Battle of the Neighborhoods- Comparing Makati and Mandaluyong City
By Jiro Tan

1. Introduction

Metro Manila, officially known as the National Capital Region (NCR), is the main metropolitan region of the Philippines and houses the seat of the government. In it lies Makati City, one of the most highly urbanized cities located in Metro Manila and is known for its upscale shopping malls, high concentration of corporate offices, and buzzing entertainment hubs. Because of these features, living in Makati City is a privilege that many people seek.

Just north of Makati City lies Mandaluyong City. While not as glamorous and developed as Makati City, Mandaluyong City is one of the fastest growing economies in Metro Manila, earning itself the moniker "The Tiger City". It is a diverse city that offers commercial districts, financial hubs, industrial areas, and plenty of shopping centers.

The goal of this project is to determine the similarities and differences between Makati and Mandaluyong City. This objective will be accomplished by comparing the neighborhoods of these cities using location and machine learning tools. By meeting this objective, we could entertain the thoughts of a person who is curious he/she can experience the Makati City lifestyle in Mandaluyong City.

2. Data Description and Acquisition

To complete this project, the two main data sets needed are neighborhood data and venue data. For neighborhood data, the barangays of Makati and Mandaluyong City will be explored. In the Philippines, the barangay is the smallest political unit and should serve as the equivalent of a neighborhood. Since only a list of the names of the barangays is needed, scraping data from Wikipedia would be sufficient. Afterwards, for every barangay, the latitude and longitude are retrieved using the geopy library.

Sources for Barangay data:

- https://en.wikipedia.org/wiki/Makati#Barangays
- https://en.wikipedia.org/wiki/Mandaluyong#Barangays

For venue data, the nearby venues for each barangay are enumerated using the Foursquare API. Since Foursquare leverages data worldwide, retrieving data for areas in the Philippines will not be an issue. Also, every entry for a venue has an equivalent category in the database, which would be used for cluster analysis.

3. Methodology

3.1. Makati and Mandaluyong City barangay data

The barangay data for each city will be scraped from the Wikipedia pages stated in section 2 of this report. The latitude and longitude of each barangay will then be found using geocoder. These coordinates will be stored into a data frame and concatenated with the data frame that contains the barangay names.

3.2. Makati and Mandaluyong City maps

The geographical coordinates of the cities will be retrieved using the geopy library. The coordinates for the barangays and the cities will then be used to create a map using Folium to visualize each city.

3.3. Venue data

The venue data for each barangay will be retrieved using the Foursquare API. A get request will be sent using the Foursquare URL with a limit of 100 venues within a 500 radius. One-hot encoding will then be performed to convert the venues into 0's and 1's so that they can be used for clustering analysis later.

3.4. Clustering

Since the primary objective of the project is to compare the barangays of Makati and Mandaluyong City, K-Means clustering is an appropriate algorithm to deploy. Using a pre-determined number of clusters, it will group the different barangays based on the patterns it detects.

3.5. Combining Makati and Mandaluyong City

After analyzing the two cities individually, the barangays will be combined into a single data frame for analysis. The methodology from sections 3.1-3.5 will be applied to generate further insights.

4. Results and Discussion

4.1. Makati and Mandaluyong City Barangay Data

The list of barangay names was first scraped from Wikipedia using Beautiful Soup.

```
#Scraping the HTML
URL = 'https://en.wikipedia.org/wiki/Makati#Barangays'
page = requests.get(URL)

soup = BeautifulSoup(page.content, 'html.parser')
table = soup.find('table', class_='sortable')

barangay = []


for row in table.find_all('tr'):
    cells = row.find_all('td')
    if(len(cells) > 0):
        barangay.append(cells[0].text.rstrip('\n'))



data = {'Barangay': barangay,}
#Creating the Data frame
makati = pd.DataFrame(data, columns=['Barangay'])
makati.head()
```

Figure 1. Code for web scraping using BeautifulSoup

After retrieving the list of barangay names, the latitude and longitude of each barangay were found using geocoder. These coordinates were then stored into a data frame, which was then concatenated with the data frame that contains the barangay names, resulting to the new data frame presented in Figure 3.

```
def get_latlng(barangay):
    # initialize your variable to None
    lat_lng_coords = None
    # loop until you get the coordinates
    while(lat_lng_coords is None):
        g = geocoder.arcgis('{}, Makati, Philippines'.format(barangay))
        lat_lng_coords = g.latlng
    return lat_lng_coords
```

Figure 2. Code for determining latitude and longitude

	Barangay	Latitude	Longitude
0	Bangkal	14.54359	121.01315
1	Bel-Air	14.56145	121.02362
2	Carmona	14.57622	121.01725
3	Cembo	14.56535	121.05088
4	Comembo	14.54841	121.06393

	Barangay	Latitude	Longitude
0	Addition Hills	14.58660	121.03829
1	Bagong Silang	14.59182	121.03091
2	Barangka Drive	14.57271	121.03796
3	Barangka Ibaba	14.57018	121.03926
4	Barangka Ilaya	14.57183	121.04789

Figure 3. Makati (left) and Mandaluyong City (right) barangay data frame

4.2. Makati and Mandaluyong City Maps

Afterwards, the geographical coordinates of the cities were retrieved using the geopy library. The coordinates for the barangays and the cities were then used to create a map using Folium to visualize each city. The maps are presented in Figure 4 and 5.

