Opening new bakeries in three cities

Contents

1 Introduction

1.1 Background

A (hypothetical) client is interested in opening new bakeries in three different cities: New York City, Chicago and Toronto. Three cities are different and it would be very difficult to make decisions regarding where to open new bakeries without thorough knowledge on these cities. However we found that a data driven decision making process can help this client decide which neighbourhoods would be the good candidates to open new ones.

1.2 Business Problem

Three decision criteria were identified as an initial step.

- Location considerations

- Baked goods considerations

- Unique considerations

For example, rent expense will be a part of location considerations and the client's speciality item will be a part of baked goods considerations. Unique considerations will include all client-specific constraints (for example, tax considerations). These will be not a part of our problem since they won't deliver homogeneous results based on dataset.

Our main decision criteria come from Foraging Theory[1]. Among many implications from Foraging Theory, we found two are especially relevant to our research. According to the theory,

1. food outlet is bunching to capture efficiency (location consideration)

2. sensory-specific satiety (i.e. the allure of variety, colour)

The second implication can be analysed as bakeries offering variety of items such as coffee shop, café, juice bar, bubble tea shop and donut shop. Therefore, we focused on finding:

1. neighbourhood where more bakeries are located (from the first implication)

2. neighbourhood where more coffee shop, café, juice bar, bubble tea shop and donut shop are located (from the second implication)

1.3 Interest

We expect this analysis will help not only this hypothetical client but also people who are interested in opening bakeries (or even coffee shops) in NYC, Chicago and/or Toronto.

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[1]More details can be found here: https://en.wikipedia.org/wiki/Optimal_foraging_theory

2 Data

2.1 Data Sources

2.1.1 Wikipedia

Wikipedia was used as our data source to grab neighbourhood data, which includes neighbourhood location and borough and/or postal code. Note that Chicago does not have borough unlike New York City or Toronto. Therefore, we used Community Areas instead.

- New York City: we will use newyork_data.json file

- Toronto: https://en.wikipedia.org/wiki/List_of_postal_codes_of_Canada:_M

- Chicago: https://en.wikipedia.org/wiki/List_of_neighborhoods_in_Chicago

2.1.2 Foursquare

We used Foursquare as our main data source.

2.2 Data Preparation

2.2.1 New York City

We decided to focus on Manhattan rather than including all suburbs to make our exercise simpler. We did not much to do as a preparation of data here since json file is already well arranged.

2.2.2 Toronto

As we did in our previous exercise, we decided to analyse Toronto borough and neighbourhoods only if borough information exists. That means, we deleted data, which does not have borough information. And we aggregated neighbourhood to the same column using join.

2.2.3 Chicago

We gathered community area and neighbourhood data from Wikipedia saved it in a spreadsheet format. We also included geospatial information as well since reading location data had a problem in the Toronto exercise. Again, similar to Toronto data, we aggregated neighbourhood data to the same column using join.

3 Methodology

3.1 Neighbourhood Map

To identify where neighbourhoods are located, we drew maps for three cities to show neighbourhoods with their geospatial information (i.e. latitude and longitude).

