

Pick Restaurant Location in Melbourne

Abstract:

This project aims to practice the skills learnt from the Data Science Course and fulfill the requirements of the IBM Data Scientist Professional certificate. We assume that our client wants to invest in a restaurant in one of the growing suburbs in Melbourne, Australia. Our task is to help him/her find the right suburb with both established population and growth potential. As this project is done in the post-pandemic period, other factors such as social distance will be considered as a limit of further growth in the crowded region, for example CBD. As this report mainly focus on the assignment tasks, some assumption will be made to contribute to the final recommendation to the client. Entrepreneurs, business owners and real estate agencies will also find this report useful.

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1. Introduction:

Melbourne is one of the most liveable cities in the world and is well-known for its culture diversity, and healthy economy. It is also home to many best-known Australian landmarks, such as the Melbourne Cricket ground, Queen Victoria market, World-Heritage-listed Royal Exhibition Building. Recent years see a fast on-track growth of the local government suburbs, such as Melton, Wyndham and Casey. Melbourne attracts about 70,000 immigrants every year since 2005 and prior to the COVID-19 pandemic. People from all over the world also brought all kinds of delicious food to the city.

In this project, we will particularly be looking into the restaurants data in all the local government areas in Melbourne. The objective of this project is to use Foursquare location data, machine learning algorithm and local clustering of venue information to determine the most suitable location to invest a new restaurant in Melbourne, Australia. All the data acquisition, cleansing processes, machine learning approaches and analysis will be discussed. By studying the type and densities of the restaurants in the local suburbs, we will discuss the similarities and characteristics of the local regions. Furthermore, depending on the government development plans, suburbs with established community and growth potential will be recommended to our clients.

2. Target Audience:

This report targets at all the stake holders who are interested in investing a restaurant in the growing suburbs in Melbourne. It is also believed that this report will benefit all the Entrepreneurs, business owners and real estate workers who are interested in the local facility data including the restaurant data.

3. Data Overview:

The data required to make recommendations for the clients are local suburbs data, geographic location data and local venue data. The local Melbourne suburb information is scraped from the Wikipedia website in reference [1], the geographic location of the Melbourne suburbs are obtained via Geocode package and the venue information is retrieved from Foursquare APIs.

Due to the limit of the report length, we couldn't prepare and analysis other important data such as job opportunity, demographics, transport, crime rate and *etc.* by ourselves. Hence, we also refer to the local planning strategy report [2] as an important source of information and the basis for our decision.

List of Melbourne suburbs

From Wikipedia, the free encyclopedia

This is a list of municipalities and their **suburbs** (neighbourhoods), townships, and rural localities in the greater metropolitan area of Melbourne, Victoria, Australia. Suburbs are defined here as localities within the legislated Urban Growth Boundary,^[1] all of which have some urban development. This line is the effective boundary of suburban Melbourne; outside it lie rural areas, and some townships of varying size.

Each suburb is followed by its **postcode**. Some suburbs share the same postcode.

Indented entries are recognised by the Geographic Names Board as unbounded neighbourhoods except when *italicised*. Those italicised usually have, or have had, Post Offices open under that name.

Information about exact suburb boundaries can be obtained from the [Department of Environment Land Water and Planning](#).

In Australia, a **suburb** is a named and bounded locality of a city, with an urban nature, regardless of its location within that city. The term "inner suburbs" refers to the older, denser, **urban areas** closer to the original colonial centre of the cities and "outer suburbs" refers to the urban areas more remote from the centre of the metropolitan area. Sometimes the term "middle ring suburb" is used to refer to areas that were urbanised early in a city's expansion after the inner suburbs had become established. This differs from British and North American usage, in which the term "suburb" is usually not applied to urban areas (**neighbourhoods**) that are close to a major city centre or inside the central city's local government boundary.

Inner City municipalities and their suburbs (followed by their 4-digit postcodes) [edit]

City of Melbourne	Postcode
Carlton	3053
Carlton South	
Carlton North	3054 (Shared with City of Yarra)
Docklands	3008
East Melbourne	3002
Jolimont	(the name of the railway station)
Flemington	3031 (Shared with City of Moonee Valley)
Kensington	3031
Melbourne	3000 (Central business district)
Melbourne	3004 (St Kilda Road area, shared with City of Port Phillip)
North Melbourne	3051 (Shared with City of Moonee Valley)
Hotham Hill	
Macaulay	(the name of the railway station)
Parkville	3052
Royal Park	
Port Melbourne	3207 (Shared with City of Port Phillip)
Fishermans Bend	(formerly Fishermen's Bend)
Garden City	
Southbank	3006 (Shared with City of Port Phillip)
South Wharf	3006
South Yarra	3141 (Shared with City of Stonnington)
West Melbourne	3003
Coode Island	

See [Melbourne city centre](#) for precincts in the CBD.

City of Port Phillip	Postcode
Albert Park	3206
Balclava	3183
Eldwood	3184
Brighton Road	
Melbourne	3004 (St Kilda Road area, shared with City of Melbourne)
Albert Park Barracks	

Figure 1. Wikipedia Page Showing List of Postcodes and Suburb names. [1]

4. Methodology

4.1. Data extraction and Cleansing

Data from Wikipedia is scraped and parsed to a pandas data frame using Beautiful Soup 4.

```
: url = 'https://en.wikipedia.org/wiki/List_of_Melbourne_suburbs'
html_text = requests.get(url).text
soup = BeautifulSoup(html_text, 'html.parser')
print(soup.prettify())

<!DOCTYPE html>
<html class="client-nojs" dir="ltr" lang="en">
<head>
<meta charset="utf-8"/>
<title>
List of Melbourne suburbs - Wikipedia
</title>
<script>
document.documentElement.className="client-js";RLCONF=[{"wgBreakFrames":!1,"wgSeparatorTransformTable":[],"wgDigitTransformable":[],"wgDefaultDateFormat":"dmy","wgMonthNames":["January","February","March","April","May","June","July","August","September","October","November","December"],"wgRequestId":109672f2c-6434-46f8-843b-8603de3e36a9,"wgCSPNonce":!1,"wgCanonicalNamespace":",","wgCanonicalSpecialPageName":!1,"wgNamespaceNumber":0,"wgPageName":"List_of_Melbourne_suburbs","wgCurRevisionId":1006848636,"wgRevisionId":1006848636,"wgArticleId":745628,"wgIsArticle":!0,"wgIsRedirect":!1,"wgAction":"view","wgUserName":null,"wgUserGroupSet":["*"],"wgCategories":!"Webarchive template wayback links","Articles with short description","Short description is different from Wikidata","Use dmy dates from October 2012","Geography of Victoria (Australia)","Lists of suburbs in Australia","Suburbs of Melbourne","Melbourne-related lists","wgPageContentLanguage":"en","wgPageContentModel":"wikitext","wgRelevantPageName":"List_of_Melbourne_suburbs","wgRelevantArticleId":745628,"wgIsProbablyEditable":!0,"wgRelevantPageIsProbablyEditable":!0,"wgRestrictionEdit":[],"wgR
```

Figure 2. Screen shots showing the soup object scraped from wiki.

