

1 Introduction

1.1 Description of Project

Singapore is a sovereign city-state and island country located in South East Asia. Toronto, on the other hand, is the most populous city in Canada located in the continent of North America. While one might say that both cities are more different than they are similar, from their cultures to the location that each city is situated. However, the sizes of both cities and their populations are in the same ranges. Furthermore, their quality of living is comparable, and there is a sizable number of Singaporeans living in Toronto and vice versa.

1.2 Aim

The aim of this project is to compare the top common venues that people like to visit in the City of Toronto and Singapore. Using location data to explore the geographical location of Singapore, key insights was gathered and will be presented in this report. This report is mainly targeted at Canadians who are currently living in Toronto and are thinking of relocating to Singapore or Singaporeans who want to relocate to Toronto. This report will hopefully provide the key insights and information that these people will need to make an informed decision.

2 Methodology

In this project, the Foursquare location data API was used to explore the geographical location of Singapore. Firstly, the data was scraped from the Wikipedia page¹ :

2.1 Data Retrieval

The beautiful soup python package was used to retrieve the data from Wikipedia and pandas library was used to process the retrieved data, separating Singapore into its respective locations by its postal sector.

	Postal district	Postal sector	General location
0	01	01, 02, 03, 04, 05, 06	Raffles Place, Cecil, Marina, People's Park
1	02	07, 08	Anson, Tanjong Pagar
2	03	14, 15, 16	Bukit Merah, Queenstown, Tiong Bahru
3	04	09, 10	Telok Blangah, Harbourfront
4	05	11, 12, 13	Pasir Panjang, Hong Leong Garden, Clementi New...
5	06	17	High Street, Beach Road (part)
6	07	18, 19	Middle Road, Golden Mile
7	08	20, 21	Little India, Farrer Park, Jalan Besar, Lavender
8	09	22, 23	Orchard, Cairnhill, River Valley
9	10	24, 25, 26, 27	Ardmore, Bukit Timah, Holland Road, Tanglin

¹ https://en.wikipedia.org/wiki/Postal_codes_in_Singapore.

10	11	28, 29, 30	Watten Estate, Novena, Thomson
11	12	31, 32, 33	Balestier, Toa Payoh, Serangoon
12	13	34, 35, 36, 37	Macpherson, Braddell
13	14	38, 39, 40, 41	Geylang, Eunos
14	15	42, 43, 44, 45	Katong, Joo Chiat, Amber Road
15	16	46, 47, 48	Bedok, Upper East Coast, Eastwood, Kew Drive
16	17	49, 50, 51	Loyang, Changi
17	18	51, 52	Simei, Tampines, Pasir Ris
18	19	53, 54, 55, 56	Serangoon Garden, Hougang, Punggol
19	20	56, 57	Bishan, Ang Mo Kio
20	21	58, 59	Upper Bukit Timah, Clementi Park, Ulu Pandan
21	22	60, 61, 62, 63, 64	Jurong, Tuas
22	23	65, 66, 67, 68	Hillview, Dairy Farm, Bukit Panjang, Choa Chu ...
23	24	69, 70, 71	Lim Chu Kang, Tengah
24	25	72, 73	Kranji, Woodgrove, Woodlands
25	26	77, 78	Upper Thomson, Springleaf
26	27	75, 76	Yishun, Sembawang
27	28	79, 80	Seletar

Figure 1: Postal Codes of areas in Singapore

The geocoder library was also used to retrieve the longitude and latitudes of the various postal sectors.

	PostalCode	Latitude	Longitude
0	01, 02, 03, 04, 05, 06	1.28372	103.851013
1	07, 08	1.27372	103.843610
2	14, 15, 16	1.28531	103.832619
3	09, 10	1.26535	103.818848
4	11, 12, 13	1.28980	103.785332

Figure 2: Latitude and Longitude of different Postal sectors

	Postal district	Postal sector	Generallocation	Latitude	Longitude
0	01	01, 02, 03, 04, 05, 06	Raffles Place, Cecil, Marina, People's Park	1.28372	103.851013
1	02	07, 08	Anson, Tanjong Pagar	1.27372	103.843610
2	03	14, 15, 16	Bukit Merah, Queenstown, Tiong Bahru	1.28531	103.832619
3	04	09, 10	Telok Blangah, Harbourfront	1.26535	103.818848
4	05	11, 12, 13	Pasir Panjang, Hong Leong Garden, Clementi New...	1.28980	103.785332

Figure 3: Table in figure 1 and 2 combined

The geolocator package was also used to find the geographical coordinate of Singapore, which is 1.357107, 103.8194992.

