

# The Battle of Neighborhoods

## Introduction Section :

### 1.1 Scenario and Problem to be resolved

I'm a beginner in data science. The challenge to resolve is being able to find a rental apartment unit in Manhattan NY that offers similar characteristics and benefits to my current situation. Therefore, in order to set a basis for comparison, I want to find a rental unit subject to the following conditions:

Apartment with min 2 bedrooms with monthly rent not to exceed US\$7000/month  
Unit located within walking distance ( $\leq 1.0$  mile, 1.6 km) from a subway metro station in Manhattan  
Area with amenities and venues similar to the ones described for current location ( See item 2.1)

### 2. Data Section:

Description of the data and its sources that will be used to solve the problem

#### 2.1 Data of Current Situation

I Currently reside in the neighborhood of 'Mccallum Street' in Downtown Singapore. I use Foursquare to identify the venues around the area of residence which are then shown in the Singapore map shown in methodology and execution in section 3.0 . It serves as a reference for comparison with the desired future location in Manhattan NY

#### 2.2 Data Required to resolve the problem

In order to make a good choice of a similar apartment in Manhattan NY, the following data is required:

List/Information on neighborhoods from Manhattan with their Geodata ( latitude and longitude).

List/Information about the subway metro stations in Manhattan with geodata. Listed apartments for rent in Manhattan area with descriptions ( how many beds, price, location, address) Venues and amenities in the Manhattan neighborhoods (e.g. top 10) 2.3 sources and manipulation The list of Manhattan neighborhoods is worked out during LAB exercise during the course. A csv file was created which will be read in order to create a dataframe and its mapping. The csv file 'mh\_neigh\_data.csv' has the following below data structure. The file will be directly read to the Jupiter Notebook for convenience and space savings. The clustering of neighborhoods and mapping will be shown however. An algorithm was used to determine the geodata from Nominatim . The actual algorithm coding may be shown in 'markdown' mode because it takes time to run.

`mh_neigh_data.tail():`

	Borough	Neighborhood	Latitude	Longitude
35	Manhattan	Turtle Bay	40.752042	-73.967708
36	Manhattan	Tudor City	40.746917	-73.971219
37	Manhattan	Stuyvesant Town	40.731000	-73.974052
38	Manhattan	Flatiron	40.739673	-73.990947

39 Manhattan Hudson Yards 40.756658 -74.000111

A list of Manhattan subway metro stops was compiled in Numbers (Apple excel) and it was completed with wikipedia data ( [https://en.wikipedia.org/wiki/List\\_of\\_New\\_York\\_City\\_Subway\\_stations\\_in\\_Manhattan](https://en.wikipedia.org/wiki/List_of_New_York_City_Subway_stations_in_Manhattan)) and information from NY Transit authority and Google maps (<https://www.google.com/maps/search/manhattan+subway+metro+stations/@40.7837297,-74.1033043,11z/data=!3m1!4b1>) for a final consolidated list of subway stops names and their address. The geolocation was obtained via an algorithm using Nominatim. Details will be shown in the execution of methodology in section 3.0. The subway csv file is "MH\_subway.csv" and the data structure is: mhsb.tail(): sub\_station sub\_address lat long

17 190 Street Subway Station Bennett Ave, New York, NY 10040, USA 40.858113 -73.932983

18 59 St-Lexington Av Station E 60th St, New York, NY 10065, USA 40.762259 -73.966271

19 57 Street Station New York, NY 10019, United States 40.764250 -73.954525

20 14 Street / 8 Av New York, NY 10014, United States 40.730862 -73.987156

21 MTA New York City 525 11th Ave, New York, NY 10018, USA 40.759809 -73.999282

A list of places for rent was collected by web-browsing real estate companies in Manhattan :

<http://www.rentmanhattan.com/index.cfm?page=search&state=results>

[https://www.nestpick.com/search?city=new-](https://www.nestpick.com/search?city=new-york&page=1&order=relevance&district=manhattan&gclid=CjwKCAiAjNjgBRAGeiwAGLlf2hkP3A-cPxjZYkURqQEswQK2jKQEpv_MvKcrIhRWRzNkc_r-fGi0lxoCA7cQAvD_BwE&type=apartment&display=list)

[york&page=1&order=relevance&district=manhattan&gclid=CjwKCAiAjNjgBRAGeiwAGLlf2hkP3A-cPxjZYkURqQEswQK2jKQEpv\\_MvKcrIhRWRzNkc\\_r-fGi0lxoCA7cQAvD\\_BwE&type=apartment&display=list](https://www.nestpick.com/search?city=new-york&page=1&order=relevance&district=manhattan&gclid=CjwKCAiAjNjgBRAGeiwAGLlf2hkP3A-cPxjZYkURqQEswQK2jKQEpv_MvKcrIhRWRzNkc_r-fGi0lxoCA7cQAvD_BwE&type=apartment&display=list)

[https://www.realtor.com/apartments/Manhattan\\_NY](https://www.realtor.com/apartments/Manhattan_NY) A csv file was compiled with the rental place that indicated: areas of Manhattan, address, number of beds, area and monthly rental price. The csv file "nnnn.csv" had the following below structure. An algorithm was used to create all the geodata using Nominatim, as shown in section 3.0. The actual algorithm coding may be shown in 'markdown' mode because it takes time to run. With the use of geolocator = Nominatim() , it was possible to determine the latitude and longitude for the subway metro locations as well as for the geodata for each rental place listed. The loop algorithms used are shown in the execution of data in section 3.0 "Great\_circle" function from geolocator was used to calculate distances between two points , as in the case to calculate average rent price for units around each subway station and at 1.6 km radius. Foursquare is used to find the avenues at Manhattan neighborhoods in general and a cluster is created to later be able to search for the venues depending of the location shown.

### 3. Methodology section:

This section represents the main component of the report where the data is gathered, prepared for analysis. The tools described are used here and the Notebook cells indicates the execution of steps.

The analysis and the strategy:

The strategy is based on mapping the above described data in section 2.0, in order to facilitate the choice of at least two candidate places for rent. The choice is made based on the demands imposed : location near a

subway, rental price and similar venues to Singapore. This visual approach and maps with popups labels allow quick identification of location, price and feature, thus making the selection very easy.

The processing of these DATA and its mapping will allow to answer the key questions to make a decision:

what is the cost of available rental places that meet the demands?

what is the cost of rent around a mile radius from each subway metro station?

what is the area of Manhattan with best rental pricing that meets criteria established?

What is the distance from work place ( Park Ave and 53 rd St) and the tentative future rental home?

What are the venues of the two best places to live? How the prices compare?

How venues distribute among Manhattan neighborhoods and around metro stations?

Are there tradeoffs between size and price and location?

Any other interesting statistical data findings of the real estate and overall data.

In [2]:

```
import numpy as np # library to handle data in a vectorized manner
import time
import pandas as pd # library for data analysis
pd.set_option('display.max_columns', None)
pd.set_option('display.max_rows', None)

import json # library to handle JSON files
import requests # library to handle requests
from pandas.io.json import json_normalize # tranform JSON file into a pandas dataframe
# uncomment this line if you haven't completed the Foursquare API lab
from geopy.geocoders import Nominatim # convert an address into latitude and longitude values
# uncomment this line if you haven't completed the Foursquare API lab
import folium # map rendering library
import folium # map rendering library
from folium import plugins

# Matplotlib and associated plotting modules
import matplotlib.cm as cm
import matplotlib.colors as colors
import seaborn as sns

# import k-means from clustering stage
from sklearn.cluster import KMeans
print('Libraries imported.')
Libraries imported.
METHODOLGY EXECUTION - Mapping Data
Singapore Map - Current residence and venues in neighborhood
```

In [3]:

```
address = 'Mccallum Street, Singapore'
geolocator = Nominatim()
```

```

location = geolocator.geocode(address)
latitude = location.latitude
longitude = location.longitude
print('The geograpical coordinate of Singapore home are {}, {}'.format(latitude, longitude))
/opt/anaconda3/lib/python3.7/site-packages/ipykernel_launcher.py:2: Deprecati
onWarning: Using Nominatim with the default "geopy/1.21.0" `user_agent` is st
rongly discouraged, as it violates Nominatim's ToS https://operations.osmfoun
dation.org/policies/nominatim/ and may possibly cause 403 and 429 HTTP errors
. Please specify a custom `user_agent` with `Nominatim(user_agent="my-applica
tion")` or by overriding the default `user_agent`: `geopy.geocoders.options.d
efault_user_agent = "my-application"`. In geopy 2.0 this will become an excep
tion.

