FOOD ITEM RECOMMENDATION, PREDICTION MODEL ALONG WITH FOOD ORDER MANAGEMENT AND DATA ANALYTICS.

Sharukhali Syed *
Student
Department of AI&DS
Thakur college of engineering and technology, Kandivali
Mumbai-400101, INDIA
shahsai11111@gmail.com

***Abstract*s - Data science powered by artificial intelligence and machine learning is a rapidly growing field that has the potential to transform various industries. In this research paper, we have leveraged this technology to develop a recommendation and prediction model that can assist kitchen staff in hotels or canteens in making informed decisions about food preparation and purchasing.[9][10]**

Our model uses past data to recommend food items that can be prepared during free time when there are no orders, increasing productivity and reducing food waste. Additionally, the model predicts the demand for specific food items on any given day, enabling staff to purchase the right amount of ingredients and avoid stockouts or excess inventory.[10]

The effectiveness of our model was evaluated using real-world data from our college canteen, and the results demonstrate its potential to improve operational efficiency and reduce costs. The model's ability to adapt to changing patterns in customer behavior makes it a valuable tool for food service establishments seeking to stay competitive in an increasingly dynamic market.

Overall, this research highlights the power of data science and machine learning to revolutionize the food industry, and the potential benefits it can bring to businesses and consumers alike.[2][3]

Keywords- data modelling, data management, artificial intelligence, machine learning, business analytics, probability modelling, food item prediction, food item recommendation, predictive analytics, data pre-processing, collaborative filtering, content based filtering, customer behaviour, data base management.

I. INTRODUCTION

Data science has become an essential component in the success of businesses in today's competitive world. With the increasing availability of data, companies are seeking ways to leverage this information to make more informed decisions and gain a competitive edge. Data science is a rapidly evolving field that focuses on the extraction of knowledge and insights from large, complex data sets. It uses various statistical and machine learning techniques to analyze and model data, ultimately providing organizations with valuable insights to improve decision-making and drive business growth.[9][10]

In this research paper, a novel data science model that uses data science techniques to provide recommendations and predictions for the food industry is proposed. Specifically, this model focusses on a recommendation and prediction for hotels, restaurants, and canteens that can help optimize their daily operations.[9]

The model presented in this research paper is designed to provide recommendations for food items that can be cooked during free hours in a canteen or restaurant based on past data. By analyzing historical data, the model can identify food items that are frequently ordered and can be prepared during periods of low customer demand, helping to reduce waste and optimize kitchen operations. In addition, the model provides predictions for food items that are likely to be popular on a given day based on probabilities calculated from historical data, allowing for better inventory management and greater profitability.

The development of this model was made possible through the use of advanced data management, artificial intelligence, and machine learning techniques. These techniques allowed us to build a powerful recommendation and prediction engine that can be used to improve decision-making in the food industry. By leveraging data science and business analytics, companies can optimize their operations, reduce waste, and increase profitability.

In this research paper, a detailed description of the working of the model is explained. The results of the model are also presented, including its accuracy and the benefits it can provide to the food industry. Ultimately, this research paper aims to demonstrate the power of data science and its ability to revolutionize the way businesses operate in the food industry.[1][2][3]

II. METHODS

The food recommendation and prediction model was developed using a combination of Python programming language and SQL database management system. The following libraries and tools were used in the development of the model:

Pandas: Used for data preprocessing and manipulation.

Matplotlib: Used for data visualization.

Tkinter: Used to create a graphical user interface (GUI) for the model.

Tkcalendar: Used to provide a calendar widget for date selection in the GUI.

Numpy: Used for numerical computations and operations on arrays.

MySQL Connector: Used to connect to the MySQL database and perform operations on the data stored in the database.

PIL (Python Imaging Library): Used to process and display images in the GUI.[5][6][7][8]

The food recommendation and prediction model was developed using a three-layer architecture, consisting of a GUI layer, a logic layer, and a database layer. The GUI layer was developed using Tkinter, which provides a user-friendly interface for inputting data and displaying results. The logic layer was developed using Python, which performs the calculations and operations necessary for the recommendation and prediction of food items. The database layer was developed using SQL, which stores and retrieves data from the MySQL database.

