

Capstone Project – The Battle of Neighborhoods

Perfect place to start an Indian Restaurant in Queens, NY.

1. Introduction - Business Problem and Describe the Data:

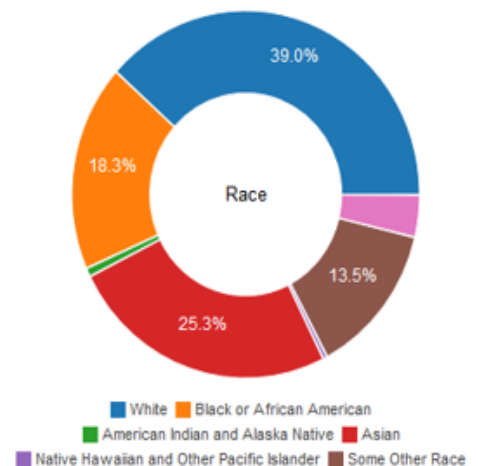
1.1 Introduction:

New York, is the most populous state in the United States. It is diverse and is the financial capital of USA. It is multicultural with 19.45 million people. New York welcomed a record of 65.2 million visitors, comprising 51.6 million domestic and 13.5 million international visitors in 2019.

It provides lot of business opportunities and business friendly environment. One of the most immigrant-friendly cities in New York is Queens, this city has a lot of immigrants from all over the world with many cultural diversity which allowing a huge types of cuisines one can offer in the restaurant business.

Queens Population by Race:

| Race | Population | Percentage |
|--|------------|------------|
| Whit | 896,722 | 39.01% |
| Asian | 580,709 | 25.26% |
| Black or African American | 421,038 | 18.32% |
| Some Other Race | 309,236 | 13.45% |
| Two or More Races | 79,731 | 3.47% |
| American Indian an Alaska Native | 9,977 | 0.43% |
| Native Hawaiian and Other Pacific Islander | 1,100 | 0.05% |



1.2 Business Problem:

As it is highly developed city so cost of doing business is also one of the highest. Thus, any new business venture or expansion needs to be analyzed carefully. The insights derived from analysis will give good understanding of the business environment which help in strategically targeting the market. This will help in reduction of risk and the return on investment will be reasonable. So in this project we will analyze the neighborhoods in Queens to identify the most profitable area to start the business to make sure whether it is a profitable idea or not. If so, where we can place it?

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1.3 Data Description:

- To identify the best location to start the business in Queens, I need to find out the number of our competitors in each neighborhoods in Queens.
- I used NY Open-Data to import the data of "Neighborhoods in New York."
<https://data.cityofnewyork.us/City-Government/Neighborhood-Tabulation-Areas-NTA-/cpf4-rkhg>
- I used Foursquare API to get the most common venues of given Borough of Queens and the Indian restaurants Id.
<https://foursquare.com/>
- I used Google API to find their geographic coordinates based on their postal code addresses.

1.4 Data Selection:

I used Google API to find their geographic coordinates of the 5 locations shortlisted for our Indian restaurant:-

| | Neighborhood | Neighborhood Latitude | Neighborhood Longitude | Venue | Venue Latitude | Venue Longitude | Venue Category |
|---|--------------|-----------------------|------------------------|------------------------------------|----------------|-----------------|-------------------|
| 0 | Astoria | 40.768509 | -73.915654 | The Gully | 40.766719 | -73.912410 | Indian Restaurant |
| 1 | Astoria | 40.768509 | -73.915654 | Tikka Indian Grill | 40.765397 | -73.918658 | Indian Restaurant |
| 2 | Astoria | 40.768509 | -73.915654 | Namaste | 40.766669 | -73.920784 | Indian Restaurant |
| 3 | Astoria | 40.768509 | -73.915654 | Mystik Masaala (Indian Food Truck) | 40.766437 | -73.920462 | Food Truck |
| 4 | Astoria | 40.768509 | -73.915654 | Mystik Masaala | 40.770163 | -73.906086 | Food Truck |

