The Battle of Neighborhood

Applied Data Science Capstone Project

coursera

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Introduction

Mediterranean diet has again exceeded all expectations to rank yet as top diet according to the US World News. It is generally accepted that the people in countries bordering the Mediterranean Sea live longer and suffer less than most Americans from cancer and cardiovascular ailments. The not-so-surprising secret is an active lifestyle, weight control, and a diet low in red meat, sugar and saturated fat and high in produce, nuts and other healthful foods. The Mediterranean Diet may offer a host of health benefits, including weight loss, heart and brain health, cancer prevention, and diabetes prevention and control. By following the Mediterranean Diet, you could also keep that weight off while avoiding chronic disease.
There isn't "a" Mediterranean diet. Greeks eat differently from Italians, who eat differently from the French and Spanish. But they share many of the same principles. Working with some health experts a Greek restauranter entrepreneur who recently migrated to New York city wants to open and develop an affordable, consumer friendly Mediterranean restaurant that will serve a variety of Mediterranean dishes. The restauranter and in addition to his business plan hired me as a Data Scientist to explore the best neighborhood in New York City to open his new venture using a well-defined Data Science Methodology and Framework to evaluate New York neighborhoods and the Mediterranean Venues.

Hence, the problem statement that will try to answer in this report is: **What's the best New York City Neighborhood to Open a new Mediterranean Restaurant?**

Methodology

In this section, I will introduce the data sources and data engineering methods that I will use for my analysis.

Data Selection

The first exercise of our project is to select our dataset. Our analysis exercise and final conclusion will largely depend upon the quality of data being used. For this purpose, I will use the dataset provided in previous labs, The New York neighborhood dataset. This dataset has a total of five boroughs and 306 neighborhoods that we will segment and process for the purpose of finding the best borough and neighborhood to open the new Mediterranean Restaurant. In addition, to the dataset, we will use **Foursquare**, one of most popular location based social networks (LBSN) so we can explore venues and especially Mediterranean restaurants in the NY neighborhoods dataset.

Data Pre-Processing

Preprocessing data is an important step in any data science project. Often raw data is very complicated and contains either erroneous, irrelevant or missing data. Hence, the first step I will do after downloading the New York neighborhoods dataset from IBM Cloud; I will explore and preprocess our dataset using some of the methods learned in this course. To download our dataset, I will use python library requests to get the data object from IBM Cloud. After a successful download, then I display the data object obtained. The first observation is that the data is in a json format that will need to be transformed into a pandas dataframe for ease of further exploration.

Once, we processed our dataset into a pandas dataframe, we need to make sure that our dataframe has the correct number of Boroughs and neighborhoods as illustrated in the below figure:

	Borough	Neighborhood	Latitude	Longitude
0	Bronx	Wakefield	40.894705	-73.847201
1	Bronx	Co-op City	40.874294	-73.829939
2	Bronx	Eastchester	40.887556	-73.827806
3	Bronx	Fieldston	40.895437	-73.905643
4	Bronx	Riverdale	40.890834	-73.912585
5	Bronx	Kingsbridge	40.881687	-73.902818
6	Manhattan	Marble Hill	40.876551	-73.910660
7	Bronx	Woodlawn	40.898273	-73.867315
8	Bronx	Norwood	40.877224	-73.879391
9	Bronx	Williamsbridge	40.881039	-73.857446

Figure 1: dataframe containing 5 boroughs and 306 neighborhoods

In addition, to getting the content of the dataframe, we can visualize all the five boroughs (Bronx, Manhattan, Brooklyn, Queens, Staten Island) and corresponding neighborhoods using folium python library on an interactive map using the Latitude and Longitude of each neighborhood and display them as markers on the map as illustrated in Figure 2.

