

Restaurant Business Prediction Analysing by Artificial Intelligence

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Step 1: Prototype Selection

Abstract

Food is an essential part of our lives. India is a diverse country with each region having its own special cuisine. Eating out was not much of Indian style, but the present senior is different. The restaurant industry in India has been emerging at a rapid pace in recent years and is expected to continue in upcoming years also. There has been exponential growth in food ordering startups in India over the past few years. To address this growth technology like Artificial Intelligence (AI) plays a vital role. Not only restaurant but street vendors too are now depended on such technology to increase their sale. The use of Artificial Intelligence will transform the restaurant industry and will help India to take a step ahead towards better economy. In this paper, we have presented a review on various AI based approaches utilized in restaurant Business.

1.Problem Statement

The restaurant industry faces various challenges that require attention and innovative solutions to thrive in a competitive market. Identifying and addressing these issues is crucial for the success and sustainability of a restaurant business.

The restaurant industry has an incredibly high turnover rate. Many new restaurants do not survive their first few years in business. In addition, the restaurant business is flooded with various factors that impact success (location, timing, atmosphere, food quality, etc), such that it can be extremely difficult to create a successful restaurant. We hope to analyse Yelp data to determine if there are certain factors that are most important for a successful restaurant. This study will be conducted individually for different cities, since geography plays an overwhelming role in food culture. In theory, our studies will reveal certain key points of success for a restaurant business.

2.Market/Customer/Business Need Assessment

Identify the target market for your restaurant, such as families, young professionals, or a specific cuisine-focused audience. Research the local area to understand the competition, demographics, and dining trends. Determine the size of the market and potential growth opportunities. Analyse consumer preferences and demands regarding food quality, pricing, ambiance, and convenience. Identify your target customers and create customer profiles (e.g., age, income level, interests, preferences). Understand their dining habits, such as frequency of dining out, preferred cuisines, and dining occasions. Identify customer pain points or unmet needs that your restaurant can address, such as limited healthy options, slow service, or lack of vegetarian/vegan choices. Determine the unique selling proposition (USP) of your restaurant that differentiates it from competitors. Assess the demand for your restaurant concept in the market. Evaluate the availability of necessary resources, including finances, skilled staff, suitable location, and required equipment.

3.Target Specifications and Characterization

Your target market is the subset of people who your product most appeals to. It's important to understand this subset because it will be the core of your business.

You might think of this group of people as repeat customers. It's important to understand repeat customers because it will help you identify what characteristics they share with one another and what it is that you offer that attracts loyal customers. Target market analysis is the process of learning these characteristics.

4.External Search (Information and Data Analysis)

The resources I used for gathering more information of the topics:

<https://dgenious.com/restaurant-analytics/>

<https://www.restroapp.com/blog/food-restaurant-business-ideas-always-work/>

<https://www.posist.com/restaurant-times/resources/complete-guide-opening-restaurant.html>

Data set I used for training and testing of model and Regression Algorithm:

<https://www.kaggle.com/code/ranganadhkodali/bangalore-restaurants-eda-analysis/input>

First import the basic libraries for data pre-processing:

```
In [82]: import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

Dataset Viewed:

```
In [65]: data = pd.read_csv("restaurant data.csv")
In [66]: data.head()
```

Out[66]:

	url	address	name	online_order	book_table	rate	votes	phone	location	rest_type	dish_li
0	https://www.zomato.com/bangalore/jalsa-banasha...	942, 21st Main Road, 2nd Stage, Banashankari, ...	Jalsa	Yes	Yes	4.1/5	775	080 42297555/r/n+91 9743772233	Banashankari	Casual Dining	Pa Lu Bu Ma: Paj Par La
1	https://www.zomato.com/bangalore/spice-elephan...	2nd Floor, 80 Feet Road, Near Big Bazaar, 6th ...	Spice Elephant	Yes	No	4.1/5	787	080 41714161	Banashankari	Casual Dining	Mon Lu Bu Choco Nirv: Thai
2	https://www.zomato.com/SanchurroBangalore?cont...	1112, Next to KIMS Medical College, 17th Cross...	San Churro Cafe	Yes	No	3.8/5	918	+91 9663487993	Banashankari	Cafe, Casual Dining	Chur Cannell Minestr Soup, Chi
3	https://www.zomato.com/bangalore/addhuri-udupi...	1st Floor, Annakuteera, 3rd Stage, Banashankar...	Addhuri Udupi Bhojana	No	No	3.7/5	88	+91 9620009302	Banashankari	Quick Bites	Ma: D
4	https://www.zomato.com/bangalore/grand-village...	10, 3rd Floor, Lakshmi Associates	Grand Village	No	No	3.8/5	166	8026612447/r/n+91 9994340005	Basavanagudi	Casual Dining	Panij Gol Ga

5.Benchmarking

Benchmarking in the restaurant business involves comparing your restaurant's performance and practices against industry standards and competitors to identify areas for improvement and best practices. Here are some key areas for benchmarking in the restaurant industry.

6.Applicable Patents

<https://patents.google.com/patent/US20130090959A1/en>

7.Applicable Regulations

- FSSAI License. This is the first and most important license you'll need to start a restaurant in India. ...

- Eating house license. ...
- Health/Trade license. ...
- Liquor license. ...
- GST Registration. ...
- Environmental clearance license.

8.Applicable Constraints

Labour Availability and Staffing

Seasonality and Demand Fluctuations

Customers Preferences and Changing Trends

Space and Infrastructure

9.Business Opportunity

Quick-Service or Fast Casual: The demand for quick-service or fast-casual restaurants has been on the rise. These establishments offer convenient and affordable options for customer seeking a faster dining experience without compromising on quality.

Food Truck or Pop-up Restaurant: Starting a food truck or pop-up restaurant can be a cost-effective way to enter the restaurant industry. These mobile or temporary setups allow you to serve customers in different locations, explore new markets, and build a following before committing to a permanent location.

Delivery and Takeout: The popularity of food delivery services has skyrocketed in recent years, and it presents a significant opportunity for restaurant businesses. You can establish a delivery-focused restaurant that partners with existing delivery platforms or create your own delivery service to reach a wider customer base.

Specialty Desserts and Beverages: Opening a dessert bar, a specialty bakery, or a cafe that focuses on unique and high-quality desserts and beverages can attract a niche customer base. Consider offering custom creations, seasonal flavours, or themed dessert experiences.

Franchise Opportunities: Franchising an established restaurant brand can provide a turnkey business opportunity with proven systems, brand

recognition, and ongoing support. Research popular franchises in your area and explore the requirements for becoming a franchisee.

10. Concept Generation

Remember to thoroughly research your target market and location to ensure your chosen concept aligns with the local demand and trends. Good luck with your restaurant business.

Farm-to-Table Delights: Focus on sourcing fresh, locally grown ingredients to create a menu that highlights seasonal flavours. Emphasize sustainability and offer a variety of vegetarian and vegan options.

Health-Conscious Eatery: Cater to health-conscious individuals by offering a menu focused on nutritious, organic, and low-calorie options. Provide detailed nutritional information for each dish and offer gluten-free, paleo, and keto-friendly alternatives.

Hyperparameters:

In the context of a restaurant business, hyperparameters refer to the key decisions and variables that can significantly impact the success and operations of the establishment. Here are some important hyperparameters to consider:

Cuisine and Menu: Decide on the type of cuisine you will specialize in and develop a well-curated menu. Consider factors such as the target market, local preferences, and available ingredients.

Pricing Strategy: Determine the pricing structure for your menu items. Consider factors like ingredient costs, overhead expenses, competitor pricing, and target market affordability.

Ambiance and Decor: Create a unique and inviting atmosphere that aligns with your target customers and concept. Decide on the interior design, lighting, music, seating arrangements, and overall ambiance.

Analysis:

```
In [4]: data.shape
```

```
Out[4]: (51717, 17)
```

```
In [5]: data.dtypes
```

```
Out[5]: url                object
address                object
name                  object
online_order          object
book_table            object
rate                 object
votes                int64
phone                object
location             object
rest_type            object
dish_liked           object
cuisines             object
approx_cost(for two people) object
reviews_list         object
menu_item            object
listed_in(type)      object
listed_in(city)      object
dtype: object
```

```
In [6]: data.columns
```

```
Out[6]: Index(['url', 'address', 'name', 'online_order', 'book_table', 'rate', 'votes',
              'phone', 'location', 'rest_type', 'dish_liked', 'cuisines',
              'approx_cost(for two people)', 'reviews_list', 'menu_item',
              'listed_in(type)', 'listed_in(city)'],
              dtype=object)
```

Pre-processing

```
In [8]: data = data.drop(['url', 'address', 'phone', 'dish_liked', 'menu_item', 'reviews_list'], axis = 1)
data.head()
```