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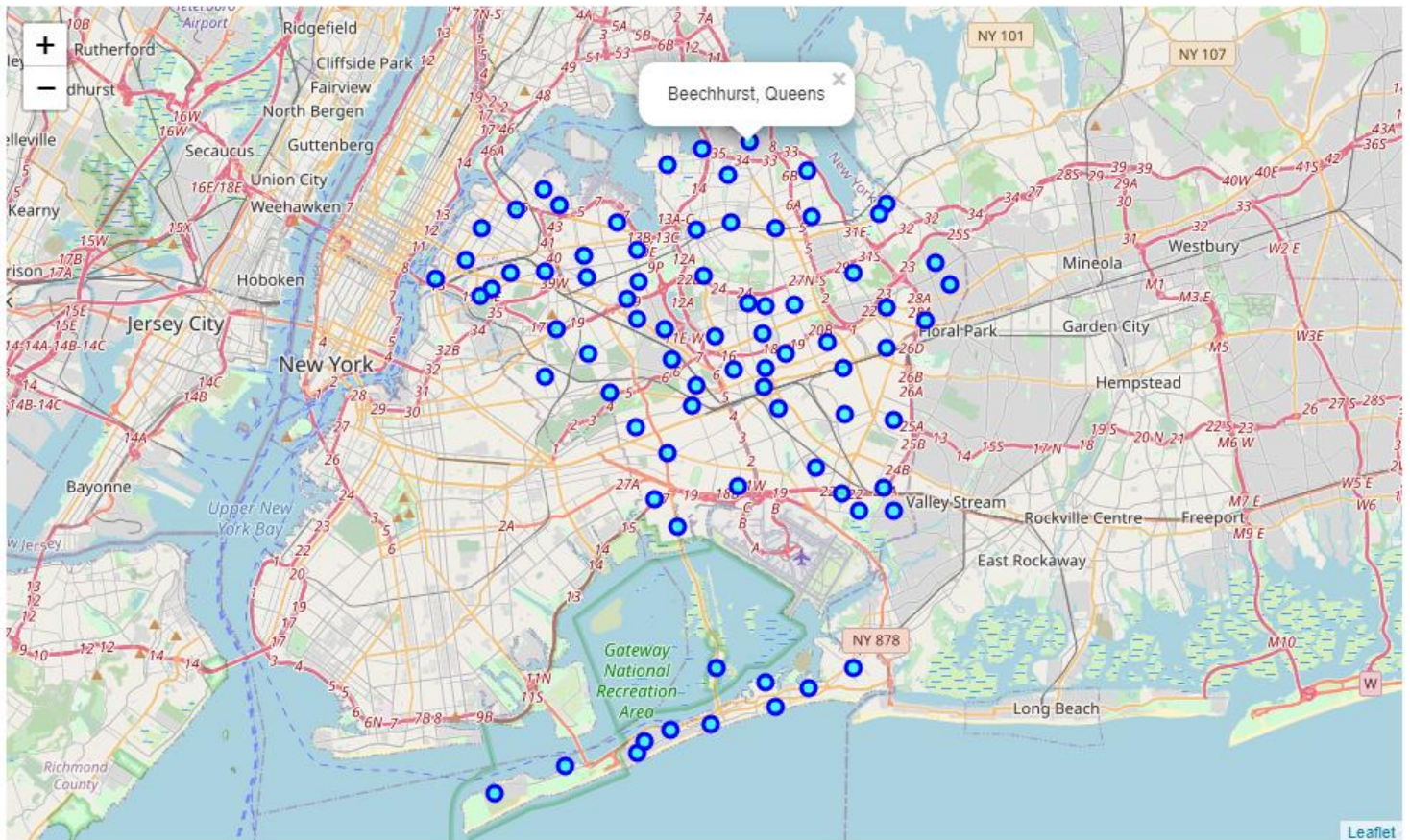
2. Methodology:

As a database, I used NY Open-Data repository in my study. My master data which has the main components Borough, Neighborhood, Latitude and Longitude information of the city.

| | Borough | Neighborhood | Latitude | Longitude |
|---|---------|-----------------|-----------|------------|
| 0 | Queens | Astoria | 40.768509 | -73.915654 |
| 1 | Queens | Woodside | 40.746349 | -73.901842 |
| 2 | Queens | Jackson Heights | 40.751981 | -73.882821 |
| 3 | Queens | Elmhurst | 40.744049 | -73.881656 |
| 4 | Queens | Howard Beach | 40.654225 | -73.838138 |

2.1 Create a map of New York with neighborhoods:

I used python folium library to visualize geographic details of Queens and its boroughs and I created a map of NYC with Queens Neighborhood. I used latitude and longitude values to get the visual as below:



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3. Analysis & Machine Learning

