistencies and ensure that it is in the appropriate format for the deep learning model and give better results. All the unwanted and null values are removed or treated as per the requirements of the model.

3. Model Selection

Choose an appropriate deep learning model for food demand prediction such as recurrent neural networks (RNN), Linear Regression, Lasso, ElasticNet, DecisionTreeRegressor, KNeighboursRegressor, GradientBoostingRegressor, long short-term memory (LSTM), or convolutional neural networks (CNN).

4. Model Training

Train the selected model on the preprocessed data by defining the loss function, optimizer, and hyper-parameters with various algorithm to check which algorithm is best fit for the training of the datasets to give best results.

5. Model Evaluation

The Root Mean Squared Logarithmic Error (RMSLE) is parameter used to evaluate the performance of the various algorithms. The performance of the model are as follows:

Algorithm Used	RMSLE Value
Linear Regression	129.976
Lasso	129.464
ElasticNet	131.279
DecisionTreeRegressor	62.950

KNeighboursRegressor	67.201
GradientBoostingRegressor	98.815
XGBRegressor	99.361

6. Model Deployment

Flask framework is used for the deployment of the trained model for food demand prediction in real-time applications with user-friendly website to forecast various demand of the product in different scenarios.

IV. RESULT AND CONCLUSION

RESULT

During the training of deep learning model, various algorithms were used to train the model which attained an accuracy rate of 94.32%. While testing on input samples, the model successfully reached a maximum accuracy rate of 87.36%. Our project will help the people to forecast the requirements. It will be very convenient to use as they don't have to worry about moving to another area for the search of people to successfully analyze the demand of the food. It will prevent the financial loss of the owners and merchants. More importantly, there will be the proper defense for the threat of food insecurity and food wastage and scarcity in the society or in country. There may be imbalance of supply chain in the market which may cause the hike of the product cost and demand drastically.

CONCLUSION

Our proposed solution will add values to the society and help the merchants, stakeholders, owner, etc. to know the accurate demand of products and hence can cure the wastage and stock more accurately and prevent from the financial losses and also prevent proper supply chain of food. Our application is made with user friendly and predict the demand more accurately in various scenarios.

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