```

The geograpical coordinate of Singapore home are 1.2784801, 103.8493717.

In [4]:

```

neighborhood_latitude=1.2792655
neighborhood_longitude=103.8480938

```

In [16]:

```

# @hidden_cell
CLIENT_ID = 'A1KXZ0XYG5LPBAZ3VJQXRWI1OLXMDXVK4RM3UVCVK11WPECH' # your Foursquare ID
CLIENT_SECRET = '2YMA31L53U5O3GWLXHW5BRGPF1QLTSBT5MIDDUPJGBKNM0IK' # your Foursquare Se
cret
VERSION = '20200222' # Foursquare API version

```

```

#print('Your credentials:')
#print('CLIENT_ID: ' + CLIENT_ID)
#print('CLIENT_SECRET: ' + CLIENT_SECRET)

```

In [17]:

```

LIMIT = 100 # limit of number of venues returned by Foursquare API
radius = 500 # define radius
# create URL
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)
url # display URL

```

Out[17]:

```
'https://api.foursquare.com/v2/venues/explore?&client_id=A1KXZ0XYG5LPBAZ3VJQX  
RWI1OLXMDXVK4RM3UVCVK11WPECH&client_secret=2YMA31L53U5O3GWLXHW5BRGPF1QLTSBT5M  
IDDUPJGBKNM0IK&v=20200222&ll=1.2792655,103.8480938&radius=500&limit=100'
```

In [18]:

```
# results display is hidden for report simplification
```

```
results = requests.get(url).json()
```

```
results
```

Out[18]:

```
{'meta': {'code': 200, 'requestId': '5e50a40747b43d00239e6f42'},  
'response': {'suggestedFilters': {'header': 'Tap to show:',  
  'filters': [{'name': 'Open now', 'key': 'openNow'}]},  
'headerLocation': 'Financial District',  
'headerFullLocation': 'Financial District, Singapore',  
'headerLocationGranularity': 'neighborhood',  
'totalResults': 177,  
'suggestedBounds': {'ne': {'lat': 1.2837655045000045,  
  'lng': 103.85258652226942},  
'sw': {'lat': 1.2747654954999954, 'lng': 103.84360107773058}},  
'groups': [{'type': 'Recommended Places',  
  'name': 'recommended',  
  'items': [{'reasons': {'count': 0,  
    'items': [{'summary': 'This spot is popular',  
      'type': 'general',  
      'reasonName': 'globalInteractionReason'}]}],  
'venue': {'id': '51b49e49abd88dd0b4e7330f',  
  'name': 'Napoleon Food & Wine Bar',  
  'location': {'address': '206 Telok Ayer Street',  
    'lat': 1.2799249387439204,  
    'lng': 103.84733300574288,  
    'labeledLatLngs': [{'label': 'display',  
      'lat': 1.2799249387439204,  
      'lng': 103.84733300574288}]},  
  'distance': 112,  
  'postalCode': '068641',  
  'cc': 'SG',  
  'neighborhood': 'Tanjong Pagar',  
  'city': 'Singapore',  
  'country': 'Singapore',  
  'formattedAddress': ['206 Telok Ayer Street', '068641', 'Singapore']}]  
,  
'categories': [{'id': '4bf58dd8d48988d123941735',  
  'name': 'Wine Bar',  
  'pluralName': 'Wine Bars',  
  'shortName': 'Wine Bar',
```

```

        'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/wine
ry_',
        'suffix': '.png'},
        'primary': True}],
        'photos': {'count': 0, 'groups': []},
        'venuePage': {'id': '58378307'}},
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        'items': [{'summary': 'This spot is popular',
        'type': 'general',
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        'name': 'Native',
        'location': {'address': '52A Amoy Street',
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        'lng': 103.84684430802805,
        'labeledLatLngs': [{'label': 'display',
        'lat': 1.2801354244146959,
        'lng': 103.84684430802805}]},
        'distance': 169,
        'postalCode': '069878',
        'cc': 'SG',
        'country': 'Singapore',
        'formattedAddress': ['52A Amoy Street', '069878', 'Singapore']},
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        'name': 'Cocktail Bar',
        'pluralName': 'Cocktail Bars',
        'shortName': 'Cocktail',
        'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/nightlife
/cocktails_',
        'suffix': '.png'},
        'primary': True}],
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        {'reasons': {'count': 0,
        'items': [{'summary': 'This spot is popular',
        'type': 'general',
        'reasonName': 'globalInteractionReason'}]},
        'venue': {'id': '50248ddde4b0bb3db3a6ff8a',
        'name': 'Pepper Bowl',
        'location': {'address': '#02-102, Amoy Street Food Centre',
        'crossStreet': '7 Maxwell Rd.',
        'lat': 1.279371,
        'lng': 103.84671,

```

```

        'labeledLatLngs': [{ 'label': 'display',
            'lat': 1.279371,
            'lng': 103.84671}],
        'distance': 154,
        'cc': 'SG',
        'city': 'Singapore',
        'country': 'Singapore',
        'formattedAddress': ['#02-102, Amoy Street Food Centre (7 Maxwell Rd.
    )',
        'Singapore']},
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        'pluralName': 'Asian Restaurants',
        'shortName': 'Asian',
        'icon': { 'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/asia
n_',
            'suffix': '.png'},
        'primary': True}],
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    { 'reasons': { 'count': 0,
        'items': [{ 'summary': 'This spot is popular',
            'type': 'general',
            'reasonName': 'globalInteractionReason'}]},
    'venue': { 'id': '55a49050498e801fbf03be73',
        'name': 'Park Bench Deli',
        'location': { 'address': '179 Telok Ayer St',
            'crossStreet': 'Amoy St',
            'lat': 1.2798723608759432,
            'lng': 103.84728710112705,
            'labeledLatLngs': [{ 'label': 'display',
                'lat': 1.2798723608759432,
                'lng': 103.84728710112705}],
            'distance': 112,
            'postalCode': '068627',
            'cc': 'SG',
            'neighborhood': 'Chinatown',
            'city': 'Singapore',
            'country': 'Singapore',
            'formattedAddress': ['179 Telok Ayer St (Amoy St)',
                '068627',
                'Singapore']},
        'categories': [{ 'id': '4bf58dd8d48988d146941735',
            'name': 'Deli / Bodega',

```

```

        'pluralName': 'Delis / Bodegas',
        'shortName': 'Deli / Bodega',
        'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/deli
_ ',
        'suffix': '.png'},
        'primary': True}],
        'photos': {'count': 0, 'groups': []}},
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        {'reasons': {'count': 0,
        'items': [{'summary': 'This spot is popular',
        'type': 'general',
        'reasonName': 'globalInteractionReason'}]}},
        'venue': {'id': '5bab10b9364d97002cc5e458',
        'name': 'Muchachos',
        'location': {'address': '#01-01 Frasers Tower',
        'crossStreet': '182 Cecil Street',
        'lat': 1.2790721332821124,
        'lng': 103.84702556749504,
        'labeledLatLngs': [{'label': 'display',
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        'lng': 103.84702556749504}]},
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        'cc': 'SG',
        'neighborhood': 'Financial District',
        'city': 'Singapore',
        'country': 'Singapore',
        'formattedAddress': ['#01-01 Frasers Tower (182 Cecil Street)',
        '069547',
        'Singapore']},
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        'shortName': 'Burritos',
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ito_',
        'suffix': '.png'},
        'primary': True}],
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        'type': 'general',
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```



```
'venue': {'id': '56ecb93dcd101850ebc08dc5',
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_',
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'primary': True}],
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'referralId': 'e-0-56ecb93dcd101850ebc08dc5-5'},
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'items': [{'summary': 'This spot is popular',
'type': 'general',
'reasonName': 'globalInteractionReason'}]},
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'lng': 103.8485128808929}]},
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'country': 'Singapore',
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'name': 'Beer Garden',
```