3.1 Analyze Each Neighborhood:

I utilized the Foursquare API to explore the venues in Queens's neighborhoods

| Neighborhood | Neighborhood Latitude | Neighborhood Longitude | Venue | Venue Latitude | Venue Longitude | Venue Category |
|------------------------|-----------------------|------------------------|-------|----------------|-----------------|----------------|
| Astoria | 1 | 1 | 1 | 1 | 1 | 1 |
| Auburndale | 1 | 1 | 1 | 1 | 1 | 1 |
| Bay; Terrace | 1 | 1 | 1 | 1 | 1 | 1 |
| Bellaire | 2 | 2 | 2 | 2 | 2 | 2 |
| Belle; Harbor | 1 | 1 | 1 | 1 | 1 | 1 |
| Bellerose | 3 | 3 | 3 | 3 | 3 | 3 |
| Briarwood | 1 | 1 | 1 | 1 | 1 | 1 |
| Broad; Channel | 4 | 4 | 4 | 4 | 4 | 4 |
| Brookville | 2 | 2 | 2 | 2 | 2 | 2 |
| Cambria; Heights | 1 | 1 | 1 | 1 | 1 | 1 |
| College; | 1 | 1 | 1 | 1 | 1 | 1 |
| Douglaston | 2 | 2 | 2 | 2 | 2 | 2 |
| Downtown; Flushing | 4 | 4 | 4 | 4 | 4 | 4 |
| Elmhurst | 1 | 1 | 1 | 1 | 1 | 1 |
| Far; Rockaway | 4 | 4 | 4 | 4 | 4 | 4 |
| Floral; Park | 3 | 3 | 3 | 3 | 3 | 3 |
| Forest; Hills; Gardens | 1 | 1 | 1 | 1 | 1 | 1 |
| Fresh; Meadows | 2 | 2 | 2 | 2 | 2 | 2 |
| Glen; Oaks | 1 | 1 | 1 | 1 | 1 | 1 |
| Hillcrest | 5 | 5 | 5 | 5 | 5 | 5 |
| Holliswood | 2 | 2 | 2 | 2 | 2 | 2 |
| Howard; Beach | 2 | 2 | 2 | 2 | 2 | 2 |
| Hunters; | 3 | 3 | 3 | 3 | 3 | 3 |
| Jackson; Heights | 1 | 1 | 1 | 1 | 1 | 1 |
| Jamaica; Center | 1 | 1 | 1 | 1 | 1 | 1 |
| Jamaica; Hills | 2 | 2 | 2 | 2 | 2 | 2 |
| Kew; Gardens; Hills | 1 | 1 | 1 | 1 | 1 | 1 |
| Lefrak; City | 1 | 1 | 1 | 1 | 1 | 1 |
| Lindenwood | 1 | 1 | 1 | 1 | 1 | 1 |
| Little; Neck | 2 | 2 | 2 | 2 | 2 | 2 |
| Long; Island; City | 2 | 2 | 2 | 2 | 2 | 2 |
| Malba | 2 | 2 | 2 | 2 | 2 | 2 |
| Neponsit | 1 | 1 | 1 | 1 | 1 | 1 |
| North; Corona | 4 | 4 | 4 | 4 | 4 | 4 |
| Oakland; Gardens | 1 | 1 | 1 | 1 | 1 | 1 |
| Ozone; Park | 3 | 3 | 3 | 3 | 3 | 3 |
| Pomonok | 2 | 2 | 2 | 2 | 2 | 2 |
| Queens; Village | 1 | 1 | 1 | 1 | 1 | 1 |
| Ravenswood | 3 | 3 | 3 | 3 | 3 | 3 |
| Rego; Park | 1 | 1 | 1 | 1 | 1 | 1 |
| Richmond; Hill | 1 | 1 | 1 | 1 | 1 | 1 |
| Rochdale | 6 | 6 | 6 | 6 | 6 | 6 |
| Rosedale | 1 | 1 | 1 | 1 | 1 | 1 |
| Roxbury | 3 | 3 | 3 | 3 | 3 | 3 |
| Seaside | 2 | 2 | 2 | 2 | 2 | 2 |
| South; Corona | 2 | 2 | 2 | 2 | 2 | 2 |
| South; Jamaica | 1 | 1 | 1 | 1 | 1 | 1 |
| South; Ozone; Park | 3 | 3 | 3 | 3 | 3 | 3 |
| Springfield; Gardens | 2 | 2 | 2 | 2 | 2 | 2 |
| St.; Albans | 4 | 4 | 4 | 4 | 4 | 4 |
| Steinway | 1 | 1 | 1 | 1 | 1 | 1 |
| Sunnyside; Gardens | 1 | 1 | 1 | 1 | 1 | 1 |
| Whitestone | 1 | 1 | 1 | 1 | 1 | 1 |
| Woodside | 4 | 4 | 4 | 4 | 4 | 4 |

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3.2 Foursquare venues

After that, explore function to get Indian restaurant in each neighborhood.

