Capstone Project –
Battle of the neighborhoods

Singapore Neighborhood Recommendation

1. Introduction

1.1 Background:

Singapore is a highly developed market economy, it is known as one of the freest, most innovative, most competitive, most dynamic and most business-friendly. It is a global hub for business and commerce, it is diverse and a financial capital. Singapore is gateway to Asia, many multinational companies has their office located in Singapore, be it their head office, regional office or branch office. Singapore is also popular among tourist and one of the most visited countries in World.

Singapore is also one of the world's most expensive city to live in. There are people of all nationality come here and settle for work. Finding a suitable place to live is a big challenge. Expats have a difficult time in selecting the place to live with recommendations flying from different sources like websites, relatives, friends, colleagues etc.

1.2 Problem:

The objective of the project is to locate and recommend a suitable place to live for an expat looking to settle in Singapore with preferred places of interest. While executing the project the rationale for selecting the location, following points will be taken into account.

- Collect and provide a data driven recommendation that is supplemented with statistical data analysis
- Give a comparison of Average rent of all the towns(neighborhood) in Singapore
- Compare the most common places of interest in all towns and rank top 10 common venue.
- Make 5 clusters with similar attributes on the basis of most common venue and then attach the average rent columns.

For this demonstration, this Project will make use of the following data:

- Singapore Median Rental Prices by town.
- Popular Food venues in the vicinity.

1.3 Interest:

Apparently, Expats looking to settle in Singapore would be very interested in finding the appropriate location to settle with preferred place of their interest nearby. Students from other countries and Tourists may also find the output of project very useful.

2. Data Acquisition and Cleaning:

2.1 Data sources

The Project has sourced data from Singapore open data sources and FourSquare API venue recommendations.

Singapore Towns and median residential rental prices

Data is retrieved from Singapore open dataset from median rent by town from https://data.gov.sg website.

The original data source contains median rental prices of Singapore HDB units from 2005 Q2 up to Q4 of 2019. The data has four columns as given below

	quarter	Town	flat_type	median_rent
0	2005-Q2	ANG MO KIO	1-RM	na
1	2005-Q2	ANG MO KIO	2-RM	na
2	2005-Q2	ANG MO KIO	3-RM	800
3	2005-Q2	ANG MO KIO	4-RM	950
4	2005-Q2	ANG MO KIO	5-RM	-

We will retrieve rental the most recent recorded rental prices from this data source (2019-Q4) being the most relevant price available at this time. For this demonstration, we will simplify the analysis by using the average rental prices of all available flat type.

Singapore Top Venue Recommendations from FourSquare API

(FourSquare website: www.foursquare.com)

We have used the FourSquare API to explore neighborhoods in selected towns in Singapore. The Foursquare explore function is used to get the most common venue categories in each neighborhood, and then we will use this feature to group the neighborhoods into clusters.

	Town	Town Latitude	Town Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	ANG MO KIO	1.370073	103.849516	FairPrice Xtra	1.369279	103.848886	Supermarket
1	ANG MO KIO	1.370073	103.849516	Old Chang Kee	1.369094	103.848389	Snack Place
2	ANG MO KIO	1.370073	103.849516	Subway	1.369136	103.847612	Sandwich Place
3	ANG MO KIO	1.370073	103.849516	MOS Burger	1.369170	103.847831	Burger Joint
4	ANG MO KIO	1.370073	103.849516	NTUC FairPrice	1.371507	103.847082	Supermarket

2.2 Data cleaning

Singapore Towns List with median residential rental prices

The table retrieved contains some un-wanted entries and needs some cleanup as discussed below:

- Drop/ignore cells with missing data.
- Use most current data record.
- Fix data types.