The data in the frame has been cleaned. For examples, the unnecessary information in the parenthesis is removed, extra brackets are deleted, postcode information is separated from the suburb information and the NaN values are cleaned. The prepared dataframe looks like below.

	City	Suburb	PostalCode	area
0	City of Melbourne	Carlton	3053	Carlton South
1	City of Melbourne	Carlton North	3054	Carlton North
2	City of Melbourne	Docklands	3008	Docklands
3	City of Melbourne	East Melbourne	3002	Jolimont
4	City of Melbourne	Flemington	3031	Flemington
5	City of Melbourne	Kensington	3031	Kensington

Figure 3. Screen shot of prepared dataframe.

4.2. Data Exploration and map generation

Geometrical data is retrieved via geocoder. Latitudes and Longitudes are attached to the dataframe.

	City	Suburb	PostalCode	area	Latitude	Longitude
0	City of Melbourne	Carlton	3053	Carlton South	-37.80101	144.96951
1	City of Melbourne	Carlton North	3054	Carlton North	-37.78918	144.97188
2	City of Melbourne	Docklands	3008	Docklands	-37.81926	144.94555
3	City of Melbourne	East Melbourne	3002	Jolimont	-37.81132	144.97799
4	City of Melbourne	Flemington	3031	Flemington	-37.78814	144.92965
5	City of Melbourne	Kensington	3031	Kensington	-37.79421	144.92754

Figure 4. Screen shot of dataframe with location data attached.

Map is generated based on the dataframe using folium map.

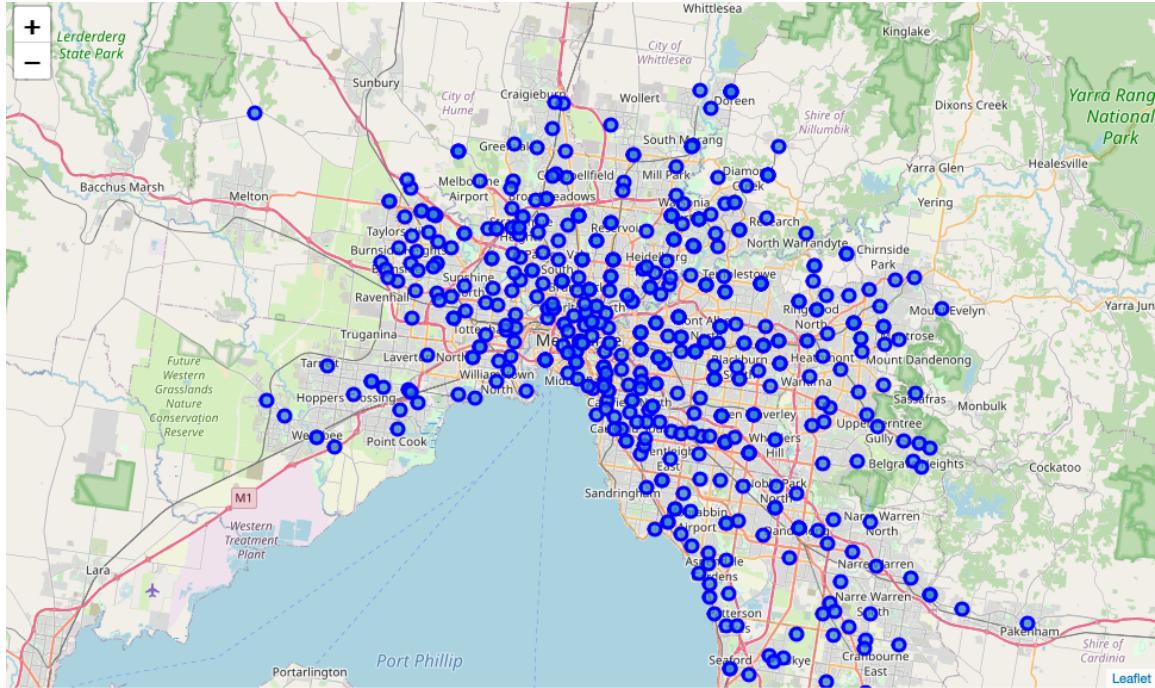


Figure 5. Screen shot of map generated via folium.

4.4 Foursquare and venue information

Foursquare is used to get the venue information at local areas.

	name	categories	lat	lng
0	D.O.C. Pizza & Mozzarella Bar	Pizza Place	-37.798954	144.968490
1	Carlton Wine Room	Wine Bar	-37.798584	144.968610
2	Baker D. Chirico	Bakery	-37.798788	144.968499
3	Gewürzhaus	Gourmet Shop	-37.799050	144.967480
4	Assembly Coffee & Tea	Coffee Shop	-37.802750	144.967290

Figure 6. Screen shot of the venue information at local areas.

We attached the venue information to the suburb dataframe.

Suburb	Suburb Latitude	Suburb Longitude	Venue	Venue Latitude	Venue Longitude	Venue Category
0 Carlton	-37.80101	144.96951	D.O.C. Pizza & Mozzarella Bar	-37.798954	144.968490	Pizza Place
1 Carlton	-37.80101	144.96951	Carlton Wine Room	-37.798584	144.968610	Wine Bar
2 Carlton	-37.80101	144.96951	Baker D. Chirico	-37.798788	144.968499	Bakery
3 Carlton	-37.80101	144.96951	Gewürzhaus	-37.799050	144.967480	Gourmet Shop
4 Carlton	-37.80101	144.96951	Assembly Coffee & Tea	-37.802750	144.967290	Coffee Shop

Figure 7. Screen shot of the venue information attached to the dataframe with local suburb information.

The Venue Categories in the dataframe are examined and organized to remove non restaurant related contents.

The Venue Categories are ['Pizza Place' 'Wine Bar' 'Bakery' 'Gourmet Shop' 'Coffee Shop' 'Frozen Yogurt Shop' 'Dessert Shop' 'Museum' 'Deli / Bodega' 'Indie Theater' 'Ice Cream Shop' 'Movie Theater' 'Italian Restaurant' 'Vegetarian / Vegan Restaurant' 'Bookstore' 'Indie Movie Theater' 'Café' 'Cheese Shop' 'Egyptian Restaurant' 'Bar' 'Monument / Landmark' 'Thai Restaurant' 'Burger Joint' 'Hookah Bar' 'Yunnan Restaurant' 'Japanese Restaurant' 'French Restaurant' 'Asian Restaurant' 'Vietnamese Restaurant' 'Lebanese Restaurant' 'Pub' 'Gastropub' 'Hotel' 'Park' 'Grocery Store' 'Tram Station' 'Restaurant' 'Australian Restaurant' 'Dog Run' 'Chinese Restaurant' 'Gym / Fitness Center' 'BBQ Joint' 'Indian Restaurant' 'Cosmetics Shop' 'Wine Shop' 'Supermarket' 'Breakfast Spot' 'Shoe Store' 'Cocktail Bar' 'Chiropractor' 'Argentinian Restaurant' 'Record Shop' 'Fish & Chips Shop' 'Middle Eastern Restaurant' 'Sculpture Garden' 'Steakhouse' 'Building' 'Stadium' 'German Restaurant' 'Salad Place' 'Tapas Restaurant' 'Garden' 'Theater' 'Mexican Restaurant' 'Hostel' 'Flower Shop' 'Malay Restaurant' 'Ethiopian Restaurant' 'Pharmacy' 'Sandwich Place' 'Dumpling Restaurant' 'Shopping Mall' 'Gym' 'Fried Chicken Joint' 'Plaza' 'Road' 'Creperie' 'Street Art' 'Spanish Restaurant' 'Music Venue' 'Art Gallery' 'Juice Bar' 'Whisky Bar' 'Cupcake Shop' 'Jewelry Store' 'Sushi Restaurant' 'Boutique' 'Discount Store' 'Pedestrian Plaza' 'City Hall' 'Portuguese Restaurant'

Figure 8. The Venue Categories including all the venues.