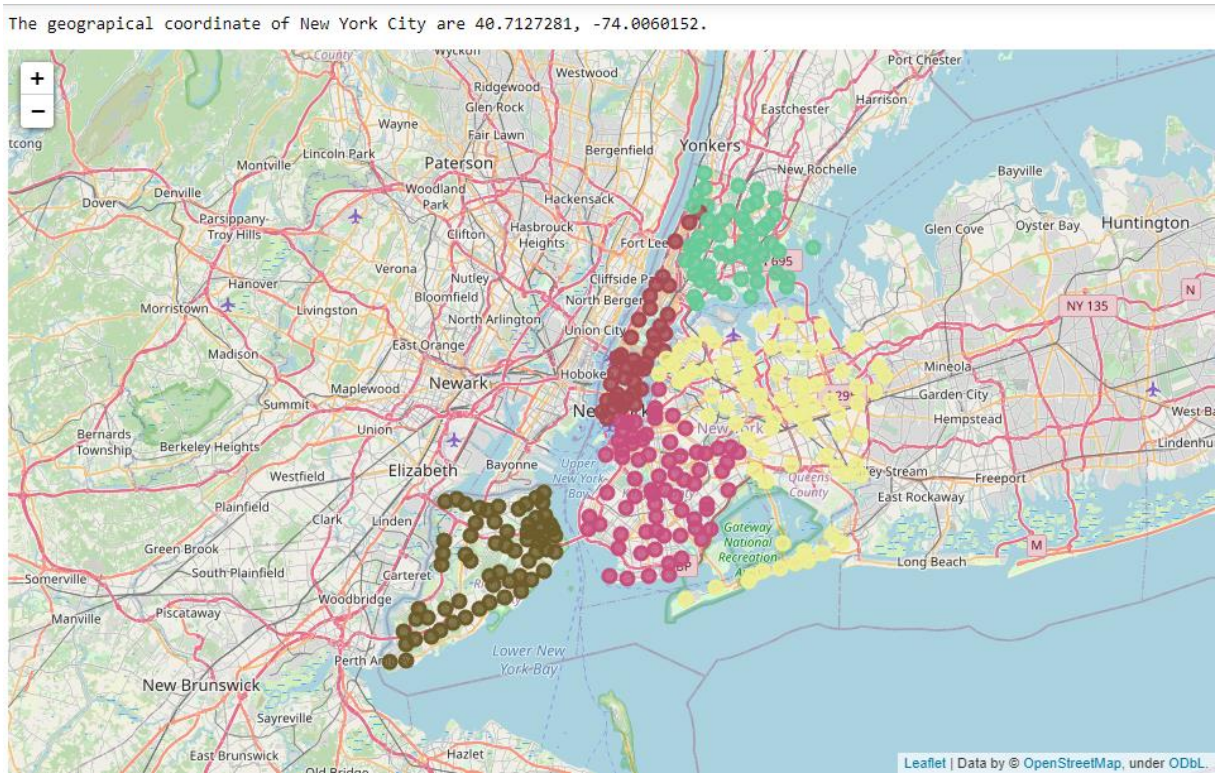

Figure 2: NY city map displaying all five boroughs and corresponding neighborhoods

Now that we have all the relevant attributes from our dataset containing all the neighborhoods and its corresponding Latitude and Longitudes, we will use Foursquare Venues API to get all the venues in New York neighborhoods. These venues can be a business e.g. a restaurant, train station or movie theater, or a private residence etc...
Using my Foursquare developer credentials, using REST request and venues API I obtained a dataframe with all New York venues and their corresponding categories. When examining the data, there are 10106 venues and 428 unique categories. Finally, I confirmed that there is a Mediterranean Restaurant category in our dataset.

	Neighborhood	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Wakefield	40.894705	-73.847201	Lollipops Gelato	40.894123	-73.845892	Dessert Shop
1	Wakefield	40.894705	-73.847201	Rite Aid	40.896649	-73.844846	Pharmacy
2	Wakefield	40.894705	-73.847201	Carvel Ice Cream	40.890487	-73.848568	Ice Cream Shop
3	Wakefield	40.894705	-73.847201	Walgreens	40.896528	-73.844700	Pharmacy
4	Wakefield	40.894705	-73.847201	Dunkin'	40.890459	-73.849089	Donut Shop
5	Wakefield	40.894705	-73.847201	Shell	40.894187	-73.845862	Gas Station
6	Wakefield	40.894705	-73.847201	Subway	40.890468	-73.849152	Sandwich Place
7	Wakefield	40.894705	-73.847201	Central Deli	40.896728	-73.844387	Deli / Bodega
8	Wakefield	40.894705	-73.847201	Louis Pizza	40.898399	-73.848810	Pizza Place
9	Wakefield	40.894705	-73.847201	Koss Quick Wash	40.891281	-73.849904	Laundromat

Figure 3: Some of the venues obtained through Foursquare API and their categories

Now and after the relevant attributes of data have been retained, the next step is to determine the appropriate format we need our data must be stored in order to be used for later analysis.

Data Transformation

In this section, we will use Machine Learning (ML) methods to transform our data to help explain our analysis and findings. Hence, the first method we will use is one hot encoding. One hot encoding is a process by which categorical variables are converted into a form which we can later use in our ML model. The categorical value represents the numerical value of the entry in the dataset. For example: if there were to be another company in the dataset, it would have been given categorical value as 4. As the number of unique entries increases, the categorical values also proportionally increase. Hence, using pandas library will transform all venues categories into categorical values. After one encoding, I group all the neighborhoods by taking the mean of the frequency of occurrence of each category as illustrated in below table (Figure 4)

