CAPSTONE PROJECT: BATTLE OF THE NEIGHBORHOODS

Singapore Visitors and Expatriates Venue Recommendation

I. PURPOSE

This document provides the details of my final peer reviewed assignment for the IBM Data Science Professional Certificate program – Coursera Capstone.

II. INTRODUCTION

Singapore is a small country and one of the most visited countries in Asia. There are a lot of websites where travelers can check and retrieve recommendations of places to stay or visit. However, most of these websites provides recommendation simply based on usual tourist attractions or key residential areas that are mostly expensive or already known for travelers based on certain keywords like "Hotel", or "Backpackers" etc. The intention on this project is to collect and provide a data driven recommendation that can supplement the recommendation with statistical data. This will also be utilizing data retrieved from Singapore open data sources and FourSquare API venue recommendations.

The sample recommender in this notebook will provide the following use case scenario:

- A person planning to visit Singapore as a Tourist or an Expat and looking for a reasonable accommodation.
- The user wants to receive venue recommendation where he can stay or rent an HDB apartment with close proximity to places of interest or search category option.
- The recommendation should not only present the most viable option, but also present a comparison table of all possible town venues.

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

- **Singapore Median Rental Prices by town.**
- **Popular Food venues in the vicinity. (Sample category selection)**

Note: While this demo makes use of Food Venue Category, Other possible categories can also be used for the same implementation such as checking categories like:

- **Outdoors and Recreation**
- **Nightlife**
- **Nearby Schools, etc.**

I will limit the scope of this search as FourSquare API only allows 50 free venue query limit per day when using a free user access.

III. DATA ACQUISITION

This demonstration will make use of the following data sources:

Singapore Towns and median residential rental prices.

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

The original data source contains median rental prices of Singapore HDB units from 2005 up to 2nd quarter of 2018. I will retrieve rental the most recent recorded rental prices from this data source (Q2 2018) being the most relevant price available at this time. For this demonstration, I will simplify the analysis by using the average rental prices of all available flat type.

Singapore Towns location data retrieved using Google maps API.

Data coordinates of Town Venues will be retrieved using google API. I also make use of MRT stations coordinate as a more important center of for all towns included in venue recommendations.

Singapore Top Venue Recommendations from FourSquare API

(FourSquare website: www.foursquare.com)

I will be using the FourSquare API to explore neighborhoods in selected towns in Singapore. The Foursquare explore function will be used to get the most common venue categories in each neighborhood, and then use this feature to group the neighborhoods into clusters. The following information are retrieved on the first query:

- **Venue ID**
- **Venue Name**
- **Coordinates : Latitude and Longitude**
- **Category Name**

Another venue query will be performed to retrieve venue ratings for each location. Note that rating information is a paid service from FourSquare and we are limited to only 50 queries per day. With this constraint, we limit the category analysis with only one type for this demo. I will try to retrieve as many ratings as possible for each retrieved venue ID.

IV. METHODOLOGY

Singapore Towns List with median residential rental prices.

The source data contains median rental prices of Singapore HDB units from 2005 up to 2nd quarter of 2018. I will retrieve the most recent recorded rental prices from this data source (Q2 2018) being the most relevant price available at this time. For this demonstration, I will simplify the analysis by using the average rental prices of all available flat type.

Data Cleanup and re-grouping. **The retrieved table contains some un-wanted entries and needs some cleanup.**

The following tasks will be performed:

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

- **Fix data types. Post Processed Singapore towns list with and median residential rental prices**

- **Adding geographical coordinates of each town location.**

2. Retrieve town coordinates.

Google API was be used to retrieve the coordinates (latitude and longitude of each town centers. For this exercise, I just used the MRT stations as the center points of each evaluated towns. The town coordinates will be used in retrieval of Foursquare API location data.

```
singapore_average_rental_prices_by_town['Latitude'] = 0.0
singapore_average_rental_prices_by_town['Longitude'] = 0.0

for idx,town in singapore_average_rental_prices_by_town['Town'].iteritems():
    address = town + " MRT station, Singapore" ; # I prefer to use MRT stations as
more important central location of each town
    url =
'https://maps.googleapis.com/maps/api/geocode/json?address={}&key={}'.format(address,
google_key)
    lat = requests.get(url).json()["results"][0]["geometry"]["location"]['lat']
    lng = requests.get(url).json()["results"][0]["geometry"]["location"]['lng']
    singapore_average_rental_prices_by_town.loc[idx,'Latitude'] = lat
    singapore_average_rental_prices_by_town.loc[idx,'Longitude'] = lng
```

V. Segmenting and Clustering Towns in Singapore

Retrieving FourSquare Places of interest.

