

An aerial photograph of a dense urban skyline, likely New York City, during the "golden hour" of sunset. The sky is filled with soft, orange and pink clouds, and the sun is low on the horizon, casting a warm glow over the city. Numerous skyscrapers and buildings of various heights and architectural styles are visible, packed closely together. The overall atmosphere is one of a bustling, modern metropolis.

Is it Possible to Find an Ideal Rental Apartment using a Data Driven Approach?

GOH JIE DA

Scenario and Background

In fall 2019, I met with a close friend, Joshua, who was employed in a reputable wealth management firm in Singapore. He had been offered an attractive relocation package to the firm's office in Manhattan, New York City (NYC). However, he was stuck in a dilemma on acceptance of the offer, citing various reasons and concerns such as:

- Missing his family
- Possibility of forgoing the convenience to his current work place
- Ability to enjoy similar level of comfort in the rental apartment with his given budget
- Uncertainty of having good Chinese cuisines within close proximity to his rental apartment

Based on the above reasons, he enquired if a data driven approach could be used to address his concerns and aid in informed decision making.



The Problem



The Data Driven Approach

The Problem

How to find an apartment in Manhattan, NYC, that meets the following conditions:

1. Rental apartment with a furnished private room
2. Monthly rental of US\$5,000/month or less
3. Located within 800 meters (m) to a subway metro station in Manhattan
4. Wide variety of Chinese cuisines within close proximity of 1 kilometre(km) to his rental apartment

Data and Libraries

Leverage on the following libraries and datasets:

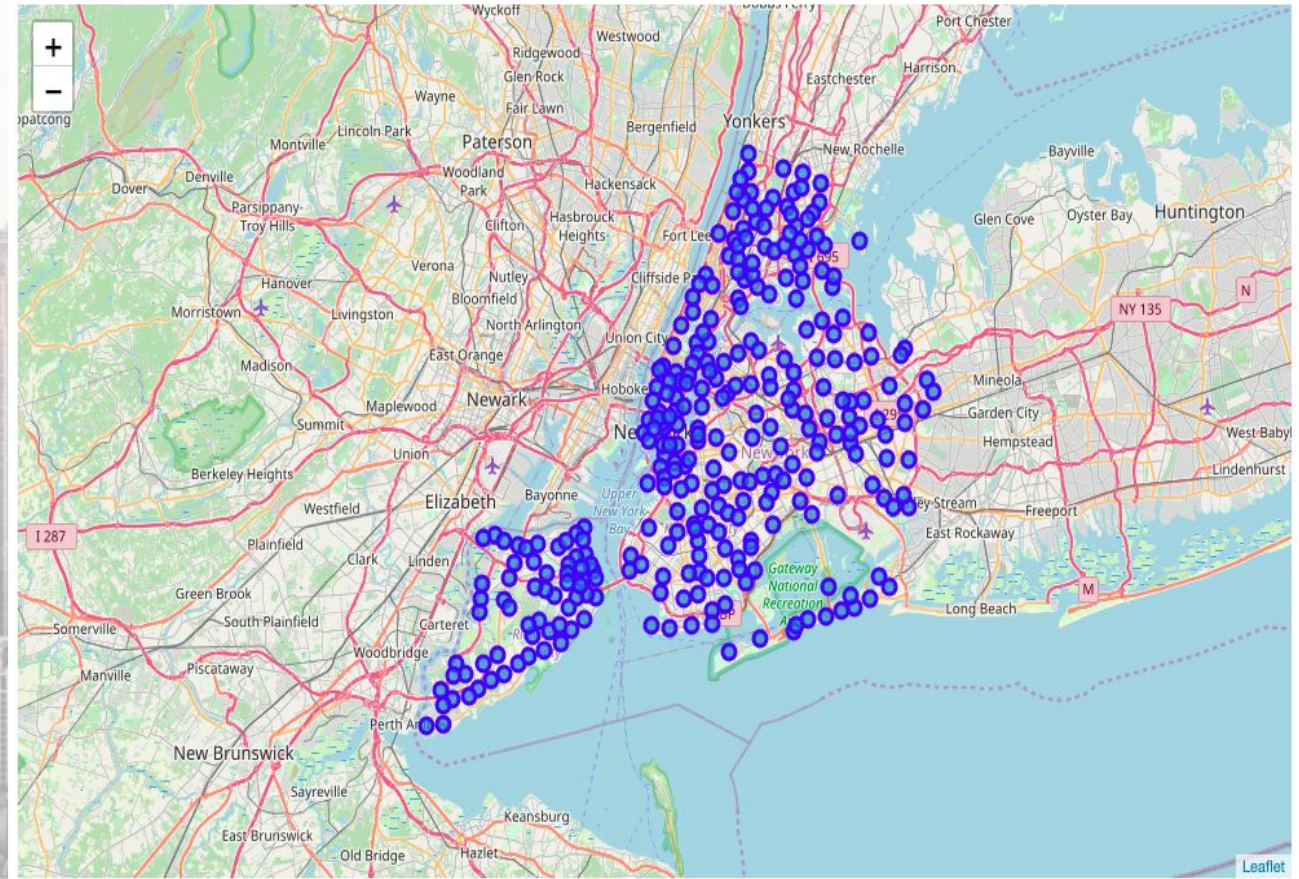
1. Geopy library to obtain the latitude and longitude values of New York City (NYC)
2. Folium to visualise the Geospatial Data
3. Foursquare API to attain the amenities within Manhattan's neighborhood in NYC
4. New York University's Spatial Data Repository for 2014 New York City Neighborhood Names Dataset
5. A python Craigslist wrapper to retrieve listings results from Craigslist site.
6. NYC Transit Subway Entrance And Exit Data from MTA Headquarters, New York City Transit

