

Culinary Venues Location Analysis in Singapore

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Background

- ❑ Culinary businesses are thriving in Singapore.
- ❑ Diversity and numbers of food courts, restaurants, dessert stalls and cafes keep growing.
- ❑ There are plenty of untapped potential markets for culinary entrepreneurs.
- ❑ Location analysis is important for culinary entrepreneurs who want to jump to this opportunity.

Thriving Culinary Venues in Singapore



Figure 1. (a) Singapore location in South East Asia. (b) Singapore's financial centre as well as tourist attraction. (c) Popular food court centre. Various Singaporean food and beverages such as (d) chili crab, (e) Singaporean noodles and (f) Tangyuan dessert.

Credit for photos are attributed to:

a. <https://en.wikipedia.org/wiki/Singapore>, b. Lau Pa Sat Hawker Centre, photo by Allie_Caulfield. - Flickr: 2012-06-17 06-30 Singapore, c. Merlion, photo by Erwin Soo, retrieved from <https://en.wikipedia.org/wiki/Singapore>, d. Chili Crab, photo by megawatts86 - originally posted to Flickr as More Chilli Crab, CC BY-SA 2.0, retrieved from Wikipedia, e. Singapore Style Noodle, photo by Charles Hayness, <https://www.flickr.com/people/87232391@N00>, retrieved from Wikipedia, f. Tangyuan Dessert, photo by Chensiyuan, retrieved from <https://commons.wikimedia.org/w/index.php?curid=3278384>

Problem Description

In summary, the target audience of this presentation is:

- **culinary entrepreneurs (food courts, restaurants, fast food joint, cafes etc), who want to open a new business**

Problems to investigate:

- **Where to open their new business?**
- **How many is their potential customers?**
- **What kind of competitors they may face?**

Why would our target audience (culinary entrepreneurs) care:

- **They need to decide a place to start their business.**
- **Without selecting the correct place, they may fail to get customers.**
- **Also, they need to differentiate themselves from competitors.**

Data Description

There are several main datasets I collected:

- **Zones and Coordinates Info for Each Location in Singapore**
 - **Collected from Wikipedia and with Geocoder**
- **Population Counts for Each Zones**
 - **Collected from Wikipedia:**
['https://en.wikipedia.org/wiki/Planning_Areas_of_Singapore'](https://en.wikipedia.org/wiki/Planning_Areas_of_Singapore)
- **Venues Category and Counts for Each Zones**
 - **Collected using Foursquare API**

Data Relevance, How it Will Solve the Problem

- **Zones and Coordinates Info for Each Location in Singapore**
 - used to identify location of various neighborhood in this city.
- **Population Counts for Each Zones**
 - Regions, with high population counts may provide our target audience (culinary entrepreneur) who want to leverage large number of customers.
- **Venues Category and Counts for Each Zones**
 - Non-culinary venues: to pair with specific offering (1) health-food-restaurant in gym and fitness centre, (2) cold beverages in outdoor parks and beaches.
 - Culinary venues: to avoid competition within similar culinary offering.
Example: ramen stalls vs noodle stalls vs udon stalls.

Data Acquisition: Coordinate Values

- I decide to use Development Guide Plans (DGP) zones or also known as planning areas to divide Singapore neighborhood.
https://en.wikipedia.org/wiki/Planning_Areas_of_Singapore
- Then, I use BeautifulSoup 4 to extract links to almost all zones in Singapore and extract coordinates location from it.
- Some zones has missing coordinates value. For these zones, we put the address into geocoder, then extract the coordinates location.

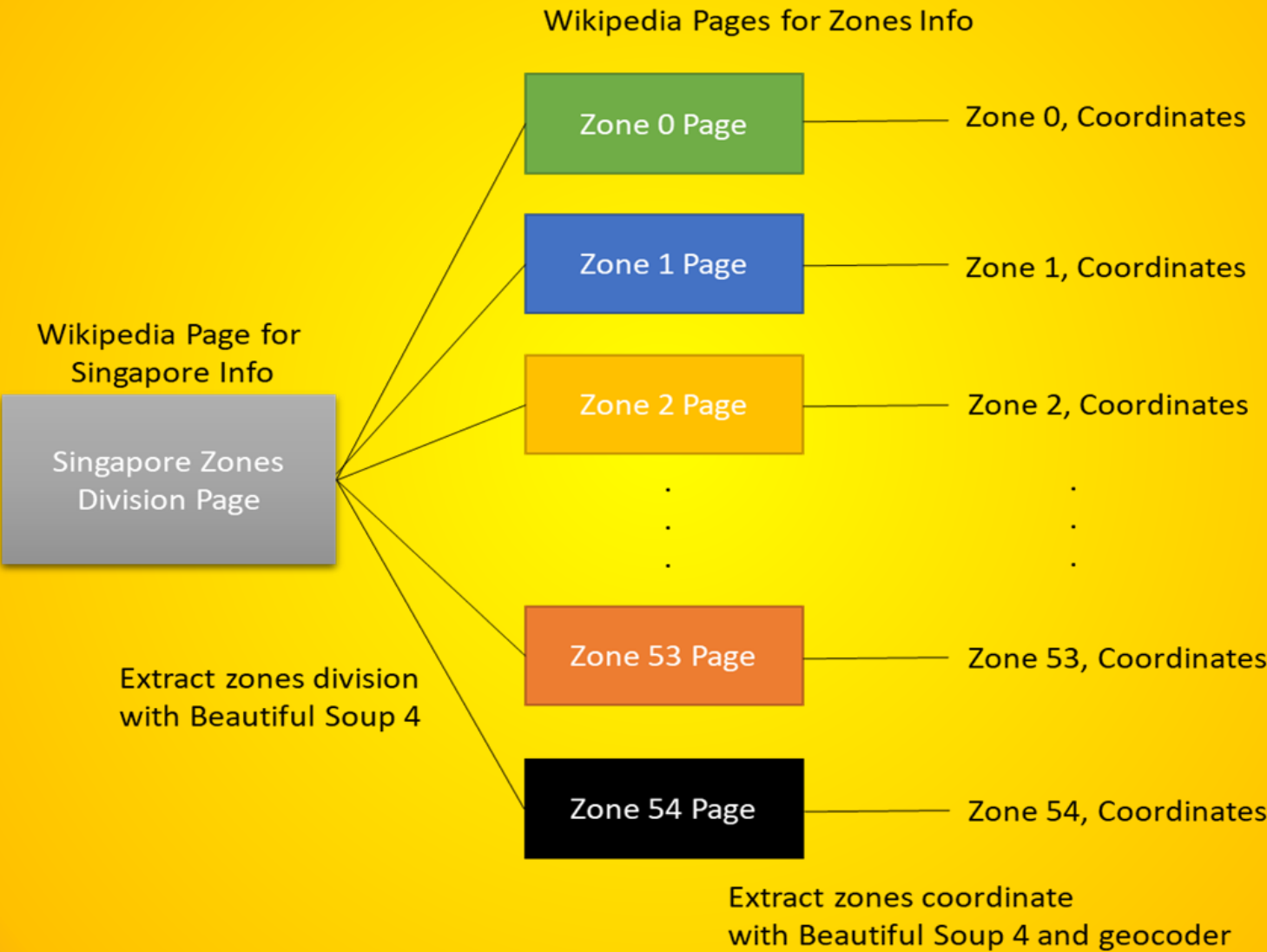


Development Guide Plans (DGP) Zones or Planning Areas in Singapore.