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. Fnally, the Folium library is used to visualize the recommended neighborhoods and their emerging clusters.**

In the ipynb notebook, the function getNearbyVenues **extracts the following information for the dataframe it generates:**

- **Venue ID**
- **Venue Name**

- **Coordinates : Latitude and Longitude**
- **Category Name**

The function getVenuesByCategory **performs the following:**

1. Category **based venue search to simulate user venue searches based on certain places of interest. This search extracts the following information:**

- **Venue ID**
- **Venue Name**
- **Coordinates : Latitude and Longitude**
- **Category Name**

2. **For each retrieved** venueID**, retrieve the venues category rating.**

The generated data frame in the second function contains the following column:

Search Venues with recommendations on : Food Venues (Restaurants, Fastfoods, etc.)

To demonstrate user selection of places of interest, We will use this Food Venues category in our further analysis.

- **This Foursquare search is expected to collect venues in the following category:**
- **category**
- **Food Courts**
- **Coffee Shops**
- **Restaurants**
- **Cafés**
- **Other food venues**

I used the FourSquare API to retrieve venue scores of locations. Note that there is max query limit of 50 in FourSquare API for free subscription. So use or query carefully.

Data cleanup un-needed entries

- **Eliminate possible venue duplicates.**
- **Improve the quality of our venue selection by removing venues with no ratings or 0.0**

Column Name	Description
Town	**Town Name**
Town Latitude	**Towns MRT station Latitude**
Town Longitude	**Town MRT station Latitude**
VenueID	**FourSquare Venue ID**
VenueName	**Venue Name**
score	**FourSquare Venue user rating**
category	**Category group name**
catID	**Category ID**
latitude	**Venue Location - latitude**
longitude	**Venue Location - longitude**

Results: Town Venue Recommendation Counts:

Town	Venue Categoy Counts
ANG MO KIO	34
BEDOK	29
BISHAN	36
BUKIT BATOK	22
BUKIT MERAH	9
BUKIT PANJANG	15
CENTRAL	46
CHOA CHU KANG	27
CLEMENTI	34
GEYLANG	25
HOUGANG	26
JURONG EAST	39
JURONG WEST	31

Town	Venue Categoy Counts
KALLANG/WHAMPOA	15
MARINE PARADE	21
PASIR RIS	17
PUNGGOL	25
QUEENSTOWN	8
SEMBAWANG	18
SENGKANG	17
SERANGOON	42
TAMPINES	25
TOA PAYOH	34
WOODLANDS	31
YISHUN	18

RESULTS: How many unique categories can be curated from all the returned venues?

```
* There are 67 uniques categories.
```

What are the top 20 most common venue types?