3.1.1 Manhattan
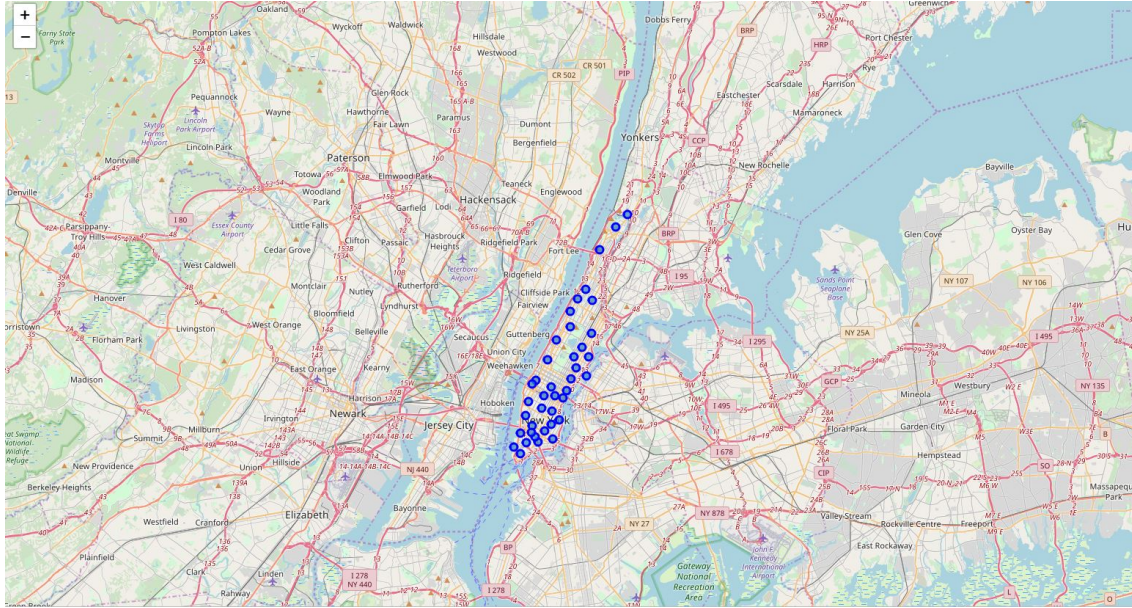
3.1.2 Toronto

3.1.3 Chicago

Note that we used Manhattan data for New York City and boroughs containing Toronto data only (i.e. boroughs containing Toronto) for Toronto data. However, since we only found less than 100 Chicago Community areas and community areas are scattered such that it is more difficult to set a criterion to make the dataset size smaller, we decided to use all Chicago community areas for this analysis.[2]
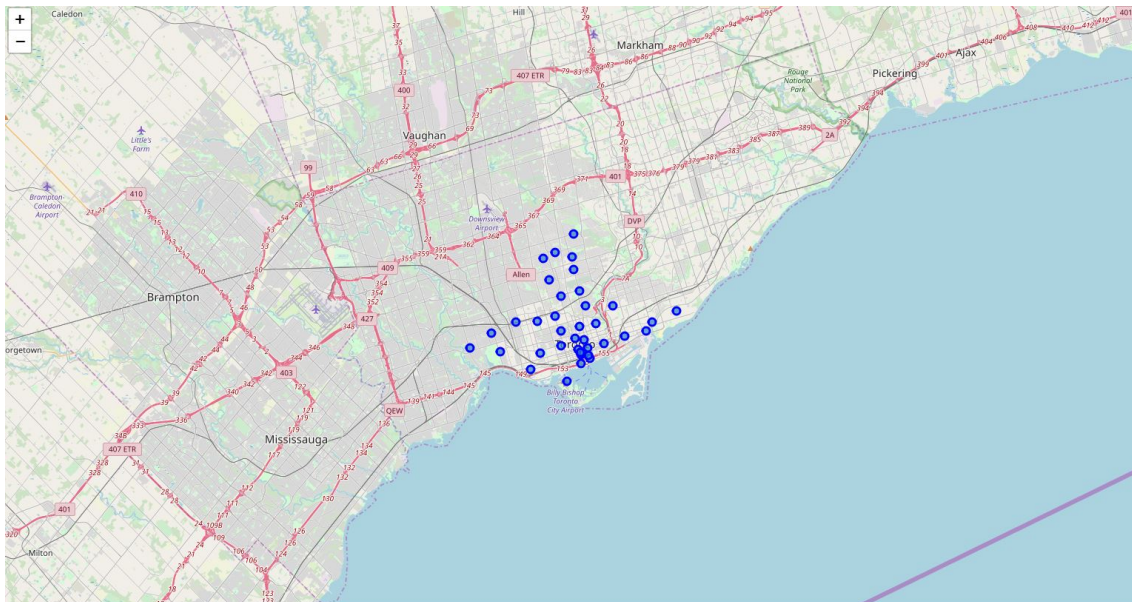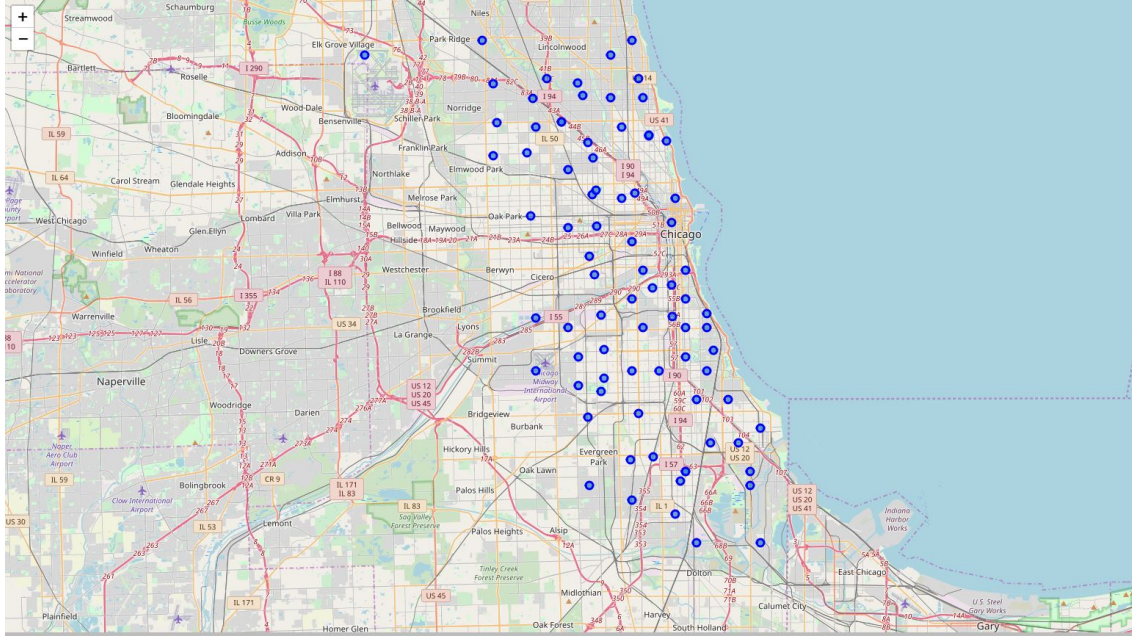
3.2 Reading Foursquare Data

For each city, we read Foursquare Data using Foursquare API. The data fields we called using a user defined function are Venue, Venue Latitude, Venue Longitude and Venue Category[3].

3.3 Analysing Each Neighbourhood

We grouped dataset by neighbourhood and by taking the mean of the frequency of occurrence of each category to determine which venue category is more popular in each neighbourhood. We, then, summarized the analysis into one table including top 10 most common venues in each neighbourhood. At this stage, we can select which neighbourhoods are good to open new bakery shops.

The following tables display the first five neighbourhood results.

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[2]Manhattan data has 40 different boroughs, Toronto data has 38 boroughs and Chicago has 82 community areas.

[3]The customized function also calls neighbourhood, neighbourhood latitude and neighbourhood longitude.