```
Out[8]:
```

	name	online_order	book_table	rate	votes	location	rest_type	cuisines	approx_cost(for two people)	listed_in(type)	listed_in(city)
0	Jalsa	Yes	Yes	4.1/5	775	Banashankari	Casual Dining	North Indian, Mughlai, Chinese	800	Buffet	Banashankari
1	Spice Elephant	Yes	No	4.1/5	787	Banashankari	Casual Dining	Chinese, North Indian, Thai	800	Buffet	Banashankari
2	San Churro Cafe	Yes	No	3.8/5	918	Banashankari	Cafe, Casual Dining	Cafe, Mexican, Italian	800	Buffet	Banashankari
3	Addhuri Udupi Bhojana	No	No	3.7/5	88	Banashankari	Quick Bites	South Indian, North Indian	300	Buffet	Banashankari
4	Grand Village	No	No	3.8/5	166	Basavanagudi	Casual Dining	North Indian, Rajasthani	600	Buffet	Banashankari

```
In [9]: data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 51717 entries, 0 to 51716
Data columns (total 11 columns):
#   Column              Non-Null Count  Dtype
---  -
0   name                 51717 non-null  object
1   online_order         51717 non-null  object
2   book_table           51717 non-null  object
3   rate                 43942 non-null  object
4   votes                51717 non-null  float64
```

```
In [12]: def handlerate (value):
          if(value == 'NEW' or value == '-'):
              return np.nan
          else:
              value = str(value).split('/')
              value = value[0]
              return float(value)
          data['rate'] = data['rate'].apply(handlerate)
          data['rate'].head()
```

```
Out[12]: 0    4.1
          1    4.1
          2    3.8
          3    3.7
          4    3.8
          Name: rate, dtype: float64
```

```
In [13]: data.rate.isnull().sum()
```

```
Out[13]: 10019
```

```
In [14]: data.rate.fillna(data['rate'].mean(), inplace = True)
          data['rate'].isnull().sum()
```

```
Out[14]: 0
```

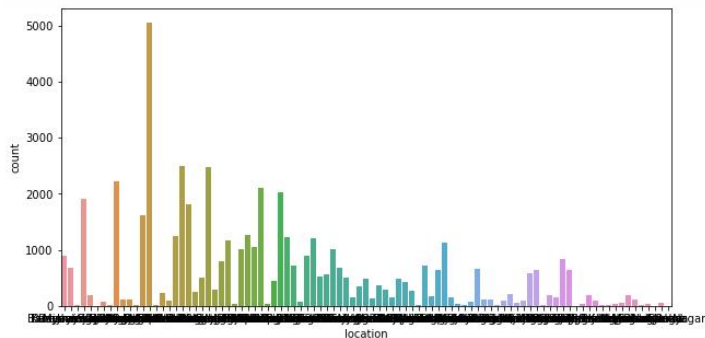
```
In [15]: data.isnull().sum()
```

```
Out[15]: name                0
          online_order        0
```

Visualizing dataset

```
In [18]: plt.figure(figsize = (10,5))
ax = sns.countplot(data['location'])
#plt.xticks(rotation = 90)
```

C:\Users\mdakr\anaconda3\lib\site-packages\seaborn\decorators.py:36: FutureWarning: Pass the following variable as a keyword argument: x. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpretation.
warnings.warn()

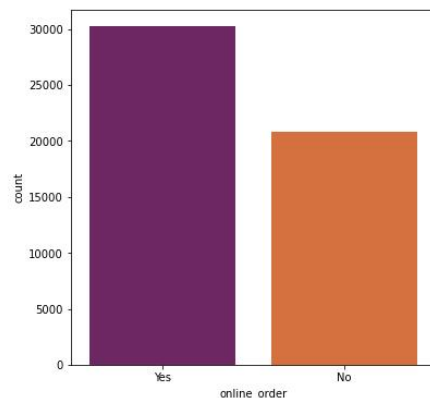


```
In [30]: plt.figure(figsize = (6,6))
sns.countplot(data['online_order'], palette = 'inferno')
```

```
In [30]: plt.figure(figsize = (6,6))
sns.countplot(data['online_order'], palette = 'inferno')
```

C:\Users\mdakr\anaconda3\lib\site-packages\seaborn\decorators.py:36: FutureWarning: Pass the following variable as a keyword argument: x. From version 0.12, the only valid positional argument will be `data`, and passing other arguments without an explicit keyword will result in an error or misinterpretation.
warnings.warn()

Out[30]: <AxesSubplot:xlabel='online_order', ylabel='count'>



Splitting the dataset for training and testing


```
In [21]: # Split the data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
```

```
In [31]: X_train
```

```
Out[31]:
```

	votes	online_order
33808	364	Yes
47323	8	No
35772	142	Yes
39245	14	No
8958	0	Yes
...
11396	0	No
45285	0	No
38621	1597	No
864	1964	Yes
15971	917	No

40833 rows × 2 columns

Model Prediction