The folium map package was then used to plot the locations on the map of Singapore for visualization purposes.

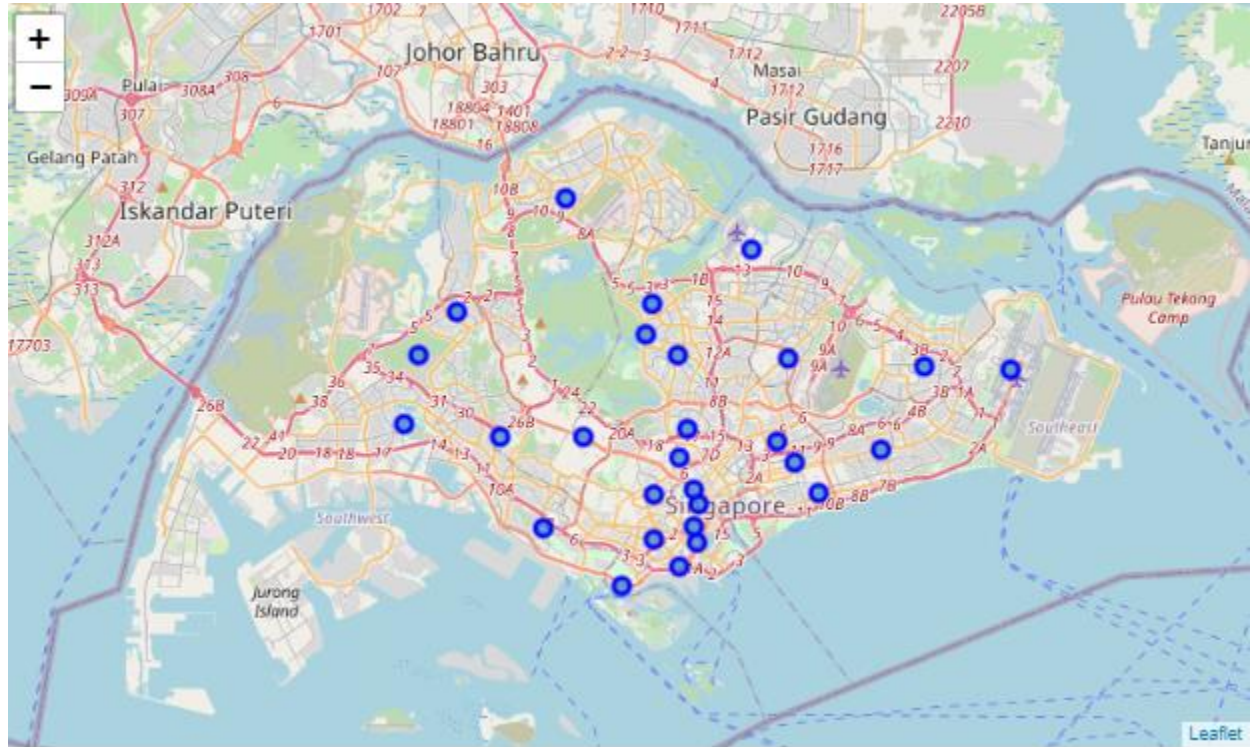


Figure 4: Map of Singapore with the Postal Sectors plotted on the map

Lastly, the Foursquare API was used in the end to retrieve the categories of various venues, before using pandas again to combine both data in both tables and sorting them in their categories.