The food data was collected from various sources and was preprocessed using Pandas. The data was then stored in the MySQL database, where it was manipulated and analyzed to generate recommendations and predictions. The results were visualized using Matplotlib and displayed in the GUI.
The model was trained on a dataset of food items, including information about the food items, such as date, time of purchase and quantity of purchase. The model was then tested on a separate dataset to evaluate its performance.[6]

III. METHODOLOGY

In this model first the data is stored in the database at the counter/reception where the name of the item, quantity purchased, total money, date and time are stored. for the recommendation system the past data is fetched and only the items sold on the same hour in the past same days (i.e. Monday, Tuesday, etc) is selected and then they are sorted based on their quantity sold and then the top 5 food items are displayed that can be cooked in the free hour to reduce the waiting time of customers. For the prediction system, the probability of food items is calculated for the day selected based on the data of the selected day and then the probabilities of the past same days are also calculated and then their mean is taken and then this data is converted into visual representation and tabular form so that the items can be purchased according for cooking for a particular day this will maximize the profit an minimize the loss.[4]

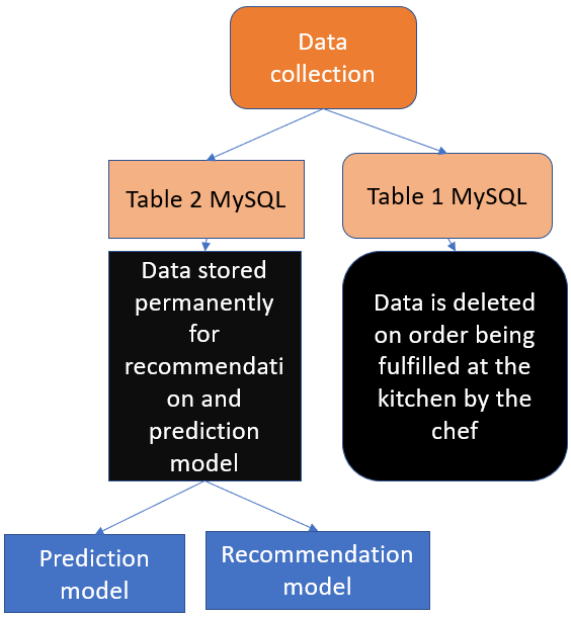


Fig. 1. Data collection [*author's own work*]

IV. APPLICATION OVERVIEW

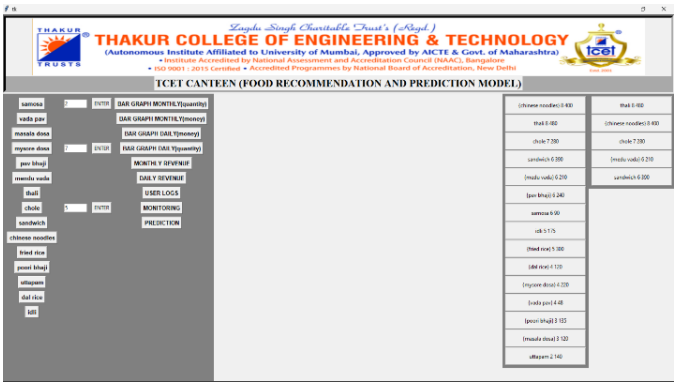


Fig. 2. Application overview [*author's own work*]

1. In the above picture of the application, there are 4 columns, the left most is for entering the orders
   - Whenever an item along with its quantity is entered its total cost is calculated in the backend and is stored in the database along with the data and time.
   - While storing the data, the data is stored in two tables, where one table is for storing the current orders pending and the next for permanent storage for data analysis, recommendation system and prediction system
2. The second column is for performing various operations and analysis whose working is explained in the later part of the paper
3. The third column shows the current orders
   If an item is cooked by the chef, then chef can click that item and then that item will be removed from this column in the application and will be deleted from the first table in the database.
4. The fourth table depicts the recommendation model whose working is explained in the coming part of the paper

