INTRODUCTION

New York is the **most populous city** in the U.S. Located at the southern tip of the state of New York, the city is the center of the New York metropolitan area, the largest metropolitan area in the world by urban landmass. New York had approximately 65.2 million visitors, comprising 51.6 million domestic and 13.5 million international visitors in 2018. Thus, business opportunities are vast in the city and so is the competition. Many big players have been attracted to this city in all areas of business. As is it a highly developed city, the cost of doing the business is huge and risk is high. Thus, any new business venture or expansion needs to be analyzed and studied carefully. This will ensure good understanding of the business environment and strategical planning to reduce the risk factor and increase returns.

BUSINESS PROBLEM

As a business and tourist hub, the city is famous for its cuisine as well. From street food to high end Michelin star restaurants, you will find everything in New York City. Various well-known chefs have their restaurants there. Eat this, not that placed New York City as one of the top cities for food.

In 2015, NYC started building public WIFI hubs in locations where pay phones used to exist. There are plans to have over 7500 WIFI hotspots installed. Hotspots are to have up to 1GBps speed internet.

The objective is to locate and determine if a restaurant's proximity to a public WIFI hotspot has influence on the rating of that restaurant. The **target audience** interested in this problem is a group of small business owners who are interested in opening a restaurant in Manhattan.

DATA ACQUISITION

This demonstration will make use of the following data sources:

New York Wifi Venue Data Set (Kaggle)
Data contains location of wifi hotspots with latitude and longitude values

New York Top Venue Recommendations from FourSquare API
(FourSquare website: www.foursquare.com)
I will be using the FourSquare API to explore venues located near NYC WIFI hotspots. The Foursquare explore function will be used to get venues located in the proximity of WIFI hotspots. Once these venues are obtained, I will be using the FourSquare API to get the rating of each venue. The resulting dataset will have the following columns:

- Venue ID
- Venue Name
- Coordinates : Latitude and Longitude
- Category Name
- Distance from WIFI point
- Rating of Venue

From these columns I will be making plots and showing stats on the relationship between distance from WIFI hotspot and rating of the venue.

METHODOLOGY

NY WIFI hotspot data was downloaded from Kaggle. This data set contains NY city public WIFI hotspots located throughout multiple boroughs. Because the data set was very large, I narrowed it down to the Borough of Manhattan. The WIFI hotspot dataset contains many columns but the following are the most useful:

- type of hotspot
- borough of hotspot
- longitude of hotspot
- latitude of the hotspot

Once the list was narrowed down to these columns, and rows within the borough of Manhattan, I retrieved the nearest venues to these hotspot locations using the FourSquare API. Because WIFI hotspot locations are densely populated compared to neighborhoods data, I limited the results to 10 venues per WIFI hotspot.

After calling the FourSquare API per WIFI venue and concatenating the results to the original WIFI hotspot list, I saved the results to a .csv file. The reason for this is twofold:

1. I wanted to narrow down the results to just restaurants and food places and it was easier to do this in Excel than in Python
2. I wanted to use Excel to calculate the distance of the venue to the WIFI hotspot using a formula:

*=ACOS(COS(RADIANS(90-C2)) *COS(RADIANS(90-G2)) +SIN(RADIANS(90-C2)) *SIN(RADIANS(90-G2)) *COS(RADIANS(D2-H2))) *6371000*

Where

C2 = Latitude of Wifi Location

D2 = Longitude of Wifi Location

G2 = Latitude of Venue Location

H2 = Longitude of Venue Location

Below is what the resulting dataframe looks like:

	Location	Location Type	Location Latitude	Location Longitude	Venue	VenueId	Venue Latitude	Venue Longitude	Venue Category	Distance Formula
0	179 WEST 26 STREET	Outdoor Kiosk	40.745968	-73.994039	Subway	4b1ff2eaf964a520372b24e3	40.746017	-73.993789	Sandwich Place	21.761316
1	179 WEST 26 STREET	Outdoor Kiosk	40.745968	-73.994039	brgr	45841feaf964a520973f1fe3	40.746157	-73.994112	Burger Joint	21.854922
2	179 WEST 26 STREET	Outdoor Kiosk	40.745968	-73.994039	Chipotle Mexican Grill	4a80bbedf964a52011f61fe3	40.746058	-73.993970	Mexican Restaurant	11.602321
3	179 WEST 26 STREET	Outdoor Kiosk	40.745968	-73.994039	Crompton Ale House	554d791f498e4550edf2c13f	40.745712	-73.993688	Sports Bar	41.028637
4	25 EAST 29 STREET	Outdoor Kiosk	40.744614	-73.985069	Marta	5406665a498e800a29690993	40.744452	-73.984675	Pizza Place	37.729108

The next step is to get the rating of each Venue located near a hotspot. This was achieved by creating a function that returns a dataframe consisting for Venue ID, Venue Name, and Venue Rating. Below is a sample of the resulting dataframe.