```

        'pluralName': 'Beer Gardens',
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beergarden_',
        'suffix': '.png'},
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    'lng': 103.84981314280776}]},
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    'country': 'Singapore',
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    'shortName': 'Hotel',
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tel_',
    'suffix': '.png'},
    'primary': True}},
    'photos': {'count': 0, 'groups': []}},
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    'referralId': 'e-0-4f704af9e4b07a4bc6edd2a9-7'},
    {'reasons': {'count': 0,
    'items': [{'summary': 'This spot is popular',
    'type': 'general',
    'reasonName': 'globalInteractionReason'}]},
    'venue': {'id': '4c57877d6201e21e49b7e86e',
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```

```

'crossStreet': 'Ann Siang Hill Park',
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'country': 'Singapore',
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,
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  'shortName': 'Café',
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_',
  'suffix': '.png'},
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  'name': 'Anglo Indian Cafe & Bar',
  'location': {'address': '1 Shenton Way',
    'lat': 1.2790836483039665,
    'lng': 103.85012677894278,
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      'lng': 103.85012677894278}],
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    'postalCode': '068803',
    'cc': 'SG',
    'neighborhood': 'Financial District',
    'country': 'Singapore',
    'formattedAddress': ['1 Shenton Way', '068803', 'Singapore']},

```

```

    'categories': [{ 'id': '4bf58dd8d48988d10f941735',
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        'shortName': 'Indian',
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an_',
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        'primary': True}],
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    'referralId': 'e-0-4fc8aecee4b08eb1f57a1a81-9'},
    { 'reasons': { 'count': 0,
        'items': [{ 'summary': 'This spot is popular',
            'type': 'general',
            'reasonName': 'globalInteractionReason' } ] },
    'venue': { 'id': '557a6b3c498ed9cb15987433',
        'name': 'ShuKuu Izakaya',
        'location': { 'address': '8 Stanley Street',
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            'lng': 103.8477615067585,
            'labeledLatLngs': [{ 'label': 'display',
                'lat': 1.280110799343203,
                'lng': 103.8477615067585 } ] },
        'distance': 101,
        'postalCode': '068727',
        'cc': 'SG',
        'city': 'Singapore',
        'country': 'Singapore',
        'formattedAddress': [ '8 Stanley Street', '068727', 'Singapore' ] },
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eeshop_',
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ult_',
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'icon': { 'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/viet
name_ ',
```

```

        'suffix': '.png'},
        'primary': True]],
        'photos': {'count': 0, 'groups': []}},
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        {'reasons': {'count': 0,
            'items': [{'summary': 'This spot is popular',
                'type': 'general',
                'reasonName': 'globalInteractionReason'}]}},
        'venue': {'id': '5887008018dc5375de1b11e0',
            'name': 'Kuro Maguro',
            'location': {'address': '7 Wallich Street, #01-04 Tanjong Pagar Centre
',
            'lat': 1.2766989535948103,
            'lng': 103.8459509163215,
            'labeledLatLngs': [{'label': 'display',
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            'distance': 372,
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            'cc': 'SG',
            'city': 'Singapore',
            'country': 'Singapore',
            'formattedAddress': ['7 Wallich Street, #01-04 Tanjong Pagar Centre',
                '078884',
                'Singapore']},
            'categories': [{'id': '4bf58dd8d48988d111941735',
                'name': 'Japanese Restaurant',
                'pluralName': 'Japanese Restaurants',
                'shortName': 'Japanese',
                'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/japa
nese_',
                'suffix': '.png'},
                'primary': True]],
                'photos': {'count': 0, 'groups': []}},
                'referralId': 'e-0-5887008018dc5375de1b11e0-88'},
                {'reasons': {'count': 0,
                    'items': [{'summary': 'This spot is popular',
                        'type': 'general',
                        'reasonName': 'globalInteractionReason'}]}},
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                        'name': 'Imakatsu',
                        'location': {'address': '#01-06 Guoco Tower',
                            'crossStreet': '7 Wallich Street',
                            'lat': 1.276605335377591,
```



```
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nese_',
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ch_',
```

[illegible]

```

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  'pluralName': 'Plazas',
  'shortName': 'Plaza',
  'icon': { 'prefix': 'https://ss3.4sqi.net/img/categories_v2/parks_out
doors/plaza_',
    'suffix': '.png' },
  'primary': True } ],
'photos': { 'count': 0, 'groups': [] },
'referralId': 'e-0-52a2d141498ecba00870d024-92',
{'reasons': { 'count': 0,
  'items': [ { 'summary': 'This spot is popular',
    'type': 'general',
    'reasonName': 'globalInteractionReason' } ] },
'venue': { 'id': '4ebca9a7d3e38e6b0bcf6f1a',
  'name': 'Imperial Treasure Super Peking Duck Restaurant 御寶至尊烤鴨店',
  'location': { 'address': '#02-08/09/10, Asia Square Tower 1',
    'crossStreet': '8 Marina View',
    'lat': 1.279406223512814,
    'lng': 103.85172794656997,
    'labeledLatLngs': [ { 'label': 'display',
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      'lng': 103.85172794656997 } ] },
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    'cc': 'SG',
    'city': 'Singapore',
    'country': 'Singapore',
    'formattedAddress': ['#02-08/09/10, Asia Square Tower 1 (8 Marina Vie
w)',
      '018960',
      'Singapore' ] },
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  'name': 'Peking Duck Restaurant',
  'pluralName': 'Peking Duck Restaurants',
  'shortName': 'Peking Duck',
  'icon': { 'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/asia
n_',

```

```

        'suffix': '.png'},
        'primary': True]],
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            'items': [{'summary': 'This spot is popular',
                'type': 'general',
                'reasonName': 'globalInteractionReason'}]}},
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                'lat': 1.2795276852422994,
                'lng': 103.84520584793185,
                'labeledLatLngs': [{'label': 'display',
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                    'lng': 103.84520584793185}]},
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            'city': 'Singapore',
            'country': 'Singapore',
            'formattedAddress': ['45 Maxwell Road', '069118', 'Singapore']},
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                'pluralName': 'Art Galleries',
                'shortName': 'Art Gallery',
                'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/arts_entertainment/artgallery_',
                    'suffix': '.png'},
                'primary': True}},
            'photos': {'count': 0, 'groups': []}},
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                    'lat': 1.2829673982020517,
                    'lng': 103.84806217253097,
                    'labeledLatLngs': [{'label': 'display',
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```

```

    'lng': 103.84806217253097}}],
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    'country': 'Singapore',
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    '049568',
    'Singapore']},
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    'name': 'Martial Arts Dojo',
    'pluralName': 'Martial Arts Dojos',
    'shortName': 'Martial Arts',
    'icon': { 'prefix': 'https://ss3.4sqi.net/img/categories_v2/shops/gym_
_martialarts_',
    'suffix': '.png' },
    'primary': True } ],
    'photos': { 'count': 0, 'groups': [] },
    'referralId': 'e-0-4b625e08f964a5208f442ae3-95' },
    { 'reasons': { 'count': 0,
    'items': [ { 'summary': 'This spot is popular',
    'type': 'general',
    'reasonName': 'globalInteractionReason' } ] },
    'venue': { 'id': '4c85b017d4e23704ca4d8588',
    'name': 'SAP Thai Food',
    'location': { 'address': '#01-58, Amoy Street Food Centre',
    'crossStreet': '7 Maxwell Road',
    'lat': 1.2791002935317128,
    'lng': 103.84709404520191,
    'labeledLatLngs': [ { 'label': 'display',
    'lat': 1.2791002935317128,
    'lng': 103.84709404520191 } ] },
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    'postalCode': '069111',
    'cc': 'SG',
    'city': 'Singapore',
    'country': 'Singapore',
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    'Singapore'] },
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    'pluralName': 'Thai Restaurants',

```

```

    'shortName': 'Thai',
    'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/thai
_ ',
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    'lng': 103.84846582949375,
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    'lng': 103.84846582949375}]},
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    'country': 'Singapore',
    'formattedAddress': ['140 Robinson Road', '068907', 'Singapore']},
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    'pluralName': 'Coffee Shops',
    'shortName': 'Coffee Shop',
    'icon': {'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/coff
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    'suffix': '.png'},
    'primary': True}},
    'photos': {'count': 0, 'groups': []}},
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    'items': [{'summary': 'This spot is popular',
    'type': 'general',
    'reasonName': 'globalInteractionReason'}]},
    'venue': {'id': '51279816e4b0e4084477c34d',
    'name': 'Wang Dae Bak Korean BBQ',
    'location': {'address': '#01-64 Cross Street Exchange',
    'crossStreet': '22 Cross Street',
    'lat': 1.2829006497635824,

```