Data Driven Approach

- Perform spatial analysis and visualisation, tapping on Folium and data obtained by Geopy library, by exploring the neighborhoods in Manhattan in greater details.
- Utilise Foursquare API to obtain the amenities within each Manhattan's neighborhood proximity.
- Implement one hot encoding and subsequently group rows by neighborhood with the mean of the frequency of occurrence in each category (of the amenities)
- Apply K-means algorithm to cluster the neighborhoods and further examine each cluster.
- Identify neighborhoods with Chinese Restaurant being the Top 2 Most Common Venue
- Employ the python Craigslist wrapper to retrieve listings results, that meet the criterias set out in the problem statement, from Craigslist site based on the above neighborhoods identified.
- Compute the distance for each listing results to its nearest subway station using haversine formula.
- Lastly, analyse the available listings that are within 800m from its nearest subway station and has a wide variety of chinese cuisines within the proximity of 1 km radius based on the neighborhoods identified to make a more informed decision.

Spatial Analysis and Visualisation - NYC

- Tapped on Folium and data obtained by Geopy library, by exploring the neighborhoods in Manhattan in greater details.



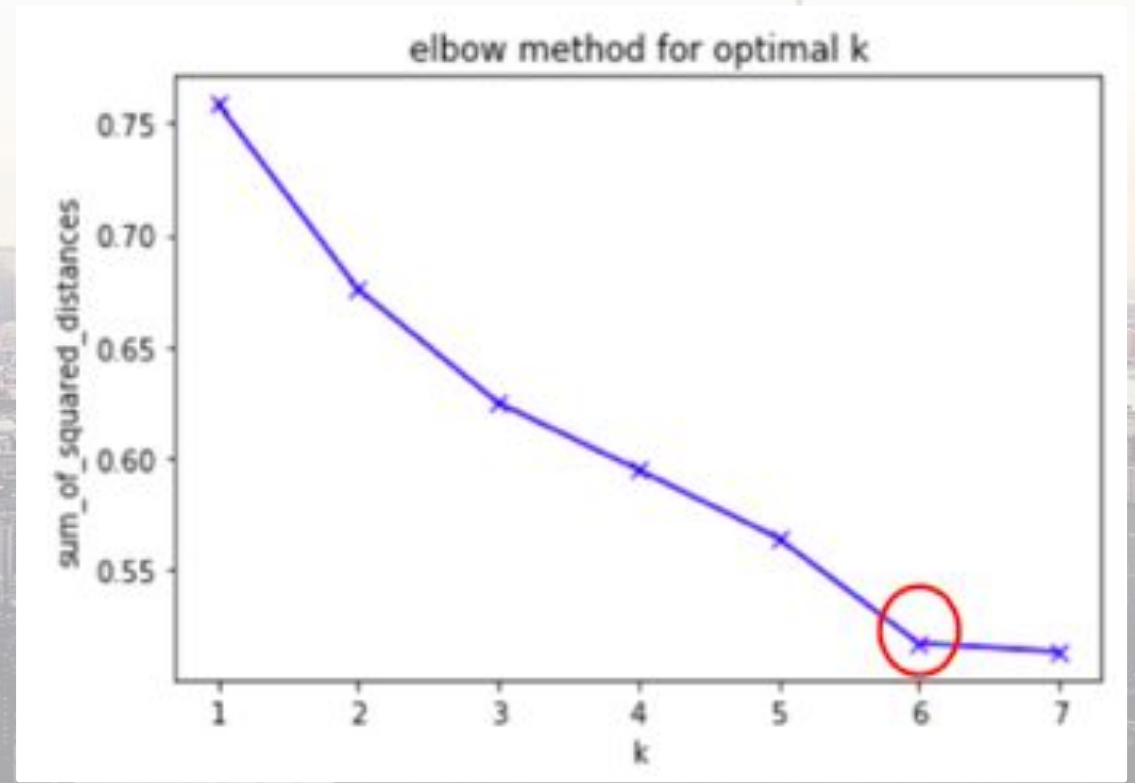
Spatial Analysis and Visualisation - Manhattan