3.3.1 Manhattan

	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	10th Most Common Venue
0	Battery Park City	Park	Coffee Shop	Hotel	Gym	Wine Shop	Shopping Mall	Italian Restaurant	Fountain	Burger Joint	Pizza Place
1	Carnegie Hill	Pizza Place	Coffee Shop	Café	Cosmetics Shop	Grocery Store	Bar	Spa	French Restaurant	Bookstore	Yoga Studio
2	Central Harlem	African Restaurant	Chinese Restaurant	Cosmetics Shop	American Restaurant	Seafood Restaurant	Gym / Fitness Center	French Restaurant	Ethiopian Restaurant	Bar	Library
3	Chelsea	Coffee Shop	Italian Restaurant	Ice Cream Shop	Nightclub	American Restaurant	Bakery	Seafood Restaurant	Theater	Hotel	Market
4	Chinatown	Chinese Restaurant	Dim Sum Restaurant	Bubble Tea Shop	American Restaurant	Vietnamese Restaurant	Cocktail Bar	Noodle House	Hotpot Restaurant	Salon / Barbershop	Bar

3.3.2 Toronto

|	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	10th Most Common Venue
0	Adelaide, King, Richmond	Italian Restaurant	Sushi Restaurant	French Restaurant	Clothing Store	Boutique	Seafood Restaurant	Café	Indian Restaurant	Bakery	Chinese Restaurant
1	Berczy Park	Coffee Shop	Sandwich Place	Hotel	Japanese Restaurant	Bar	Italian Restaurant	French Restaurant	Spa	Gym	Bakery
2	Brockton, Exhibition Place, Parkdale Village	Korean Restaurant	Hotel	Hotel Bar	Cosmetics Shop	Coffee Shop	Japanese Restaurant	Italian Restaurant	Cocktail Bar	Boutique	Bakery
3	Business Reply Mail Processing Centre 969 Eastern	Bar	Playground	Park	German Restaurant	Pet Service	Harbor / Marina	Farmers Market	Cocktail Bar	Coffee Shop	Heliport
4	CN Tower, Bathurst Quay, Island airport, Harbo...	Italian Restaurant	Pizza Place	American Restaurant	Bagel Shop	Cocktail Bar	Bar	Mexican Restaurant	Thrift / Vintage Store	Coffee Shop	Grocery Store

3.3.3 Chicago

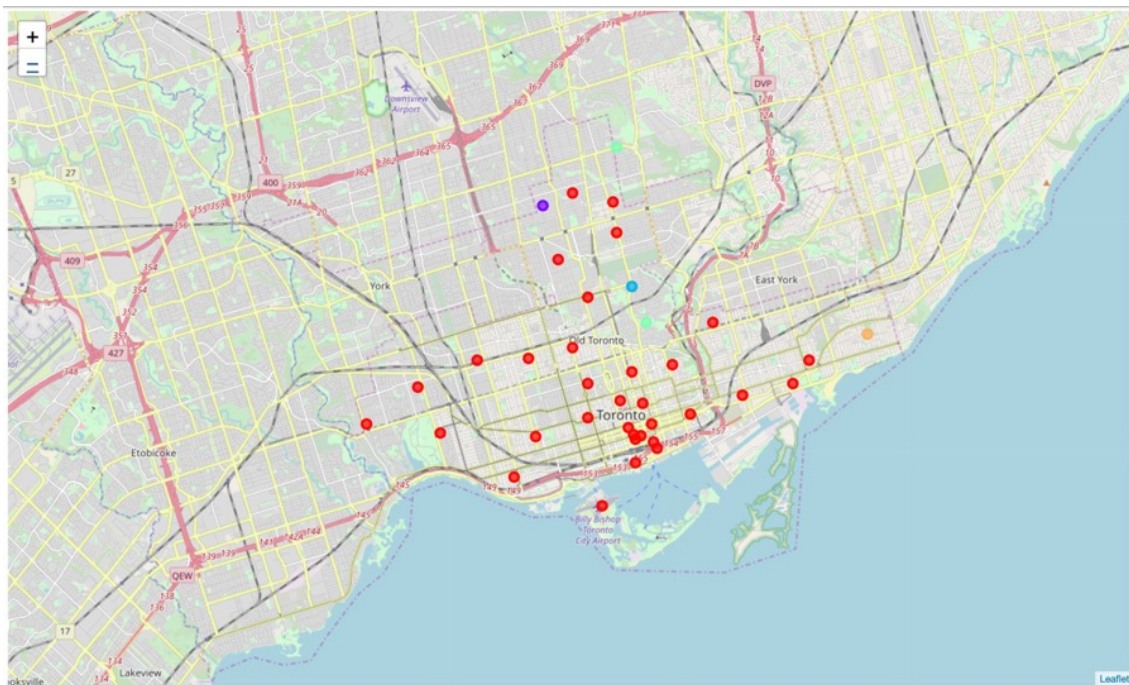|	Neighbourhood	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
0	Albany Park, Mayfair, North Mayfair, Ravenswoo...	Coffee Shop	Discount Store	Donut Shop	Tennis Stadium	Big Box Store	Supplement Shop	Shoe Store	Seafood Restaurant	Sandwich Place	Yoga Studio
1	Andersonville, Edgewater, Edgewater Beach, Edg...	Italian Restaurant	Cosmetics Shop	New American Restaurant	Gastropub	Wine Bar	Jazz Club	French Restaurant	Bakery	Park	American Restaurant
2	Archer Heights	Chinese Restaurant	Dim Sum Restaurant	Bubble Tea Shop	American Restaurant	Vietnamese Restaurant	Cocktail Bar	Noodle House	Hotpot Restaurant	Salon / Barbershop	Bar
3	Armour Square, Chinatown, Wentworth Gardens	Café	Bakery	Mobile Phone Shop	Grocery Store	Mexican Restaurant	New American Restaurant	Sandwich Place	Park	Supplement Shop	Supermarket
4	Ashburn, Ashburn Estates, Beverly View, Crestl...	Mexican Restaurant	Café	Pizza Place	Lounge	Bakery	Deli / Bodega	Park	Restaurant	Chinese Restaurant	Spanish Restaurant

3.4 *k*-Means Clustering

Finally, we ran *k*-means clustering to check what other neighbourhoods show similar characteristics as our selection once we select the neighbourhoods in three cities.

