

# House Price Analysis of Adelaide



The image is captured from <http://www.icmlc.com/contactus.html>

## *IBM Data Science Professional Certificate Capstone Project – The Battle of Neighborhoods*

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## A. Introduction

### A.1 Background

Adelaide is the capital city of the state of South Australia, and the fifth-most populous city of Australia. It is a planned city, designed by the first Surveyor-General of South Australia, Colonel William Light. His plan, sometimes referred to as "Light's Vision", arranged Adelaide in a grid, with five squares in the Adelaide city centre and a ring of parks, known as the Adelaide Parklands, surrounding it. It has a mediterranean climate.<sup>i</sup> The city has hot, dry summers and cool winters with moderate rainfall.



Adelaide has been consistently listed in the world's top 10 most livable cities through the 2010s by The Economist Intelligence Unit. It was also ranked the most livable city in Australia by the Property Council of Australia.<sup>ii</sup>

South Australia has population of over 1.7 million. Over 75% of the population (over 1.3 million) lives within the metropolitan capital of Adelaide, which is also 5.5% of national population. 25% of South Australian residents were born outside of Australia. According to Australia census, the top five ancestries for people in Adelaide are: English, Australian, Scottish, German and Irish. The top five languages (other than English) spoken in Adelaide are: Italian, Greek, Mandarin, Vietnamese and Cantonese. The top six countries of birth for people in Adelaide are: Australia, England, Italy, India, China and Scotland.<sup>iii</sup>

Adelaide has 473 properties available for rent and 359 properties for sale. Median property prices over the last year range from \$698,750 for houses to \$439,830 for units. If you are looking for an investment property, consider houses in Adelaide rent out for \$450 PW with an annual rental yield of 3.3% and units rent for \$440 PW with a rental yield of 5.2%. Based on five years of sales, Adelaide has seen a compound growth rate of 3.5% for houses and 1.2% for units.<sup>iv</sup>

### A.2 Objectives

The house price in CBD, Inner Northern suburb, Eastern suburb and Southern suburb are high due to the proximity to the city center.<sup>v</sup>

As property investors, they are interested to invest the houses which have large potential growth or have stable and high rent.

As permanent residents, they are interested to purchase or rent houses in low price with convenient to work and access to necessities.

This project aims to provide the insights for foreigners to understand more the house market in Adelaide. It analyzes the median house sales price in Adelaide by different suburbs. Beyond the price figures, the most popular venues in each suburbs will be analyzed.

## B. Data Source

Adelaide is divided into many suburbs. To understand geographical features of Adelaide, the list of suburb is firstly considered in data preparation.

### List of Adelaide suburbs <sup>vi</sup>

This is a list of the suburbs of Adelaide, with their postcodes and local government areas (LGAs). This article does not include suburbs and localities within the Adelaide Hills region.

Suburb	Post Code	LGA	Year Estab. [citation needed]	Dist. <sup>[4]</sup> (km) [citation needed]	Area (ha) [citation needed]	Population [citation needed]
Adelaide	5000	City of Adelaide	1837	-	1,005	15,115 <sup>[5]</sup>
North Adelaide	5006	City of Adelaide	1837	0.5	420	6,950 <sup>[6]</sup>
Auldana	5072	City of Burnside	1847 <sup>[7]</sup>	9	312	625 <sup>[8]</sup>
Beaumont	5066	City of Burnside	1870	5.9	158	2,557 <sup>[9]</sup>
Beulah Park	5067	City of Burnside	1941 <sup>[10]</sup>	5	60	1,602 <sup>[11]</sup>
Burnside	5066	City of Burnside	1839	5.75	300	2,930 <sup>[12]</sup>
Dulwich	5065	City of Burnside	1854	2.4	112	1,678 <sup>[13]</sup>
Eastwood	5063	City of Burnside	1875	3	148	764 <sup>[14]</sup>
Erindale	5066	City of Burnside	1912	6	118	1,186 <sup>[15]</sup>

### Metro median house sales <sup>vii</sup>

The second data preparation is to collect Adelaide house sales past record. In South Australian Government Data Directory, it is found the quarterly metropolitan median house sales from 2015 Q1 to 2020 Q3 divided into different suburbs. There are past sales figure per each quarters and will be used for data analysis further.

Field	Value
Title	Metro median house sales
Type	Dataset
Language	aar
Licence	<a href="#">Creative Commons Attribution</a>
Data Status	active
Update Frequency	daily
Landing Page	<a href="https://data.sa.gov.au/data/dataset/0d447195-1158-4a3c-8cc7-0e333b87eb72">https://data.sa.gov.au/data/dataset/0d447195-1158-4a3c-8cc7-0e333b87eb72</a>
Date Published	2015-07-03
Date Updated	2020-11-10
Data Granularity	Quarterly by suburb
Temporal Coverage	2015-01-01 - 2016-10-31
Geospatial Coverage	Metropolitan Adelaide
Jurisdiction	Government of South Australia
Data Portal	data.sa.gov.au
Publisher/Agency	Attorney-General's Department

City	Suburb	Sales 1Q 2014	Median 1Q 2014	Sales 1Q 2015	Median 1Q 2015	Median Change
ADELAIDE	ADELAIDE	5	647500	6	757500	16.99%
ADELAIDE	NORTH ADELAIDE	9	1100000	4	992500	-9.77%
ADELAIDE HILLS	ALDGATE	16	605000	17	685000	13.22%
ADELAIDE HILLS	ASHTON					
ADELAIDE HILLS	BALHANNAH	1	335000	9	439000	31.04%
ADELAIDE HILLS	BASKET RANGE			1	951000	
ADELAIDE HILLS	BELAIR	8	532500	18	595000	11.74%
ADELAIDE HILLS	BIRDWOOD	1	547000	3	425000	-22.30%
ADELAIDE HILLS	BRADBURY			1	505000	
ADELAIDE HILLS	BRIDGEWATER	16	391000	12	405500	3.71%
ADELAIDE HILLS	CAREY GULLY	1	450000	1	530000	17.78%
ADELAIDE HILLS	CASTAMBUL					
ADELAIDE HILLS	CHAIN OF PONDS					
ADELAIDE HILLS	CHARLESTON	1	425000	1	435000	2.35%
ADELAIDE HILLS	CHERRYVILLE					
ADELAIDE HILLS	CRAFERS	3	450000	5	565000	25.56%
ADELAIDE HILLS	CRAFERS WEST	3	590000	3	577000	-2.20%

