Project Python Foundations: FoodHub Data Analysis

Marks: 60

Context

The number of restaurants in New York is increasing day by day. Lots of students and busy professionals rely on those restaurants due to their hectic lifestyles. Online food delivery service is a great option for them. It provides them with good food from their favorite restaurants. A food aggregator company FoodHub offers access to multiple restaurants through a single smartphone app.

The app allows the restaurants to receive a direct online order from a customer. The app assigns a delivery person from the company to pick up the order after it is confirmed by the restaurant. The delivery person then uses the map to reach the restaurant and waits for the food package. Once the food package is handed over to the delivery person, he/she confirms the pick-up in the app and travels to the customer's location to deliver the food. The delivery person confirms the drop-off in the app after delivering the food package to the customer. The customer can rate the order in the app. The food aggregator earns money by collecting a fixed margin of the delivery order from the restaurants.

Objective

The food aggregator company has stored the data of the different orders made by the registered customers in their online portal. They want to analyze the data to get a fair idea about the demand of different restaurants which will help them in enhancing their customer experience. Suppose you are hired as a Data Scientist in this company and the Data Science team has shared some of the key questions that need to be answered. Perform the data analysis to find answers to these questions that will help the company to improve the business.

Data Description

The data contains the different data related to a food order. The detailed data dictionary is given below.

Data Dictionary

- order_id: Unique ID of the order
- customer_id: ID of the customer who ordered the food
- restaurant_name: Name of the restaurant
- cuisine_type: Cuisine ordered by the customer
- cost: Cost of the order
- day_of_the_week: Indicates whether the order is placed on a weekday or weekend (The weekday is from Monday to Friday and the weekend is Saturday and Sunday)
- rating: Rating given by the customer out of 5
- food_preparation_time: Time (in minutes) taken by the restaurant to prepare the food. This is calculated by taking the difference between the timestamps of the restaurant's order confirmation and the delivery person's pick-up confirmation.
- delivery_time: Time (in minutes) taken by the delivery person to deliver the food package. This is calculated by taking the difference between the timestamps of the delivery person's pick-up confirmation and drop-off information

Let us start by importing the required libraries

In [65]:

```
# import libraries for data manipulation
import numpy as np
import pandas as pd
```

```
# import libraries for data visualization
import matplotlib.pyplot as plt
import seaborn as sns

# to suppress warnings
import warnings
warnings.filterwarnings('ignore')
```

Understanding the structure of the data

In [66]:

```
# uncomment and run the following lines for Google Colab
# from google.colab import drive
# drive.mount('/content/drive')
```

In [67]:

```
# read the data
df = pd.read_csv('foodhub_order.csv')
# returns the first 5 rows
df.head()
```

Out[67]:

	order_id	customer_id	restaurant_name	cuisine_type	cost_of_the_order	day_of_the_week	rating	food_preparation_time	d
0	1477147	337525	Hangawi	Korean	30.75	Weekend	Not given	25	
1	1477685	358141	Blue Ribbon Sushi Izakaya	Japanese	12.08	Weekend	Not given	25	
2	1477070	66393	Cafe Habana	Mexican	12.23	Weekday	5	23	
3	1477334	106968	Blue Ribbon Fried Chicken	American	29.20	Weekend	3	25	
4	1478249	76942	Dirty Bird to Go	American	11.59	Weekday	4	25	

Observations:

The DataFrame has 9 columns as mentioned in the Data Dictionary. Data in each row corresponds to the order placed by a customer.

Question 1: How many rows and columns are present in the data? [0.5 mark]

In [68]:

```
# To obtain number of rows and columns
df.shape
```

Out[68]:

```
(1898, 9)
```

Observations:

Total number of rows = 1898

Total number of columns = 9

Question 2: What are the datatypes of the different columns in the dataset? (The info() function can be used) [0.5 mark]

In [69]:

In [69]:

```
# Use info() to print a concise summary of the DataFrame
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1898 entries, 0 to 1897
Data columns (total 9 columns):
 #   Column                 Non-Null Count  Dtype  
---  ------                 --------------  -----  
 0   order_id               1898 non-null   int64  
 1   customer_id            1898 non-null   int64  
 2   restaurant_name        1898 non-null   object 
 3   cuisine_type           1898 non-null   object 
 4   cost_of_the_order      1898 non-null   float64
 5   day_of_the_week        1898 non-null   object 
 6   rating                 1898 non-null   object 
 7   food_preparation_time  1898 non-null   int64  
 8   delivery_time          1898 non-null   int64  
dtypes: float64(1), int64(4), object(4)
memory usage: 133.6+ KB
```

Observations:

The data has 1898, 0 to 1897 data entries same as number of rows.

There are 9 columns in total which is represented by Data columns(total 9 columns).

Consider order_id 1898 non-null int64 indicates column named 'order_id' which has 1898 non-null observations having the data type 'int64'

Likewise there are 4 columns which are int64 datatype, 4 columns which are object datatype, 1 column which is float64 datatype.

memory used to store this dataframe is 133.6+ KB.

Question 3: Are there any missing values in the data? If yes, treat them using an appropriate method. [1 mark]

In [70]:

```
# To check the missing data isnull() is used
df.isnull().sum()
```

Out[70]:

```
order_id                 0
customer_id              0
restaurant_name          0
cuisine_type             0
cost_of_the_order        0
day_of_the_week          0
rating                   0
food_preparation_time    0
delivery_time            0
dtype: int64
```

Observations:

1. **The above output gives number of missing values in each of the columns.**
2. **there are no missing values in any column.**

Question 4: Check the statistical summary of the data. What is the minimum, average, and maximum time it takes for food to be prepared once an order is placed? [2 marks]

In [71]:

```
# describe() function to check the statisticle summary of the data
df.describe()
```

Out[71]:

	order_id	customer_id	cost_of_the_order	food_preparation_time	delivery_time
count	1.898000e+03	1898.000000	1898.000000	1898.000000	1898.000000
mean	1.477496e+06	171168.478398	16.498851	27.371970	24.161749
std	5.480497e+02	113698.139743	7.483812	4.632481	4.972637
min	1.476547e+06	1311.000000	4.470000	20.000000	15.000000
25%	1.477021e+06	77787.750000	12.080000	23.000000	20.000000
50%	1.477496e+06	128600.000000	14.140000	27.000000	25.000000
75%	1.477970e+06	270525.000000	22.297500	31.000000	28.000000
max	1.478444e+06	405334.000000	35.410000	35.000000	33.000000

Observations:

The above table output gives the statisticle summary of all columns in the dataframe.

