It's Time to Move: Surviving the Daily Grind of Commuting in Metro Manila

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I. Introduction of the Problem

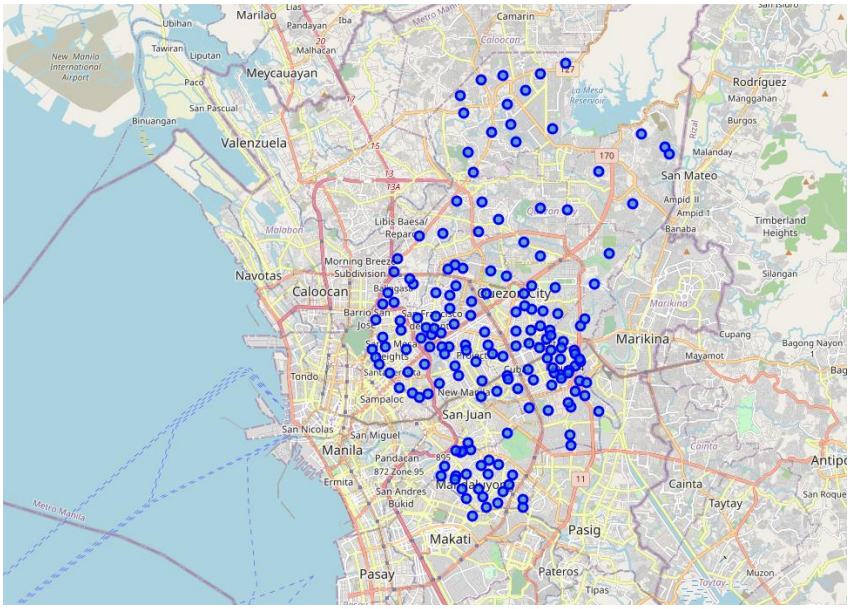
Metro Manila is the capital of the Philippines and is composed of sixteen cities and one municipality. Segmenting these cities are *barangays* which are the smallest unit of government in the Philippines. In 2019, the TomTom Traffic index listed Metro Manila as the second most congested city globally with a congestion rate of 71%. To put this figure into perspective, a person who normally takes 30 mins to get to work will spend an additional 29 minutes on the road during morning rush hours and 38 more minutes during evening rush hours. That is more than double the usual travel time! In addition to overcrowded roads, public transportation in Manila such as buses, trains and have become unviable options for many due to reliability issues and hazard concerns. The implication of this to the general population is very severe, especially those who reside far from their workplaces. Apartments and rental houses within and near the Central Business Districts (CBDs) have consistently appreciated in value as people look to live nearer to their workplace. Point-to-point (P2P) transport services like Grab and Uber (then) are so highly demanded that surge pricing has become astronomical. However, a lot of people are willing to pay the price of living near CBDs rather than sacrifice their health and time enduring the daily torture of commuting in Metro Manila.

A friend lives in Barangay Batasan Hills in Quezon City, the largest city in Metro Manila. On a "good" day, it takes him an average of 2 hours to get to the office in Makati City and another 2 hours to go back home to Barangay Batasan Hills. If it rains or if someone's car got busted on the road, it is guaranteed that he will be in transit for more than 4 hours for the day. His situation, like many people in Manila, is inhumane. A lot of precious time is wasted on the road. Time that could have been used to more productive activities. And so, he has decided to move closer to his work. However, he cannot afford living in the CBD but a place nearer compared to his current residence will surely interest him. Also, setting his distance issues aside, he loves his current residence with all the nearby establishments fitting his lifestyle. Thus, he is looking for a Barangay nearer to CBD but still maintaining the type of profile he is enjoying currently at Barangay Batasan Hills. This project aims to help my friend find the most suitable Barangay in Mandaluyong City where he can relocate to. Mandaluyong is adjacent to Makati City and is more affordable to live in.

