The Battle of Neighbourhoods

Introduction

In the last 5 weeks we have learnt how we can use the location data of a particular neighbourhood and draw interesting conclusions from that which can actually solve critical business problems. We have learnt how to use the Foursquare API to get the locational data of a particular location, the exploratory data analysis using python and pandas has helped us to restructure our data and perform useful operations like data cleaning and handling missing values. The folium library has been used to draw the maps of different geolocations as retrieved from the JSON file created due to the data extraction from Foursquare generated URL.

In week 4 and week 5 of our project we need to assign tasks to ourselves ie defining business problems and from the knowledge we achieved from our previous weeks, we need to put this into action to solve the business queries.

The Task

This project, and associated files, were produced as to meet the final objectives of Coursera's IBM Applied Data Science Capstone Certificate program. The following sections are the objectives in meeting this criterion.

Section 1: Clearly define a problem or an idea of your choice, where you would need to leverage the Foursquare location data to solve or execute. Remember that data science problems always target an audience and are meant to help a group of stakeholders solve a problem, so make sure that you explicitly describe your audience and why they would care about your problem. This submission will eventually become your Introduction/Business Problem section in your final report. So I recommend that you push the report (having your Introduction/Business Problem section only for now) to your Github repository and submit a link to it.

Section 2: Describe the data that you will be using to solve the problem or execute your idea. Remember that you will need to use the Foursquare location data to solve the problem or execute your idea. You can absolutely use other datasets in combination with the Foursquare location data. So make sure that you provide adequate explanation and discussion, with examples, of the data that you will be using, even if it is only Foursquare location data. This submission will eventually become your Data section in your final report. So I recommend that you push the report (having your Data section) to your Github repository and submit a link to it.

1.Problem Description and Background discussion

Determining suitable locations to set up quarantine centres in New York city due to massive outbreak of COVID-19

1.1.Background:

Due to the outbreak of the highly contagious and deadly corona(COVID-19) virus the world is witnessing deaths ,panics and health hazard.The virus is showing no sign to stop and by the time the vaccine comes out the only way to protect ourselves is to make social distancing among ourselves.The government has set up quarantine centres in New York city to keep the virus affected patients and those having travel history in recent past for 14 days in those locations.
However,the disease being highly contagious, it is very important to set up the quarantine stations in those places where the population is low and and the health facilities like hospitals are also near to those stations.
The neighbourhood data with the geo locations will give us data about the locations where there is a possibility of mass gathering.So when the government decides to start the unlock phase it will be easier for them to decide what places to open and what not to avoid the mass gathering.

1.2 Business Problem:

So the main idea behind this project is two-fold. First, it's to analyse the population data of New York city to check what places of the city is less populous so that government can set quarantine centres in those locations and second is to identify the places where there could be possibility of mass gathering so that those places could be taken under surveillance.

2. Data Sources

1.Population Data of US

To analyse the population data of the New York city we need to analyse the a data set containing the post codes of the city and the population. From this dataset available in Kaggle we get the population data of the year 2010 for the whole country.
LINK: http://zipatlas.com/us/ny/zip-code-comparison/population-density.htm

2. Post codes of New York

Now from the population data of the whole United States we need to determine the population of the Zip codes of various locations of New York. So we merge the previous data frame with this data frame on the postcodes.
Link: https://www.zipcodestogo.com/New%20York/

3.Postcode Geolocation

Now to access the neighbourhood we need to get the geolocations of the different postcodes of New York city. The data set that gives the geolocations and the postcodes is given below.

Link : https://cocl.us/new_york_dataset

4.Foursquare API data

Now to access the possible locations where mass gathering can take place, we use the Foursquare API data with our own client-ID. We take a given radios and set the latitude and longitude of New York to get the locations of various points of gathering. The data can be derived from the Foursquare's website.