Following are min, max and average of the time taken for food preparation:

minimum = 20

mean/average = 27.371970

maximum = 35

Question 5: How many orders are not rated? [1 mark]

In [72]:

```
# Help to get count of unique values in the column
df['rating'].value_counts()
```

Out[72]:

```
rating
Not given    736
5            588
4            386
3            188
Name: count, dtype: int64
```

Observations:

736 order is not rated

Exploratory Data Analysis (EDA)

Univariate Analysis

Question 6: Explore all the variables and provide observations on their distributions. (Generally, histograms, boxplots, countplots, etc. are used for univariate exploration.) [9 marks]

In [73]:

```
df.head()
```

Out[73]:

	order_id	customer_id	restaurant_name	cuisine_type	cost_of_the_order	day_of_the_week	rating	food_preparation_time	d
0	1477147	337525	Hangawi	Korean	30.75	Weekend	Not given	25	
1	1477685	358141	Blue Ribbon Sushi Izakaya	Japanese	12.08	Weekend	Not given	25	
2	1477070	66393	Cafe Habana	Mexican	12.23	Weekday	5	23	
3	1477334	106968	Blue Ribbon Fried Chicken	American	29.20	Weekend	3	25	
4	1478249	76942	Dirty Bird to Go	American	11.59	Weekday	4	25	

Box Plot

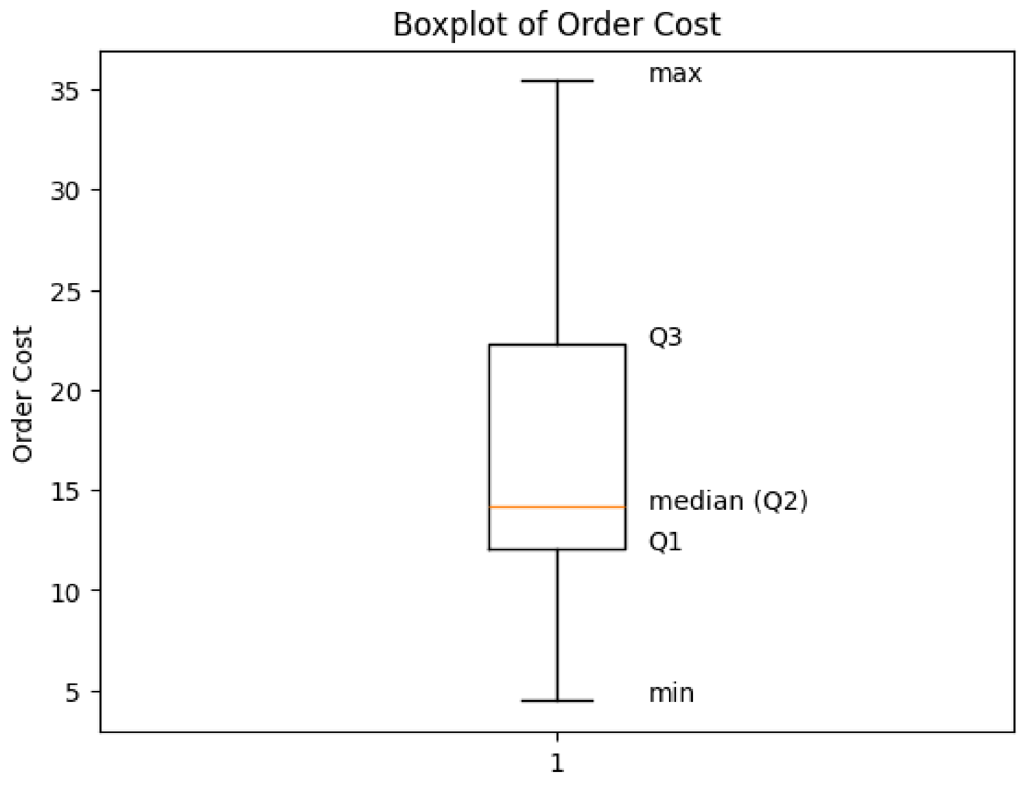
In [74]:

```
# plot a distribution of Order Cost
plt.boxplot(df['cost_of_the_order'])

# add labels for five number summary
plt.text(x = 1.1, y = df['cost_of_the_order'].min(), s ='min')
plt.text(x = 1.1, y = df.cost_of_the_order.quantile(0.25), s ='Q1')
plt.text(x = 1.1, y = df['cost_of_the_order'].median(), s ='median (Q2)')
plt.text(x = 1.1, y = df.cost_of_the_order.quantile(0.75), s ='Q3')
plt.text(x = 1.1, y = df['cost_of_the_order'].max(), s ='max')


# add the graph title and axes labels
plt.title('Boxplot of Order Cost')
plt.ylabel('Order Cost')

# display the plot
plt.show()
```



Observations:

The above plot indicates that the median of order cost is close to Q1 rather than Q3 which means the oder cost is positively skewed

Count Plot

In [75]:

```
df.head()
```

Out[75]:

	order_id	customer_id	restaurant_name	cuisine_type	cost_of_the_order	day_of_the_week	rating	food_preparation_time	d
0	1477147	337525	Hangawi	Korean	30.75	Weekend	Not given	25	
1	1477685	358141	Blue Ribbon Sushi Izakaya	Japanese	12.08	Weekend	Not given	25	
2	1477070	66393	Cafe Habana	Mexican	12.23	Weekday	5	23	
3	1477334	106968	Blue Ribbon Fried Chicken	American	29.20	Weekend	3	25	
4	1478249	76942	Dirty Bird to Go	American	11.59	Weekday	4	25	

In [76]:

```
df.cuisine_type.value_counts()
```

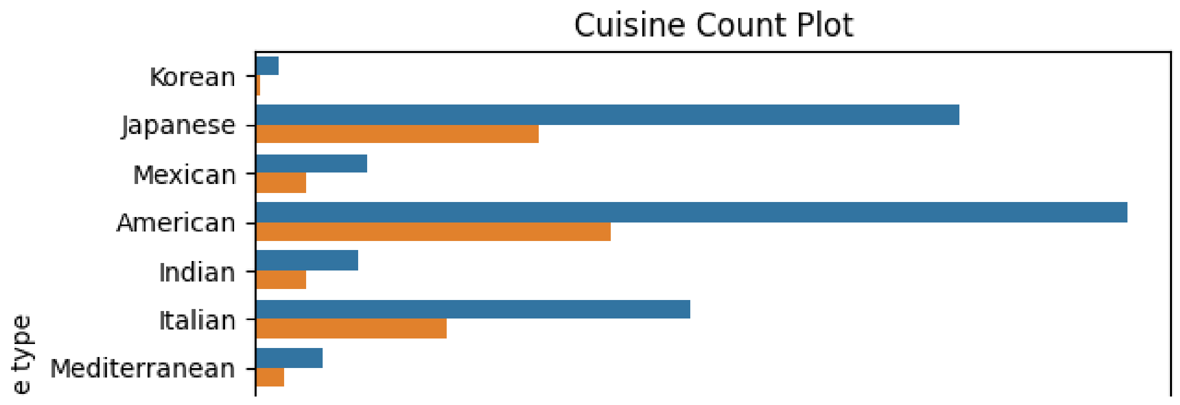
Out[76]:

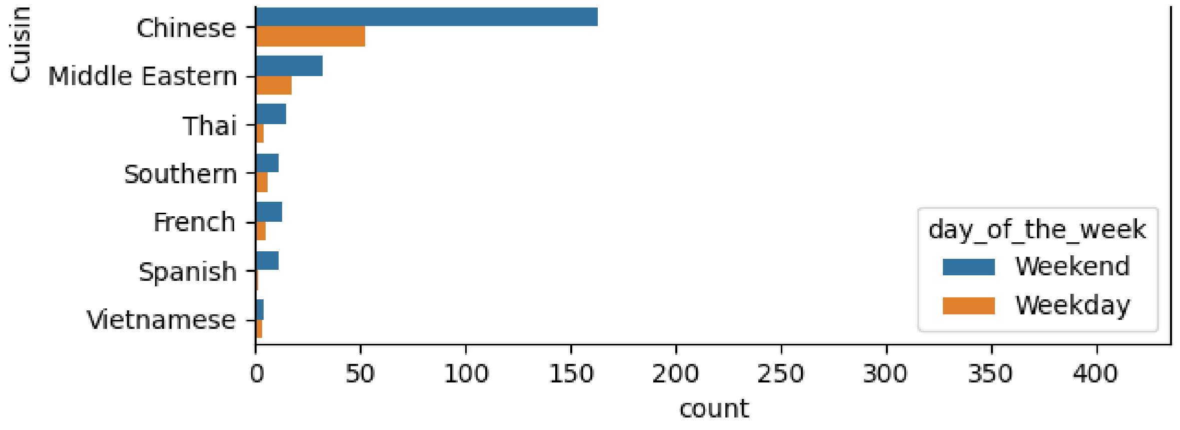
```
cuisine_type
American          584
Japanese          470
Italian           298
Chinese           215
Mexican            77
Indian             73
Middle Eastern     49
Mediterranean      46
Thai               19
French             18
Southern           17
Korean             13
Spanish            12
Vietnamese          7
Name: count, dtype: int64
```

In [77]:

```
# count of observations for each cuisine_type based on day_of_the_week
#'day_of_the_week' as hue parameter
sns.countplot(data = df, y = 'cuisine_type', hue = 'day_of_the_week')

plt.title('Cuisine Count Plot')
plt.ylabel('Cuisine type')
# display the plot
plt.show()
```





Observations:

The above plot clearly shows that American cuisine is more popular on weekends followed by Japanese and Italian

Question 7: Which are the top 5 restaurants in terms of the number of orders received? [1 mark]

In [78]:

```
# sort restaurants and display top 5 based on number of orders received
df.restaurant_name.value_counts()[0:5]
```

Out[78]:

```
restaurant_name
Shake Shack                  219
The Meatball Shop            132
Blue Ribbon Sushi            119
Blue Ribbon Fried Chicken     96
Parm                          68
Name: count, dtype: int64
```

Observations:

The top 5 restaurants and thier order

Shake Shack =219 orders

The Meatball shop =132 orders

Blur Ribbon Sushi =119 orders

Blue Ribbon Fried Chicken =96 orders

Parm =68 orders

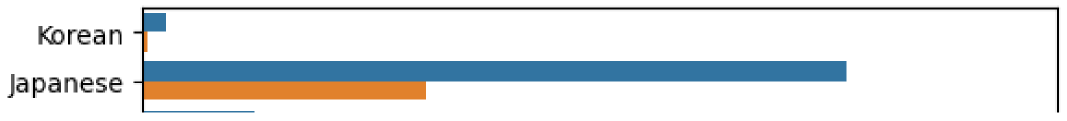
Question 8: Which is the most popular cuisine on weekends? [1 mark]

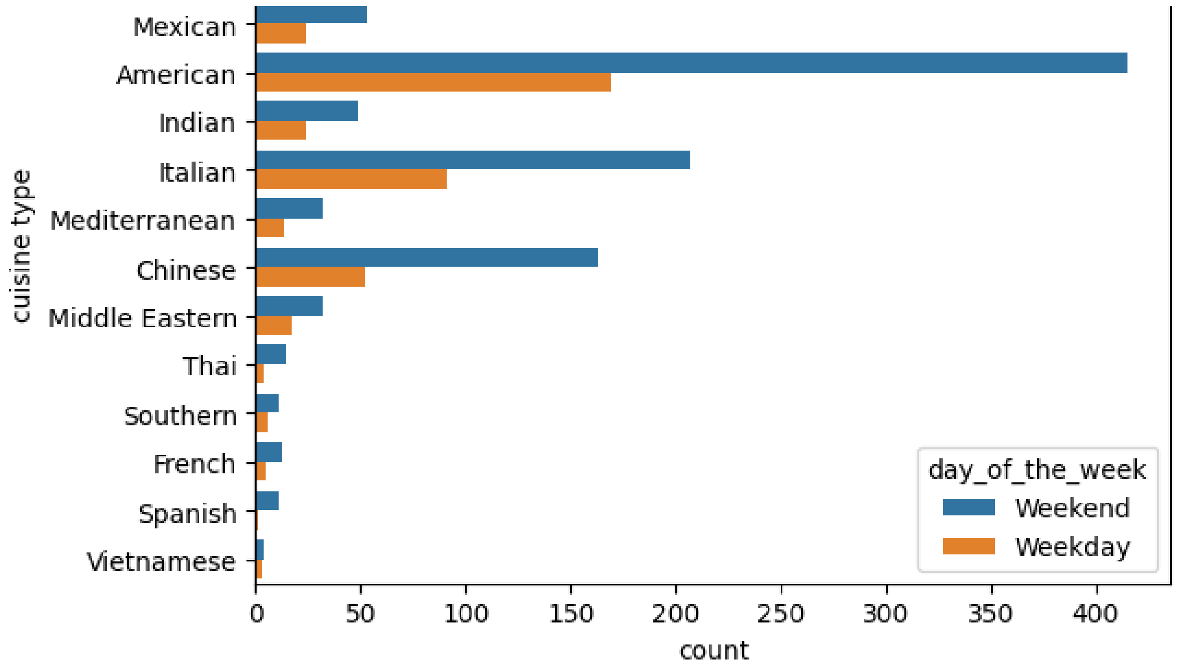
In [79]:

```
sns.countplot(data = df, y = 'cuisine_type', hue = 'day_of_the_week')

plt.ylabel('cuisine type')

# display the plot
plt.show()
```





Observations:

the most popular cuisine on weekends is American

Question 9: What percentage of the orders cost more than 20 dollars? [2 marks]

In [80]:

```
# Conditional count function to find number of orders greater than $20
count=(df['cost_of_the_order']>20).sum()

#total numbers of orders
total=df.shape[0]

percentage_orders_greater_than_20=(count/total)*100
round(percentage_orders_greater_than_20,2)
```

Out[80]:

```
29.24
```

Observations:

29.24% of the orders cost more than $20

Question 10: What is the mean order delivery time? [1 mark]

In [81]:

```
# describe() function is used to check the statisticle summary of the data
df.describe()['delivery_time']
```

Out[81]:

```
count    1898.000000
mean       24.161749
std         4.972637
min        15.000000
25%        20.000000
50%        25.000000
75%        28.000000
max        33.000000
Name: delivery_time, dtype: float64
```

Observations:

The mean order delivery time is 24.16

Question 11: The company has decided to give 20% discount vouchers to the top 3 most frequent customers. Find the IDs of these customers and the number of orders they placed. [1 mark]

In [82]:

```
# Sort and display top 3 customers based on number of orders placed
df.customer_id.value_counts()[0:3]
```

Out[82]:

```
customer_id
52832    13
47440    10
83287     9
Name: count, dtype: int64
```

Observations:

The top 3 most frequent customers' IDs and thier order are as below

1. **ID - 52832 , order 13**
2. **ID - 47440 , order 10**
3. **ID - 83287 , order 10**

Multivariate Analysis

Question 12: Perform a multivariate analysis to explore relationships between the important variables in the dataset. (It is a good idea to explore relations between numerical variables as well as relations between numerical and categorical variables) [10 marks]

In [83]:

```
# Filtering ratings column and removing not given ratings
df_valid_ratings=df[~df['rating'].str.contains("Not given")]

# New filtered data frame which has all ratings given as integer
df_valid_ratings['rating']=df_valid_ratings['rating'].astype('int')

# Adding total time column which is sum of food preparation time and delivery time
df_valid_ratings['total_time'] = df_valid_ratings['food_preparation_time'] + df_valid_ra
tings['delivery_time']
df_valid_ratings
```

Out[83]:

	order_id	customer_id	restaurant_name	cuisine_type	cost_of_the_order	day_of_the_week	rating	food_preparation_ti
2	1477070	66393	Cafe Habana	Mexican	12.23	Weekday	5	
3	1477334	106968	Blue Ribbon Fried Chicken	American	29.20	Weekend	3	
4	1478249	76942	Dirty Bird to Go	American	11.59	Weekday	4	
5	1477224	147468	Tamarind TriBeCa	Indian	25.22	Weekday	3	
7	1477859	89574	Barbounia	Mediterranean	5.97	Weekday	3	
...	...	...	...	...	...	...	...	
1889	1478190	94152	RedFarm Broadway	Chinese	8.68	Weekday	3	

	order_id	customer_id	restaurant_name	cuisine_type	cost_of_the_order	day_of_the_week	rating	food_preparation_ti
1890	1477316	164776	TAO	Japanese	15.67	Weekend	5	
1893	1476701	292602	Chipotle Mexican Grill $1.99 Delivery	Mexican	22.31	Weekend	5	
1894	1477421	397537	The Smile	American	12.18	Weekend	5	
1896	1477513	64151	Jack's Wife Freda	Mediterranean	12.18	Weekday	5	

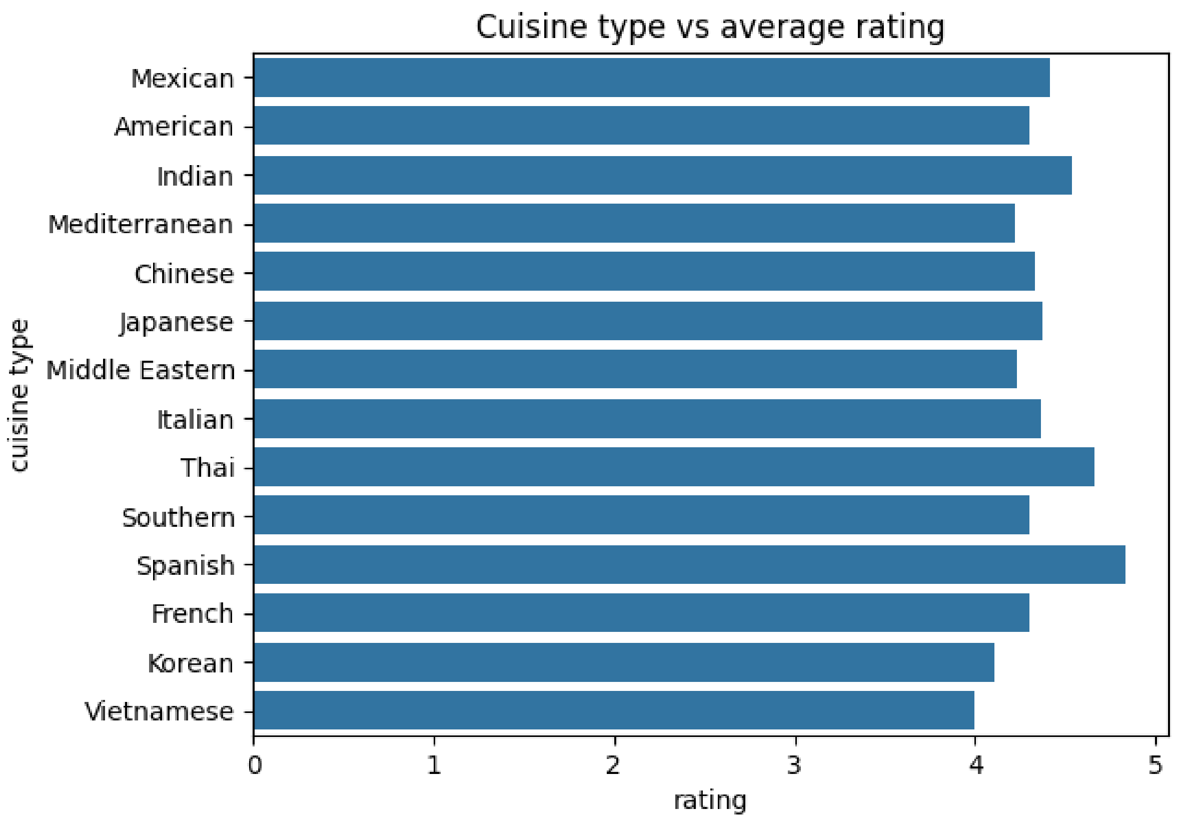
1162 rows × 10 columns

Bar Plot (Bivariate) - to know cuisine type and its ratings

In [84]:

```
# bar plot of average rating vs cuisine type
sns.barplot(
    x=df_valid_ratings['rating'],
    y=df_valid_ratings['cuisine_type'],
    data=df_valid_ratings,
    ci=None)

plt.title('Cuisine type vs average rating')
plt.ylabel('cuisine type')
plt.show()
```



Observations:

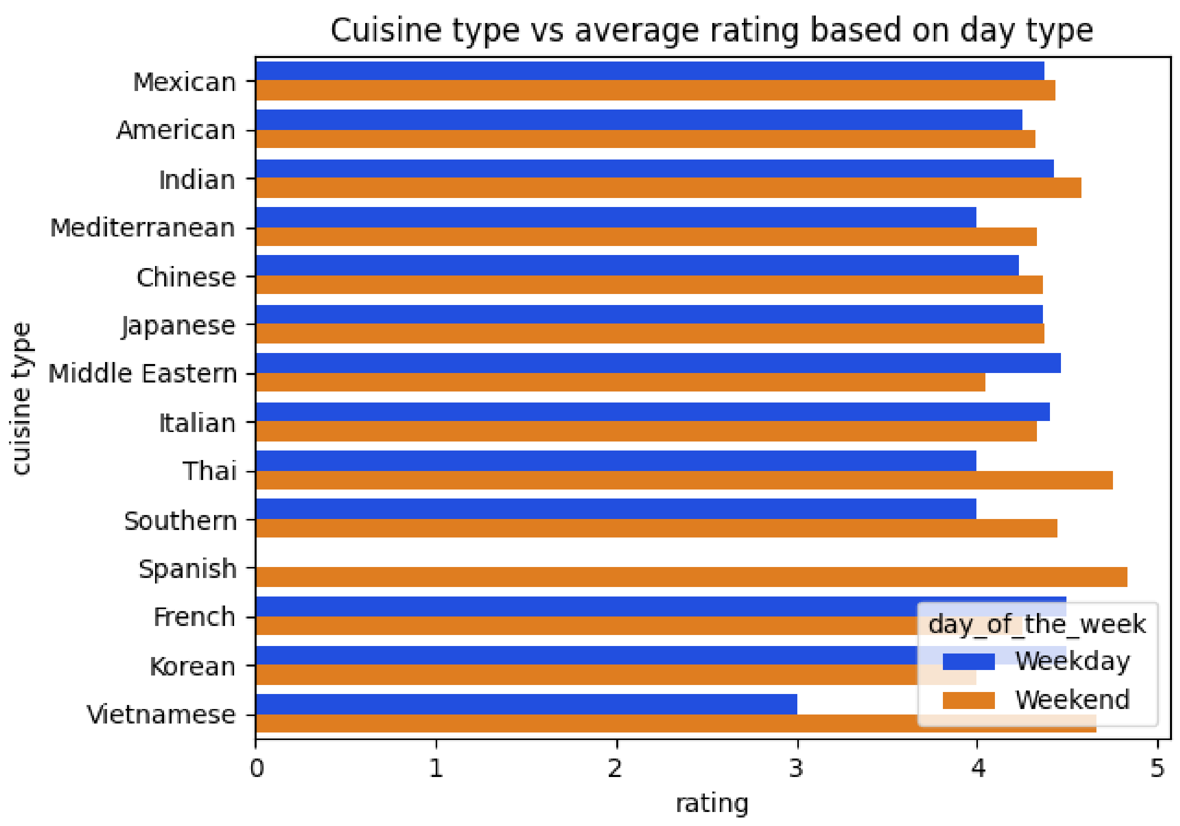
The above plot shows that Spanish cuisine has highest average ratings followed by Thai and Indian

Bar Plot (Multivariate) -Cuisine type vs average rating based on day type

In [85]:

```
# bar plot of average rating vs cuisine type with hue as day of the week
sns.barplot(
    x=df_valid_ratings['rating'],
    y=df_valid_ratings['cuisine_type'],
    data=df_valid_ratings,
    palette='bright',
    hue=df_valid_ratings['day_of_the_week'],
    ci=None)

plt.title('Cuisine type vs average rating based on day type')
plt.ylabel('cuisine type')
plt.show()
```



Observations:

Although there are no ratings given for Spanish cuisine on weekdays. Vietnamese cuisine has a average rating of 3 on weekday and average rating of 4.8 on weekends.

Pair Plot

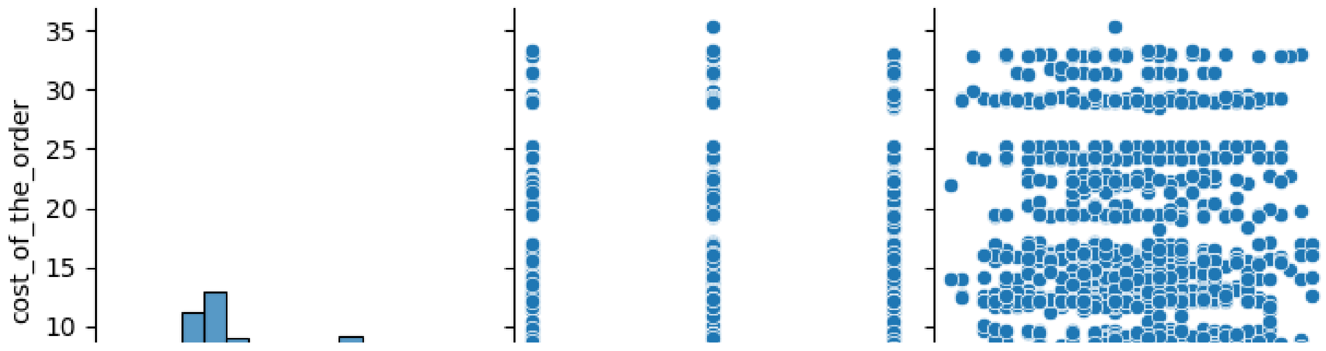
In [95]:

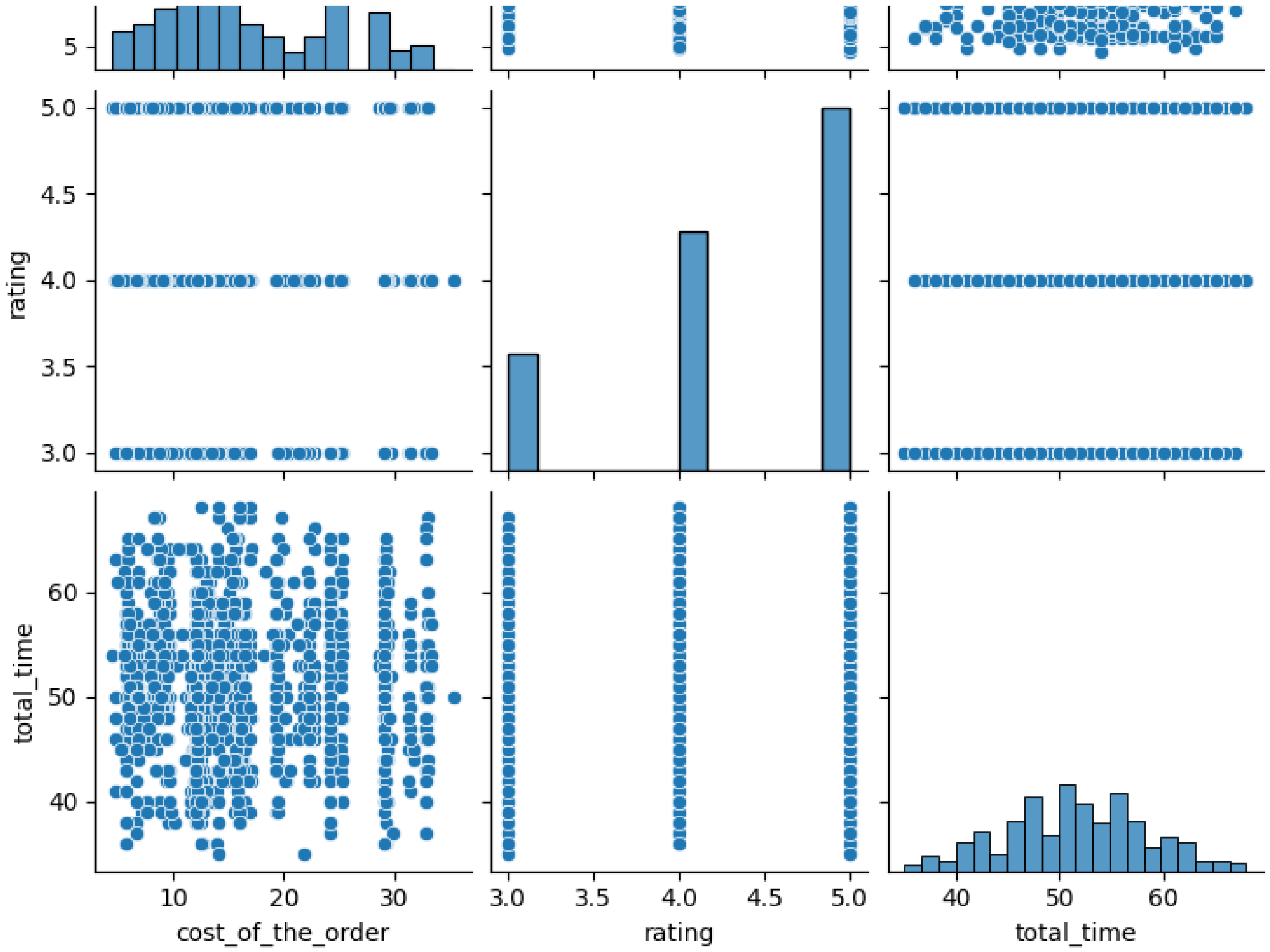
```
# set the figure size
plt.figure(figsize = (8,8))

# plot a pair plot
sns.pairplot(df_valid_ratings[["cost_of_the_order", "rating", "total_time"]])

# display the plot
plt.show()
```

```
<Figure size 800x800 with 0 Axes>
```