V. WORKING OF THE RECOMMENDATION MODEL

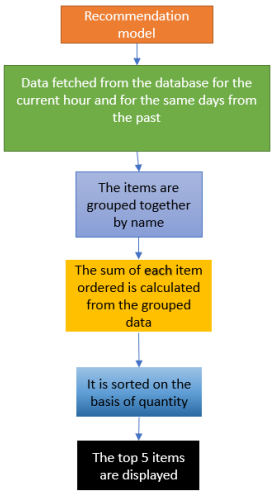


Fig. 3. Flowchart of recommendation model [*author's own work*]

1. The data is fetched from the database for the current hour slot based on the past same days.
2. Suppose if the day is Monday and the time is 12:20 then all the data for the time slot 12-13 pm and for all the past Mondays will be fetched from database.
3. Here the data is fetched only for the same days because people usually follow the same trend for same days, since there is high probability for a person to eat the same food item on particular days like a student of a college might usually eat a particular food item in Monday and another on Tuesday and follow this trend. So for good accuracy in prediction, the data is fetched only for those days.
4. The second reason for this is timing, usually in colleges, there is fixed time table and hence majority of people usually come in recess time and hence the recommendation system here would be very accurate since along with the same days it is fetching and computing data for the Same time slot like if the current time is 2:35, then the data will be fetched for the time slot 2:00 to 3:00. This would give precise recommendations with a very less variation.
5. Then the items will be grouped together, i.e., there might be many orders for the same item then their sum will be calculated.
6. the food items will then be sorted based on their quantities. And only the top five food items will be displayed.
7. As it can be noticed, the recommendation model sorts the items based on quantity and also displays the total amount which it sums to.

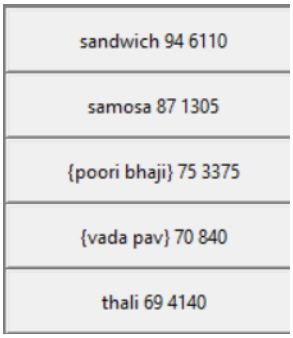


Fig. 4. Recommendation column of application [*author's own work*]

VI. WORKING OF THE PREDICTION MODEL

1. first the date in input from the calendar displayed

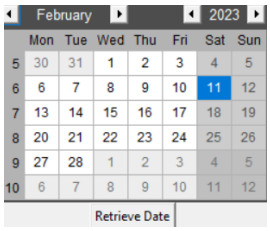


Fig. 5. Calendar for accepting the date [*author's own work*]

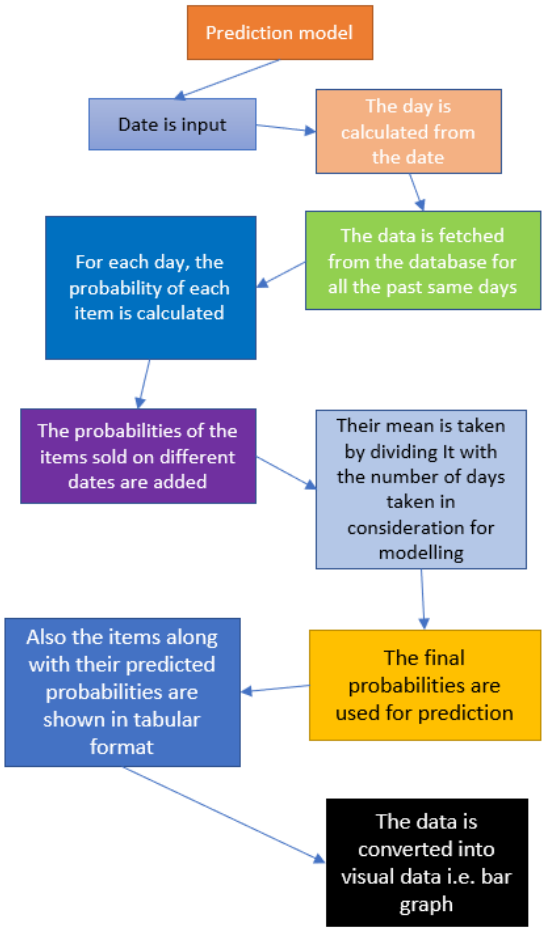


Fig. 6. Flowchart of prediction model [*author's own work*]