Link: https://foursquare.com/

Approach

1.Importing Important Libraries

```
# Importing Important Libraries

import pandas as pd
import numpy as np
import requests
import json
from bs4 import BeautifulSoup
import folium
from geopy.geocoders import Nominatim
import matplotlib.pyplot as plt
import matplotlib.cm as cm
import matplotlib.colors as colors
%matplotlib inline

```

2.Web Scrapping and Population Dataframe creation

```
# Web Scrapping using BeautifulSoup

with open('NY_Population.html') as html_file:
    soup=BeautifulSoup(html_file,'lxml')

table = soup.find('table')
table
population_df = pd.read_html(str(table))[0]
population_df.drop(population_df.index[0:15],inplace=True)
population_df=population_df.reset_index(drop=True)
population_df.drop(columns=[0,2,3,5,6],inplace=True)
population_df=population_df.rename(columns={1:'zipcode',4:'population'})
population_df.head()
#population_df.shape

```

	zipcode	population
0	10162	1726
1	10028	44987
2	10128	59856
3	10031	60221
4	10009	58595

3.Web Scrapping and Geotag Dataframe creation

In [311]:
```
# Extracting Geo location of the neighbourhood datas and Borough and making dataframes

with open('nyu_2451_34572-geojson.json') as json_data:
    newyork_data = json.load(json_data)
neighborhoods_data = newyork_data['features']
neighborhoods_data
neighborhoods_data[0]
# define the dataframe columns
column_names = ['Borough', 'Neighborhood', 'Latitude', 'Longitude']

# instantiate the dataframe
neighborhoods = pd.DataFrame(columns=column_names)
neighborhoods

for data in neighborhoods_data:
    borough = neighborhood_name = data['properties']['borough']
    neighborhood_name = data['properties']['name']

    neighborhood_latlon = data['geometry']['coordinates']
    neighborhood_lat = neighborhood_latlon[1]
    neighborhood_lon = neighborhood_latlon[0]

    neighborhoods = neighborhoods.append({'Borough': borough,
                                          'Neighborhood': neighborhood_name,
                                          'Latitude': neighborhood_lat,
                                          'Longitude': neighborhood_lon}, ignore_index=True)
neighborhoods.head(3)
#neighborhoods.shape
```

Out[311]:

	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

4.Merging 2 Dataframes and Missing value handling

In [304]:
```
df = pd.merge(df1,neighborhoods,on="Borough", how='left')        #Merging the 2 dataframes from left
df.head()
```

Out[304]:

	zipcode	Borough	population	Neighborhood	Latitude	Longitude
0	10001	New York	17310	NaN	NaN	NaN
1	10002	New York	84870	NaN	NaN	NaN
2	10003	New York	53673	NaN	NaN	NaN
3	10005	New York	884	NaN	NaN	NaN
4	10006	New York	1447	NaN	NaN	NaN

In [305]:
```
# Handling Missin values
# Dropping those rows having Missing Values

df.isnull().sum()
df.dropna( axis=0, how='any',inplace=True)
df = df.reset_index(drop=True)                          #Resetting Index
```