	Neighbourhood	Neighbourhood Latitude	Neighbourhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0	Raffles Place, Ceoil, Marina, People's Park	1.28372	103.851013	CITY Hot Pot Shabu shabu	1.284173	103.851585	Hotpot Restaurant
1	Raffles Place, Ceoil, Marina, People's Park	1.28372	103.851013	Virgin Active	1.284608	103.850815	Gym / Fitness Center
2	Raffles Place, Ceoil, Marina, People's Park	1.28372	103.851013	The Salad Shop	1.285523	103.851177	Salad Place
3	Raffles Place, Ceoil, Marina, People's Park	1.28372	103.851013	CULINARYON	1.284876	103.850933	Comfort Food Restaurant
4	Raffles Place, Ceoil, Marina, People's Park	1.28372	103.851013	The Fullerton Bay Hotel	1.283878	103.853314	Hotel

Figure 5: Every single venue that was within the 200 radii of each Neighbourhood

Neighbourhood	Neighbourhood Latitude	Neighbourhood Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
Anson, Tanjong Pagar	100	100	100	100	100	100
Ardmore, Bukit Timah, Holland Road, Tanglin	5	5	5	5	5	5
Balestier, Toa Payoh, Serangoon	25	25	25	25	25	25
Bedok, Upper East Coast, Eastwood, Kew Drive	58	58	58	58	58	58
Bishan, Ang Mo Kio	13	13	13	13	13	13
Bukit Merah, Queenstown, Tiong Bahru	97	97	97	97	97	97
Geylang, Eunos	75	75	75	75	75	75
High Street, Beach Road (part)	68	68	68	68	68	68
Hillview, Dairy Farm, Bukit Panjang, Choa Chu Kang	24	24	24	24	24	24
Jurong, Tuas	18	18	18	18	18	18
Katong, Joo Chiat, Amber Road	100	100	100	100	100	100
Kranji, Woodgrove, Woodlands	8	8	8	8	8	8
Little India, Farrer Park, Jalan Besar, Lavender	32	32	32	32	32	32
Loyang, Changi	24	24	24	24	24	24
Macpherson, Braddell	14	14	14	14	14	14
Middle Road, Golden Mile	69	69	69	69	69	69
Orchard, Cairnhill, River Valley	100	100	100	100	100	100
Pasir Panjang, Hong Leong Garden, Clementi New Town	16	16	16	16	16	16
Raffles Place, Cecil, Marina, People's Park	54	54	54	54	54	54
Seletar	6	6	6	6	6	6
Serangoon Garden, Hougang, Punggol	42	42	42	42	42	42
Simei, Tampines, Pasir Ris	17	17	17	17	17	17
Telok Blangah, Harbourfront	80	80	80	80	80	80
Upper Bukit Timah, Clementi Park, Ulu Pandan	6	6	6	6	6	6
Upper Thomson, Springleaf	26	26	26	26	26	26
Watten Estate, Novena, Thomson	63	63	63	63	63	63
Yishun, Sembawang	6	6	6	6	6	6

Figure 6: Venues grouped by each Neighbourhood

It could be seen that there were 197 unique categories from all the queries retrieved.

2.2 Analysing each Neighbourhood

One hot encoding was used to transform all data into values for ease of analysis. The top 10 venues within each location was then listed out, and the top 10 places from each neighborhood was outputted after some churning of data.

```

----Anson, Tanjong Pagar----
      venue  freq
0  Japanese Restaurant 0.13
1      Coffee Shop    0.11
2          Café      0.06
3          Hotel     0.05
4  Ramen Restaurant  0.04
5      Food Court    0.04
6          Bakery    0.03
7  Korean Restaurant 0.03
8  Italian Restaurant 0.02
9  Indian Restaurant  0.02

```

Figure 7: Top 10 places from Anson and Tanjong Pagar

The venues were then sorted in descending order.

Neighbourhood	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
Anson, Tanjong Pagar	Japanese Restaurant	Coffee Shop	Café	Hotel	Ramen Restaurant	Food Court	Bakery	Korean Restaurant	Italian Restaurant
Ardmore, Bukit Timah, Holland Road, Tanglin	Café	Football Stadium	Pool	Bus Station	Gym	Zoo Exhibit	French Restaurant	Food Stand	Food Court
Balestier, Toa Payoh, Serangoon	Chinese Restaurant	Bakery	Dessert Shop	Snack Place	Coffee Shop	Grocery Store	Monument / Landmark	Frozen Yogurt Shop	Pool
Bedok, Upper East Coast, Eastwood, Kew Drive	Coffee Shop	Chinese Restaurant	Asian Restaurant	Food Court	Japanese Restaurant	Sandwich Place	Supermarket	Bakery	Fast Food Restaurant
Bishan, Ang Mo Kio	Chinese Restaurant	Park	Dessert Shop	Food Court	Japanese Restaurant	Dog Run	Bus Station	General Entertainment	Asian Restaurant

Figure 8: Venues in each Neighbourhood sorted in descending order

2.3 Clustering neighborhoods using k means

The neighbourhoods were clustered into areas using k means method. The number of clusters was set to 5 because in Singapore is normally separated into 5 different areas: North, South, East, West, and Central.

