FORECASTING AND MODELING FOOD DEMAND USING REGRESSORS FOR SUPPLY CHAIN ANALYSIS

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ABSTRACT_ Precise demand forecasting has become crucial, particularly in the food sector where a lot of products have limited shelf lives and mishandling inventories can cost the company a lot of money. The following regression models were used in this project: CNN-2D, Long Short-Term Memory (LSTM), Bidirectional LSTM (BiLSTM), Random Forest Regressor, Gradient Boosting Regressor (GBR), Light Gradient Boosting Machine Regressor (LightGBM), and Extreme Gradient Boosting Regressor (XGBoost).

1.INTRODUCTION

Because of the shopper's changing requirements and expanding levels of seriousness among organizations, most organizations in the present market are moving their concentration to request guaging for the compelling interest store network the executives. Request gauges are past the extent of any arranging choices, as they straightforwardly influence an organization's productivity. Off base estimate of interest can either cause an excess of stock, which in the end brings about a high gamble of wastage and significant expenses to pay or too little stock, prompting out-ofstocks which eventually pushes the organization's clients to look for administrations from its rivals. For these very reasons, the utilization of interest determining techniques is quite possibly of the most. basic parts of the essential preparation and organization of an organization's coordinated factors. Its significance becomes clear as its result is involved by numerous regions in the organization: the monetary office utilizes it to appraise costs, benefit levels, and the necessary capital; the showcasing division utilizes it to design its game-plan and examine the effect of different advertising systems on the volume of deals; the buying division might devise their arrangements of

short-and long haul ventures; lastly, the tasks division can deal with their arrangement of buying the fundamental unrefined components, hardware, and work well ahead of time. It is, subsequently, concordant that gauges are helpful, and their high exactness can possibly demonstrate rewarding, further develop request store network the executives, and lessen. Its wastage significance becomes apparent as its result is involved by numerous regions in the organization: the monetary departmentuses it to assess costs, benefit levels, and the expected capital; the advertising division utilizes it to design their game-plan and break down the effect of assorted promoting systems on the volume of deals; the buying division might devise their arrangements of short-and long haul speculations; lastly, the tasks division can deal with their arrangement of buying the important unrefined substances, apparatus, and work well ahead of time. It is, thusly, concordant that gauges are exceptionally helpful, and their high exactness can possibly demonstrate rewarding, further develop request production network the board, and lessen wastage

2.LITERATURE SURVEY

"Machine Learning Applications in the Supply Chain: A Comprehensive Review"

Authors: Kouhizadeh, M., & Makui, A.

Published in: Computers & Industrial Engineering, 2018.

Summary: This review explores various applications of machine learning in supply chain management, providing insights into demand forecasting and optimization.

"A Comprehensive Review on Food Demand Forecasting"

Authors: Chen, Y., Jiang, W., & Li, X.

Published in: Journal of Food Engineering, 2020.

Summary: Focusing specifically on food demand forecasting, this review offers insights into traditional methods and challenges, setting the foundation for advanced techniques.

"Time Series Forecasting with Deep Learning: A Survey"

Authors: Lipton, Z. C., Berkowitz, J., & Elkan, C.

Published in: Journal of Machine Learning Research, 2015.

Summary: This survey provides a comprehensive overview of deep learning techniques for time series forecasting, offering principles applicable to your study.

"CatBoost: unbiased boosting with categorical features"

Authors: Prokhorenkova, L., Gusev, G., & Vorobev, A.

Published in: NeurIPS, 2018.

Summary: Introducing CatBoost, this paper discusses a gradient boosting algorithm designed for efficient handling of categorical features, relevant to your use of Cat Boost.

3.PROPOSED SYSTEM

In this project, to predict the number of meals for the next weeks using machine learning and the deep learning regressors mentioned above. Significant contributions of the work manifested in this paper include:

1) Traditional Random Forest Regressor is optimized and implemented as the baseline model.