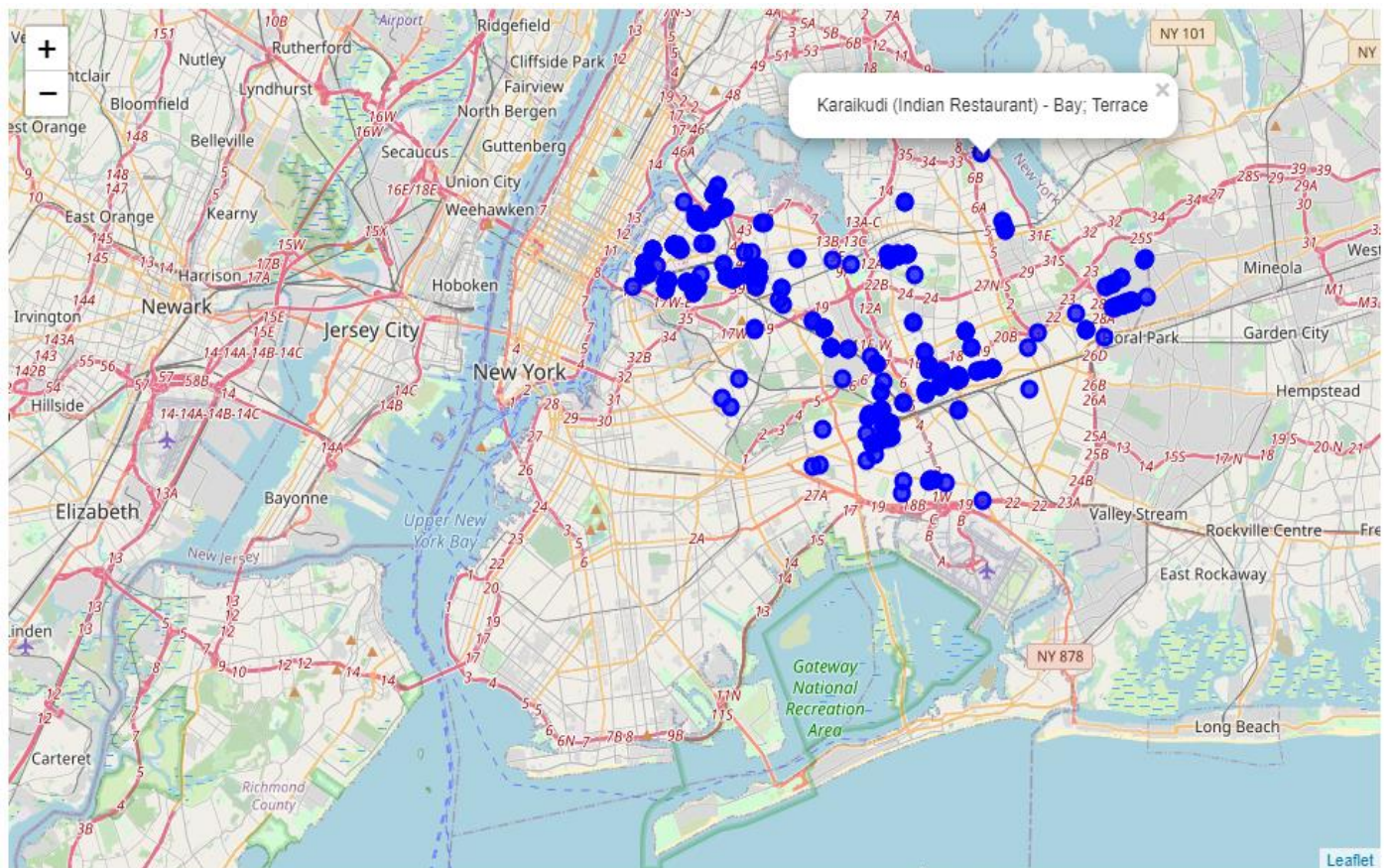
| | Neighborhood | Neighborhood Latitude | Neighborhood Longitude | Venue | Venue Latitude | Venue Longitude | Venue Category |
|---|--------------|-----------------------|------------------------|-------------------------------------|----------------|-----------------|-------------------|
| 0 | Astoria | 40.768509 | -73.915654 | The Gully | 40.766719 | -73.912410 | Indian Restaurant |
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| 4 | Astoria | 40.768509 | -73.915654 | Mysttik Masaala | 40.770163 | -73.906086 | Food Truck |

In Queens there is 427 Indian Restaurants are currently operating.

```
newyork_venues_indian.shape
```

```
(427, 7)
```

Visualize the geographic details of Queens and its boroughs and I created a map of Queens with geographical distribution of the Indian restaurants in each borough



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Analyze the data to find out the top 10 food categories in Queens:

| | count | mean | std | min | 25% | 50% | 75% | max |
|----------------------------------|-------|----------|----------|-----|----------|----------|-----|----------|
| Caribbean Restaurant | 48.0 | 0.030382 | 0.149294 | 0.0 | 0.000000 | 0.000000 | 0.0 | 1.000000 |
| Indian Chinese Restaurant | 48.0 | 0.031250 | 0.159995 | 0.0 | 0.000000 | 0.000000 | 0.0 | 1.000000 |
| Indian Restaurant | 48.0 | 0.839561 | 0.231071 | 0.0 | 0.776786 | 0.912077 | 1.0 | 1.000000 |
| North Indian Restaurant | 48.0 | 0.030084 | 0.085826 | 0.0 | 0.000000 | 0.000000 | 0.0 | 0.500000 |
| Food Truck | 48.0 | 0.017981 | 0.060472 | 0.0 | 0.000000 | 0.000000 | 0.0 | 0.333333 |
| Island | 48.0 | 0.006944 | 0.048113 | 0.0 | 0.000000 | 0.000000 | 0.0 | 0.333333 |
| Middle Eastern Restaurant | 48.0 | 0.013393 | 0.056623 | 0.0 | 0.000000 | 0.000000 | 0.0 | 0.333333 |
| Chinese Restaurant | 48.0 | 0.017804 | 0.046476 | 0.0 | 0.000000 | 0.000000 | 0.0 | 0.200000 |
| Hookah Bar | 48.0 | 0.004774 | 0.025512 | 0.0 | 0.000000 | 0.000000 | 0.0 | 0.166667 |
| Asian Restaurant | 48.0 | 0.002342 | 0.008510 | 0.0 | 0.000000 | 0.000000 | 0.0 | 0.047619 |

In summary of this graph 63 unique categories were returned by Foursquare, then I created a table which shows list of top 10 venue category for each borough in below table.