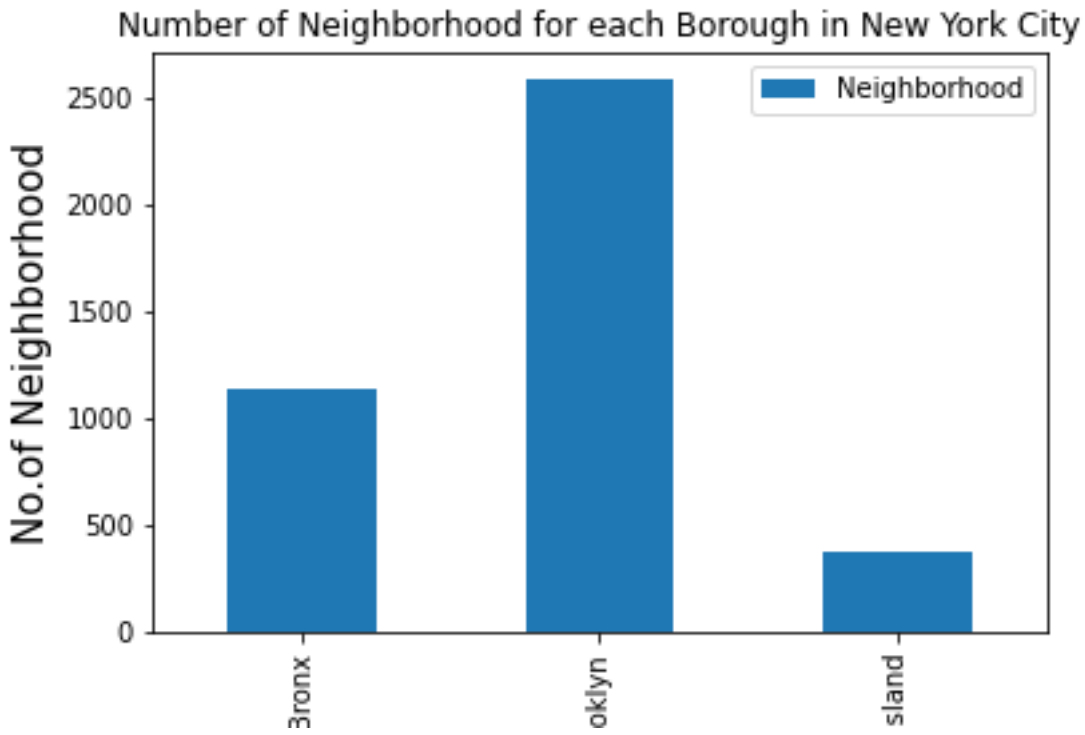
In [306]:
```
df.head()
```

Out[306]:

	zipcode	Borough	population	Neighborhood	Latitude	Longitude
0	10301	Staten Island	38805	St. George	40.644982	-74.079353
1	10301	Staten Island	38805	New Brighton	40.640615	-74.087017
2	10301	Staten Island	38805	Stapleton	40.626928	-74.077902
3	10301	Staten Island	38805	Rosebank	40.615305	-74.069805
4	10301	Staten Island	38805	West Brighton	40.631879	-74.107182

5.Plotting Number of Neighbourhoods of different Borough

In [310]:
```
# PLotting which Borough in NY has the most number of Neighbourhoods

# title
plt.title('Number of Neighborhood for each Borough in New York City')
#On x-axis
plt.xlabel('Borough', fontsize = 15)
#On y-axis
plt.ylabel('No.of Neighborhood', fontsize=15)
#giving a bar plot
df.groupby('Borough')['Neighborhood'].count().plot(kind='bar')
#Legend
plt.legend()
#displays the plot
plt.savefig('BoroughBarplot.png')
print("The Plot Shows Brooklyn has most Number of Neighbourhoods so the population of Brooklyn is likely to be more. So Spe
plt.tight_layout()

```



The Plot Shows Brooklyn has most Number of Neighbourhoods so the population of Brooklyn is likely to be more. So Special care needs to be taken to control the corona virus spread.