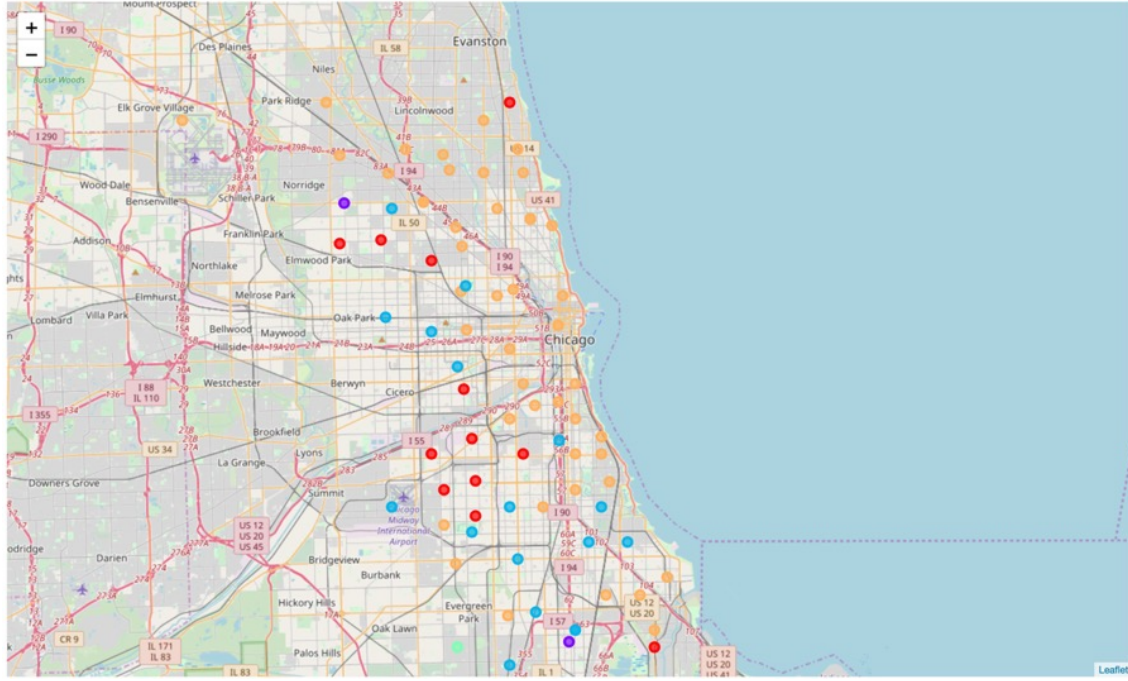The following maps display city maps with neighbourhoods in coloured clusters.

3.4.1 Manhattan
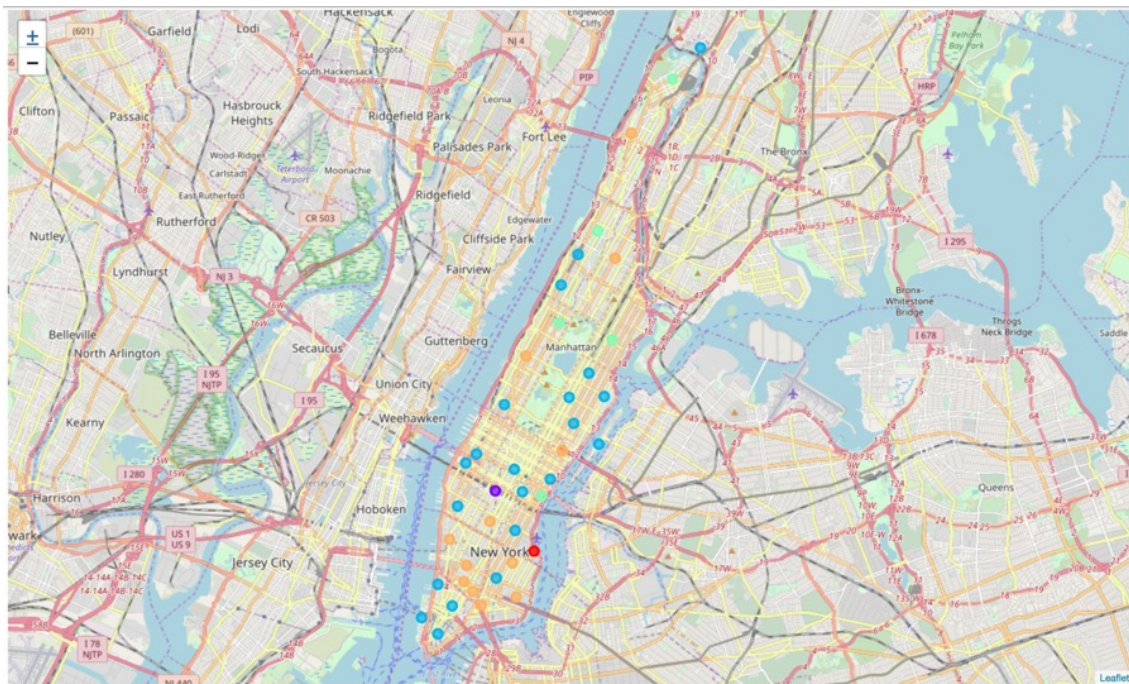
3.4.2 Toronto

3.4.3 Chicago

3.5 Neighbourhood Selection

We ranked neighbourhood by applying following equation[4].