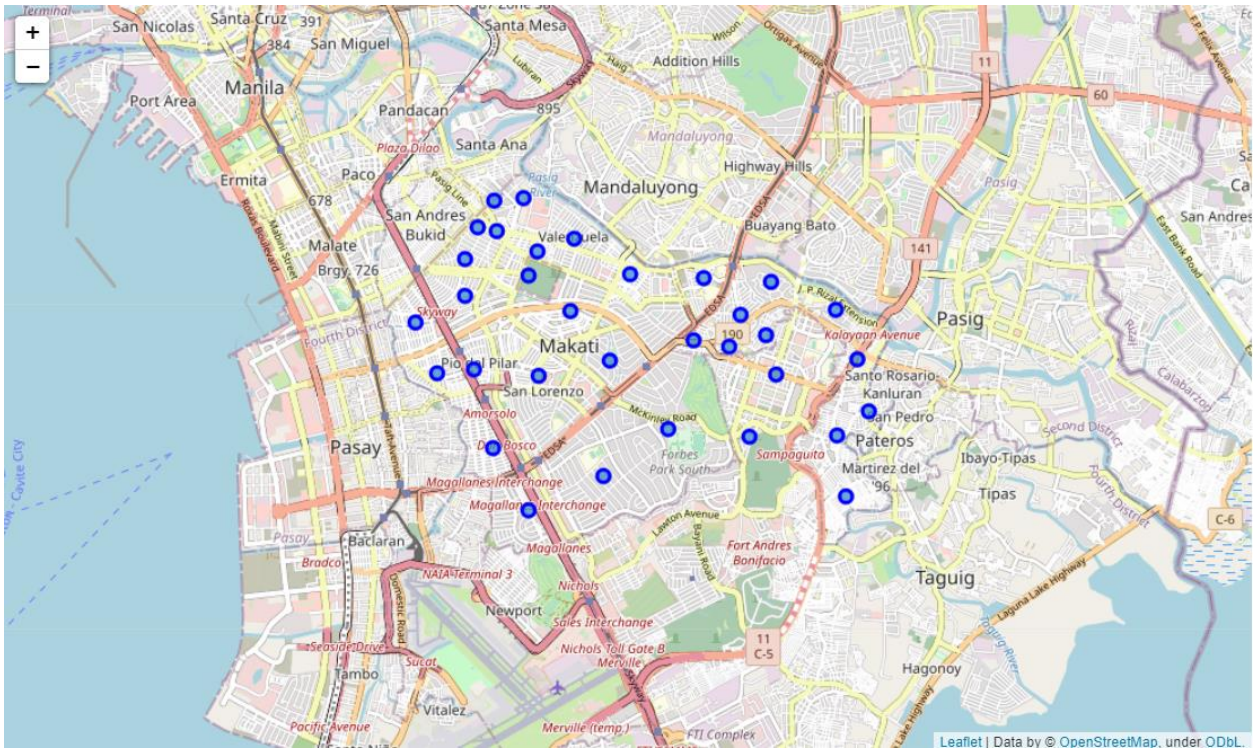

Figure 4. Makati City barangay map

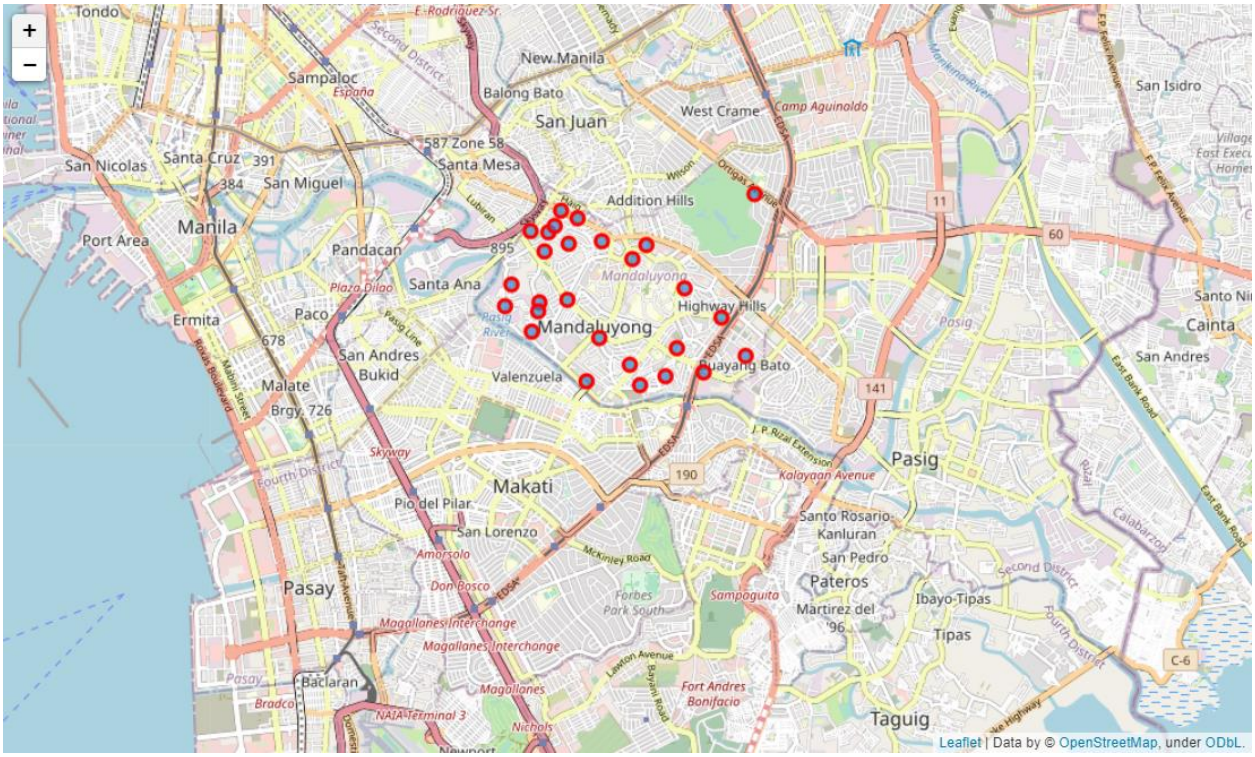

Figure 5. Mandaluyong City barangay map

4.3. Venue Data

Using the Foursquare API, 100 venues surrounding each barangay from Makati and Mandaluyong City within a radius of 500 were found. Makati City resulted in a total of 183 unique categories while Mandaluyong City had 89 unique categories.