- Utilise Foursquare API to obtain the amenities within each Manhattan's neighborhood proximity.



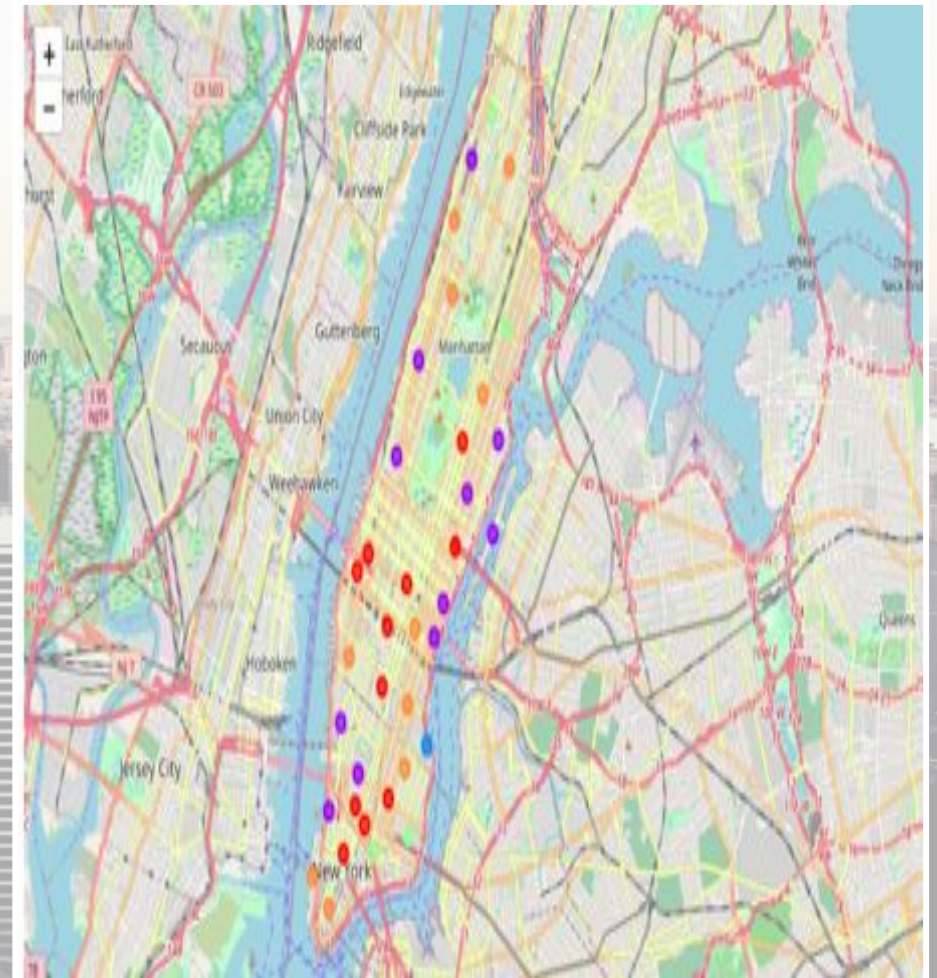
K-means Algorithm

- Applied “Elbow Method” to determine this optimal value of k .
- K-means algorithm to cluster the neighborhoods into 6 clusters and further examine each cluster.