II. Data Acquisition and Preparation

The first set of data needed is a list of barangays in Quezon City and Mandaluyong City. Fortunately, this is available from the Philippine Statistics Authority (PSA) website. Next is to obtain coordinates data for each of these barangays. I utilized the datasets from Geonames.org which already has this data for all barangays in the Philippines. There were many challenges in trying to marry the data from these two sources. First, the spellings of the barangays may differ due to a mix of typographical errors and differing naming conventions related to Spanish/Filipino names. A manual check and renaming were done to ensure that the names are the same between the two files. Second, you can only download the full list which include all the barangays in the Philippines. This was a minor setback in the data preparation

phase because it is common for barangays in the Philippines to have the same names. An additional step to extract the barangays from only Quezon City and Mandaluyong was performed. I also had to visualize the data points using folium multiple times to ensure that I am able to use the correct coordinates for the barangays I intend to use in the analysis.



Lastly, not all the sought-after barangays are listed in Geonames. Fortunately, there were only a few missing and so searching the coordinates manually in the internet did not take too much effort. The complete and final dataset can be downloaded from my Github repository ("QCMandaluyongCoordinates.csv").

The second set of data required are the nearby venues for each barangay. Here I utilized the power of Foursquare where I connected to its API to gather venue data such as venue names, coordinates and category within the radius of 200 of each barangay. To be able to execute this efficiently, I created a function that takes the name of the Barangay, its coordinates and a given radius as inputs. I used a radius of 200 because anything higher will breach the limit to the number of calls set by Foursquare and the code will run into an error. The function then communicates with the Foursquare database via API and stores the information in a new dataframe.

	Barangay	Barangay Latitude	Barangay Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Addition Hills	14.5816	121.0384	Worlwide Corporate Center Food Court	14.582606	121.038334	Food Court
1	Alicia	14.6614	121.0253	7-Eleven	14.660103	121.026284	Convenience Store
2	Alicia	14.6614	121.0253	7-Eleven	14.662062	121.025295	Convenience Store
3	Alicia	14.6614	121.0253	7-Eleven	14.660059	121.025606	Convenience Store
4	Amihan	14.6320	121.0680	Goolayan sa Batino	14.633251	121.069298	Convenience Store

The data was then grouped by Barangay followed by an application of one-hot encoding to transform the text data into indicator variables which makes it possible to perform calculations for each barangay characteristics.

	Barangay	American Restaurant	Arcade	Asian Restaurant	Athletics & Sports	BBQ Joint	Badminton Court	Bakery	Bank	Bar	Basketball Court	Bed & Breakfast	Beer Garden	Bookstore	Boutique	Bowling Alley	Boxing Gym	Breakfast Spot	Bridal Shop	Bubble Tea Shop	Buffet	Building	Burger Joint	Burrito Place	Bus Station	Café	Campground	Casino	Chinese Restaurant
0	Addition Hills	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	Alicia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Alicia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	Alicia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	Amihan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

The data was again grouped by Barangay to list all the normalized variables coming from the same Barangay into one line.

	Barangay	American Restaurant	Arcade	Asian Restaurant	Athletics & Sports	BBQ Joint	Badminton Court	Bakery	Bank	Bar	Basketball Court	Bed & Breakfast	Beer Garden	Bookstore	Boutique	Bowling Alley	Boxing Gym	Breakfast Spot	Bridal Shop	Bubble Tea Shop	Buffet	Building	Burger Joint	Burrito Place	Bus Station	C
0	Addition Hills	0.000000	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	0.00	0.000000	0.000000	0.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0	0.000000	0.000000	0.0	0.000
1	Alicia	0.000000	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	0.00	0.000000	0.000000	0.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0	0.000000	0.000000	0.0	0.000
2	Amihan	0.000000	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	0.00	0.000000	0.000000	0.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0	0.000000	0.000000	0.0	0.000
3	Amoranto Senior Avenue	0.000000	0.0	0.000000	0.125000	0.000000	0.125000	0.000000	0.00	0.000000	0.000000	0.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0	0.000000	0.000000	0.0	0.125
4	Baesa	0.000000	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	0.00	0.000000	0.000000	0.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0	0.000000	0.000000	0.0	0.000
5	Bagbag	0.000000	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	0.00	0.250000	0.000000	0.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0	0.000000	0.000000	0.0	0.000
6	Bagong Lipunan ng Camp Crame	0.000000	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	0.00	0.000000	0.000000	0.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0	0.000000	0.000000	0.2	0.000
7	Bagong Silang	0.000000	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	0.00	0.000000	0.200000	0.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0	0.000000	0.000000	0.0	0.000