	Barangay	Latitude	Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Bangkal	14.54359	121.01315	100g Burger's	14.545715	121.013222	Burger Joint
1	Bangkal	14.54359	121.01315	Kaito Japanese Carinderia	14.543683	121.012782	Japanese Restaurant
2	Bangkal	14.54359	121.01315	FitFast Wellness and Fitness Center	14.547046	121.014352	Gym
3	Bangkal	14.54359	121.01315	Spare Strike	14.540995	121.011987	Tapas Restaurant
4	Bangkal	14.54359	121.01315	Nova Gallery	14.544795	121.016941	Art Gallery

Figure 6. Makati City barangay nearby venues

	Barangay	Latitude	Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Addition Hills	14.5866	121.03829	Puñta Comida Callejera	14.588428	121.041284	South American Restaurant
1	Addition Hills	14.5866	121.03829	Han Pao Teahouse	14.588300	121.042348	Tea Room
2	Addition Hills	14.5866	121.03829	Orgánico Gourmet	14.590390	121.038077	Restaurant
3	Addition Hills	14.5866	121.03829	Max's Restaurant	14.589118	121.041923	Fried Chicken Joint
4	Addition Hills	14.5866	121.03829	McDonald's	14.589305	121.037035	Fast Food Restaurant

Figure 7. Mandaluyong City barangay nearby venues

One-hot encoding was then applied to convert the venue category column into 0's and 1's. It is important to apply one-hot encoding to model the variables where each row only has one feature with a value of 1. This is useful in allowing K-means clustering to be performed. After one-hot encoding was applied, the barangays were grouped to find the mean of the frequency of occurrence.

	Barangay	American Restaurant	Art Gallery	Arts & Crafts Store	Arts & Entertainment	Asian Restaurant	Athletics & Sports	Australian Restaurant	BBQ Joint	Bakery	Bar	Baseball Field	Basketball Court	Beer Bar
0	Bangkal	0.0	0.090909	0.000000	0.030303	0.000000	0.000000	0.0	0.030303	0.000000	0.060606	0.0	0.00	0.000000
1	Bel-Air	0.0	0.000000	0.011628	0.000000	0.000000	0.011628	0.0	0.000000	0.011628	0.000000	0.0	0.00	0.000000
2	Carmona	0.0	0.000000	0.000000	0.000000	0.000000	0.029412	0.0	0.058824	0.000000	0.000000	0.0	0.00	0.029412
3	Cembo	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	0.0	0.000000	0.000000	0.000000	0.0	0.25	0.000000
4	Comembo	0.0	0.000000	0.000000	0.000000	0.071429	0.000000	0.0	0.000000	0.000000	0.000000	0.0	0.00	0.000000

Figure 8. Makati City barangay venue frequency occurrence

	Barangay	American Restaurant	Asian Restaurant	Athletics & Sports	Auto Garage	BBQ Joint	Bakery	Bar	Basketball Court	Beer Garden	Bookstore	Boxing Gym	Breakfast Spot	Bubble Tea Shop	Burger Joint	Burrito Place
0	Addition Hills	0.000000	0.0	0.0	0.0	0.00	0.00	0.076923	0.153846	0.0	0.000000	0.0	0.000000	0.0	0.000000	0.0
1	Bagong Silang	0.037037	0.0	0.0	0.0	0.00	0.00	0.000000	0.000000	0.0	0.037037	0.0	0.037037	0.0	0.000000	0.0
2	Barangka Drive	0.000000	0.0	0.0	0.0	0.05	0.05	0.050000	0.000000	0.0	0.000000	0.0	0.000000	0.0	0.050000	0.0
3	Barangka Ibaba	0.000000	0.0	0.0	0.0	0.00	0.00	0.200000	0.000000	0.0	0.000000	0.0	0.000000	0.0	0.000000	0.0
4	Barangka Ilaya	0.000000	0.0	0.0	0.0	0.00	0.00	0.000000	0.000000	0.0	0.000000	0.0	0.000000	0.0	0.058824	0.0

Figure 9. Mandaluyong City barangay venue frequency occurrence

The data frame containing the ten most common venues was then created for each barangay. The contents were derived from Figure 8 and Figure 9, listed in descending order.