K-means Algorithm

- Cluster 1: Gym, Fitness Centre and Italian restaurant appear quite frequently in the Top 10 Most Common Venue.
- Suggest that people living in these Neighbourhoods love to exercise and enjoy Italian Cuisine.
- Cluster 5: Most with Chinese Restaurants, Mexican Restaurants, Café and Bakery within its Top 10 Most Common Venue.
- Suggest that people living in these Neighbourhoods are food lovers and food enthusiasts who love to explore new places and try new food.



Chinese cuisine within Close Proximity

- Identify neighbourhoods with Chinese Restaurant being the Top 2 Most Common Venue to address my friend's concern of having good Chinese cuisine within close proximity from the rental apartment.
- Observed that **Chinatown, Central Harlem and Lower East Side** are our ideal Neighbourhoods with Chinese Restaurants being the top most frequented places.

| | Borough | Neighborhood | Latitude | Longitude | Cluster Labels | 1st Most Common Venue | 2nd Most Common Venue |
|----|-----------|-----------------|-----------|------------|----------------|-----------------------|-----------------------|
| 1 | Manhattan | Chinatown | 40.715618 | -73.994279 | 4 | Chinese Restaurant | Cocktail Bar |
| 6 | Manhattan | Central Harlem | 40.815976 | -73.943211 | 5 | Seafood Restaurant | Chinese Restaurant |
| 20 | Manhattan | Lower East Side | 40.717807 | -73.980890 | 4 | Chinese Restaurant | Coffee Shop |

Listing Data from Craigslist

- Utilised a python Craigslist wrapper to retrieve all the available rental listings from the Craigslist website based on the predefined criteria.
- Defined the criteria:
 - Furnished apartment
 - Private room
 - Manhattan area
 - Monthly rental \leq US\$5,000/month.

| | datetime | geotag | has_image | id | last_updated | name | price | repost_of | |
|---|------------------|------------------------|-----------|------------|------------------|--|--------|--------------|---|
| 0 | 2020-04-10 21:21 | (40.7597, -73.9918) | 1.0 | 7106563366 | 2020-04-10 21:21 | NO-FEE HOME at TIMES SQUARE - IN HEART OF MANH... | \$2250 | 7.090551e+09 | https://newyork.craigslist.org/mnh |
| 1 | 2020-04-10 19:39 | (40.7627, -73.9932) | 1.0 | 7106526986 | 2020-04-10 19:39 | FURNISHED Large 1BDR apt for rent in Manhattan... | \$2100 | NaN | https://newyork.craigslist.org/mnh |
| 2 | 2020-04-10 18:34 | (40.7975, -73.9683) | 1.0 | 7106499097 | 2020-04-10 18:34 | 1 bed, 1 bath, 5 closets, FURNISHED. courtyard... | \$2600 | NaN | https://newyork.craigslist.org/mnh |
| 3 | 2020-04-10 17:51 | (40.756527, -73.99402) | 1.0 | 7106478207 | 2020-04-10 17:51 | HELL'S KITCHEN--AMAZING 3 BD/2BA WITH PRIVATE ... | \$4500 | NaN | https://newyork.craigslist.org/mnh |
| 4 | 2020-04-10 12:03 | (41.0888, -73.5435) | 1.0 | 7106264385 | 2020-04-10 12:03 | 1family very private house 4500\$4 bed,3 vaths | \$4500 | NaN | https://newyork.craigslist.org/mnh |
| 5 | 2020-04-10 08:27 | (40.7443, -73.9781) | 1.0 | 7106155589 | 2020-04-10 08:27 | Charming studio by owner | \$2690 | NaN | https://newyork.craigslist.org/mnh |
| 6 | 2020-04-10 07:57 | (40.7443, -73.9781) | 1.0 | 7106148565 | 2020-04-10 07:57 | Beautiful 1 bedroom apartment by owner | \$3290 | 7.079387e+09 | https://newyork.craigslist.org/mnh |
| 7 | 2020-04-10 07:20 | (40.82451, -73.951853) | 1.0 | 7106141925 | 2020-04-10 07:20 | Mention COVID 19 Discount \$50 NO FEE Affordabl... | \$1575 | 7.013814e+09 | https://newyork.craigslist.org/mnh |

Subway Station Data from NYC Transit

- Utilised the NYC Transit Subway Entrance And Exit Data from MTA Headquarters, New York City Transit.
- Dataset consists of the subway station's division, line name, station name and the station's latitude and longitude information.