Observations:

The numerical variables such as cost of order, rating, food preparation time and delivery time has no correlation.

Heatmap

In [96]:

```
# compute correlation
corr_matrix = (df_valid_ratings[["cost_of_the_order", "rating", "total_time"]]).corr()

corr_matrix
```

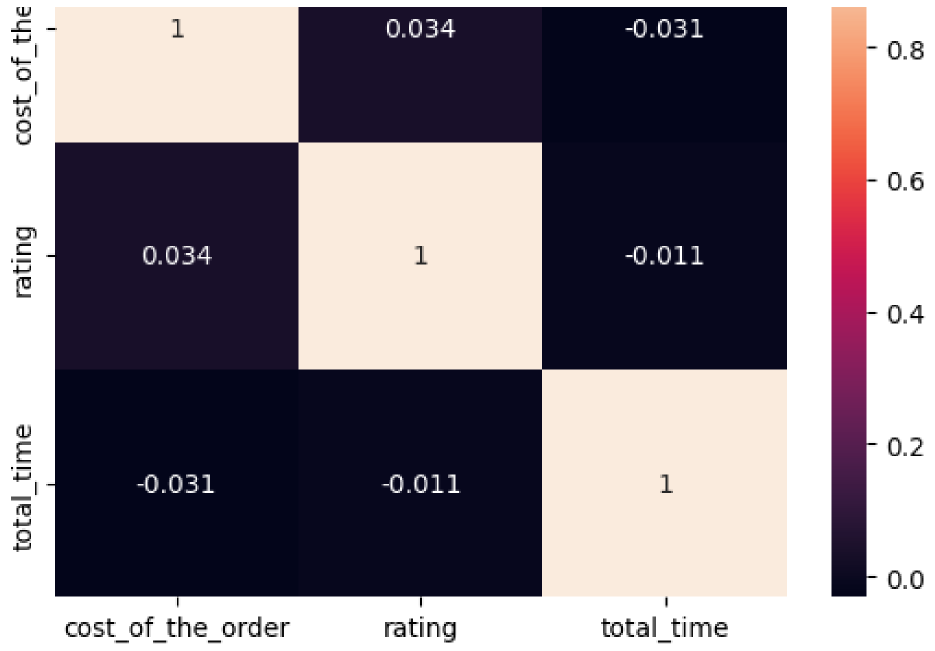
Out[96]:

	cost_of_the_order	rating	total_time
cost_of_the_order	1.000000	0.033983	-0.030796
rating	0.033983	1.000000	-0.011348
total_time	-0.030796	-0.011348	1.000000

In [97]:

```
# plot heatmap
# 'annot=True' returns the correlation values
sns.heatmap(corr_matrix, annot = True)

# display the plot
plt.show()
```



Observations:

There is no correlation between total time taken (food preparation time + Delivery time) and rating.

Question 13: The company wants to provide a promotional offer in the advertisement of the restaurants. The condition to get the offer is that the restaurants must have a rating count of more than 50 and the average rating should be greater than 4. Find the restaurants fulfilling the criteria to get the promotional offer. [3 marks]

In [86]:

```
# To dispplay restaurants that have rating count greater than 50
value_counts = df_valid_ratings.restaurant_name.value_counts()
value_counts[value_counts > 50]
```

Out[86]:

```
restaurant_name
Shake Shack                  133
The Meatball Shop             84
Blue Ribbon Sushi             73
Blue Ribbon Fried Chicken     64
Name: count, dtype: int64
```

In [87]:

```
# Filtering the data for above restaurants
options = ['Shake Shack', 'The Meatball Shop', 'Blue Ribbon Sushi', 'Blue Ribbon Fried C
hicken']

# selecting rows based on condition
Count_greater_than_50_mean_df = df_valid_ratings[df_valid_ratings['restaurant_name'].isin
(options)]

Count_greater_than_50_mean_df

# Calculating average to check it they are greater than 4 for the above four restaurants
average_rating = Count_greater_than_50_mean_df.groupby('restaurant_name').agg({'rating':[
'mean']})
average_rating
```

Out[87]:

	rating
	mean
restaurant_name	

	rating
	mean
restaurant_name	
Blue Ribbon Fried Chicken	4.328125
Blue Ribbon Sushi	4.219178
Shake Shack	4.278195
The Meatball Shop	4.511905

Observations:

Based on above analysis, following four restaurants have rating count more than 50 and the average rating is greater than 4:

Blue Ribbon Fried Chicken

Blue Ribbon Sushi

Shake Shack

The Meatball Shop

Question 14: The company charges the restaurant 25% on the orders having cost greater than 20 dollars and 15% on the orders having cost greater than 5 dollars. Find the net revenue generated by the company across all orders. [3 marks]

In [88]:

```
# To check column names
df.head()
```

Out[88]:

	order_id	customer_id	restaurant_name	cuisine_type	cost_of_the_order	day_of_the_week	rating	food_preparation_time	d
0	1477147	337525	Hangawi	Korean	30.75	Weekend	Not given	25	
1	1477685	358141	Blue Ribbon Sushi Izakaya	Japanese	12.08	Weekend	Not given	25	
2	1477070	66393	Cafe Habana	Mexican	12.23	Weekday	5	23	
3	1477334	106968	Blue Ribbon Fried Chicken	American	29.20	Weekend	3	25	
4	1478249	76942	Dirty Bird to Go	American	11.59	Weekday	4	25	