	Postal district	Postal sector	General location	Latitude	Longitude	Cluster_Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue
0	01	01, 02, 03, 04, 05, 06	Raffles Place, Cecil, Marina, People's Park	1.283720	103.851013	0	Hotel	Salad Place	Cocktail Bar	Coffee Shop
1	02	07, 08	Anson, Tanjong Pagar	1.273720	103.843610	0	Japanese Restaurant	Coffee Shop	Café	Hotel
2	03	14, 15, 16	Bukit Merah, Queenstown, Tiong Bahru	1.285310	103.832619	0	Café	Chinese Restaurant	Asian Restaurant	Noodle House
3	04	09, 10	Telok Blangah, Harbourfront	1.265350	103.818848	0	Clothing Store	Chinese Restaurant	Toy / Game Store	Bakery
4	05	11, 12, 13	Pasir Panjang, Hong Leong Garden, Clementi New...	1.289800	103.785332	0	Coffee Shop	Office	Asian Restaurant	Restaurant
5	06	17	High Street, Beach Road (part)	1.290580	103.849584	0	Japanese Restaurant	Hotel	Italian Restaurant	Bar
6	07	18, 19	Middle Road, Golden Mile	1.300120	103.851990	0	Café	Hotel	Japanese Restaurant	Chinese Restaurant
7	08	20, 21	Little India, Farrer Park, Jalan Besar, Lavender	1.308880	103.849407	3	Indian Restaurant	Vegetarian / Vegan Restaurant	Sporting Goods Shop	Restaurant
8	09	22, 23	Orchard, Caimhill, River Valley	1.304484	103.832353	0	Boutique	Sushi Restaurant	Japanese Restaurant	Hotel
9	10	24, 25, 26, 27	Ardmore, Bukit Timah, Holland Road, Tanglin	1.329488	103.802053	1	Café	Football Stadium	Pool	Bus Station
10	11	28, 29, 30	Watten Estate, Novena, Thomson	1.319988	103.843414	0	Café	Coffee Shop	Hotel	Italian Restaurant
11	12	31, 32, 33	Balestier, Toa Payoh, Serangoon	1.332388	103.847014	0	Chinese Restaurant	Bakery	Dessert Shop	Snack Place
12	13	34, 35, 36, 37	Macpherson, Braddell	1.327333	103.885232	2	Food Court	Asian Restaurant	Bistro	Bus Station