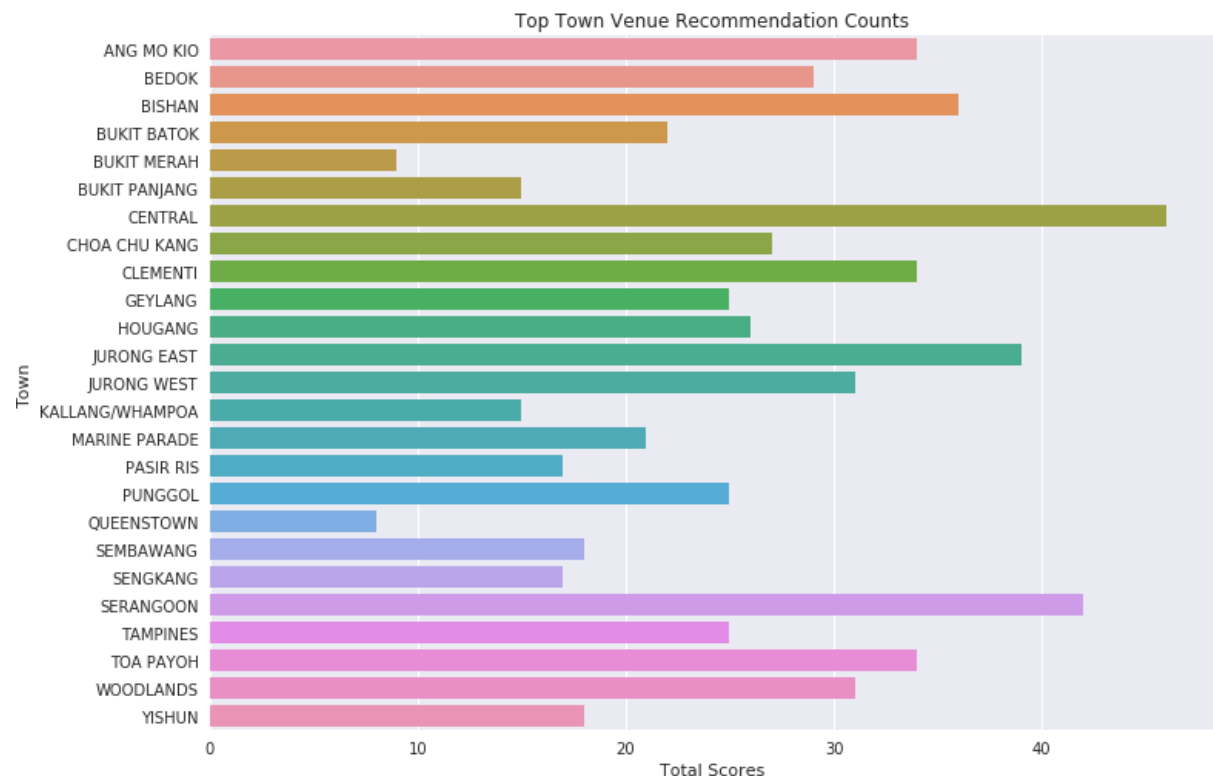Top 10 Recommended Venue in Food Category Type
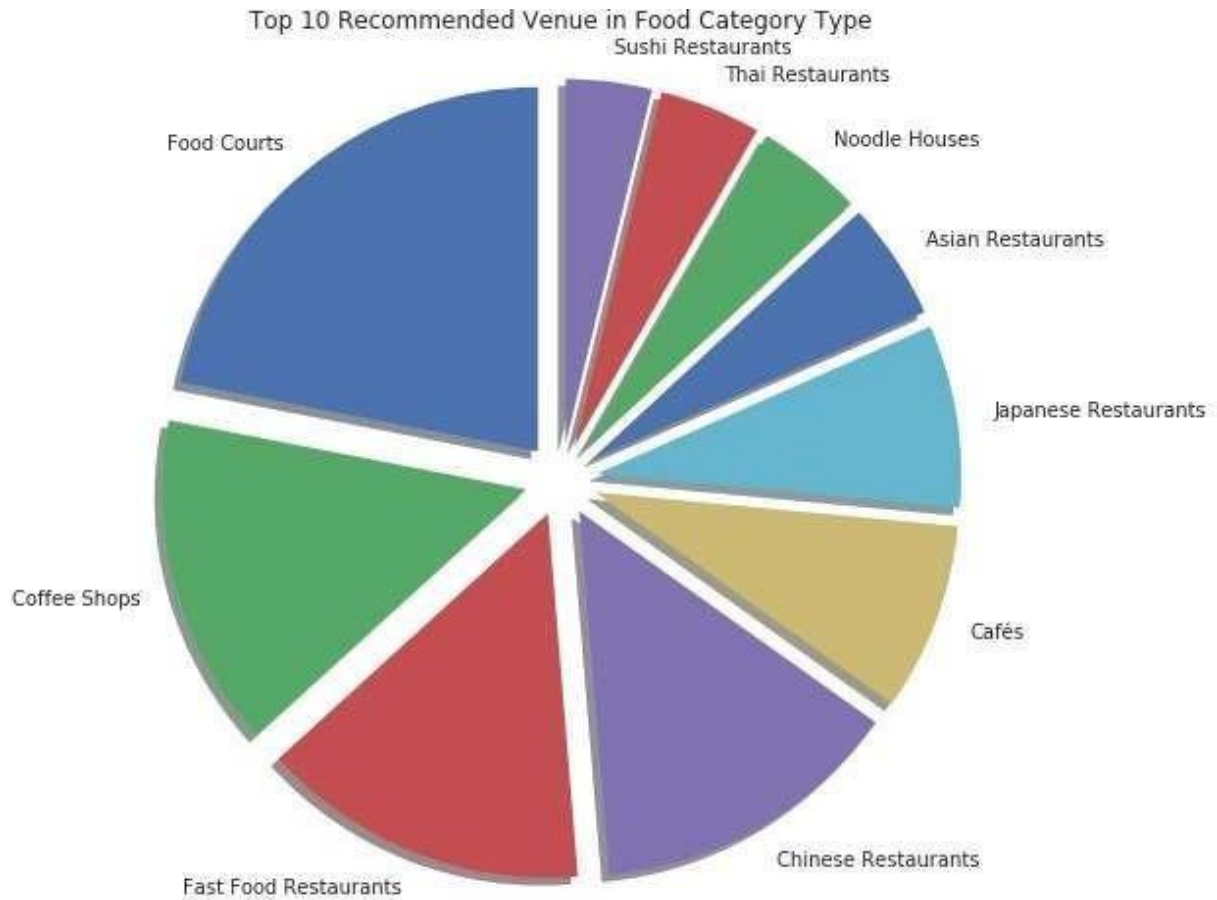
What are the top 10 Venue Recommendation Scores?

