

# Active Aging in Singapore

## A data analysis report

Samuel Soh

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## Introduction

The population in most developed countries worldwide, including Singapore, is aging fast. By 2030, 1 among 4 people here will be past retirement age. This will mean nearly a million people, with longer life expectancy. It is therefore important on a national level to think about how to care for them, so that they are healthy and happy in their silver years.

The government has already initiated strategic plans to encourage citizens to keep active and healthy into their retirement years. Private sector companies are also welcomed to participate in the roadmap.

SilverCare, is a (pseudo) US multinational company looking to extend their presence into the Asian countries, and their Marketing Director would like to know more about the elderly market segmentation available in Singapore. An understanding of the existing elderly care service and facilities available in the neighbourhood would also help in the company's SWOT analysis and market positioning.

## Dataset

To support the elder care market analysis, the following data are required:

- (1) the neighbourhood areas,
- (2) the neighbourhood areas' population age group, education level, and household income
- (3) the neighbourhood areas' nearby elder care services and facilities

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In order to get the neighbourhood areas, the Master Plan 2019 Planning Area Boundary KML file from Data.gov.sg will be used. This will provide the area name, region and boundaries. E.g. Bukit Merah, Central Region. The latitude and longitude of the various areas were added on with OpenStreetMap Nominatim. E.g. Bukit Merah, 1.270439, 103.828318.

For understanding of the areas' population demographics, Onemap.gov.sg provides the necessary details from 2015 (latest available). E.g. Bedok, University:5550, SGD3000-3999:8128, Age\_60-64:20360.

To discover any nearby elder care facilities, the Foursquare venue was searched for terms like 'elder(s)' and 'eldercare'. Results returned were however, too thin and mostly for food. Hence, data from Agency for Integrated Care (AIC) - Map for Eldercare Service Locator was used instead. E.g. Ang Mo Kio, AWWA Senior Activity Centre, Blk 123 Ang Mo Kio Ave 6 #01-4011 Singapore 560123. The location coordinates were also added.

## Methodology

The master data consist of all the neighbourhood areas in Singapore, as follows:

area_name	area_region	Latitude	Longitude
BUKIT MERAH	CENTRAL REGION	1.270439	103.828318
BUKIT PANJANG	WEST REGION	1.379149	103.761413
BUKIT TIMAH	CENTRAL REGION	1.354690	103.776372
CENTRAL WATER CATCHMENT	NORTH REGION	1.375708	103.801743
CHANGI	EAST REGION	1.351080	103.990064

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Complimenting the above, are the demographics data. For the population age groups, the interest is only on the seniors. The data is thus filtered and further classified into 'active senior' (age 55 to 64), 'slow senior' (age 65 to 79) and 'dependent senior' (age 80 and above).

planning_area	gender	year	age_55_64	age_65_79	age_80_above
Ang Mo Kio	Total	2015	26780	22860	5550
Bedok	Total	2015	43970	33390	8770
Bishan	Total	2015	14060	9730	2460
Bukit Batok	Total	2015	21140	11280	2540
Bukit Merah	Total	2015	22660	22100	6550

In terms of education, the categories are consolidated into 'Secondary and below', 'Post Secondary and Diplomas', and 'University and above'

planning_area	university	year	secondary_and_below	post_secondary_and_diploma
Bukit Merah	2400	2015	16600	4500
Bukit Panjang	3000	2015	21700	6300
Bukit Timah	2500	2015	10800	2400

Further, the income group are determined as below, (with the income level brackets rounded to the nearest data available):

- Low income = below \$1900 (referencing ComCare criteria)

- Middle income = \$1901 to \$6810 (referencing Average Monthly Household income from Work (excluding employer CPF contributions), via Singstat.gov.sg)
- High income = \$6811 to \$19254
- Affluent income = \$19255 and above ((referencing Average household income by dwelling, (Condominium), via Singstat.gov.sg)

planning_area	year	below_sgd_1999	sgd_1999_to_6999	sgd_7000_to_17499	sgd_17500_above
Bukit Merah	2015	19000	13300	15800	7000
Bukit Panjang	2015	4500	12200	18600	6000
Bukit Timah	2015	3900	1600	5700	12500
Choa Chu Kang	2015	5000	14600	23300	6300
Clementi	2015	6600	8300	9900	5600

