Coursera Capstone Project

CHOOSING THE TOWN TO LIVE IN SINGAPORE

IBM DATA SCIENCE CERTIFICATION

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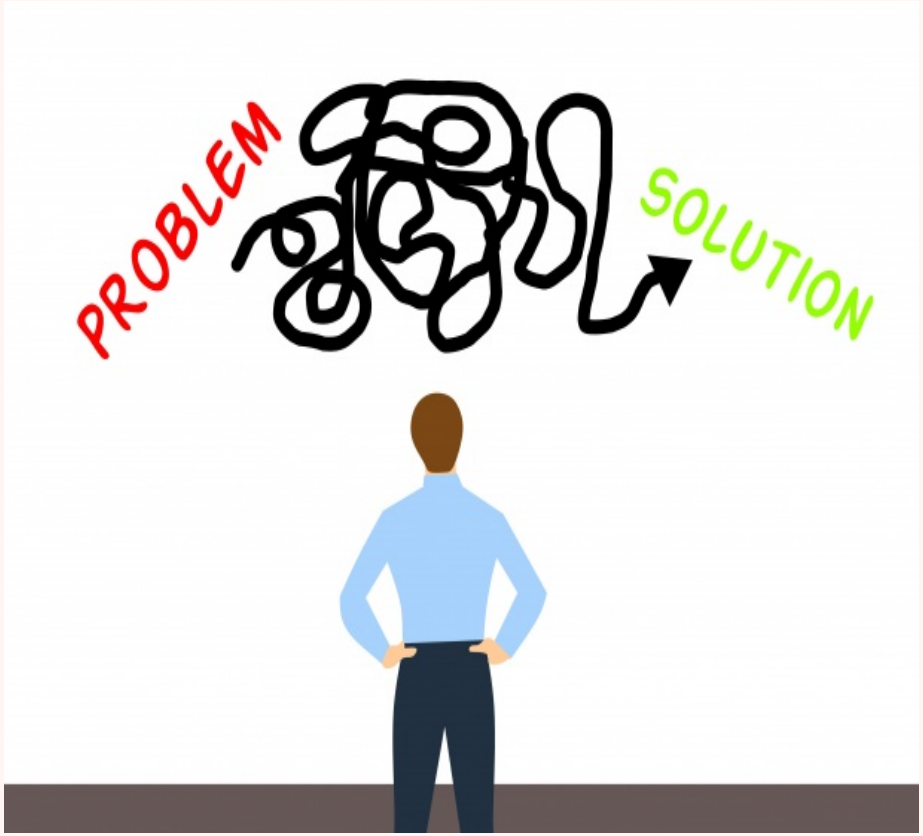
CONTENTS

INTRODUCTION

“ Life is about choices. Some we regret, some we’re proud of. Some will haunt us forever ”



BACKGROUND

Making a choice is always a difficult thing to do, because we don't know if we will be happy with our choice or regret it, days / weeks / months from when we made the choice. Let's face the truth, most of the times we regret our choices, saying I should have talked to more people before deciding on something or 'done more research'.

" Before you make a choice make sure you can live with it "

Especially if you have to choose your place of living, you have to literally live with your choice. Choosing your place of living is a big choice for almost everyone and we try to get as much details possible before we make that leap of faith. Singapore (SG) the city state is an amazing place to live in, if only we knew where to make our choice of stay. It has a plethora of attractions, restaurants, amenities, venues, towns to choose from. That statement poses the first problem for anyone hunting for a place to stay.

Fortunately that's where **Data Science** comes in, as we have abundant data and the proper knowledge, tools and means to sift through them to slice and dice it, and get meaningful results out of it in an easy to understand and visually attractive format, which can help us choose more wisely with the available facts.

ROBIN WANTS TO CHOOSE

A prospective homebuyer or a tenant wannabe decides to choose a place to live in the island of Singapore. The person has a few basic specifications or needs that cannot be compromised. Let's call the person with a gender neutral common name - Robin.