III. Exploratory Data Analysis

I took the opportunity to generate interesting results from the data prepared in the last section. For instance, I populated the top 5 venues per barangay based on their frequency. The information extracted at this stage is already helpful for my friend as this gives him an idea on what type of establishments he can expect to see for each barangay. Another table is generated which is quite similar to the first one but is showing the top 10 venues instead. Note that due to rounding, the order of establishments may differ between the two tables.

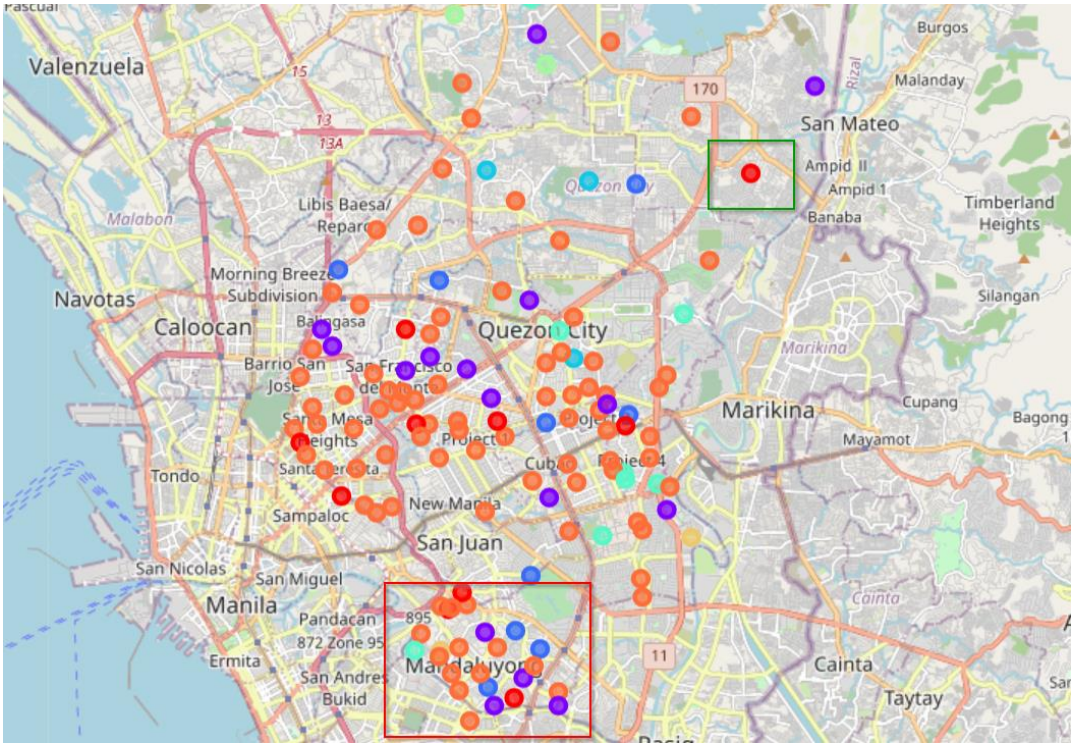
```
----Addition Hills----
           venue  freq
0     Food Court   1.0
1      Rest Area   0.0
2  Movie Theater   0.0
3    Music Store   0.0
4     Nail Salon   0.0


----Alicia----
                 venue  freq
0    Convenience Store   1.0
1  American Restaurant   0.0
2            Pet Store   0.0
3           Nail Salon   0.0
4            Nightclub   0.0


----Amihan----
                 venue  freq
0    Convenience Store   1.0
1  American Restaurant   0.0
2            Pet Store   0.0
3           Nail Salon   0.0
4            Nightclub   0.0
```