	Venue Category	Suburb	Suburb Latitude	Suburb Longitude	Venue	Venue Latitude	Venue Longitude
0	Italian Restaurant	141	141	141	141	141	141
1	Fast Food Restaurant	118	118	118	118	118	118
2	Asian Restaurant	96	96	96	96	96	96
3	Thai Restaurant	92	92	92	92	92	92
4	Vietnamese Restaurant	78	78	78	78	78	78
5	Japanese Restaurant	77	77	77	77	77	77
6	Chinese Restaurant	72	72	72	72	72	72
7	Australian Restaurant	65	65	65	65	65	65
8	Indian Restaurant	60	60	60	60	60	60
9	Portuguese Restaurant	58	58	58	58	58	58
10	Sushi Restaurant	48	48	48	48	48	48
11	Malay Restaurant	39	39	39	39	39	39
12	Mexican Restaurant	38	38	38	38	38	38
13	Middle Eastern Restaurant	36	36	36	36	36	36
14	French Restaurant	30	30	30	30	30	30
15	Dumpling Restaurant	29	29	29	29	29	29

Figure 9. The Venue Categories with restaurants organised in a suburb number descending order.

4.3. Machine Learning with one hot encoding

We perform the One Hot Encoding technique which transforms the categorical data into Numerical Data for Machine Learning algorithms. Each venue in the above table has been turned into the frequency of venues appearing in each Suburb.

Suburb	Afghan Restaurant	African Restaurant	American Restaurant	Argentinian Restaurant	Asian Restaurant	Australian Restaurant	Austrian Restaurant	Brazilian Restaurant	Burmese Restaurant	...	Szechuan Restaurant	Taiwanese Restaurant	Total
12 Carlton	0	0	0	0	0	0	0	0	0	0 ...	0	0	0
15 Carlton	0	0	0	0	0	0	0	0	0	0 ...	0	0	0
17 Carlton	0	0	0	0	0	0	0	0	0	0 ...	0	0	0
22 Carlton	0	0	0	0	0	0	0	0	0	0 ...	0	0	0
23 Carlton	0	0	0	0	0	0	0	0	0	0 ...	0	0	0

Figure 10. Screen shot of the dataframe where the venues has been turned into venue appearing frequency with One Hot Encoding.

4.4. K-Means Clustering and analysis

The rows were grouped by suburbs and by average of the frequency of occurrence of each venue category.

Suburb	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	Asian Restaurant	Sushi Restaurant	Portuguese Restaurant	Australian Restaurant	French Restaurant	Italian Restaurant	Tapas Restaurant	Vietnamese Restaurant	Brazilian Restaurant	Indian Restaurant
1 Abbotsford	Greek Restaurant	Afghan Restaurant	Peking Duck Restaurant	Russian Restaurant	Ramen Restaurant	Portuguese Restaurant	Polish Restaurant	Peruvian Restaurant	Molecular Gastronomy Restaurant	Korean Restaurant
2 Ai	Asian Restaurant	Sushi Restaurant	Portuguese Restaurant	Australian Restaurant	French Restaurant	Italian Restaurant	Tapas Restaurant	Vietnamese Restaurant	Brazilian Restaurant	Indian Restaurant
3 Airport West	Fast Food Restaurant	Japanese Restaurant	Portuguese Restaurant	Sushi Restaurant	Afghan Restaurant	Peruvian Restaurant	Russian Restaurant	Ramen Restaurant	Polish Restaurant	Molecular Gastronomy Restaurant

Figure 11. Screen shot showing the rows were group by suburbs by average of the frequency of occurrence of each venue category.

Top ten venues of local suburbs were obtained for each suburb in the dataframe

City	Suburb	area	PostalCode	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
0 City of Melbourne	Carlton	Carlton South	3053	-37.80101	144.96951	1.0	Italian Restaurant	French Restaurant	Yunnan Restaurant	Thai Restaurant	Lebanese Restaurant	Egyptian Restaurant	Japanese Restaurant
1 City of Melbourne	Carlton North		3054	-37.78918	144.97188	0.0	Italian Restaurant	Argentinian Restaurant	Australian Restaurant	Indian Restaurant	Thai Restaurant	Chinese Restaurant	Afghan Restaurant
2 City of Melbourne	Docklands		3008	-37.81926	144.94555	0.0	Vietnamese Restaurant	Italian Restaurant	Tapas Restaurant	Australian Restaurant	Middle Eastern Restaurant	Thai Restaurant	German Restaurant
3 City of Melbourne	East Melbourne	Jolimont	3002	-37.81132	144.97799	0.0	Indian Restaurant	Asian Restaurant	Australian Restaurant	Mexican Restaurant	Afghan Restaurant	Russian Restaurant	Ramen Restaurant
4 City of Melbourne	Flemington		3031	-37.78814	144.92965	0.0	Malay Restaurant	Vietnamese Restaurant	Asian Restaurant	Ethiopian Restaurant	Middle Eastern Restaurant	Japanese Restaurant	Dumpling Restaurant

Figure 12. Screen shot showing each suburb with its top 10 popular restaurants in a dataframe grouped with different cluster labels.