## C. Methodology

### C.1 Geolocation of Suburbs

The latitudes and longitudes of each suburbs are mapped through [geopy.geocoders.Nominatim<sup>viii</sup>](#) library.

	suburb	postcode	district	area	population	latitude	longitude
0	Adelaide	5000	City of Adelaide	1,005.0000	15115	-34.9282	138.5999
1	North Adelaide	5006	City of Adelaide	420.0000	6950	-34.9085	138.5954
2	Auldana	5072	City of Burnside	312.0000	625	-34.9180	138.6869
3	Beaumont	5066	City of Burnside	158.0000	2557	-34.9500	138.6593
4	Beulah Park	5067	City of Burnside	60.0000	1602	-34.9177	138.6452

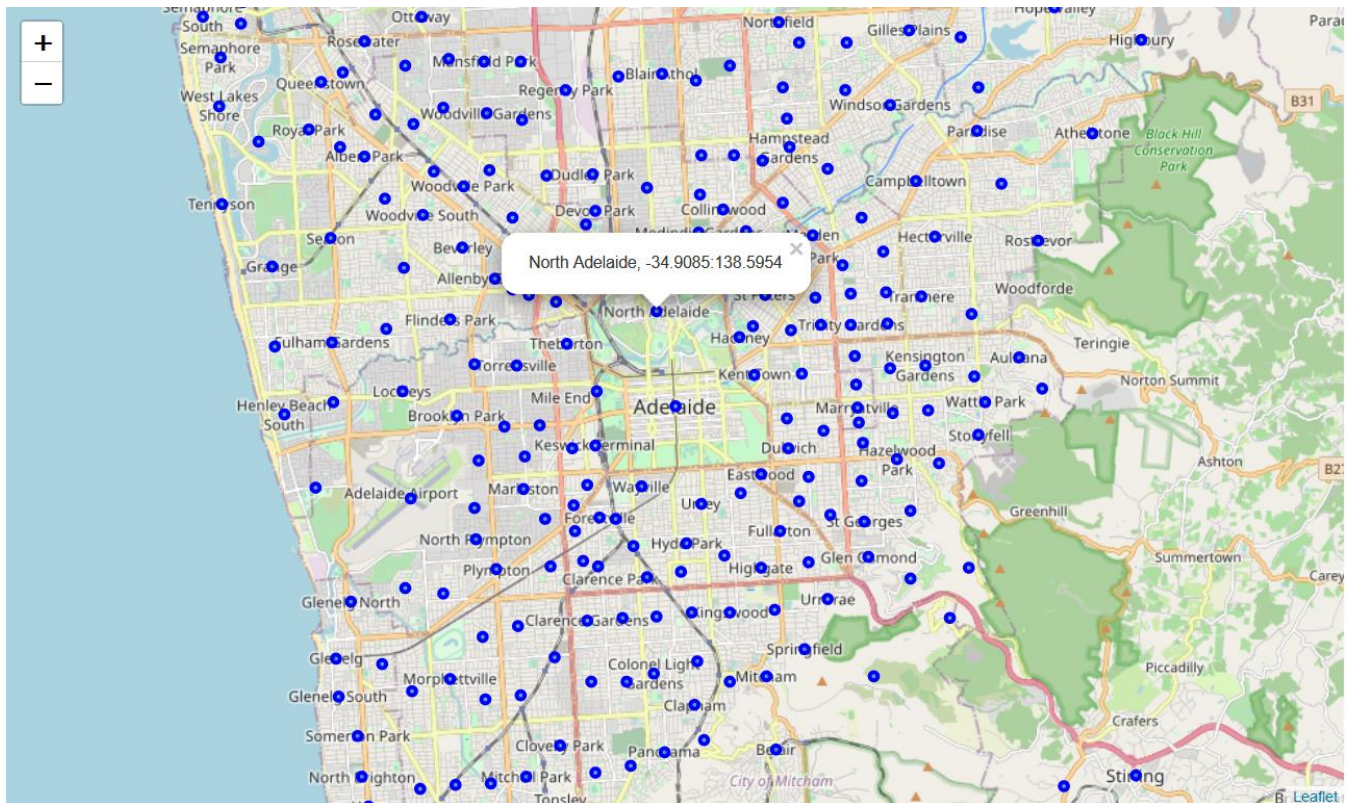
This library is also used for calculate the distance (in km) of each suburbs to Adelaide CBD.

suburb	distance
ADELAIDE	0.00
MILE END	1.83
KENT TOWN	1.99
WAYVILLE	2.00
HACKNEY	2.18

### C.2 Map Visualization of Suburbs

The mapped data of “suburb”, “latitude” and “longitude” are used to generate a map view through [folium<sup>ix</sup>](#) map rendering library.





The center of each suburb is marked by blue circle marker and the distance among suburbs is close together except in rural area. In addition, the map view can provide the insight to set the right radius of searching area later on.

In addition, the South Australia suburbs GeoJSON<sup>x</sup> is used to clearly visualize the boundaries of each suburbs. It then combines with distance and suburb house price data to form a choropleth map for data visualization.

### C.3 Data Processing of House Sales

The metropolitan median house sales figures are saved by quarterly in separate Excel files in “Data SA”<sup>xi</sup> website. The house sales data are then read and merged in one DataFrame through [pandas](#)<sup>xii</sup> library for further analysis and processing use.

	suburb	Median_2015_Q1	Median_2015_Q2	Median_2015_Q3	Median_2015_Q4	Median_2016_Q1	Median_2016_Q2	Median_2016_Q3	Median_2016_Q4
0	Aberfoyle Park	361,250.00	447,500.00	435,000.00	402,500.00	412,500.00	380,500.00	412,500.00	395,000.00
1	Adelaide	757,500.00	785,000.00	600,000.00	320,000.00	750,000.00	nan	747,500.00	683,000.00
2	Adelaide Airport	nan	nan	nan	nan	nan	nan	nan	nan
3	Albert Park	415,500.00	400,000.00	451,750.00	377,500.00	nan	467,000.00	525,000.00	475,000.00
4	Alberton	387,500.00	518,000.00	nan	666,500.00	452,500.00	453,000.00	461,500.00	515,250.00

The mean value among suburbs in each quarter will be calculated to evaluate the house sales trend in past five years.