Let's denote 10 most popular venues matrix by M. We will also denote Bakery by B, Coffee shops/Café/Bubble tea by C, Juice bar by J, and Donut shop by D[5].

$$Score = [\mathbb{1}_B(M) \times 4 + \mathbb{1}_C(M) \times 3 + \mathbb{1}_J(M) \times 2 + \mathbb{1}_D(M) \times 1] \times \begin{bmatrix} 10 \\ 9 \\ \vdots \\ 1 \end{bmatrix} \tag{1}$$

We ranked the result to come up with neighbourhood recommendation.

4 Result

4.1 Manhattan

	Borough	Neighborhood	Latitude	Longitude	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
22	Manhattan	Little Italy	40.719324	-73.997305	1	Bakery	Café	Seafood Restaurant	Sandwich Place	Bubble Tea Shop	Chinese Restaurant	Clothing Store	Salon / Barbershop	Mediterranean Restaurant	Ice Cream Shop

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[4]We will select neighbourhood(s) in each city, which have most bakeries (weight = 4), coffee shops, café and bubble tea shop (weight = 3), juice bar (weight = 2) and donut shop (weight = 1). We will also give weights from 10 to 1 with respect to 1st most common venus to 10th most common venue.

[5]$\mathbb{1}_A(x)$ is an indicator function. If $x \in A$, it is 1; otherwise 0.

It seems that the best neighbourhood in Manhattan to open a new bakery shop is Little Italy. Considering Italian culture where people appreciate good coffee and bread, this is not a surprising result. The first most common venue is bakery followed by café.

4.2 Toronto

	PostalCode	Borough	Neighbourhood	Latitude	Longitude	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
13	M5A	Downtown Toronto	Harbourfront, Regent Park	43.65426	-79.360636	0	Coffee Shop	Bakery	Park	Café	Pub	Theater	Breakfast Spot	Restaurant	Mexican Restaurant	Bank

Harbourfront/Regent Park were ranked as the best neighbourhood to open a new bakery shop. It shows coffee shop and bakery as the first two venues followed by park and café. Since there have been new coffee shops opening in that neighbourhood, it is also as expected[6].

4.3 Chicago

	Community Area	Neighbourhood	Latitude	Longitude	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue	4th Most Common Venue	5th Most Common Venue	6th Most Common Venue	7th Most Common Venue	8th Most Common Venue	9th Most Common Venue	10th Most Common Venue
36	Hyde Park	East Hyde Park, Hyde Park	41.794446	-87.593924	2	Sandwich Place	Coffee Shop	Yoga Studio	Bakery	Bookstore	Bubble Tea Shop	Shopping Mall	Shipping Store	Café	Rental Car Location

Hyde Park has the highest ranking among all neighbourhood. Hyde Park is where the University of Chicago is located. Many students often go to café/coffee shop to study. If a new bakery store has good seating area serving coffee or tea as well, Hyde Park will be a good place to open a new one.

5 Discussion

Although we get the highest ranking neighbourhood in each city, we decided to investigate further to see what other neighbourhoods have similarities with this highest ranking neighbourhood. In section 3.4, we already performed the k-means clustering for this purpose.

5.1 Cluster Analysis

The following tables summarize the list of neighbourhoods, which are in the same category as the highest ranking neighbourhood.

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[6]It is close to Leslieville, which is a desirable neighbourhood for young professionals. It is also quite close to downtown core.

5.1.1 Manhattan

	Neighborhood	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
1	Chinatown	Chinese Restaurant	Dim Sum Restaurant	Cocktail Bar	American Restaurant	Vietnamese Restaurant	Bar	Bubble Tea Shop	Noodle House	Hotpot Restaurant	Salon / Barbershop
5	Manhattanville	Coffee Shop	Park	Sushi Restaurant	Italian Restaurant	Mexican Restaurant	Seafood Restaurant	Indian Restaurant	Bus Stop	Lounge	Bike Trail
9	Yorkville	Bar	Gym	Coffee Shop	Italian Restaurant	Pizza Place	Japanese Restaurant	Wine Shop	Deli / Bodega	Diner	Sushi Restaurant
10	Lenox Hill	Italian Restaurant	Coffee Shop	Sushi Restaurant	Gym / Fitness Center	Pizza Place	Sporting Goods Shop	Burger Joint	Gym	Mexican Restaurant	Bakery
12	Upper West Side	Italian Restaurant	Bar	Coffee Shop	Indian Restaurant	Wine Bar	Bakery	Mediterranean Restaurant	Burger Joint	Vegetarian / Vegan Restaurant	Yoga Studio
17	Chelsea	Coffee Shop	Ice Cream Shop	Italian Restaurant	Nightclub	Bakery	Theater	Hotel	American Restaurant	Seafood Restaurant	French Restaurant
18	Greenwich Village	Italian Restaurant	Sushi Restaurant	French Restaurant	Clothing Store	Café	Seafood Restaurant	Bakery	Indian Restaurant	Boutique	Burger Joint
19	East Village	Bar	Wine Bar	Mexican Restaurant	Ice Cream Shop	Vegetarian / Vegan Restaurant	Cocktail Bar	Chinese Restaurant	Coffee Shop	Pizza Place	Ramen Restaurant
20	Lower East Side	Café	Art Gallery	Coffee Shop	Japanese Restaurant	Sandwich Place	Ramen Restaurant	Pizza Place	Cocktail Bar	Chinese Restaurant	Shoe Store
22	Little Italy	Bakery	Café	Seafood Restaurant	Sandwich Place	Bubble Tea Shop	Chinese Restaurant	Clothing Store	Salon / Barbershop	Mediterranean Restaurant	Ice Cream Shop
23	Soho	Clothing Store	Boutique	Women's Store	Men's Store	Shoe Store	Art Gallery	Mediterranean Restaurant	Coffee Shop	Italian Restaurant	Yoga Studio
27	Gramercy	Italian Restaurant	Pizza Place	American Restaurant	Bagel Shop	Cocktail Bar	Hotel	Grocery Store	Thrift / Vintage Store	Mexican Restaurant	Coffee Shop
30	Carnegie Hill	Pizza Place	Coffee Shop	Bar	Café	Cosmetics Shop	Yoga Studio	Spa	Bookstore	French Restaurant	Grocery Store
31	Noho	Italian Restaurant	French Restaurant	Cocktail Bar	Coffee Shop	Bookstore	Grocery Store	Mexican Restaurant	Gift Shop	Boutique	Hotel
35	Turtle Bay	Sushi Restaurant	Hotel	Steakhouse	Italian Restaurant	Coffee Shop	French Restaurant	Café	Park	Japanese Restaurant	Wine Bar