| | Division | Line | Station Name | Station Latitude | Station Longitude | Station Location |
|----|----------|----------|--------------|------------------|-------------------|-------------------------|
| 0 | BMT | 4 Avenue | 25th St | 40.660397 | -73.998091 | (40.660397, -73.998091) |
| 2 | BMT | 4 Avenue | 36th St | 40.655144 | -74.003549 | (40.655144, -74.003549) |
| 5 | BMT | 4 Avenue | 45th St | 40.648939 | -74.010006 | (40.648939, -74.010006) |
| 9 | BMT | 4 Avenue | 53rd St | 40.645069 | -74.014034 | (40.645069, -74.014034) |
| 14 | BMT | 4 Avenue | 59th St | 40.641362 | -74.017881 | (40.641362, -74.017881) |

Remaining Conditions

- With the rental listing results from Craigslist and the subway station data from New York City Transit, the remaining 2 conditions can be addressed:
 1. Compute the listings (using haversine formula) which are within 1km radius from the identified ideal Neighbourhoods (Chinatown, Central Harlem and Lower East Side); and
 2. Calculate and obtain the listings which are within 800m from the nearest subway station

Solution

- **TWO** available listings met all the conditions.
- One of the listings, in Middletown West, is within 800m to 3 different subway stations (which explains there are 3 entries with the same Listing ID).
- Another listing, in Chelsea, is about 200m to the 18th St subway station.

| | Listing ID | Neighbourhood Name | Distance to Neighbourhood | Neighbourhood Lat | Neighbourhood Long | Distance to Station | Station Name | Station Lat | Station Long | Listing Lat | Listing Long | date |
|---|------------|--------------------|---------------------------|-------------------|--------------------|---------------------|--------------|-------------|--------------|-------------|--------------|------|
| 0 | 7106563366 | Chinatown | 0.959947 | 40.715618 | -73.994279 | 0.626803 | 23rd St | 40.741303 | -73.989344 | 40.7597 | -73.9918 | 2010 |
| 1 | 7106563366 | Chinatown | 0.959947 | 40.715618 | -73.994279 | 0.556162 | 28th St | 40.745494 | -73.988691 | 40.7597 | -73.9918 | 2010 |
| 2 | 7106563366 | Chinatown | 0.959947 | 40.715618 | -73.994279 | 0.529002 | 34th St | 40.749567 | -73.987950 | 40.7597 | -73.9918 | 2010 |
| 3 | 7105859261 | Chinatown | 0.875714 | 40.715618 | -73.994279 | 0.193972 | 18th St | 40.741040 | -73.997871 | 40.7402 | -73.9996 | 2009 |

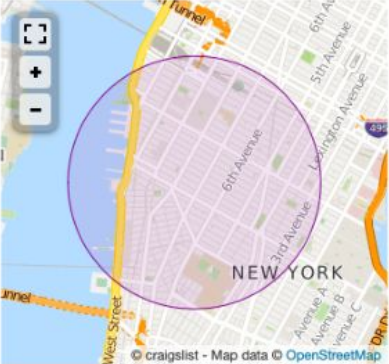

Solution

- Listing located in Chelsea looks relatively more appealing.
- The flat looks bright and comfortable with a cosy living room, a fully fitted kitchen and a clean and tidy bathroom with a bath.
- Merely 200m away from the 18th St subway station with many Chinese Restaurants within close proximity.
- US\$2000 below budget.
- Made this recommendation to Joshua.

reply favorite hide flag Posted 2 days ago print

\$3000 / 1br - 650ft² - Clean and efficient apartment (Chelsea)

image 1 of 12



1BR / 1Ba 650ft² available now

cats are OK - purrr

dogs are OK - woof

furnished

apartment

w/d in unit

no smoking

street parking

3000\$ monthly / secure deposit 3000\$ all utility included.
Mint renovated 1 large bedroom apartment, ground floor. Located in Chelsea 2 block away from the High Line Park and close to all the cooler restaurant and club of NYC. Close to all transportation 5 minute from Penn Station and subway A-E-C 2-3 -L train just around the corner. (249 W 15th St New York) 1 queen size bedroom with full bathroom + large nice living room, fully equipped kitchen and dining table 42" flat screen TV+, wireless internet, surround system stereo and DVD, air conditioning and heat.

An aerial photograph of the New York City skyline, featuring numerous skyscrapers and buildings. The Empire State Building is prominent in the center. The text "Thank You" is overlaid in a large, bold, dark red font. The background is slightly faded to make the text stand out.

Thank You