For the towns rental data we have found the average rental of each town for the period of 2019-Q4. We have also removed unwanted columns as shown below:

|	Town	median_rent
0	ANG MO KIO	2033.333333
1	BEDOK	2112.500000
2	BISHAN	2200.000000
3	BUKIT BATOK	1950.000000
4	BUKIT MERAH	2175.000000
5	BUKIT PANJANG	1757.500000
6	CENTRAL	2375.000000
7	CHOA CHU KANG	1883.333333
8	CLEMENTI	2250.000000
9	GEYLANG	2183.333333
10	HOUGANG	1982.500000
11	JURONG EAST	2100.000000
12	JURONG WEST	1982.500000
13	KALLANG/WHAMPOA	2293.333333
14	MARINE PARADE	1950.000000
15	PASIR RIS	2116.666667
16	PUNGGOL	1900.000000
17	QUEENSTOWN	2170.000000
18	SEMBAWANG	1900.000000
19	SENGKANG	1887.500000
20	SERANGOON	2162.500000
21	TAMPINES	2100.000000
22	TOA PAYOH	2166.666667
23	WOODLANDS	1762.500000
24	YISHUN	1887.500000

Retrieve town coordinates

Using geopy geocoders nominatim library, which convert an address into latitude and longitude values, we obtained the coordinates of towns are attached with the Singapore Town and Rent table as shown below:

Town	median_rent	Latitude	Longitude
ANG MO KIO	2033.333333	1.370073	103.849516
BEDOK	2112.500000	1.323976	103.930216
BISHAN	2200.000000	1.351452	103.848250
BUKIT BATOK	1950.000000	1.349057	103.749591
BUKIT MERAH	2175.000000	1.280628	103.830591
BUKIT PANJANG	1757.500000	1.378629	103.762136
CENTRAL	2375.000000	1.340863	103.830392
CHOA CHU KANG	1883.333333	1.384749	103.744534
CLEMENTI	2250.000000	1.315100	103.765231
GEYLANG	2183.333333	1.318186	103.887056
HOUGANG	1982.500000	1.371904	103.892725
JURONG EAST	2100.000000	1.333115	103.742297
JURONG WEST	1982.500000	1.339636	103.707339
KALLANG/WHAMPOA	2293.333333	1.325110	103.867168
MARINE PARADE	1950.000000	1.302689	103.907395
PASIR RIS	2116.666667	1.373031	103.949255
PUNGGOL	1900.000000	1.405258	103.902330
QUEENSTOWN	2170.000000	1.294623	103.806045
SEMBAWANG	1900.000000	1.449093	103.820055
SENGKANG	1887.500000	1.391330	103.895294
SERANGOON	2162.500000	1.349763	103.873721
TAMPINES	2100.000000	1.346893	103.947341
TOA PAYOH	2166.666667	1.335391	103.849741
WOODLANDS	1762.500000	1.436897	103.786216
YISHUN	1887.500000	1.429384	103.835028

