

PROJECT REPORT

DEMANDEST-AI POWERED FOOD DEMAND FORECASTING

1.INTRODUCTION

1.1 Project Overview

A food delivery service has to deal with a lot of perishable raw materials which makes it all, the most important factor for such a company is to accurately forecast daily and weekly demand. Too much inventory in the warehouse means more risk of wastage, and not enough could lead to out-of-stocks - and push customers to seek solutions from your competitors. The replenishment of majority of raw materials is done on weekly basis and since the raw material is perishable, the procurement planning is of utmost importance, the task is to predict the demand for the next 10 weeks.

1.2 Purpose

The main aim of this project is to create an appropriate machine learning model to forecast the number of orders to gather raw materials for next ten weeks. To achieve this, we should know the information about of fulfilment center like area, city etc., and meal information like category of food sub category of food price of the food or discount in particular week. By using this data, we can use any classification algorithm to forecast the quantity for 10 weeks. A web application is built which is integrated with the model built.

2.LITERATURE SURVEY

2.1 Existing Problem

The replenishment of majority of raw materials is done on weekly basis and since the raw material is perishable, the procurement planning is of utmost importance. Secondly, staffing of the centers is also one area wherein accurate demand forecasts are really helpful. This is done through manual process.

2.2 References

-<https://smartinternz.com/ibm-build-a-thon-2021>
https://www.kaggle.com/kannanaikkal/demand?est-AIpoweredfooddemandforecasting?select=fulfilment_center_info.csv

2.3 Problem Statement Definition

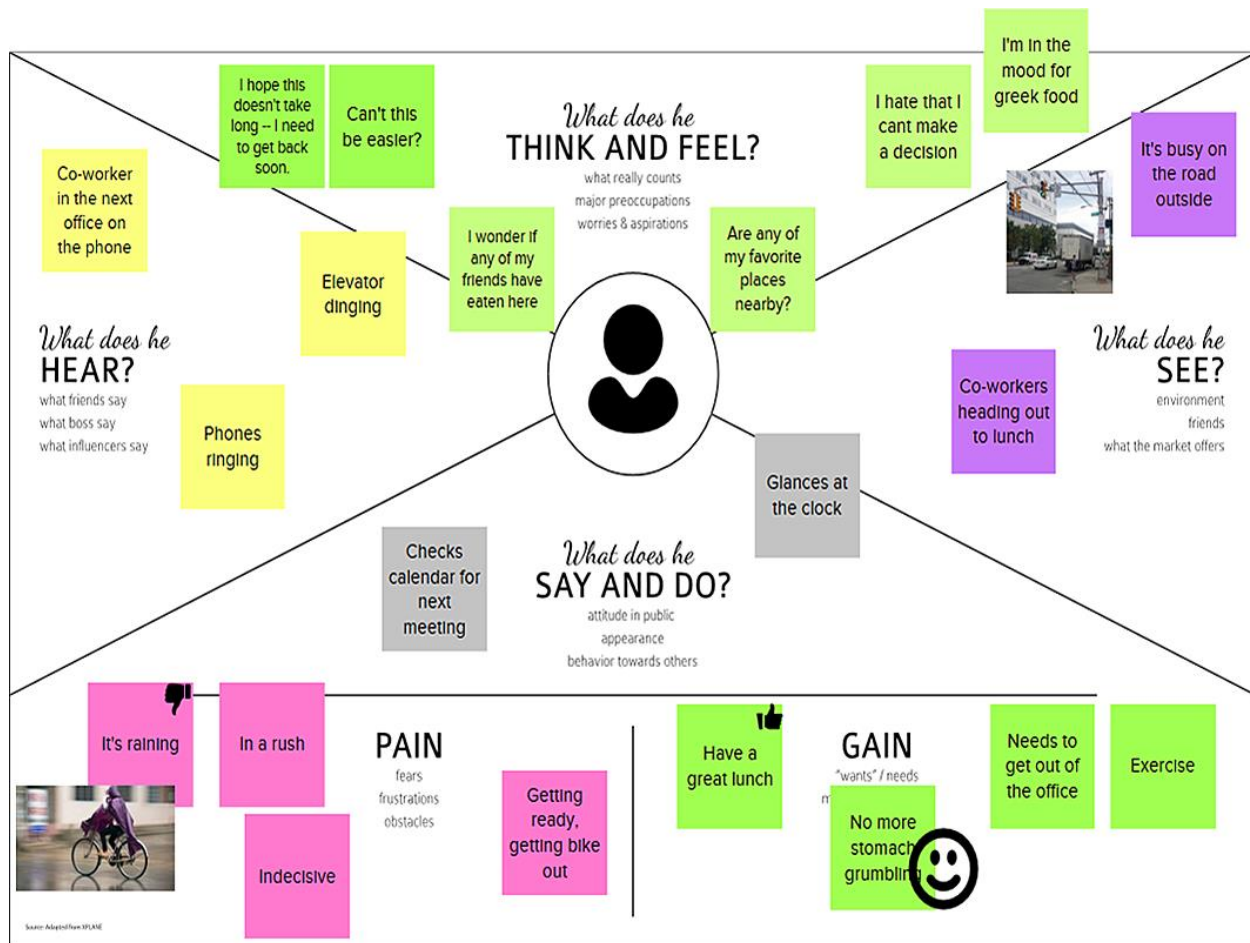
The Customer Problem Statement template helps you focus on what matters to create experiences people will love. A well-articulated customer problem statement allows you and your team to find the ideal solution for the challenges your customers face. Throughout the process, you'll also be able to empathize with your customers, which helps you better understand how they perceive your product or service