Figure 9: Neighbourhoods with their Cluster labels

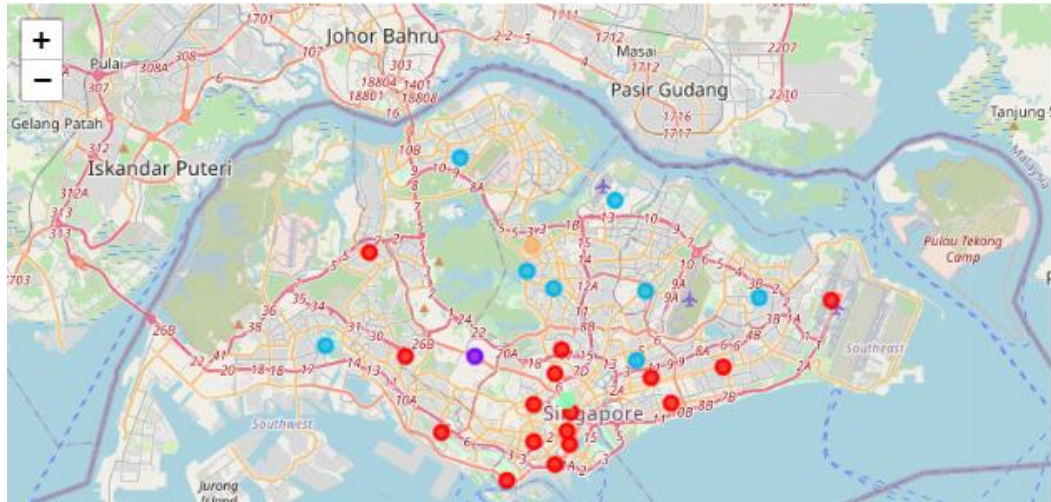


Figure 10: Neighbourhoods with their Cluster plotted on the Singapore map

Postal sector	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
0 01, 02, 03, 04, 05, 06	0	Hotel	Salad Place	Cocktail Bar	Coffee Shop	Food Court	French Restaurant	Japanese Restaurant	Italian Restaurant	Nightclub	Gym / Fitness Center
1 07, 08	0	Japanese Restaurant	Coffee Shop	Café	Hotel	Ramen Restaurant	Food Court	Bakery	Korean Restaurant	Italian Restaurant	Indian Restaurant
2 14, 15, 16	0	Café	Chinese Restaurant	Asian Restaurant	Noodle House	Hotel	Seafood Restaurant	Bookstore	Bakery	Coffee Shop	Thai Restaurant
3 09, 10	0	Clothing Store	Chinese Restaurant	Toy / Game Store	Bakery	Fast Food Restaurant	Food Court	Asian Restaurant	Spa	Office	Coffee Shop
4 11, 12, 13	0	Coffee Shop	Office	Asian Restaurant	Restaurant	Medical Center	Kebab Restaurant	Pharmacy	Beer Bar	Vietnamese Restaurant	Hong Kong Restaurant
5 17	0	Japanese Restaurant	Hotel	Italian Restaurant	Bar	Cocktail Bar	Concert Hall	Bistro	Shopping Mall	Nightclub	Bakery
6 18, 19	0	Café	Hotel	Japanese Restaurant	Chinese Restaurant	Gaming Cafe	Sandwich Place	Bakery	Ice Cream Shop	Art Museum	Art Gallery
8 22, 23	0	Boutique	Sushi Restaurant	Japanese Restaurant	Hotel	Bakery	Cosmetics Shop	Shopping Mall	Coffee Shop	Asian Restaurant	Department Store
10 28, 29, 30	0	Café	Coffee Shop	Hotel	Italian Restaurant	Japanese Restaurant	Ramen Restaurant	Chinese Restaurant	Bakery	Thai Restaurant	Asian Restaurant
11 31, 32, 33	0	Chinese Restaurant	Bakery	Dessert Shop	Snack Place	Coffee Shop	Grocery Store	Monument / Landmark	Frozen Yogurt Shop	Pool	Café
13 38, 39, 40, 41	0	Shopping Mall	Fast Food Restaurant	Food Court	Asian Restaurant	Supermarket	Coffee Shop	Chinese Restaurant	Indonesian Restaurant	Ramen Restaurant	Café
14 42, 43, 44, 45	0	Chinese Restaurant	Asian Restaurant	Coffee Shop	Japanese Restaurant	Indian Restaurant	Hotel	Shopping Mall	Café	Bar	Bakery
15 46, 47, 48	0	Coffee Shop	Chinese Restaurant	Asian Restaurant	Food Court	Japanese Restaurant	Sandwich Place	Supermarket	Bakery	Fast Food Restaurant	Dessert Shop
16 49, 50, 81	0	Airport Lounge	Boutique	Airport	Ice Cream Shop	Supermarket	Border Crossing	Sandwich Place	Café	Bubble Tea Shop	Duty-free Shop
20 58, 59	0	Café	Plaza	Playground	Bus Line	Bus Stop	Cafeteria	Zoo Exhibit	Football Stadium	Food Stand	Food Court
22 65, 66, 67, 68	0	Coffee Shop	Café	Fast Food Restaurant	Playground	Paper / Office Supplies Store	Furniture / Home Store	Bubble Tea Shop	Chinese Restaurant	Bookstore	Noodle House