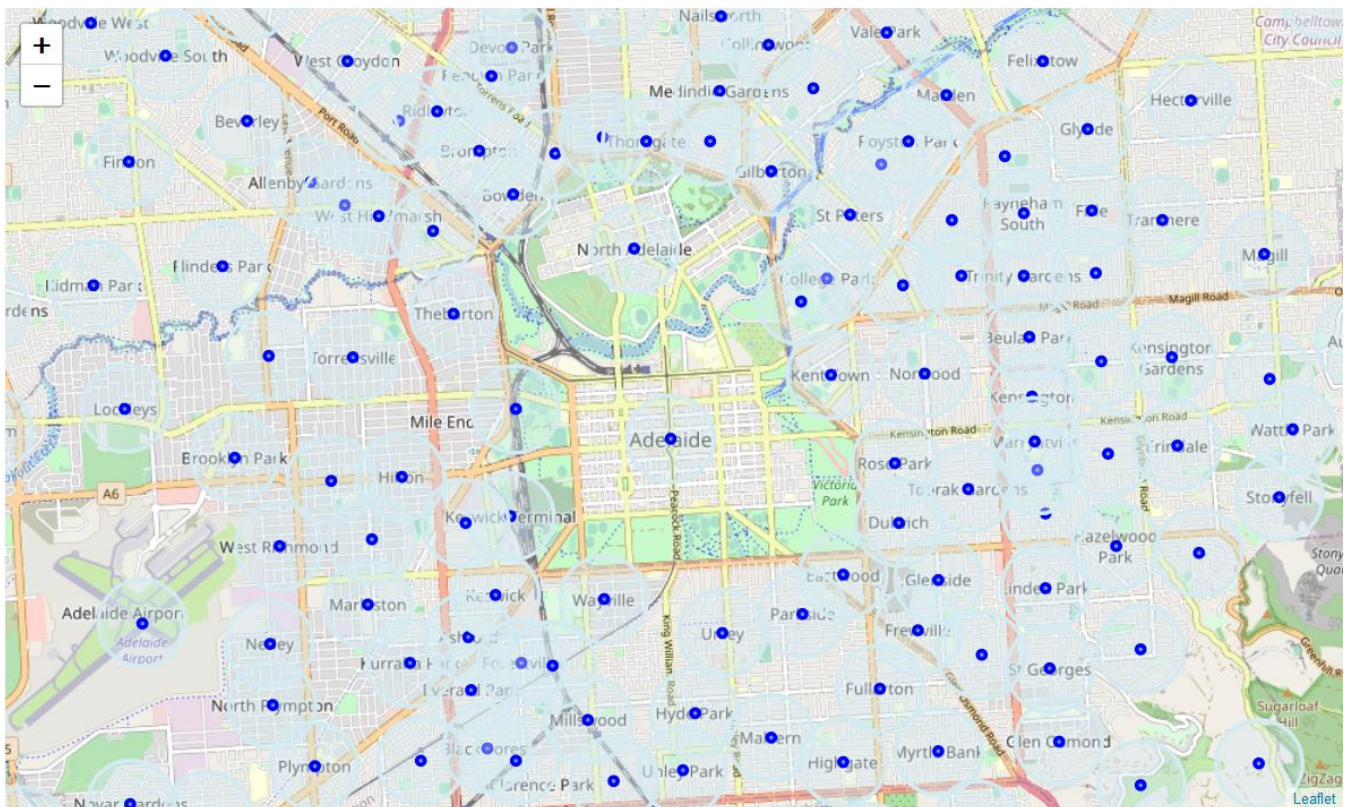
After merging the data “distance to CBD” and median sales price, the scatter plot will be created to visualize the relationship between “distance to CBD” and house sales.

Then, the k-Means clustering machine learning will be applied to segment the suburbs by variables “distance to CBD” and house sales.

### C.4 Popular Venues in Each Suburbs

The popular venues in each suburbs can be found through Foursquare API<sup>xiii</sup>. This API provides real-time access to Foursquare’s global database of rich venue data and user content. In the “Explore” endpoint search, it can provide venue recommendations by input the target geolocation. The radius parameter can be set to define the area of recommendation and the result can be sorted by venue popularity.

In the map view, it is found that the radius 500m can cover most of the area and will not overlap too much among the suburbs. So, the radius 500m is selected in coming popular venue search.