```

'lng': 103.84811639785767,
'latitude': 1.2829006497635824,
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'cc': 'SG',
'city': 'Singapore',
'country': 'Singapore',
'formattedAddress': ['#01-64 Cross Street Exchange (22 Cross Street)']
,
'048421',
'Singapore']},
'categories': [{ 'id': '4bf58dd8d48988d113941735',
'name': 'Korean Restaurant',
'pluralName': 'Korean Restaurants',
'shortName': 'Korean',
'icon': { 'prefix': 'https://ss3.4sqi.net/img/categories_v2/food/kore
an_',
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'referralId': 'e-0-51279816e4b0e4084477c34d-98'},
'reasons': { 'count': 0,
'items': [{ 'summary': 'This spot is popular',
'type': 'general',
'reasonName': 'globalInteractionReason' } ]},
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'name': 'The Daily Cut',
'location': { 'address': '#B2-16 Guoco Tower',
'crossStreet': '7 Wallich Street',
'lat': 1.2767265621171775,
'lng': 103.8452612818406,
'latitude': 1.2767265621171775,
'lng': 103.8452612818406}],
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'cc': 'SG',
'city': 'Tanjong Pagar',
'state': 'Singapore',
'country': 'Singapore',
'formattedAddress': ['#B2-16 Guoco Tower (7 Wallich Street)',
'078884'],

```

```

        'Singapore']},
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d_',
        'suffix': '.png'},
        'primary': True}],
        'photos': { 'count': 0, 'groups': []}},
        'referralId': 'e-0-58255545b244c8385714dd29-99'}}]]]]}

```

In [19]:

```

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 [20]:

```

venues = results['response']['groups'][0]['items']
SGnearby_venues = json_normalize(venues) # flatten JSON
# filter columns
filtered_columns = ['venue.name', 'venue.categories', 'venue.location.lat', 'venue.location.lng']
SGnearby_venues = SGnearby_venues.loc[:, filtered_columns]
# filter the category for each row
SGnearby_venues['venue.categories'] = SGnearby_venues.apply(get_category_type, axis=1)
# clean columns
SGnearby_venues.columns = [col.split(".")[ -1] for col in SGnearby_venues.columns]

```

SGnearby\_venues.shape

Out [20]:

```
(100, 4)
```

In [21]:

```

# Venues near current Singapore residence place
SGnearby_venues.head(10)

```

Out [21]:



	name	categories	lat	lng
0	Napoleon Food & Wine Bar	Wine Bar	1.279925	103.847333
1	Native	Cocktail Bar	1.280135	103.846844
2	Pepper Bowl	Asian Restaurant	1.279371	103.846710
3	Park Bench Deli	Deli / Bodega	1.279872	103.847287
4	Muchachos	Burrito Place	1.279072	103.847026
5	Mellower Coffee	Café	1.277814	103.848188
6	Freehouse	Beer Garden	1.281254	103.848513
7	Sofitel So Singapore	Hotel	1.280017	103.849813
8	PS.Cafe	Café	1.280468	103.846264
9	Anglo Indian Cafe & Bar	Indian Restaurant	1.279084	103.850127

In [22]:

Map of Singapore residence place **with** venues **in** Neighborhood - **for** reference

File "<ipython-input-22-d6a907a1a1ea>", line 1

Map of Singapore residence place with venues in Neighborhood - for reference

^

SyntaxError: invalid syntax

In [23]:

latitude=1.2792655

longitude=103.8480938

# create map of Singapore place using latitude and longitude values

map\_sg = folium.Map(location=[latitude, longitude], zoom\_start=18)

# add markers to map

for lat, lng, label in zip(SGnearby\_venues['lat'], SGnearby\_venues['lng'], SGnearby\_venues['name']):

label = folium.Popup(label, parse\_html=True)

folium.RegularPolygonMarker(

```
[lat, lng],
number_of_sides=30,
radius=7,
popup=label,
color='blue',
fill_color='#0f0f0f',
fill_opacity=0.6,
).add_to(map_sg)
```

map\_sg

Out [23]:

In [24]:

## MANHATTAN NEIGHBORHOODS - DATA AND MAPPING

Cluster neighborhood data was produced **with** Foursquare during course lab work. A csv file was produced containing the neighborhoods around the **40** Boroughs. Now, the csv file **is** just read **for** convenience **and** consolidation of report

File "<ipython-input-24-622129cbed0>", line 1

MANHATTAN NEIGHBORHOODS - DATA AND MAPPING

^

SyntaxError: invalid syntax

In [39]:

```
manhattan_data = pd.read_csv('/Users/jnagarajan/Documents/mh_neigh_data.csv')
manhattan_data.head()
```

Out [39]:

	Borough	Neighborhood	Latitude	Longitude	Cluster Labels	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	Manhattan	Marble Hill	40.876551	-73.910660	2	Coffee Shop	Discount Store	Yoga Studio	Steakhouse	Supermarket Shop	Tennis Stadium	Shoe Store	Gym	Bank	Seafood Restaurant
1	Manhattan	Chinatown	40.715618	-73.994279	2	Chinese Restaurant	Cocktail Bar	Dim Sum Restaurant	American Restaurant	Vietnamese Restaurant	Salon / Barber Shop	Noodle House	Bakery	Bubble Tea Shop	Ice Cream Shop

	Borough	Neighborhood	Latitude	Longitude	Cluster Labels	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
2	Manhattan	Washington Heights	40.851903	-73.936900	4	Café	Bakery	Mobile Phone Shop	Pizza Place	Sandwich Place	Park	Gym	Latin American Restaurant	Tapas Restaurant	Mexican Restaurant
3	Manhattan	Inwood	40.867684	-73.921210	3	Mexican Restaurant	Lounge	Pizza Place	Café	Wine Bar	Bakery	American Restaurant	Park	Frozen Yogurt Shop	Spanish Restaurant
4	Manhattan	Hamilton Heights	40.823604	-73.949688	0	Mexican Restaurant	Coffee Shop	Café	Deli / Bodega	Pizza Place	Liquor Store	Indian Restaurant	Sushi Restaurant	Sandwich Place	Yoga Studio

```
In [40]:
manhattan_data.tail()
```

Out[40]:

	Borough	Neighborhood	Latitude	Longitude	Cluster Labels	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
35	Manhattan	Turtle Bay	40.752042	-73.967708	3	Italian Restaurant	Coffee Shop	Steakhouse	Wine Bar	Sushi Restaurant	Hotel	Noodle House	Indian Restaurant	Japanese Restaurant	French Restaurant

	Borough	Neighborhood	Latitude	Longitude	Cluster Labels	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
36	Manhattan	Tudor City	40.746917	-73.971219	3	Café	Park	Pizza Place	Mexican Restaurant	Greek Restaurant	Sushi Restaurant	Hotel	Deli / Bodega	Diner	Dog Run
37	Manhattan	Stuyvesant Town	40.731000	-73.974052	4	Bar	Park	Boat or Ferry	Basketball Court	Coffee Shop	Baseball Field	Gas Station	Beer Garden	Harbor / Marina	Playground
38	Manhattan	Flatiron	40.739673	-73.990947	3	Italian Restaurant	American Restaurant	Gym	Gym / Fitness Center	Yoga Studio	Vegan / Vegetarian Restaurant	Bakery	Clothing Store	Cosmetics Shop	Cycle Studio
39	Manhattan	Hudson Yards	40.756658	-74.000111	2	Coffee Shop	Italian Restaurant	Hotel	Theater	American Restaurant	Café	Gym / Fitness Center	Thai Restaurant	Restaurant	Gym

Manhattan Borough neighborhoods - data with top 10 clustered venue

In [42]:

```
manhattan_merged = pd.read_csv('/Users/jnagarajan/Documents/manhattan_merged.csv')
manhattan_merged.head()
```

Out [42]:

	Borough	Neighborhood	Latitude	Longitude	Cluster Labels	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	Manhattan	Marble Hill	40.876551	-73.910660	2	Coffee Shop	Discount Store	Yoga Studio	Steakhouse	Supplement Shop	Tennis Stadium	Shoe Store	Gym	Bank	Seafood Restaurant
1	Manhattan	Chinatown	40.715618	-73.994279	2	Chinese Restaurant	Cocktail Bar	Dim Sum Restaurant	American Restaurant	Vietnamese Restaurant	Salon / Barber Shop	Noodle House	Bakery	Bubble Tea Shop	Ice Cream Shop
2	Manhattan	Washington Heights	40.851903	-73.936900	4	Café	Bakery	Mobile Phone Shop	Pizza Place	Sandwich Place	Park	Gym	Latin American Restaurant	Tapas Restaurant	Mexican Restaurant
3	Manhattan	Inwood	40.867684	-73.921210	3	Mexican Restaurant	Lounge	Pizza Place	Café	Wine Bar	Bakery	American Restaurant	Park	Frozen Yogurt Shop	Spanish Restaurant
4	Manhattan	Hamilton Heights	40.823604	-73.949688	0	Mexican Restaurant	Coffee Shop	Café	Deli / Bodega	Pizza Place	Liquor Store	Indian Restaurant	Sushi Restaurant	Sandwich Place	Yoga Studio

Map of Manhattan neighborhoods with top 10 clustered venues

In [43]:

```
# create map of Manhattan using latitude and longitude values from Nominatim
```

```
latitude= 40.7308619
```

```
longitude= -73.9871558
```

```
kclusters=5
```

```
map_clusters = folium.Map(location=[latitude, longitude], zoom_start=13)
```

```
# set color scheme for the clusters
```

```
x = np.arange(kclusters)
ys = [i+x+(i*x)**2 for i in range(kclusters)]
colors_array = cm.rainbow(np.linspace(0, 1, len(ys)))
rainbow = [colors.rgb2hex(i) for i in colors_array]
```

```
# add markers to the map
```

```
markers_colors = []
```

```
for lat, lon, poi, cluster in zip(manhattan_merged['Latitude'], manhattan_merged['Longitude'], manhattan_merged['Neighborhood'], manhattan_merged['Cluster Labels']):
```

```
    label = folium.Popup(str(poi) + ' Cluster ' + str(cluster), parse_html=True)
```

```
    folium.CircleMarker(
        [lat, lon],
        radius=20,
        popup=label,
        color=rainbow[cluster-1],
        fill=True,
        fill_color=rainbow[cluster-1],
        fill_opacity=1).add_to(map_clusters)
```

```
# add markers for rental places to map
```

```
for lat, lng, label in zip(manhattan_data['Latitude'], manhattan_data['Longitude'], manhattan_data['Neighborhood']):
```

```
    label = folium.Popup(label, parse_html=True)
```

```
    folium.CircleMarker(
        [lat, lng],
        radius=5,
        popup=label,
        color='blue',
        fill=True,
        fill_color='#3186cc',
        fill_opacity=1,
        parse_html=False).add_to(map_clusters)
```

```
map_clusters
```

Out [43] :

Examine a particular Cluster - print venues After examining several cluster data , I concluded that cluster # 2 resembles closer the Singapore place, therefore providing guidance as to where to look for the future apartment . Assign a value to 'kk' to explore a given cluster

In [44] :

## kk is the cluster number to explore

kk = 2

manhattan\_merged.loc[manhattan\_merged['Cluster Labels'] == kk, manhattan\_merged.columns[[1] + list(range(5, manhattan\_merged.shape[1]))]]

Out[44]:

	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	Marble Hill	Coffee Shop	Discount Store	Yoga Studio	Steakhouse	Supplement Shop	Tennis Stadium	Shoe Store	Gym	Bank	Seafood Restaurant
1	Chinatown	Chinese Restaurant	Cocktail Bar	Dim Sum Restaurant	American Restaurant	Vietnamese Restaurant	Salon / Barbershop	Noodle House	Bakery	Bubble Tea Shop	Ice Cream Shop
6	Central Harlem	African Restaurant	Seafood Restaurant	French Restaurant	American Restaurant	Cosmetics Shop	Chinese Restaurant	Event Space	Liquor Store	Beer Bar	Gym / Fitness Center
9	Yorkville	Coffee Shop	Gym	Bar	Italian Restaurant	Sushi Restaurant	Pizza Place	Mexican Restaurant	Deli / Bodega	Japanese Restaurant	Pub
14	Clinton	Theater	Italian Restaurant	Coffee Shop	American Restaurant	Gym / Fitness Center	Hotel	Wine Shop	Spa	Gym	Indie Theater
23	Soho	Clothing Store	Boutique	Women's Store	Shoe Store	Men's Store	Furniture / Home Store	Italian Restaurant	Mediterranean Restaurant	Art Gallery	Design Studio
26	Morningside Heights	Coffee Shop	American Restaurant	Park	Bookstore	Pizza Place	Sandwich Place	Burger Joint	Café	Deli / Bodega	Tennis Court

	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
34	Sutton Place	Gym / Fitness Center	Italian Restaurant	Furniture / Home Store	Indian Restaurant	Dessert Shop	American Restaurant	Bakery	Juice Bar	Boutique	Sushi Restaurant
39	Hudson Yards	Coffee Shop	Italian Restaurant	Hotel	Theater	American Restaurant	Café	Gym / Fitness Center	Thai Restaurant	Restaurant	Gym

In [46]:

```
mh_rent=pd.read_csv('/Users/jnagarajan/Documents/MH_flats_price.csv')
mh_rent.head()
```

Out [46]:

	Address	Area	Price_per_ft2	Rooms	Area-ft2	Rent_Price	Lat	Long	Unnamed: 8
0	West 105th Street	Upper West Side	2.94	5	3400	10000	NaN	NaN	NaN
1	East 97th Street	Upper East Side	3.57	3	2100	7500	NaN	NaN	NaN
2	West 105th Street	Upper West Side	1.89	4	2800	5300	NaN	NaN	NaN
3	CARMINE ST.	West Village	3.03	2	1650	5000	NaN	NaN	NaN
4	171 W 23RD ST.	Chelsea	3.45	2	1450	5000	NaN	NaN	NaN

In [47]:

```
mh_rent.tail()
```

Out [47]:



	Address	Area	Price_per_ft2	Rooms	Area-ft2	Rent_Price	Lat	Long	Unnamed: 8
139	200 East 72nd Street	Rental in Lenox Hill	5.15	3	1700	8750	NaN	NaN	NaN
140	50 Murray Street	No fee rental in Tribeca	7.11	2	1223	8700	NaN	NaN	NaN
141	300 East 56th Street	No fee rental in Midtown East	3.87	3	2100	8118	NaN	NaN	NaN
142	1930 Broadway	No fee rental in Central Park West	5.06	2	1600	8095	NaN	NaN	NaN
143	33 West 9th Street	Rental in Greenwich Village	6.67	2	1500	10000	NaN	NaN	NaN

```
for n in range(len(mh_rent)): address= mh_rent['Address'][n] address=(mh_rent['Address'][n]+ ' , '+'
Manhattan NY ') geolocator = Nominatim() location = geolocator.geocode(address) latitude =
location.latitude longitude = location.longitude mh_rent['Lat'][n]=latitude
mh_rent['Long'][n]=longitude
```

In [51]:

```
mh_rent.to_csv('MH_rent_latlong.csv',index=False)
```

In [52]:

```
mh_rent=pd.read_csv('/Users/jnagarajan/Documents/MH_rent_latlong.csv')
mh_rent.head()
```

Out [52]:

	Address	Area	Price_per_ft2	Rooms	Area-ft2	Rent_Price	Lat	Long
0	West 105th Street	Upper West Side	2.94	5	3400	10000	40.799771	-73.966213
1	East 97th Street	Upper East Side	3.57	3	2100	7500	40.788585	-73.955277
2	West 105th Street	Upper West Side	1.89	4	2800	5300	40.799771	-73.966213

	Address	Area	Price_per_ft2	Rooms	Area-ft2	Rent_Price	Lat	Long
3	CARMINE ST.	West Village	3.03	2	1650	5000	40.730523	-74.001873
4	171 W 23RD ST.	Chelsea	3.45	2	1450	5000	40.744118	-73.995299