| | Neighborhood | 1st Most Common Venue | 2nd Most Common Venue | 3rd Most Common Venue | 4th Most Common Venue | 5th Most Common Venue | 6th Most Common Venue | 7th Most Common Venue | 8th Most Common Venue | 9th Most Common Venue | 10th Most Common Venue |
|---|------------------|-----------------------|-----------------------|-----------------------|-------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|------------------------|
| 0 | Astoria | Indian Restaurant | Food Truck | Hookah Bar | Tibetan Restaurant | Snack Place | North Indian Restaurant | Middle Eastern Restaurant | Island | Indian Chinese Restaurant | Himalayan Restaurant |
| 1 | Astoria; Heights | Indian Restaurant | Food Truck | Tibetan Restaurant | Snack Place | North Indian Restaurant | Middle Eastern Restaurant | Island | Indian Chinese Restaurant | Hookah Bar | Himalayan Restaurant |
| 2 | Bay; Terrace | Indian Restaurant | Tibetan Restaurant | Snack Place | North Indian Restaurant | Middle Eastern Restaurant | Island | Indian Chinese Restaurant | Hookah Bar | Himalayan Restaurant | Halal Restaurant |
| 3 | Bayside | Indian Restaurant | Tibetan Restaurant | Snack Place | North Indian Restaurant | Middle Eastern Restaurant | Island | Indian Chinese Restaurant | Hookah Bar | Himalayan Restaurant | Halal Restaurant |
| 4 | Bellaire | Indian Restaurant | Tibetan Restaurant | Snack Place | North Indian Restaurant | Middle Eastern Restaurant | Island | Indian Chinese Restaurant | Hookah Bar | Himalayan Restaurant | Halal Restaurant |

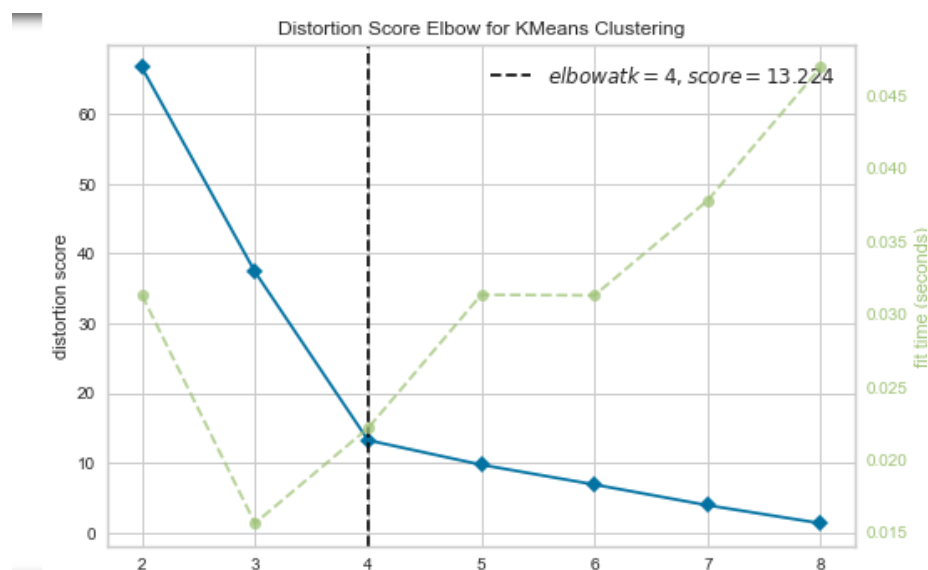
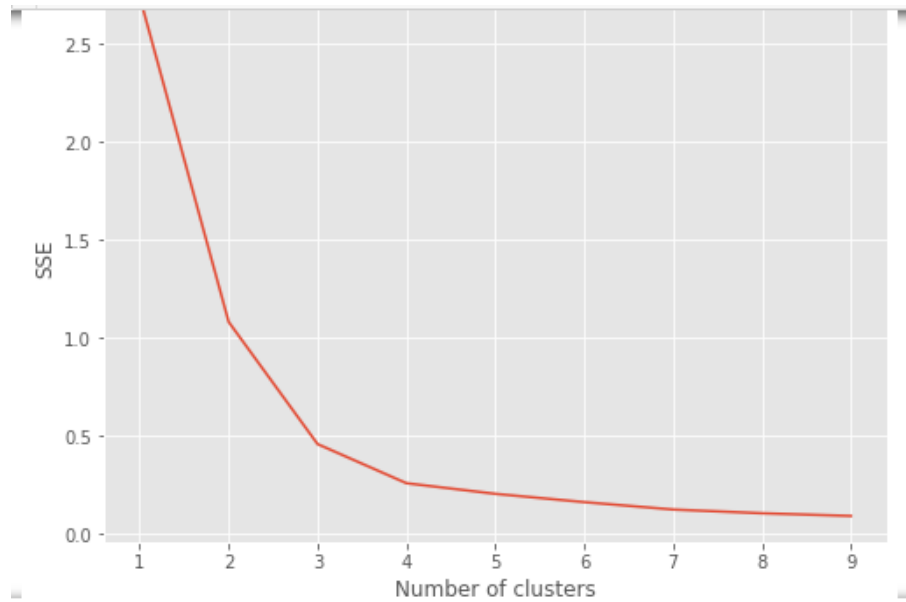
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4. Predictive Modelling:

We have some common venue categories in boroughs. In this reason I used unsupervised learning K-means algorithm to cluster the boroughs.

