

Introduction

International and domestic travel movements and oversea students are significantly disrupted due to the outbreak of COVID-19. In February 2020, overseas visitor arrivals to Australia decreased 26% compared to the same month a year ago.[\[1\]](#)

Tourism and international students in Australia are an important component of the Australian economy. Tourism consists of domestic and international components and the contribution was a record \$44.6 billion in 2019.[\[2\]](#) International education was worth \$32.4 billion to the Australian economy in 2017–18.[\[3\]](#)

The economy, international and domestic movements are expected to rebound as the pandemic finishes. This report explores the neighbourhoods in three popular Australian local government areas (LGA) and nine capital cities of selected countries and makes recommendations for tourists, international students and people who are going to move around in Australia.

This report presents the similarity and dissimilarity among the twelve areas by analysing venues in neighbourhoods. Neighbourhoods are grouped into clusters based on venue categories by using K-means clustering algorithm.

In this report, only suburbs in LGAs in Australia, Shanghai and Beijing China will be presented, discussed as illustration.

Data

1. LGAs in Australia

In 2019, New South Wales, Victoria and Queensland are the top 3 states in Australia for foreign enrolment and arrivals.[\[4\]](#) [\[5\]](#)

Suburbs in the City of Sydney, the City of Melbourne and the City of Brisbane, as they have highest population density in New South Wales, Victoria and Queensland respectively.[\[6\]](#)

2. Source countries

China, India, Nepal, Vietnam and Malaysia are the top 5 countries and regions sending students to Australia.[\[7\]](#) China, New Zealand, USA, UK and Japan are the top 5 source countries of short-term visitor arrivals in Australia.[\[8\]](#)

Administration divisions are defined and named differently in these countries. In this analysis, administration division is named suburb for consistency and clarity. Suburbs in the capital cities of India, Nepal, Vietnam, Malaysia, UK and Japan are included in this analysis.

Considering the close relationship between Australia and New Zealand, the large population in China, India and USA, the top two populous cities in each country are included in this analysis. These cities are Auckland City and Christchurch in New Zealand [\[9\]](#), Beijing and Shanghai in China[\[10\]](#), Delhi and Mumbai city in India[\[11\]](#) and New York City and Los Angeles in US[\[12\]](#).

Methodology

1. Scrape and process data

In this analysis, suburb names are scraped from Wikipedia using Beautiful Soup Python Library. The latitude and longitude coordinates of suburbs are located using GeoPy.

	Address	Suburb	Region	Latitude	Longitude
0	Qianmen, Beijing China	Qianmen	Beijing China	39.898759	116.391641
1	Tian'anmen, Beijing China	Tian'anmen	Beijing China	39.907359	116.391263
2	Di'anmen, Beijing China	Di'anmen	Beijing China	39.931232	116.368196
3	Chongwenmen, Beijing China	Chongwenmen	Beijing China	39.899737	116.411957
4	Xuanwumen Station, Beijing China	Xuanwumen Station	Beijing China	39.898387	116.368014

The data of the top 100 venues that are in each suburb within a radius of 500 meters are collected by using Foursquare API.

	Address	Suburb	Latitude	Suburb	Longitude	Venue	Venue	Latitude	Venue	Longitude	Venue Category
0	Qianmen, Beijing China	39.898759	116.391641	Starbucks Reserve (星巴克甄选)	39.896581	116.390618	Coffee Shop				
1	Qianmen, Beijing China	39.898759	116.391641	Blue Note Beijing	39.899744	116.395392	Lounge				
2	Qianmen, Beijing China	39.898759	116.391641	Page One (叶壹堂)	39.896714	116.390846	Bookstore				
3	Qianmen, Beijing China	39.898759	116.391641	Lost Heaven 花马天堂	39.900272	116.395612	Yunnan Restaurant				
4	Qianmen, Beijing China	39.898759	116.391641	四季民福	39.895811	116.391262	Beijing Restaurant				

There are 337 unique venue categories.