Let's see Singapore and its towns in a maps

The geograpical coordinate of Singapore 1.357107, 103.8194992.
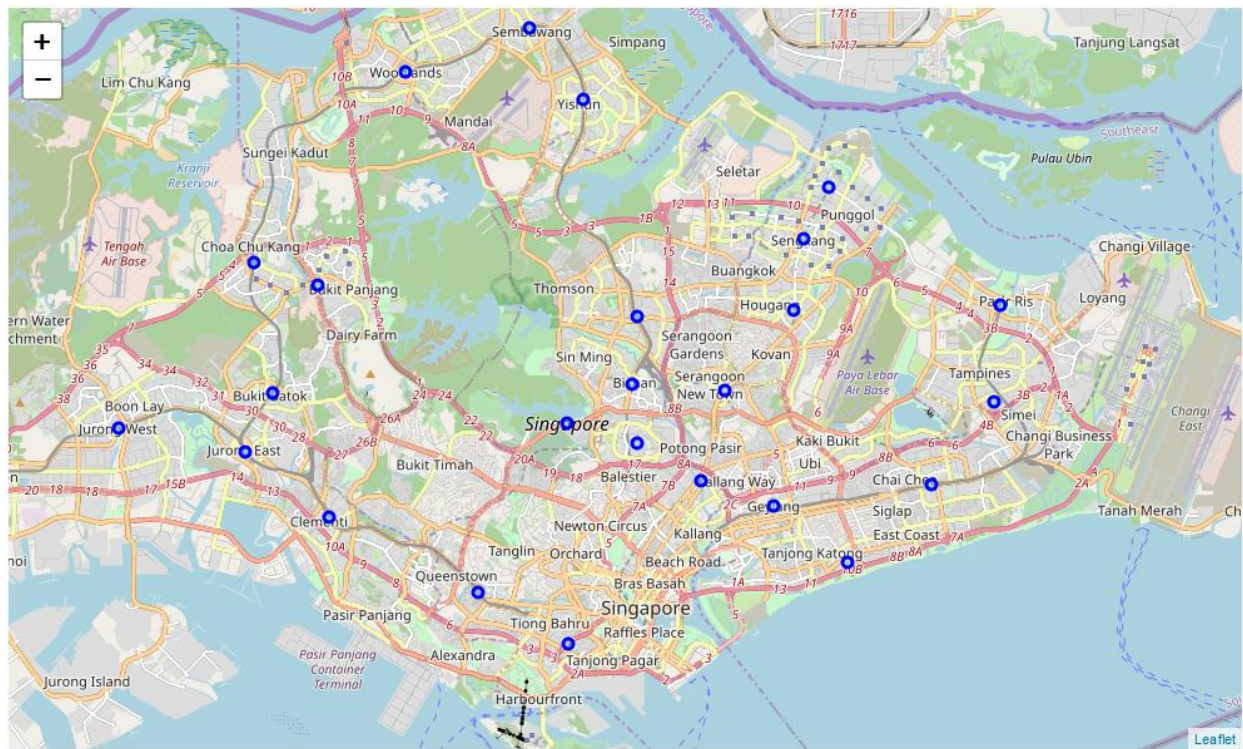
3. Methodology:

For achieving the objective of our project we will take a recourse to unsupervised approach for machine learning such as segmenting and k-means clustering. Unsupervised learning is a type of machine learning that looks for previously undetected patterns in a data set with no pre-existing labels and with a minimum of human supervision.

In the first step we have downloaded the median rental prices of various towns in Singapore. Further we have taken average of rental prices of all available flat type and attached the coordinates to Towns. Using Foursquare API we have downloaded nearby places data with their ratings.

In the second step we will explore the neighborhoods and analyze each Singapore Town nearby recommended venues from the data downloaded using Foursquare.

In the third and final step we will rank the top ten most common nearby place of interest. We will also run k-means to cluster the Towns into 5 clusters based on Top ten most common nearby venue and present our findings in a map.

3.1 Explore Neighborhoods

Using the Foursquare API, the explore API function was be used to get the most common venue categories in each neighborhood, and then used this feature to group the neighborhoods into clusters. The *k*-means clustering algorithm was used for the analysis. Finally, the Folium library is used to visualize the recommended neighborhoods and their emerging clusters.

A single function **getNearbyVenues** is defined. It single handedly performs following tasks

- Uses the Foursquare credentials and version to get the data of nearby most common venues
- Get the top 100 venues that are within a radius of 500 meters of each of the towns
- The venues are categorized based on their basic functions. For example Fairprice shop is categorized as Supermarket, MacDonald is categorized burger Joint.
- Clean the json and structure it into a *pandas* dataframe

Next, check how many venues were returned for each neighborhood

	Town Latitude	Town Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
Town						
ANG MO KIO	42	42	42	42	42	42
BEDOK	58	58	58	58	58	58
BISHAN	44	44	44	44	44	44
BUKIT BATOK	22	22	22	22	22	22
BUKIT MERAH	39	39	39	39	39	39
BUKIT PANJANG	43	43	43	43	43	43
CENTRAL	4	4	4	4	4	4
CHOA CHU KANG	19	19	19	19	19	19
CLEMENTI	64	64	64	64	64	64
GEYLANG	35	35	35	35	35	35
HOUGANG	35	35	35	35	35	35
JURONG EAST	75	75	75	75	75	75
JURONG WEST	64	64	64	64	64	64
KALLANG/WHAMPOA	16	16	16	16	16	16
MARINE PARADE	37	37	37	37	37	37
PASIR RIS	31	31	31	31	31	31
PUNGGOL	47	47	47	47	47	47
QUEENSTOWN	16	16	16	16	16	16
SEMBAWANG	14	14	14	14	14	14
SENGKANG	31	31	31	31	31	31
SERANGOON	40	40	40	40	40	40
TAMPINES	15	15	15	15	15	15
TOA PAYOH	45	45	45	45	45	45
WOODLANDS	55	55	55	55	55	55
YISHUN	45	45	45	45	45	45