6.Analysing Brooklyn Data

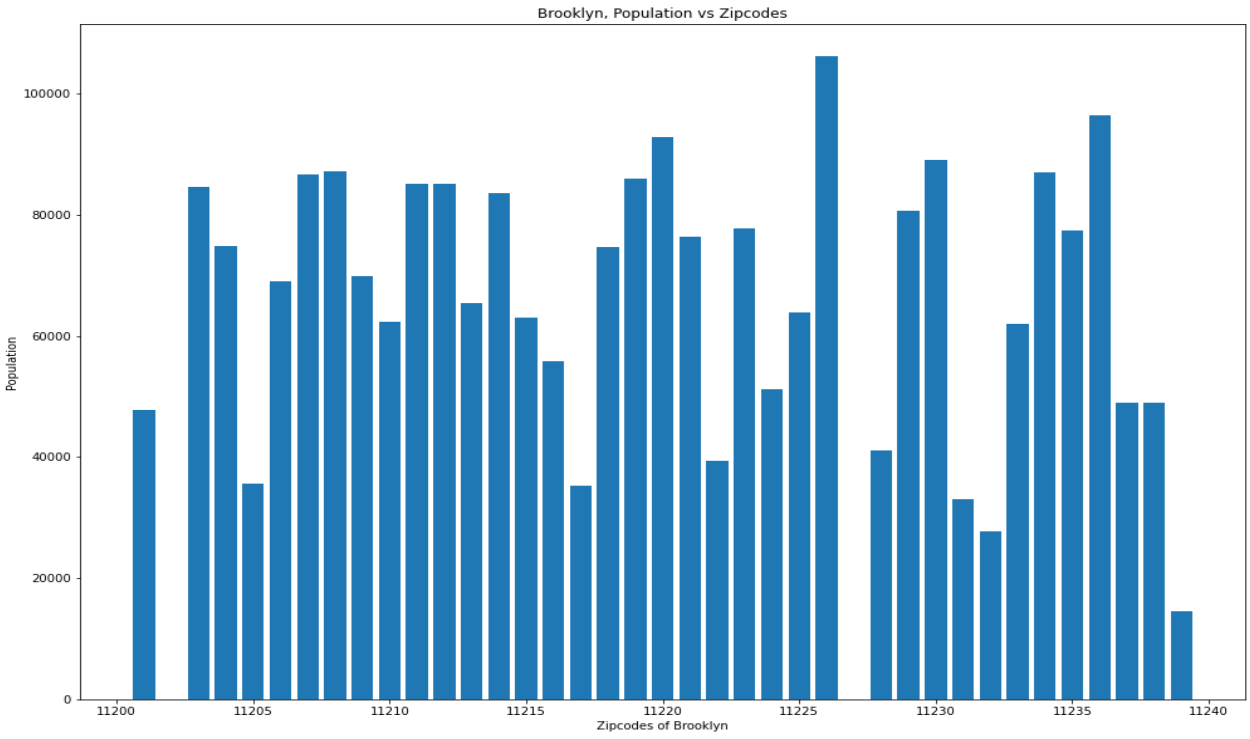
As Brooklyn has most number of Neighborhoods so lets examine the demographic of Brooklyn

In [291]:
```
df.population=df.population.astype('int')                # Making population datatype as integer
df.zipcode=df.zipcode.astype('int')                      # Making zipcode datatype as integer
filter=df['Borough']=="Brooklyn"                         # filter only for Brooklyn Borough
df=df.loc[filter]
df=df.sort_values(by='population',ascending=True)        # Sorting population from Low to High
df = df.reset_index(drop=True)
df.head(10)
```

Out[291]:

	zipcode	Borough	population	Neighborhood	Latitude	Longitude
0	11239	Brooklyn	14620	Erasmus	40.646926	-73.948177
1	11239	Brooklyn	14620	Brooklyn Heights	40.695864	-73.993782
2	11239	Brooklyn	14620	Cobble Hill	40.687920	-73.998561
3	11239	Brooklyn	14620	Carroll Gardens	40.680540	-73.994654
4	11239	Brooklyn	14620	Red Hook	40.676253	-74.012759
5	11239	Brooklyn	14620	Gowanus	40.673931	-73.994441
6	11239	Brooklyn	14620	Fort Greene	40.688527	-73.972906
7	11239	Brooklyn	14620	Bedford Stuyvesant	40.687232	-73.941785
8	11239	Brooklyn	14620	Park Slope	40.672321	-73.977050
9	11239	Brooklyn	14620	East New York	40.669926	-73.880699

In [292]:
```
# Plotting Zipcode Vs Population to get an idea about the Population distribution in different places

x=df.zipcode
y=df.population
plt.figure(figsize=(14,10))
plt.xlabel('Zipcodes of Brooklyn')
plt.ylabel('Population')
plt.title("Brooklyn, Population vs Zipcodes")
plt.bar(x,y)
plt.tight_layout()
plt.savefig('PopulationVsZipBarplot.png')     #Saving The Image
```



7.Brooklyn Neighbourhood In map

In [295]:
```
address = 'Brooklyn, New York, USA'                          # Address of the location which is to be examined

geolocator = Nominatim(user_agent="NY_Traveller")
location = geolocator.geocode(address)                # To access the location of the given adress
latitude = location.latitude                          # To access the latitude of Brooklyn,NY,USA
longitude = location.longitude                        # To access the Longitude of Brooklyn,NY,USA

print('The geograpical coordinate of NY is : {}, {}.'.format(latitude, longitude))
```

```
The geograpical coordinate of NY is : 40.6501038, -73.9495823.
```