2. Analyse suburbs

Perform one hot encoding and prepare the dataset for ML algorithm

	Address	Accessories Store	African Restaurant	Airport	Airport Service	American Restaurant	Antique Shop	Arcade	Arepas Restaurant	Argentinian Restaurant	Art Gallery	Art Museum	Arts & Crafts Store	Arts & Entertainment	Asian Restaurant
0	Qianmen, Beijing China	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	Qianmen, Beijing China	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Qianmen, Beijing China	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	Qianmen, Beijing China	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	Qianmen, Beijing China	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Group rows by suburb and by taking the mean of the frequency of occurrence of each category.

	Address	Accessories Store	African Restaurant	Airport	Airport Service	American Restaurant	Antique Shop	Arcade	Arepas Restaurant	Argentinian Restaurant	Art Gallery	Art Museum	Arts & Crafts Store	Arts & Entertainment	Asian Restaurant
0	Acacia Ridge, City of brisbane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	Albion, City of brisbane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	Alderley, City of brisbane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	Alexandria, Sydney	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	Algester, City of brisbane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Get the top 10 most common venues in each suburb

	Address	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	Acacia Ridge, City of brisbane	Fast Food Restaurant	Sandwich Place	Mexican Restaurant	Zoo Exhibit	Food	Farmers Market	Filipino Restaurant	Fish & Chips Shop	Fish Market	Flea Market
1	Albion, City of brisbane	Café	Train Station	Indian Restaurant	Gym	Fast Food Restaurant	Sandwich Place	Turkish Restaurant	Comedy Club	Bakery	Farmers Market
2	Alderley, City of brisbane	Train Station	Grocery Store	Gas Station	Thrift / Vintage Store	Supermarket	Thai Restaurant	Pizza Place	Athletics & Sports	Flea Market	Fast Food Restaurant
3	Alexandria, Sydney	Café	Basketball Court	Italian Restaurant	Lebanese Restaurant	Flea Market	Australian Restaurant	Bar	Zoo Exhibit	Food	Filipino Restaurant
4	Algester, City of brisbane	Chinese Restaurant	Zoo Exhibit	Food & Drink Shop	Fast Food Restaurant	Filipino Restaurant	Fish & Chips Shop	Fish Market	Flea Market	Flower Shop	Food

3. Cluster suburbs

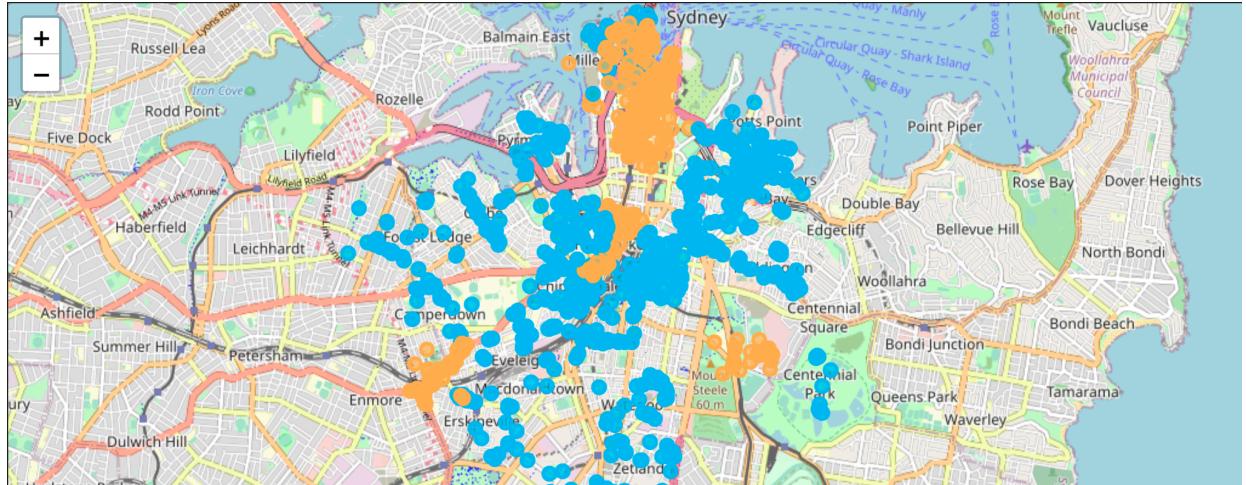
As venues in a suburb may belong to the same venue categories, k-means algorithm is used to cluster suburbs into 5 clusters.