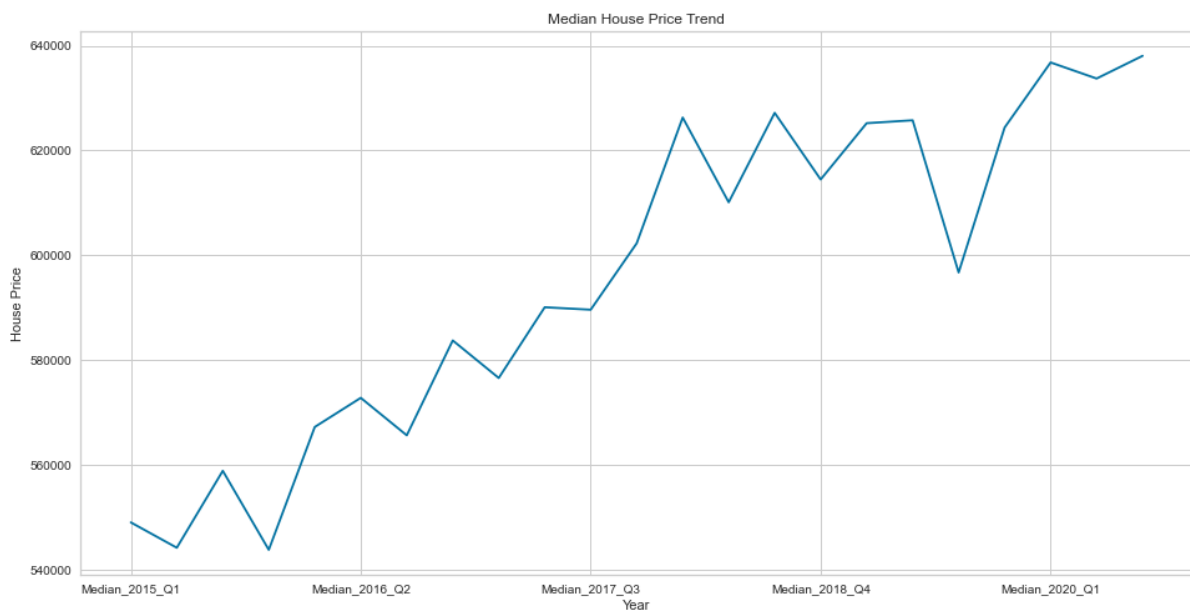


The information of popular venues in each suburb is retrieved for segmentation. To evaluate the similarity of each suburbs, the k-Means clustering machine learning will be applied by the popular venue category. As a result, the suburbs are segmented by similar popular neighborhood.

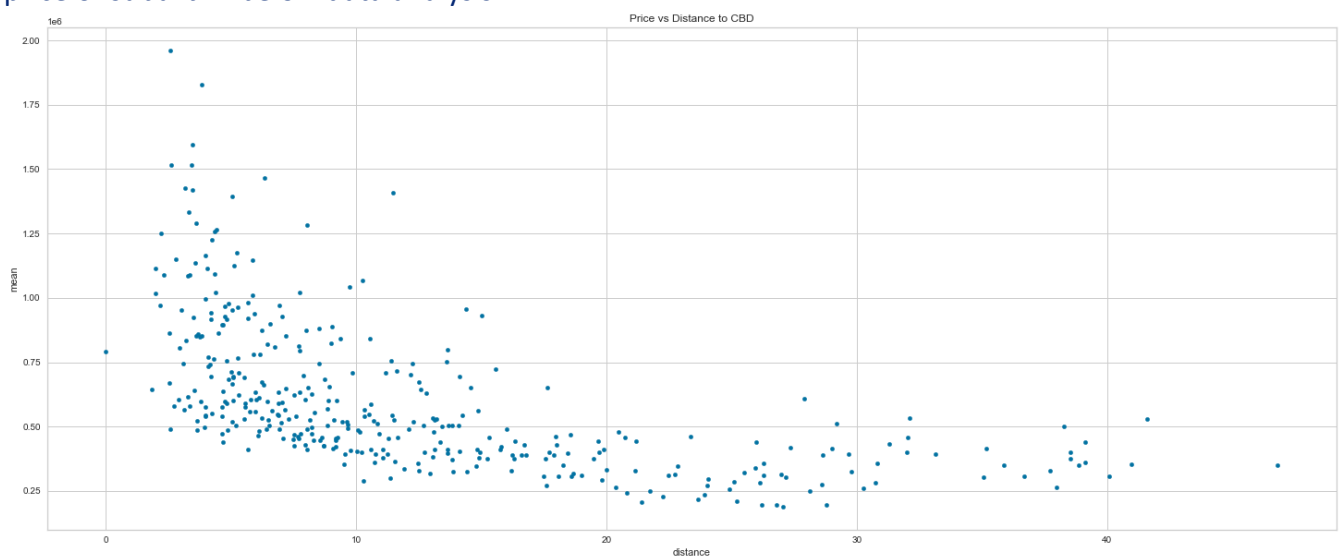
## D. Results & Discussions

### D.1 Exploratory Data Analysis on House Price

This is a line plot to show the quarterly median house price in each year. The house price in Adelaide gradually increases along the time period except that there is a sudden drop in Q3 2019.



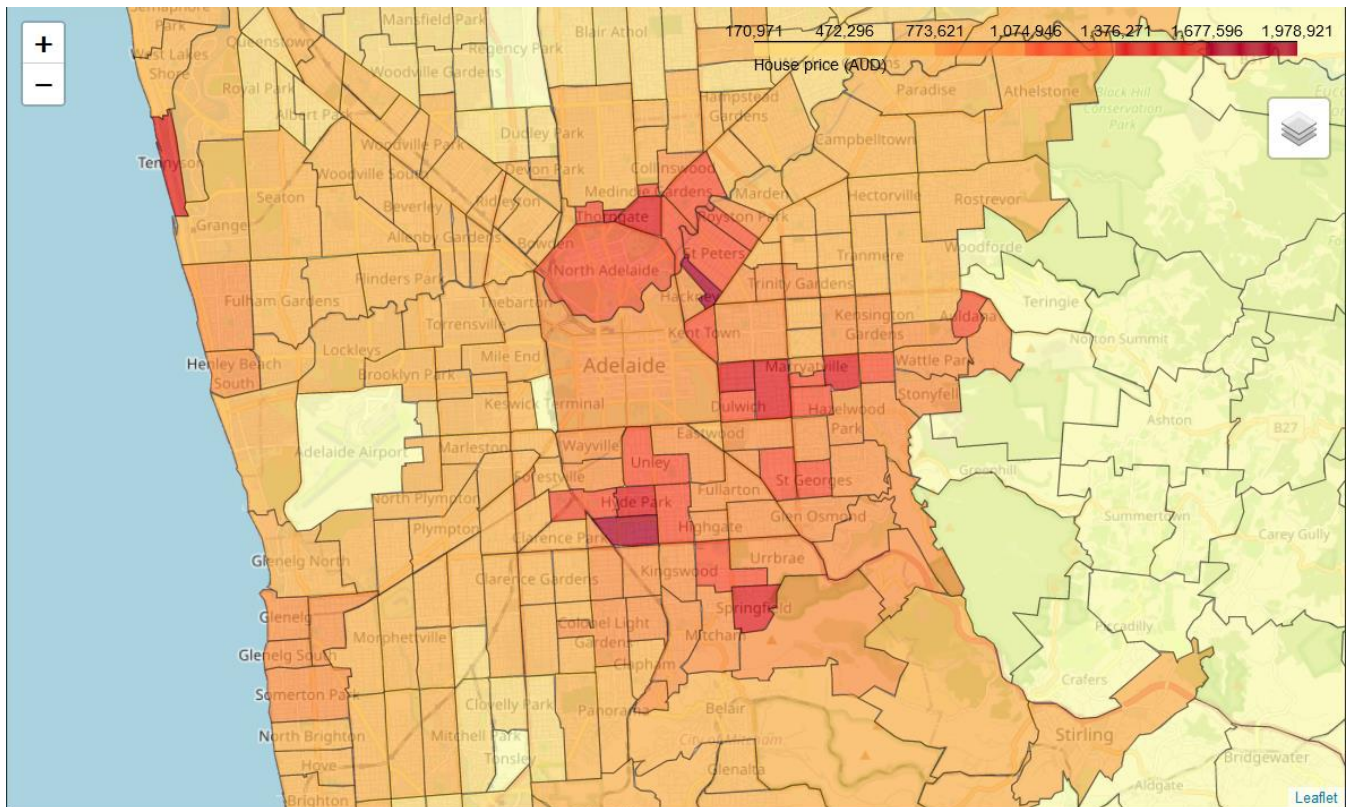
The below scatter plot is created by merging the suburb data of "distance to Adelaide CBD" and suburb 5-year mean house price. The 5-year mean house price will also be used to represent the median house price of suburb in below data analysis.