142 unique categories curated from all the returned venues

3.2 Analyze Each Neighborhood

One hot encoding technique is used analyze categories of most common venue in the vicinity of the town. Machine learning algorithms cannot work with categorical data directly. One hot encoding is representation of categorical variables as binary vectors. This first requires that the categorical values be mapped to integer values. Then, each integer value is represented as a binary vector that is all zero values except the index of the integer, which is marked with a '1'.

Let's examine the new dataframe size

	Town	Accessories Store	American Restaurant	Arcade	Arts & Crafts Store	Asian Restaurant	BBQ Joint	Bakery	Bank	Basketball Court	Bay	Bike Rental / Bike Share	Bistro	Bookstore	Boutique
0	ANG MO KIO	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	ANG MO KIO	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	ANG MO KIO	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	ANG MO KIO	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	ANG MO KIO	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Shape of the dataframe returns (936, 143)

Next, group rows by neighborhood and by taking the mean of the frequency of occurrence of each category

	Town	Accessories Store	American Restaurant	Arcade	Arts & Crafts Store	Asian Restaurant	BBQ Joint	Bakery	Bank	Basketball Court	Bay	Bike Rental / Bike Share
0	ANG MO KIO	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.023810	0.02381	0.000000	0.00	0.000000
1	BEDOK	0.000000	0.017241	0.000000	0.000000	0.051724	0.000000	0.017241	0.00000	0.000000	0.00	0.000000
2	BISHAN	0.000000	0.000000	0.000000	0.000000	0.022727	0.000000	0.000000	0.00000	0.000000	0.00	0.000000
3	BUKIT BATOK	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.00000	0.000000	0.00	0.000000
4	BUKIT MERAH	0.000000	0.025641	0.000000	0.000000	0.102564	0.000000	0.025641	0.00000	0.000000	0.00	0.000000
5	BUKIT PANJANG	0.000000	0.023256	0.000000	0.000000	0.069767	0.023256	0.023256	0.00000	0.000000	0.00	0.000000
6	CENTRAL	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.00000	0.000000	0.25	0.000000
7	CHOA CHU KANG	0.000000	0.000000	0.000000	0.000000	0.052632	0.000000	0.052632	0.00000	0.000000	0.00	0.000000
8	CLEMENTI	0.000000	0.015625	0.000000	0.015625	0.046875	0.015625	0.015625	0.00000	0.000000	0.00	0.000000
9	GEYLANG	0.000000	0.000000	0.000000	0.000000	0.085714	0.000000	0.028571	0.00000	0.028571	0.00	0.000000
10	HOUGANG	0.000000	0.000000	0.000000	0.000000	0.028571	0.000000	0.000000	0.00000	0.000000	0.00	0.000000
11	JURONG EAST	0.013333	0.000000	0.000000	0.000000	0.013333	0.000000	0.013333	0.00000	0.000000	0.00	0.000000
12	JURONG WEST	0.000000	0.015625	0.000000	0.000000	0.109375	0.015625	0.015625	0.00000	0.000000	0.00	0.000000
13	KALLANG/WHAMPOA	0.000000	0.000000	0.000000	0.000000	0.062500	0.000000	0.000000	0.00000	0.000000	0.00	0.000000
14	MARINE PARADE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.027027	0.00000	0.000000	0.00	0.000000
15	PASIR RIS	0.000000	0.000000	0.000000	0.000000	0.032258	0.000000	0.064516	0.00000	0.000000	0.00	0.032258
16	PUNGGOL	0.000000	0.000000	0.000000	0.000000	0.042553	0.000000	0.042553	0.00000	0.000000	0.00	0.000000