Problem Statement (PS)	I am (Customer)	I'm trying to	But	Because	Which makes me feel
PS-1	Organization	Get accurate prediction as a result	Need prediction for long duration	It takes long time to do the analysis	Disappointed
PS-2	Small Scale	Get prediction in low cost	It's not affordable for an accurate prediction	Prediction takes much time and effort	Depressed

3.IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas

An empathy map is a simple, easy-to-digest visual that captures knowledge about a user's behaviours and attitudes. It is a useful tool to help teams better understand their users. Creating an effective solution requires understanding the true problem and the person who is experiencing it. The exercise of creating the map helps participants consider things from the user's perspective along with his or her goals and challenges.



3.2 Ideation & Brainstorming

Ideation is the process where you generate ideas and solutions through sessions such as Sketching, Prototyping, Brainstorming, Brainwriting, Worst Possible Idea, and a wealth of other ideation techniques. Ideation is also the third stage in the Design Thinking process.

Brainstorming provides a free and open environment that encourages everyone within a team to participate in the creative thinking process that leads to problem solving. Prioritizing volume over value, out-of-the-box ideas are welcome and built upon, and all participants are encouraged to collaborate, helping each other develop a rich amount of creative solutions

3.3 Proposed Solution

The data set is related to a meal delivery company which operates in multiple cities. They have various fulfilment centers in these cities for dispatching meal orders to their customers. The dataset consists of historical data of demand for a product-center combination for weeks 1 to 145. With the given data and information, the task is to predict the demand for the next 10 weeks (Weeks: 146-155) for the center-meal combinations, so that these fulfilment centers stock the necessary raw materials accordingly.

Demand forecasting helps companies in several readily apparent areas, such as production, scheduling and customer service. The client wants you to help these centers with demand forecasting for upcoming weeks so that these centers will plan the stock of raw materials accordingly. The replenishment of majority of raw materials is done on weekly basis and since the raw material is perishable, the procurement planning is of utmost importance. Secondly, staffing of the centers is also one area wherein accurate demand forecasts are really helpful. Given the following information, the task is to predict the demand for the next 10 weeks (Weeks: 146-155) for the center-meal combinations in the test set.

The replenishment of raw materials is done only on weekly basis and since the raw material is perishable, the procurement planning is of utmost importance. Therefore predicting the Demand helps in reducing the wastage of raw materials which would result in the reduced cost of operation. Increased customer satisfaction by timely fulfilling their expectations and requirements.

3.4 Problem Solution Fit

A constrained forecast is a forecast of sales or delivery volume that is realistically limited by the operational abilities and supply capacity of the business – particularly factors affecting the supply of materials, availability of labour, production capacity and cashflow.

This strategic management framework was first developed by Alexander Osterwalder in the mid-2000s. While the original canvas is applicable to any business, regardless of size, history, or budget, additional canvases have popped up in various niches. The simplicity of the business model canvas is what makes it so successful. The canvas is plain, looking much like a billboard or whiteboard. It's comprised of nine criteria that express the important character traits for your business' story, ranging from who you know to how you make money to what you have. The canvas acts as an advertisement to attract business investors or other founders.