```
In [22]: from sklearn.preprocessing import OneHotEncoder
```

```
In [23]: # Initialize OneHotEncoder
encoder = OneHotEncoder(sparse=False, handle_unknown='ignore')
```

```
In [24]: # Fit and transform the categorical features in the training set
X_train_encoded = encoder.fit_transform(X_train)
```

```
In [25]: # Transform the categorical features in the testing set
X_test_encoded = encoder.transform(X_test)
```

```
In [26]: from sklearn.linear_model import LinearRegression
```

```
In [27]: # Initialize the Linear Regression model
model = LinearRegression()
```

```
In [28]: # Train the model
model.fit(X_train_encoded, y_train)
```

```
Out[28]: LinearRegression()
```

11. Concept Development

Utilizing artificial intelligence (AI) in the concept development of a restaurant business can offer unique opportunities to enhance customer experiences, optimize operations, and provide personalized services.

12. Final Product Prototype/ Product Details

Product Details: Our AI-enhanced restaurant management system is designed to optimize various aspects of restaurant operations, streamline processes, and deliver a personalized dining experience. It incorporates artificial intelligence and machine learning algorithms to improve efficiency, enhance customer satisfaction, and increase profitability. Here are the key features and details of the product prototype.

a) Feasibility

The feasibility of a restaurant business in machine learning (ML) depends on various factors specific to ML integration within the restaurant industry.

b) Viability

The viability of a restaurant business incorporating machine learning (ML) depends on several factors that need to be carefully considered. Here are key aspects to assess the viability of a restaurant business in ML:

ML Applications in the Restaurant Industry: Evaluate the specific ML applications that can benefit your restaurant business. This could include personalized menu recommendations, demand forecasting, customer sentiment analysis, inventory optimization, fraud detection, or automated processes. Determine the potential impact of ML on improving operational efficiency, enhancing customer experiences, and increasing profitability.

Data Availability and Quality: Assess the availability and quality of data required for ML implementation. ML algorithms rely on large volumes of quality data for training and making accurate predictions. Evaluate if your restaurant has access to relevant data, such as customer preferences, sales data, inventory information, and operational metrics, and if it can be effectively collected and stored.

c) Monetization

Monetizing a restaurant business that incorporates machine learning (ML) can be achieved through various avenues. Here are some potential monetization strategies:

Enhanced Customer Experience: Utilize ML algorithms to provide personalized and tailored experiences to customers. This can include personalized menu recommendations, customized offers and promotions, and targeted marketing campaigns. By delivering a superior customer experience, you can increase customer satisfaction and loyalty, leading to repeat business and positive word-of-mouth referrals.

Upselling and Cross-Selling: ML algorithms can analyse customer data and preferences to suggest relevant upsell and cross-sell opportunities. By leveraging ML-powered recommendations, you can increase average order value and generate additional revenue. For example, the system can suggest wine pairings or complementary dishes to enhance the dining experience and drive higher sales.

Step 2: Prototype Development

Github Link:

https://github.com/mdakram4300/Restaurent_Business_Analysis-Fynn_Labes.git

Step 3: Business Modelling

Business modelling for a restaurant business involves creating a framework that outlines key elements of your business, including your value proposition, target market, revenue streams, cost structure, and key activities. Business modelling for a restaurant business that incorporates machine learning (ML) involves integrating ML into various aspects of your business model.

It's important to continuously evaluate and refine your business model as you implement ML in your restaurant business. Stay updated on the latest ML advancements, monitor market trends, and seek feedback from customers to ensure that your ML-driven initiatives align with their expectations and deliver tangible value to your business.

Step 4: Financial Modelling

To design a linear financial model for a restaurant business, where the market is growing linearly, we can use the equation:

$$y = m * x(t) + c$$

Where:

- y represents the total profit of the restaurant.
- m is the pricing of your product, representing the profit per unit sold.
- x(t) represents the total sales, which is a function of time and represents the market growth.
- c represents the production, maintenance, and other costs associated with running the restaurant businesses.

Conclusion

In conclusion, incorporating Artificial Intelligence (AI) and Machine Learning (ML) into a restaurant business has the potential to revolutionize operations, enhance customer experiences, optimize processes, and drive financial success.

It's important to note that successful implementation of AI and ML in a restaurant business requires careful planning, investment in technology infrastructure, data management, and staff training. Additionally, ethical considerations, data privacy, and security must be addressed to maintain customer trust.

Overall, by harnessing the power of AI and ML, restaurants can enhance customer experiences, streamline operations, drive revenue growth, and gain a competitive edge in the dynamic and evolving restaurant industry.