Figure 11: Singapore - Cluster 1

Postal sector	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	
9	24, 25, 26, 27	1	Café	Football Stadium	Pool	Bus Station	Gym	Zoo Exhibit	French Restaurant	Food Stand	Food Court	Food & Drink Shop

Figure 12: Singapore - Cluster 2

	Postal sector	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
12	34, 35, 36, 37	2	Food Court	Asian Restaurant	Bistro	Bus Station	French Restaurant	Chinese Restaurant	Vegetarian / Vegan Restaurant	Noodle House	Coffee Shop	Soccer Field
17	51, 52	2	Coffee Shop	Park	Convenience Store	Stadium	Café	Supermarket	Asian Restaurant	Trail	Lighting Store	Restaurant
18	53, 54, 55, 82	2	Chinese Restaurant	Café	Coffee Shop	Bus Station	Convenience Store	Dim Sum Restaurant	Bakery	Asian Restaurant	Playground	Restaurant
19	56, 57	2	Chinese Restaurant	Park	Dessert Shop	Food Court	Japanese Restaurant	Dog Run	Bus Station	General Entertainment	Asian Restaurant	Skating Rink
21	60, 61, 62, 63, 64	2	Bus Station	Zoo Exhibit	Sandwich Place	Bakery	Café	Chinese Restaurant	Coffee Shop	Discount Store	Food Court	Garden
24	72, 73	2	Fast Food Restaurant	Food Court	Restaurant	Pizza Place	Supermarket	Soccer Field	Park	Bus Station	Zoo Exhibit	Food Stand
25	77, 78	2	Chinese Restaurant	Asian Restaurant	Park	Japanese Restaurant	Bus Station	Seafood Restaurant	Breakfast Spot	Café	Restaurant	Food Court
27	79, 80	2	Resort	Gastropub	Airport Terminal	Food Court	Asian Restaurant	Café	Field	Fried Chicken Joint	French Restaurant	Football Stadium

Figure 13: Singapore - Cluster 3

Postal sector	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	
7	20, 21	3	Indian Restaurant	Vegetarian / Vegan Restaurant	Sporting Goods Shop	Restaurant	Bakery	Museum	Rock Club	Motel	Coffee Shop	Hotel

Figure 14: Singapore - Cluster 4

Postal sector	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	
26	75, 76	4	Office	Restaurant	Playground	Food & Drink Shop	Chinese Restaurant	Bar	Zoo Exhibit	French Restaurant	Football Stadium	Food Stand

Figure 15: Singapore - Cluster 5

2.4 Comparing clusters and general observations

From the map plotted in section 2.3, it can be seen that the 5 clusters were mostly correctly predicted, with a few outliers. There is a cluster towards the north-east (Teal), a cluster along the East coast stretches towards the West coast, one cluster in Bukit Timah, one in CBD, and lastly one in Lentor.

3 Comparing Singapore and Toronto

3.1 Data for Toronto

From Cluster 1, it could be seen that the most common venues are restaurants, coffee shops and pizza places.

From Cluster 2, the most common venues are Grocery stores, Parks and Pizza places.

For Cluster 3, the most common venues are Parks, Playground and Yoga Studios

For Cluster 4, the most common venues are Paper / Office Supplies Store, Baseball Field and Yoga Studios

For Cluster 5, the most common venues are Gardens, Yoga Studio and Farmers market

3.2 Comparison

It can be seen from the data of Clusters in Singapore that the city state has no shortage of food, most popular places in Clusters 1 – 4 has food as a top venue. As such, Singapore's Clusters 1 – 4 are the most similar to Toronto's clusters 1 and 2, while Singapore's Clusters 5 is the most similar to Toronto's clusters 3 – 5.

4 Conclusion

In conclusion, it can be seen that since Singapore's Clusters 1 – 4 are the most similar to Toronto's clusters 1 and 2, while Singapore's Clusters 5 is the most similar to Toronto's clusters 3 – 5, these are the places that Canadians and Singaporeans should relocate to. For example, a Singaporean living in Cluster 3 should relocating to Toronto cluster 1 or 2. This should help the Singaporean adjust best to the new environment after relocation. This guide should not be standalone and users should use the results from this report with other indicators to best decide area of relocation.