First, I will initiate this clustering is to find the optimal number of clusters for the dataset to find out the k value.



After analyzing the elbow method along with distortion score and squared error, the optimal k value is 4.

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Here is the merged table with cluster labels for each borough.

| Cluster Labels | Neighborhood | 1st Most Common Venue | 2nd Most Common Venue | 3rd Most Common Venue | 4th Most Common Venue | 5th Most Common Venue | 6th Most Common Venue | 7th Most Common Venue | 8th Most Common Venue | 9th Most Common Venue | 10th Most Common Venue | |
|----------------|--------------|-----------------------|-----------------------|-----------------------|-----------------------|-------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|----------------------|
| 0 | 3 | Astoria | Indian Restaurant | Food Truck | Hookah Bar | Tibetan Restaurant | Snack Place | North Indian Restaurant | Middle Eastern Restaurant | Island | Indian Chinese Restaurant | Himalayan Restaurant |
| 1 | 0 | Astoria; Heights | Indian Restaurant | Food Truck | Tibetan Restaurant | Snack Place | North Indian Restaurant | Middle Eastern Restaurant | Island | Indian Chinese Restaurant | Hookah Bar | Himalayan Restaurant |
| 2 | 3 | Bay; Terrace | Indian Restaurant | Tibetan Restaurant | Snack Place | North Indian Restaurant | Middle Eastern Restaurant | Island | Indian Chinese Restaurant | Hookah Bar | Himalayan Restaurant | Halal Restaurant |
| 3 | 3 | Bayside | Indian Restaurant | Tibetan Restaurant | Snack Place | North Indian Restaurant | Middle Eastern Restaurant | Island | Indian Chinese Restaurant | Hookah Bar | Himalayan Restaurant | Halal Restaurant |
| 4 | 3 | Bellaire | Indian Restaurant | Tibetan Restaurant | Snack Place | North Indian Restaurant | Middle Eastern Restaurant | Island | Indian Chinese Restaurant | Hookah Bar | Himalayan Restaurant | Halal Restaurant |

5. Result:

Using K-mean to clustering data area with less number of Indian Restaurants - Clustering Queens neighborhoods with k = 4

5.1 Cluster 1, Label = 0:

| | Neighborhood | 1st Most Common Venue | 2nd Most Common Venue | 3rd Most Common Venue | 4th Most Common Venue | 5th Most Common Venue | 6th Most Common Venue | 7th Most Common Venue | 8th Most Common Venue | 9th Most Common Venue | 10th Most Common Venue |
|----|--------------------|-------------------------|-------------------------|-----------------------|-----------------------|---------------------------|---------------------------|---------------------------|---------------------------|-----------------------|------------------------|
| 1 | Astoria; Heights | Indian Restaurant | Food Truck | Tibetan Restaurant | Snack Place | North Indian Restaurant | Middle Eastern Restaurant | Island | Indian Chinese Restaurant | Hookah Bar | Himalayan Restaurant |
| 6 | Blissville | Indian Restaurant | North Indian Restaurant | Chinese Restaurant | Tibetan Restaurant | Snack Place | Middle Eastern Restaurant | Island | Indian Chinese Restaurant | Hookah Bar | Himalayan Restaurant |
| 18 | Hunters; | Indian Restaurant | North Indian Restaurant | Food Truck | Tibetan Restaurant | Snack Place | Middle Eastern Restaurant | Island | Indian Chinese Restaurant | Hookah Bar | Himalayan Restaurant |
| 26 | Long; Island; City | Indian Restaurant | North Indian Restaurant | Food Truck | Tibetan Restaurant | Snack Place | Middle Eastern Restaurant | Island | Indian Chinese Restaurant | Hookah Bar | Himalayan Restaurant |
| 27 | Maspeth | North Indian Restaurant | Indian Restaurant | Tibetan Restaurant | Snack Place | Middle Eastern Restaurant | Island | Indian Chinese Restaurant | Hookah Bar | Himalayan Restaurant | Halal Restaurant |

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```
Indian Restaurant          9
North Indian Restaurant    1
Name: 1st Most Common Venue, dtype: int64
-----
```

```
North Indian Restaurant    4
Hookah Bar                 1
Food Truck                 1
Middle Eastern Restaurant  1
Indian Restaurant          1
Caribbean Restaurant      1
Island                     1
Name: 2nd Most Common Venue, dtype: int64
-----
```