Cluster Labels	Address	Suburb	Region	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	Suburb Latitude	Suburb Longitude	Venue	Last
0	4 Acacia Ridge, City of brisbane	Acacia Ridge	City of brisbane	Fast Food Restaurant	Sandwich Place	Mexican Restaurant	Zoo Exhibit	Food	Farmers Market	Filipino Restaurant	Fish & Chips Shop	Fish Market	Flea Market	-27.585731	153.025206	Subway	-27.585731
0	4 Acacia Ridge, City of brisbane	Acacia Ridge	City of brisbane	Fast Food Restaurant	Sandwich Place	Mexican Restaurant	Zoo Exhibit	Food	Farmers Market	Filipino Restaurant	Fish & Chips Shop	Fish Market	Flea Market	-27.585731	153.025206	KFC	-27.585731
0	4 Acacia Ridge, City of brisbane	Acacia Ridge	City of brisbane	Fast Food Restaurant	Sandwich Place	Mexican Restaurant	Zoo Exhibit	Food	Farmers Market	Filipino Restaurant	Fish & Chips Shop	Fish Market	Flea Market	-27.585731	153.025206	McDonald's	-27.585731
0	4 Acacia Ridge, City of brisbane	Acacia Ridge	City of brisbane	Fast Food Restaurant	Sandwich Place	Mexican Restaurant	Zoo Exhibit	Food	Farmers Market	Filipino Restaurant	Fish & Chips Shop	Fish Market	Flea Market	-27.585731	153.025206	Guzman Gomez	-27.585731
1	2 Albion, City of brisbane	Albion	City of brisbane	Café	Train Station	Indian Restaurant	Gym	Fast Food Restaurant	Sandwich Place	Turkish Restaurant	Comedy Club	Bakery	Farmers Market	-27.430364	153.042120	Brew Bakers	-27.430364