2. then the data is fetched from the database for the given date and the probability of each item is calculated as shown below

$$\frac{\sum quantity\ of\ an\ item}{\sum quantities\ of\ all\ items\ sold}$$

3. the probabilities of all the items are calculated in the same way [10]
4. then the probabilities of all the items for the past same days is also calculated by fetching the data from the database for the past same days and then the mean is taken for the probabilities of each item as shown below

$$\frac{\sum probabilites\ of\ an\ item}{\sum number\ of\ days\ data\ is\ fetched\ from\ past}$$

5. in this way the average probability of each item is calculated for the same days in the past (here day means Monday, Tuesday, etc) [10]
6. This can be understood as suppose the day chosen is Monday, Then the data is retrieved for Monday, then the items with the same name are grouped together and the total number of items sold for each item is calculated. Then the sum of the items sold is calculated and the probability of each item is

calculated by dividing with the sum. The same procedure is follower for all the past Mondays. Then for each item suppose it is 'samosa' then the probability of samosa is added for all the Mondays and then it is divided by the number of Mondays for which the data is manipulated, this is done to increase the accuracy of the prediction system since if we directly add the quantitates sold for a particular item for all the days and then find the probabilities then it would be very inaccurate since there might be days where due to some events etc the sale of items were decreased but this will not affect the prediction if we directly find the sum and find the probability therefore first we have to find the probability of an item separately for each day and then take its mean this would be more accurate. This could be better understood by the below graphical explanation.

7. this data is then displayed on the application and also its visual representation is displayed i.e., it is converted into a bar graph as shown below

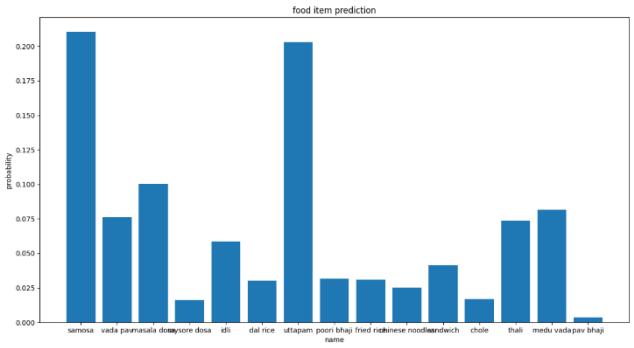


Fig. 7. Prediction graph [*author's own work*]

name	probability
samosa	0.210481
vada pav	0.0761721
masala dosa	0.100148
mysore dosa	0.016213
idli	0.0586453
dal rice	0.0300533
uttapam	0.20299
poori bhaji	0.031635
fried rice	0.0308374
chinese noodles	0.025308
sandwich	0.0415208
chole	0.0170038
thali	0.0737993
medu vada	0.0816346
pav bhaji	0.00355894

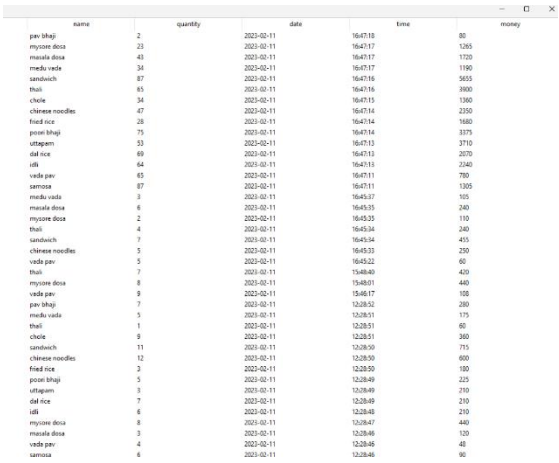
Fig. 8. Prediction table with probabilities [*author's own work*]

VII. DATA ANALYSIS

There are also several options in the application which can be very useful for data analysis