It is visualized that the house price decreases in non-linear relationship along the increasing of the distance to Adelaide CBD and the house price sharply decreases in the first 15 kilometers and then the curve becomes flat.



By combining the data in the above scatter plot and geolocation of each suburb's boundaries, the different house sales in each suburb can be visualized in the choropleth map.

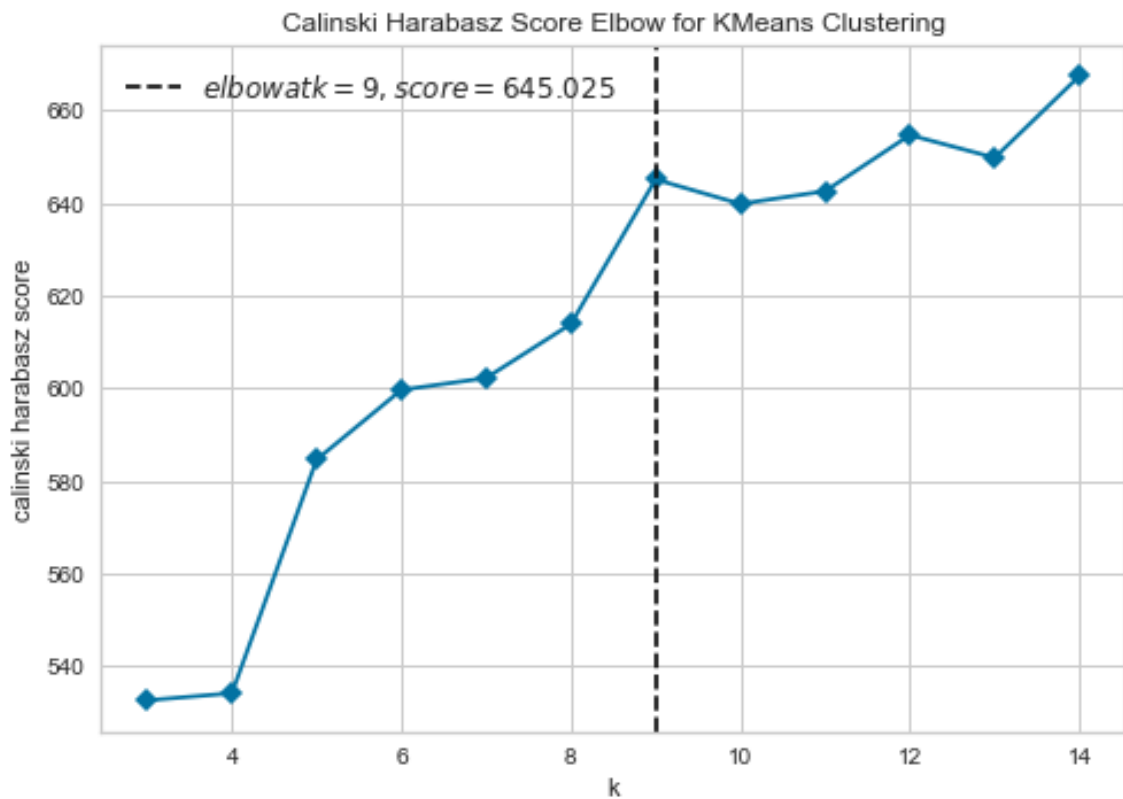


In the choropleth map, it is found that the median house prices in some suburbs such as Unley Park, College Park, Rose Park, Toorak Gardens, Leabrook, Thorngate, Hyde Park, etc which are surrounding to the Adelaide CBD are comparatively higher than the others. Besides, there are suburbs which are far from the Adelaide CBD with high house price such as Tennyson, Springfield and Auldana.

In this choropleth map view, it can be easily understood the relationship between the distance to CBD and house price. The audiences can quickly identify which suburbs to choose for affordable house price.