Now let's print each neighborhood along with the top 5 most common venues

```
----ANG MO KIO----
              venue  freq
0        Food Court  0.10
1       Coffee Shop  0.10
2       Supermarket  0.05
3   Bubble Tea Shop  0.05
4       Snack Place  0.05


----BEDOK----
                venue  freq
0  Chinese Restaurant  0.07
1         Coffee Shop  0.07
2          Food Court  0.05
3  Japanese Restaurant 0.05
4    Asian Restaurant  0.05


----BISHAN----
                venue  freq
0          Food Court  0.11
1  Chinese Restaurant  0.07
2         Coffee Shop  0.07
3     Bubble Tea Shop  0.07
4                Café  0.07


----BUKIT BATOK----
                  venue  freq
0           Coffee Shop  0.18
1  Fast Food Restaurant  0.09
2            Food Court  0.09
3    Chinese Restaurant  0.09
4         Bowling Alley  0.05


----BUKIT MERAH----
                venue  freq
0    Asian Restaurant  0.10
1  Chinese Restaurant  0.10
2                Café  0.10
3          Food Court  0.08
4           Bookstore  0.05
```

```
----KALLANG/WHAMPOA----
                venue  freq
0  Chinese Restaurant  0.25
1         Coffee Shop  0.19
2   Convenience Store  0.06
3          Food Court  0.06
4                Park  0.06


----MARINE PARADE----
                 venue  freq
0  Japanese Restaurant  0.11
1                Hotel  0.11
2            Multiplex  0.08
3       Massage Studio  0.08
4          Salad Place  0.05


----PASIR RIS----
                  venue  freq
0            Food Court  0.10
1  Fast Food Restaurant  0.10
2    Italian Restaurant  0.06
3           Supermarket  0.06
4                  Pool  0.06


----PUNGGOL----
                  venue  freq
0           Snack Place  0.06
1       Sandwich Place  0.04
2  Fast Food Restaurant  0.04
3    Chinese Restaurant  0.04
4            Shoe Store  0.04


----QUEENSTOWN----
                venue  freq
0          Food Court  0.25
1        Noodle House  0.12
2  Chinese Restaurant  0.12
3  Italian Restaurant  0.06
4                Café  0.06
```

----BUKIT PANJANG----

	venue	freq
0	Sushi Restaurant	0.07
1	Fast Food Restaurant	0.07
2	Coffee Shop	0.07
3	Asian Restaurant	0.07
4	Café	0.07

----CENTRAL----

	venue	freq
0	Reservoir	0.25
1	Trail	0.25
2	Park	0.25
3	Bay	0.25
4	Portuguese Restaurant	0.00

----CHOA CHU KANG----

	venue	freq
0	Coffee Shop	0.16
1	Fast Food Restaurant	0.11
2	Italian Restaurant	0.05
3	Supermarket	0.05
4	Furniture / Home Store	0.05

----CLEMENTI----

	venue	freq
0	Coffee Shop	0.09
1	Food Court	0.09
2	Chinese Restaurant	0.05
3	Dessert Shop	0.05
4	Asian Restaurant	0.05

----GEYLANG----

	venue	freq
0	Chinese Restaurant	0.20
1	Noodle House	0.11
2	Food Court	0.09
3	Asian Restaurant	0.09
4	Vegetarian / Vegan Res	0.09

----SEMBAWANG----

	venue	freq
0	Coffee Shop	0.21
1	Fast Food Restaurant	0.14
2	Bistro	0.07
3	Shopping Mall	0.07
4	Chinese Restaurant	0.07

----SENGKANG----

	venue	freq
0	Coffee Shop	0.10
1	Fast Food Restaurant	0.10
2	Food Court	0.06
3	Sculpture Garden	0.03
4	Supermarket	0.03

----SERANGOON----

	venue	freq
0	Coffee Shop	0.08
1	Chinese Restaurant	0.08
2	Clothing Store	0.08
3	Japanese Restaurant	0.05
4	Fast Food Restaurant	0.05

----TAMPINES----

	venue	freq
0	Coffee Shop	0.20
1	Supermarket	0.13
2	Fast Food Restaurant	0.13
3	Chinese Restaurant	0.13
4	Seafood Restaurant	0.13