```
Middle Eastern Restaurant  7
Island                     2
North Indian Restaurant    1
Name: 6th Most Common Venue, dtype: int64
-----
```

5.2 Cluster 2, Label = 1:

| | Neighborhood | 1st Most Common Venue | 2nd Most Common Venue | 3rd Most Common Venue | 4th Most Common Venue | 5th Most Common Venue | 6th Most Common Venue | 7th Most Common Venue | 8th Most Common Venue | 9th Most Common Venue | 10th Most Common Venue |
|----|---------------------|---------------------------|---------------------------|-----------------------|-------------------------|---------------------------|---------------------------|-----------------------|-----------------------|-----------------------|------------------------|
| 24 | Kew; Gardens; Hills | Indian Restaurant | Indian Chinese Restaurant | Tibetan Restaurant | Snack Place | North Indian Restaurant | Middle Eastern Restaurant | Island | Hookah Bar | Himalayan Restaurant | Halal Restaurant |
| 31 | Pomonok | Indian Chinese Restaurant | Tibetan Restaurant | Snack Place | North Indian Restaurant | Middle Eastern Restaurant | Island | Indian Restaurant | Hookah Bar | Himalayan Restaurant | Halal Restaurant |

```
Indian Chinese Restaurant    1
Indian Restaurant            1
Name: 1st Most Common Venue, dtype: int64
-----
```

```
Indian Chinese Restaurant    1
Tibetan Restaurant           1
Name: 2nd Most Common Venue, dtype: int64
-----
```