Top Town Venue Recommendation Counts

Analyze Each Singapore Town nearby recommended venues

- ## **Technique : One HotEncoding**

```python
# one hot encoding
sg_onehot = pd.get_dummies(singapore_town_venues[['category']], prefix="",
prefix_sep="")

# add Town column back to dataframe
sg_onehot['Town'] = singapore_town_venues['Town']

# move neighborhood column to the first column
fixed_columns = [sg_onehot.columns[-1]] + list(sg_onehot.columns[:-1])
sg_onehot = sg_onehot[fixed_columns]

# Check returned one hot encoding data:
print('One hot encoding returned "{}" rows.'.format(sg_onehot.shape[0]))

# Regroup rows by town and mean of frequency occurrence per category.
sg_grouped = sg_onehot.groupby('Town').mean().reset_index()

print('One hot encoding re-group returned "{}" rows.'.format(sg_grouped.shape[0]))
sg_grouped.head()
One hot encoding returned "644" rows.
One hot encoding re-group returned "25" rows.
```

Analysis of Singapore Town most visited venues

Town=< ANG MO KIO >

	venue	freq
0	Food Courts	0.18
1	Fast Food Restaurants	0.12
2	Japanese Restaurants	0.06
3	Dessert Shops	0.06
4	Sushi Restaurants	0.06
5	Cafés	0.06
6	Snack Places	0.03
7	Noodle Houses	0.03
8	Ramen Restaurants	0.03
9	Restaurants	0.03

Town=< BEDOK >

	venue	freq
0	Coffee Shops	0.21
1	Food Courts	0.10
2	Sushi Restaurants	0.07
3	Japanese Restaurants	0.07
4	Fast Food Restaurants	0.07
5	American Restaurants	0.03
6	Chinese Restaurants	0.03
7	Sandwich Places	0.03
8	Indonesian Restaurants	0.03
9	Indian Restaurants	0.03

Town=< BISHAN >

	venue	freq
0	Coffee Shops	0.14
1	Japanese Restaurants	0.11
2	Chinese Restaurants	0.11
3	Food Courts	0.08
4	Fast Food Restaurants	0.08
5	Cafés	0.08

6	Bubble Tea Shops	0.06
7	American Restaurants	0.03
8	Sandwich Places	0.03
9	Italian Restaurants	0.03

Town=< BUKIT BATOK >

	venue	freq
0	Food Courts	0.27
1	Coffee Shops	0.14
2	Chinese Restaurants	0.14
3	Fast Food Restaurants	0.14
4	Japanese Restaurants	0.05
5	Sandwich Places	0.05
6	Ice Cream Shops	0.05
7	Italian Restaurants	0.05
8	Thai Restaurants	0.05
9	Asian Restaurants	0.05

Town=< BUKIT MERAH >

	venue	freq
0	Chinese Restaurants	0.44
1	Coffee Shops	0.22
2	Food Courts	0.11
3	Bistros	0.11
4	Cafes	0.11
5	Malay Restaurants	0.00
6	Noodle Houses	0.00
7	Modern European Restaurants	0.00
8	Miscellaneous Shops	0.00
9	Mexican Restaurants	0.00

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```
# Town=< BUKIT PANJANG >
                 venue freq
0     Chinese Restaurants   0.20
1      Indian Restaurants   0.13
2        Thai Restaurants   0.13
3             Food Courts   0.13
4            Burger Joints 0.07
5      Seafood Restaurants   0.07
6   Vietnamese Restaurants   0.07
7        Asian Restaurants   0.07
8            Noodle Houses 0.07
9                    Cafés 0.07
```

```
# Town=< CLEMENTI >
                     venue freq
0               Food Courts   0.24
1    Fast Food Restaurants   0.09
2              Coffee Shops   0.09
3        Dim Sum Restaurants 0.06
4        Japanese Restaurants 0.06
5           Thai Restaurants 0.06
6         Asian Restaurants   0.06
7        Chinese Restaurants 0.06
8      Fried Chicken Joints   0.06
9                     Cafés 0.03
```

```
# Town=< CENTRAL >
                      venue freq
0                     Cafés 0.09
1        Chinese Restaurants 0.09
2              Coffee Shops   0.07
3          Ramen Restaurants 0.07
4              Food Courts    0.07
5                     Diners 0.04
6       Japanese Restaurants 0.04
7        Hotpot Restaurants 0.04
8              Noodle Houses  0.04
9     Fast Food Restaurants   0.04
```

```
# Town=< GEYLANG >
                           venue freq
0              Chinese Restaurants 0.24
1              Dim Sum Restaurants 0.12
2                      Food Courts 0.08
3   Vegetarian / Vegan Restaurants 0.08
4                     Coffee Shops  0.08
5                    Noodle Houses 0.08
6              Seafood Restaurants 0.08
7                       BBQ Joints 0.04
8            Fast Food Restaurants  0.04
9                Asian Restaurants 0.04
```