----TOA PAYOH----

	venue	freq
0	Chinese Restaurant	0.13
1	Noodle House	0.13
2	Food Court	0.09
3	Coffee Shop	0.09
4	Snack Place	0.09

```
    ----HOUGANG----                          ----WOODLANDS----
       venue                 freq               venue                 freq
    0 Food Court             0.11            0 Coffee Shop            0.05
    1 Fast Food Restaurant   0.09            1 Café                   0.05
    2 Chinese Restaurant     0.09            2 Japanese Restaurant    0.05
    3 Café                   0.06            3 Electronics Store      0.04
    4 Supermarket            0.06            4 Chinese Restaurant     0.04


    ----JURONG EAST----                      ----YISHUN----
       venue                 freq               venue                 freq
    0 Japanese Restaurant    0.08            0 Food Court             0.07
    1 Chinese Restaurant     0.07            1 Chinese Restaurant     0.07
    2 Café                   0.05            2 Italian Restaurant     0.04
    3 Coffee Shop            0.05            3 Supermarket            0.04
    4 Food Court             0.05            4 Hainan Restaurant      0.04


    ----JURONG WEST----
       venue                 freq
    0 Japanese Restaurant    0.11
    1 Asian Restaurant       0.11
    2 Fast Food Restaurant   0.08
    3 Chinese Restaurant     0.06
    4 Coffee Shop            0.05
```

We now write a function **return_most_common_venues** to sort the venues in descending order. Then create the new dataframe and display the top 10 venues for each neighborhood. The output is indicated below:
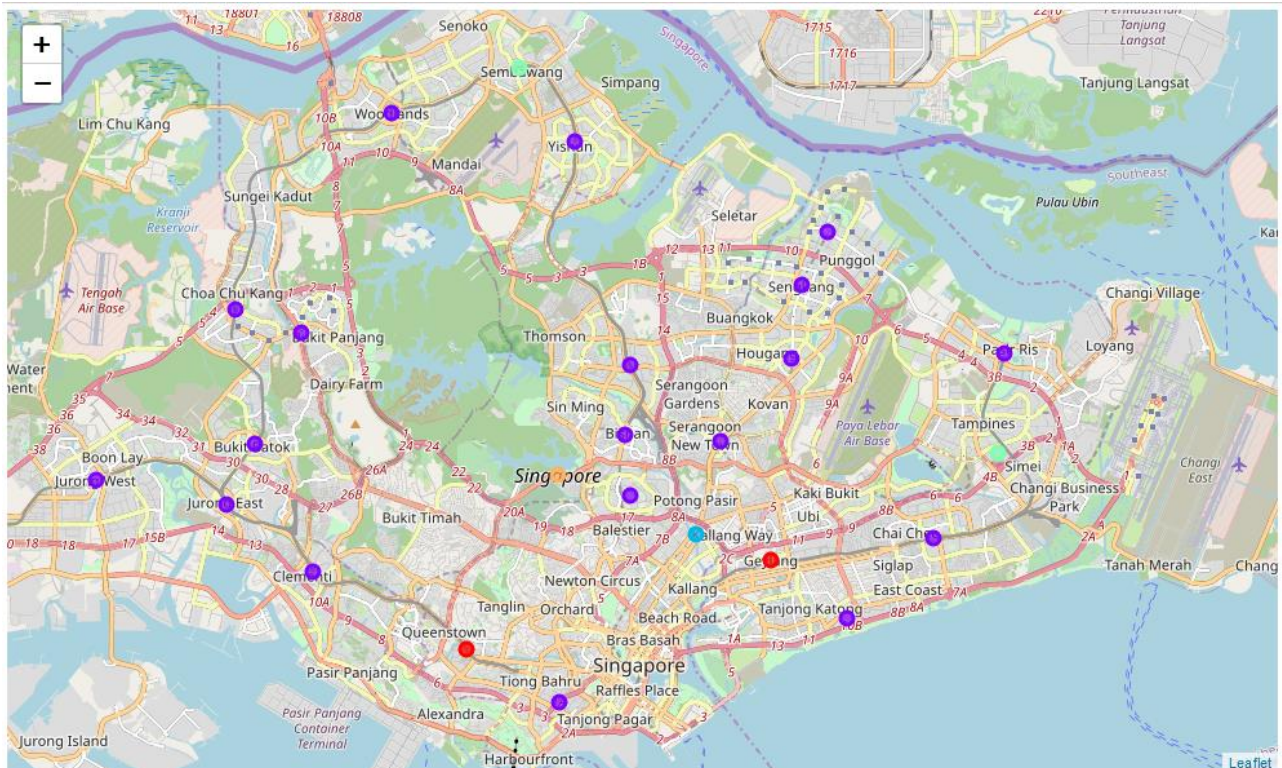
	Town	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
0	ANG MO KIO	Coffee Shop	Food Court	Supermarket	Snack Place	Japanese Restaurant	Bubble Tea Shop	Dessert Shop	Modern European Restaurant	Chinese Restaurant	Ramen Restaurant
1	BEDOK	Chinese Restaurant	Coffee Shop	Asian Restaurant	Japanese Restaurant	Sandwich Place	Food Court	Café	Supermarket	Fast Food Restaurant	Malay Restaurant
2	BISHAN	Food Court	Bubble Tea Shop	Café	Coffee Shop	Chinese Restaurant	Cosmetics Shop	Supermarket	Ice Cream Shop	Japanese Restaurant	Shopping Mall
3	BUKIT BATOK	Coffee Shop	Fast Food Restaurant	Chinese Restaurant	Food Court	Department Store	Grocery Store	Sandwich Place	Multiplex	Café	Shopping Mall
4	BUKIT MERAH	Café	Asian Restaurant	Chinese Restaurant	Food Court	Coffee Shop	Bookstore	Noodle House	Restaurant	Yoga Studio	Bus Station