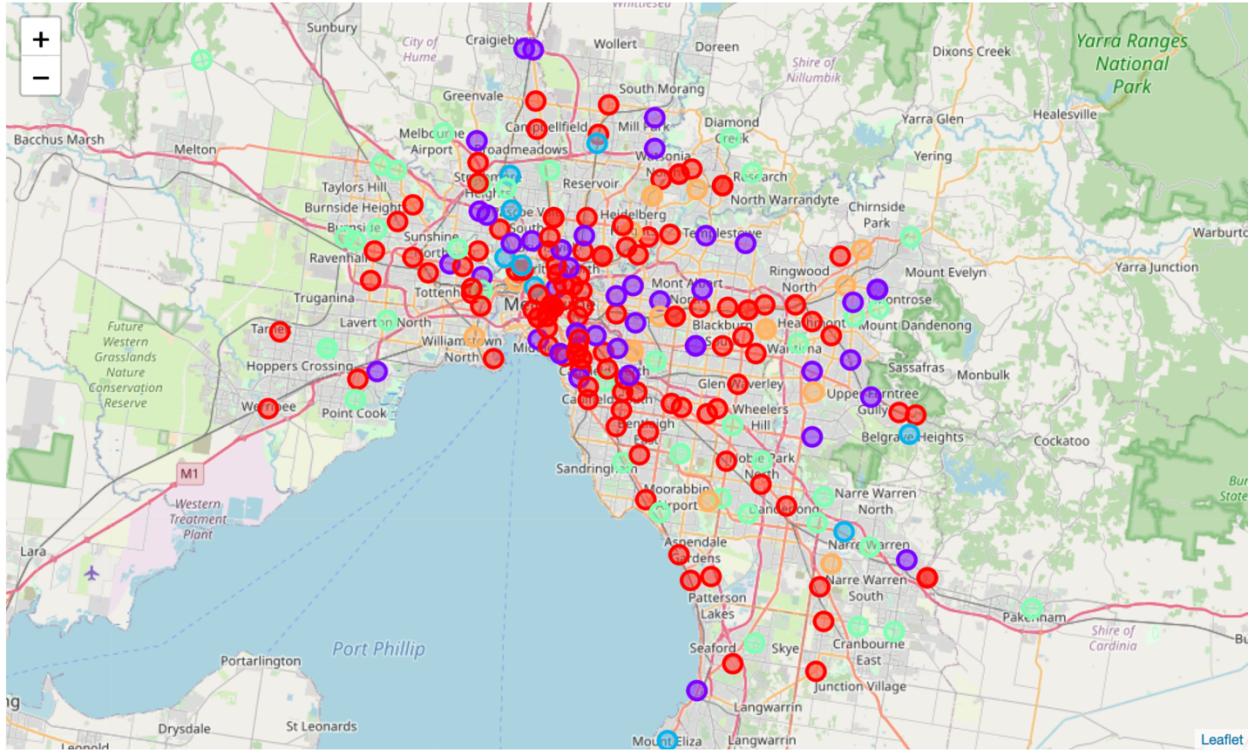


Figure 13. Map of Restaurant clusters showing cluster geometrical distribution in Melbourne.

5 Clusters of the suburbs are showing in the Figures below.

Class 0: Mixed Restaurant

```
1 Local_merged['Cluster Labels'] == 0, Local_merged.columns[[1] + list(range(5, Local_merged.shape[1]))]].head(20)
2
```

	Suburb	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
1	Carlton North	144.97188	0.0	Italian Restaurant	Argentinian Restaurant	Australian Restaurant	Indian Restaurant	Thai Restaurant	Chinese Restaurant	Afghan Restaurant	Russian Restaurant	Ramen Restaurant	Portuguese Restaurant
2	Docklands	144.94555	0.0	Vietnamese Restaurant	Italian Restaurant	Tapas Restaurant	Australian Restaurant	Middle Eastern Restaurant	Thai Restaurant	German Restaurant	Peking Duck Restaurant	Ramen Restaurant	Portuguese Restaurant
3	East Melbourne	144.97799	0.0	Indian Restaurant	Asian Restaurant	Australian Restaurant	Mexican Restaurant	Afghan Restaurant	Russian Restaurant	Ramen Restaurant	Portuguese Restaurant	Polish Restaurant	Peruvian Restaurant
4	Flemington	144.92965	0.0	Malay Restaurant	Vietnamese Restaurant	Asian Restaurant	Ethiopian Restaurant	Middle Eastern Restaurant	Japanese Restaurant	Dumpling Restaurant	Polish Restaurant	Russian Restaurant	Ramen Restaurant
6	Melbourne	144.96751	0.0	Asian Restaurant	Sushi Restaurant	Portuguese Restaurant	Australian Restaurant	French Restaurant	Italian Restaurant	Tapas Restaurant	Vietnamese Restaurant	Brazilian Restaurant	India Restaurant
7	Melbourne	144.96751	0.0	Asian Restaurant	Sushi Restaurant	Portuguese Restaurant	Australian Restaurant	French Restaurant	Italian Restaurant	Tapas Restaurant	Vietnamese Restaurant	Brazilian Restaurant	India Restaurant
9	Southbank	144.96093	0.0	Japanese Restaurant	Australian Restaurant	Italian Restaurant	Cantonese Restaurant	Seafood Restaurant	Sushi Restaurant	Chinese Restaurant	French Restaurant	Peking Duck Restaurant	Molecular Gastronomy Restaurant
10	South Wharf	144.95151	0.0	Australian Restaurant	Lebanese Restaurant	Spanish Restaurant	Thai Restaurant	Japanese Restaurant	Italian Restaurant	Vietnamese Restaurant	Seafood Restaurant	Mexican Restaurant	Mediterranean Restaurant
12	West Melbourne	144.95038	0.0	Malay Restaurant	Italian Restaurant	Middle Eastern Restaurant	Himalayan Restaurant	Chinese Restaurant	Indonesian Restaurant	Mexican Restaurant	African Restaurant	Korean Restaurant	Moder European Restaurant
14	Balaclava	144.99565	0.0	Vietnamese Restaurant	Fast Food Restaurant	Vegetarian / Vegan Restaurant	Australian Restaurant	Mediterranean Restaurant	Japanese Restaurant	Tapas Restaurant	Sushi Restaurant	Afghan Restaurant	Peking Duck Restaurant
15	Melbourne	144.96751	0.0	Asian Restaurant	Sushi Restaurant	Portuguese Restaurant	Australian Restaurant	French Restaurant	Italian Restaurant	Tapas Restaurant	Vietnamese Restaurant	Brazilian Restaurant	India Restaurant

Figure 14. Cluster 0 and each suburb's top 10 most common restaurants.

Class 1: Italian Restaurant

```
1 Local_merged.loc[Local_merged['Cluster Labels'] == 1, Local_merged.columns[[1] + list(range(5, Local_merged.shap
2
```