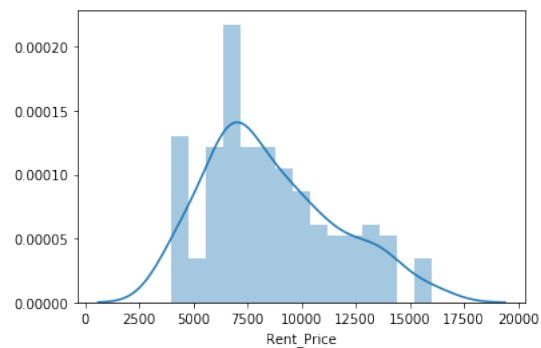
Manhattan apartment rent price statistics

In [54]:

```
import seaborn as sns
sns.distplot(mh_rent['Rent_Price'],bins=15)
```

Out [54]:

<matplotlib.axes.\_subplots.AxesSubplot at 0x1a20fb4190>

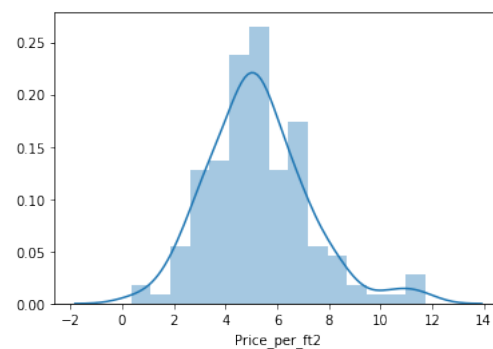


In [55]:

```
import seaborn as sns
sns.distplot(mh_rent['Price_per_ft2'],bins=15)
```

Out [55]:

<matplotlib.axes.\_subplots.AxesSubplot at 0x1a23c4ae90>

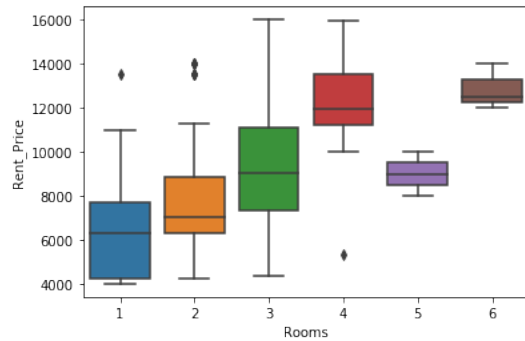


In [56]:

```
sns.boxplot(x='Rooms', y='Rent_Price', data=mh_rent)
```

Out [56]:

<matplotlib.axes.\_subplots.AxesSubplot at 0x1a24677610>



Map of Manhattan apartments for rent The popups will indicate the address and the monthly price for rent thus making it convenient to select the target apartment with the price condition estipulated (max US7000 )

In [57]:

```
# create map of Manhattan using latitude and longitude values from Nominatim
```

```
latitude= 40.7308619
```

```
longitude= -73.9871558
```

```
map_manhattan_rent = folium.Map(location=[latitude, longitude], zoom_start=12.5)
```

```
# add markers to map
```

```
for lat, lng, label in zip(mh_rent['Lat'], mh_rent['Long'], '$ ' + mh_rent['Rent_Price'].astype(str) + ', ' + mh_rent['Address']):
```

```
    label = folium.Popup(label, parse_html=True)
```

```
    folium.CircleMarker(
```

```
        [lat, lng],
```

```
        radius=6,
```

```
        popup=label,
```

```
        color='blue',
```

```
        fill=True,
```

```
        fill_color='#3186cc',
```

```
        fill_opacity=0.7,
```

```
        parse_html=False).add_to(map_manhattan_rent)
```

```
map_manhattan_rent
```

Out[57]:

Map of Manhattan showing the places for rent and the cluster of venues

Now, one can point to a rental place for price and address location information while knowing the cluster venues around it. This is an insightful way to explore rental possibilities

In [58]:

```
# create map of Manhattan using latitude and longitude values from Nominatim
```

```
latitude= 40.7308619
```

```
longitude= -73.9871558
```

```
# create map with clusters
```

```
kclusters=5
```

```

map_clusters2 = folium.Map(location=[latitude, longitude], zoom_start=13)

# set color scheme for the clusters
x = np.arange(kclusters)
ys = [i+x+(i*x)**2 for i in range(kclusters)]
colors_array = cm.rainbow(np.linspace(0, 1, len(ys)))
rainbow = [colors.rgb2hex(i) for i in colors_array]

# add markers to the map
markers_colors = []
for lat, lon, poi, cluster in zip(manhattan_merged['Latitude'], manhattan_merged['Longitude'], manhattan_merged['Neighborhood'], manhattan_merged['Cluster Labels']):
    label = folium.Popup(str(poi) + ' Cluster ' + str(cluster), parse_html=True)
    folium.CircleMarker(
        [lat, lon],
        radius=20,
        popup=label,
        color=rainbow[cluster-1],
        fill=True,
        fill_color=rainbow[cluster-1],
        fill_opacity=0.7).add_to(map_clusters2)

# add markers to map for rental places
for lat, lng, label in zip(mh_rent['Lat'], mh_rent['Long'], '$ ' + mh_rent['Rent_Price'].astype(str) + mh_rent['Address']):
    label = folium.Popup(label, parse_html=True)
    folium.CircleMarker(
        [lat, lng],
        radius=6,
        popup=label,
        color='blue',
        fill=True,
        fill_color='#3186cc',
        fill_opacity=0.7,
        parse_html=False).add_to(map_clusters2)

# Adds tool to the top right
from folium.plugins import MeasureControl
map_manhattan_rent.add_child(MeasureControl())

# FMeasurement ruler icon to establish distnces on map
from folium.plugins import FloatImage
url = ('https://media.licdn.com/mpr/mpr/shrinknp_100_100/AEEAAQAAAAAAAAAlgAAAAJGE3OTA4YTdlLTkzZjUtNDJfYy1iZThlLWQ5OTNkYzlhNm40OQ.jpg')

```

```
FloatImage(url, bottom=5, left=85).add_to(map_manhattan_rent)
```

```
map_clusters2
```

Out [58] :

Now one can explore a particular rental place and its venues in detail In the map above, examination of apartments with rental place below 7000/month is straightforward while knowing the venues around it. We could find an apartment with at the right price and in a location with desirable venues. The next step is to see if it is located near a subway metro station, in next cells work

In [59] :

```
## kk is the cluster number to explore
```

```
kk = 3
```

```
manhattan_merged.loc[manhattan_merged['Cluster Labels'] == kk, manhattan_merged.columns[[1] + list(range(5, manhattan_merged.shape[1]))]]
```

Out [59] :

	Neighbor hood	1st Most Comm on Venue	2nd Most Comm on Venue	3rd Most Comm on Venue	4th Most Comm on Venue	5th Most Comm on Venue	6th Most Comm on Venue	7th Most Comm on Venue	8th Most Comm on Venue	9th Most Comm on Venue	10th Most Comm on Venue
3	Inwood	Mexican Restau rant	Lounge	Pizza Place	Café	Wine Bar	Bakery	American Restau rant	Park	Frozen Yogurt Shop	Spanis h Restaur ant
5	Manhattan ville	Deli / Bodega	Italian Restau rant	Seafoo d Restaur ant	Mexican Restaur ant	Sushi Restaur ant	Beer Garden	Coffee Shop	Falafel Restau rant	Bike Trail	Other Nightlif e
10	Lenox Hill	Sushi Restau rant	Italian Restau rant	Coffee Shop	Gym / Fitness Center	Pizza Place	Burger Joint	Deli / Bodega	Gym	Sportin g Goods Shop	Thai Restaur ant
12	Upper West Side	Italian Restau rant	Bar	Bakery	Vegeta rian / Vegan Restaur ant	Indian Restaur ant	Coffee Shop	Cosme tics Shop	Wine Bar	Mexican Restau rant	Sushi Restaur ant
16	Murray Hill	Sandwich Place	Hotel	Japanes e Restaur ant	Gym / Fitness Center	Coffee Shop	Salon / Barbers hop	Burger Joint	French Restau rant	Bar	Italian Restaur ant