4.0 Cluster Neighborhoods

Run *k*-means to cluster the neighborhood into 5 clusters. Let's create a new dataframe that includes the cluster as well as the top 10 venues for each neighborhood.

	Town	median_rent	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
0	ANG MO KIO	2033.333333	1.370073	103.849516	1	Coffee Shop	Food Court	Supermarket	Snack Place	Japanese Restaurant	Bubble Tea Shop	Dessert Shop
1	BEDOK	2112.500000	1.323976	103.930216	1	Chinese Restaurant	Coffee Shop	Asian Restaurant	Japanese Restaurant	Sandwich Place	Food Court	Café
2	BISHAN	2200.000000	1.351452	103.848250	1	Food Court	Bubble Tea Shop	Café	Coffee Shop	Chinese Restaurant	Cosmetics Shop	Supermarket
3	BUKIT BATOK	1950.000000	1.349057	103.749591	1	Coffee Shop	Fast Food Restaurant	Chinese Restaurant	Food Court	Department Store	Grocery Store	Sandwich Place
4	BUKIT MERAH	2175.000000	1.280628	103.830591	1	Café	Asian Restaurant	Chinese Restaurant	Food Court	Coffee Shop	Bookstore	Noodle House

Finally, let's visualize the resulting clusters

4.1 Examine Cluster

Now, we can can examine each cluster and determine the discriminating venue categories that distinguish each cluster.

Cluster 1

This clusters is more Chinese food centric with Chinese food, noodle house and food court appearing frequently in top most common venue. The median rent is however on the higher side, more than 2100.

	Town	median_rent	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	
9	GEYLANG	2183.333333	Chinese Restaurant	Noodle House	Asian Restaurant	Food Court	Vegetarian / Vegan Restaurant	Seafood Restaurant	Grocery Store	Dim Sum Restaurant	Pool	
17	QUEENSTOWN	2170.000000	Food Court	Chinese Restaurant	Noodle House	Steakhouse	Pool	Train Station	Italian Restaurant	Spa	Seafood Restaurant	

Cluster 2

This cluster is the largest cluster of all with 19 of the total 25 towns falling in this cluster. It is more diverse than cluster 1 in terms of food choices. coffee shop, food court, fast food restaurants are among the topmost common venue. Chinese and Japanese restaurants are also among most common choices. The range of median rent also high, from 1757 in Bukit Panjang to 2250 in Clementi.