Robin has a few specifications or conditions that are a must to be adhered to as a basic need. This Capstone project paper is an attempt to help Robin or any similar person to navigate that first essential step towards finalising the place to live. So anyone who wants to buy a property or find a place to live in Singapore is a target audience for this paper.

Robin's basic requirements regarding the town/place of stay in Singapore is

1. There should not be too many people living around.
2. Some key amenities are required to be around the living area within a walking distance
3. There should be an open water area close by.

SOLVING ROBIN'S PROBLEM

This paper aims to help solve the requirements of Robin, using the concepts learnt and practised in the Coursera IBM Data Science Professional Certificate course. The requirements are quantitatively interpreted as below so that they can be solved using the Data Science principles, tools and techniques.

Problem statement	Interpretation	Variable	Quantification
There should not be too many people living around	The number of people living around should be less than average of people across the towns of Singapore	Population	Population < Average population across SG Towns
Some amenities are required to be around the living area in a walking distance	Requirement is to have exercising options like gym and Shopping Malls close by, Needs options for drinking with places serving whisky and wine in that order.	Venues	Venue choices to be within a 1 kilometre radius
There should be a open water area close by	Any kind of waterbody like a Pond, River, Stream or Sea to be in the vicinity.	Natural feature	Feature to be within a 1 kilometre radius