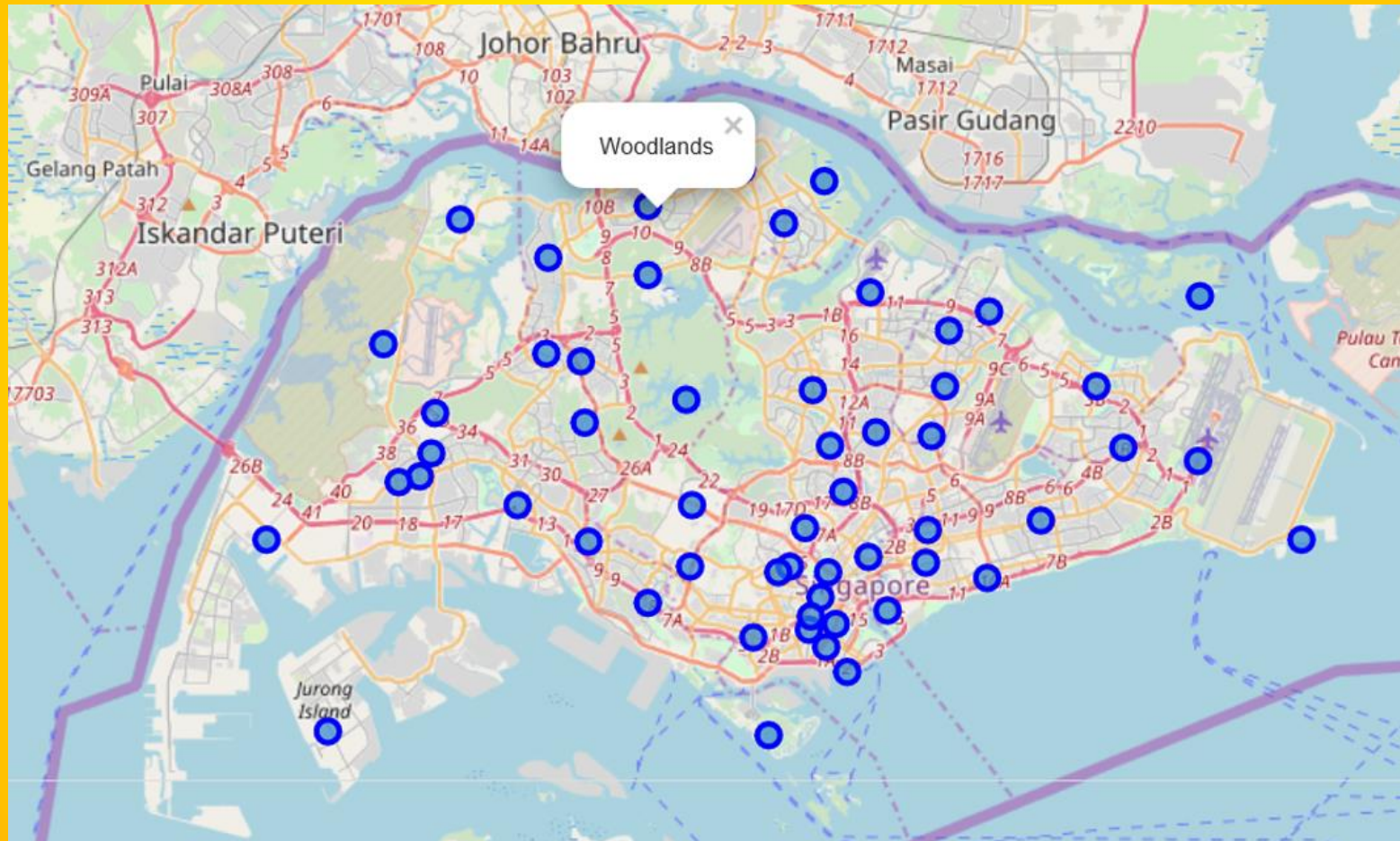


Example of coordinates value in Wikipedia page for each neighborhood.

Data Acquisition: Coordinate Values



Folium Map for Acquired Neighborhood Coordinates



Data Acquisition: Population for Each Neighborhood

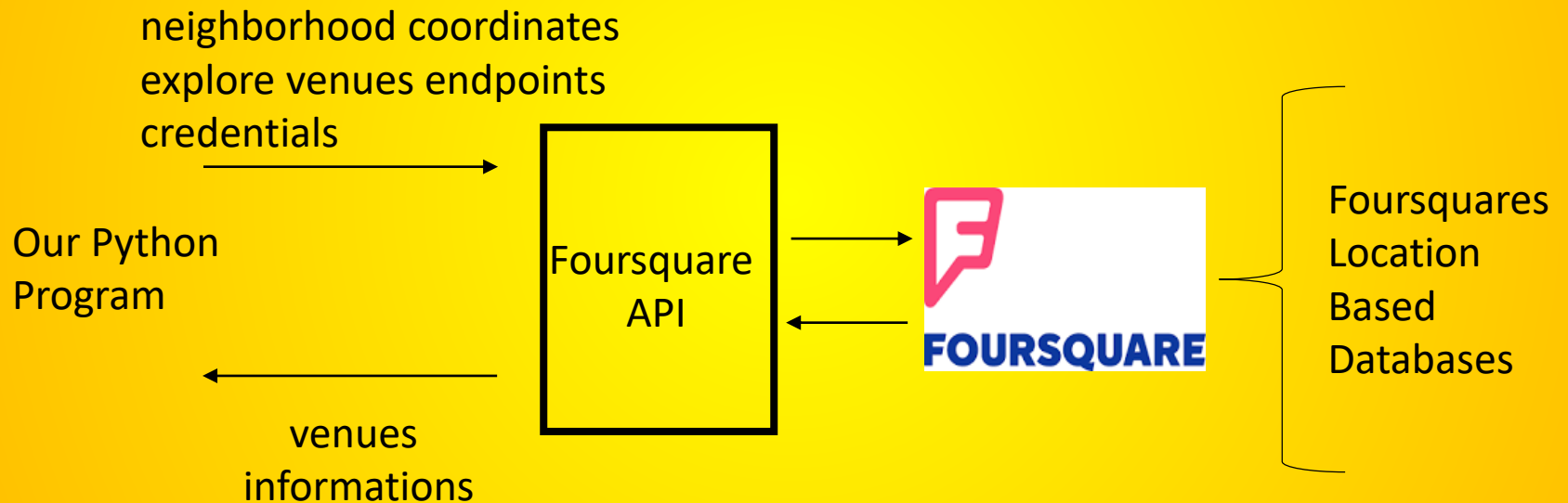
| Name (English) ↕ | Malay ↕ | Chinese ↕ | Pinyin ↕ | Tamil ↕ | Region ↕ | Area (km2) ↕ | Population ^[7] ↕ | Density (/km2) ↕ |
|-------------------------|----------------------------|-----------|----------------------|----------------------------|------------|--------------|-----------------------------|------------------|
| Ang Mo Kio | | 宏茂桥 | Hóng mào qiáo | ஆங் மோ கியோ | North-East | 13.94 | 165,710 | 12,000 |
| Bedok | * | 勿洛 | Wù luò | பிடோக் | East | 21.69 | 281,300 | 13,000 |
| Bishan | | 碧山 | Bì shān | பீஷான் | Central | 7.62 | 88,490 | 12,000 |
| Boon Lay | | 文礼 | Wén lǐ | பூன் லே | West | 8.23 | 30 | 3.6 |
| Bukit Batok | * | 武吉巴督 | Wǔjǐ bā dū | புக்கிட் பாத்தோக் | West | 11.13 | 144,410 | 13,000 |
| Bukit Merah | * | 红山 | Hóng shān | புக்கிட் மேரா | Central | 14.34 | 151,870 | 11,000 |
| Bukit Panjang | * | 武吉班让 | Wǔjǐ bān ràng | புக்கிட் பஞ்சாங் | West | 8.99 | 140,820 | 16,000 |
| Bukit Timah | * | 武吉知马 | Wǔjǐ zhī mǎ | புக்கித் திமா | Central | 17.53 | 77,280 | 4,400 |
| Central Water Catchment | Kawasan Tadahan Air Tengah | 中央集水区 | Zhōngyāng jí shuǐ qū | மத்திய நீர் தீர்ப்பிடிப்பு | North | 37.15 | * | * |
| Changi | * | 樟宜 | Zhāng yí | சாங்கி | East | 40.61 | 2,080 | 62.3 |
| Changi Bay | Teluk Changi | 樟宜湾 | Zhāng yí wān | சாங்கி பே | East | 1.7 | * | * |
| Choa Chu Kang | | 蔡厝港 | Cài cuò gǎng | சுவா கு காங் | West | 6.11 | 187,510 | 31,000 |
| Clementi | | 金文泰 | Jīn wéntài | கிளிமெண்டி | West | 9.49 | 93,000 | 9,800 |
| Downtown Core | Pusat Bandar | 市中心 | Shì zhōngxīn | சின்கப்பூர் நகர மையத்தில் | Central | 4.34 | 2,510 | 580 |

Wikitable format from: https://en.wikipedia.org/wiki/Planning_Areas_of_Singapore

| | DGP zones | zone_links | latitude | longitude | population | areas |
|---|-------------|------------------------------|----------|------------|------------|-------|
| 0 | Ang Mo Kio | /wiki/Ang_Mo_Kio | 1.370167 | 103.845619 | 165710 | 13.94 |
| 1 | Bedok | /wiki/Bedok | 1.323600 | 103.927339 | 281300 | 21.69 |
| 2 | Bishan | /wiki/Bishan,_Singapore | 1.350833 | 103.851389 | 88490 | 7.62 |
| 3 | Boon Lay | /wiki/Boon_Lay_Planning_Area | 1.347735 | 103.708826 | 30 | 8.23 |
| 4 | Bukit Batok | /wiki/Bukit_Batok | 1.359031 | 103.763681 | 144410 | 11.13 |