```
Island                       1
Middle Eastern Restaurant     1
Name: 6th Most Common Venue, dtype: int64
-----
```

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5.2 Cluster 3, Label = 2:

| | Neighborhood | 1st Most Common Venue | 2nd Most Common Venue | 3rd Most Common Venue | 4th Most Common Venue | 5th Most Common Venue | 6th Most Common Venue | 7th Most Common Venue | 8th Most Common Venue | 9th Most Common Venue | 10th Most Common Venue |
|----|----------------|-----------------------|-----------------------|-----------------------|-------------------------|---------------------------|-----------------------|-----------------------|---------------------------|-----------------------|------------------------|
| 39 | South; Jamaica | Caribbean Restaurant | Tibetan Restaurant | Snack Place | North Indian Restaurant | Middle Eastern Restaurant | Island | Indian Restaurant | Indian Chinese Restaurant | Hookah Bar | Himalayan Restaurant |

Caribbean Restaurant 1

Name: 1st Most Common Venue, dtype: int64

Tibetan Restaurant 1

Name: 2nd Most Common Venue, dtype: int64

Island 1

Name: 6th Most Common Venue, dtype: int64

5.3 Cluster 4, Label = 3:

| | Neighborhood | 1st Most Common Venue | 2nd Most Common Venue | 3rd Most Common Venue | 4th Most Common Venue | 5th Most Common Venue | 6th Most Common Venue | 7th Most Common Venue | 8th Most Common Venue | 9th Most Common Venue | 10th Most Common Venue |
|---|--------------|-----------------------|-----------------------|-----------------------|-------------------------|---------------------------|-------------------------|---------------------------|-----------------------|---------------------------|------------------------|
| 0 | Astoria | Indian Restaurant | Food Truck | Hookah Bar | Tibetan Restaurant | Snack Place | North Indian Restaurant | Middle Eastern Restaurant | Island | Indian Chinese Restaurant | Himalayan Restaurant |
| 2 | Bay; Terrace | Indian Restaurant | Tibetan Restaurant | Snack Place | North Indian Restaurant | Middle Eastern Restaurant | Island | Indian Chinese Restaurant | Hookah Bar | Himalayan Restaurant | Halal Restaurant |
| 3 | Bayside | Indian Restaurant | Tibetan Restaurant | Snack Place | North Indian Restaurant | Middle Eastern Restaurant | Island | Indian Chinese Restaurant | Hookah Bar | Himalayan Restaurant | Halal Restaurant |
| 4 | Bellaire | Indian Restaurant | Tibetan Restaurant | Snack Place | North Indian Restaurant | Middle Eastern Restaurant | Island | Indian Chinese Restaurant | Hookah Bar | Himalayan Restaurant | Halal Restaurant |
| 5 | Bellerose | Indian Restaurant | Tibetan Restaurant | Snack Place | North Indian Restaurant | Middle Eastern Restaurant | Island | Indian Chinese Restaurant | Hookah Bar | Himalayan Restaurant | Halal Restaurant |

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Indian Restaurant 35

Name: 1st Most Common Venue, dtype: int64

Tibetan Restaurant 24

Chinese Restaurant 5

Middle Eastern Restaurant 2

Food Truck 1

Caribbean Restaurant 1

Dosa Place 1

North Indian Restaurant 1

Name: 2nd Most Common Venue, dtype: int64

Island 24

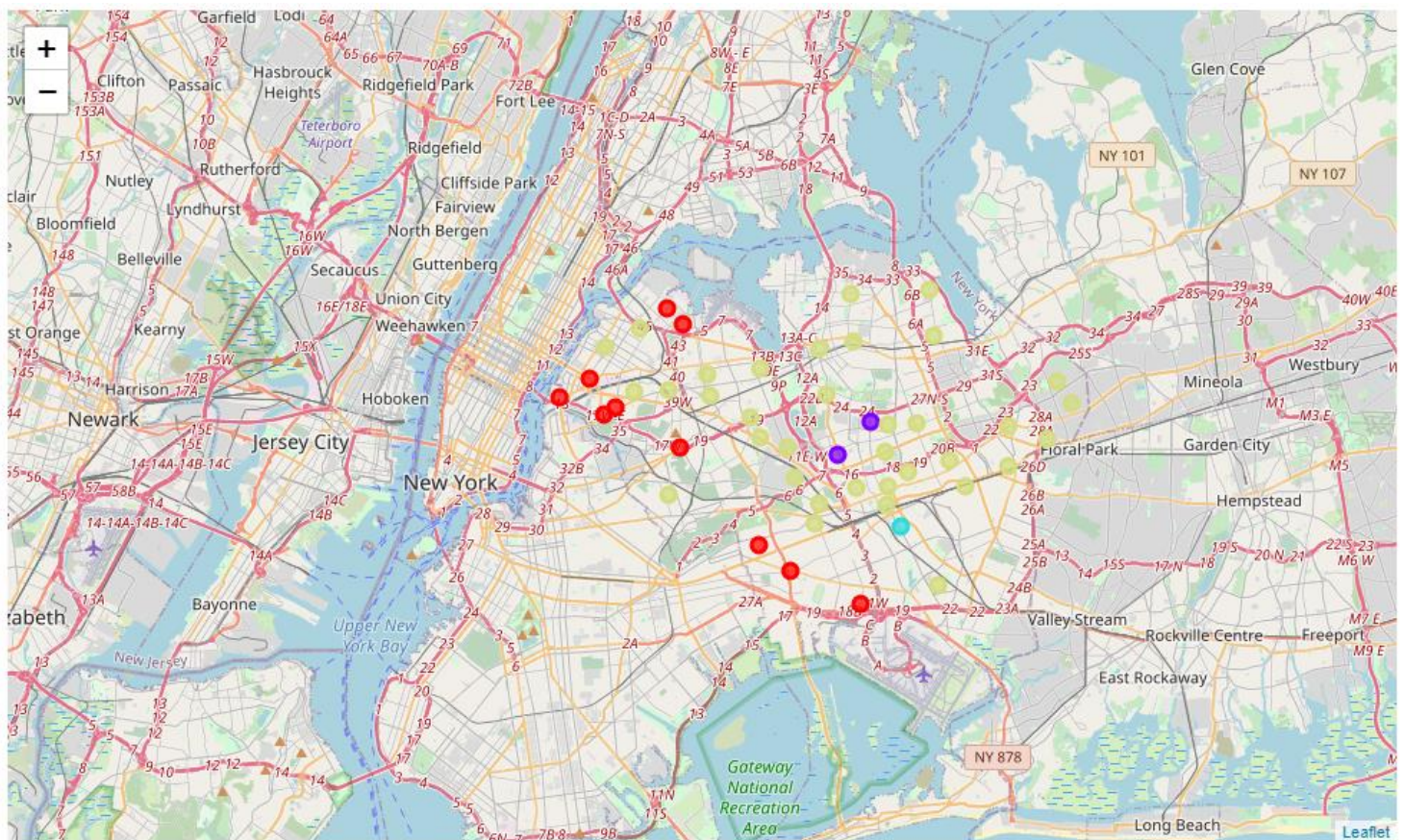
North Indian Restaurant 6

Middle Eastern Restaurant 4

Asian Restaurant 1

Name: 6th Most Common Venue, dtype: int64

5.4 Clusters Visualization:



Based on data-frame analysis above Cluster 1 (Kew; Gardens - Hills), (Pommonok) and Cluster 2 (South Jamaica) areas are the best places to open a new Indian restaurant business.

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6. Discussion:

According to this analysis, Kew; Gardens - Hills, Pomonok and South Jamaica borough will provide the least competition for the new upcoming Indian restaurant as there is very little Indian restaurants spread or no Indian restaurants in few neighborhoods.

Kew; Gardens - Hills, Pomonok is the best place to open an Indian restaurants based on the lease competition and Indian population distribution.

6. Conclusion:

I have got a chance to work on a business problem with real world data set. I have used many libraries of python to fetch, manipulate and visualize the data. I have also used the foursquare API to focus on the venue details of each neighborhood of Queens. I used NY Open-Data to import the data of "Neighborhoods in New York and scrapped it for further analysis. For achieving valuable insights, I have applied machine learning algorithms to the scrapped data and to predict the outcome of the business problem.

Some of the drawbacks of this analysis are — the clustering is completely based only on data obtained from Foursquare API and the data about the Indian population distribution is also not up-to date. Even Though there are lots of areas where it can be improved yet this analysis has certainly provided us with some good insights, preliminary information on possibilities & a head start into this business problem by setting the step stones properly.

The goals of the project were met and, with some more work, could easily be developed into a fully pledged application that could support the opening a business idea in an unknown location. Hopefully, this project helps acts as initial guidance to take more complex real-life challenges using data-science.

Please find this project on GitHub.

<https://dataplatform.cloud.ibm.com/analytics/notebooks/v2/de87e4a7-4149-4ac1-858b-b97796536f33/view?projectid=6eaf45ad-2a42-497e-855e-220736668f1d&context=cpdaas>

<https://www.linkedin.com/pulse/perfect-place-start-indian-restaurant-queens-ny-hani-abousoraia>