Observing the Map of Brooklyn

In [296]:
```
# create map of Toronto using latitude and longitude values
map_NY = folium.Map(location=[latitude, longitude], zoom_start=12)

# add markers to map
for lat, lng, borough, neighborhood ,population in zip(df['Latitude'], df['Longitude'],
                                                       df['Borough'],df['Neighborhood'],df['population']):
    label = '{}, {}'.format(neighborhood,population)
    label = folium.Popup(label, parse_html=True)
    folium.CircleMarker(
        [lat, lng],
        radius=8,
        popup=label,
        color='red',
        fill=True,
        fill_color='#3186cc',
        fill_opacity=0.6,
        parse_html=False).add_to(map_NY)

map_NY
```

Brooklyn Neighbourhood Map

Out[296]:

8.Foursquare API and URL making

In [265]:

```
radius=100000
LIMIT=10000
neighborhood_latitude=Df.loc[0,"Latitude"]
neighborhood_longitude=Df.loc[0,"Longitude"]
neighbourhood_name = Df.loc[0, 'Neighborhood']


url = 'https://api.foursquare.com/v2/venues/explore?&client_id={}&client_secret={}&v={}&ll={},{}&radius={}&limit={}'.format(
    CLIENT_ID,
    CLIENT_SECRET,
    VERSION,
    neighborhood_latitude,
    neighborhood_longitude,
    radius,
    LIMIT)

print("The Foursquare URL to extract the Erasmus Neighbourhood data is :",url)
```

```
The Foursquare URL to extract the Erasmus Neighbourhood data is : https://api.foursquare.com/v2/venues/explore?&client_id=LPYCJ
IALAJDLBBT31E4ES13IPEWMCDYK5U3WBGXWBNGWM3AF&client_secret=2TRPJHGRCOFPWS1QVERZB1JXZ5DTBYOH0HLDKN2US5XXVPLQ&v=20180604&ll=40.703
17632822692,-73.9887528074504&radius=100000&limit=10000
```

In [266]:

```
#Making Json file from the url made
results = requests.get(url).json()
#results
def get_category_type(row):
    try:
        categories_list = row['categories']
    except:
        categories_list = row['venue.categories']

    if len(categories_list) == 0:
        return None
    else:
        return categories_list[0]['name']
```

In [267]:

```
venues = results['response']['groups'][0]['items']
nearby_venues = pd.json_normalize(venues)                       # flatten JSON

# filter columns
filtered_columns = ['venue.name', 'venue.categories', 'venue.location.lat', 'venue.location.lng']
nearby_venues =nearby_venues.loc[:, filtered_columns]

# filter the category for each row
nearby_venues['venue.categories'] = nearby_venues.apply(get_category_type, axis=1)

# clean columns
nearby_venues.columns = [col.split(".")[-1] for col in nearby_venues.columns]
nearby_venues["Neighbourhood"]=df.Neighborhood
nearby_venues["Neighbourhood_lat"]=df.Latitude
nearby_venues["Neighbourhood_lng"]=df.Longitude
nearby_venues.rename(columns={"lat":"Venue_lat","lng":"Venue_lng","name":"Venue"},inplace=True)
nearby_venues.head()
```

Out[267]:

	Venue	categories	Venue_lat	Venue_lng	Neighbourhood	Neighbourhood_lat	Neighbourhood_lng
0	Pebble Beach	Beach	40.704329	-73.990265	Erasmus	40.646926	-73.948177
1	Brooklyn Bridge Park	Park	40.702282	-73.996456	Brooklyn Heights	40.695864	-73.993782
2	Brooklyn Heights Promenade	Scenic Lookout	40.698462	-73.996707	Cobble Hill	40.687920	-73.998561
3	Brooklyn Bridge	Bridge	40.705967	-73.996707	Carroll Gardens	40.680540	-73.994654
4	Brooklyn Bridge Park - Pier 1	Park	40.702900	-73.995987	Red Hook	40.676253	-74.012759