4.REQUIREMENT ANALYSIS

4.1 Functional Requirement

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registration through Gmail Registration through LinkedIN
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	User login	Login via Google Login WithEmail id and Password
FR-4	Admin Login	Login Via Google Login WithEmail id and Password
FR-5	Admin Login	Description of the issues contactinformation
FR-6	E-mail	Login alertness

4.2 Non-Functional Requirements

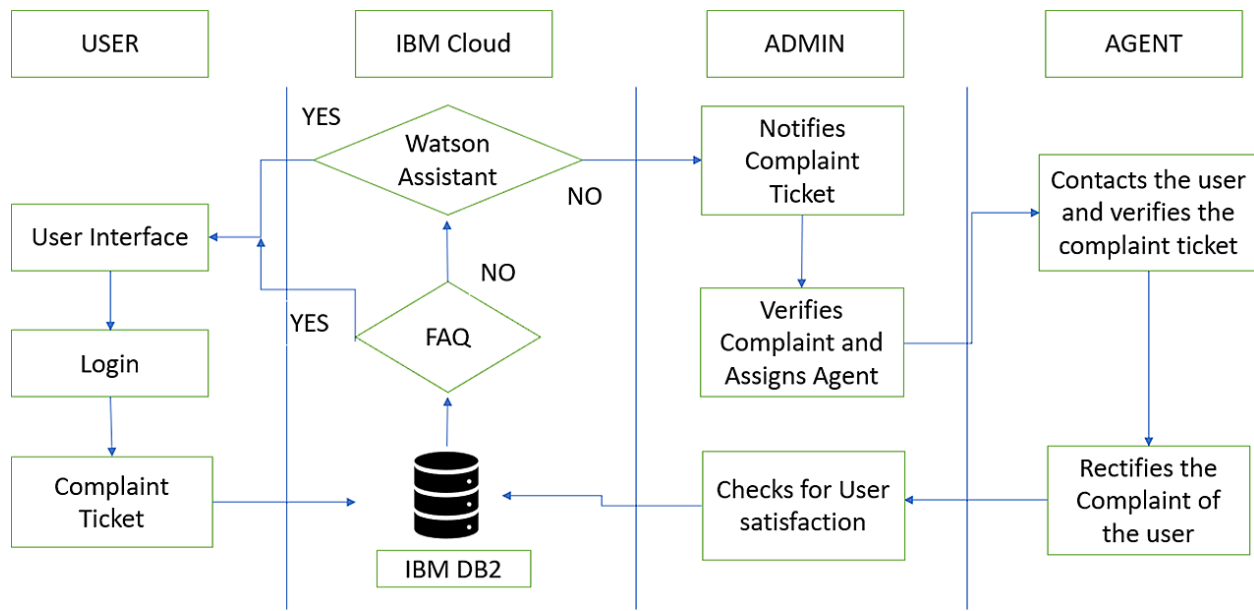
FR No.	Non-Functional Requirement	Description
NFR-1	Usability	To provide the solution to the problem.
NFR-2	Security	Track of login authentication
NFR-3	Reliability	Tracking of decade status through email
NFR-4	Performance	Effective development of web

		application
NFR-5	Availability	24/7service
NFR-6	Scalability	Agents scalability as per the number of customers