In [89]:

```
# Calculate and add revenue column based on order cost conditions
def calculate_revenue(cost):
    if cost>20:
        return (cost*0.25)
    elif cost>5:
        return (cost*0.15)
    else:
        return 0

df['revenue']=df['cost_of_the_order'].apply(calculate_revenue)

revenue=df['revenue'].sum()
round(revenue,2)
```

Out[89]:

```
6166.3
```

Observations:

Net revenue generated by the company across all orders is $6166.3

Question 15: The company wants to analyze the total time required to deliver the food. What percentage of orders take more than 60 minutes to get delivered from the time the order is placed? (The food has to be prepared and then delivered.) [2 marks]

In [90]:

```
# Adding a column Total time
df['total_time'] = df['food_preparation_time'] + df['delivery_time']
df
```

Out[90]:

	order_id	customer_id	restaurant_name	cuisine_type	cost_of_the_order	day_of_the_week	rating	food_preparation_ti
0	1477147	337525	Hangawi	Korean	30.75	Weekend	Not given	
1	1477685	358141	Blue Ribbon Sushi Izakaya	Japanese	12.08	Weekend	Not given	
2	1477070	66393	Cafe Habana	Mexican	12.23	Weekday	5	
3	1477334	106968	Blue Ribbon Fried Chicken	American	29.20	Weekend	3	
4	1478249	76942	Dirty Bird to Go	American	11.59	Weekday	4	
...	...	...	...	...	...	...	...	
1893	1476701	292602	Chipotle Mexican Grill $1.99 Delivery	Mexican	22.31	Weekend	5	
1894	1477421	397537	The Smile	American	12.18	Weekend	5	
1895	1477819	35309	Blue Ribbon Sushi	Japanese	25.22	Weekday	Not given	
1896	1477513	64151	Jack's Wife Freda	Mediterranean	12.18	Weekday	5	
1897	1478056	120353	Blue Ribbon Sushi	Japanese	19.45	Weekend	Not given	

1898 rows × 11 columns

In [91]:

```
# Conditional count function to find number of orders that took longer than 60 minutes
count=(df['total_time']>60).sum()

#total numbers of orders
total=df.shape[0]

percentage_total_time_greater_than_60=(count/total)*100
round(percentage_total_time_greater_than_60,2)
```

Out[91]:

```
10.54
```

Observations:

10.54% of the orders took longer than 60 minutes

Question 16: The company wants to analyze the delivery time of the orders on weekdays and weekends. How does the mean delivery time vary during weekdays and weekends? [2 marks]

In [92]:

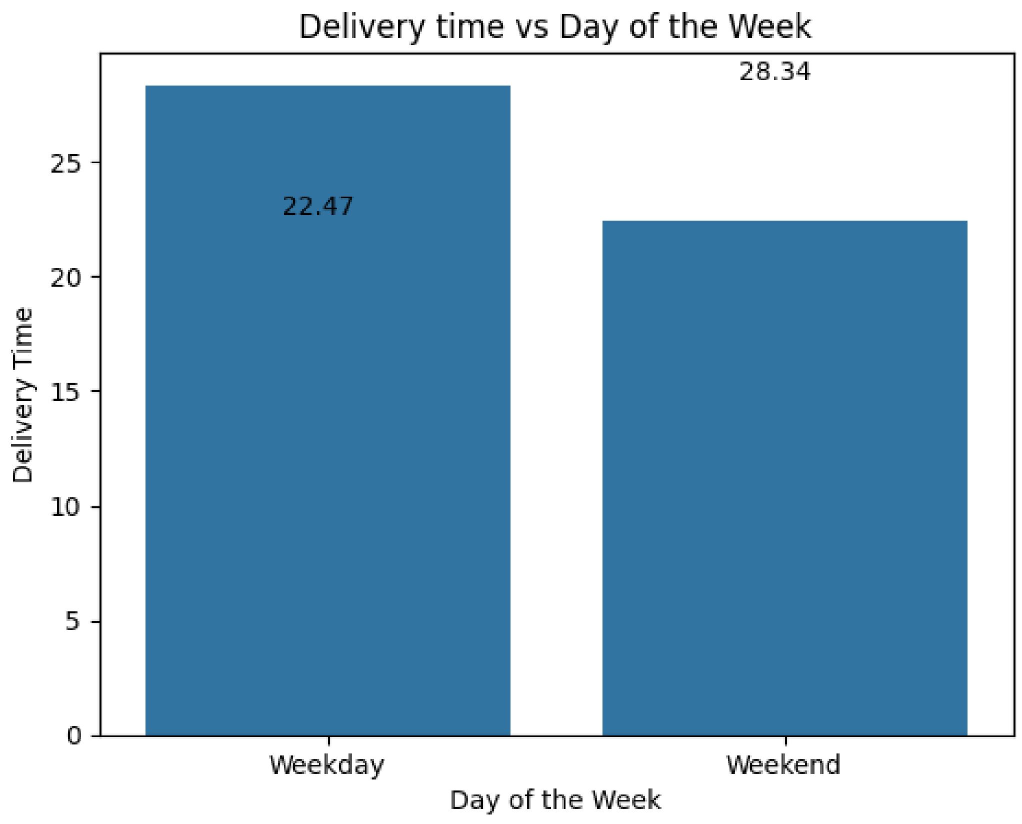
```
import seaborn as sns
import matplotlib.pyplot as plt

# Assuming df is your DataFrame and is cleaned as per previous discussions
sns.barplot(
    x='day_of_the_week',
    y='delivery_time',
    data=df,
    ci=None,
    order=['Weekday', 'Weekend']  # Explicitly define the order of categories
)

# Calculate means
delivery_time_means = df.groupby('day_of_the_week')['delivery_time'].mean()
delivery_time_mean_weekend = round(delivery_time_means['Weekend'], 2)
delivery_time_mean_weekday = round(delivery_time_means['Weekday'], 2)

# Adding text to the plot for mean values
plt.text(x = -0.1, y = delivery_time_mean_weekend + 0.2, s = str(delivery_time_mean_week
end))
plt.text(x = 0.9, y = delivery_time_mean_weekday + 0.2, s = str(delivery_time_mean_weekd
ay))

plt.title('Delivery time vs Day of the Week')
plt.xlabel('Day of the Week')
plt.ylabel('Delivery Time')
plt.show()
```



Observations:

The mean delivery time of the orders on weekends is 22.47 and weekdays is 28.34

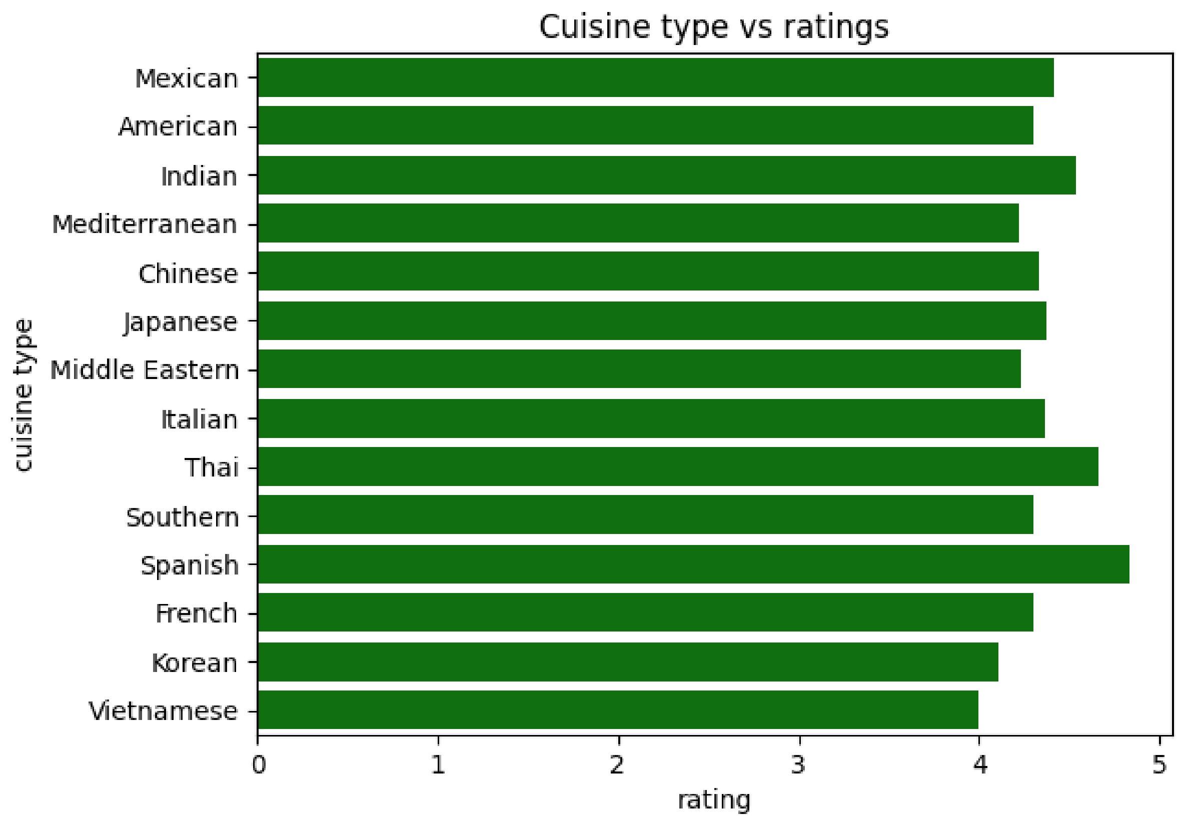
Conclusion and Recommendations

Question 17: What are your conclusions from the analysis? What recommendations would you like to share to help improve the business? (You can use cuisine type and feedback ratings to drive your business recommendations.) [6 marks]

In [93]:

```
# To check average ratings vs cuisine type
sns.barplot(
    x=df_valid_ratings['rating'],
    y=df_valid_ratings['cuisine_type'],
    data=df_valid_ratings,
    color='green',
    ci=None)

plt.title("Cuisine type vs ratings")
plt.ylabel('cuisine type')
plt.show()
```

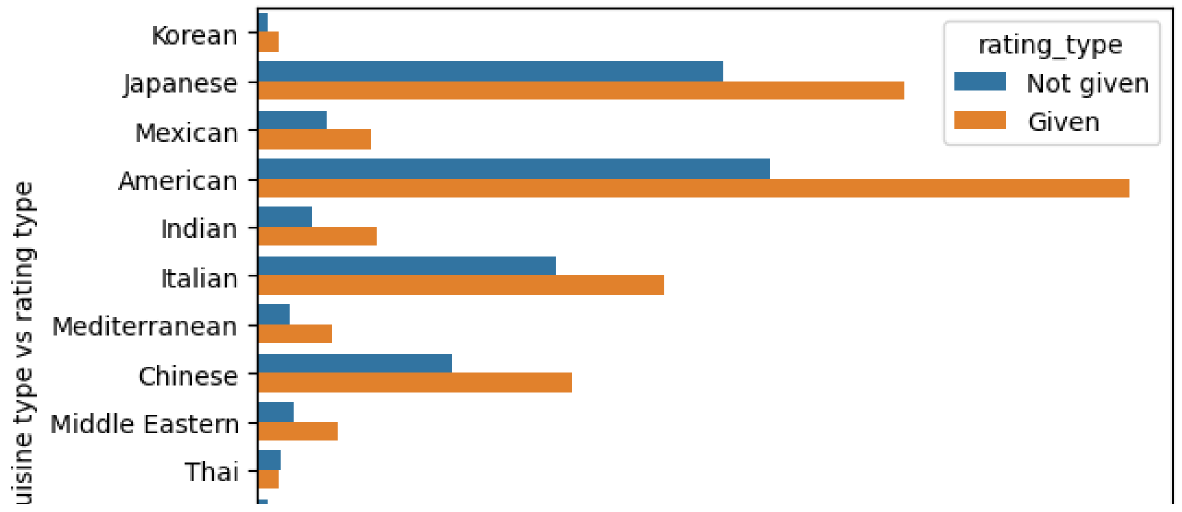


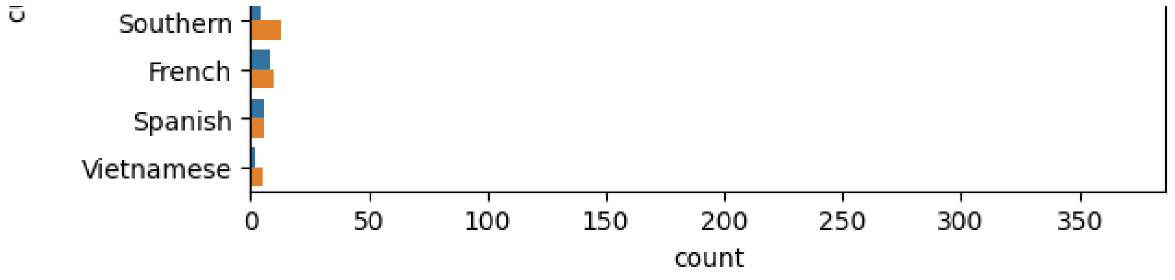
In [94]:

```
# To check how many customers gave ratings and how many did not give ratings vs cuisine t
ype
df['rating_type']=df['rating'].apply(lambda rating: 'Not given' if rating == "Not given"
else 'Given')

sns.countplot(data = df, y = 'cuisine_type', hue = 'rating_type')

plt.ylabel('cuisine type vs rating type')
# display the plot
plt.show()
```





Conclusions:

- Spanish cuisine has more average ratings followed by Thai and Indian
- Vietnamese has low average rating followed by Korean
- There are more than 50% customers across each cuisine type who haven't given any ratings

Recommendations:

- Cuisine types which has higher average ratings can be featured on the app and fed into the recommendation system which will help improve customer experience.
- Encourage customers to provide feedback ratings and incentivize them to do so. This will help us understand better about what cuisine types are doing well and improve where there are gaps.