	Suburb	Longitude	Cluster Labels	1st Most Common Venue	2nd Most Common Venue	3rd Most Common Venue
0	Carlton	144.969510	1.0	Italian Restaurant	French Restaurant	Yunnan Restaurant
11	South Yarra	144.992710	1.0	Italian Restaurant	Japanese Restaurant	Mexican Restaurant
13	Albert Park	144.951260	1.0	Italian Restaurant	Seafood Restaurant	Middle Eastern Restaurant
17	Ripponlea	144.994950	1.0	Molecular Gastronomy Restaurant	Jewish Restaurant	Italian Restaurant
20	St Kilda West	144.974220	1.0	Australian Restaurant	Italian Restaurant	Indian Restaurant
31	Fitzroy North	144.983680	1.0	Italian Restaurant	Vegetarian / Vegan Restaurant	Indian Restaurant
50	Thornbury	145.000920	1.0	Italian Restaurant	Tapas Restaurant	Australian Restaurant
53	Craigieburn	144.945480	1.0	Italian Restaurant	Afghan Restaurant	Molecular Gastronomy Restaurant
57	Westmeadows	144.884480	1.0	Italian Restaurant	Chinese Restaurant	Afghan Restaurant
59	Brunswick East	144.975740	1.0	Italian Restaurant	Portuguese Restaurant	Southern / Soul Food Restaurant
60	Brunswick West	144.944460	1.0	Italian Restaurant	Asian Restaurant	Afghan Restaurant
71	Mill Park	145.075160	1.0	Italian Restaurant	Turkish Restaurant	Fast Food Restaurant
74	Balwyn	145.081590	1.0	Malay Restaurant	Japanese Restaurant	Italian Restaurant
78	Hawthorn East	145.055520	1.0	Italian Restaurant	Mexican Restaurant	Portuguese Restaurant
79	Kew	145.034110	1.0	Italian Restaurant	Chinese Restaurant	Fast Food Restaurant
80	Kew East	145.052010	1.0	Asian Restaurant	Italian Restaurant	Afghan Restaurant
83	Boronia	145.285580	1.0	Fast Food Restaurant	Middle Eastern Restaurant	Italian Restaurant
84	Rowville	145.245000	1.0	Portuguese Restaurant	Afghan Restaurant	Singaporean Restaurant
85	Upper Ferntree Gully	145.307310	1.0	Italian Restaurant	Fast Food Restaurant	Indian Restaurant
87	Wantirna South	145.244620	1.0	Italian Restaurant	Malay Restaurant	Vietnamese Restaurant

Figure 15. Cluster 1 and each suburb's top 10 most common restaurants.

Class 2:Middle East/ Afghan Restaurant

```
1 Local_merged.loc[Local_merged['Cluster Labels'] == 2, Local_merged.columns[[1] + list(range(5, Local_merged.shap
2
```

	Suburb	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
8	North Melbourne	144.94609	2.0	Malay Restaurant	Middle Eastern Restaurant	Afghan Restaurant	Singaporean Restaurant	Lebanese Restaurant	Mediterranean Restaurant	Mexican Restaurant	Modern European Restaurant	Molecular Gastronomy Restaurant	Pek Duck Restaurant
63	Glenroy	144.92057	2.0	Fast Food Restaurant	Middle Eastern Restaurant	Peking Duck Restaurant	Seafood Restaurant	Russian Restaurant	Ramen Restaurant	Portuguese Restaurant	Polish Restaurant	Peruvian Restaurant	Afghan Restaurant
72	Thomastown	145.01431	2.0	Middle Eastern Restaurant	Halal Restaurant	Afghan Restaurant	Peking Duck Restaurant	Russian Restaurant	Ramen Restaurant	Portuguese Restaurant	Polish Restaurant	Peruvian Restaurant	Molecular Gastronomy Restaurant
114	Belgrave Heights	145.34959	2.0	Middle Eastern Restaurant	Afghan Restaurant	Singaporean Restaurant	Lebanese Restaurant	Malay Restaurant	Mediterranean Restaurant	Mexican Restaurant	Modern European Restaurant	Molecular Gastronomy Restaurant	Pek Duck Restaurant
129	Hallam	145.27902	2.0	Middle Eastern Restaurant	Afghan Restaurant	Singaporean Restaurant	Lebanese Restaurant	Malay Restaurant	Mediterranean Restaurant	Mexican Restaurant	Modern European Restaurant	Molecular Gastronomy Restaurant	Pek Duck Restaurant
171	Mount Eliza	145.09025	2.0	Middle Eastern Restaurant	Afghan Restaurant	Singaporean Restaurant	Lebanese Restaurant	Malay Restaurant	Mediterranean Restaurant	Mexican Restaurant	Modern European Restaurant	Molecular Gastronomy Restaurant	Pek Duck Restaurant
217	Ascot Vale	144.91556	2.0	Indian Restaurant	Middle Eastern Restaurant	Molecular Gastronomy Restaurant	Russian Restaurant	Ramen Restaurant	Portuguese Restaurant	Polish Restaurant	Peruvian Restaurant	Peking Duck Restaurant	Afghan Restaurant
224	Strathmore	144.92204	2.0	Middle Eastern Restaurant	Thai Restaurant	Fast Food Restaurant	Afghan Restaurant	Peking Duck Restaurant	Ramen Restaurant	Portuguese Restaurant	Polish Restaurant	Peruvian Restaurant	Peruvian Restaurant
225	Travancore	144.93285	2.0	Fast Food Restaurant	Middle Eastern Restaurant	Peking Duck Restaurant	Seafood Restaurant	Russian Restaurant	Ramen Restaurant	Portuguese Restaurant	Polish Restaurant	Peruvian Restaurant	Afghan Restaurant

Figure 16. Cluster 2 and each suburb's top 10 most common restaurants.

Class 3: Fast Food

```
1 Local_merged.loc[Local_merged['Cluster Labels'] == 3, Local_merged.columns[[1] + list(range(5, Local_merged.shap
2
```

	Suburb	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 Ven
55	Melbourne Airport	144.849340	3.0	Fast Food Restaurant	Spanish Restaurant	Portuguese Restaurant	Middle Eastern Restaurant	Afghan Restaurant	Peruvian Restaurant	Russian Restaurant	Ramen Restaurant	Polish Restaurant	Molecular Gastronomy Restaurant
62	Fawkner	144.962750	3.0	Fast Food Restaurant	Peking Duck Restaurant	Seafood Restaurant	Russian Restaurant	Ramen Restaurant	Portuguese Restaurant	Polish Restaurant	Peruvian Restaurant	Afghan Restaurant	Korean Restaurant
64	Oak Park	144.916980	3.0	Fast Food Restaurant	Peking Duck Restaurant	Seafood Restaurant	Russian Restaurant	Ramen Restaurant	Portuguese Restaurant	Polish Restaurant	Peruvian Restaurant	Afghan Restaurant	Korean Restaurant
65	Diamond Creek	145.157070	3.0	Fast Food Restaurant	Peking Duck Restaurant	Seafood Restaurant	Russian Restaurant	Ramen Restaurant	Portuguese Restaurant	Polish Restaurant	Peruvian Restaurant	Afghan Restaurant	Korean Restaurant
68	Research	145.180360	3.0	Chinese Restaurant	Fast Food Restaurant	Afghan Restaurant	Peruvian Restaurant	Seafood Restaurant	Russian Restaurant	Ramen Restaurant	Portuguese Restaurant	Polish Restaurant	Peking Duck Restaurant
73	Ashburton	145.077160	3.0	Sushi Restaurant	Fast Food Restaurant	Afghan Restaurant	Peking Duck Restaurant	Russian Restaurant	Ramen Restaurant	Portuguese Restaurant	Polish Restaurant	Peruvian Restaurant	Molecular Gastronomy Restaurant
86	Wantirna	145.229070	3.0	Fast Food Restaurant	Japanese Restaurant	Peking Duck Restaurant	Seafood Restaurant	Russian Restaurant	Ramen Restaurant	Portuguese Restaurant	Polish Restaurant	Peruvian Restaurant	Afghan Restaurant
92	Bayswater North	145.290460	3.0	Fast Food Restaurant	Peking Duck Restaurant	Seafood Restaurant	Russian Restaurant	Ramen Restaurant	Portuguese Restaurant	Polish Restaurant	Peruvian Restaurant	Afghan Restaurant	Korean Restaurant
99	Kilsyth South	145.316530	3.0	Fast Food Restaurant	Peking Duck Restaurant	Seafood Restaurant	Russian Restaurant	Ramen Restaurant	Portuguese Restaurant	Polish Restaurant	Peruvian Restaurant	Afghan Restaurant	Korean Restaurant

Figure 17. Cluster 3 and each suburb's top 10 most common restaurants.