Pandas Dataframe Format

Data Acquisition: Venues for Each Neighborhood



Data Acquisition:

Example of Venues for Individual Neighborhood

Out [53] :

| | name | categories | lat | lng |
|----|---|--------------------|----------|------------|
| 0 | Bishan - Ang Mo Kio Park | Park | 1.362219 | 103.846250 |
| 1 | Aramsa ~ The Garden Spa | Spa | 1.362292 | 103.847602 |
| 2 | FairPrice Xtra | Supermarket | 1.369279 | 103.848886 |
| 3 | Face Ban Mian 非板面 (Ang Mo Kio) | Noodle House | 1.372031 | 103.847504 |
| 4 | 龍海鮮螃蟹王 Mellben Seafood | Seafood Restaurant | 1.368324 | 103.836764 |
| 5 | NTUC FairPrice | Supermarket | 1.371507 | 103.847082 |
| 6 | Pond Gardens | Park | 1.366381 | 103.834190 |
| 7 | Subway | Sandwich Place | 1.369136 | 103.847612 |
| 8 | Sin Ming Roti Prata (Faisal & Aziz Curry Musli... | Indian Restaurant | 1.355269 | 103.836719 |
| 9 | MOS Burger | Burger Joint | 1.369170 | 103.847831 |
| 10 | Kam Jia Zhuang Restaurant | Asian Restaurant | 1.368167 | 103.844118 |
| 11 | Dog Run @ Bishan Park | Dog Run | 1.365967 | 103.844024 |
| 12 | Central Delights | College Cafeteria | 1.377691 | 103.856590 |
| 13 | Bangkok Street Mookata | BBQ Joint | 1.365688 | 103.853186 |
| 14 | Middle Rock Garden Bar | Bar | 1.362181 | 103.847203 |
| 15 | Boon Tong Kee 文東記 | Chinese Restaurant | 1.367917 | 103.836972 |
| 16 | Prodigal Roasters | Coffee Shop | 1.382212 | 103.841347 |
| 17 | Chocolat N' Spice | Bakery | 1.351867 | 103.837558 |
| 18 | Lao San Kway Chap 老三標汁·豬什汤 | Chinese Restaurant | 1.367916 | 103.837008 |
| 19 | Tomyum Mama | Thai Restaurant | 1.353415 | 103.834441 |
| 20 | PLAYe | Hobby Shop | 1.369109 | 103.848225 |
| 21 | Double Scoops | Ice Cream Shop | 1.367655 | 103.839277 |

Methodology

Exploratory Data Analysis and Inferential Statistical Testing

In terms of exploratory data analysis (EDA), we will try to categorize the venues category in more organized manner. We will tabulate all of culinary and non-culinary category in easily understandable terms.

We will use inferential statistical testing to investigate what kinds of culinary venues is more popular in particular neighborhood. However, it is also important to predict what kinds of potential venues is missing from particular neighborhood.

Methodology

Machine Learning for Neighborhood Clustering

We will use K-Nearest Neighbor method to cluster the neighborhood in order to understand the overall segmentation shared by the neighborhoods. We will use the neighborhood clustering in two different ways:

1. Clustering based on overall population count, venues count, and planning areas type

We will cluster the neighborhood based on population count, venues count, and planning areas type. In terms of population count, a well populated neighborhood may provide significant number of residential customers.

2. Clustering based on culinary venues

Apart from the above considerations, we can further cluster the neighborhood also based on the culinary venues that they already have. This way we can offer our target audience, the culinary entrepreneurs, with data that can help them to check their competitors and their potential customers.

Results:

Exploratory Data Analysis Part 1

- In average, there are 72624 person for each neighborhood.
- The most populous neighborhood, Bedok, has 281300 domestic residents in this zone.
- The median population is in 20030 which is in Outram.
- There are some zones that has zero person since they are in reserved regions.

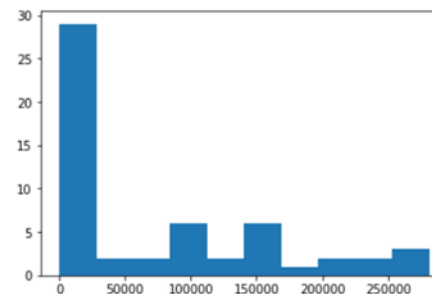
```
In [118]: df_final['population'].describe()

Out[118]: count      55.000000
          mean      72624.000000
          std       88304.424485
          min         0.000000
          25%       180.000000
          50%      20030.000000
          75%      130650.000000
          max      281300.000000
          Name: population, dtype: float64
```

Statistic of population count for all neighborhoods in Singapore.

```
In [132]: plt.hist(df_final['population'], bins=10)

Out[132]: (array([29.,  2.,  2.,  6.,  2.,  6.,  1.,  2.,  2.,  3.]),
          array([ 0., 28130., 56260., 84390., 112520., 140650., 168780.,
                196910., 225040., 253170., 281300.]),
          <a list of 10 Patch objects>)
```



Histogram of population count for all neighborhoods in Singapore.

Results:

Exploratory Data Analysis Part 2

- The number of venues in average is 29.7 venues for each neighborhood.
- The median count of venues is 19.
- The distribution is dominated by some neighborhood that has significantly higher counts of venues than the other.
- There is at least one venues for each neighborhood.

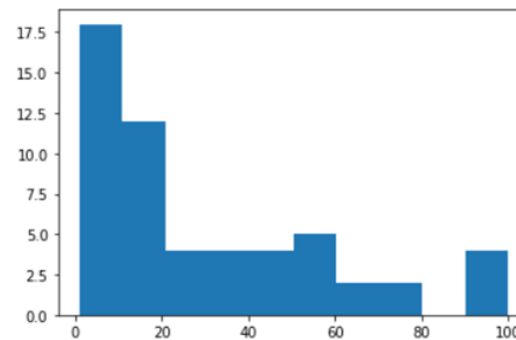
```
In [133]: df_final['venues_count'].describe()

Out[133]: count      55.000000
          mean      29.727273
          std       28.610704
          min        1.000000
          25%        7.000000
          50%       19.000000
          75%       46.000000
          max      100.000000
          Name: venues_count, dtype: float64
```

Statistic of venues count for all neighborhoods in Singapore.

```
In [137]: plt.hist(df_final['venues_count'], bins=10)

Out[137]: (array([18., 12., 4., 4., 4., 5., 2., 2., 0., 4.]),
          array([ 1., 10.9, 20.8, 30.7, 40.6, 50.5, 60.4, 70.3, 80.2,
                90.1, 100. ]),
          <a list of 10 Patch objects>)
```



Histogram of venues count for all neighborhoods in Singapore.