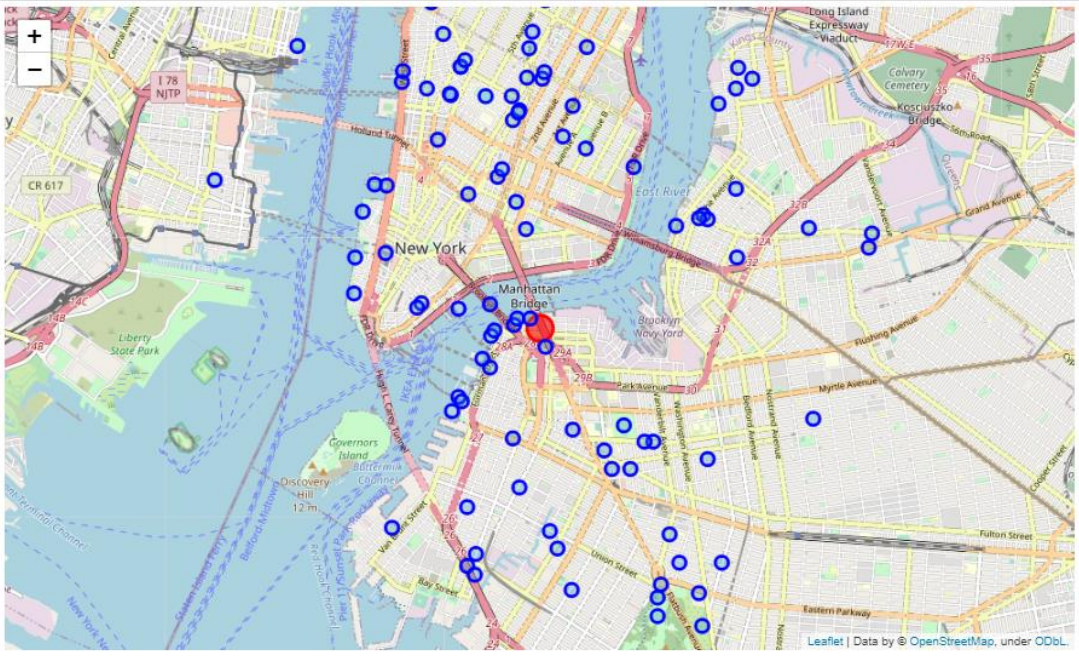
This dataframe gives us the data of various venue location so that we can analyse the venues of the Brooklyn datas.

9.Mapping Brooklyn Venues

In [270]:

```
# create map of Brooklyn using the selected neighbourhood latitude and longitude values
map_tohood = folium.Map(location=[neighborhood_latitude, neighborhood_longitude], zoom_start=12.5)

#add a red circle marker to represent the selected neighborhood
folium.CircleMarker(
    [neighborhood_latitude, neighborhood_longitude],
    radius=12,
    color='red',
    popup= Df["Neighborhood"],
    fill = True,
    fill_color = 'red',
    fill_opacity = 0.6
).add_to(map_tohood)



# add markers to map
for lat, lng, name, categories in zip(nearby_venues['Venue_lat'], nearby_venues['Venue_lng'], nearby_venues['Venue'], nearby
    label = '{}, {}'.format(name, categories)
    label = folium.Popup(label, parse_html=True)
    folium.CircleMarker(
        [lat, lng],
        radius=6,
        popup=label,
        color='blue',
        fill=True,
        fill_color='#3199cc',
        fill_opacity=0.3).add_to(map_tohood)

map_tohood
```

Out[270]:



Observations and conclusions

1. Among the NY Boroughs Brooklyn is Most Populous
2. Brooklyn has 30 Unique zipcode Locations and population is segregated according to those locations
3. The Plot we created shows the Populations densities in those postcode areas
4. Among the 100 limited observations from Foursquare we see what locations of the city Dumbo has the probability of having public gathering
5. We get an idea of how the venues of distributed in the Unlock period which locations can be opened to avoid mass gathering

Limitations

1.The population data we have used is of 2010 census.So the current population will vary from the actual one
2.Foursquare API doesnot give us the locations of hospital and healthcare centres