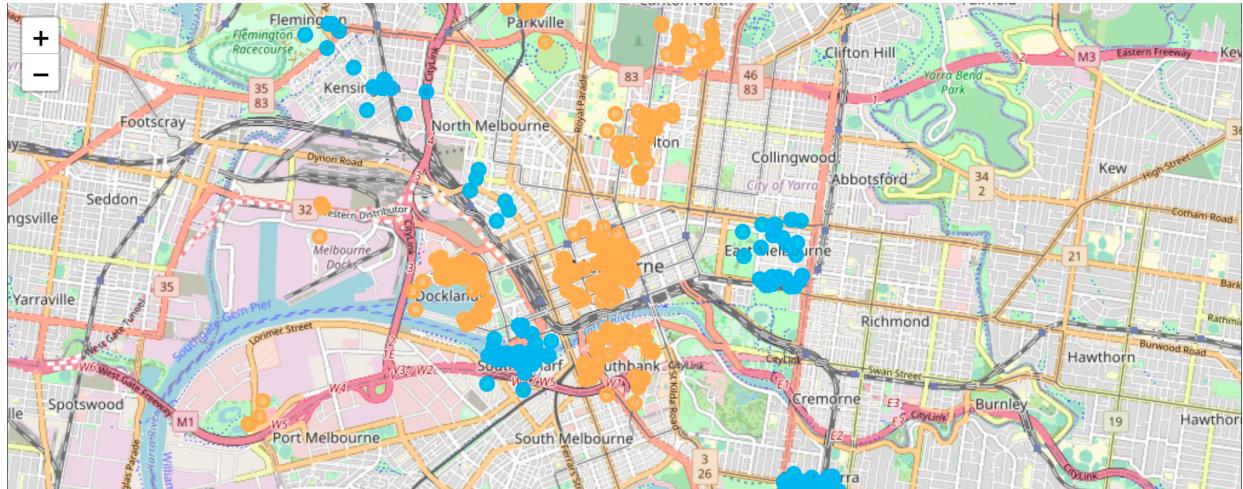
4. Data visualisation

Clusters are visualised on maps using Folium package

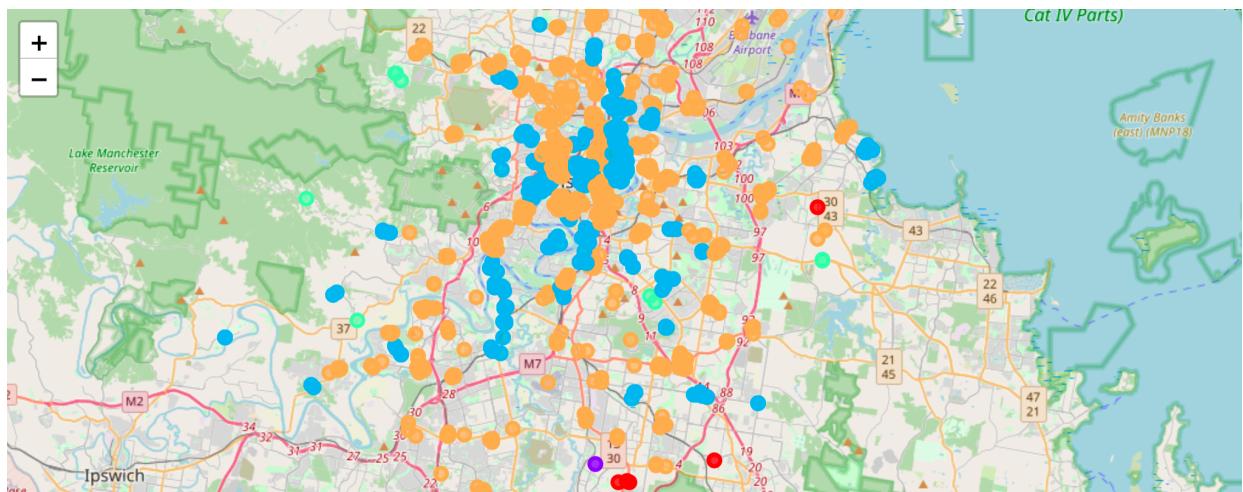
The City of Sydney and clusters



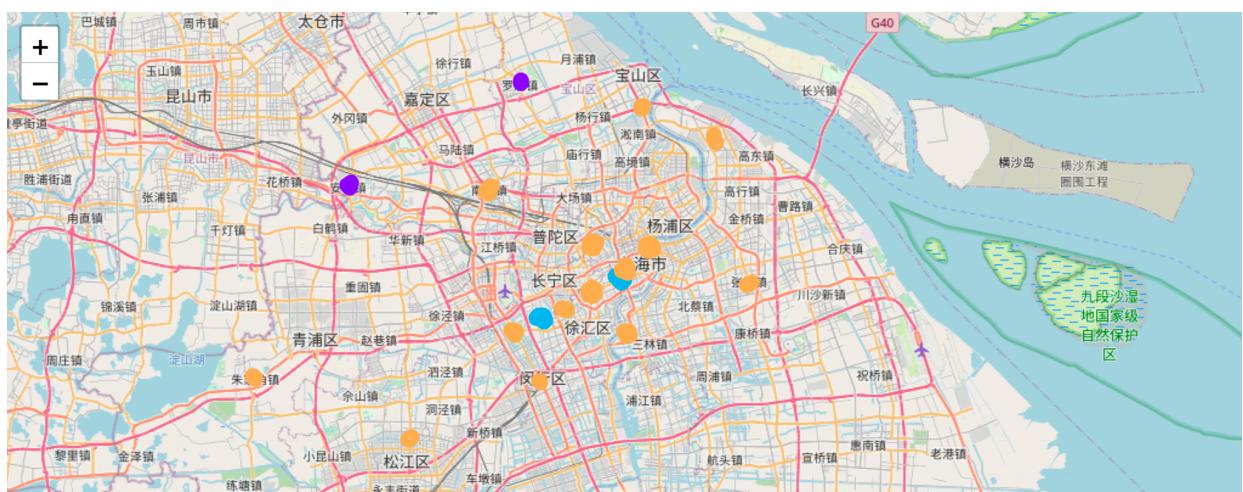
The City of Melbourne and clusters



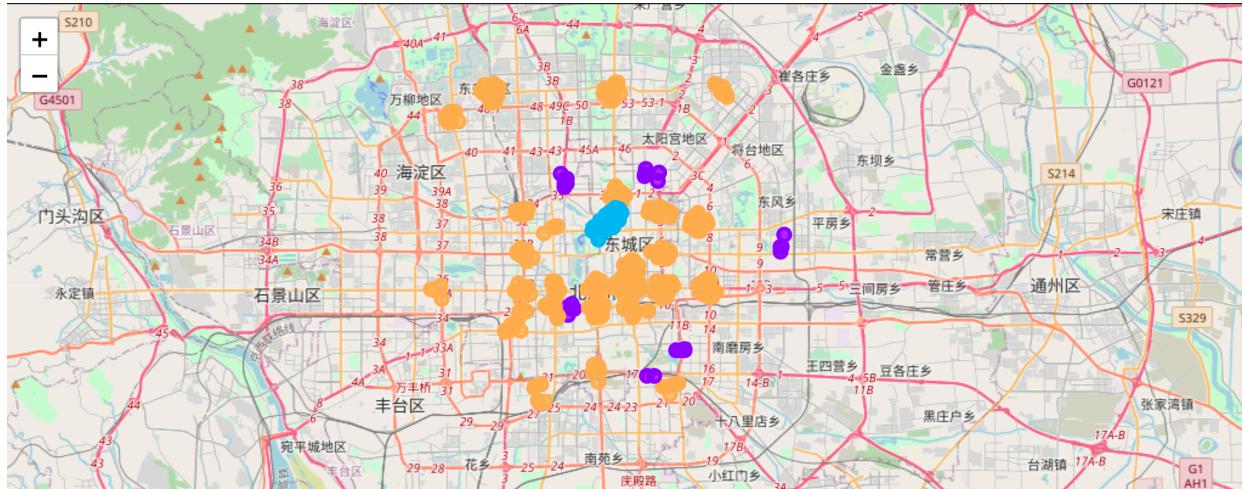
The City of Brisbane and clusters



Shanghai, China and clusters



Beijing, China and clusters



Results

As shown in the maps, cluster 2 and 4 are the largest clusters. Another interesting result is that based on the 10 most common venue categories in each suburb, suburbs in Beijing and Shanghai are clustered into cluster 1, 2, 4 and suburbs in Sydney and Melbourne are clustered into cluster 2, 4.

Suburbs in City of brisbane are labeled as [4 2 1 0 3]
Suburbs in Sydney are labeled as [2 4]
Suburbs in Beijing China are labeled as [4 1 2]
Suburbs in Shanghai China are labeled as [1 4 2]
Suburbs in Melbourne are labeled as [4 2]

By examining each cluster, we can determine the discriminating venue categories that distinguish each cluster and identify the similarity between suburbs in regions.