Results: Exploratory Data Analysis Part 3

Culinary Venues in Singapore Neighborhoods

| Major Category | Category (some category may belong to more than one major category) | Explanation |
|--------------------------------------|---|---|
| Food Court and Cafeteria | 'Food Court', 'Breakfast Spot', 'Bistro', 'Deli / Bodega', 'Food Stand', 'Bed & Breakfast', 'Cafeteria', 'Food & Drink Shop', 'Street Food Gathering', 'Comfort Food Restaurant' | General food court and cafeteria, not food or culinary culture specific. |
| Fastfood | 'Burger Joint', 'Sandwich Place', 'Fast Food Restaurant', 'Fried Chicken Joint', 'Steakhouse', 'Burrito Place', 'Wings Joint', 'BBQ Joint', 'Fish & Chips Shop', 'Diner', 'Buffet', 'Pizza Place' | Fastfood (burger, sandwich, fried chicken etc) |
| Dessert, Beverages, and Cafe | 'Dessert Shop', 'Snack Place', 'Coffee Shop', 'Bubble Tea Shop', 'Frozen Yogurt Shop', 'Café', 'Ice Cream Shop', 'Cha Chaan Teng', 'Juice Bar', 'Tea Room', 'Chocolate Shop' | Places that provide dessert without heavy meal, dessert and beverages focused |
| Pub, Bar, Alcoholic Beverages | 'Gastropub', 'Beer Garden', 'Beer Bar', 'Bar', 'Cocktail Bar', 'Club House', 'Nightclub', 'Hotel Bar', 'Whisky Bar', 'Pub', 'Wine Bar', 'Brewery', 'Wine Shop', 'Sake Bar', 'Sports Bar', 'Rock Club' | Focused on alcoholic beverages |
| Bakery, Doughnut and Bagel | 'Bakery', 'Bagel Shop', 'Donut Shop', 'Pastry Shop', 'Creperie', 'Cupcake Shop' | Bakery and similar establishments |
| East Asian Restaurant | 'Asian Restaurant', 'Chinese Restaurant', 'Japanese Restaurant', 'Hong Kong Restaurant', 'Shaanxi Restaurant', 'Cantonese Restaurant', 'Chinese Breakfast Place', 'Korean Restaurant', 'Japanese Curry Restaurant', 'Taiwanese Restaurant', 'Hainan Restaurant', 'Dongbei Restaurant', 'Szechuan Restaurant', 'Peking Duck Restaurant', 'Seafood Restaurant', 'Sushi Restaurant', 'Hotpot Restaurant', 'Noodle House', 'Ramen Restaurant', 'Udon Restaurant', 'Dumpling Restaurant', 'Dim Sum Restaurant' | Chinese, Japanese, Korean, and other East Asian Restaurant |
| South East Asian Restaurant | 'Thai Restaurant', 'Malay Restaurant', 'Indonesian Restaurant', 'Filipino Restaurant', 'Vietnamese Restaurant', 'Halal Restaurant' | South East Asian Restaurant |
| Indian and Middle Eastern Restaurant | 'Indian Restaurant', 'Middle Eastern Restaurant', 'Kebab Restaurant', 'North Indian Restaurant', 'South Indian Restaurant', 'Halal Restaurant', 'Vegetarian / Vegan Restaurant' | Indian and Middle Eastern Restaurant |
| Western Restaurant | 'Modern European Restaurant', 'American Restaurant', 'French Restaurant', 'Italian Restaurant', 'Mexican Restaurant', 'Spanish Restaurant', 'German Restaurant', 'Mediterranean Restaurant', 'Greek Restaurant', 'English Restaurant', 'Cuban Restaurant', 'New American Restaurant', 'Southern / Soul Food Restaurant', 'Australian Restaurant' | Western (Europe, American, and Australian) Restaurant |
| Seafood and Sushi | 'Seafood Restaurant', 'Sushi Restaurant', 'Hotpot Restaurant' | May overlap with Japanese and Chinese restaurant. |
| Udon, Noodle, Ramen | 'Noodle House', 'Ramen Restaurant', 'Udon Restaurant' | Noodle like cuisine. Most East Asian and South East Asian Restaurant may provide this kind of food as well. |
| Dumpling and Dimsum | 'Dumpling Restaurant', 'Dim Sum Restaurant' | May overlap with Chinese Restaurant. |
| Health, Vegetarian, Salad | 'Health Food Store', 'Salad Place', 'Soup Place', 'Vegetarian / Vegan Restaurant', | Vegetable and health focused food. |

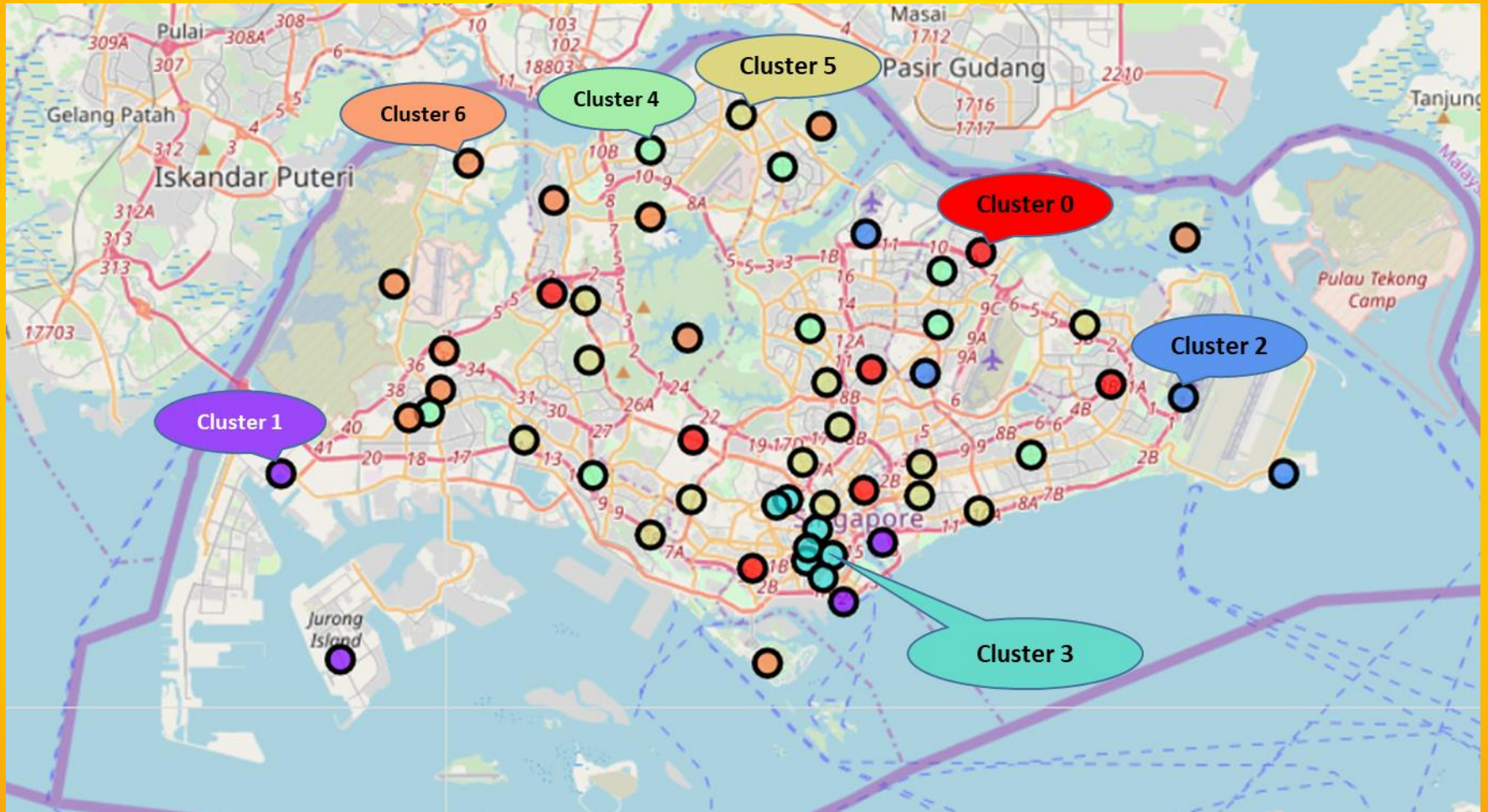
Results: Exploratory Data Analysis Part 4

Non-Culinary Venues in Singapore Neighborhoods

| Major Category | Category | Explanation |
|---|---|--|
| Shopping | 'Supermarket', 'Shopping Mall', 'Electronics Store', 'Convenience Store', 'Department Store', 'Clothing Store', 'Bookstore', 'Plaza', 'Cosmetics Shop', 'Kids Store', 'Grocery Store', 'Video Store', 'Sporting Goods Shop', 'Men's Store', 'Smoke Shop', 'Shoe Store', 'Pet Store', 'Kitchen Supply Store', 'Other Repair Shop', 'Mobile Phone Shop', 'Optical Shop', 'Miscellaneous Shop', 'Jewelry Store', 'Stationery Store', 'Paper / Office Supplies Store', 'Flea Market', 'Gift Shop', 'Bike Rental / Bike Share', 'Fruit & Vegetable Store', 'Flower Shop', 'Auto Garage', 'Bike Shop', 'Shopping Plaza', 'Market', 'Print Shop', 'Night Market', 'Furniture / Home Store', 'Shop & Service', 'Video Game Store' | Shopping places |
| Finance | 'Bank', 'Business Service' | Finance Centres |
| Entertainment | 'Multiplex', 'Karaoke Bar', 'Movie Theater', 'Theater', 'Concert Hall', 'General Entertainment', 'Music Venue', 'Theme Park Ride / Attraction', 'Indie Theater', 'Arts & Entertainment', 'Museum', 'Art Gallery', 'Recreation Center', 'Casino', 'Arcade' | Entertainment Places |
| Park, Garden, Waterbody, Outdoor | 'Trail', 'Garden', 'Garden Center', 'Dog Run', 'Skate Park', 'Park', 'Waterfront', 'Outdoor Sculpture', 'Bridge', 'Bay', 'Sculpture Garden', 'Canal', 'Scenic Lookout', 'Playground', 'Other Great Outdoors', 'Harbor / Marina', 'Beach', 'Pier', 'Cruise', 'River', 'Lighthouse' | Park, Garden, Waterbody, Outdoor Locations |
| Transport | 'Bus Station', 'Train Station', 'Bus Line', 'Light Rail Station', 'Tunnel', 'Platform', 'Airport Service', 'Airport', 'Boat or Ferry', 'Bus Stop', 'Airport Terminal', 'Metro Station' | Transport Hub |
| Sports and Health | 'Gym', 'Gym / Fitness Center', 'Pool Hall', 'Pharmacy', 'Pool', 'Soccer Stadium', 'Martial Arts Dojo', 'Basketball Court', 'Gym Pool', 'Golf Course', 'Medical Center', 'Doctor's Office', 'Golf Driving Range', 'Stadium', 'Field', 'Soccer Field', 'Racetrack' | Sports and Health Places |
| Beauty Care | 'Salon / Barbershop', 'Spa', 'Massage Studio', 'Yoga Studio', 'Dance Studio', 'Boutique' | Beauty Care Places |
| Hotel and Inn | 'Hotel', 'Motel', 'Hostel', 'Rest Area' | Hotel and Inn Places |
| Education | 'General College & University', 'Student Center', 'Speakeasy', 'High School' | Education Places |
| Other | 'Hobby Shop', 'Gaming Cafe', 'Performing Arts Venue', 'History Museum', 'Arts & Crafts Store', 'Monument / Landmark', 'Lounge', 'Event Space', 'Office', 'Government Building', 'Housing Development', 'Post Office', 'Farm' | Other |