```
# Town=< CHOA CHU KANG >
                      venue freq
0      Fast Food Restaurants   0.15
1              Food Courts   0.11
2             Coffee Shops   0.11
3             Noodle Houses 0.11
4          Asian Restaurants   0.07
5             Dessert Shops   0.04
6             Burger Joints 0.04
7    Portuguese Restaurants   0.04
8           Sandwich Places   0.04
9                     Cafés 0.04
```

```
# Town=< HOUGANG >
                      venue freq
0               Food Courts   0.19
1     Fast Food Restaurants   0.15
2              Coffee Shops   0.12
3         Asian Restaurants   0.08
4        Chinese Restaurants 0.08
5             Dessert Shops   0.04
6                     Cafés 0.04
7      Fish & Chips Shops    0.04
8           Sandwich Places 0.04
9           Shopping Malls    0.04
```

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```
# Town=< JURONG EAST >
                      venue  freq
0              Food Courts  0.13
1      Japanese Restaurants  0.13
2        Chinese Restaurants 0.10
3   Fast Food Restaurants   0.08
4                    Cafés 0.08
5              Coffee Shops 0.05
6                   Diners 0.03
7  Chinese Breakfast Places 0.03
8        Ramen Restaurants 0.03
9             Noodle Houses 0.03
```

```
# Town=< MARINE PARADE >
                       venue  freq
0             Noodle Houses 0.29
1    Chinese Restaurants  0.14
2    Seafood Restaurants  0.10
3       Asian Restaurants  0.10
4               BBQ Joints 0.05
5                     Bars 0.05
6   Dim Sum Restaurants  0.05
7       Thai Restaurants  0.05
8         Dessert Shops  0.05
9              Coffee Shops 0.05
```

```
# Town=< JURONG WEST >
                       venue freq
0    Fast Food Restaurants   0.16
1      Chinese Restaurants   0.13
2        Asian Restaurants   0.10
3    Japanese Restaurants   0.10
4              Food Courts   0.10
5                    Cafés 0.06
6             Wings Joints 0.03
7          Sandwich Places   0.03
8    Hong Kong Restaurants   0.03
9    Indonesian Restaurants   0.03
```

```
# Town=< PASIR RIS >
                       venue freq
0    Fast Food Restaurants   0.18
1              Food Courts   0.18
2             Coffee Shops   0.12
3          Sandwich Places 0.06
4   Hong Kong Restaurants 0.06
5                 Bakeries 0.06
6        Asian Restaurants   0.06
7      Italian Restaurants   0.06
8        Sushi Restaurants 0.06
9               Restaurants 0.06
```

```
# Town=< KALLANG/WHAMPOA >
                     venue freq
0              Food Courts  0.20
1             Noodle Houses 0.13
2             Snack Places 0.13
3               BBQ Joints 0.13
4    Chinese Restaurants   0.13
5    Seafood Restaurants   0.07
6               Soup Places 0.07
7       Thai Restaurants   0.07
8      Indian Restaurants   0.07
9     Italian Restaurants   0.00
```

```
# Town=< PUNGGOL >
                      venue  freq
0              Food Courts   0.16
1      Seafood Restaurants   0.08
2    Fast Food Restaurants   0.08
3                    Cafés 0.08
4               Soup Places   0.04
5        Ramen Restaurants   0.04
6          Sandwich Places   0.04
7  Comfort Food Restaurants   0.04
8              Coffee Shops   0.04
9       Chinese Restaurants   0.04
```

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```
#  Town=< QUEENSTOWN >
                    venue freq
0           Chinese Restaurants 0.38
1                  Food Courts  0.25
2              Thai Restaurants 0.12
3           Italian Restaurants 0.12
4             Malay Restaurants  0.12
5          American Restaurants  0.00
6           Macanese Restaurants 0.00
7   Modern European Restaurants 0.00
8           Miscellaneous Shops  0.00
9            Mexican Restaurants 0.00
```

```
#  Town=< SERANGOON >
                    venue freq
0   Fast Food Restaurants  0.14
1            Coffee Shops  0.10
2     Japanese Restaurants 0.10
3        Indian Restaurants  0.05
4                    Cafés 0.05
5              Steakhouses 0.05
6        Sushi Restaurants 0.05
7      Chinese Restaurants 0.05
8              Food Courts  0.05
9          Thai Restaurants 0.05
```