A. USER LOGS

This will show the history of purchases for the selected date which will be inputted from the displayed calendar upon clicking the user logs button



name	quantity	date	time	money
pav bhaji	2	2023-02-11	16:47:10	80
mysore dosa	23	2023-02-11	16:47:17	1265
masala dosa	43	2023-02-11	16:47:17	1720
medu vada	34	2023-02-11	16:47:17	1190
sandwich	87	2023-02-11	16:47:16	5655
thali	65	2023-02-11	16:47:16	3900
chole	34	2023-02-11	16:47:15	1360
chinese noodles	47	2023-02-11	16:47:14	2350
fried rice	28	2023-02-11	16:47:14	1680
poori bhaji	75	2023-02-11	16:47:14	3375
uttapam	53	2023-02-11	16:47:13	3710
dal rice	69	2023-02-11	16:47:13	2070
idli	64	2023-02-11	16:47:13	2240
vada pav	65	2023-02-11	16:47:11	780
samosa	87	2023-02-11	16:47:11	1305
medu vada	3	2023-02-11	16:45:37	105
masala dosa	6	2023-02-11	16:45:35	240
mysore dosa	2	2023-02-11	16:45:35	110
thali	4	2023-02-11	16:45:34	240
sandwich	7	2023-02-11	16:45:34	455
chinese noodles	5	2023-02-11	16:45:33	250
vada pav	5	2023-02-11	16:45:22	60
thali	7	2023-02-11	15:48:40	420
mysore dosa	8	2023-02-11	15:48:01	440
vada pav	9	2022-02-11	15:46:17	108
pav bhaji	7	2023-02-11	12:28:52	280
medu vada	5	2023-02-11	12:28:51	175
thali	1	2023-02-11	12:28:51	60
chole	9	2023-02-11	12:28:51	360
sandwich	11	2023-02-11	12:28:50	715
chinese noodles	12	2023-02-11	12:28:50	600
fried rice	3	2023-02-11	12:28:50	180
poori bhaji	5	2023-02-11	12:28:49	225
uttapam	3	2023-02-11	12:28:49	210
dal rice	7	2023-02-11	12:28:49	210
idli	6	2023-02-11	12:28:48	210
mysore dosa	8	2023-02-11	12:28:47	440
masala dosa	3	2023-02-11	12:28:46	120
vada pav	4	2023-02-11	12:28:46	48
samosa	6	2023-02-11	12:28:46	90

Fig. 9. User logs windows [*author's own work*]

B. MONITERING

a. This will first display the user logs for the selected date

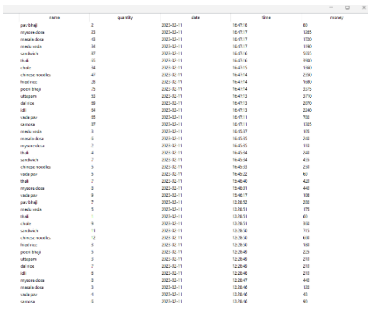


Fig. 10. User logs window [*author's own work*]

b. Then it will display the bar graph of items sold that day

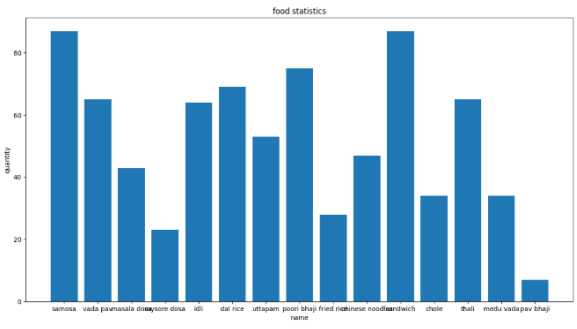


Fig. 11. Bar graph (item quantity vs name of item) [*author's own work*]

c. Then it will show the total revenue earned that day

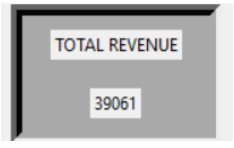


Fig. 12. Application overview [*author's own work*]

C. MONTHLY REVENUE

This will display the total monthly revenue of that month

Fig. 13. Application overview [*author's own work*]

D. MONTHLY ANALYSIS (MONEY)

This will show the monthly statistics of the items sold that month in terms of money

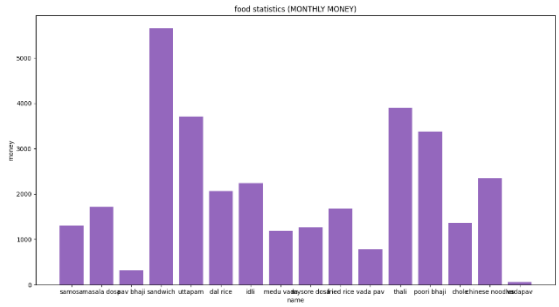


Fig. 14. Bar graph (money vs name of item) [*author's own work*]