DATA DESCRIPTION & SOURCE

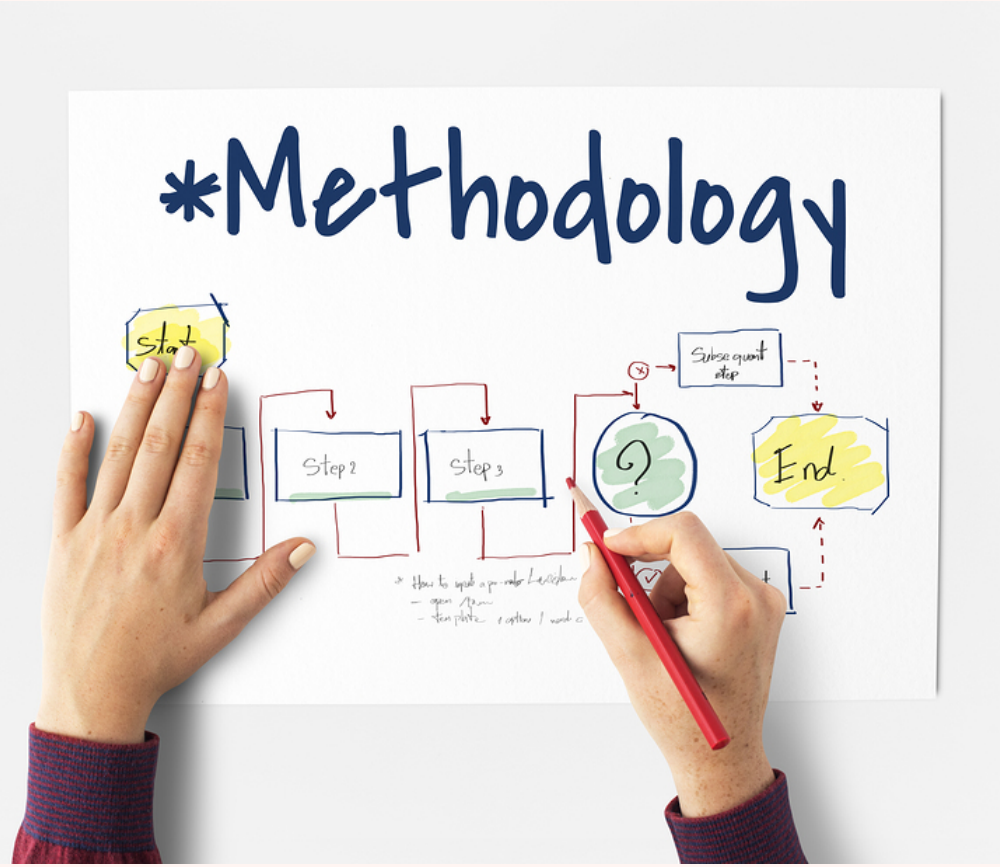
DESCRIPTION OF DATA & THE SOURCE

1. **Singapore towns and their population** : The Singapore Government publishes data sets available for public view and this site has a specific and suitable data set for the project's requirement. The Housing and Development Board (HDB) of Singapore has a data set with the various SG Towns and their population for a 10 year period between 2008 and 2018. [**data.gov.sg**]

2. **Singapore towns' Co-ordinates** : For getting the SG Town's coordinates of latitude and longitude we will use the Python Geocoder ArcGIS package

3. **Venue Details of Singapore towns**: We will use Foursquare API top get the venue details of the SG Towns.The Foursquare API provides comprehensive location data that can be used to get details of nearby venues, and details of these venues in a given area of SG Towns. Interestingly, it also has natural features like river & Waterfront that will be useful in our specific project requirement.
[**https://developer.foursquare.com/developer/**]

METHODOLOGY



HOW DO WE DO IT

The sequence of steps to be followed in solving the problem for this Project will be as follows

1. First we will install the required packages of Python and import relevant Python libraries that are required for data loading, wrangling, analysis, graphs and maps rendering
2. Next we will get the available data on towns of Singapore from the SG Government's official data website and load that data into the Jupiter notebook
3. Then we will analyse and clean the SG towns' data and shortlist the data based on our requirement.
4. Then we will use the Geocoder package to get the geographical coordinates (Latitude & Longitude) for the SG towns
5. Followed by using the Foursquare API to receive the nearby venues and their details for all the towns that we have shortlisted.
6. Finally we will analyse the venue data based on our initial 3 requirements, and finalise the most appropriate SG Town where Robin can choose to stay
7. As an additional step, we will display the SG map with the shortlisted SG Towns and the selected township will be hardcoded and displayed with a marker.

1

First we will install the required packages of Python and import relevant Python libraries that are required for data loading, wrangling, analysis, graphs and maps rendering

```
! pip install folium==0.5.0
print('Installed Folium for the map')
!pip install geopy
print('Installed Geopy')
!pip install geocoder
print('Installed Geocoder')
```