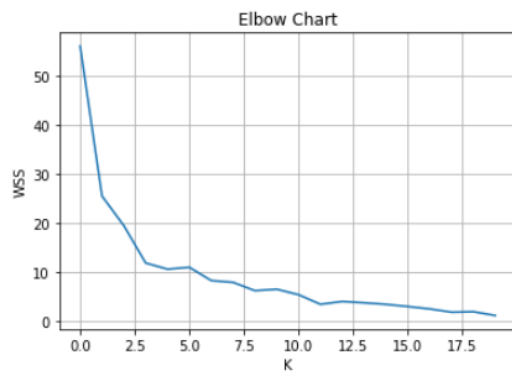
Lastly, the number of elderly activity centres and day care centres were summed up by neighbourhoods.

Area	Total_ActiveCentre	Area	Total_DayCare
Serangoon	3	Ang Mo Kio	4
Tampines	7	Bedok	4
Toa Payoh	11	Bishan	2
Woodlands	10	Bukit Batok	4
Yishun	8	Bukit Merah	5

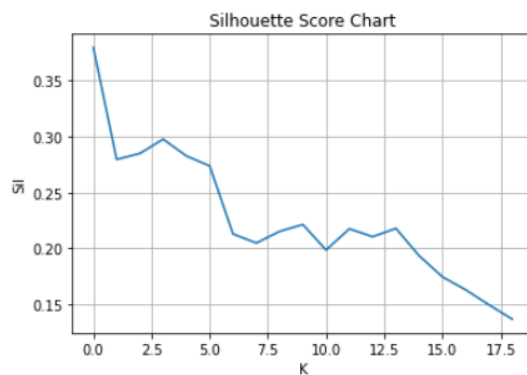
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The neighbourhood areas' population education level, income level, seniors' age group, and number of elderly care centres thus formed the featureset for market segmentation.

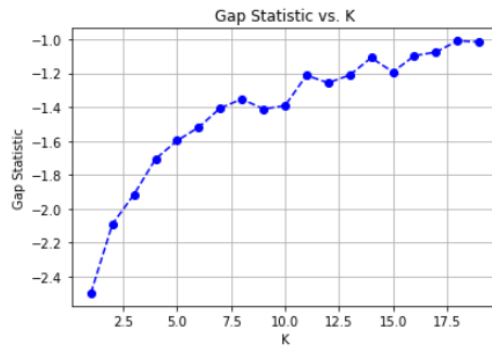
For unsupervised learning, the K-Means algorithm is one of the most common and effective clustering methods being used. At the same time, finding the optimal number of clusters (k) can be rather subjective. The Elbow Score, Silhouette Score and the Gap Analysis Score were used as a reference for finding a good k value.



Optimal k is 5.



Optimal k is 3.