```
#  Town=< SEMBAWANG >
                    venue freq
0             Food Courts  0.28
1            Coffee Shops  0.17
2         Asian Restaurants 0.11
3     Fast Food Restaurants 0.11
4       Italian Restaurants 0.06
5                  Bistros  0.06
6     Japanese Restaurants 0.06
7        Sushi Restaurants 0.06
8      Chinese Restaurants 0.06
9                    Cafés 0.06
```

```
#  Town=< TAMPINES >
                    venue freq
0             Food Courts  0.20
1            Coffee Shops  0.16
2     Fast Food Restaurants  0.12
3       Italian Restaurants  0.08
4     Japanese Restaurants 0.08
5      American Restaurants  0.04
6       Seafood Restaurants 0.04
7       Fried Chicken Joints  0.04
8       Dumpling Restaurants  0.04
9              Pizza Places 0.04
```

```
#  Town=< SENGKANG >
                    venue freq
0             Food Courts  0.18
1            Coffee Shops  0.18
2     Fast Food Restaurants  0.18
3                    Cafés 0.18
4       English Restaurants  0.06
5      Chinese Restaurants 0.06
6              Restaurants 0.06
7        Sushi Restaurants 0.06
8          Sandwich Places 0.06
9      Mexican Restaurants 0.00
```

```
#  Town=< TOA PAYOH >
                    venue freq
0            Coffee Shops  0.18
1     Fast Food Restaurants  0.12
2              Food Courts  0.12
3      Chinese Restaurants 0.12
4              Snack Places 0.06
5                    Cafés 0.06
6             Burger Joints  0.03
7          Sandwich Places 0.03
8       Italian Restaurants  0.03
9        Asian Restaurants  0.03
```

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```
#  Town=< WOODLANDS >
                venue freq
0            Food Courts  0.16
1    Japanese Restaurants 0.13
2                  Cafés 0.10
3  Fast Food Restaurants  0.10
4           Coffee Shops  0.10
5     Chinese Restaurants 0.10
6    American Restaurants  0.06
7     Italian Restaurants  0.03
8   Fried Chicken Joints   0.03
9            Pizza Places 0.03
```

```
#  Town=< YISHUN >
                  venue freq
0              Food Courts  0.28
1       Hainan Restaurants 0.06
2  Hong Kong Restaurants 0.06
3        Halal Restaurants  0.06
4         Thai Restaurants 0.06
5  Fast Food Restaurants   0.06
6       Sushi Restaurants 0.06
7       Bubble Tea Shops   0.06
8     Fish & Chips Shops   0.06
9           Burger Joints  0.06
```

RESULTS: Categorized Result

	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
0	ANG MO KIO	Food Courts	Fast Food Restaurants	Dessert Shops	Japanese Restaurants	Sushi Restaurants	Cafés	Ramen Restaurants	Hong Kong Restaurants
1	BEDOK	Coffee Shops	Food Courts	Sushi Restaurants	Japanese Restaurants	Fast Food Restaurants	Wings Joints	Fried Chicken Joints	Indian Restaurants
2	BISHAN	Coffee Shops	Japanese Restaurants	Chinese Restaurants	Fast Food Restaurants	Food Courts	Cafés	Bubble Tea Shops	American Restaurants
3	BUKIT BATOK	Food Courts	Coffee Shops	Fast Food Restaurants	Chinese Restaurants	Asian Restaurants	Thai Restaurants	Pizza Places	Ice Cream Shops
4	BUKIT MERAH	Chinese Restaurants	Coffee Shops	Food Courts	Bistros	Cafés	Dongbei Restaurants	Comfort Food Restaurants	Dessert Shops

RESULTS : *k*-means Cluster Results

Clustered results for **k**-means to cluster with 5 clusters.

	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
0	ANG MO KIO	Food Courts	Fast Food Restaurants	Dessert Shops	Japanese Restaurants	Sushi Restaurants	Cafés	Ramen Restaurants	Hong Kong Restaurants

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	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
1	BEDOK	Coffee Shops	Food Courts	Sushi Restaurants	Japanese Restaurants	Fast Food Restaurants	Wings Joints	Fried Chicken Joints	Indian Restaurants
2	BISHAN	Coffee Shops	Japanese Restaurants	Chinese Restaurants	Fast Food Restaurants	Food Courts	Cafés	Bubble Tea Shops	American Restaurants
3	BUKIT BATOK	Food Courts	Coffee Shops	Fast Food Restaurants	Chinese Restaurants	Asian Restaurants	Thai Restaurants	Pizza Places	Ice Cream Shops
4	BUKIT MERAH	Chinese Restaurants	Coffee Shops	Food Courts	Bistros	Cafés	Dongbei Restaurants	Comfort Food Restaurants	Dessert Shops

RESULTS: Merged Cluster Table with rental prices.