	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
17	Chelsea	Coffee Shop	Italian Restaurant	Ice Cream Shop	Bakery	Nightclub	Theater	Art Gallery	Seafood Restaurant	American Restaurant	Hotel
18	Greenwich Village	Italian Restaurant	Sushi Restaurant	French Restaurant	Clothing Store	Chinese Restaurant	Café	Indian Restaurant	Bakery	Seafood Restaurant	Electronics Store
27	Gramercy	Italian Restaurant	Restaurant	Thrift / Vintage Store	Cocktail Bar	Bagel Shop	Coffee Shop	Pizza Place	Mexican Restaurant	Grocery Store	Wine Shop
29	Financial District	Coffee Shop	Hotel	Gym	Wine Shop	Steakhouse	Bar	Italian Restaurant	Pizza Place	Park	Gym / Fitness Center
31	Noho	Italian Restaurant	French Restaurant	Cocktail Bar	Gift Shop	Bookstore	Grocery Store	Mexican Restaurant	Hotel	Sushi Restaurant	Coffee Shop
32	Civic Center	Gym / Fitness Center	Bakery	Italian Restaurant	Cocktail Bar	French Restaurant	Sandwich Place	Coffee Shop	Gym	Yoga Studio	Park
35	Turtle Bay	Italian Restaurant	Coffee Shop	Steakhouse	Wine Bar	Sushi Restaurant	Hotel	Noodle House	Indian Restaurant	Japanese Restaurant	French Restaurant
36	Tudor City	Café	Park	Pizza Place	Mexican Restaurant	Greek Restaurant	Sushi Restaurant	Hotel	Deli / Bodega	Diner	Dog Run
38	Flatiron	Italian Restaurant	American Restaurant	Gym	Gym / Fitness Center	Yoga Studio	Vegetarian / Vegan	Bakery	Clothing Store	Cosmetics Shop	Cycle Studio



```
mh.head()
(76, 4)
```

Out [63] :

	sub_station	sub_address	lat	long
0	Dyckman Street Subway Station	170 Nagle Ave, New York, NY 10034, USA	40.861857	-73.924509
1	57 Street Subway Station	New York, NY 10106, USA	40.764250	-73.954525
2	Broad St	New York, NY 10005, USA	40.730862	-73.987156
3	175 Street Station	807 W 177th St, New York, NY 10033, USA	40.847991	-73.939785
4	5 Av and 53 St	New York, NY 10022, USA	40.764250	-73.954525

In [64] :

```
# removing duplicate rows and creating new set mhsb1
mhsb1=mh.drop_duplicates(subset=['lat','long'], keep="last").reset_index(drop=True)
mhsb1.shape
```

Out [64] :

```
(22, 4)
```

In [65] :

```
mhsb1.tail()
```

Out [65] :

	sub_station	sub_address	lat	long
17	190 Street Subway Station	Bennett Ave, New York, NY 10040, USA	40.858113	-73.932983
18	59 St-Lexington Av Station	E 60th St, New York, NY 10065, USA	40.762259	-73.966271
19	57 Street Station	New York, NY 10019, United States	40.764250	-73.954525
20	14 Street / 8 Av	New York, NY 10014, United States	40.730862	-73.987156
21	MTA New York City	525 11th Ave, New York, NY 10018, USA	40.759809	-73.999282

In [66] :

```
# map subway stations
# create map of Manhattan using latitude and longitude values obtain previoulsy via Moninatim geolocator
```



```
latitude=40.7308619
longitude=-73.9871558
```

```
map_mhsub1 = folium.Map(location=[latitude, longitude], zoom_start=12)
```

```
# add markers of subway locations to map
```

```
for lat, lng, label in zip(mhsub1['lat'], mhsub1['long'], mhsub1['sub_station'].astype(str)):
```

```
    label = folium.Popup(label, parse_html=True)
```

```
    folium.RegularPolygonMarker(
```

```
        [lat, lng],
```

```
        number_of_sides=6,
```

```
        radius=6,
```

```
        popup=label,
```

```
        color='red',
```

```
        fill_color='red',
```

```
        fill_opacity=2.5,
```

```
    ).add_to(map_mhsub1)
```

```
map_mhsub1
```

Out[66]:

Map of Manhattan showing places for rent and the subway locations nearby Now, we can visualize the desirable rental places and their nearest subway station. Popups display rental address and monthly rental price and the subway station name. Notice that the icon in the top-right corner is a "ruler" that allows to measure the distance from a rental place to an specific subway station

In [68]:

```
mh_rent.head()
```

Out[68]:

	Address	Area	Price_per_ft2	Rooms	Area-ft2	Rent_Price	Lat	Long
0	West 105th Street	Upper West Side	2.94	5	3400	10000	40.799771	-73.966213
1	East 97th Street	Upper East Side	3.57	3	2100	7500	40.788585	-73.955277
2	West 105th Street	Upper West Side	1.89	4	2800	5300	40.799771	-73.966213
3	CARMINE ST.	West Village	3.03	2	1650	5000	40.730523	-74.001873
4	171 W 23RD ST.	Chelsea	3.45	2	1450	5000	40.744118	-73.995299

In [69]:

```
# create map of Manhattan using latitude and longitude values from Nominatim
latitude= 40.7308619
longitude= -73.9871558

map_manhattan_rent = folium.Map(location=[latitude, longitude], zoom_start=13.3)

# add markers to map
for lat, lng, label in zip(mh_rent['Lat'], mh_rent['Long'], '$ ' + mh_rent['Rent_Price'].astype(str) + mh_rent['Address']):
    label = folium.Popup(label, parse_html=True)
    folium.CircleMarker(
        [lat, lng],
        radius=6,
        popup=label,
        color='blue',
        fill=True,
        fill_color='#3186cc',
        fill_opacity=0.7,
        parse_html=False).add_to(map_manhattan_rent)

# add markers of subway locations to map
for lat, lng, label in zip(mhsub1['lat'], mhsub1['long'], mhsub1['sub_station'].astype(str)):
    label = folium.Popup(label, parse_html=True)
    folium.RegularPolygonMarker(
        [lat, lng],
        number_of_sides=6,
        radius=6,
        popup=label,
        color='red',
        fill_color='red',
        fill_opacity=2.5,
    ).add_to(map_manhattan_rent)

# Adds tool to the top right
from folium.plugins import MeasureControl
map_manhattan_rent.add_child(MeasureControl())

# Measurement ruler icon tool to measure distances in map
from folium.plugins import FloatImage
url = ('https://media.licdn.com/mpr/mpr/shrinknp_100_100/AEEAAQAAAAAAAAAIAAAAJGE3OTA4YTdlLTkzZjUtNDYyYy1iZThlLWQ5OTNkYzlhNzM4OQ.jpg')
FloatImage(url, bottom=5, left=85).add_to(map_manhattan_rent)
```

```
map_manhattan_rent
```

Out [69] :

## 4.0 Results

In [71] :

```
# create map of Manhattan using latitude and longitude values from Nominatim
```

```
latitude= 40.7308619
```

```
longitude= -73.9871558
```

```
map_mh_one = folium.Map(location=[latitude, longitude], zoom_start=13.3)
```

```
# add markers to map
```

```
for lat, lng, label in zip(mh_rent['Lat'], mh_rent['Long'], '$ ' + mh_rent['Rent_Price'].astype(str) + ', ' + mh_rent['Address']):
```

```
    label = folium.Popup(label, parse_html=True)
```

```
    folium.CircleMarker(
```

```
        [lat, lng],
```

```
        radius=6,
```

```
        popup=label,
```

```
        color='blue',
```

```
        fill=True,
```

```
        fill_color='#3186cc',
```

```
        fill_opacity=0.7,
```

```
        parse_html=False).add_to(map_mh_one)
```

```
# add markers of subway locations to map
```

```
for lat, lng, label in zip(mhsub1['lat'], mhsub1['long'], mhsub1['sub_station'].astype(str) ):
```

```
    label = folium.Popup(label, parse_html=True)
```

```
    folium.RegularPolygonMarker(
```

```
        [lat, lng],
```

```
        number_of_sides=6,
```

```
        radius=6,
```

```
        popup=label,
```

```
        color='red',
```

```
        fill_color='red',
```

```
        fill_opacity=2.5,
```

```
    ).add_to(map_mh_one)
```

```
# set color scheme for the clusters
```

```
kclusters=5
```

```
x = np.arange(kclusters)
```

```
ys = [i+x+(i*x)**2 for i in range(kclusters)]
```

```
colors_array = cm.rainbow(np.linspace(0, 1, len(ys)))
```

```
rainbow = [colors.rgb2hex(i) for i in colors_array]
```

```

# add markers to the map
markers_colors = []
for lat, lon, poi, cluster in zip(manhattan_merged['Latitude'], manhattan_merged['Longitude'], manhattan_me
rged['Neighborhood'], manhattan_merged['Cluster Labels']):
    label = folium.Popup(str(poi) + ' Cluster ' + str(cluster), parse_html=True)
    folium.CircleMarker(
        [lat, lon],
        radius=15,
        popup=label,
        color=rainbow[cluster-1],
        fill=True,
        fill_color=rainbow[cluster-1],
        fill_opacity=0.7).add_to(map_mh_one)

# Adds tool to the top right
from folium.plugins import MeasureControl
map_mh_one.add_child(MeasureControl())

# Measurement ruler icon tool to measure distances in map
from folium.plugins import FloatImage
url = ('https://media.licdn.com/mpr/mpr/shrinknp_100_100/AEEAAQAAAAAAAAAAlgAAAAJGE3OTA4YTdlLT
kzZjUtNDFjYy1iZThlLWQ5OTNkYzlhNzM4OQ.jpg')
FloatImage(url, bottom=5, left=85).add_to(map_mh_one)