	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	Food Court	Deli / Bodega	Flower Shop	Filipino Restaurant	Fast Food Restaurant	Farmers Market	Entertainment Service	English Restaurant	Empanada Restaurant	Electronics Store
1	Alicia	Convenience Store	Yoga Studio	Electronics Store	Filipino Restaurant	Fast Food Restaurant	Farmers Market	Entertainment Service	English Restaurant	Empanada Restaurant	Dumpling Restaurant
2	Amihan	Convenience Store	Yoga Studio	Electronics Store	Filipino Restaurant	Fast Food Restaurant	Farmers Market	Entertainment Service	English Restaurant	Empanada Restaurant	Dumpling Restaurant
3	Amoranto Senior Avenue	Filipino Restaurant	Plaza	Athletics & Sports	Badminton Court	Gym Pool	Gym / Fitness Center	Stadium	Café	Empanada Restaurant	Fast Food Restaurant

While the information gathered here is valuable, this still does not give us an accurate depiction of which barangays in Mandaluyong City is close in terms of characteristics to his current barangay which is Batasan Hills. The next section will provide a solution to this problem.

IV. Modeling: K-Means Clustering

I used the K-Means Clustering methodology to segment the barangays based on the establishments within their scope. This allows me to differentiate the 'features' of each barangay and assess which ones are closer to the "feature" of Barangay Batasan Hills. In this methodology, one has to choose the number of clusters, k, or in other words, the number of segments. I started with k=5 but the results lacked differentiation as a huge number of barangays in Mandaluyong City are classified to one cluster. As a solution, I increased the value of k and set it to 8. The visualization results are shown:



The barangay enclosed in a green quadrilateral is Barangay Batasan Hills located in Quezon City. The barangays enclosed in the red quadrilateral at the bottom of the image are the barangays in Mandaluyong City. Makati City, where the CBD is, is just adjacent below Mandaluyong City. The results show that the following barangays in Mandaluyong City share the same characteristics as Batasan Hills:

1. Barangka Itaas
2. Daang Bakal
3. Burol

Top 10 Venue Types for Batasan Hills and Candidate Barangays for Relocation

	Barangay	City	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
21	Barangka Itaas	Mandaluyong	14.5707	121.0423	0	Filipino Restaurant	Yoga Studio	Deli / Bodega	Flower Shop	Fast Food Restaurant	Farmers Market	Entertainment Service	English Restaurant	Empanada Restaurant	Electronics Store
22	Batasan Hills	Quezon City	14.68469	121.09547	0	Mountain	Filipino Restaurant	Yoga Studio	Deli / Bodega	Fast Food Restaurant	Farmers Market	Entertainment Service	English Restaurant	Empanada Restaurant	Electronics Store
29	Burol	Mandaluyong	14.5898	121.0276	0	Chinese Restaurant	Filipino Restaurant	Bookstore	Empanada Restaurant	Flower Shop	Fast Food Restaurant	Farmers Market	Entertainment Service	English Restaurant	Yoga Studio
36	Daang Bakal	Mandaluyong	14.5934	121.0304	0	Chinese Restaurant	Salon / Barbershop	Supermarket	Filipino Restaurant	Diner	Dim Sum Restaurant	Distillery	Donut Shop	Drugstore	Flower Shop

V. Conclusion

By using data from Foursquare and PSA, we were able to apply the K-Means clustering methodology to be able to determine which barangays in Mandaluyong City closely resembles Batasan Hills in Quezon City in terms of the types of establishments surrounding the barangay. While there is no technically correct choice for the number of clusters, we can run the analysis multiple times with different choices for k to narrow down the number of barangays in each cluster and thus making it easier to choose the most suitable barangay in the list. In this paper, we were able to narrow down the choice into three barangays in Mandaluyong City. No more 4-hour commute time!