```
from google.colab import drive
drive.mount('/content/drive',force_remount=True)

%cd "drive/My Drive/Data Science/Exp 12-Plots"
```

```
Mounted at /content/drive
/content/drive/My Drive/Data Science/Exp 12-Plots
```

What is matplotlib?

Matplotlib is a Python 2D plotting library which produces publication quality figures in a variety of hardcopy formats and interactive environments across platforms. Matplotlib can be used in Python scripts, the Python and IPython shells, the Jupyter notebook, web application servers, and four graphical user interface toolkits.

Understanding the Dataset and the Problem Statement

We will be analyzing the Food Demand Forecasting project in this matplotlib tutorial. The aim of this project is to predict the number of food orders that customers will place in the upcoming weeks with the company. We will, of course, only spend time on the exploration stage of the project.

Let us first import the relevant libraries:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
plt.style.use('seaborn')
```

Our dataset has three dataframes: df_meal describing the meals, df_center describing the food centers, and df_food describing the overall food order. Have a look at them below:

```
df_meal = pd.read_csv('Dataset/meal_info.csv')
df_meal.head()
```

	meal_id	category	cuisine
0	1885	Beverages	Thai
1	1993	Beverages	Thai
2	2539	Beverages	Thai
3	1248	Beverages	Indian
4	2631	Beverages	Indian

```
df_center = pd.read_csv('Dataset/fulfilment_center_info.csv')
df_center.head()
```

	center_id	city_code	region_code	center_type	op_area
0	11	679	56	TYPE_A	3.7
1	13	590	56	TYPE_B	6.7
2	124	590	56	TYPE_C	4.0
3	66	648	34	TYPE_A	4.1
4	94	632	34	TYPE_C	3.6

```
df_food = pd.read_csv('Dataset/train.csv')
df_food.head()
```

	id	week	center_id	meal_id	checkout_price	base_price	emailer_for_promotion	homepage_featu
1	1466964	1	55	1993	136.83	135.83	0	

I will first merge all the three dataframes into a single dataframe. This will make it easier to manipulate the data while plotting it:

```
df = pd.merge(df_food,df_center,on='center_id')
df = pd.merge(df,df_meal,on='meal_id')
```

```
df.head()
```

	id	week	center_id	meal_id	checkout_price	base_price	emailer_for_promotion	homepage_featu
0	1379560	1	55	1885	136.83	152.29	0	
1	1018704	2	55	1885	135.83	152.29	0	
2	1196273	3	55	1885	132.92	133.92	0	
3	1116527	4	55	1885	135.86	134.86	0	
4	1343872	5	55	1885	146.50	147.50	0	

12 (A):

Bar Graph:

First, we want to find the most popular food item that customers have bought from the company.

I will be using the Pandas pivot_table function to find the total number of orders for each category of the food item:

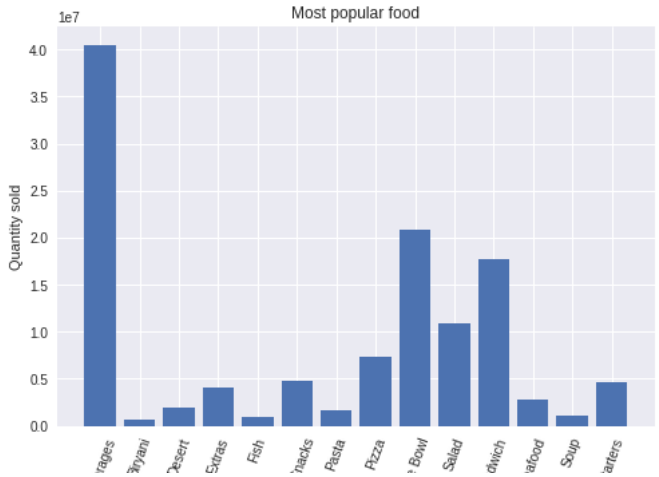
```
table = pd.pivot_table(data=df,index='category',values='num_orders',aggfunc=np.sum)
table
```

category	num_orders
Beverages	40480525
Biryani	631848
Desert	1940754
Extras	3984979
Fish	871959
Other Snacks	4766293
Pasta	1637744
Pizza	7383720
Rice Bowl	20874063
Salad	10944336
Sandwich	17636782
Seafood	2715714
Soup	1039646
Starters	4649122

Next, I will try to visualize this using a bar graph.

Bar graph is generated using plt.bar() in matplotlib:

```
# Barplot
plt.bar(table.index,table['num_orders'])
plt.xticks(rotation=70)
plt.xlabel('Food item')
plt.ylabel('Quantity sold')
plt.title('Most popular food')
plt.show()
```



It is always important to label your axis. You can do this by employing the plt.xlabel() and plt.ylabel() functions. You can use plt.title() for naming the title of the plot. If your xticks are overlapping, rotate them using the rotate parameter in plt.xticks() so that they are easy to view for the audience.

You can save your plot using the plt.savefig() function by providing the file path as a parameter. Finally, always display your plot using plt.show().

While analyzing the plot, we can see that Beverages were the most popular food item sold by the company. Wait, was it because they were sold with almost all the meals? Was Rice Bowl the most popular food item?

Let's divide the total food item order by the number of unique meals it is present in.

```
#dictionary for meals per food item
item_count = {}

for i in range(table.index.nunique()):
    item_count[table.index[i]] = table.num_orders[i]/df_meal[df_meal['category']==table.index[i]].shape[0]

#bar plot
plt.bar([x for x in item_count.keys()],[x for x in item_count.values()],color='orange')

#adjust xticks
plt.xticks(rotation=70)

#label x-axis
plt.xlabel('Food item')

#label y-axis
plt.ylabel('No. of meals')

#label the plot
plt.title('Meals per food item')

#save plot
plt.savefig('Dataset/matplotlib_plotting_7.png',dpi=300,bbox_inches='tight')

#display plot
plt.show()
```

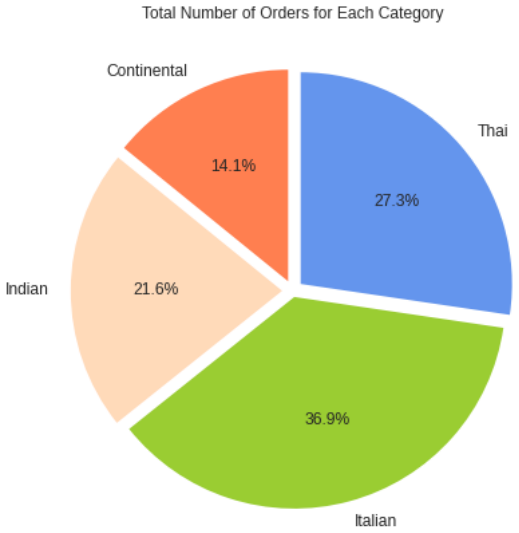
12 (B):

Pie Chart:

A pie chart is suitable to show the proportional distribution of items within the same category

Let us now see the ratio of orders from each cuisine.

```
plt.figure(figsize=(6,6))
colors = ['coral','#FFDAB9','yellowgreen','#6495ED']
plt.pie(df.groupby(['cuisine']).num_orders.sum(),
    labels=df.groupby(['cuisine']).num_orders.sum().index,
    shadow=False,
    colors=colors,
    explode=(0.05, 0.05, 0.03,0.05),
    startangle=90,
    autopct='%1.1f%%',pctdistance=0.6,
    textprops={'fontsize': 12})
plt.title('Total Number of Orders for Each Category')
plt.tight_layout()
plt.show()
```



- I used plt.pie() to draw the pie chart and adjust its parameters to make it more appealing.
- The autopct parameter was used to print the values within the pie chart up to 1 decimal place.
- The explode parameter was used to offset the Italian wedge to make it stand out from the rest.
- This makes it instantly clear to the viewer that people love Italian food!

12 (C):

Box Plot:

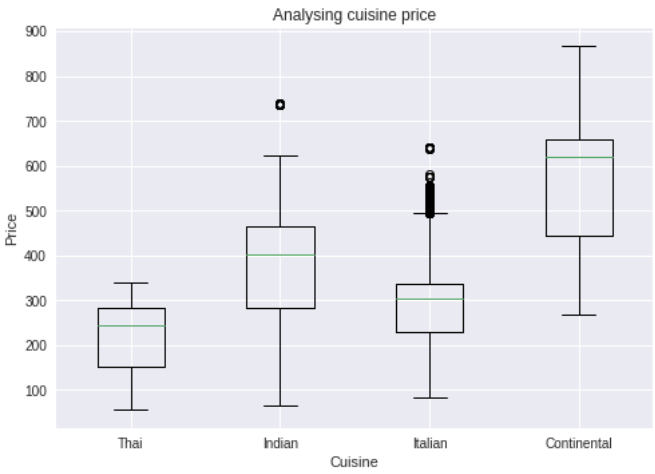
Box plot gives statistical information about the distribution of numeric data divided into different groups. It is useful for detecting outliers within each group.

Since we are discussing cuisine, let's check out which one is the most expensive cuisine! For this, I will be using a Box Plot.

- The lower, middle and upper part of the box represents the 25th, 50th, and 75th percentile values respectively.
- List itemThe top whisker represents Q3+1.5*IQR
- The bottom whisker represents Q1-1.5*IQR
- Outliers are shown as scatter points
- Shows skewness in the data