Non-culinary venues info is useful to pair up with specific culinary options offering.

Results: Kmeans Clustering with 7 clusters



Results: Kmeans Clustering with 7 clusters

| Cluster | Population Count /neighborhood | Venues Count/ neighborhood | Neighborhoods General Description |
|-----------|-----------------------------------|-------------------------------|---|
| Cluster 0 | 77280 - 257110 | 4 to 12 | heavily populated residential area with few venues |
| Cluster 1 | 0 - 70 | 1 to 13 | industrial areas |
| Cluster 2 | 0 - 2080 | 6 to 20 | airport / airbases areas |
| Cluster 3 | 0 - 20030 | 61 to 100 | financial areas district |
| Cluster 4 | 93000 - 281300 | 32 to 63 | heavily populated residential area with lots of venues |
| Cluster 5 | 9930 - 146920 | 17 to 58 | moderately populated residential area with moderate amount of venues |
| Cluster 6 | 0 to 2090 | 1 to 18 | Sparsely populated areas. Some is in or nearby natural reserved areas. Far from urban centre. |

Discussion: Case Study 1

Opening Healthy Food Near Health and Sport Centre

We want to study whether we can find location of health and sport centre that require healthy food options. This will be useful for culinary entrepreneur who have plans on this specific category.

Discussion: Case Study 1

Opening Healthy Food Near Health and Sport Centre

Statistic of Health Foods Venues Count and Health Centres Count.

```
In [266]: df_case1[['health_foods', 'health_centres']].describe()
```

```
Out[266]:
```

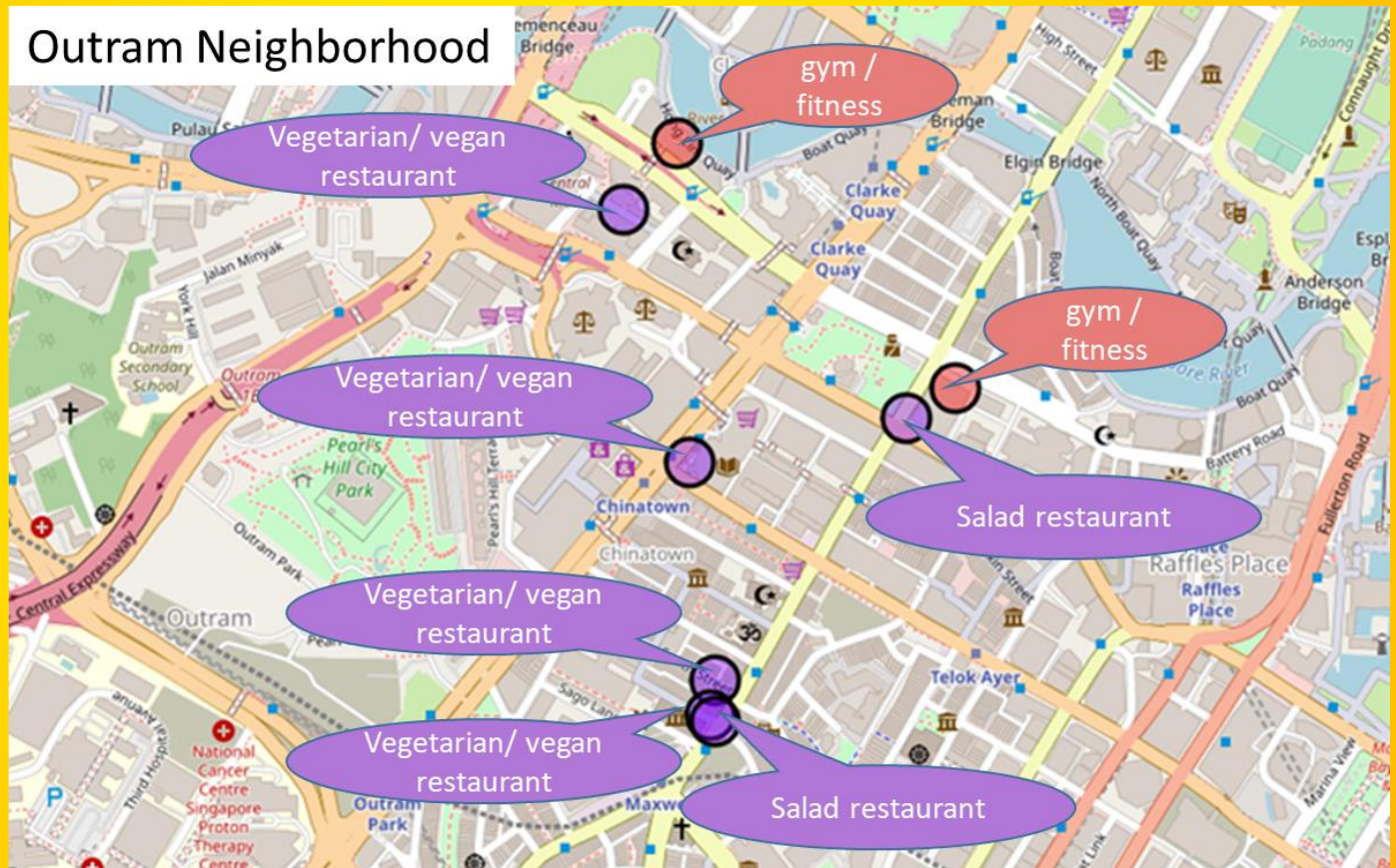
| | health_foods | health_centres |
|-------|--------------|----------------|
| count | 31.000000 | 31.000000 |
| mean | 1.000000 | 2.129032 |
| std | 1.591645 | 1.586231 |
| min | 0.000000 | 0.000000 |
| 25% | 0.000000 | 1.000000 |
| 50% | 0.000000 | 2.000000 |
| 75% | 1.000000 | 3.000000 |
| max | 7.000000 | 6.000000 |

Health Foods and Health Centres Count for Each Neighborhood

| | health_foods | health_centres |
|------------------|--------------|----------------|
| Neighborhood | | |
| Ang Mo Kio | 1 | 4 |
| Bedok | 2 | 0 |
| Bishan | 0 | 5 |
| Boon Lay | 0 | 1 |
| Bukit Batok | 1 | 2 |
| Bukit Panjang | 0 | 3 |
| Bukit Timah | 0 | 1 |
| Changi Bay | 0 | 1 |
| Clementi | 1 | 2 |
| Downtown Core | 2 | 2 |
| Geylang | 1 | 2 |
| Hougang | 1 | 1 |
| Jurong East | 0 | 3 |
| Marina East | 0 | 3 |
| Marine Parade | 2 | 0 |
| Museum | 0 | 1 |
| Newton | 1 | 1 |
| Novena | 1 | 2 |
| Outram | 7 | 2 |
| Pasir Ris | 1 | 0 |
| Pioneer | 0 | 6 |
| Queenstown | 0 | 2 |
| Rochor | 3 | 0 |
| Sengkang | 0 | 2 |
| Singapore River | 5 | 3 |
| Southern Islands | 0 | 4 |
| Straits View | 2 | 6 |
| Tanglin | 0 | 2 |
| Toa Payoh | 0 | 2 |
| Woodlands | 0 | 1 |
| Yishun | 0 | 2 |