Cluster 0 - Park

	Address	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	Bridgeman Downs, City of brisbane	Park	Zoo Exhibit	Food & Drink Shop	Fast Food Restaurant	Filipino Restaurant	Fish & Chips Shop	Fish Market	Flea Market	Flower Shop	Food
33	Calamvale, City of brisbane	Bus Stop	Ice Cream Shop	Park	Food & Drink Shop	Fast Food Restaurant	Filipino Restaurant	Fish & Chips Shop	Fish Market	Flea Market	Flower Shop
110	Heathwood, City of brisbane	Park	Pier	Bus Stop	Supermarket	Fried Chicken Joint	Farmers Market	Fast Food Restaurant	Filipino Restaurant	Fish & Chips Shop	Fish Market
136	Kuraby, City of brisbane	Park	Zoo Exhibit	Food & Drink Shop	Fast Food Restaurant	Filipino Restaurant	Fish & Chips Shop	Fish Market	Flea Market	Flower Shop	Food
170	Nudgee, City of brisbane	Park	Grocery Store	Zoo Exhibit	Food	Fast Food Restaurant	Filipino Restaurant	Fish & Chips Shop	Fish Market	Flea Market	Flower Shop
206	Shorncliffe, City of brisbane	Park	Pier	Harbor / Marina	Beach	Café	Train Station	Farmers Market	Fast Food Restaurant	Filipino Restaurant	Fish & Chips Shop
240	Wakerley, City of brisbane	Park	Zoo Exhibit	Food & Drink Shop	Fast Food Restaurant	Filipino Restaurant	Fish & Chips Shop	Fish Market	Flea Market	Flower Shop	Food

Cluster 1 – Chinese restaurant

	Address	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
4	Algester, City of brisbane	Chinese Restaurant	Zoo Exhibit	Food & Drink Shop	Fast Food Restaurant	Filipino Restaurant	Fish & Chips Shop	Fish Market	Flea Market	Flower Shop	Food
8	Anting, Shanghai China	Chinese Restaurant	Fast Food Restaurant	Music Venue	Park	Food	Farmers Market	Filipino Restaurant	Fish & Chips Shop	Fish Market	Flea Market
63	Deshengmen, Beijing China	Chinese Restaurant	Hotpot Restaurant	Baseball Field	Hotel	Design Studio	Diner	Food & Drink Shop	Fast Food Restaurant	Filipino Restaurant	Fish & Chips Shop
103	Guanggumen, Beijing China	Chinese Restaurant	Middle Eastern Restaurant	Food	Zoo Exhibit	Food & Drink Shop	Fast Food Restaurant	Filipino Restaurant	Fish & Chips Shop	Fish Market	Flea Market
113	Hepingli Subdistrict, Beijing China	Chinese Restaurant	Fast Food Restaurant	Asian Restaurant	Metro Station	Bakery	Food & Drink Shop	Filipino Restaurant	Fish & Chips Shop	Fish Market	Flea Market
114	Hepingmen, Beijing China	Chinese Restaurant	Peking Duck Restaurant	Beijing Restaurant	Korean Restaurant	French Restaurant	Fountain	Farmers Market	Fast Food Restaurant	Filipino Restaurant	Fish & Chips Shop
139	Luodian, Shanghai China	Chinese Restaurant	Restaurant	Bakery	Fried Chicken Joint	Flower Shop	Falafel Restaurant	Farmers Market	Fast Food Restaurant	Filipino Restaurant	Fish & Chips Shop
175	Panjiayuan Station, Beijing China	Motel	Chinese Restaurant	Park	Beijing Restaurant	Farmers Market	Filipino Restaurant	Fish & Chips Shop	Fish Market	Flea Market	Flower Shop