5.1.2 Toronto

	Neighbourhood	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	The Beaches	0	Coffee Shop	Pub	Neighborhood	Health Food Store	Ethiopian Restaurant	Electronics Store	Eastern European Restaurant	Dumpling Restaurant	Dessert Shop	Donut Shop
1	The Danforth West, Riverdale	0	Greek Restaurant	Coffee Shop	Ice Cream Shop	Bookstore	Furniture / Home Store	Italian Restaurant	Cosmetics Shop	Brewery	Bubble Tea Shop	Restaurant
2	The Beaches West, India Bazaar	0	Park	Sandwich Place	Pizza Place	Light Rail Station	Ice Cream Shop	Liquor Store	Burger Joint	Burrito Place	Fast Food Restaurant	Fish & Chips Shop
3	Studio District	0	Café	Coffee Shop	Italian Restaurant	American Restaurant	Bakery	Brewery	Coworking Space	Bookstore	Latin American Restaurant	Middle Eastern Restaurant
5	Davisville North	0	Gym	Clothing Store	Breakfast Spot	Burger Joint	Food & Drink Shop	Sandwich Place	Hotel	Asian Restaurant	Park	Creperie
6	North Toronto West	0	Clothing Store	Coffee Shop	Sporting Goods Shop	Yoga Studio	Bagel Shop	Grocery Store	Chinese Restaurant	Rental Car Location	Dessert Shop	Diner
7	Davisville	0	Sandwich Place	Dessert Shop	Pizza Place	Sushi Restaurant	Italian Restaurant	Café	Coffee Shop	Park	Seafood Restaurant	Burger Joint
9	Deer Park, Forest Hill SE, Rathnelly, South Hi...	0	Coffee Shop	Pub	Sushi Restaurant	Bagel Shop	Fried Chicken Joint	Sports Bar	American Restaurant	Convenience Store	Light Rail Station	Vietnamese Restaurant
11	Cabbagetown, St. James Town	0	Coffee Shop	Restaurant	Pizza Place	Bakery	Pub	Italian Restaurant	Park	Café	Gym / Fitness Center	Playground
12	Church and Wellesley	0	Japanese Restaurant	Coffee Shop	Gay Bar	Sushi Restaurant	Burger Joint	Restaurant	Gym	Fast Food Restaurant	Pub	Men's Store
13	Harbourfront, Regent Park	0	Coffee Shop	Bakery	Park	Pub	Theater	Breakfast Spot	Restaurant		Mexican Restaurant	Bank
14	Ryerson, Garden District	0	Coffee Shop	Clothing Store	Café	Cosmetics Shop	Middle Eastern Restaurant	Bar	Thai Restaurant	Ramen Restaurant	Sporting Goods Shop	Diner
15	St. James Town	0	Coffee Shop	Restaurant	Café	Hotel	Italian Restaurant	Cosmetics Shop	Breakfast Spot	Gastropub	Cocktail Bar	Beer Bar
16	Berczy Park	0	Coffee Shop	Cocktail Bar	Cheese Shop	Bakery	Steakhouse	Seafood Restaurant	Farmers Market	Café	Pub	Restaurant
17	Central Bay Street	0	Coffee Shop	Italian Restaurant	Café	Bubble Tea Shop	Burger Joint	Ice Cream Shop	Bar	Sushi Restaurant	Middle Eastern Restaurant	Chinese Restaurant
18	Adelaide, King, Richmond	0	Coffee Shop	Café	Thai Restaurant	Steakhouse	American Restaurant	Burger Joint	Restaurant	Sushi Restaurant	Asian Restaurant	Hotel
19	Harbourfront East, Toronto Islands, Union Station	0	Coffee Shop	Aquarium	Hotel	Café	Italian Restaurant	Fried Chicken Joint	Pizza Place	Brewery	Bakery	Scenic Lookout
20	Design Exchange, Toronto Dominion Centre	0	Coffee Shop	Café	Hotel	Restaurant	American Restaurant	Deli / Bodega	Gastropub	Italian Restaurant	Beer Bar	Seafood Restaurant
21	Commerce Court, Victoria Hotel	0	Coffee Shop	Café	Hotel	Restaurant	American Restaurant	Deli / Bodega	Steakhouse	Seafood Restaurant	Bakery	Gastropub
24	The Annex, North Midtown, Yorkville	0	Coffee Shop	Sandwich Place	Café	Pizza Place	Liquor Store	Burger Joint	Jewish Restaurant	Cheese Shop	BBQ Joint	Pub
25	Harbord, University of Toronto	0	Café	Restaurant	Bakery	Japanese Restaurant	Bar	Bookstore	Sandwich Place	Beer Bar	Beer Store	Noodle House
26	Chinatown, Grange Park, Kensington Market	0	Café	Vegetarian / Vegan Restaurant	Bar	Vietnamese Restaurant	Bakery	Dumpling Restaurant	Mexican Restaurant	Coffee Shop	Chinese Restaurant	Grocery Store
27	CN Tower, Bathurst Quay, Island airport, Harbo...	0	Airport Service	Airport Lounge	Airport Terminal	Boat or Ferry	Sculpture Garden	Harbor / Marina	Plane	Airport Gate	Airport Food Court	Airport
28	Stn A PO Boxes 25 The Esplanade	0	Coffee Shop	Restaurant	Café	Seafood Restaurant	Italian Restaurant	Pub	Cocktail Bar	Hotel	Creperie	Park
29	First Canadian Place, Underground city	0	Coffee Shop	Café	Hotel	Restaurant	American Restaurant	Deli / Bodega	Steakhouse	Seafood Restaurant	Bakery	Bar
30	Christie	0	Grocery Store	Café	Park	Convenience Store	Baby Store	Italian Restaurant	Athletics & Sports	Restaurant	Nightclub	Diner
31	Dovercourt Village, Dufferin	0	Supermarket	Pharmacy	Bakery	Pizza Place	Pool	Music Venue	Middle Eastern Restaurant	Café	Discount Store	Brewery
32	Little Portugal, Trinity	0	Bar	Asian Restaurant	Coffee Shop	Men's Store	Cocktail Bar	Vietnamese Restaurant	Restaurant	New American Restaurant	Bakery	Café
33	Brockton, Exhibition Place, Parkdale Village	0	Breakfast Spot	Café	Coffee Shop	Yoga Studio	Bar	Burrito Place	Restaurant	Caribbean Restaurant	Climbing Gym	Gym
34	High Park, The Junction South	0	Café	Mexican Restaurant	Bar	Fast Food Restaurant	Arts & Crafts Store	Grocery Store	Music Venue	Diner	Cajun / Creole Restaurant	Sandwich Place
35	Parkdale, Roncesvalles	0	Breakfast Spot	Gift Shop	Restaurant	Dessert Shop	Eastern European Restaurant	Burger Joint	Bar	Bank	Dog Run	Movie Theater
36	Runnymede, Swansea	0	Coffee Shop	Café	Pizza Place	Italian Restaurant	Sushi Restaurant	Bookstore	Latin American Restaurant	Falafel Restaurant	South American Restaurant	Sandwich Place
37	Business Reply Mail Processing Centre 969 Eastern	0	Light Rail Station	Yoga Studio	Park	Smoke Shop	Skate Park	Brewery	Burrito Place	Restaurant	Recording Studio	Comic Shop