|	median_rent	Latitude	Longitude	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Commo Venue
Town									
ANG MO KIO	2033.333333	1.369972	103.849588	1	Food Courts	Fast Food Restaurants	Dessert Shops	Japanese Restaurants	Sushi Restauran
BEDOK	2087.500000	1.324011	103.930172	3	Coffee Shops	Food Courts	Sushi Restaurants	Japanese Restaurants	Fast Food Restauran
BISHAN	2233.333333	1.351042	103.849930	3	Coffee Shops	Japanese Restaurants	Chinese Restaurants	Fast Food Restaurants	Food Cou
BUKIT BATOK	1962.500000	1.348506	103.749222	1	Food Courts	Coffee Shops	Fast Food Restaurants	Chinese Restaurants	Asian Restauran
BUKIT MERAH	2162.500000	1.289642	103.816798	2	Chinese Restaurants	Coffee Shops	Food Courts	Bistros	Cafés

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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
BUKIT PANJANG	1737.500000	1.276068	103.791904	4	Chinese Restaurants	Thai Restaurants	Food Courts	Indian Restaurants	Cafés
CENTRAL	2450.000000	1.288155	103.846718	3	Cafés	Chinese Restaurants	Food Courts	Coffee Shops	Ramen Restauran
CHOA CHU KANG	1933.333333	1.385385	103.744337	1	Fast Food Restaurants	Food Courts	Noodle Houses	Coffee Shops	Asian Restauran
CLEMENTI	2263.333333	1.315070	103.765246	1	Food Courts	Fast Food Restaurants	Coffee Shops	Fried Chicken Joints	Asian Restauran
GEYLANG	2166.666667	1.316367	103.882772	4	Chinese Restaurants	Dim Sum Restaurants	Food Courts	Noodle Houses	Coffee Shops
HOUGANG	1962.500000	1.371331	103.892544	1	Food Courts	Fast Food Restaurants	Coffee Shops	Chinese Restaurants	Asian Restauran
JURONG EAST	2150.000000	1.333143	103.742329	3	Food Courts	Japanese Restaurants	Chinese Restaurants	Fast Food Restaurants	Cafés
JURONG WEST	1975.000000	1.338556	103.705828	3	Fast Food Restaurants	Chinese Restaurants	Japanese Restaurants	Asian Restaurants	Food Cou
KALLANG/WHAM POA	2300.000000	1.311478	103.871351	0	Food Courts	Chinese Restaurants	BBQ Joints	Noodle Houses	Snack Places
MARINE PARADE	1950.000000	1.308410	103.888814	0	Noodle Houses	Chinese Restaurants	Asian Restaurants	Seafood Restaurants	Snack Places
PASIR RIS	2066.666667	1.373191	103.949353	1	Food Courts	Fast Food Restaurants	Coffee Shops	Italian Restaurants	Asian Restauran
PUNGGOL	1825.000000	1.405170	103.902356	1	Food	Seafood	Cafés	Fast Food	Chinese