	Neighborhoods	Accessories Store	Adult Boutique	Afghan Restaurant	African Restaurant	Airport Terminal	American Restaurant	Antique Shop	Arcade	Arepa Restaurant	...	Warehouse Store	Waste Facility	Waterfront
0	Allerton	0.0	0.0	0.0	0.0	0.0	0.000000	0.0	0.0	0.0	...	0.0	0.0	0.0
1	Annadale	0.0	0.0	0.0	0.0	0.0	0.181818	0.0	0.0	0.0	...	0.0	0.0	0.0
2	Arden Heights	0.0	0.0	0.0	0.0	0.0	0.000000	0.0	0.0	0.0	...	0.0	0.0	0.0
3	Arlington	0.0	0.0	0.0	0.0	0.0	0.000000	0.0	0.0	0.0	...	0.0	0.0	0.0
4	Arrochar	0.0	0.0	0.0	0.0	0.0	0.000000	0.0	0.0	0.0	...	0.0	0.0	0.0
5	Arverne	0.0	0.0	0.0	0.0	0.0	0.000000	0.0	0.0	0.0	...	0.0	0.0	0.0
6	Astoria	0.0	0.0	0.0	0.0	0.0	0.000000	0.0	0.0	0.0	...	0.0	0.0	0.0
7	Astoria Heights	0.0	0.0	0.0	0.0	0.0	0.000000	0.0	0.0	0.0	...	0.0	0.0	0.0
8	Auburndale	0.0	0.0	0.0	0.0	0.0	0.047619	0.0	0.0	0.0	...	0.0	0.0	0.0
9	Bath Beach	0.0	0.0	0.0	0.0	0.0	0.000000	0.0	0.0	0.0	...	0.0	0.0	0.0

Figure 4: Mean of the frequency of occurrence of each category in New York neighborhoods

Now let's obtain our final dataset that has the mean of the frequency of all the Mediterranean Restaurant in New York neighborhoods.

	Neighborhoods	Mediterranean Restaurant
0	Allerton	0.000000
1	Annadale	0.000000
2	Arden Heights	0.000000
3	Arlington	0.000000
4	Arrochar	0.045455
5	Arverne	0.000000
6	Astoria	0.030303
7	Astoria Heights	0.000000
8	Auburndale	0.000000
9	Bath Beach	0.000000

Figure 5: Mean of the frequency of occurrence of Mediterranean Restaurant in New York neighborhoods

Mining Data

Now that we cleaned up our dataset, we are ready to use Machine Learning algorithms to recommend the best neighborhood for opening the next healthy Mediterranean cuisine. For this we will be using the unsupervised learning algorithm, **k-means clustering** to cluster New York neighborhoods based on the neighborhoods that have similar averages of Mediterranean Restaurant in that neighborhood.

One of the most fundamental steps for any unsupervised algorithm is to determine the optimal number of clusters into which the data may be clustered. In order to that we will use the **Elbow Method** which is one of the most popular methods to determine this optimal value of k.

Based in the visualization of *Figure 2*, we can hypothetically see that the optimal number of clusters may be around 5. But visualizing the data alone cannot always give the right answer. Hence, using the Elbow method technique in the **sklearn** library of python, we define the following:

- **Distortion:** It is calculated as the average of the squared distances from the cluster centers of the respective clusters. Typically, the Euclidean distance metric is used.
- **Inertia:** It is the sum of squared distances of samples to their closest cluster center.

We iterate the values of k from 2 to 20 and calculate the values of distortions for each value of k and calculate the distortion and inertia for each value of k in the given range.

For this purpose, we imported **KElbowVisualizer** from the **Yellowbrick** package. Then we fit our K-Means model above to the Elbow visualizer.

Below graph illustrates the Elbow method using distortion:

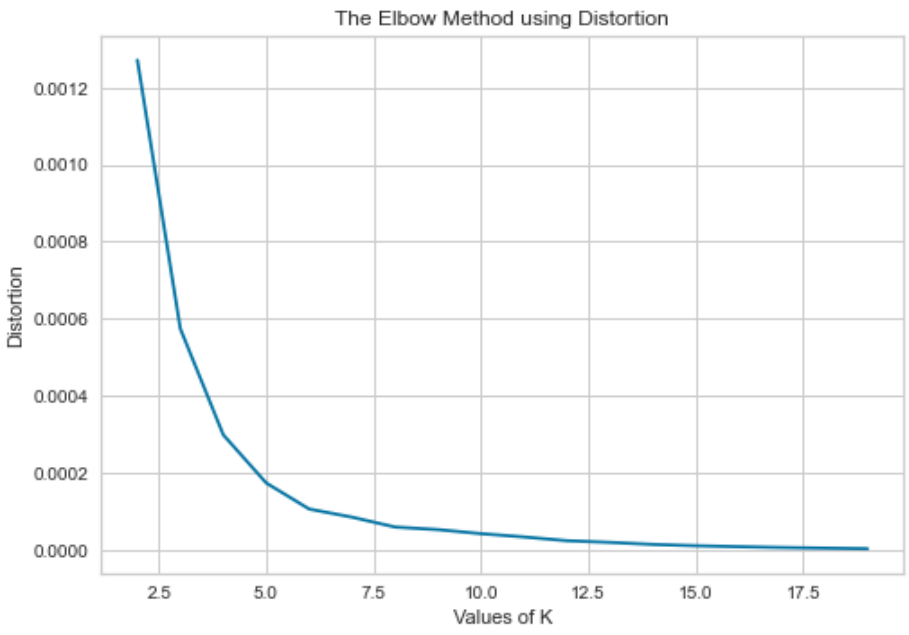

Figure 6: The Elbow Method using distortion

Using the different values of Inertia, we get the below output:

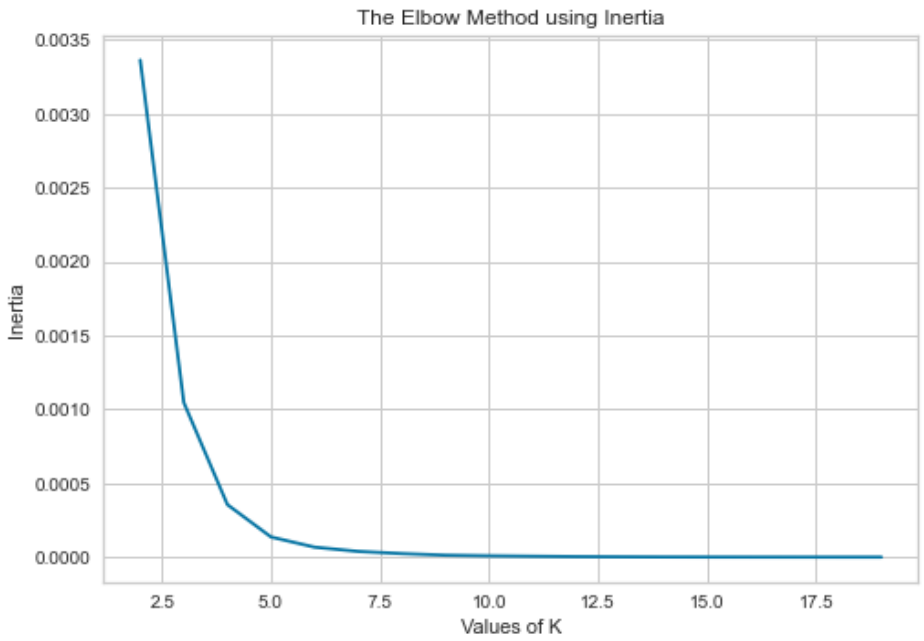

Figure 7: The Elbow Method using inertia

To determine the optimal number of clusters, as illustrated by both the distortion and inertia method, we have to select the value of k at the "elbow" i.e. the point after which the distortion/inertia start decreasing in a linear fashion. Thus, for the given data, we conclude that the optimal number of clusters for the data is **5**.

Neighborhoods that had a similar mean frequency of Mediterranean Restaurants were divided into 5 clusters. Each of these clusters was labelled from 0 to 4. After, we merged the venue data and add the cluster labels we create a new table which would be the basis for analyzing new opportunities for opening a new Mediterranean Restaurant in one of New York City neighborhoods as illustrated in Figure 8.

	Neighborhoods	Mediterranean Restaurant	Cluster Labels
0	Allerton	0.000000	1
1	Annadale	0.000000	1
2	Arden Heights	0.000000	1
3	Arlington	0.000000	1
4	Arrochar	0.045455	0
5	Arverne	0.000000	1
6	Astoria	0.030303	4
7	Astoria Heights	0.000000	1
8	Auburndale	0.000000	1
9	Bath Beach	0.000000	1

Figure 8: Mediterranean Restaurant frequency/ with cluster labels.

Finally, and prior to analyzing the results, we can visualize our newly obtained clusters that had a similar mean frequency of Mediterranean restaurants using Folium python package.