## D.2 Segmentation of Distance to CBD versus House Price

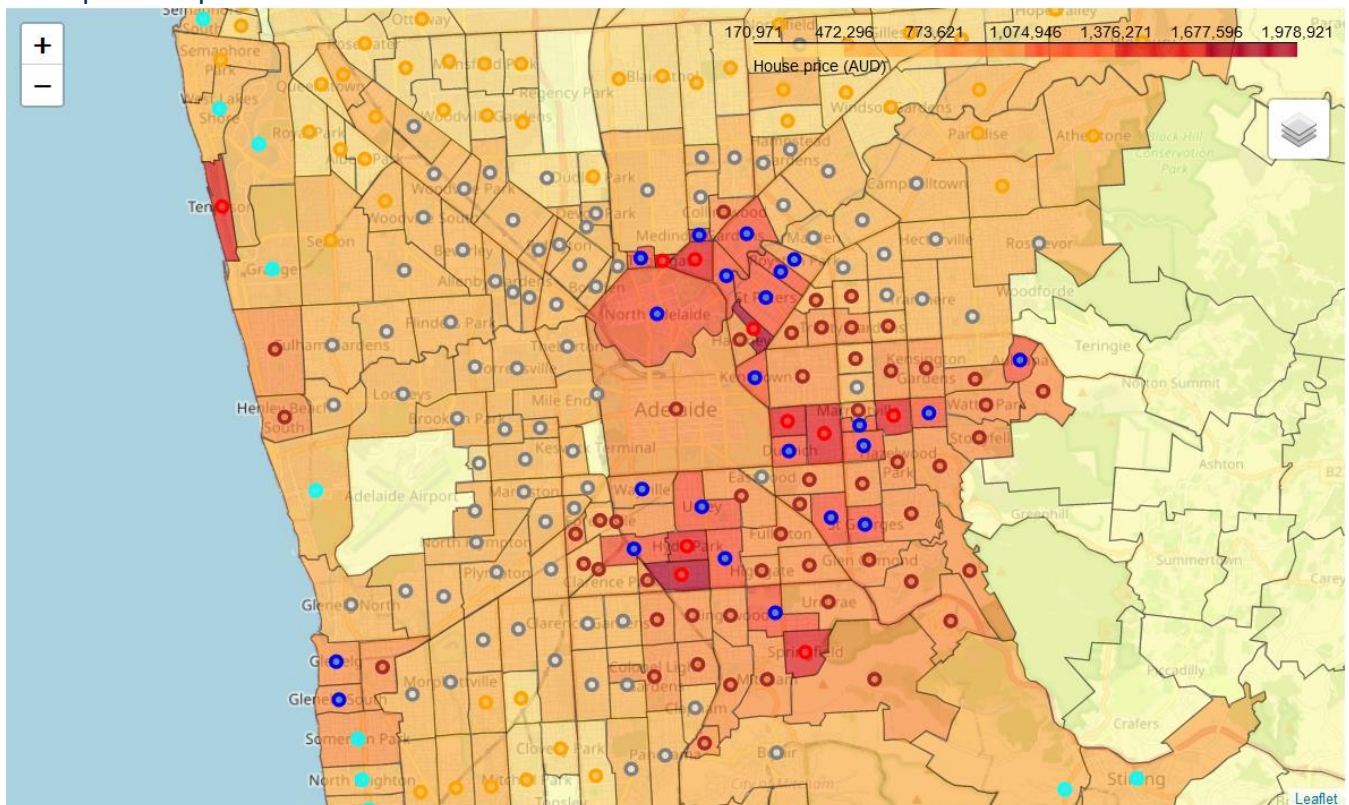
The K-means clustering algorithm is used to cluster the data of distance to CBD and house price.



Refer to Calinski Harabasz Score Elbow analysis, the optimized number of cluster is 9. Below are the result after clustering.

distance			distance		
mean			mean		
k_cluster			suburb		k_cluster
0	5.72	585,595.39	ADELAIDE	0.00	7
1	26.36	314,305.47	MILE END	1.83	0
2	4.45	1,153,788.68	KENT TOWN	1.99	2
3	10.57	453,222.41	WAYVILLE	2.00	2
4	37.48	386,484.90	HACKNEY	2.18	7
5	17.52	379,212.61			
6	4.54	1,552,854.44			
7	5.24	873,520.36			
8	12.84	738,398.71			

After the suburbs are segmented by different cluster, the segmented data are then plot to the choropleth map as below.



In this segmented choropleth map, the data are more readable. The audience can easily identify which suburbs have the similar distance to CBD with similar house price.

### D.3 Popularity of Suburbs

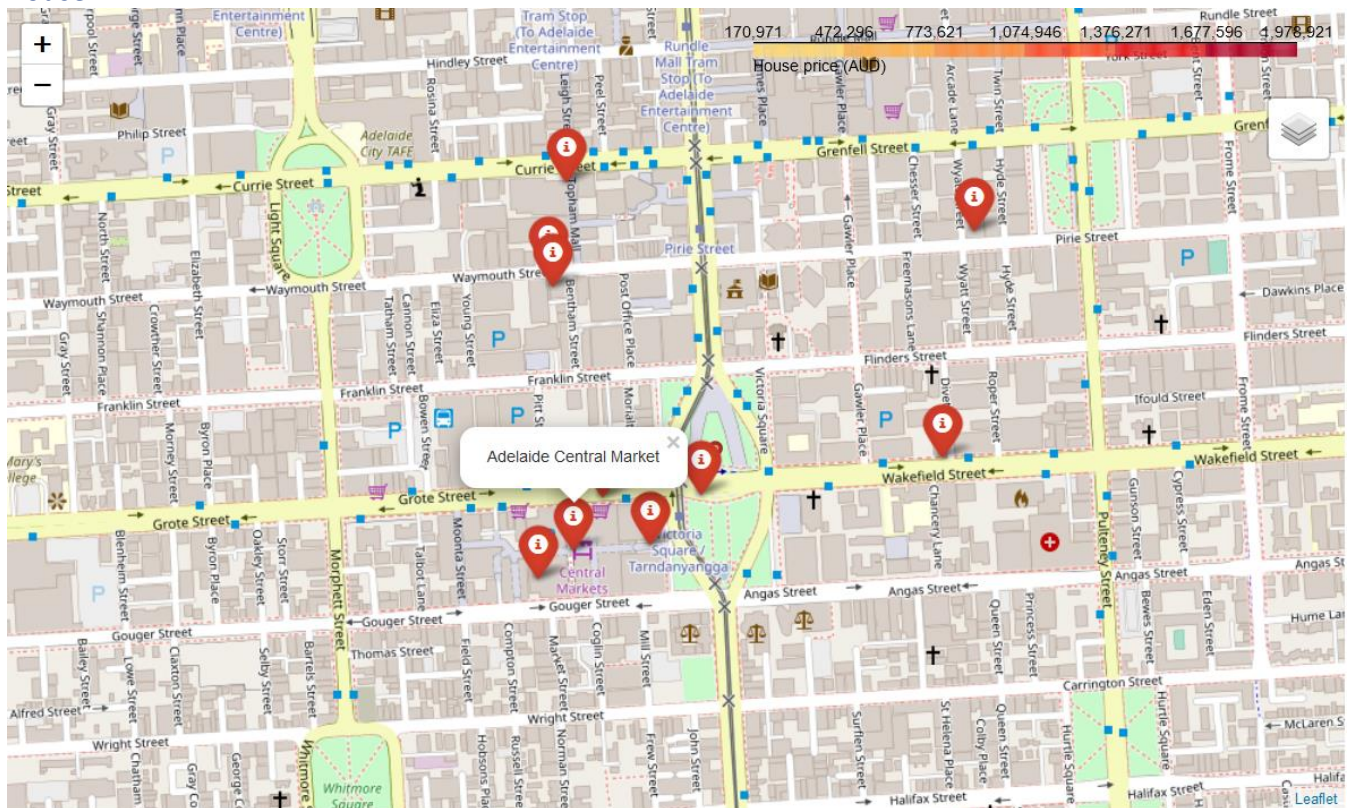
By using Foursquare API <sup>xiv</sup>, the popular venues in each suburb with radius 500m are found.