E. MONTHLY ANALYSIS (QUANTITY)

This will show the monthly statistics of the items sold that month in terms of quantity

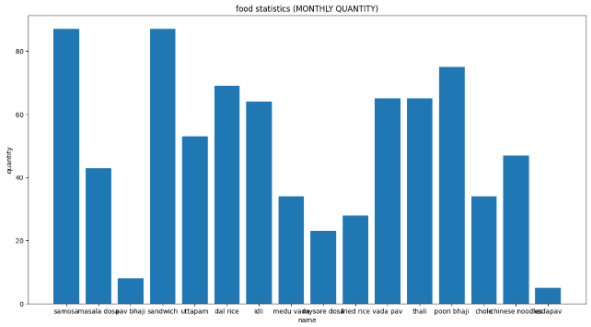


Fig. 15. Bar graph (item quantity vs name of item) [*author's own work*]

F. DAILY ANALYSIS(QUANTITY)

This will show the analysis of items sold that day in terms of quantity

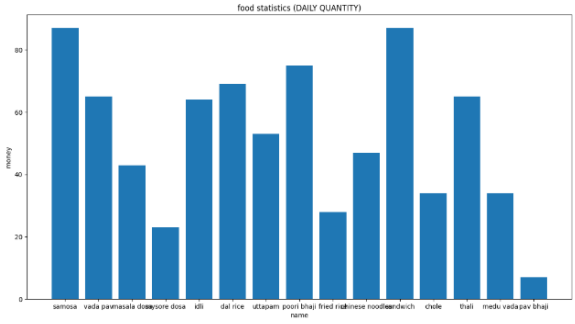


Fig. 16. Bar graph (item quantity vs name of item) [*author's own work*]

G. DAILY ANALYSIS(MONEY)

This will show the analysis of items sold that day in terms of money

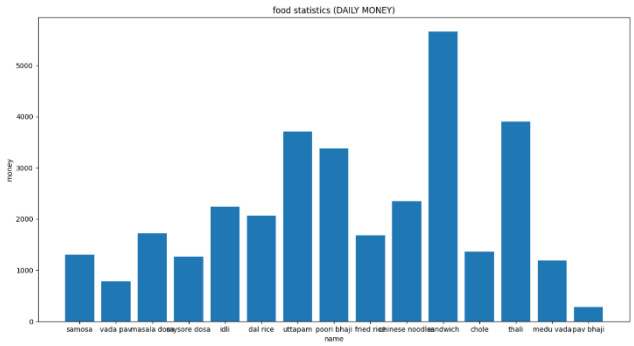


Fig. 17. Bar graph (money vs name of item) [*author's own work*]

VIII. ADVANTAGES OF THE PROPOSED MODEL

1. Reduced Cooked food wastage: The food recommendation model can help to reduce cooked food wastage by providing accurate predictions of food demand. This can help hotel and canteen operators to plan for the appropriate quantities of food to be prepared, reducing the risk of over-preparing food that may go to waste.
2. Reduced Food material wastage: The prediction model can help to reduce food material wastage by providing accurate predictions of food demand. This can help hotel and canteen operators to plan for the appropriate quantities of food materials to be purchased, reducing the risk of over-purchasing food materials that may go to waste.
3. Crowd management: The recommendation model can help to manage crowds in hotels and canteens by providing accurate predictions of food demands and hence fulfilling the order as soon as it is ordered. This can help operators to plan for staffing and seating arrangements, reducing wait times and improving customer experience.
4. Customer health and hygiene: if the food materials are ordered on guess work, then there might be high chances for materials to be left unused and if they are used for cooking after many days of storage then they can affect the health of the customers. This problem can be solved using the prediction model proposed.
5. Profitability: The prediction model can help hotel and canteen operators to improve their profits by providing accurate predictions of food demand. This can help operators to make informed decisions about which foods to include on their menus and to plan for the appropriate quantities of food to be prepared.
6. Pricing: the products can be priced accordingly based on the data analysis provided in the created application.
7. Menu changes: the menu items can be changed, i.e., if some food items are sold rarely then those can be removed from the menu using the data analysis techniques provided in the application.