```
#dictionary for base price per cuisine
c_price = {}
```

```
for i in df['cuisine'].unique():
    c_price[i] = df[df['cuisine']==i].base_price


#plotting boxplot
plt.boxplot([x for x in c_price.values()],labels=[x for x in c_price.keys()])

#x and y-axis labels
plt.xlabel('Cuisine')
plt.ylabel('Price')

#plot title
plt.title('Analysing cuisine price')

#save and display
plt.savefig('Dataset/matplotlib_plotting_9.png',dpi=300,bbox_inches='tight')
plt.show();
```



Continental cuisine was the most expensive cuisine served by the company! Even its median price is higher than the maximum price of all the cuisines.

12 (D):

Histogram:

A histogram shows the distribution of numeric data through a continuous interval by segmenting data into different bins. Useful for inspecting skewness in the data.

Since base_price is a continuous variable, we will inspect its range in different distinct orders using a histogram. We can do this using plt.hist().

```
#plotting histogram
plt.hist(df['base_price'],rwidth=0.9,alpha=0.3,color='blue',bins=15,edgecolor='red')

#x and y-axis labels
plt.xlabel('Base price range')
plt.ylabel('Distinct order')

#plot title
plt.title('Inspecting price effect')

#save and display the plot
plt.savefig('Dataset\matplotlib_plotting_10.png',dpi=300,bbox_inches='tight')
plt.show();
```

I have chosen the number of bins as 15 and it is evident that most of the orders had a base price of ~300.

It is easy to confuse histograms with bar plots. But remember, histograms are used with continuous data whereas bar plots are used with categorical data.

12 (E):

Line Chart and Subplots:

A line plot is useful for visualizing the trend in a numerical value over a continuous time interval.

How are the weekly and monthly sales of the company varying? This is a critical business question that makes or breaks the marketing strategy. Before exploring that, I will create two lists for storing the week-wise and month-wise revenue of the company:

```
#new revenue column
df['revenue'] = df.apply(lambda x: x.checkout_price*x.num_orders,axis=1)

#new month column
df['month'] = df['week'].apply(lambda x: x//4)

#list to store month-wise revenue
month=[]
month_order=[]

for i in range(max(df['month'])):
    month.append(i)
    month_order.append(df[df['month']==i].revenue.sum())

#list to store week-wise revenue
week=[]
week_order=[]

for i in range(max(df['week'])):
    week.append(i)
    week_order.append(df[df['week']==i].revenue.sum())
```

I will compare the revenue of the company in every week as well as in every month using two line-plots drawn side by side. For this, I will be using the plt.subplots() function.

To understand how this function works, you need to know what **Figure, Axes,** and **Axis** are in a matplotlib plot.

Figure is the outermost container for the Matplotlib plot(s). There can a single or multiple plots, called **Axes**, within a Figure. Each of these Axes contains the x and y-axis known as the **Axis**.

The **plt.subplots()** figure returns the figure and axes. You can provide as an input to the function how you want to display the axes within the figure. These will be adjusted using the **nrows** and **ncols** parameters. You can even adjust the size of the figure using the **figsize** parameter.

Axes are returned as a list. To plot for specific axes, you can access them as a list object. The rest of the plotting is done the same way as simple plots:

```
#subplots returns a Figure and an Axes object
fig,ax=plt.subplots(nrows=1,ncols=2,figsize=(20,5))

#manipulating the first Axes
ax[0].plot(week,week_order)
ax[0].set_xlabel('Week')
ax[0].set_ylabel('Revenue')
ax[0].set_title('Weekly income')

#manipulating the second Axes
ax[1].plot(month,month_order)
ax[1].set_xlabel('Month')
ax[1].set_ylabel('Revenue')
```

```
ax[1].set_title('Monthly income')