5.PROJECT DESIGN

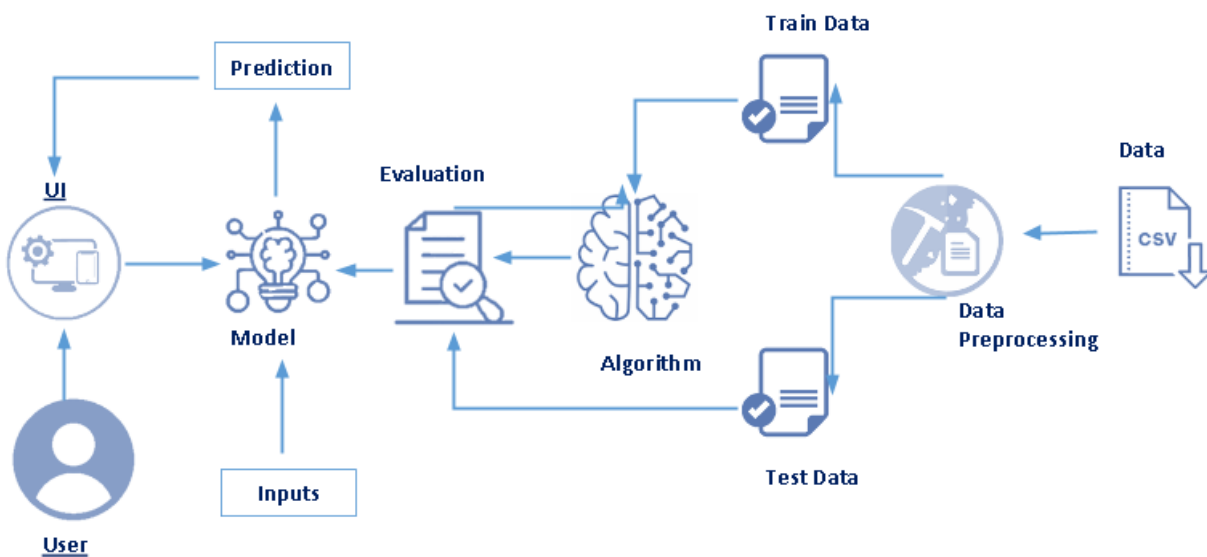
5.1 Data Flow Diagrams

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.



5.2 Solution & Technical Architecture

Solution architecture is a complex process – with many sub-processes – that bridges the gap between business problems and technology solutions. Its goals are to. Find the best tech solution to solve existing business problems. Describe the structure, characteristics, behavior, and other aspects of the software to project stakeholders. ☒ Define features, development phases, and solution requirements. Provide specifications according to which the solution is defined, managed, and delivered.



5.3 User Stories

The User Stories are:

- Customer(Mobile User)
- Customer(Web User)
- Customer Care Executive
- Administrator

6.PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning & Estimation

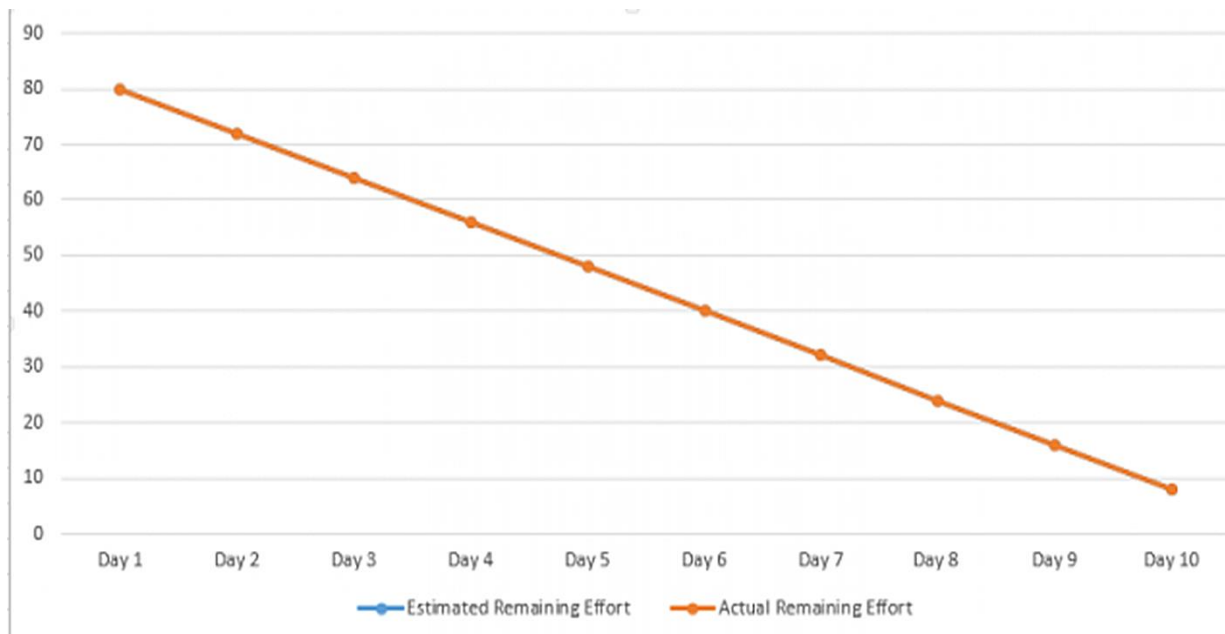
The number of order forecasts is of utmost importance to determine the right courier supply in a city. Based on the insights gathered, shown in Figure 9, planning supply is key for Wolt to be ready and to keep the consumers satisfied with an excellent delivery service level. This process of planning supply is carried out by creating Scheduled Hours slots to the couriers in advance. The number of Scheduled Hour slots would correlate with the expected orders of that week. Therefore, the OMs need to know how many orders they expect to plan better at a specific time of the day or week. For example, if they know the weekdays' demand increases, then they would add the Scheduled Hours on the weekends because they need more supply. In contrast to the hourly or daily expected orders, the OMs would also like to see a significant granular forecast (weekly or monthly), since they could plan the onboarding of couriers, if necessary.