	Barangay	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	Bangkal	Convenience Store	Art Gallery	Fast Food Restaurant	Furniture / Home Store	Nightclub	Cocktail Bar	Bar	Hardware Store	Burger Joint	Sporting Goods Shop
1	Bel-Air	Coffee Shop	Pizza Place	Steakhouse	Spa	Japanese Restaurant	Restaurant	Café	Filipino Restaurant	Creperie	Donut Shop
2	Carmona	Convenience Store	Coffee Shop	Fast Food Restaurant	BBQ Joint	Burrito Place	Shopping Plaza	Burger Joint	Dim Sum Restaurant	Café	Outdoor Event Space
3	Cembo	Basketball Court	Convenience Store	Pharmacy	Park	Diner	Donut Shop	Frozen Yogurt Shop	Fried Chicken Joint	French Restaurant	Food Truck
4	Comembo	Fast Food Restaurant	Convenience Store	Diner	Chinese Restaurant	Asian Restaurant	Breakfast Spot	Fish Market	Gym / Fitness Center	Frozen Yogurt Shop	Fried Chicken Joint

Figure 10. Makati City barangay top venues category

	Barangay	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	Addition Hills	Convenience Store	Basketball Court	Pizza Place	Shopping Mall	South American Restaurant	Restaurant	Bar	Fried Chicken Joint	Tea Room	Fast Food Restaurant
1	Bagong Silang	Fast Food Restaurant	Convenience Store	Chinese Restaurant	Filipino Restaurant	American Restaurant	Bookstore	Donut Shop	Coffee Shop	Café	Bus Station
2	Barangka Drive	Spa	Convenience Store	Pharmacy	Nightclub	Massage Studio	Salon / Barbershop	Fast Food Restaurant	Filipino Restaurant	Burger Joint	Fish Market
3	Barangka Ibaba	Hotel	Taco Place	Bar	Food Truck	Fast Food Restaurant	Yoga Studio	Filipino Restaurant	Dim Sum Restaurant	Diner	Donut Shop
4	Barangka Ilaya	Filipino Restaurant	Sandwich Place	Health & Beauty Service	Shopping Mall	Hotel	Japanese Restaurant	Fast Food Restaurant	Massage Studio	Donut Shop	Dance Studio

Figure 11. Mandaluyong City barangay top venues category

4.4. Clustering Using K-Means

Using the data frame that was created using one-hot encoding, it became possible to apply K-means clustering. To perform this algorithm, the Scikit-learn package was imported and utilized. After trial and error, it was determined that a pre-defined clustering number of 3 was suitable for both Makati and Mandaluyong City.

	Barangay	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 M Comm Ve
0	Bangkal	14.54359	121.01315	0	Convenience Store	Fast Food Restaurant	Art Gallery	Cocktail Bar	Burger Joint	Nightclub	Chinese Restaurant	Bar	Spa	Restau
1	Bel-Air	14.56145	121.02362	0	Coffee Shop	Spa	Café	Japanese Restaurant	Steakhouse	Pizza Place	Restaurant	Filipino Restaurant	Sandwich Place	S Restau
2	Carmona	14.57622	121.01725	0	Convenience Store	Coffee Shop	BBQ Joint	Fried Chicken Joint	Fast Food Restaurant	Restaurant	Shopping Plaza	Dessert Shop	Burger Joint	Bu P
3	Cembo	14.56535	121.05088	1	Basketball Court	Park	Convenience Store	Pharmacy	Yoga Studio	French Restaurant	Food Court	Food & Drink Shop	Fish Market	Fili Restau
4	Comembo	14.54841	121.06393	1	Fast Food Restaurant	Convenience Store	Pharmacy	Breakfast Spot	Diner	Asian Restaurant	Fish Market	Gym / Fitness Center	Yoga Studio	F Chic