suburb	suburb_lat	suburb_long	venue_id	venue_name	venue_lat	venue_long	category_id	category
Aberfoyle Park	-35.0706	138.6011	4dc75b66d164eb9ca01e9f56	Iron Chef	-35.0726	138.6010	4bf58dd8d48988d142941735	Asian Restaurant
Aberfoyle Park	-35.0706	138.6011	4c9dc5a10e9bb1f78b84e05f	Cellarbrations	-35.0726	138.6010	4bf58dd8d48988d186941735	Liquor Store
Aberfoyle Park	-35.0706	138.6011	502e1979e4b01882f8228759	Rest n Go Station by Gintel	-35.0715	138.6012	4bf58dd8d48988d1ed941735	Spa
Aberfoyle Park	-35.0706	138.6011	53030167498e44c7e884b5eb	waterlily fashion	-35.0690	138.5976	4bf58dd8d48988d108951735	Women's Store
Adelaide	-34.9282	138.5999	4b4566d4f964a520140c26e3	Adelaide Central Market	-34.9295	138.5977	4bf58dd8d48988d1fa941735	Farmers Market

Suburb	1st_Popular_Venue	2nd_Popular_Venue	3rd_Popular_Venue	4th_Popular_Venue	5th_Popular_Venue	6th_Popular_Venue	7th_Popular_Venue	8
Aberfoyle Park	Iron Chef	Cellarbrations	Rest n Go Station by Gintel	waterlily fashion				
Adelaide	Adelaide Central Market	Central Market Arcade	Coles	Victoria Square (Tamdanyangga)	Lady Burra Brewhouse	Lucia's Fine Foods	Peppers Waymouth Hotel	
Albert Park	Spotlight	Lai Industries Pty Ltd	Louvre House					
Alberton	Alberton Hotel	Alberton Railway Station	Ned Kelly's Bakery & Cafe		BP	Alberton IGA		
Aldinga	Home Grain Bakery	Aldinga Hotel	Aldinga Seafood	The Old Vine Cafe				

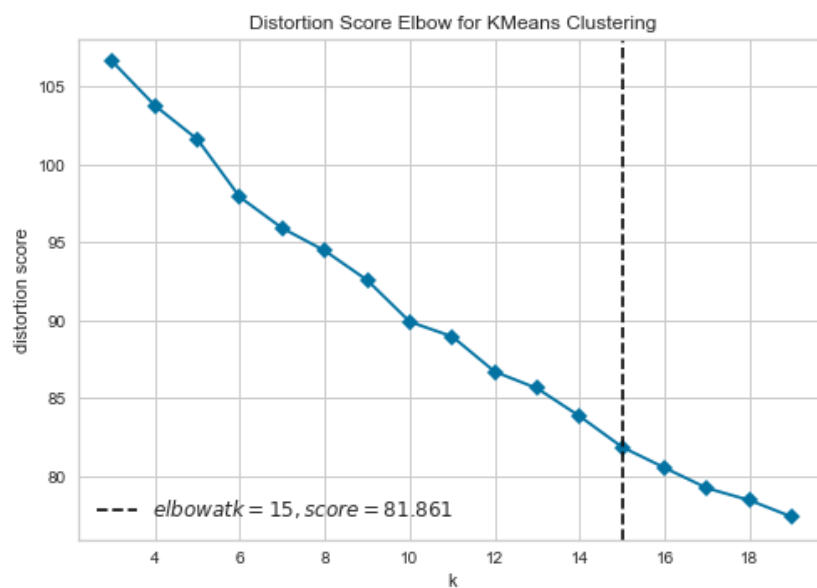


The popular venues are then plotted into the map view for data visualization. The audiences can easily identify the location of each popular venues inside each suburbs to decide the exact location of target house.