6.2 Sprint Delivery Schedule

We have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) per iteration unit (story points per day).

$$AV = \frac{\text{sprint duration}}{\text{velocity}} = \frac{20}{10} = 2$$

6.3 Reports From JIRA



7.CODING & SOLUTIONING

7.1 & 7.2 Feature 1 & Feature 2

```
import numpy as np
import pandas as pd
pd.set_option('display.max_columns', None)
import matplotlib.pyplot as plt
import matplotlib.patches as mpatches
matplotlib inline
import seaborn as sns
import plotly.io as pio
import plotly.graph_objects as go
from plotly.offline import init_notebook_mode, iplot
from sklearn.preprocessing import StandardScaler
import warnings
warnings.filterwarnings('ignore')
```

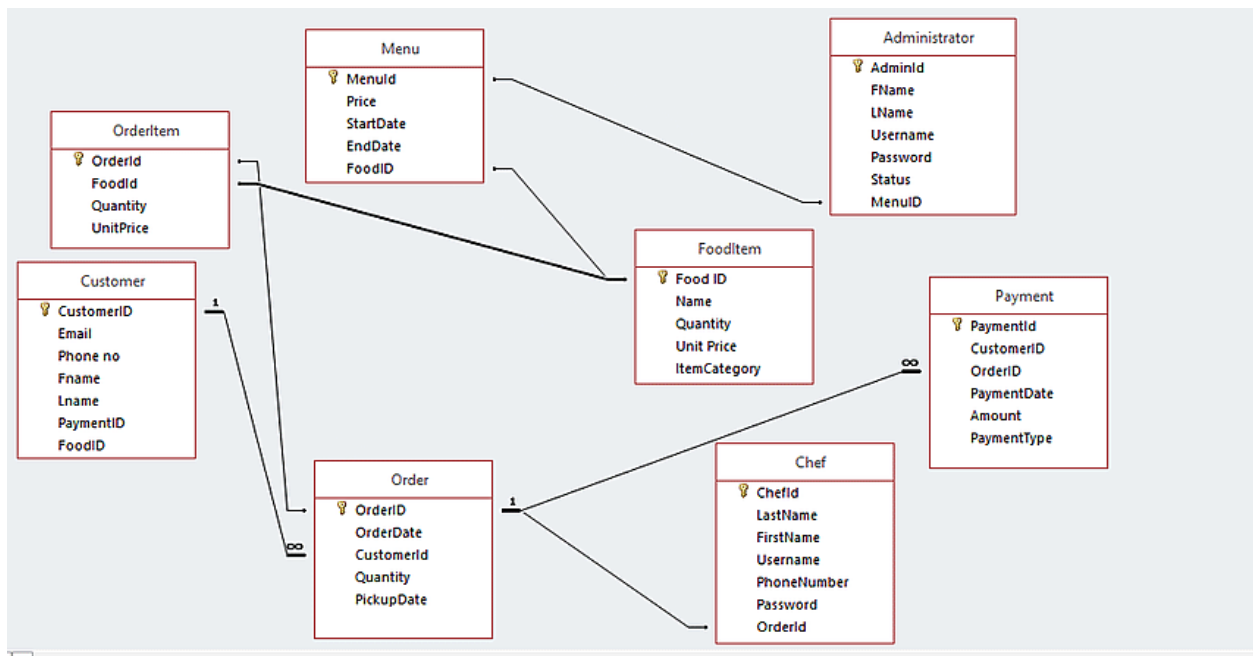
```
data=pd.read_csv('train.csv')
center=pd.read_csv('fulfilment_center_info.csv')
meal=pd.read_csv('meal_info.csv')
test=pd.read_csv('test_QoiMO9B.csv')
```

SOFTWARE FEATURES USED FOR THIS CODE

- Anaconda.
- Jupyter notebook.
- Spyder IDE.