Discussion: Case Study 1

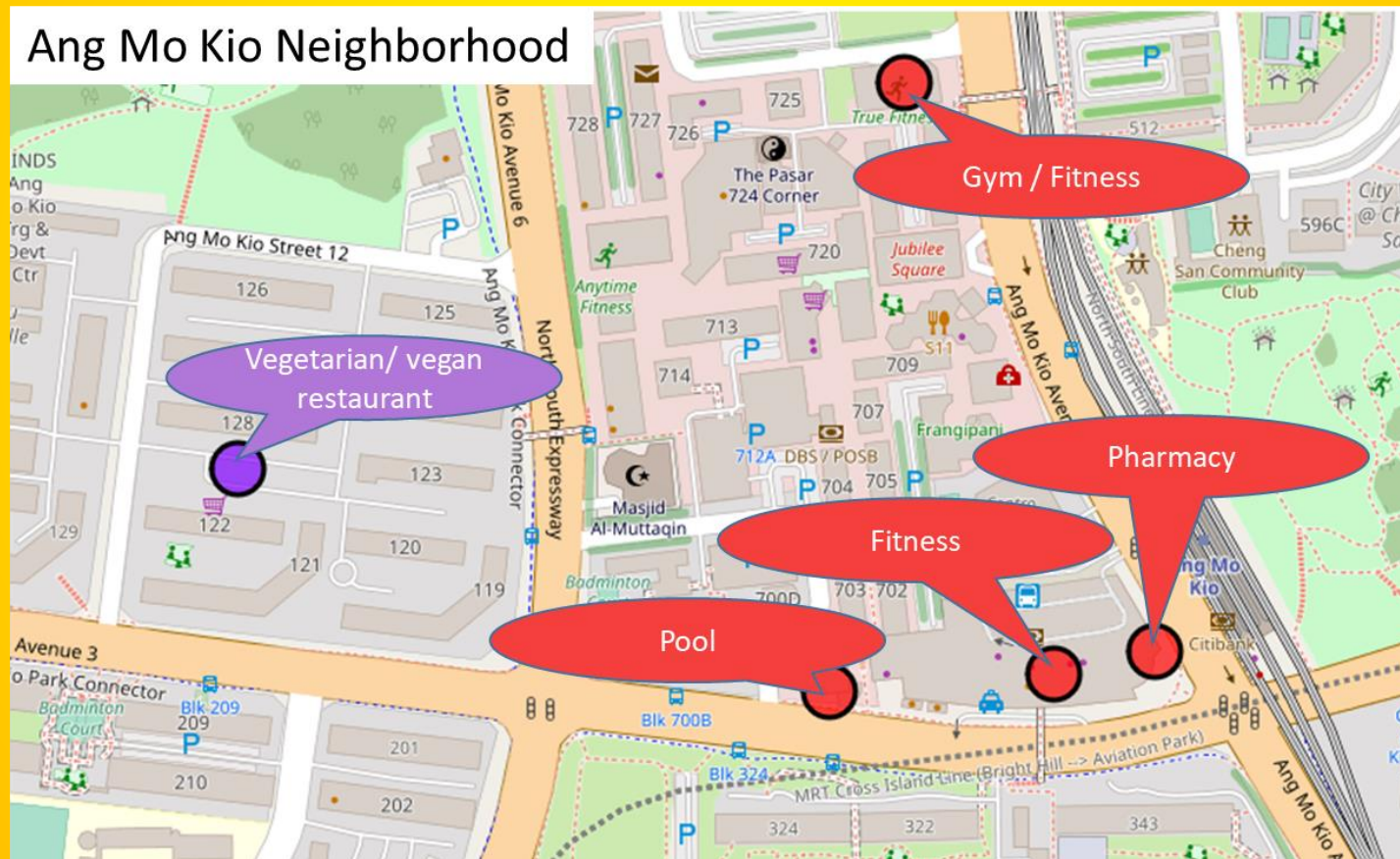
Opening Healthy Food Near Health and Sport Centre



Opening up vegetarian or salad restaurant in this neighborhood will be very competitive. A lots of people have the same idea!

Discussion: Case Study 1

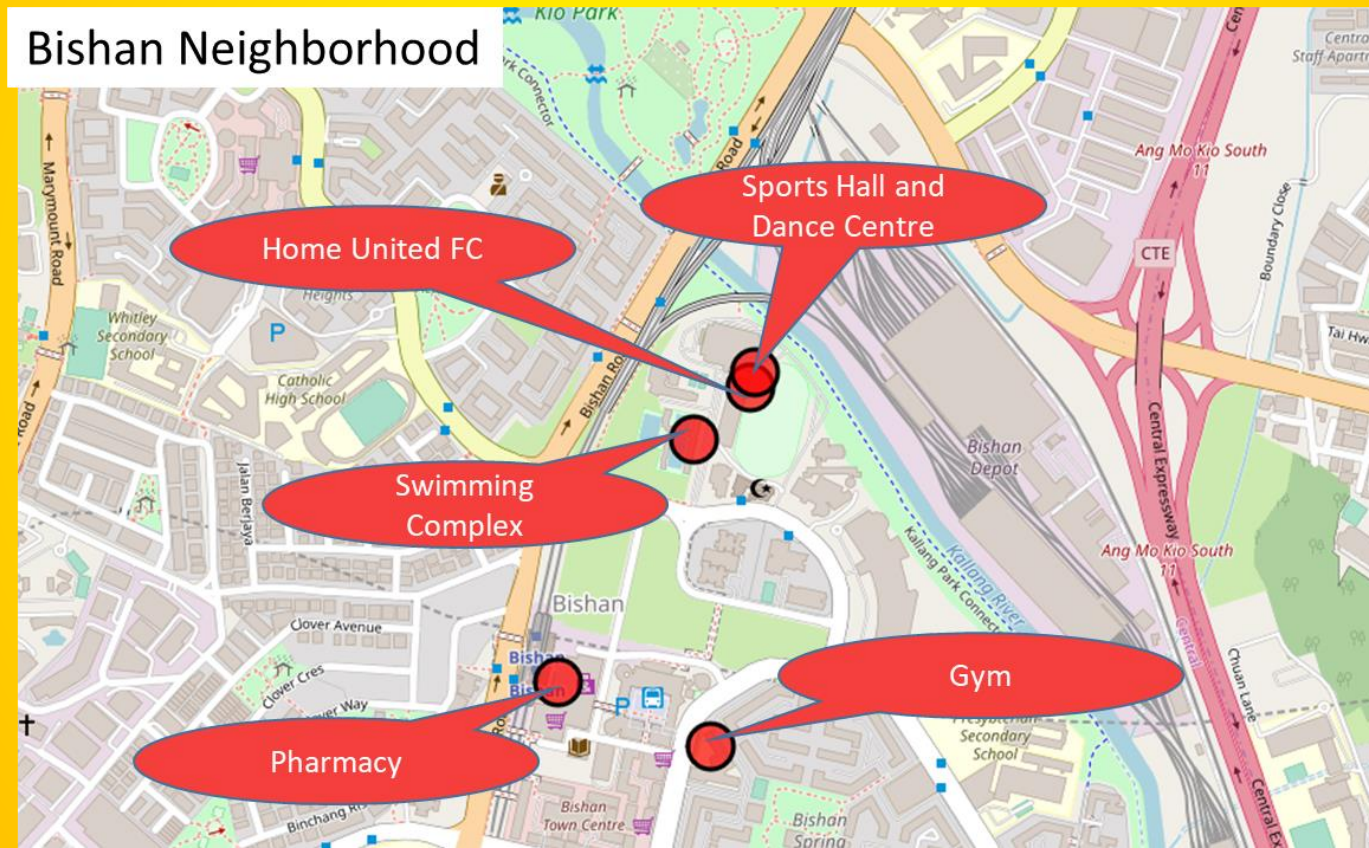
Opening Healthy Food Near Health and Sport Centre



Only one healthy food options around this neighborhood. It seems has a prospect.

Discussion: Case Study 1

Opening Healthy Food Near Health and Sport Centre



No healthy food options around here! Seems like a good opportunity!