Figure 12. Makati City data frame with cluster labels

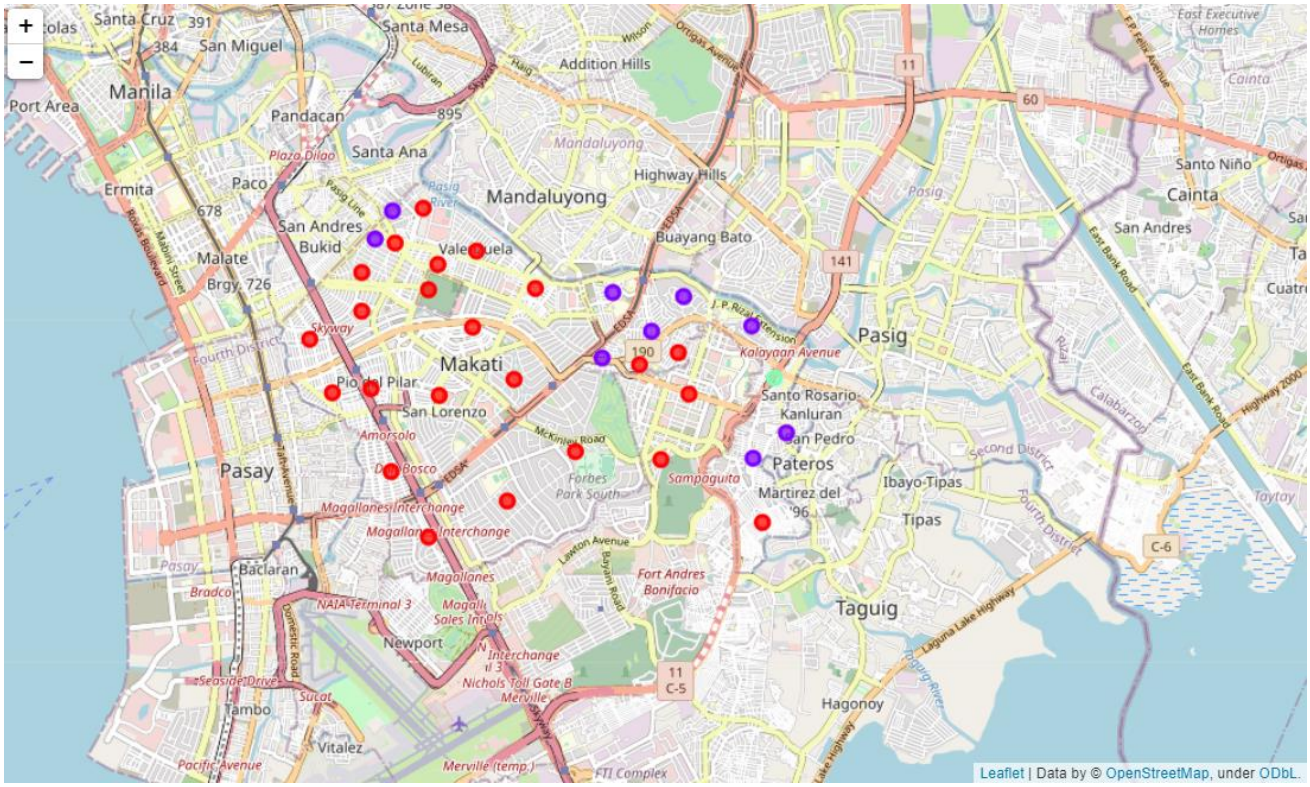

Figure 13. Makati City clustering visualization

	Barangay	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 Mo Commo Venu
0	Addition Hills	14.58660	121.03829	0	Convenience Store	Basketball Court	Pizza Place	Shopping Mall	South American Restaurant	Restaurant	Bar	Fried Chicken Joint	Tea Room	Fast Foo Restaura
1	Bagong Silang	14.59182	121.03091	1	Fast Food Restaurant	Convenience Store	Chinese Restaurant	Filipino Restaurant	American Restaurant	Bookstore	Donut Shop	Coffee Shop	Café	Bu Static
2	Barangka Drive	14.57271	121.03796	2	Spa	Convenience Store	Pharmacy	Nightclub	Massage Studio	Salon / Barbershop	Fast Food Restaurant	Filipino Restaurant	Burger Joint	Fis Mark