- Numpy.
- Pandas.
- Matplotlib.
- Seaborn.
- Sklearn/Scikit-learn.
- Flask.

7.3 Database Schema



8.TESTING

8.1 Test Cases

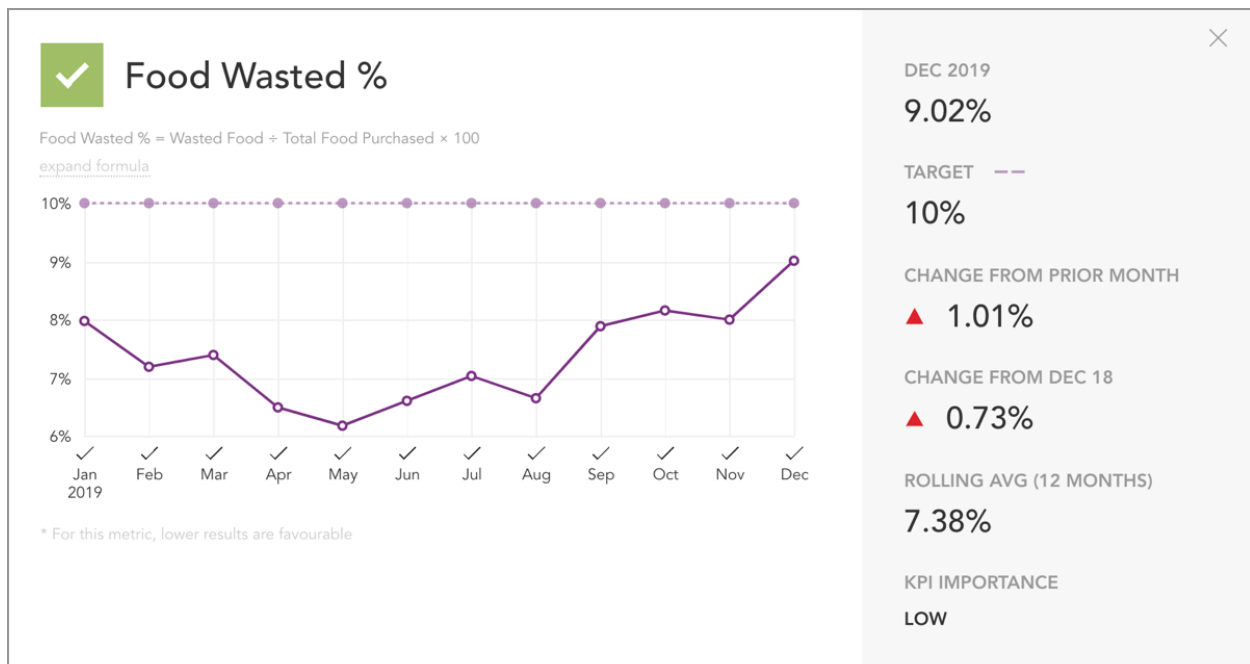
The purpose of testing is to discover errors. Testing is the process of trying to discover every conceivable fault or weakness in a work product. It provides a way to check the functionality of components, sub-assemblies, assemblies and/or a finished product. It is the process of exercising software with the intent of ensuring that the Software System meets its requirements and user expectations and does not fail in an unacceptable manner.

8.2 User Acceptance Testing

User Acceptance Testing is a critical phase of any project and requires significant participation by the end user. It also ensures that the system meets the functional requirements.

9.RESULTS

9.1 Performance Metrics



10. ADVANTAGES & DISADVANTAGES

Advantages

- Easy to use and deploy.

Disadvantages

- Requires maintaining dataset and regular update and testing.

11.CONCLUSION

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.

12.FUTURE WORK

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.

13.APPENDIX

Source Code & Project Demo Link

<https://github.com/IBM-EPBL/IBM-Project-54962-1663228187.git>