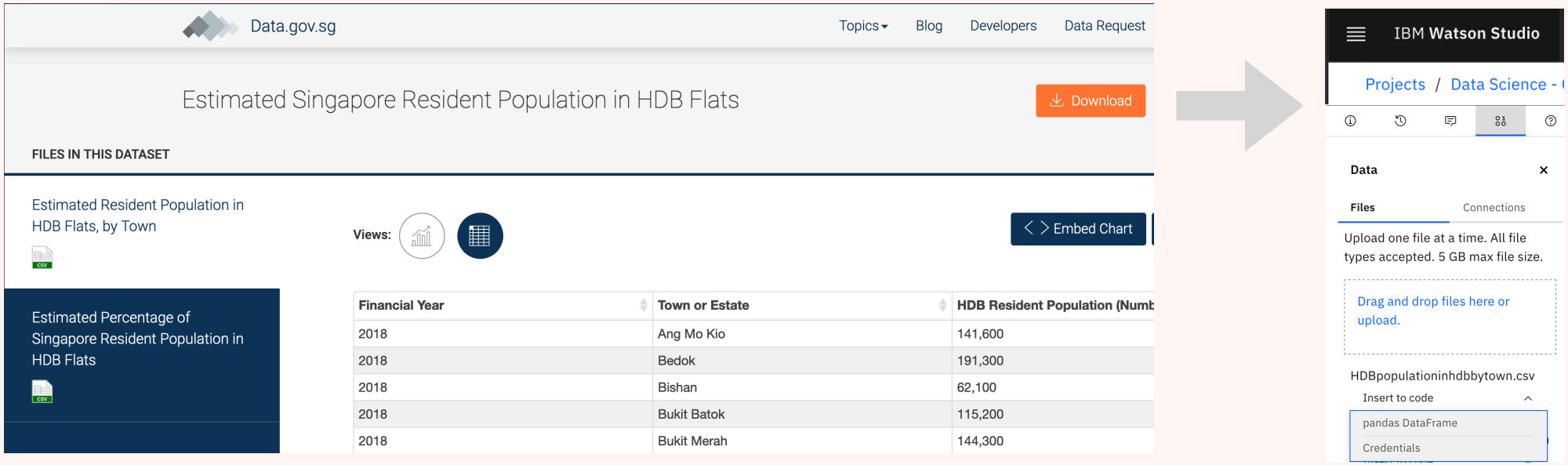
```
import pandas as pd # This library is for data analsysis
import numpy as np  # This library is for handling data
import requests # This library is for handling requests
import folium   # This library is for creating the maps
import json     # This library is for handling json files
import geocoder # This library is for getting coordinates
from geopy.geocoders import Nominatim     # This library is to convert into latitude and longitude values
from IPython.display import Image         # THis library is for rendering the map images
from pandas.io.json import json_normalize # tranform JSON file into a pandas dataframe
import matplotlib.pyplot as plt           # This library is to plot bar graphs etc
import matplotlib.cm as cm
import matplotlib.colors as colors

print('All the necessary libraries have been imported')
```

```
All the necessary libraries have been imported
```

2

Next we will get the available data on towns of Singapore from the SG Government's official data website and load that data into the Jupyter notebook in IBM Watson studio with the Insert to code option utilising the pandas DataFrame option and utilising the auto generated code and reading into a DataFrame



3

Then we will analyse and clean the SG towns' data and shortlist the data based on our requirement.

In [4]:
```
df_HDB = pd.read_csv(body)
df_HDB.rename(columns = {'financial_year':'YEAR','town_or_estate':'SGTOWN','population':'POP'}, inplace = True)
df_HDB
```

Out[4]:

	YEAR	SGTOWN	POP
0	2008	Ang Mo Kio	148200
1	2008	Bedok	197900
2	2008	Bishan	66500
3	2008	Bukit Batok	109100
4	2008	Bukit Merah	140600
...	...	...	...
290	2018	Serangoon	68000
291	2018	Tampines	231800
292	2018	Toa Payoh	104200
293	2018	Woodlands	242800
294	2018	Yishun	197300

295 rows × 3 columns

In [5]:
```
# Choosing only the latest year data and then dropping the year column and resetting the index
df_HDB1 = df_HDB[df_HDB['YEAR']==2018]
df_HDB1 = df_HDB1.drop(columns=['YEAR'])
df_HDB1.reset_index(drop=True, inplace=True)
df_HDB1
```

Out[5]:

	SGTOWN	POP
0	Ang Mo Kio	141600
1	Bedok	191300
2	Bishan	62100
3	Bukit Batok	115200
4	Bukit Merah	144300
5	Bukit Panjang	120100
6	Bukit Timah	8300
7	Central Area	27300
8	Choa Chu Kang	168500
9	Clementi	71900

4

Then we will use the Geocoder package to get the geographical coordinates (Latitude & Longitude) for the SG towns. And using folium a simple map is rendered showing all the 26 towns of Singapore using the coordinates read into the DataFrame