5.1.3 Chicago

	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	10th Most Common Venue
0	Albany Park, Mayfair, North Mayfair, Ravenswoo...	Sandwich Place	Shoe Store	Fried Chicken Joint	Chinese Restaurant	Café	Korean Restaurant	Cocktail Bar	Bakery	Bus Station	Grocery Store
2	Armour Square, Chinatown, Wentworth Gardens	Chinese Restaurant	Italian Restaurant	Cosmetics Shop	Sports Bar	Sandwich Place	Asian Restaurant	Breakfast Spot	Hot Dog Joint	Department Store	Electronics Store
3	Ashburn, Ashburn Estates, Beverly View, Crestl...	Cosmetics Shop	Electronics Store	Light Rail Station	Italian Restaurant	Pizza Place	Cupcake Shop	Currency Exchange	Flea Market	Fish Market	Fish & Chips Shop
4	Auburn Gresham, Gresham	Fast Food Restaurant	Lounge	Discount Store	Greek Restaurant	Cosmetics Shop	Pharmacy	Fish & Chips Shop	Financial or Legal Service	Filipino Restaurant	Dry Cleaner
8	Avondale, Jackowo, Wacławowo	Park	Food Truck	Chinese Restaurant	Donut Shop	Bar	Rental Car Location	Supermarket	Storage Facility	Road	Discount Store
9	Polish Village	Coffee Shop	Pizza Place	Bar	Gym	Sandwich Place	Hobby Shop	Chinese Restaurant	Brewery	Bus Line	Taco Place
12	Bridgeport	Park	Chinese Restaurant	Mobile Phone Shop	Art Gallery	Pharmacy	Coffee Shop	Bar	Pizza Place	Wings Joint	Grocery Store
17	West Chesterfield	Convenience Store	Intersection	Dry Cleaner	Floating Market	Flea Market	Fish Market	Fish & Chips Shop	Financial or Legal Service	Filipino Restaurant	Fast Food Restaurant
20	Bronzeville, Dearborn Homes, Groveland Park, L...	Fast Food Restaurant	Sandwich Place	Historic Site	Fried Chicken Joint	Pharmacy	Spa	Shipping Store	Seafood Restaurant	Salon / Barbershop	Restaurant
22	East Garfield Park, Fifth City	Burger Joint	Pet Service	Garden Center	Pharmacy	Warehouse Store	Liquor Store	Public Art	Bus Line	Train Station	Diner
24	Andersonville, Edgewater, Edgewater Beach, Edg...	Sandwich Place	Mexican Restaurant	Sushi Restaurant	Asian Restaurant	Restaurant	Coffee Shop	Pharmacy	Thai Restaurant	Deli / Bodega	Mobile Phone Shop
26	Englewood, Hamilton Park	Café	ATM	Coffee Shop	Donut Shop	Restaurant	Seafood Restaurant	Supermarket	Sandwich Place	Liquor Store	Grocery Store
27	Edgebrook, Forest Glen, Old Edgebrook, Saugana...	Moving Target	Gym	Nature Preserve	Garden	Yoga Studio	Dry Cleaner	Fish & Chips Shop	Financial or Legal Service	Filipino Restaurant	Fast Food Restaurant
31	Grand Boulevard, Legends South (Robert Taylor ...	American Restaurant	Lounge	Train Station	Bakery	Burger Joint	Clothing Store	Fast Food Restaurant	Food	Jazz Club	Art Gallery
32	Grand Crossing, Greater Grand Crossing, Park M...	Lounge	Fried Chicken Joint	Intersection	Arts & Crafts Store	Flower Shop	Currency Exchange	Donut Shop	Park	American Restaurant	Seafood Restaurant
33	Hegewisch	Lounge	Baseball Field	Yoga Studio	Food	Floating Market	Flea Market	Fish Market	Fish & Chips Shop	Financial or Legal Service	Filipino Restaurant
36	East Hyde Park, Hyde Park	Sandwich Place	Coffee Shop	Yoga Studio	Bakery	Bookstore	Bubble Tea Shop	Shopping Mall	Shipping Store	Café	Rental Car Location
37	Avondale Gardens, Irving Park, Kilbourn Park, ...	Coffee Shop	Pizza Place	Bar	Gym	Sandwich Place	Hobby Shop	Chinese Restaurant	Brewery	Bus Line	Taco Place
38	Gladstone Park, Jefferson Park	Bar	Video Store	Coffee Shop	Eastern European Restaurant	Theater	Pharmacy	Filipino Restaurant	Fried Chicken Joint	Sushi Restaurant	Supermarket
39	Kenwood, North Kenwood	Gym / Fitness Center	Pharmacy	Liquor Store	Fried Chicken Joint	Tennis Court	Clothing Store	Asian Restaurant	Department Store	Art Gallery	Boutique
40	Boystown, Graceland West, Lake View, Lake View...	Gay Bar	Sports Bar	Sandwich Place	Bar	Pizza Place	Coffee Shop	Mexican Restaurant	Japanese Restaurant	Sporting Goods Shop	Diner
41	Sheridan Station Corridor	Gay Bar	Sports Bar	Sandwich Place	Bar	Pizza Place	Mexican Restaurant	Baseball Stadium	General Entertainment	Japanese Restaurant	Diner
42	Lincoln Park, Old Town Triangle, Park West, Ra...	Harbor / Marina	Playground	Dog Run	Comedy Club	Bar	Farmers Market	Ethiopian Restaurant	Falafel Restaurant	Farm	Filipino Restaurant
43	Bowmanville, Budlong Woods, Lincoln Square, Ra...	Bar	Sandwich Place	Café	Gym	Yoga Studio	Italian Restaurant	Pub	Pizza Place	Coffee Shop	Eastern European Restaurant
44	Bucktown, Kosciuszko Park, Logan Square, Palme...	Coffee Shop	Bar	Latin American Restaurant	Food & Drink Shop	Café	Thrift / Vintage Store	New American Restaurant	Cocktail Bar	Bookstore	Art Gallery
46	McKinley Park	Chinese Restaurant	Burger Joint	Accessories Store	Video Game Store	Donut Shop	Café	Bus Station	Discount Store	Pharmacy	Sandwich Place
48	Beverly Woods, Kennedy Park, Morgan Park, West...	Restaurant	Currency Exchange	Grocery Store	Train Station	Yoga Studio	Eastern European Restaurant	Electronics Store	Ethiopian Restaurant	Falafel Restaurant	Farm

5.2 Implication

We found that multiple neighbourhoods are similar to highest ranked neighbourhoods in all three cities. Hence, it is recommended to take a look at the neighbourhoods in the same cluster as the highest ranking neighbourhoods. As we discussed in section 1, we did not consider any unique constraints as well as any other exogenous factors. When we decide where to open a new bakery store, these factors should be considered simultaneously. The approach we took here could be a starting point and by applying other constraints and factors, we can reach our ultimate conclusion more effectively and efficiently.

6 Conclusion

We have discussed which neighbourhood we want to choose to open a new bakery store in three cities: Manhattan, Toronto, and Chicago. We used Foursquare data and geospatial data for this purpose. We did not take into account unique circumstances and exogenous factors. We sorted the result from Foursquare with respect to the frequency of venue categories and score them using our ranking function. We, then, found the highest ranking neighbourhood in each city. We further ran k-mean clustering to check what other neighbourhoods belong to the same cluster as the highest ranking cluster. Chicago had only one neighbourhood in the cluster, while Manhattan and Toronto had multiple neighbourhoods in the same cluster. It is important to take a look at other neighbourhoods with unique circumstances as well as exogenous factors (such as rent).

Decision making is not purely quantitative nor purely qualitative. The result is most meaningful and the process is most efficient if we combine both quantitative methodology and qualitative methodology. We believe that the similar approach can be used for the city planning for the municipal government.