IX. FUTURE DIRECTIONS

1) Expanding the dataset to include more food-related data such as nutritional information, ingredient lists, or customer reviews for more personalized recommendations and predictions.[1]
2) Experimenting with different machine learning algorithms, such as neural networks or decision trees, to improve the accuracy of the model.[2]
3) Developing a personalized recommendation system by incorporating user feedback and using techniques such as collaborative filtering or content-based filtering.[5]
4) Collecting feedback from users through surveys or feedback forms embedded in the GUI to continually improve the model.[4]
5) Optimizing preprocessing techniques, such as data cleaning or feature engineering, to further improve the accuracy and efficiency of the model.[7]
6) Testing the model on a larger and more diverse dataset to ensure its robustness and generalizability.[8]
7) Integrating the food recommendation and prediction model with other tools or systems, such as inventory management software or customer relationship management systems, for even more valuable insights and optimization of overall business operations.[6]

X. ACKNOWLEDGMENT

I would like to express my sincere gratitude to Ms. Siddhi Shekhar Ambre, my mentor, for her guidance and support throughout the research process. Her expert advice, insightful comments, and constructive feedback were instrumental in shaping this work. I am also grateful to TCET for providing me with the opportunity to present this research at the Multicon event, a prestigious forum for the publication of research papers. Their encouragement and support have been instrumental in making this project possible. I would also like to acknowledge the efforts of the Multicon organizing committee for providing a platform to showcase our research.

XII. CONCLUSION

It can be concluded that profit for any hotel/canteen/etc can be maximized and the loss can be minimized with the use of the application and the recommendation and prediction model. Acknowledgment

The prediction model created can be utilized for purchasing the materials for cooking the food according to the prediction which will minimize the loss of money due to rotting of unused materials due to improper guess work

The recommendation model will reduce the waiting time of customers and will reduce the crowd and will lead to better overall space management in the hotel/canteen since the chef can cook the food based on recommendation in the free time.

In this study, we presented a food recommendation and prediction model that was developed using a combination of Python programming language, SQL database management system, and Tkinter graphical user interface library. The model was designed to provide recommendations and predictions based on a user's food preferences and past food consumption patterns.

The results showed that the model was able to provide accurate recommendations and predictions based on the food data. The use of probabilities and the calculation of their mean improved the accuracy of the predictions made by the model. The graphical user interface provided by Tkinter was user-friendly and made it easy for users to input data and view results.

XIII. REFERENCES

[1] Xiaohong Iris Quan, Jihong Sanderson, *Understanding The Artificial Intelligence Business Ecosystem*, ieee explore.ieee.org, 2019

[2] Doug rose, *Artificial intelligence for business*, Pearson FT Press, Publication date : 9 December 2020

[3] Matt Taddy, *Business data science*, McGraw Hill Publication date : 23 August 2019.

[4] John Medicine, *artificial intelligence and machine learning for business*, new era publishing Ltd, year 2020

[5] Isaacson Walter, *Steve Jobs: the exclusive biography paperback*, ab-cus, 2015.

[6] Z. Zhang and Y. Zhang, "*Automated writing evaluation system: Tapping its potential for learner engagement*", *IEEE* Engineering Management Review, vol.46, no. 3, pp. 29-33,2018.

[7] R. Shams, "*Developing machine learning products better and faster at startups*", *IEEE Engineering Management Review*, vol. 46, no. 3, pp. 36-39, 2018.

[8] Carral, R. and Kajanto, M. (2008), *"Nokia: a case study in managing industry downturn"*, Journal of Business Strategy, Vol. 29 No. 1, pp. 25-33

[9] W. Min, S. Jiang and R. Jain, "Food Recommendation: Framework, Existing Solutions, and Challenges," in IEEE Transactions on Multimedia, vol. 22, no. 10, pp. 2659-2671, Oct. 2020, doi: 10.1109/TMM.2019.2958761.

[10] An Introduction to Probability Theory and Its Applications, Volume 1, 3rd Edition by William Feller, ISBN: 978-0-471-25708-0 January 1991