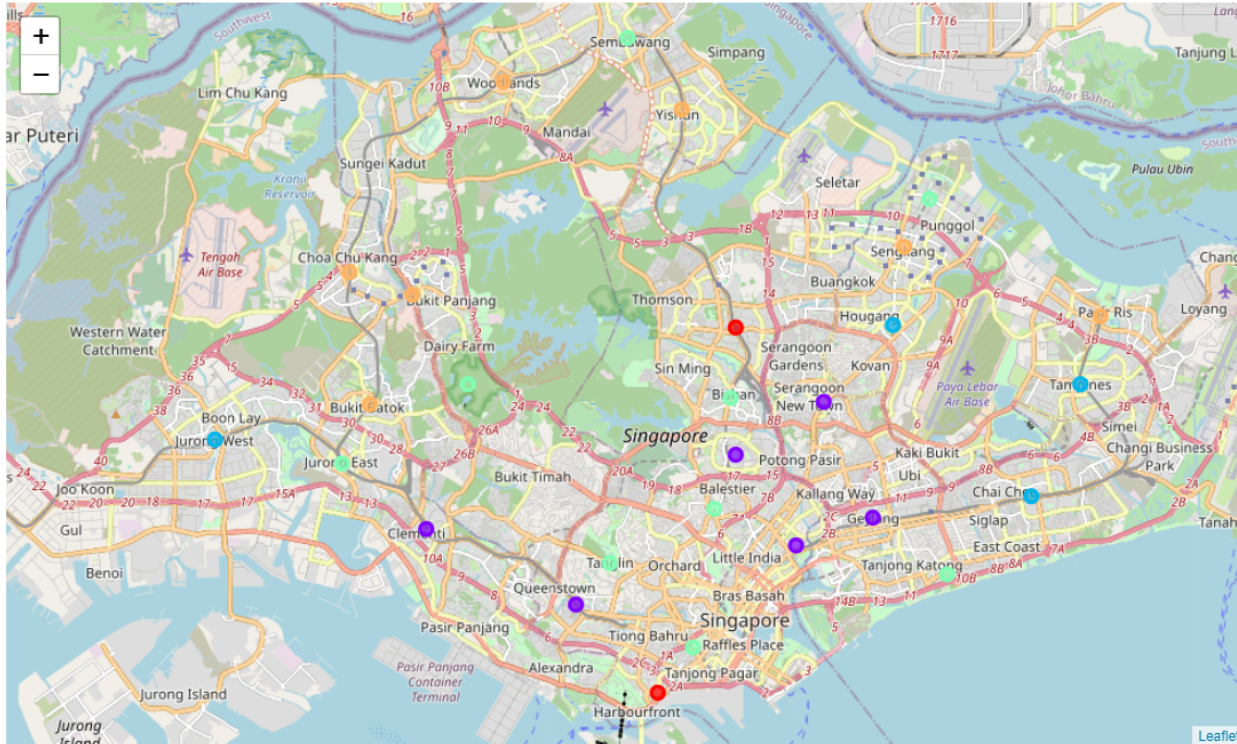


Optimal k is 19.

The decision was to use the optimal k value of 5 as seen in the Elbow Chart. Given 28 neighbourhood areas, 3 clusters can be low in terms of market segmentation and 19 clusters is rather high for the total number of neighbourhoods.

## Results

The following neighbourhood clusters were produced by the k means algorithm.



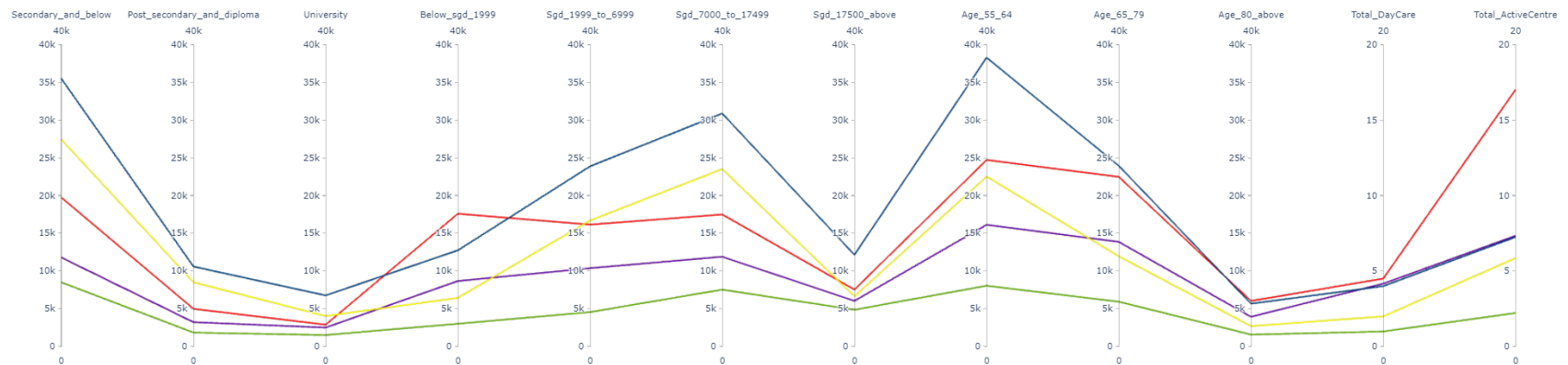
- Cluster 0 - Red
- Cluster 1 - Purple
- Cluster 2 - Blue
- Cluster 3 - Green
- Cluster 4 - Yellow



The resulting clusters with their mean feature values are as follows.