3	Barangka Ibaba	14.57018	121.03926	2	Hotel	Taco Place	Bar	Food Truck	Fast Food Restaurant	Yoga Studio	Filipino Restaurant	Dim Sum Restaurant	Diner	Don Sho
4	Barangka Ilaya	14.57183	121.04789	2	Filipino Restaurant	Sandwich Place	Health & Beauty Service	Shopping Mall	Hotel	Japanese Restaurant	Fast Food Restaurant	Massage Studio	Donut Shop	Danc Stud

Figure 14. Mandaluyong City data frame with cluster labels

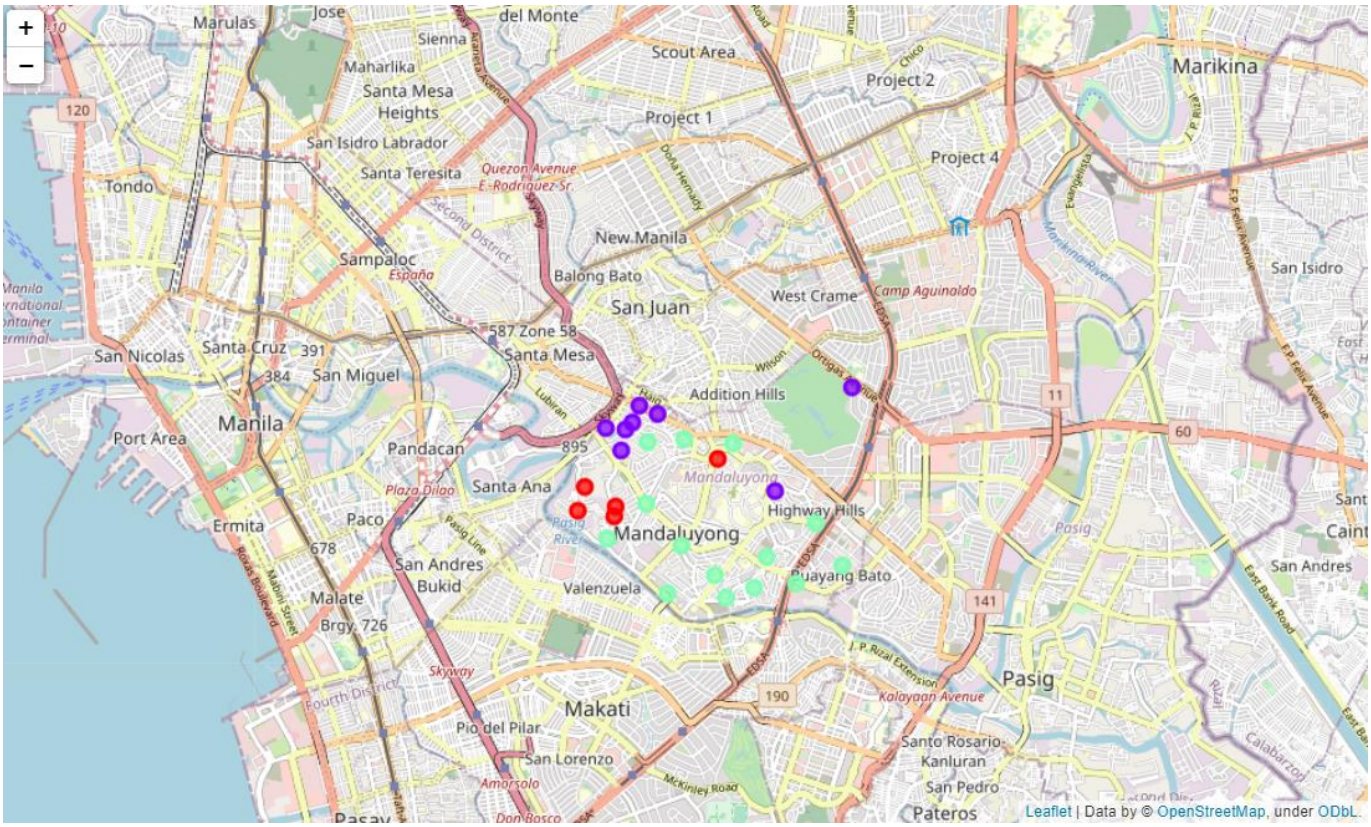

Figure 15. Mandaluyong City clustering visualization

		Mandaluyong City		Makati City	
Map Dot Color	**Cluster Label**	**Count**	**Most Common Venue**	**Count**	**Most Common Venue**
Red	0	5	Basketball Court	23	Restaurant (Different cuisines)
Purple	1	8	Fast Food Restaurant	9	Fast Food Restaurant/Convenience Store
Green	2	14	Convenience Store	1	Soccer Field