Class 4: Thai restaurant.

```
1 Local_merged.loc[Local_merged['Cluster Labels'] == 4, Local_merged.columns[[1] + list(range(5, Local_merged.shap
2
```

	Suburb	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 Venu
5	Kensington	144.927540	4.0	Japanese Restaurant	Thai Restaurant	Afghan Restaurant	Molecular Gastronomy Restaurant	Ramen Restaurant	Portuguese Restaurant	Polish Restaurant	Peruvian Restaurant	Peking Duck Restaurant	Middle Eastern Restaurant
38	Heidelberg Heights	145.050470	4.0	Indian Restaurant	Thai Restaurant	Afghan Restaurant	Ramen Restaurant	Portuguese Restaurant	Polish Restaurant	Peruvian Restaurant	Peking Duck Restaurant	Molecular Gastronomy Restaurant	Moder European Restaurant
42	Macleod	145.073470	4.0	Thai Restaurant	Afghan Restaurant	Molecular Gastronomy Restaurant	Russian Restaurant	Ramen Restaurant	Portuguese Restaurant	Polish Restaurant	Peruvian Restaurant	Peking Duck Restaurant	Moder European Restaurant
43	Montmorency	145.120770	4.0	Thai Restaurant	Chinese Restaurant	Afghan Restaurant	Peking Duck Restaurant	Russian Restaurant	Ramen Restaurant	Portuguese Restaurant	Polish Restaurant	Peruvian Restaurant	Molecular Gastronomy Restaurant
47	Macleod	145.073470	4.0	Thai Restaurant	Afghan Restaurant	Molecular Gastronomy Restaurant	Russian Restaurant	Ramen Restaurant	Portuguese Restaurant	Polish Restaurant	Peruvian Restaurant	Peking Duck Restaurant	Moder European Restaurant
75	Canterbury	145.080830	4.0	Thai Restaurant	Afghan Restaurant	Molecular Gastronomy Restaurant	Russian Restaurant	Ramen Restaurant	Portuguese Restaurant	Polish Restaurant	Peruvian Restaurant	Peking Duck Restaurant	Moder European Restaurant
76	Glen Iris	145.052220	4.0	Thai Restaurant	Afghan Restaurant	Molecular Gastronomy Restaurant	Russian Restaurant	Ramen Restaurant	Portuguese Restaurant	Polish Restaurant	Peruvian Restaurant	Peking Duck Restaurant	Moder European Restaurant
93	Croydon	145.280190	4.0	Thai Restaurant	Afghan Restaurant	Molecular Gastronomy Restaurant	Russian Restaurant	Ramen Restaurant	Portuguese Restaurant	Polish Restaurant	Peruvian Restaurant	Peking Duck Restaurant	Moder European Restaurant
95	Croydon North	145.298030	4.0	Thai Restaurant	Afghan Restaurant	Molecular Gastronomy Restaurant	Russian Restaurant	Ramen Restaurant	Portuguese Restaurant	Polish Restaurant	Peruvian Restaurant	Peking Duck Restaurant	Moder European Restaurant
..	Indian	Thai	Afghan	Ramen	Portuguese	Polish	Peruvian	Peking	Molecular	..

Figure 18. Cluster 4 and each suburb's top 10 most common restaurants.

5. Results and Discussion:

We plotted the number of suburbs as a function of the most popular restaurant in local suburb. (Figure 14.) It shows that the Italian restaurant is most popular restaurant in 140 suburbs of Melbourne. It is followed by fast food restaurants and Asian restaurants. Although Asian restaurant doesn't show up as top rank in the plot, it has many sub cuisines, such as the following ranked Thai, Vietnamese, Japanese and Chinese cuisines.

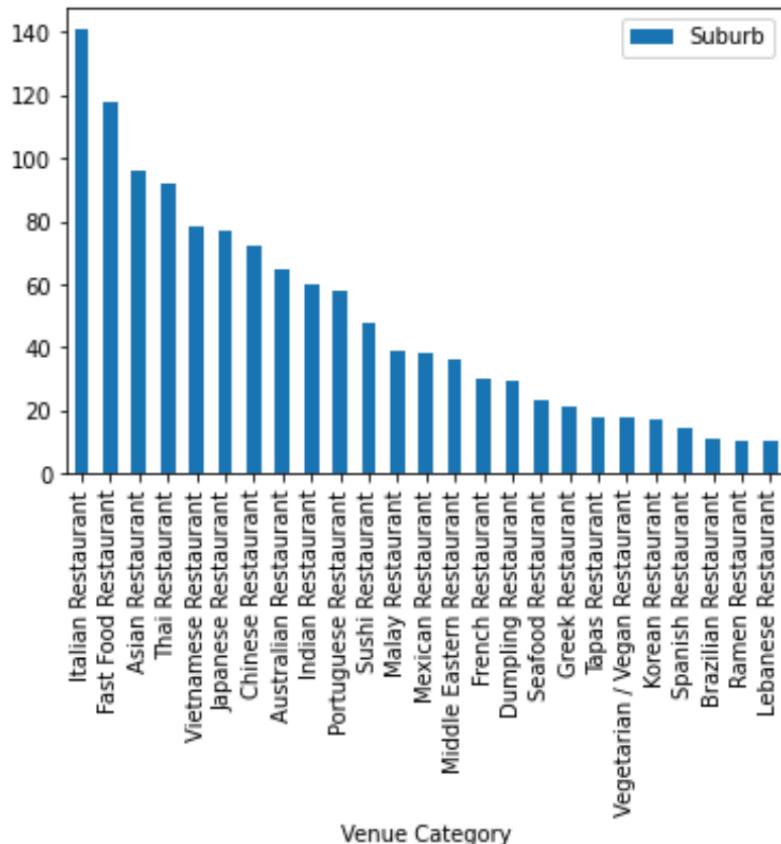


Figure 19. Suburb Numbers with the most popular local restaurant.

Suburbs of Cluster 0 are indicated in the red circles in the Map (Figure 13). Cluster 0 contains 126 suburbs (Figure 20) and has a broader coverage compared to all the other 4 clusters. Most of the suburbs are located in the CBD region and the east, south east, north and west corridors in Melbourne. Asian restaurants followed by Chinese and Vietnamese restaurants are the top3 picks in the 1st most common restaurants. While Afghan restaurants are also very popular as the 2nd most common restaurants in these suburbs. (Figure 21)

```
1 | loc_cl0.shape  
(126, 13)
```

Figure 20. Screen shot showing data shape of cluster 0.