IBM Watson Studio All Search

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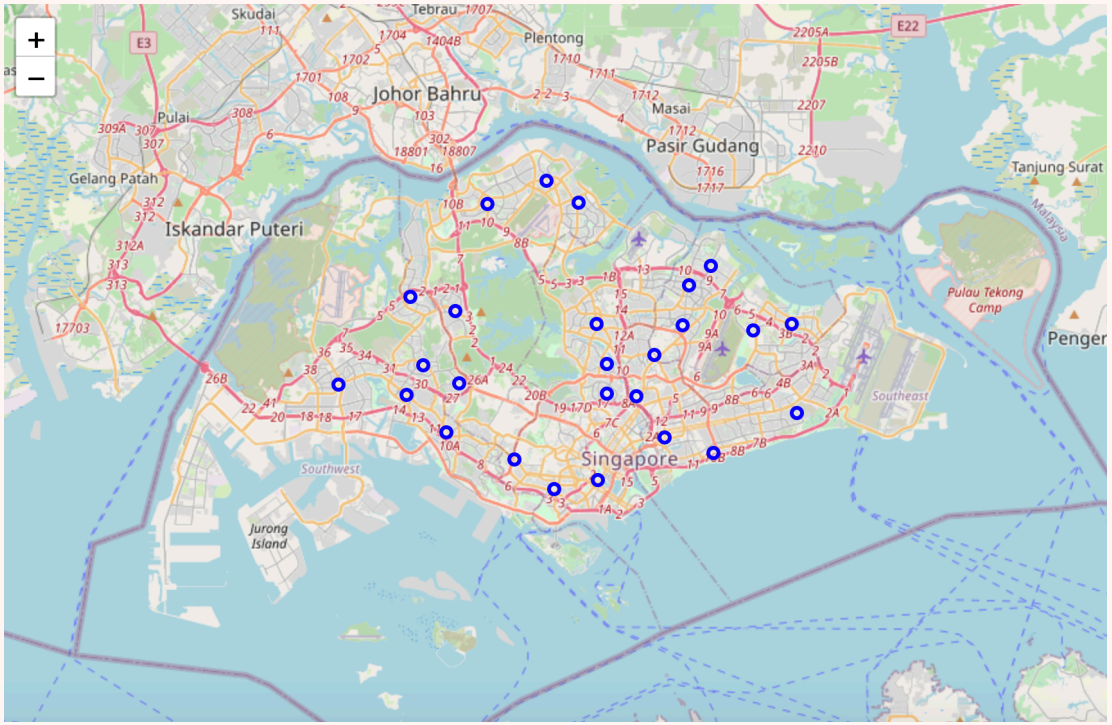
In [6]:
```
# Geocoding each SG town
lati = []
longi = []
for i in range(0,df_HDB1.shape[0]):
    SGTOWN = df_HDB1.iloc[i,0]
    g = geocoder.arcgis('{},Singapore'.format(SGTOWN))
    lati.append(g.latlng[0])
    longi.append(g.latlng[1])

df_HDB1['Latitude'] = lati
df_HDB1['Longitude'] = longi

df_HDB1
```

Out[6]:

	SGTOWN	POP	Latitude	Longitude
0	Ang Mo Kio	141600	1.37161	103.84546
1	Bedok	191300	1.32425	103.95297
2	Bishan	62100	1.35079	103.85110
3	Bukit Batok	115200	1.34952	103.75277
4	Bukit Merah	144300	1.28417	103.82306
5	Bukit Panjang	120100	1.37877	103.76977
6	Bukit Timah	8300	1.34041	103.77221
7	Central Area	27300	1.28883	103.84625
8	Choa Chu Kang	168500	1.38616	103.74618



5

Using the Foursquare API and my credentials, we obtain the nearby venues and their details for all the towns of Singapore. We also find that there are 183 unique venues across the island, and a snapshot of the unique type of venues is as below

```
df_SGVENUE.head(10)
```

Out[62]:

	SGTOWN	NAME	TYPE
0	Bishan	Tori-Q	Japanese Restaurant
1	Bishan	Starbucks	Coffee Shop
2	Bishan	Dian Xiao Er 店小二	Chinese Restaurant
3	Bishan	Gymm Boxx XL	Gym
4	Bishan	Bishan Cafeteria (Eating House)	Food Court
5	Bishan	食香阁 Shi Xiang Ge La Mian . Shaved Noodle	Shaanxi Restaurant
6	Bishan	Din Tai Fung 鼎泰豐	Dumpling Restaurant
7	Bishan	Popular Bookstore	Bookstore
8	Bishan	Bishan Sports Hall	Stadium
9	Bishan	Pet Lovers Centre	Pet Store

```
In [16]: df_SGVENUE['TYPE'].unique()
```

```
Out[16]: array(['Japanese Restaurant', 'Coffee Shop', 'Chinese Restaurant', 'Gym',
                'Food Court', 'Shaanxi Restaurant', 'Dumpling Restaurant',
                'Bookstore', 'Stadium', 'Pet Store', 'Pool', 'Electronics Store',
                'Ice Cream Shop', 'Supermarket', 'Shopping Mall',
                'Asian Restaurant', 'Cosmetics Shop', 'Pharmacy',
                'Thai Restaurant', 'Seafood Restaurant', 'Bubble Tea Shop', 'Park',
                'Fried Chicken Joint', 'Café', 'Multiplex', 'Gastropub',
                'Italian Restaurant', 'Department Store',
                'Eastern European Restaurant', 'Bus Station', 'Basketball Court',
                'Trail', 'Noodle House', 'Steakhouse', 'Bakery', 'Bus Line',
                'Korean Restaurant', 'Music Venue', 'Bistro', 'Indian Restaurant',
                'BBQ Joint', 'Nature Preserve', 'Escape Room', 'Dessert Shop',
                'Beer Store', 'Dim Sum Restaurant', 'Diner', 'Sandwich Place',
                'Bar', 'Hainan Restaurant', 'Gas Station', 'Grocery Store',
                'Massage Studio', 'Fast Food Restaurant', 'Australian Restaurant',
                'Spanish Restaurant', 'Gaming Cafe', 'Pizza Place', 'Soup Place',
                'College Cafeteria', 'Convenience Store', 'Resort', 'Cafeteria',
                'Gym / Fitness Center', 'Historic Site', 'Snack Place',
                'Bike Trail', 'Waterfront', 'Cocktail Bar', 'Shopping Plaza',
                'Vegetarian / Vegan Restaurant', 'Hotel', 'River', 'Nightclub',
                'Wine Shop', 'Hotel Bar', 'Brewery', 'Hotpot Restaurant',
                'Mexican Restaurant', 'Yoga Studio', 'Lounge', 'Art Gallery',
                'Wine Bar', 'Buffet', 'Sake Bar', 'Hostel', 'Whisky Bar',
                'Pedestrian Plaza', 'Miscellaneous Shop', 'Canal',
                'French Restaurant', 'Persian Restaurant', 'Restaurant',
                'Monument / Landmark', 'History Museum', 'Comfort Food Restaurant',
                'Beer Garden', 'Salad Place', 'Bridge', 'Spa',
                'Martial Arts School', 'Event Space', 'Concert Hall',
                'English Restaurant', 'Buddhist Temple', 'Video Game Store',
                'Arts & Crafts Store', 'Chinese Breakfast Place', 'Garden', 'Pub',
```

6

Finally we will analyse the venue data based on our initial 3 requirements, and finalise the most appropriate SG Town where Robin can choose to stay. Shortlist the specific venues - Gym, Waterfront, Shopping Mall, Wine & Whisky bar. Applying a custom weightage, we arrive at a consolidated score and sort descending by the score to get the Town with highest score

```
In [19]: SGPIV = pd.pivot_table(df_SGVENUE,index='SGTOWN',columns='TYPE',aggfunc=np.siz
         SGPIV.columns = SGPIV.columns.droplevel(0)
         SGPIV
```

Out[19]:

TYPE	ATM	Accessories Store	American Restaurant	Art Gallery	Arts & Crafts Store	Asian Restaurant	Athletics & Sports	Australian Restaurant
SGTOWN								
Bishan	0	0	0	0	0	3	0	0
Bukit Timah	0	0	0	0	0	2	0	1
Central Area	0	0	0	2	0	0	0	0
Clementi	0	0	0	0	1	4	0	0
Geylang	0	0	0	0	0	4	1	0
Jurong East	0	2	1	0	0	0	0	0

```
In [20]: # Selecting only the choice of venues for selection criteria & applying weightage
         SGPIV1 = SGPIV.loc[:,['Gym','Waterfront','Shopping Mall','Wine Bar','Whisky Bar']]

         SGPIV1['Score'] = SGPIV1['Gym']*0.2+ \
                           SGPIV1['Waterfront']*0.2+ \
                           SGPIV1['Shopping Mall']*0.1+ \
                           SGPIV1['Wine Bar']*0.2+ \
                           SGPIV1['Whisky Bar']*0.1

         # Get the dataframe with Score in descending order
         SGPIV1 = SGPIV1.sort_values(by='Score',ascending=False)
         SGPIV1
```

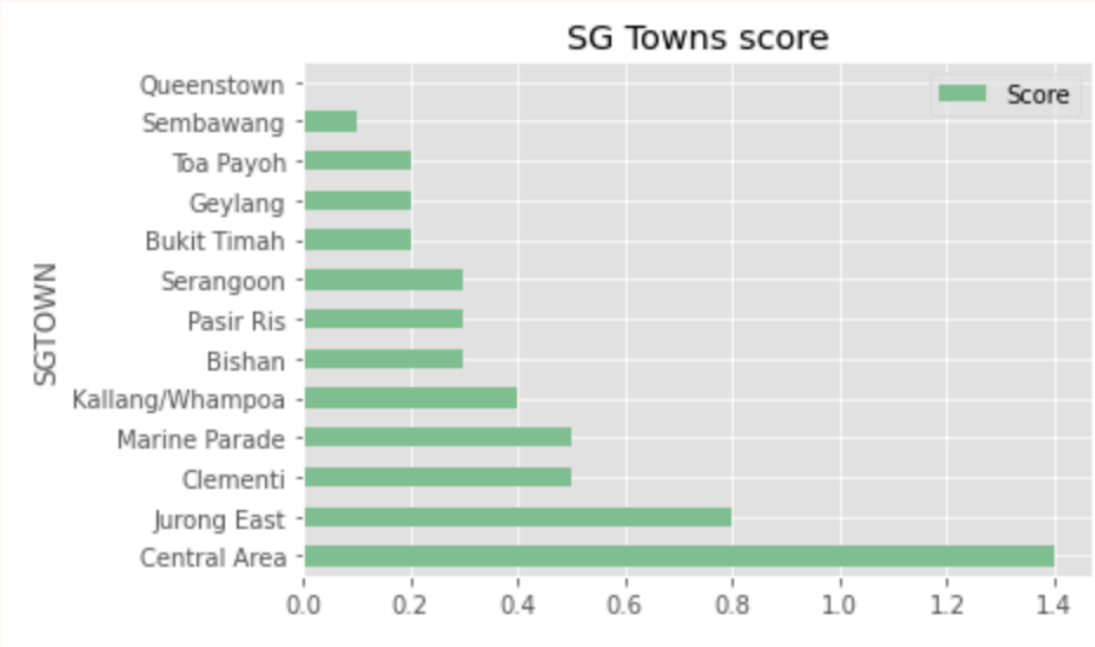
Out[20]:

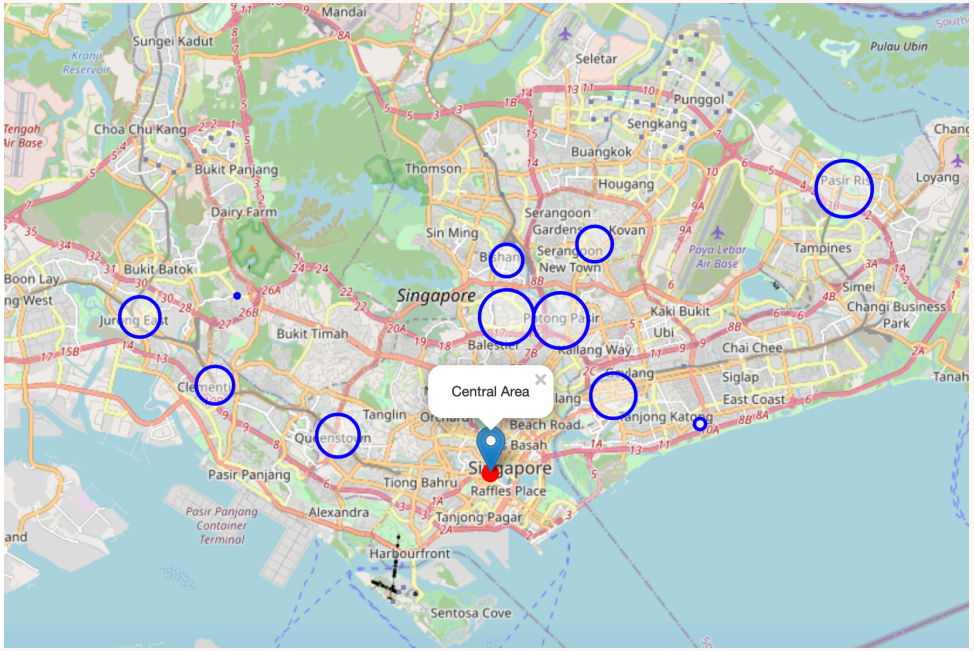
TYPE	Gym	Waterfront	Shopping Mall	Wine Bar	Whisky Bar	Score
SGTOWN						
Central Area	2	1	1	3	1	1.4
Jurong East	1	0	4	0	0	0.6
Kallang/Whampoa	3	0	0	0	0	0.6
Clementi	2	0	1	0	0	0.5
Marine Parade	0	1	1	1	0	0.5
Serangoon	1	0	1	1	0	0.5

RESULTS

7

We calculated the scores and sorted them by descending order to find the highest scoring town of Singapore. It can be graphically displayed to have a better visual representation for ease of viewing. A map of Singapore with the shortlisted SG Towns indicated by their population size and the selected township with a popup are rendered for Robin's chosen town. [The current analysis points to Central area town for Robin to live in]





DISCUSSION

DISCUSSION

The available Singapore Government data was very relevant for the problem with the available population across the Singapore town areas. But being a fast growing city, this **data needs to be refreshed to have the latest** population which could affect the shortlisted town areas, and potentially change the highest scoring town as well.

A **relatively shorter subset of the venue was taken with 5 unique** types However there are a lot of relevant types that can be added to this mix and a much different ordering could result if the entire list is analysed and chosen.

The **weightage assigned to different types** is another key criteria in tweaking the results of the paper, that can vary with different weightage applied.

This approach **can be applied to any city / country in the world to choose a place** where people want to live based on their criteria. It can be a starting point to which various other criteria can be easily added like the cost of homes, HDB housing Vs Condominiums, etc.

The folium map rendered has markers whose radius depicts the population size across the shortlisted towns and the final chosen Town by a popup. This can further be refined by using a choropleth map to portray population across for a different visualisation approach.

CONCLUSION

In this Capstone project we have established an approach for a prospective homebuyer or a tenant who can decide to choose a place to live in the island of Singapore using Data Science tools and techniques.

This approach caters to their specifications or conditions utilising the data available from Government and public agencies. This would be an useful tool for anyone who is trying to shortlist localities or suburbs to live, based on their wants and desires and can be easily upgraded with additional criteria and tweaked to the requirement.

This Capstone project paper would therefore help Robin or any similar person to navigate that first essential step towards finalising the place to live.