	Town	median_rent	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
0	ANG MO KIO	2033.333333	Coffee Shop	Food Court	Supermarket	Snack Place	Japanese Restaurant	Bubble Tea Shop	Dessert Shop	Modern European Restaurant	Chinese Restaurant
1	BEDOK	2112.500000	Chinese Restaurant	Coffee Shop	Asian Restaurant	Japanese Restaurant	Sandwich Place	Food Court	Café	Supermarket	Fast Food Restaurant
2	BISHAN	2200.000000	Food Court	Bubble Tea Shop	Café	Coffee Shop	Chinese Restaurant	Cosmetics Shop	Supermarket	Ice Cream Shop	Japanese Restaurant
3	BUKIT BATOK	1950.000000	Coffee Shop	Fast Food Restaurant	Chinese Restaurant	Food Court	Department Store	Grocery Store	Sandwich Place	Multiplex	Café
4	BUKIT MERAH	2175.000000	Café	Asian Restaurant	Chinese Restaurant	Food Court	Coffee Shop	Bookstore	Noodle House	Restaurant	Yoga Studio
5	BUKIT PANJANG	1757.500000	Coffee Shop	Fast Food Restaurant	Café	Sushi Restaurant	Asian Restaurant	Ramen Restaurant	Noodle House	Pharmacy	Shopping Mall

Cluster 3

The Chinese restaurant and coffee shop are the most common venue in this cluster, however if you refer the table given above for the frequency, you will find the two venue are highly concentrated than others. The rent of Kallang/Whampoa is also on higher side.

	Town	median_rent	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	
13	KALLANG/WHAMPOA	2293.333333	Chinese Restaurant	Coffee Shop	Pet Store	Food Court	Park	Convenience Store	Restaurant	Bus Station	Asian Restaurant	

Cluster 4

Coffee shop and fast food restaurant are the most common venue in this cluster.

	Town	median_rent	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	
18	SEMBAWANG	1900.0	Coffee Shop	Fast Food Restaurant	Chinese Restaurant	Snack Place	Bus Station	Bus Stop	Bistro	Supermarket	Shopping Mall	
21	TAMPINES	2100.0	Coffee Shop	Supermarket	Chinese Restaurant	Fast Food Restaurant	Seafood Restaurant	Indian Restaurant	Bus Station	Food Court	Noodle House	

Cluster 5

Someone who is more outgoing and adventure oriented then this cluster is for him. With only one town in the cluster, Central has 0.25 frequency for Bay, Reservoir, Trail and Park each.

	Town	median_rent	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
6	CENTRAL	2375.0	Bay	Reservoir	Trail	Park	Yoga Studio	Food Truck	Food Court	Flower Shop	Fish & Chips Shop	Filipino Restaurant

5.0 Discussion and Conclusion

Singapore is a small country with a whole host of interesting venues scattered around the town, the information extracted in this notebook present on the town areas, will be a good supplement to web based recommendations for expats, visitors, students to find out nearby venues of interest and be a useful aid in deciding a place to stay or where to go during their visits. In this Project, Analysis of best town venue recommendations based mainly on Food venue category, outdoor and recreation areas has been presented.

Using Foursquare API, we have collected a good amount of venue recommendations in Singapore Towns. Sourcing from the venue recommendations from Foursquare has its limitation, the list of venues is not exhaustive list of all the available venues is the area. Furthermore, not all the venues found in the area has a stored ratings. The results therefore may significantly change, when more information are collected on those with missing data.

The generated clusters from our results shows that there are very good and interesting places located in areas where the median rents are cheaper. This kind of results may be very interesting for expats who are also on budget constraints.

The towns in cluster 2 has a wide range of rent and offer more diverse set of choices for food. Therefore for expats choosing a town in cluster 2 is preferred. Someone who likes more Chinese food than anything else than towns in cluster 1 should be his/her choice. The cluster 5 is for outdoors and recreation areas.