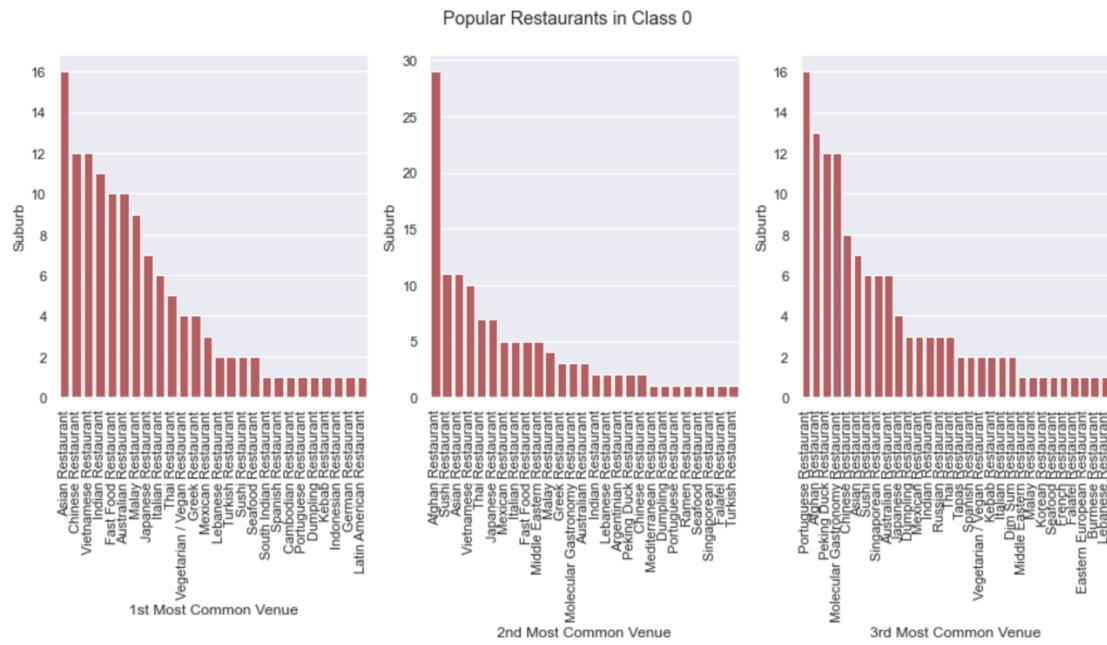


Figure 21. Bar charts showing restaurant popularity of Cluster 0 (Red circles on map).

Suburbs of Cluster 1 are indicated in the purple circles in the Map (Figure 13). Cluster 1 contains 42 suburbs (Figure 22) and are mainly located at the east, north inner and outer city regions. In this cluster, the most popular restaurant is dominated by the Italian restaurants. (Figure 23.) At the same time, Afghan restaurants occupies most popular positions as the 2nd and 3rd most common restaurants in these suburbs.

```
1 | loc_cl1.shape
(42, 13)
```

Figure 22. Screen shot showing data shape of cluster 1.



Figure 23. Bar charts showing restaurant popularity of Cluster 1 (Purple circles on map).

Suburbs of Cluster 2 are indicated in the blue circles in the Map (Figure 13). Cluster 2 contains 9 suburbs (Figure 24) and are located at the west inner city, north and far east regions of Melbourne. People in these suburbs has a preference of middle/eastern food, afghan food and fast food over other options. (Figure 25)

loc_cl2.shape

(9, 13)

Figure 24. Screen shot showing data shape of cluster 2.

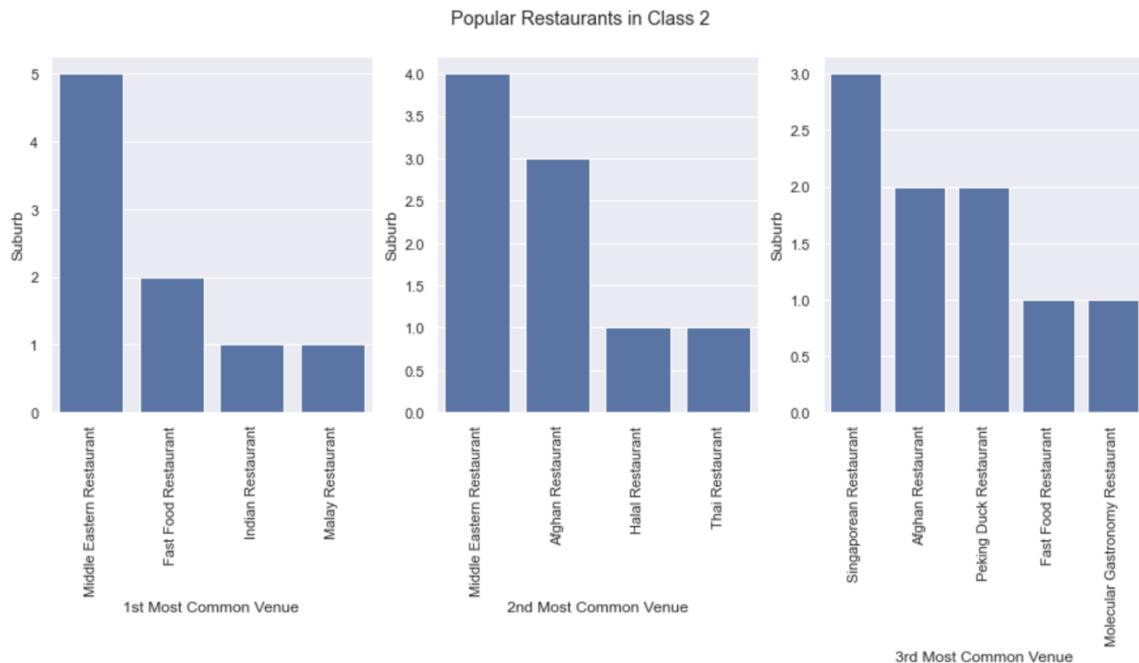


Figure 25. Bar charts showing restaurant popularity of Cluster 2 (Blue circles on map).

Suburbs of Cluster 3 are indicated in the green circles in the Map (Figure 13). Cluster 3 contains 38 suburbs (Figure 26) and are located in the exurban region of Melbourne. People's choices are limited to fast food restaurants, together with Pecking duck and Seafood restaurants as their 2nd and 3rd choices. (Figure 27)

```
1 loc_cl3.shape
```

(38, 13)

Figure 26. Screen shot showing data shape of cluster 3.