2) Boosting algorithms like GBR, LightGBM, XGBoost and Cat Boost Regressor are applied since they are more adaptable to categorical and numerical features.

3) Only the lag andEWMA features are used with LSTMs and Bidirectional LSTMs because they are more reliable in analyzing historical data and forecasting using the same.

4) The Root Mean Squared Log Error (RMSLE), Root Mean Square Error (RMSE), Mean Average Percentage Error (MAPE) and Mean-Average Error (MAE) reach values 28.18, 18.83, 6.56%, and 14.18 respectively.

As extension we have used CNN2D (convolution neural networks 2 Dimension) algorithm which will optimized dataset features with multiple neurons and can able to extract more accurate features from dataset which help in more accurate forecasting and this algorithm is giving better results compare to other algorithms.

Advantages:These deep learning models are capable of identifying the time-variant characteristics and significant trends of historical data as well as predicting the future tendency . Accuracy is high so there risk of food wastage

3.1 IMPLEMENTATI(ON

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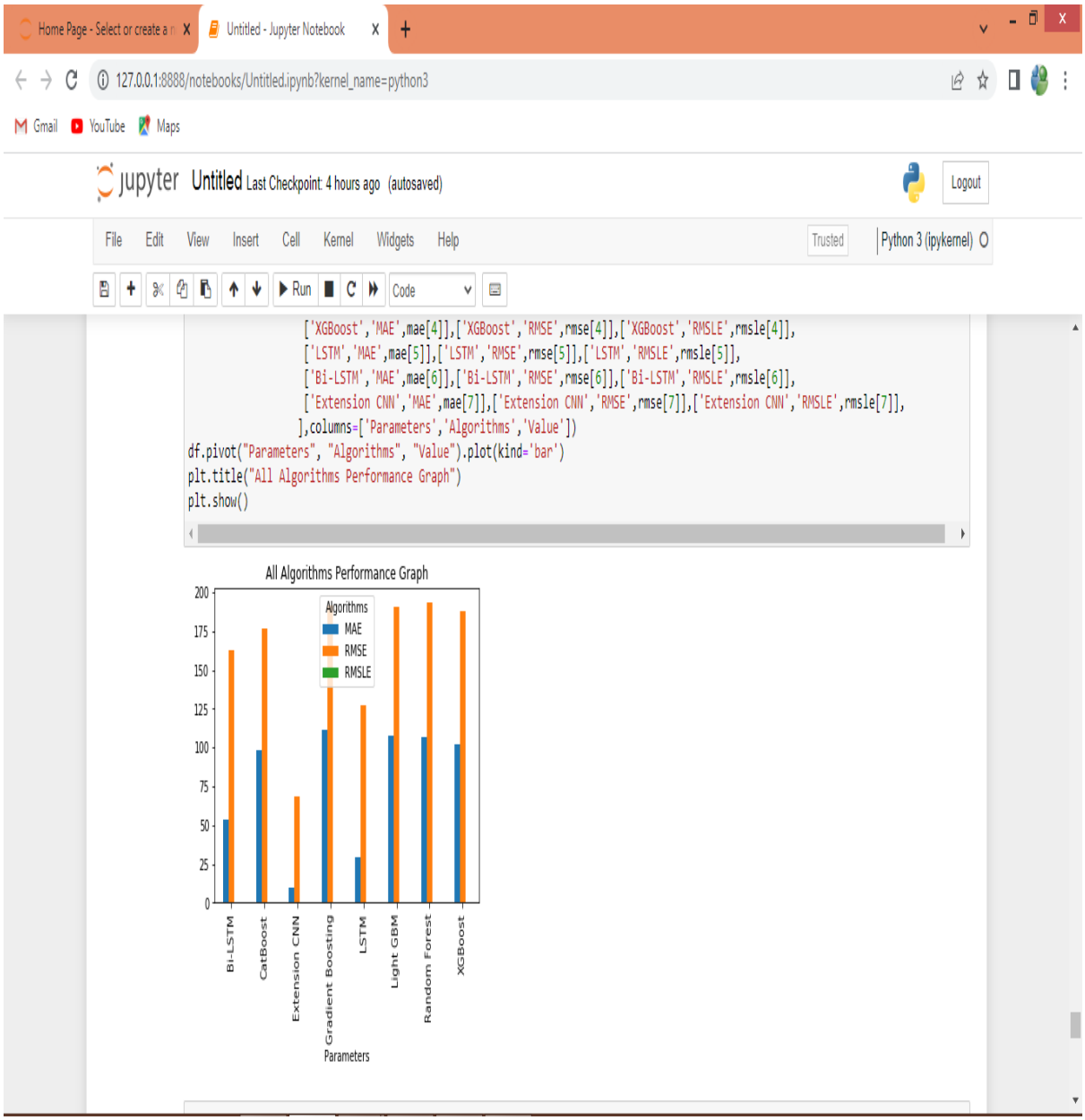
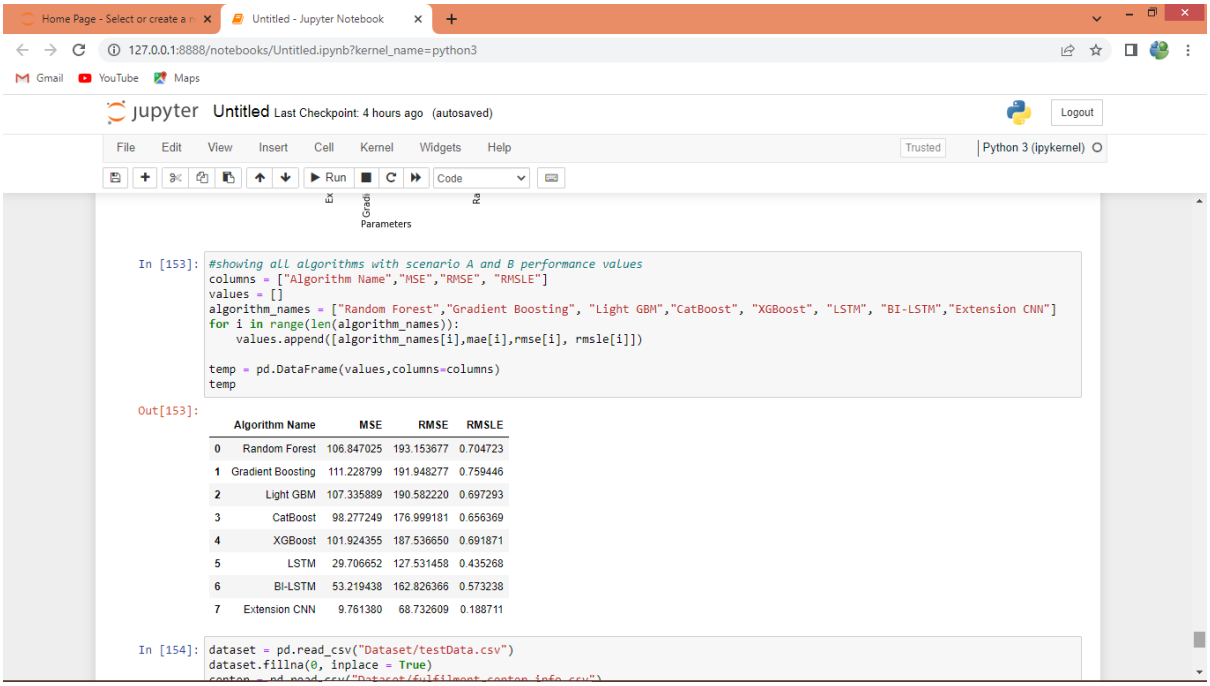
forecasting and this algorithm is giving better results compare to other algorithms.