Discussion: Case Study 2

Opening Ramen Noodles Shop in Populated Residential Areas

- Most neighborhood have at least one noodles based shop but may have up to 5 of them.
- If someone want to open a new family friendly ramen shop in residential areas, the best bet is to find a neighborhood with the most population while have the fewer number of noodle venues.

Number of noodles based shops (Noodle, Ramen, Udon) in Singapore's Neighborhoods.

```
df_case2['noodle_cluster'] = df_case2['population/noodle_venues'].apply(population_per_noodle_venues_encoder)
df_case2 = df_case2.sort_values('population/noodle_venues', ascending=False)
df_case2
```

| | Neighborhood | noodle_foods | population | longitude | latitude | population/noodle_venues | noodle_cluster |
|----|-----------------|--------------|------------|------------|----------|--------------------------|----------------|
| 5 | Jurong West | 1 | 266720 | 103.704444 | 1.339722 | 266720.000000 | 0 |
| 1 | Bedok | 2 | 281300 | 103.927339 | 1.323600 | 140650.000000 | 0 |
| 4 | Geylang | 1 | 111610 | 103.886944 | 1.320556 | 111610.000000 | 0 |
| 17 | Yishun | 2 | 214940 | 103.835364 | 1.430367 | 107470.000000 | 0 |
| 2 | Bukit Panjang | 2 | 140820 | 103.762500 | 1.380833 | 70410.000000 | 1 |
| 16 | Toa Payoh | 2 | 120480 | 103.856328 | 1.334303 | 60240.000000 | 1 |
| 0 | Ang Mo Kio | 3 | 165710 | 103.845619 | 1.370167 | 55236.666667 | 1 |
| 12 | Queenstown | 2 | 97870 | 103.786128 | 1.294167 | 48935.000000 | 2 |
| 6 | Marine Parade | 1 | 47250 | 103.907778 | 1.303056 | 47250.000000 | 2 |
| 3 | Clementi | 2 | 93000 | 103.764939 | 1.316181 | 46500.000000 | 2 |
| 8 | Novena | 2 | 48950 | 103.842431 | 1.320858 | 24475.000000 | 2 |
| 10 | Outram | 3 | 20030 | 103.843889 | 1.284889 | 6676.666667 | 3 |
| 13 | River Valley | 4 | 9930 | 103.886149 | 1.308398 | 2482.500000 | 3 |
| 14 | Singapore River | 5 | 2980 | 103.845154 | 1.289178 | 596.000000 | 4 |
| 9 | Orchard | 2 | 990 | 103.832876 | 1.305272 | 495.000000 | 4 |
| 7 | Museum | 1 | 420 | 103.848500 | 1.296611 | 420.000000 | 4 |
| 11 | Paya Lebar | 2 | 40 | 103.887821 | 1.353899 | 20.000000 | 4 |
| 15 | Straits View | 2 | 0 | 103.850553 | 1.278552 | 0.000000 | 4 |

Discussion: Case Study 2

Opening Ramen Noodles Shop in Populated Residential Areas

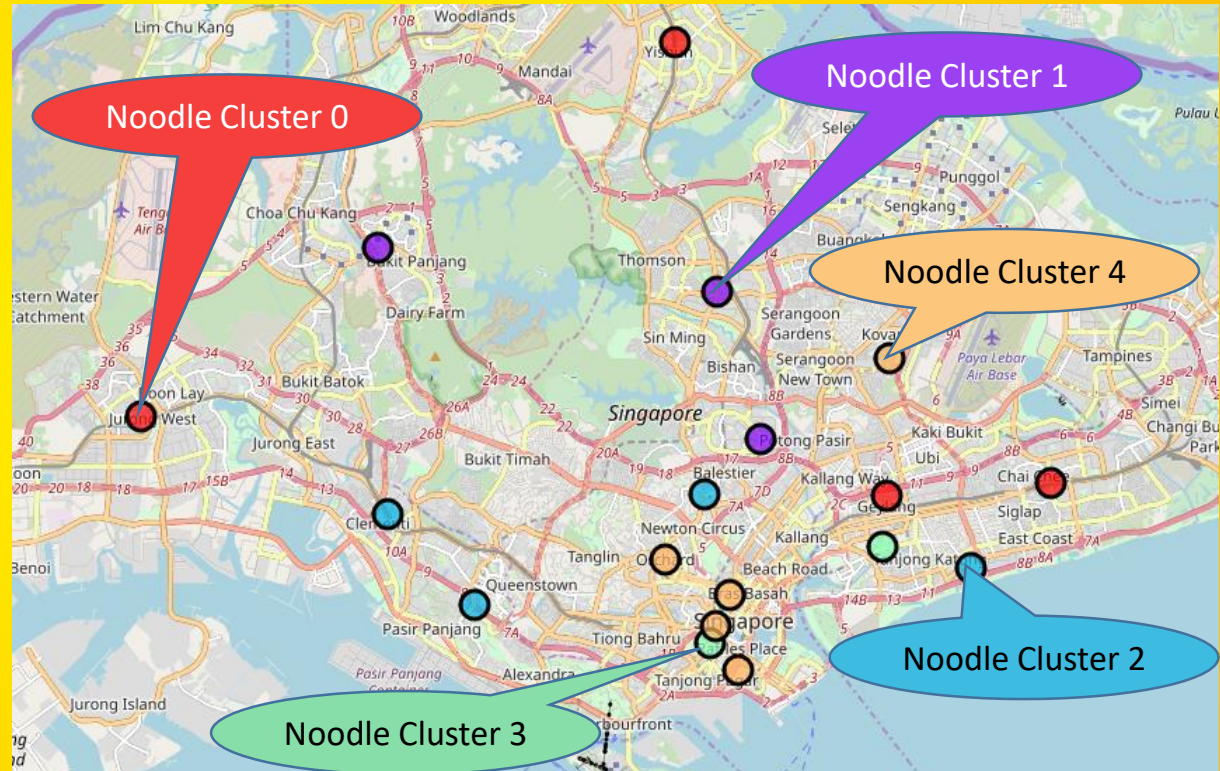
Cluster 4: < 1000
persons / existing
noodles shops

Cluster 3: 1000 to
10000 persons /
existing noodles shops

Cluster 2: 10000 to
50000 persons /
existing noodles shops

Cluster 1: 50000 to
100000 persons /
existing noodles shops

Cluster 0: > 100000
persons / existing
noodles shops



Neighborhood in Cluster 0 is good for family friendly ramen noodles restaurant!

Discussion: Case Study 3

Opening Bubble Tea Stall at Outdoor Parks and Beaches

- If we want to open a refreshment stall, for example selling bubble tea, it may be a good idea to sell them at outdoor parks and beachers.
- In the hot and humid tropical island climate of Singapore, in such places, sweet and cold beverages may sell very well.
- So we need to locate the number of outdoor parks and beaches venues at each neighborhood.

The number of refreshments stalls (cold beverages, desserts, tea shops, cafe) in Singapore Neighborhood.