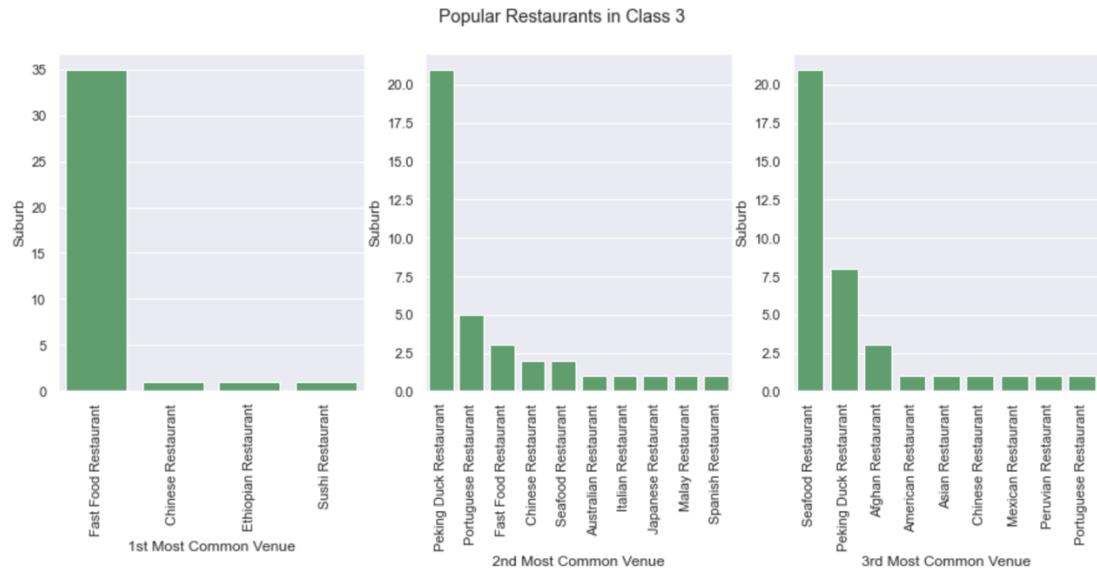


Figure 27. Bar charts showing restaurant popularity of Cluster 3 (Green circles on map).

Suburbs of Cluster 4 are indicated in the blue circles in the Map (Figure 13). Cluster 4 contains 16 suburbs (Figure 28) and are located at north west corridor and exurban of the far east and south east of Melbourne. In these suburbs, one can find Thai restaurants are most common places to visit. Not surprisingly, Afghan restaurants, Indian restaurants and fast food are follower ups. (Figure 29)

```
: 1 loc_cl4.shape
: (16, 13)
```

Figure 28. Screen shot showing data shape of cluster 4.

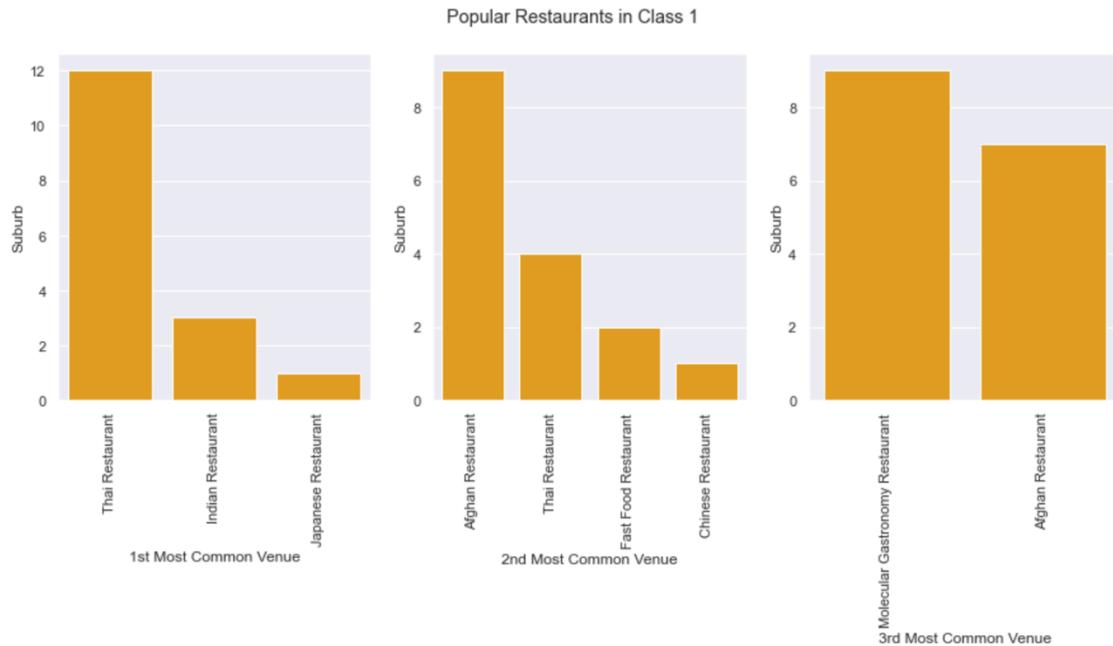


Figure 29. Bar charts showing restaurant popularity of Cluster 4 (Orange circles on map).

6. Conclusion:

Melbourne has a large range of restaurant choices including Italian, Asian, Thai, Vietnamese, Japanese, Chinese, Indian, Malay, Mexico, French, Greek, Korean restaurants and many more. People can find most of the restaurants in the CBD and along almost all the city corridors to the east, south east, north and south west suburbs. The Asian cuisines (including Thai, Vietnamese, Japanese, Chinese, Indian, Malay and et. al.), Italian restaurants, and fast food restaurants exceed in large numbers. In the east and north inner city, there is a Italian restaurant domination. In the North west corridors and some far from city suburbs in the east and south east, middle eastern food are popular. In the exurban areas Thai and fast food becomes most common choices. The data also suggested that the fast food becomes the most common choices is because of the lack of other choices. At the meantime, most suburbs see the existance of the Afghan restaurants.

It is not hard to find that the types of popular restaurants are closely related to the taste of immigration in the local region. In order to choose a restaurant location in the post pandemic period, the government's development plan should also been taken into consideration. In the Melbourne Future Growth Map (Figure 30), we can see that the far south east corridor, north west and south west is going to see more developments. Comparing these regions in map (Figure 13), we find the far south east has the most potential to start or invest in a restaurant business as it still lacks restaurant diversity. At the moment, people's choice is constraint to the fast food. In a future as the city growth, we are expected to see a boom of restaurant diversity. We would like to recommend to start/ invest in a Afghan or Asian restaurant as they are the most popular choices in the similar suburbs.



Map 14

Metropolitan and major activity centres

- | | | |
|--|--|---|
| <ul style="list-style-type: none"> ★ Central city ● Metropolitan activity centre ● Metropolitan activity centre — future • Major activity centre * Major activity centre — future | <ul style="list-style-type: none"> — Urban growth boundary — Urban area — Growth area — Green wedge land | <ul style="list-style-type: none"> — Road network — Rail network — Waterway — Waterbody |
|--|--|---|

Figure 30. Map of Melbourne future growth.

References:

- [1] <https://www.planmelbourne.vic.gov.au>
- [2] https://en.wikipedia.org/wiki/List_of_Melbourne_suburbs