### D.4 Segmentation of Popular Venues

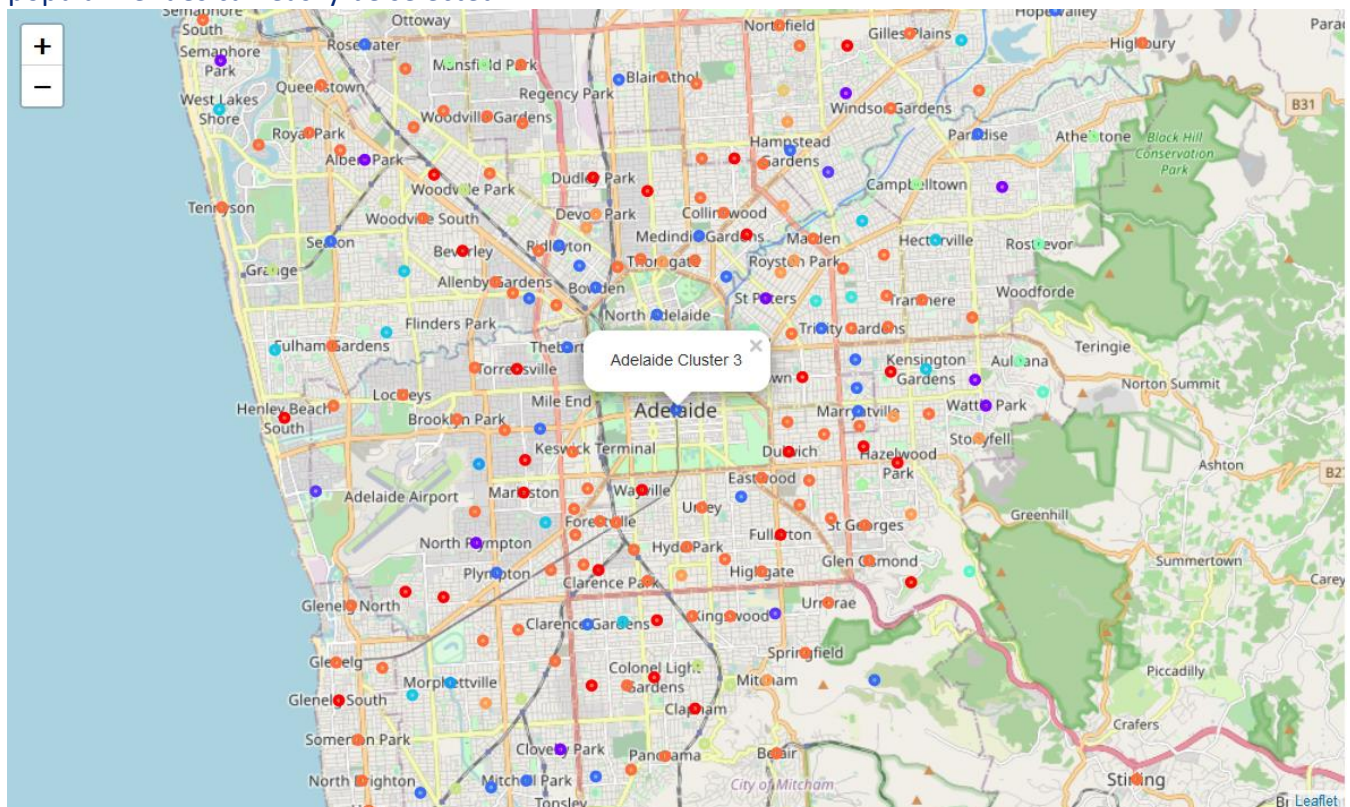
The popular venues are classified by different venue categories. The data are then clustered by K-means clustering algorithm.



According to Distortion Score Elbow, 15 clusters will be chosen.



The clusters of popular venue categories are then plotted in map view. The suburbs which have similar popular venues can easily be selected.



Cluster	Suburbs	Venue Categories
3	Adelaide, Beulah Park, Birkenhead, Bowden, Brompton, Brown Hill Creek, Clarence Gardens, Davoren Park, Elizabeth East, Gilberton, Hackney, Hampstead Gardens, Hilton, Hope Valley, Kensington, Kilburn, Marion, Marryatville, Maylands, Medindie Gardens, Mitchell Park, Morphett Vale, North Adelaide, Paradise, Parkside, Plympton, Ridleyton, Rosewater, Seaton, St Kilda, St Marys, Tea Tree Gully, Thebarton, Warradale, West Hindmarsh, Willaston	Afghan Restaurant, Airport Lounge, Art Gallery, Arts & Crafts Store, Asian Restaurant, Athletics & Sports, Auto Workshop, Bakery, Bar, Beer Store, Boat Launch, Breakfast Spot, Brewery, Burger Joint, Bus Stop, Café, Chinese Restaurant, Clothing Store, Coffee Shop, Diner, Discount Store, Electronics Store, Farmers Market, Fast Food Restaurant, Fish & Chips Shop, Flower Shop, Food Court, Forest, Fried Chicken Joint, Garden Center, Gas Station, Gastropub, German Restaurant, Golf Course, Gourmet Shop, Greek Restaurant, Grocery Store, Gym, Gym / Fitness Center, Historic Site, Hobby Shop, Home Service, Hotel, Ice Cream Shop, Indian Restaurant, Italian Restaurant, Liquor Store, Market, Massage Studio, Miscellaneous Shop, Mongolian Restaurant, Music Venue, Noodle House, Paper / Office Supplies Store, Park, Pet Store, Pharmacy, Pizza Place, Playground, Pub, Record Shop, Restaurant, Sandwich Place, Seafood Restaurant, Shopping Mall, Ski Area, Ski Lodge, Sports Club, Supermarket, Sushi Restaurant, Thai Restaurant, Thrift / Vintage Store, Trail, Train Station, Vietnamese Restaurant, Wine Shop

## E. Conclusion

This House Price Analysis of Adelaide is a capstone project of the course “IBM Data Science Professional Certificate”. The result increases the visibility to provide the insight of Adelaide house market. It can help foreigners to quickly understand the house market in Adelaide and to select the favorite suburbs to further search the house price data further. Thanks for your reading.

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<sup>i</sup> Tapper, Andrew; Tapper, Nigel (1996). Gray, Kathleen (ed.). The weather and climate of Australia and New Zealand (First ed.). Melbourne, Australia: Oxford University Press. p. 300. ISBN 0-19-553393-3.

<sup>ii</sup> <https://en.wikipedia.org/wiki/Adelaide>

<sup>iii</sup> <http://www.population.net.au/adelaide-population/>

<sup>iv</sup> <https://www.realestate.com.au/neighbourhoods/adelaide-5000-sa>

<sup>v</sup> [https://en.wikipedia.org/wiki/List\\_of\\_Adelaide\\_suburbs](https://en.wikipedia.org/wiki/List_of_Adelaide_suburbs)

<sup>vi</sup> [https://en.wikipedia.org/wiki/List\\_of\\_Adelaide\\_suburbs](https://en.wikipedia.org/wiki/List_of_Adelaide_suburbs)

<sup>vii</sup> <https://data.sa.gov.au/data/dataset/metro-median-house-sales>

<sup>viii</sup> <https://geopy.readthedocs.io/en/stable/#nominatim>

<sup>ix</sup> <https://python-visualization.github.io/folium/>

<sup>x</sup> <https://data.sa.gov.au/data/dataset/suburb-boundaries>

<sup>xi</sup> <https://data.sa.gov.au/data/dataset/metro-median-house-sales>

<sup>xii</sup> <https://pandas.pydata.org/>

<sup>xiii</sup> <https://developer.foursquare.com/docs/places-api/>

<sup>xiv</sup> <https://developer.foursquare.com/docs/places-api/>