```

map\_mh\_one

Out [71] :

Problem Resolution - Select the apartment for rent  
Venues for Apartment 1 - Cluster 2

In [72] :

```

## kk is the cluster number to explore
kk = 2
manhattan_merged.loc[manhattan_merged['Cluster Labels'] == kk, manhattan_merged.columns[[1] + list(ran
ge(5, manhattan_merged.shape[1]))]]

```

Out [72] :

	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	Marble Hill	Coffee Shop	Discount Store	Yoga Studio	Steakhouse	Supplement Shop	Tennis Stadium	Shoe Store	Gym	Bank	Seafood Restaurant

	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	Chinatown	Chinese Restaurant	Cocktail Bar	Dim Sum Restaurant	American Restaurant	Vietnamese Restaurant	Salon / Barbershop	Noodle House	Bakery	Bubble Tea Shop	Ice Cream Shop
6	Central Harlem	African Restaurant	Seafood Restaurant	French Restaurant	American Restaurant	Cosmetics Shop	Chinese Restaurant	Event Space	Liquor Store	Beer Bar	Gym / Fitness Center
9	Yorkville	Coffee Shop	Gym	Bar	Italian Restaurant	Sushi Restaurant	Pizza Place	Mexican Restaurant	Deli / Bodega	Japanese Restaurant	Pub
14	Clinton	Theater	Italian Restaurant	Coffee Shop	American Restaurant	Gym / Fitness Center	Hotel	Wine Shop	Spa	Gym	Indie Theater
23	Soho	Clothing Store	Boutique	Women's Store	Shoe Store	Men's Store	Furniture / Home Store	Italian Restaurant	Mediterranean Restaurant	Art Gallery	Design Studio
26	Morningside Heights	Coffee Shop	American Restaurant	Park	Bookstore	Pizza Place	Sandwich Place	Burger Joint	Café	Deli / Bodega	Tennis Court
34	Sutton Place	Gym / Fitness Center	Italian Restaurant	Furniture / Home Store	Indian Restaurant	Dessert Shop	American Restaurant	Bakery	Juice Bar	Boutique	Sushi Restaurant
39	Hudson Yards	Coffee Shop	Italian Restaurant	Hotel	Theater	American Restaurant	Café	Gym / Fitness Center	Thai Restaurant	Restaurant	Gym

In [73]:

## *kk* is the cluster number to explore

*kk* = 3

```
manhattan_merged.loc[manhattan_merged['Cluster Labels'] == kk, manhattan_merged.columns[[1] + list(range(5, manhattan_merged.shape[1]))]]
```

Out [73] :

	Neighbor hood	1st Most Comm on Venue	2nd Most Comm on Venue	3rd Most Comm on Venue	4th Most Comm on Venue	5th Most Comm on Venue	6th Most Comm on Venue	7th Most Comm on Venue	8th Most Comm on Venue	9th Most Comm on Venue	10th Most Comm on Venue
3	Inwood	Mexican Restau rant	Lounge	Pizza Place	Café	Wine Bar	Bakery	Americ an Restau rant	Park	Frozen Yogurt Shop	Spanis h Restaur ant
5	Manhattan ville	Deli / Bodeg a	Italian Restau rant	Seafoo d Restaur ant	Mexican Restaur ant	Sushi Restaur ant	Beer Garden	Coffee Shop	Falafel Restaur ant	Bike Trail	Other Nightlif e
1 0	Lenox Hill	Sushi Restau rant	Italian Restau rant	Coffee Shop	Gym / Fitness Center	Pizza Place	Burger Joint	Deli / Bodeg a	Gym	Sportin g Goods Shop	Thai Restaur ant
1 2	Upper West Side	Italian Restau rant	Bar	Bakery	Vegeta rian / Vegan Restaur ant	Indian Restaur ant	Coffee Shop	Cosme tics Shop	Wine Bar	Mexican Restaur ant	Sushi Restaur ant
1 6	Murray Hill	Sandwi ch Place	Hotel	Japanes e Restaur ant	Gym / Fitness Center	Coffee Shop	Salon / Barbers hop	Burger Joint	French Restaur ant	Bar	Italian Restaur ant
1 7	Chelsea	Coffee Shop	Italian Restaur ant	Ice Cream Shop	Bakery	Nightcl ub	Theater	Art Gallery	Seafoo d Restaur ant	Americ an Restaur ant	Hotel
1 8	Greenwic h Village	Italian Restaur ant	Sushi Restaur ant	French Restaur ant	Clothin g Store	Chines e Restaur ant	Café	Indian Restaur ant	Bakery	Seafoo d Restaur ant	Electro nics Store
2 7	Gramercy	Italian Restaur ant	Restaur ant	Thrift / Vintage Store	Cockta il Bar	Bagel Shop	Coffee Shop	Pizza Place	Mexican	Grocer y Store	Wine Shop

	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
									Restaurant		
29	Financial District	Coffee Shop	Hotel	Gym	Wine Shop	Steakhouse	Bar	Italian Restaurant	Pizza Place	Park	Gym / Fitness Center
31	Noho	Italian Restaurant	French Restaurant	Cocktail Bar	Gift Shop	Bookstore	Grocery Store	Mexican Restaurant	Hotel	Sushi Restaurant	Coffee Shop
32	Civic Center	Gym / Fitness Center	Bakery	Italian Restaurant	Cocktail Bar	French Restaurant	Sandwich Place	Coffee Shop	Gym	Yoga Studio	Park
35	Turtle Bay	Italian Restaurant	Coffee Shop	Steakhouse	Wine Bar	Sushi Restaurant	Hotel	Noodle House	Indian Restaurant	Japanese Restaurant	French Restaurant
36	Tudor City	Café	Park	Pizza Place	Mexican Restaurant	Greek Restaurant	Sushi Restaurant	Hotel	Deli / Bodega	Diner	Dog Run
38	Flatiron	Italian Restaurant	American Restaurant	Gym	Gym / Fitness Center	Yoga Studio	Vegetarian / Vegan Restaurant	Bakery	Clothing Store	Cosmetics Shop	Cycle Studio

**5.0 DISCUSSION** In general, I am positively impressed with the overall organization, content and lab works presented during the Coursera IBM Certification Course I feel this Capstone project presented me a great opportunity to practice and apply the Data Science tools and methodologies learned. I have created a good project that I can present as an example to show my potential. I feel I have acquired a good starting point to become a professional Data Scientist and I will continue exploring to creating examples of practical cases

**6.0 CONCLUSIONS** I feel rewarded with the efforts, time and money spent. I believe this course with all the topics covered is well worthy of appreciation. This project has shown me a practical application to resolve a real situation that has impacting personal and financial impact using Data Science tools. The mapping with Folium is a very powerful technique to consolidate information and make the analysis and decision thoroughly and with confidence. I would recommend for use in

similar situations. One must keep abreast of new tools for DS that continue to appear for application in several business fields