Cluster 2 – coffee shop

	Address	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	Albion, City of brisbane	Café	Train Station	Indian Restaurant	Gym	Fast Food Restaurant	Sandwich Place	Turkish Restaurant	Comedy Club	Bakery	Farmers Market
3	Alexandria, Sydney	Café	Basketball Court	Italian Restaurant	Lebanese Restaurant	Flea Market	Australian Restaurant	Bar	Zoo Exhibit	Food	Filipino Restaurant
6	Annandale, Sydney	Café	Grocery Store	Park	Pub	Asian Restaurant	Garden Center	Snack Place	Fish & Chips Shop	Liquor Store	Fried Chicken Joint
11	Ashgrove, City of brisbane	Café	Supermarket	Fruit & Vegetable Store	Pharmacy	Sushi Restaurant	Shopping Mall	Farmers Market	Bakery	Sandwich Place	Cocktail Bar
13	Auchenflower, City of brisbane	Basketball Court	Thai Restaurant	Café	Restaurant	Mexican Restaurant	Pizza Place	Coffee Shop	Zoo Exhibit	Flower Shop	Filipino Restaurant
15	Banyo, City of brisbane	Café	Train Station	Coffee Shop	Mediterranean Restaurant	Zoo Exhibit	Fast Food Restaurant	Filipino Restaurant	Fish & Chips Shop	Fish Market	Flea Market
17	Bardon, City of brisbane	Bowling Green	Gym	Convenience Store	Café	Zoo Exhibit	Food & Drink Shop	Filipino Restaurant	Fish & Chips Shop	Fish Market	Flea Market
18	Beaconsfield, Sydney	Café	Coffee Shop	Furniture / Home Store	Pet Store	Sporting Goods Shop	Thai Restaurant	Grocery Store	Liquor Store	Sandwich Place	Electronics Store
29	Brisbane CBD, City of brisbane	Café	Bar	Coffee Shop	Japanese Restaurant	Hotel	Sushi Restaurant	Restaurant	Vietnamese Restaurant	Bakery	Italian Restaurant
30	Brookfield, City of brisbane	Market	Tennis Court	Café	Coffee Shop	Farmers Market	Filipino Restaurant	Fish & Chips Shop	Fish Market	Flea Market	Flower Shop
34	Camp Hill, City of brisbane	Record Shop	Sporting Goods Shop	Antique Shop	Café	Bistro	Zoo Exhibit	Food	Fast Food Restaurant	Filipino Restaurant	Fish & Chips Shop

Cluster 3 – Bus station

	Address	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
44	Chandler, City of brisbane	Bus Station	Food Court	Fast Food Restaurant	Filipino Restaurant	Fish & Chips Shop	Fish Market	Flea Market	Flower Shop	Food	Food & Drink Shop
117	Holland Park West, City of brisbane	Home Service	Bus Station	Zoo Exhibit	Food & Drink Shop	Fast Food Restaurant	Filipino Restaurant	Fish & Chips Shop	Fish Market	Flea Market	Flower Shop
176	Parkinson, City of brisbane	Shop & Service	Bus Station	Zoo Exhibit	Food & Drink Shop	Fast Food Restaurant	Filipino Restaurant	Fish & Chips Shop	Fish Market	Flea Market	Flower Shop
180	Pinjarra Hills, City of brisbane	Bus Station	Food Court	Fast Food Restaurant	Filipino Restaurant	Fish & Chips Shop	Fish Market	Flea Market	Flower Shop	Food	Food & Drink Shop
235	Upper Brookfield, City of brisbane	Bus Station	Food Court	Fast Food Restaurant	Filipino Restaurant	Fish & Chips Shop	Fish Market	Flea Market	Flower Shop	Food	Food & Drink Shop
236	Upper Kedron, City of brisbane	Bus Station	Garden Center	Fruit & Vegetable Store	Food & Drink Shop	Fast Food Restaurant	Filipino Restaurant	Fish & Chips Shop	Fish Market	Flea Market	Flower Shop