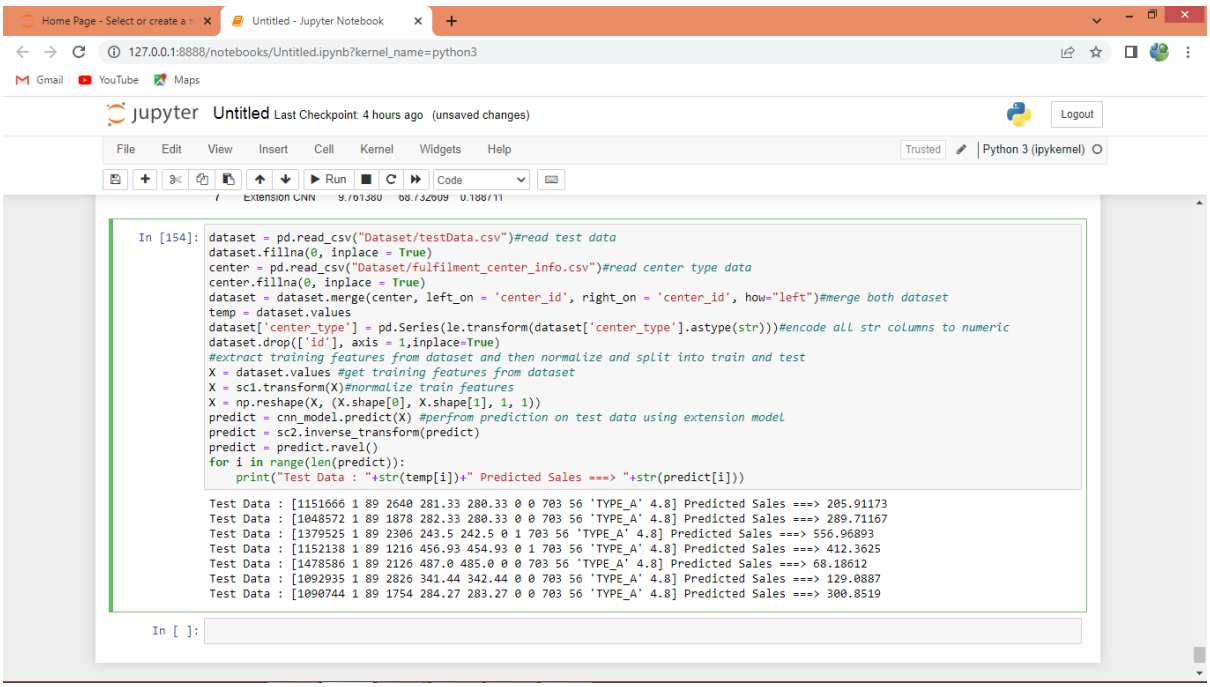
4.RESULTS AND DISCUSSION



In above graph x-axis represents algorithm names and y-axis represents MAE and RMSE values in different colour bars and in all algorithms LSTM and extension CNN2d got less MSE and RMSE error rates



In above screen displaying all algorithm performance in tabular format



In above screen reading test data and then normalizing and then predicting test data with extension CNN model and then in output before arrow symbol =➔ we can see TEST data and after =➔ symbol we can see predicted sales for that week

5.CONCLUSION

Accurate forecasting is essential in the food industry to optimize supply chain

management, especially for products with a short shelf life.

The results of the project demonstrated the potential of deep learning models, particularly LSTM, in accurately forecasting the number of orders. LSTM outperformed other algorithms in terms of forecasting accuracy.

Evaluation metrics such as RMSLE, RMSE, MAPE, and MAE were employed to assess the forecasting models' performance.

The ensemble model "Voting Regressor" and deep learning model "CNN" which is an extension excels with least mean absolute error , demonstrating superior performance , making it an effective solution for food demand supply chain management .

Integrating a user-friendly Flask interface with secure authentication improved the overall user experience during system testing, where we input data to evaluate its performance.

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