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	median_rent	Latitude	Longitude	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Commo Venue
Town									
					Courts	Restaurants		Restaurants	Restauran
QUEENSTOWN	2162.500000	1.294835	103.805902	4	Chinese Restaurants	Food Courts	Malay Restaurants	Thai Restaurants	Italian Restauran
SEMBAWANG	1883.333333	1.449080	103.820058	1	Food Courts	Coffee Shops	Asian Restaurants	Fast Food Restaurants	Chinese Restauran
SENGKANG	1900.000000	1.391661	103.895453	3	Coffee Shops	Cafés	Food Courts	Fast Food Restaurants	Sandwich Places
SERANGOON	2187.500000	1.349787	103.873635	3	Fast Food Restaurants	Japanese Restaurants	Coffee Shops	Food Courts	Steakhous
TAMPINES	2075.000000	1.354430	103.942760	1	Food Courts	Coffee Shops	Fast Food Restaurants	Japanese Restaurants	Italian Restauran
TOA PAYOH	2210.000000	1.332330	103.847425	3	Coffee Shops	Chinese Restaurants	Food Courts	Fast Food Restaurants	Cafés
WOODLANDS	1762.500000	1.436945	103.786516	3	Food Courts	Japanese Restaurants	Coffee Shops	Cafés	Chinese Restauran
YISHUN	1900.0000	1.42954	103.8350	1	Food Court	Hainan Restaura	Bubble Tea	Halal Restaura	Hong Kon
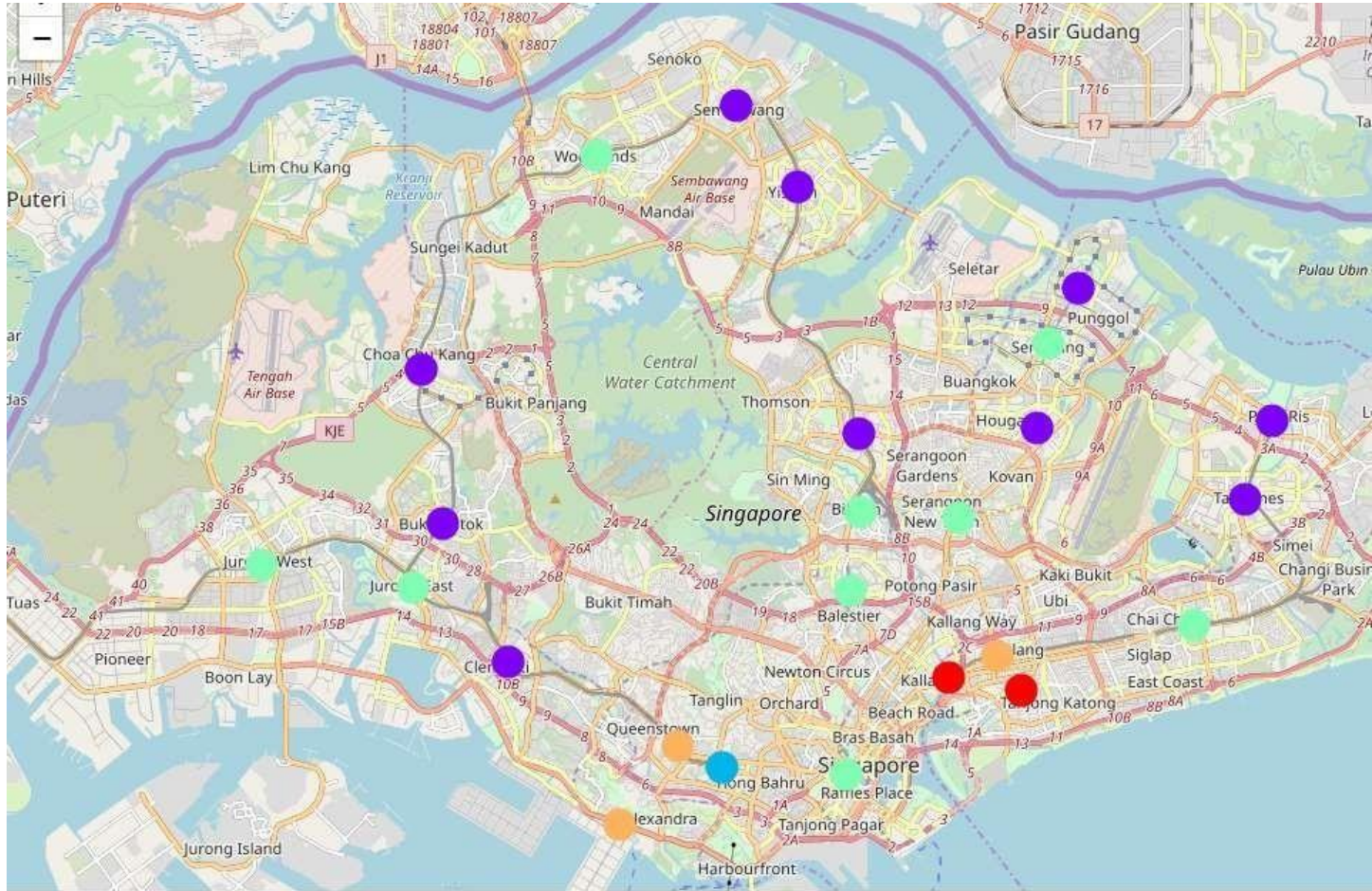
Download Github:singapore_food_venues Download Github:singapore_outdoorAndRecreation Download Github:singapore_Nightlife

IV. Discussion and Conclusion

On this notebook, Analysis of best town venue recommendations based on Food venue category has been presented. Recommendations based on other user searches like available outdoor and recreation areas are also available. As 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 visitors 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.

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 the area has a stored ratings. For this reason, the number of analyzed venues is only about 50% of all the available venues initially collected. 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 travelers who are also on budget constraints. Our results also yielded some interesting findings. For instance, The initial assumption among websites providing recommendations is that the Central Area that have the highest median rent also have better food venues. The results however show that while Marine Parade, a cheaper location has better rated food courts. Result shows that most popular food venue among Singaporeans, residents and visitors are Food Courts, Coffee Shops and Fast Food Restaurants. **The highest rated Food Courts are located in** Marine Parade**, and in** Central Area**.**

I will be providing a other supplementary Inferential Statics in the future about on these data collected and also update in a new notebook using other categories. For now, this completes the requirements for this task.

Thank you.

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Final Assignment: Capstone Project: Battle of Neighborhoods