	Latitude	Longitude	university	secondary_and_below	post_secondary_and_diploma	below_sgd_1999	sgd_1999_to_6999	sgd_7000_to_17499	sgd_17500_above	age_55_64	age_65_79	age_80_above	Total_DayCare	Total_ActiveCentre
Cluster Labels														
0	1.320260	103.838921	2900.000000	19750.000000	5000.000000	17600.000000	16150.000000	17500.000000	7550.000000	24720.000000	22480.000000	6050.000000	4.500000	17.000000
1	1.320637	103.841335	2516.666667	11800.000000	3233.333333	8683.333333	10383.333333	11900.000000	6050.000000	16131.666667	13868.333333	3943.333333	4.166667	7.333333
2	1.347267	103.868418	6775.000000	35500.000000	10600.000000	12750.000000	23875.000000	30875.000000	12150.000000	38280.000000	23937.500000	5680.000000	4.000000	7.250000
3	1.345023	103.832638	1533.333333	8511.111111	1855.555556	3022.222222	4566.666667	7544.444444	4877.777778	8057.777778	5944.444444	1590.000000	1.000000	2.222222
4	1.392108	103.817331	4042.857143	27428.571429	8514.285714	6457.142857	16700.000000	23514.285714	6657.142857	22511.428571	11958.571429	2710.000000	2.000000	5.857143

Below chart shows clearer the various clusters' feature values relative to one another (based on the clusters' mean values).



- Cluster 0 (Red line) - Among the highest number of 'age 65 and above', highest number of low income groups, and highest number of elderly active centres.
- Cluster 1 (Purple line) - Lower overall senior population, and medium number of elderly care centres.
- Cluster 2 (Blue line) - Highest overall senior population (and highest age 55 to 64), and highest overall income level.
- Cluster 3 (Green line) - Lowest overall senior population, and lowest number of elderly care centres.

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- Cluster 4 (Yellow line) - Medium overall senior population, higher overall income level, and lower number of elderly care centres.

Also from the above chart, the education level trend is observed to be standard across the various clusters, showing a commonly lower level of university graduates within the neighbourhood areas compared to secondary and below educations.

## Discussion

From the cluster analysis above, SilverCare can explore the various market segments in the following ways:

- Cluster 2 (Highest income/population group with medium number of elderly care facilities) - to provide premium activities and care packages, with focus on active seniors.
- Cluster 4 (Higher income group, medium senior population, with lower number of elderly care facilities) - to provide higher tier activities and care packages, with focus on active seniors.
- Cluster 1 (Balanced income group, lower senior population, with medium number of elderly care facilities) - to provide mid tier activities and care packages.
- Cluster 3 (Balanced income group, lowest senior population, with lowest number of elderly care centres) - to combine with Cluster 1 as a service target group.
- Cluster 0 (Lowest (with balanced) income group, higher senior population, with highest number of elderly active centres) - to provide lower/mid tier activities and care packages, bearing in mind the high number of competitions for the elderly active centres.

Once SilverCare has set up a presence in Singapore, further service can be zoomed into gender and religion groups. The individual religious beliefs of seniors is important in their end of life care. Also, there are significantly more females in the age

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80 and above group. The emotions of elderly ladies can be more sensitive than elderly men and thus better cared for by caregivers.

## **Conclusion**

Active aging is an important theme for many developed countries. More services and facilities would be needed for such a purpose in the years ahead. This would help to provide the elderly folks with a healthy and dignified lifestyle into their sunset years.