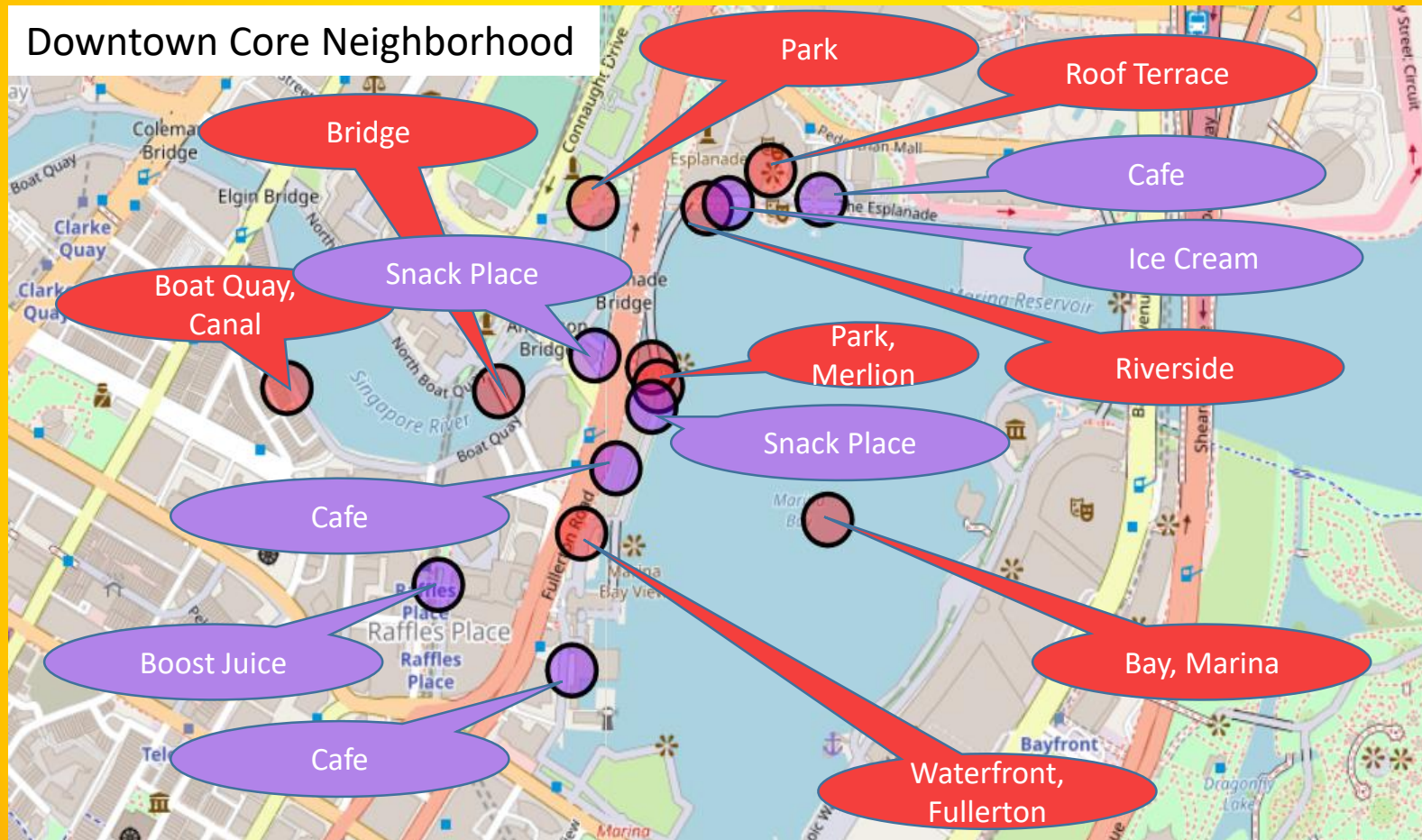
```
In [370]: df_case3['population'] = df_case3['Neighborhood'].apply(neighborhood_population_dictionary_function)
df_case3a = df_case3.sort_values('refreshment per venues')[['Neighborhood', 'refreshing_desserts_beverages_venues', 'outdoor_park_venues']]
df_case3a.head(20)
```

Out[370]:

| | Neighborhood | refreshing_desserts_beverages_venues | outdoor_park_venues | refreshment per venues | population |
|----|-----------------------|--------------------------------------|---------------------|------------------------|------------|
| 16 | Mandai | 0 | 2 | 0.000000 | 2090 |
| 18 | Marina South | 0 | 9 | 0.000000 | 0 |
| 17 | Marina East | 0 | 1 | 0.000000 | 0 |
| 22 | North-Eastern Islands | 0 | 1 | 0.000000 | 50 |
| 11 | Downtown Core | 7 | 9 | 0.777778 | 2510 |
| 41 | Tuas | 1 | 1 | 1.000000 | 70 |
| 37 | Southern Islands | 1 | 1 | 1.000000 | 1800 |
| 32 | Seletar | 1 | 1 | 1.000000 | 250 |
| 36 | Singapore River | 5 | 4 | 1.250000 | 2980 |
| 40 | Tos Payoh | 2 | 1 | 2.000000 | 120480 |
| 35 | Serangoon | 2 | 1 | 2.000000 | 117310 |
| 31 | Rochor | 3 | 1 | 3.000000 | 13450 |
| 34 | Sengkang | 3 | 1 | 3.000000 | 240640 |
| 43 | Yishun | 7 | 2 | 3.500000 | 214940 |
| 19 | Marine Parade | 4 | 1 | 4.000000 | 47250 |
| 14 | Jurong West | 11 | 2 | 5.500000 | 266720 |
| 6 | Bukit Panjang | 6 | 1 | 6.000000 | 140820 |
| 20 | Museum | 9 | 1 | 9.000000 | 420 |
| 25 | Outram | 9 | 1 | 9.000000 | 20030 |
| 1 | Bedok | 10 | 1 | 10.000000 | 281300 |

Discussion: Case Study 3

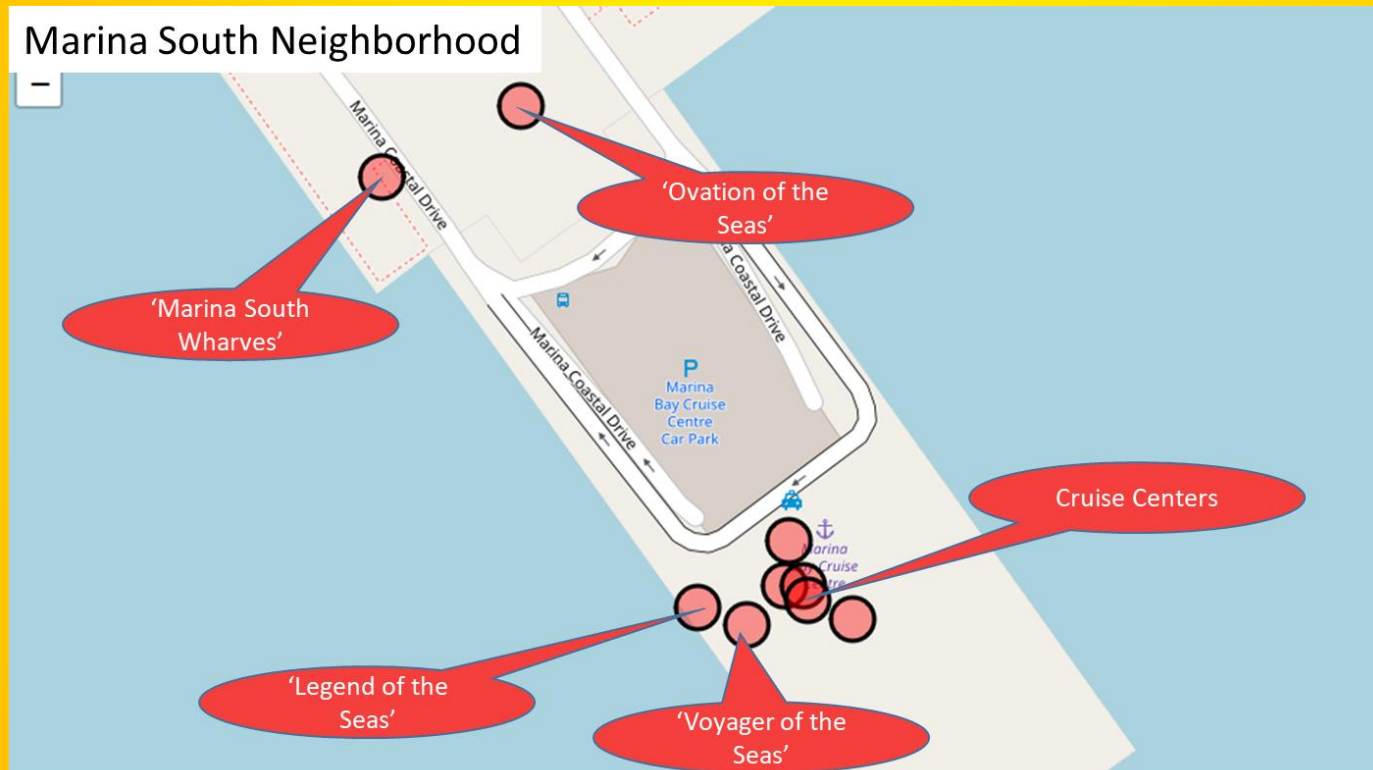
Opening Bubble Tea Stall at Outdoor Parks and Beaches



Plenty of outdoor venues. There are competitors for juice, ice cream, and cafes. No bubble tea stall, but complementary product options are widely available.

Discussion: Case Study 3

Opening Bubble Tea Stall at Outdoor Parks and Beaches



Decent number of outdoor venues. Lacks of any competitive stalls for cold beverages and desserts. Seems like a good opportunity!

Conclusion

- ❑ In this report, I studied the clustering of Singapore's neighborhoods based on their population and venues count.
- ❑ Using Foursquare API, I collected detailed information about local venues to study culinary and non-culinary venues on each particular neighborhood.
- ❑ Subsequently, I used this information to study locations for new culinary venues that can serve the particular locale needs and requirements.
- ❑ These model can be useful to help culinary entrepreneurs to decide locations that offer numerous customers and with fewer number of competitors.