Figure 16. Clustering results summary

Based on the results of the clustering in Figure 16, a common theme arises between the two cities. When clustered into 3 groups, the first cluster contains convenience stores, the second cluster contains restaurants, and the third cluster contains a sports facility. They are different, however, in terms of quantity when split into barangays. For Mandaluyong City, majority of barangays have convenience stores as the most common venue while for Makati City, majority of barangays have restaurants as the most common venue. Furthermore, basketball courts are more prominent in Mandaluyong City whereas a soccer field is unique to Makati City.

4.5. Visualizing Common Venues for Makati and Mandaluyong City

In Figure 18 and Figure 19, the bar graph of the most common venues for Makati and Mandaluyong City are presented. Both cities have convenience store and fast-food restaurant as the top venues, respectively. The venues that complete the top 5 for Makati City are coffee shop, Japanese restaurant, and Filipino restaurant while for Mandaluyong City, these venues are Filipino restaurant, Chinese restaurant, and burger joint. Interestingly, there are no Japanese restaurants in the top 15 for Mandaluyong City while there are no Chinese restaurants in the top 15 for Makati City. Further research could be conducted to analyze demographics and preferences of people residing in these cities.

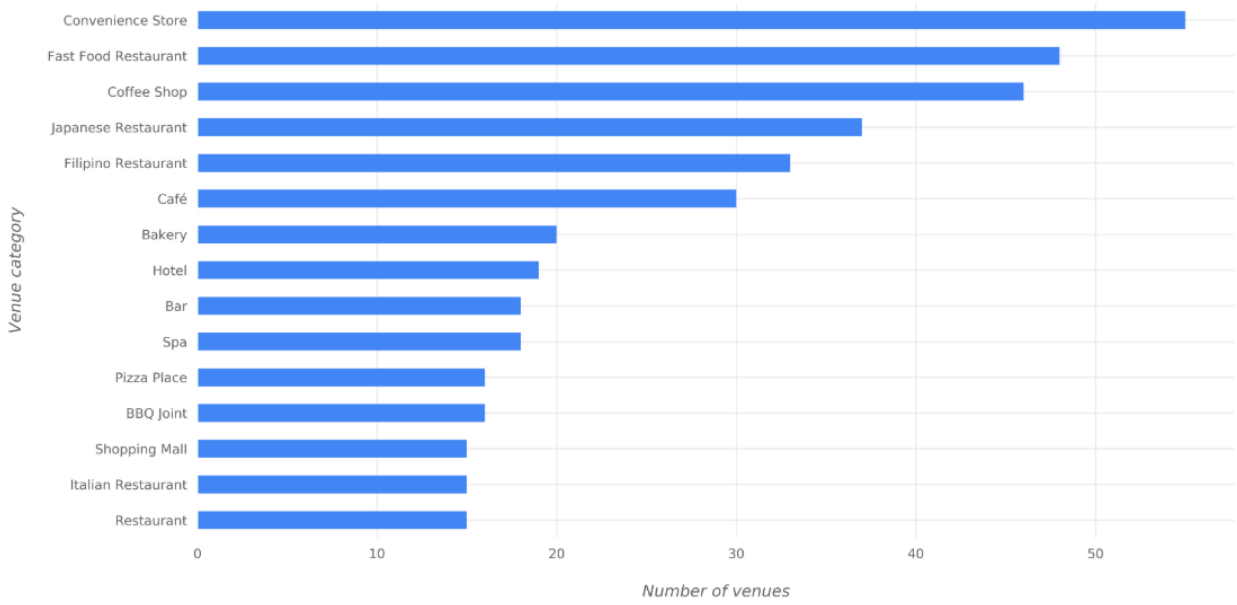

Figure 18. Makati City most common venues

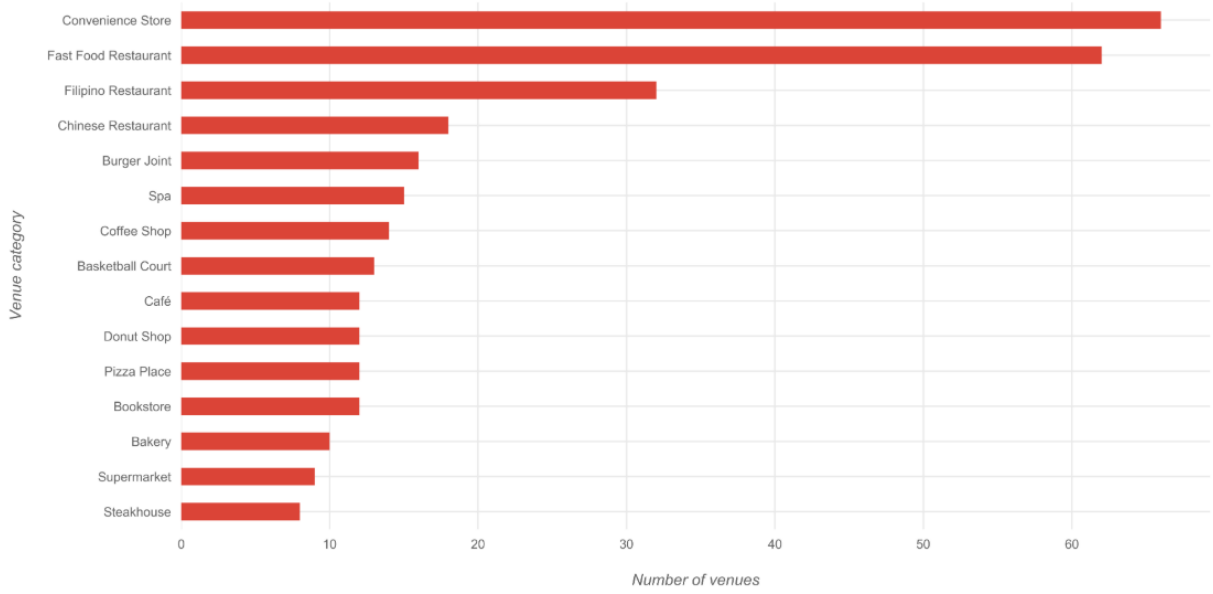

Figure 19. Mandaluyong City most common venues

4.6. Combining Makati and Mandaluyong City

After exploring Makati and Mandaluyong City individually, they were then merged into a single data frame for a different perspective in clustering. As seen in Figure 20, the barangays were distinguished by their cities by adding a suffix of "_Mandaluyong" or "_Makati".

	Barangay	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 M Comm Ver
0	Addition Hills_Mandaluyong	Convenience Store	Basketball Court	Restaurant	Bar	South American Restaurant	Tea Room	Fast Food Restaurant	Pizza Place	Fried Chicken Joint	Shopp
1	Bagong Silang_Mandaluyong	Fast Food Restaurant	Filipino Restaurant	Convenience Store	Chinese Restaurant	Bookstore	Salon / Barbershop	Supermarket	Spa	Donut Shop	C
2	Bangkal_Makati	Convenience Store	Art Gallery	Fast Food Restaurant	Nightclub	Cocktail Bar	Furniture / Home Store	Bar	Gym	Donut Shop	Res
3	Barangka Drive_Mandaluyong	Convenience Store	Diner	Spa	Bridal Shop	Fish Market	Filipino Restaurant	Pharmacy	Fast Food Restaurant	Shoe Store	Massa Stu
4	Barangka Ibaba_Mandaluyong	Fast Food Restaurant	Taco Place	Hotel	Bar	Yoga Studio	Frozen Yogurt Shop	Fried Chicken Joint	French Restaurant	Food Truck	Food Co

Figure 20. Merged data frame of most common venues

To find the optimal number of clusters, the elbow method was applied. Looking at Figure 21, k-means clustering was run on the data set for a range of 1-10. It was determined that the optimal value for k was 3. Hence, 3 clusters were used in initiating the algorithm.