Cluster 4 - Balance

	Address	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	Acacia Ridge, City of brisbane	Fast Food Restaurant	Sandwich Place	Mexican Restaurant	Zoo Exhibit	Food	Farmers Market	Filipino Restaurant	Fish & Chips Shop	Fish Market	Flea Market
2	Alderley, City of brisbane	Train Station	Grocery Store	Gas Station	Thrift / Vintage Store	Supermarket	Thai Restaurant	Pizza Place	Athletics & Sports	Flea Market	Fast Food Restaurant
5	Andingmen, Beijing China	Coffee Shop	Café	Furniture / Home Store	Chinese Restaurant	Spa	Food Truck	Mexican Restaurant	New American Restaurant	Bistro	Tea Room
7	Annerley, City of brisbane	Café	Pharmacy	Train Station	Comic Shop	Burger Joint	Supermarket	Camera Store	Grocery Store	Sandwich Place	Coffee Shop
9	Archerfield, City of brisbane	Furniture / Home Store	Food & Drink Shop	Farmers Market	Fast Food Restaurant	Filipino Restaurant	Fish & Chips Shop	Fish Market	Flea Market	Flower Shop	Food
10	Ascot, City of brisbane	Burger Joint	Bakery	Sushi Restaurant	Train Station	Thai Restaurant	Clothing Store	Cocktail Bar	Flea Market	Café	Grocery Store
12	Aspley, City of brisbane	Department Store	Ice Cream Shop	Supermarket	Fast Food Restaurant	Pharmacy	Steakhouse	Sushi Restaurant	Mexican Restaurant	Shopping Mall	Chinese Restaurant
14	Bald Hills, City of brisbane	Indian Restaurant	Food & Drink Shop	Farmers Market	Fast Food Restaurant	Filipino Restaurant	Fish & Chips Shop	Fish Market	Flea Market	Flower Shop	Food
16	Barangaroo, Sydney	Pub	Park	Hotel	Café	Brewery	Planetarium	Bakery	Coffee Shop	Tapas Restaurant	Boat or Ferry
19	Beijing CBD, Beijing China	Coffee Shop	Chinese Restaurant	Hotel	Dessert Shop	Café	Karaoke Bar	Fast Food Restaurant	Shopping Mall	Cocktail Bar	Noodle House
20	Beixinqiao Subdistrict, Beijing China	Russian Restaurant	Coffee Shop	Chinese Restaurant	Hotpot Restaurant	Grocery Store	Dongbei Restaurant	Tea Room	Sandwich Place	Cantonese Restaurant	Park
21	Bellbowrie, City of brisbane	Pizza Place	Bus Station	Fast Food Restaurant	Shopping Mall	Office	Café	Gym	Supermarket	Food Court	Food & Drink Shop

Discussion

The City of Brisbane is divided into smaller suburbs and therefore parks and bus stations are stand out in some suburb.

The cluster result will be more meaningful if the other 4 regions were divided into smaller segments. We will be able to take the insight of the area of culture centre, infrastructure and facilities, bus station, nature parks and etc in each region.

Conclusion

According to available dataset, suburbs in the City of Sydney, the City of Melbourne, the City of Brisbane, Beijing and Shanghai can be clustered as park area, Chinese restaurant area, coffee shop area, bus station area and a balanced area.

There are more coffee shop areas in Australia while more Chinese restaurant area in China.

[1]<https://www.abs.gov.au/ausstats/abs@.nsf/Latestproducts/3401.0Media%20Release1Feb%202020?opendocument&tabname=Summary&prodno=3401.0&issue=Feb%202020&num=&view=>

[2] *Latest International Visitor Survey (Ivs) Results* Australian Trade and Investment Commission, Australian Government

[3] *Overseas students in Australian higher education: a quick guide* Parliament of Australia

[4] *Overseas students in Australian higher education: a quick guide* Parliament of Australia

[5]<https://www.abs.gov.au/ausstats/abs@.nsf/Latestproducts/3401.0Media%20Release1Feb%202020?opendocument&tabname=Summary&prodno=3401.0&issue=Feb%202020&num=&view=>

[6] The Australian Bureau of Statistics

[7] *Overseas students in Australian higher education: a quick guide* Parliament of Australia

[8]

<https://www.abs.gov.au/ausstats/abs@.nsf/Latestproducts/3401.0Media%20Release1Feb%202020?opendocument&tabname=Summary&prodno=3401.0&issue=Feb%202020&num=&view=>

[9] Statistics New Zealand

[10] <http://www.stats.gov.cn/english/>

[11] http://censusindia.gov.in/2011-prov-results/paper2/data_files/India2/1.%20Data%20Highlight.pdf

[12] <http://tourism-intelligence.com/Signatures/THE%20TOP%20TEN%20US%20STATES%20FOR%20OUTBOUND%20TRAVEL.pdf>