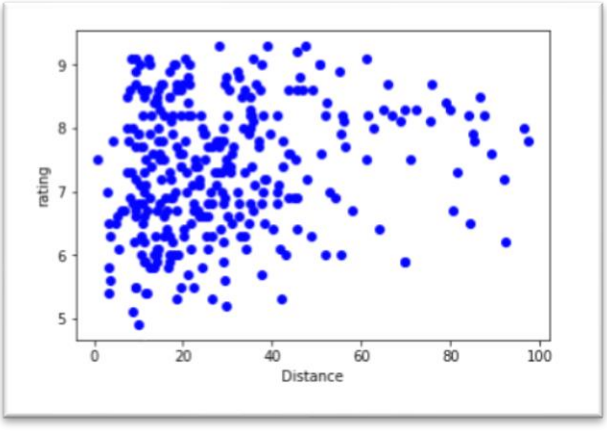
	venue.id	venue.name	venue.rating
0	4b1ff2eaf964a520372b24e3	Subway	6.5
1	45841feaf964a520973f1fe3	brgr	6.1
2	4a80bbedf964a52011f61fe3	Chipotle Mexican Grill	7.1
3	554d791f498e4550edf2c13f	Crompton Ale House	7.0
4	5406665a498e800a29690993	Marta	9.0

Next I merged the output of the ratings dataframe with the dataframe containing WIFI hotspot locations and nearby venues. Because two separate hotspots could be in the vicinity of a single venue, I de-duped the results by taking the hotspot that was closest to the venue. Below is a sample of the resulting dataframe:

	VenueId	distance_min	venue.rating	Venue Category
0	4b1ff2eaf964a520372b24e3	21.761316	6.5	Sandwich Place
1	45841feaf964a520973f1fe3	21.854922	6.1	Burger Joint
2	4a80bbedf964a52011f61fe3	11.602321	7.1	Mexican Restaurant
3	554d791f498e4550edf2c13f	41.028637	7.0	Sports Bar
4	5406665a498e800a29690993	37.729108	9.0	Pizza Place

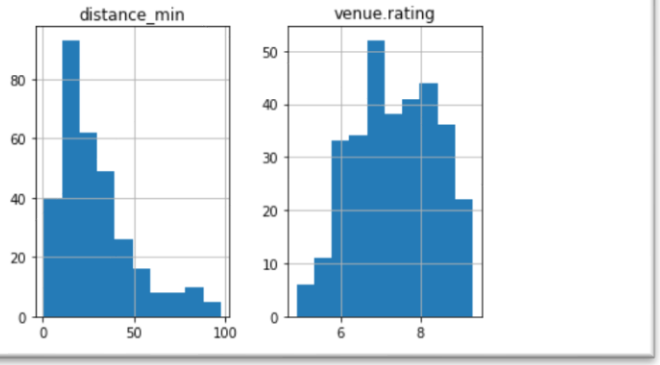
Analysis and Modeling Approach

The first attempt was to show if there is any kind of relationship between rating and distance from public WIFI point. Below is a scatter plot of distance vs. rating:



The relationship between the two variables is not apparent from visual inspection. Also taking a histogram of venue ratings and distances from the nearest WIFI point yielded the following results:

```
viz = ny_wifi_merged_reduced[['distance_min','venue.rating']]
viz.hist()
plt.show()
```



Based on these results, I decided to change the approach to a cluster analysis.

Clustering

I decided to change the approach to this business problem by clustering the venues using venue category, rating, and distance. Recall that the objective

First, I encoded the venue categories by using the Pandas get dummies function to convert the categories into Boolean values. Each category becomes a dataframe column where a particular Venue ID is assigned a value of 1 if that Venue ID falls into category. Below is a sample of the resulting dataframe.

	African Restaurant	American Restaurant	Asian Restaurant	Australian Restaurant	BBQ Joint	Bagel Shop	Bar	Bed & Breakfast	Breakfast Spot	Bubble Tea Shop	Burger Joint	Burrito Place
0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	1	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0

Then I added the ratings and distances back to the dataframe. I ran a K-means cluster analysis using a cluster size of 5. The result of the cluster analysis has the following amount of venues in each cluster.

```
Out[52]: 3    116
         1     90
         2     65
         0     29
         4     17
         Name: Cluster Labels, dtype: int64
```

Next I examined each of the clusters looking at the mean rating, mean distance to venue and the number of venue categories in each cluster.

Cluster 1

```
7.724137931034482
59.925001177241384
Bar                                4
Pizza Place                        3
Coffee Shop                        3
Vegetarian / Vegan Restaurant      2
Italian Restaurant                 2
Japanese Restaurant                2
Sandwich Place                     2
```

Cluster 2

```
7.275555555555558
24.507427978333336
Sandwich Place              6
Bar                         6
Pub                         5
Pizza Place                 5
American Restaurant         5
Coffee Shop                 5
New American Restaurant     4
Sports Bar                  3
Salad Place                 3
Italian Restaurant          3
```

Cluster 3

```
7.549230769230769
39.05632044815383
Coffee Shop                 7
Pizza Place                 5
Sandwich Place              5
Bar                         5
Japanese Restaurant         4
Indian Restaurant           4
Bagel Shop                  4
```

Cluster 4

```
7.18448275862069
11.797680268336212
Coffee Shop                13
Pizza Place                 9
Bar                         8
Mexican Restaurant          7
Pub                         7
American Restaurant         7
Burger Joint                5
Diner                       4
Sandwich Place              4
```

Cluster 5

```
7.729411764705881
85.43385327176469
Bar                             3
Breakfast Spot                  2
Coffee Shop                     2
Mediterranean Restaurant        1
American Restaurant             1
African Restaurant              1
Pub                             1
Burger Joint                    1
```

Discussion and Conclusion

On this notebook, analysis of the best location and type of restaurant to open in Manhattan has been presented. Here are some of the findings:

- Based on rating of restaurants, types of restaurants, and proximity of restaurant to a NYC WIFI hotspot, I determined what recommendation to make to business on type and location of restaurant.
- Using FourSquare API, I have collected a good amount of data regarding the restaurants located near a NYC WIFI hotspot in the area.
- The sourcing from FourSquare had its limitations though. There are many restaurant venues located near a NYC WIFI hotspot, but only a subset of these venues actually have a rating. Therefore the recommendation may have changed if I had access to more data.
- Based on the data available, and the generated clusters from the data, I recommend that the business stakeholders open a **Sandwich shop** located within **50m** of a NYC WIFI hotspot.