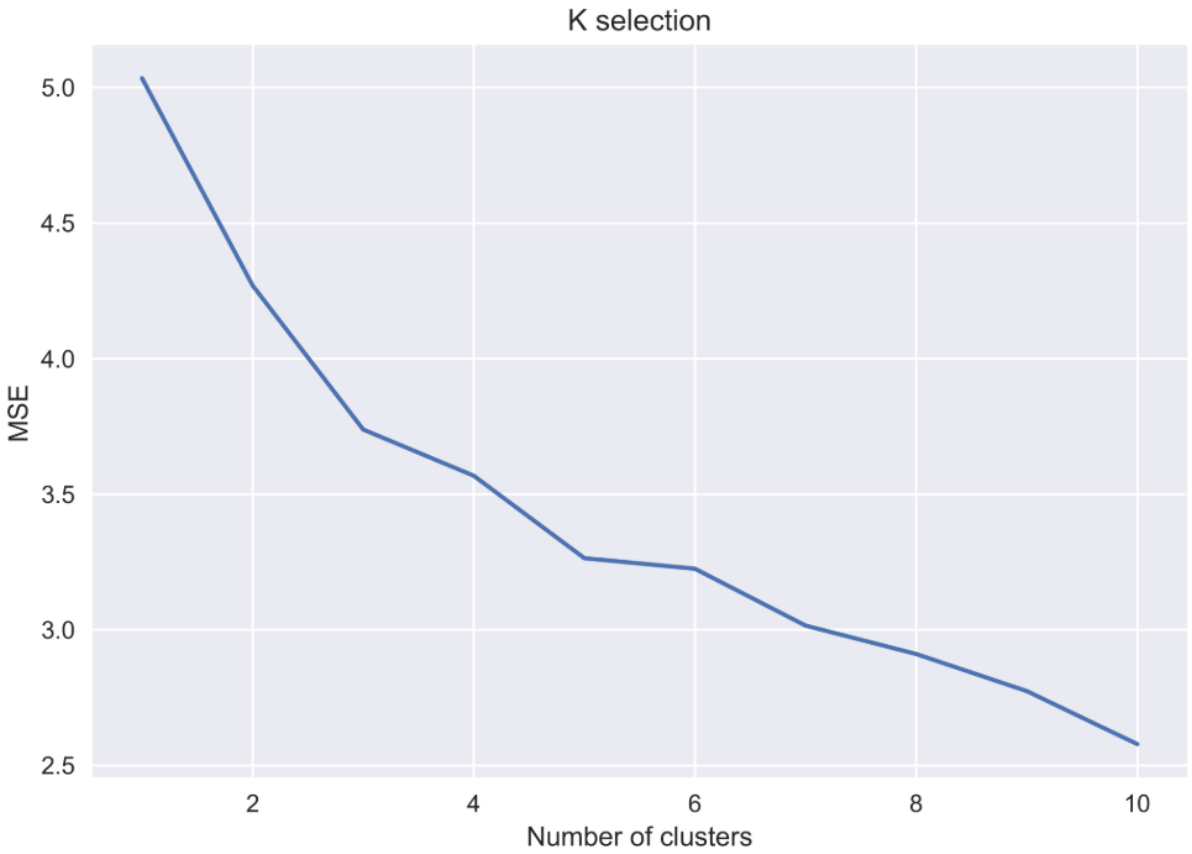

Figure 21. K-Means clustering elbow method

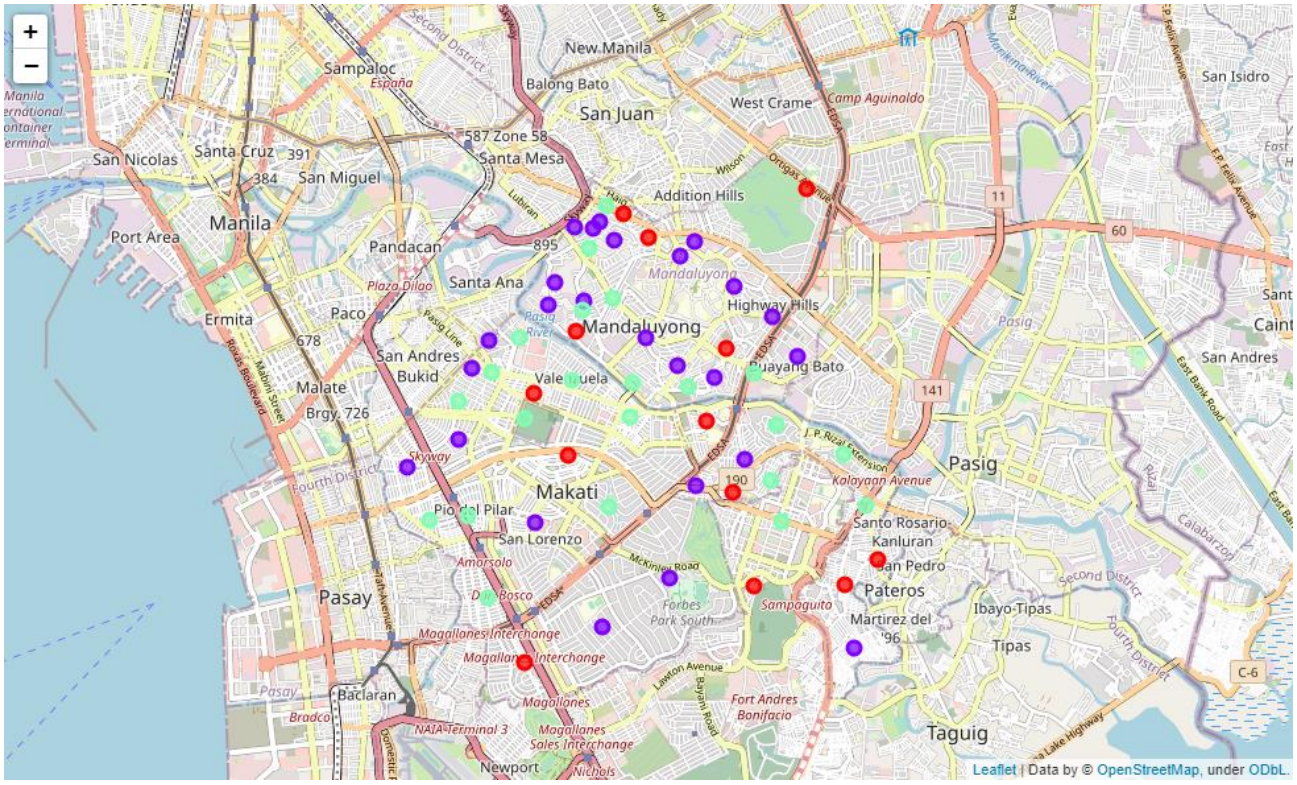

Figure 22. Merged cities clustering visualization

Map Dot Color	Cluster Label	Count	Most Common Venue
Red	0	13	Fast Food Restaurant
Purple	1	25	Restaurant (Different cuisines)
Green	2	22	Convenience Store

Figure 22. Merged cities clustering summary

After combining the barangays from Makati and Mandaluyong City, it could be seen in Figure 22 that the most common venues are fast food restaurants, restaurants of different cuisines, and convenience stores. These findings are generally consistent with the results from the previous discoveries in Figure 16, though the sports facilities are no longer the most common venue in any cluster. Furthermore, the results suggest that Makati and Mandaluyong City are heavily commercialized areas. Convenience stores and fast-food restaurants are usually located in high-traffic areas where people are constantly on the go.

5. Conclusion

Based on the analysis from this project, it could be inferred that the barangays of Makati and Mandaluyong City are very similar. The results of the clustering and the utilization of

location data to determine the most common venues of each barangay agree with the established description of the cities: Makati as the city with the most highly concentrated corporate offices and Mandaluyong as one of the fastest growing economies and commercial hubs in Metro Manila. Hence, if a person intends to experience the fast-paced lifestyle of Makati City, Mandaluyong City would be a suitable alternative.

Since this project was limited to using location data, future studies could include more variables such as housing prices, cost of living, demographics, and crime rate to render an even clearer comparison between the two cities.