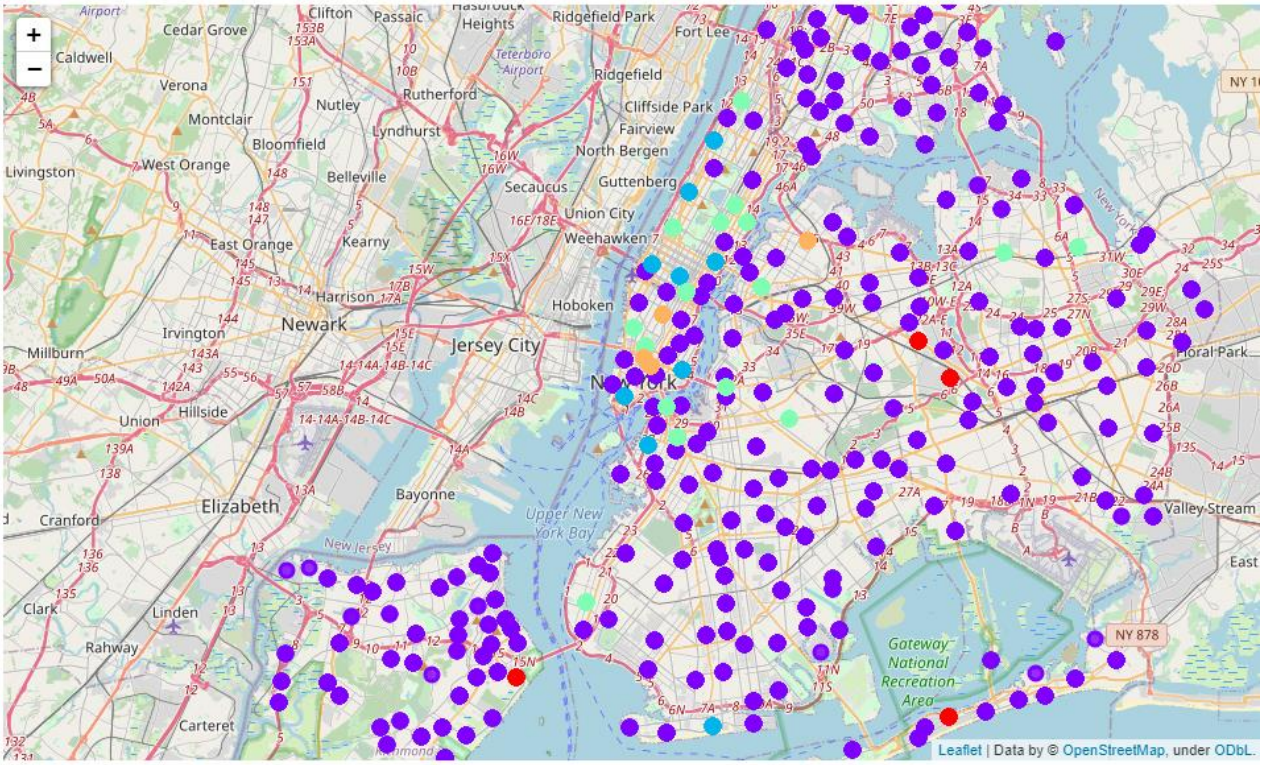

Figure 9: Map of Mediterranean Restaurant frequency/ with cluster labels.

Cluster 1: Electric Indigo
Cluster 2: Cerulean
Cluster 3: Aquamarine
Cluster 4: Orange
Cluster 5: Red

Results Evaluation

Using k-means Clustering and Elbow method, we concluded that the optimum K value is 5. Now and after we obtained a total of 5 clusters, we can start evaluating each cluster by checking the number of neighborhoods in each cluster and the average Mediterranean restaurant in that cluster.
First, let's find out how many neighborhoods exist per Cluster:

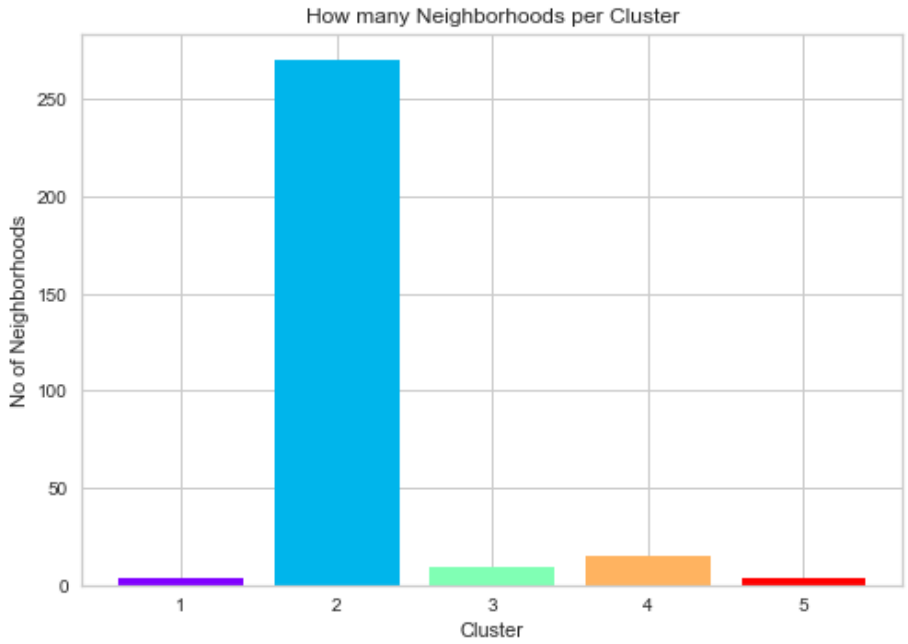

Figure 10: Number of neighborhoods per Cluster

Cluster1:	4	Cluster 3:	9	Cluster 5:	4
Cluster 2:	270	Cluster 4:	15		

As shown in Figure 10 the cluster with most neighborhoods is Cluster 2.