#save and display the plot
plt.savefig('Dataset/matplotlib_plotting_11.png',dpi=300,bbox_inches='tight')
plt.show();
```

12 (F):

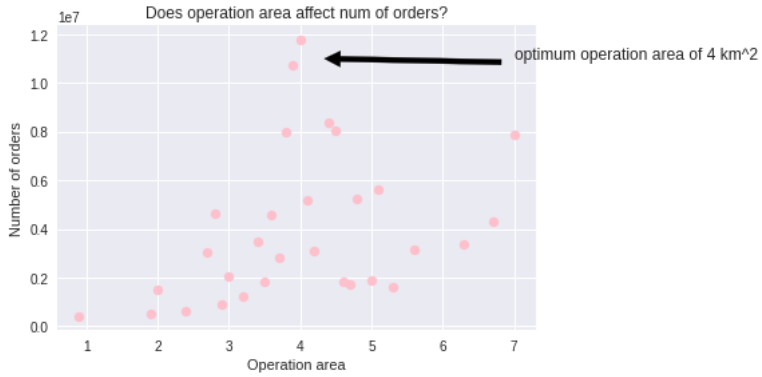
Scatter Plot:

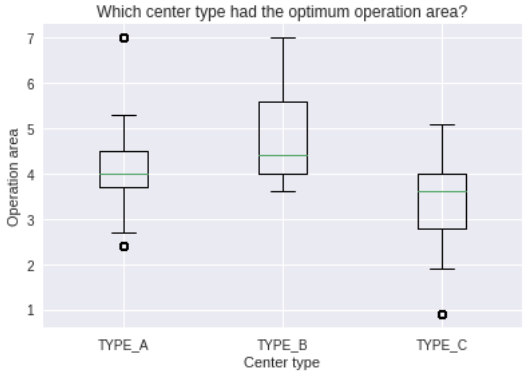
Scatter plots are useful for showing the relationship between two variables. Any correlation between variables or outliers in the data can be easily spotted using scatter plots.

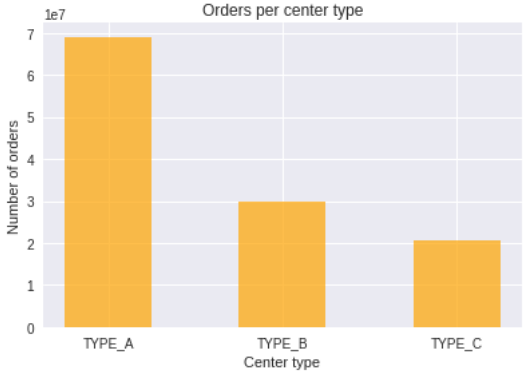
Finally, I will try to analyze whether the center type had any effect on the number of orders from different center types. I will do this by comparing a scatter plot, a boxplot and a bar graph in the same figure.

We have already seen the use of boxplots and bar graphs, but scatter plots have their own advantages.

```
center_type_name = ['TYPE_A','TYPE_B','TYPE_C']

#relation between op area and number of orders
op_table=pd.pivot_table(df,index='op_area',values='num_orders',aggfunc=np.sum)

#relation between center type and op area
c_type = {}
for i in center_type_name:
    c_type[i] = df[df['center_type']==i].op_area

#relation between center type and num of orders
center_table=pd.pivot_table(df,index='center_type',values='num_orders',aggfunc=np.sum)

#subplots
fig,ax = plt.subplots(nrows=3,ncols=1,figsize=(8,12))

#scatter plots
ax[0].scatter(op_table.index,op_table['num_orders'],color='pink')
ax[0].set_xlabel('Operation area')
ax[0].set_ylabel('Number of orders')
ax[0].set_title('Does operation area affect num of orders?')
ax[0].annotate('optimum operation area of 4 km^2',xy=(4.2,1.1*10**7),xytext=(7,1.1*10**7),arrowprops=dict(facecolor='black', shrink=0.05)

#boxplot
ax[1].boxplot([x for x in c_type.values()], labels=[x for x in c_type.keys()])
ax[1].set_xlabel('Center type')
ax[1].set_ylabel('Operation area')
ax[1].set_title('Which center type had the optimum operation area?')

#bar graph
ax[2].bar(center_table.index,center_table['num_orders'],alpha=0.7,color='orange',width=0.5)
ax[2].set_xlabel('Center type')
ax[2].set_ylabel('Number of orders')
ax[2].set_title('Orders per center type')

#show figure
plt.tight_layout()
plt.savefig('Dataset/matplotlib_plotting_12.png',dpi=300,bbox_inches='tight')
plt.show()
```







The scatter plot makes it instantly visible that the optimum operation area of a center is 4 km sq. The boxplot shows that the TYPE_A center type had the most number of optimum size centers because of a compact box with a median around 4 km sq. Because of this, they had more orders placed by customers than any other center type.

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