Now, let's examine the average number of Mediterranean restaurants per Cluster; as shown in Figure 11, the average of Mediterranean Restaurants per Cluster are distributed as follows:

Cluster 1 = 0.047619
Cluster 2 = 0.000010
Cluster 3 = 0.023256
Cluster 4 = 0.015873
Cluster 5 = 0.03

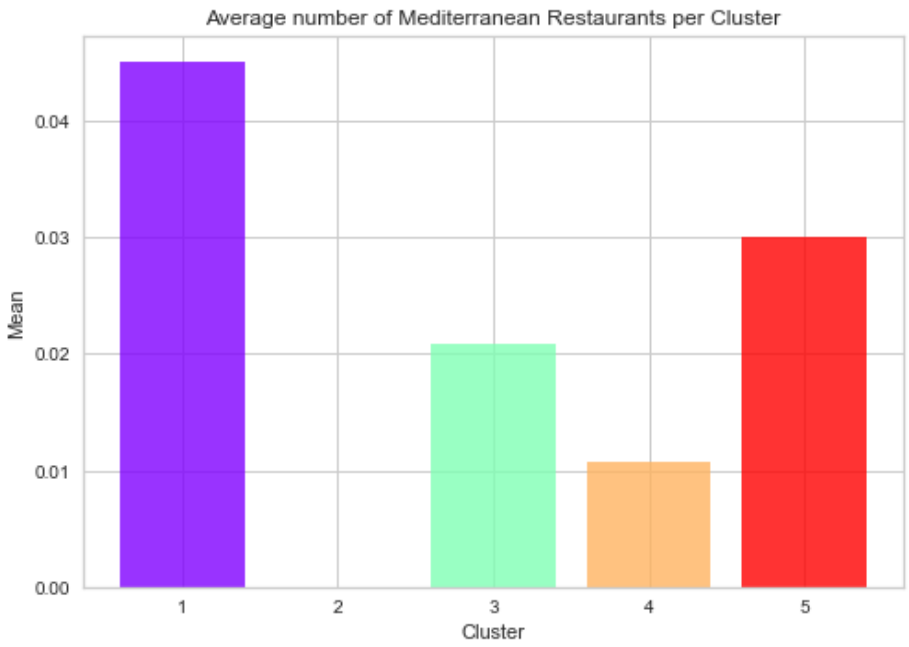

Figure 11: Average number of Mediterranean Restaurants per Cluster

Both Figure 10 and Figure 11 gives us some critical information to our cluster's analysis. As illustrated, although Cluster 1 and Cluster 5 both have only 4 neighborhoods, they both have the highest average number of Mediterranean restaurant 0.047619 and 0.03 respectively while Cluster 2 which has 270 neighborhoods has no Mediterranean restaurant.
Now, we can examine each cluster and determine to determine which borough and neighborhood is best to open the next Mediterranean restaurant.

Cluster 1:

	Borough	Neighborhood	Mediterranean Restaurant	Cluster Labels	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Queens	Rego Park	0.047619	0	40.728974	-73.857827	CVS pharmacy	40.726791	-73.853772	Pharmacy
32	Queens	Rego Park	0.047619	0	40.728974	-73.857827	Rego Park Wines & Liquors	40.731312	-73.860061	Liquor Store
24	Queens	Rego Park	0.047619	0	40.728974	-73.857827	Dunkin'	40.727152	-73.853196	Donut Shop
25	Queens	Rego Park	0.047619	0	40.728974	-73.857827	Fresh Value Market Place	40.729675	-73.862703	Health Food Store
26	Queens	Rego Park	0.047619	0	40.728974	-73.857827	Paris Baguette	40.730136	-73.861580	Bakery
...	...	...	...	...	...	...	...	...	...	...
63	Queens	Rockaway Park	0.040000	0	40.580343	-73.841534	The Beach at 118th Street	40.577346	-73.838159	Beach
64	Queens	Rockaway Park	0.040000	0	40.580343	-73.841534	Rockaway Beach - 120th Street	40.578322	-73.840387	Beach
65	Queens	Rockaway Park	0.040000	0	40.580343	-73.841534	Belle Harbor Steak & Seafood	40.581202	-73.837846	Steakhouse
66	Queens	Rockaway Park	0.040000	0	40.580343	-73.841534	Beach 126th St	40.577649	-73.846148	Beach
55	Queens	Rockaway Park	0.040000	0	40.580343	-73.841534	Dunkin' / Baskin-Robbins	40.581195	-73.838149	Donut Shop

Figure 12: Cluster 1: Queens – highest average of Mediterranean Restaurant

Cluster 1 is in Queens Borough and contains 4 neighborhoods with 104 unique venues in which there are five Mediterranean restaurants equating to 0.047619 average as the restaurants are concentrated in two neighborhoods Rego Park and Rockway Park

Cluster 2:

	Borough	Neighborhood	Mediterranean Restaurant	Cluster Labels	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Bronx	Wakefield	0.0	1	40.894705	-73.847201	Koss Quick Wash	40.891281	-73.849904	Laundromat
5191	Queens	Bay Terrace	0.0	1	40.782843	-73.776802	WW (Weight Watchers)	40.779026	-73.779324	Weight Loss Center
5159	Queens	Bay Terrace	0.0	1	40.553988	-74.139166	Key Food SuperStore	40.554627	-74.143766	Supermarket
5158	Queens	Bay Terrace	0.0	1	40.553988	-74.139166	Liquor Land	40.554070	-74.143502	Liquor Store
5157	Queens	Bay Terrace	0.0	1	40.553988	-74.139166	All County Garage Door	40.551868	-74.135523	Home Service
...	...	...	...	...	...	...	...	...	...	...
2571	Brooklyn	Prospect Park South	0.0	1	40.647009	-73.962613	Island Express	40.647111	-73.958108	Caribbean Restaurant
2570	Brooklyn	Prospect Park South	0.0	1	40.647009	-73.962613	Downtown Natural Market	40.649271	-73.963707	Grocery Store
2569	Brooklyn	Prospect Park South	0.0	1	40.647009	-73.962613	Mattress Firm	40.648562	-73.958382	Mattress Store
2568	Brooklyn	Prospect Park South	0.0	1	40.647009	-73.962613	Angelo's Pizza	40.644068	-73.958202	Pizza Place
7726	Staten Island	Fox Hills	0.0	1	40.617311	-74.081740	Mona's Cuisine	40.618282	-74.084975	African Restaurant

Figure 13: Cluster 2: No Mediterranean Restaurant in some Bronx, Queens, Brooklyn and Staten Island neighborhoods

Cluster 2 contains four boroughs Bronx, Queens, Brooklyn and Staten Island and has the highest number of neighborhoods at 270 with 6001 unique venues with no Mediterranean restaurants

Cluster 3:

	Borough	Neighborhood	Mediterranean Restaurant	Cluster Labels	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Brooklyn	Brighton Beach	0.023256	2	40.576825	-73.965094	Ocean parkway reigelmans boardwalk	40.574756	-73.968583	Beach
519	Manhattan	Morningside Heights	0.023256	2	40.808000	-73.963896	Nous Espresso Bar - Graduate Student Center	40.807533	-73.960879	Café
495	Manhattan	Morningside Heights	0.023256	2	40.808000	-73.963896	Hartley Pharmacy	40.809272	-73.959231	Pharmacy
494	Manhattan	Morningside Heights	0.023256	2	40.808000	-73.963896	Broadway Au Lait	40.811514	-73.961346	Coffee Shop
493	Manhattan	Morningside Heights	0.023256	2	40.808000	-73.963896	Columbia Opticians	40.810312	-73.958881	Optical Shop
...	...	...	...	...	...	...	...	...	...	...
359	Manhattan	Midtown	0.020000	2	40.754691	-73.981669	Joanna Vargas Skin Care	40.753136	-73.980721	Spa
358	Manhattan	Midtown	0.020000	2	40.754691	-73.981669	The Lionel Pincus and Princess Firyal Map Divi...	40.753423	-73.981686	Art Gallery
357	Manhattan	Midtown	0.020000	2	40.754691	-73.981669	Stone Bridge Pizza & Salad	40.752586	-73.980459	Pizza Place
356	Manhattan	Midtown	0.020000	2	40.754691	-73.981669	L'ADRESSE	40.753766	-73.985096	Café
719	Manhattan	Sutton Place	0.020000	2	40.760280	-73.963556	Adyar Anand Bhavans Pvt ltd	40.759346	-73.962434	Food Court

Figure 14: Cluster 3: Several Mediterranean Restaurant in Brooklyn and Manhattan neighborhoods

Cluster 3 contains only 2 boroughs Brooklyn and Manhattan and has only nine neighborhoods with 15 Mediterranean restaurants out of 681 unique venues spread out through four neighborhoods Brighton Beach, Morningside Heights, Midtown and Sutton Place.

Cluster 4:

	Borough	Neighborhood	Mediterranean Restaurant	Cluster Labels	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
352	Manhattan	Hamilton Heights	0.015873	3	40.823604	-73.949688	Harlem Brothers Pizza	40.823895	-73.944182	Pizza Place
384	Manhattan	Hamilton Heights	0.015873	3	40.823604	-73.949688	Wat's On Your Plate	40.825632	-73.948494	Caribbean Restaurant
386	Manhattan	Hamilton Heights	0.015873	3	40.823604	-73.949688	Anchor Wine Bar	40.825424	-73.951204	Wine Bar
387	Manhattan	Hamilton Heights	0.015873	3	40.823604	-73.949688	Bikram Yoga Harlem	40.825672	-73.948887	Yoga Studio
388	Manhattan	Hamilton Heights	0.015873	3	40.823604	-73.949688	Fumo	40.821412	-73.950499	Italian Restaurant
...	...	...	...	...	...	...	...	...	...	...
898	Queens	Murray Hill	0.006849	3	40.748303	-73.978332	Maison Thai	40.744969	-73.975770	Thai Restaurant
899	Queens	Murray Hill	0.006849	3	40.748303	-73.978332	Windsor Wine Shop	40.744696	-73.978847	Wine Shop
900	Queens	Murray Hill	0.006849	3	40.748303	-73.978332	Baby Bo's Cantina	40.745048	-73.975748	Mexican Restaurant
901	Queens	Murray Hill	0.006849	3	40.748303	-73.978332	Spice Symphony	40.744652	-73.981020	Indian Restaurant
747	Manhattan	Murray Hill	0.006849	3	40.748303	-73.978332	Sam's Place	40.749335	-73.977226	Italian Restaurant

Figure 15: Cluster 4: Scattered Mediterranean Restaurant in some Queens and Manhattan neighborhoods

Cluster 4 is in Manhattan, Brooklyn and Queens Boroughs and contains 15 neighborhoods with 1208 unique venues in which there are 16 Mediterranean restaurants equating to 0.015873 average.

Cluster 5:

	Borough	Neighborhood	Mediterranean Restaurant	Cluster Labels	Neighborhood Latitude	Neighborhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
201	Queens	Astoria	0.030303	4	40.768509	-73.915654	Burger Club	40.766487	-73.920578	Burger Joint
275	Queens	Astoria	0.030303	4	40.768509	-73.915654	Sugar Freak	40.764443	-73.916055	Cajun / Creole Restaurant
273	Queens	Astoria	0.030303	4	40.768509	-73.915654	Tikka Indian Grill	40.765397	-73.918658	Indian Restaurant
272	Queens	Astoria	0.030303	4	40.768509	-73.915654	Chip	40.765517	-73.919339	Dessert Shop
271	Queens	Astoria	0.030303	4	40.768509	-73.915654	Basil Brick Oven Pizza	40.770865	-73.920080	Pizza Place
...	...	...	...	...	...	...	...	...	...	...
130	Manhattan	Soho	0.030000	4	40.722184	-74.000657	Pi Greek Bakerie	40.723516	-74.003444	Bakery
129	Manhattan	Soho	0.030000	4	40.722184	-74.000657	Y7 Studio - Soho	40.721441	-73.998936	Yoga Studio
128	Manhattan	Soho	0.030000	4	40.722184	-74.000657	La Esquina	40.721598	-73.997471	Mexican Restaurant
127	Manhattan	Soho	0.030000	4	40.722184	-74.000657	Crosby Street Hotel	40.723011	-73.997454	Hotel
398	Manhattan	Flatiron	0.030000	4	40.739673	-73.990947	Novità Cucina Creativa	40.739455	-73.986548	Italian Restaurant

Figure 16: Cluster 5: Second highest average of Mediterranean restaurants in some Queens and Manhattan neighborhoods.

Cluster 5 covers Queens and Manhattan Boroughs and contains 15 neighborhoods with 346 unique venues in which there are 12 Mediterranean restaurants equating to the second concentration of Mediterranean restaurants after Cluster 1.

Discussion

Based on the above analysis of all our optimum clusters, we can conclude that The concentration of Mediterranean restaurants in New York City are in Clusters 1 and 5 with the neighborhoods Rego Park, Rockway Park, Astoria, Soho and Flatiron have the highest average of Mediterranean restaurants followed by Clusters 3 and 4. We can conclude that both boroughs Queens and Manhattan share the highest number of Mediterranean restaurants in followed by Brooklynn while Bronx and Staten Island have little to no Mediterranean restaurants. In addition, Cluster 2 has the greatest number of neighborhoods at 270, but no Mediterranean restaurant.

Therefore, we think that the optimum place to put a new Mediterranean Restaurant is in Staten Island as there are 63 Neighborhoods in the area but no Mediterranean Restaurants, hence, eliminating any competition. The second-best Borough is the Bronx, having 70 neighborhoods in the area with little to no Mediterranean Restaurants gives a good opportunity for opening a new restaurant.

Finally, note that some of the drawbacks of this analysis are that the clustering is completely based on data obtained from the Foursquare API. Also, the analysis does not take into consideration of additional features for example menu cost, menu price average of other restaurants, neighborhood traffic, etc...

Conclusion

This concludes the optimal findings for our Capstone project and recommendation to our Greek restaurateur entrepreneur to open the next healthy Mediterranean restaurant in New York City. We started with a problem statement that required us to search for the right dataset to do our analysis and apply machine learning algorithms to recommend to our Greek restauranteur entrepreneur the best location to open the next healthy Mediterranean restaurant in New York City. Finally, we wrapped the findings with our results evaluation and final recommendation based on the data we have and assumptions made for the project.