# Appendixes

Cluster Labels	area_name	area_region	Latitude	Longitude	university	secondary_and_below	post_secondary_and_diploma	below_sgd_1999	sgd_1999_to_6999	sgd_7000_to_17499	sgd_17500_above	age_55_64	age_65_79	age_80_above	Total_DayCare	Total_ActiveCentre
0	BUKIT MERAH	CENTRAL REGION	1.270439	103.828318	2400.0	16600.0	4500.0	19000.0	13300.0	15800.0	7000.0	22660.0	22100.0	6550.0	5.0	22.0
0	ANG MO KIO	NORTH-EAST REGION	1.370080	103.849523	3400.0	22900.0	5500.0	16200.0	19000.0	19200.0	8100.0	26780.0	22860.0	5550.0	4.0	12.0
1	GEYLANG	CENTRAL REGION	1.318186	103.887056	2700.0	12700.0	2800.0	8800.0	11700.0	12500.0	4500.0	17690.0	13640.0	4090.0	3.0	8.0
1	TOA PAYOH	CENTRAL REGION	1.335391	103.849741	2700.0	13700.0	4300.0	11400.0	12700.0	13000.0	6000.0	18200.0	16950.0	5160.0	3.0	11.0
1	CLEMENTI	WEST REGION	1.315100	103.765231	1700.0	9900.0	2000.0	6600.0	8300.0	9900.0	5600.0	13180.0	12150.0	2680.0	5.0	7.0
1	SERANGOON	NORTH-EAST REGION	1.349761	103.873684	4200.0	14500.0	4000.0	6600.0	8900.0	13700.0	9800.0	19940.0	13510.0	3590.0	6.0	3.0
1	QUEENSTOWN	CENTRAL REGION	1.294623	103.806037	2300.0	9400.0	3200.0	9900.0	10000.0	10800.0	4900.0	12880.0	13550.0	4200.0	2.0	7.0
1	KALLANG	CENTRAL REGION	1.310759	103.866262	1500.0	10600.0	3100.0	8800.0	10700.0	11500.0	5500.0	14900.0	13410.0	3940.0	6.0	8.0
2	TAMPINES	EAST REGION	1.354653	103.943571	7900.0	32600.0	12000.0	10100.0	23900.0	34600.0	11400.0	39850.0	21270.0	5070.0	4.0	7.0
2	BEDOK	EAST REGION	1.323976	103.930216	7500.0	36600.0	10400.0	19400.0	26100.0	28300.0	18600.0	43970.0	33390.0	8770.0	4.0	9.0
2	JURONG WEST	WEST REGION	1.339636	103.707339	5600.0	43700.0	11500.0	11600.0	24900.0	36700.0	8600.0	34970.0	19620.0	3490.0	3.0	9.0
2	HOUGANG	NORTH-EAST REGION	1.370801	103.892544	6100.0	29100.0	8500.0	9900.0	20600.0	23900.0	10000.0	34330.0	21470.0	5390.0	5.0	4.0
3	PUNGGOL	NORTH-EAST REGION	1.405197	103.902350	1200.0	15800.0	2500.0	3200.0	8400.0	17900.0	3800.0	8690.0	5620.0	1170.0	0.0	4.0
3	BISHAN	CENTRAL REGION	1.350986	103.848255	3100.0	11200.0	3300.0	4400.0	5400.0	10600.0	7300.0	14060.0	9730.0	2460.0	2.0	5.0
3	MARINE PARADE	CENTRAL REGION	1.302689	103.907395	1100.0	5100.0	1000.0	3700.0	3400.0	3900.0	4100.0	6260.0	6190.0	1970.0	0.0	0.0
3	JURONG EAST	WEST REGION	1.333108	103.742294	1800.0	10600.0	2700.0	4000.0	8300.0	9700.0	3400.0	13440.0	8810.0	1800.0	2.0	3.0
3	SEMBAWANG	NORTH REGION	1.449093	103.820055	2200.0	12800.0	3000.0	1300.0	7000.0	12000.0	2900.0	8330.0	4420.0	1110.0	1.0	1.0
3	NOVENA	CENTRAL REGION	1.320526	103.843881	1000.0	5800.0	1100.0	2800.0	3500.0	4500.0	5100.0	6220.0	5430.0	1910.0	3.0	3.0
3	OUTRAM	CENTRAL REGION	1.282870	103.837860	400.0	1900.0	400.0	2700.0	2500.0	2000.0	1200.0	3240.0	3250.0	1160.0	1.0	3.0
3	TANGLIN	CENTRAL REGION	1.306044	103.815280	500.0	2600.0	300.0	1200.0	1000.0	1600.0	3600.0	2400.0	1860.0	520.0	0.0	0.0
3	BUKIT TIMAH	CENTRAL REGION	1.354690	103.776372	2500.0	10800.0	2400.0	3900.0	1600.0	5700.0	12500.0	9880.0	8190.0	2210.0	0.0	1.0
4	PASIR RIS	EAST REGION	1.373031	103.949255	5000.0	21800.0	8300.0	4000.0	9600.0	19600.0	7400.0	17520.0	8710.0	2490.0	2.0	1.0
4	BUKIT PANJANG	WEST REGION	1.379149	103.761413	3000.0	21700.0	6300.0	4500.0	12200.0	18600.0	6000.0	18560.0	9930.0	2300.0	0.0	2.0
4	SENGKANG	NORTH-EAST REGION	1.391924	103.895491	3400.0	37600.0	8700.0	5300.0	19200.0	31600.0	8700.0	21910.0	12190.0	2610.0	1.0	7.0
4	BUKIT BATOK	WEST REGION	1.349057	103.749591	4400.0	18300.0	6600.0	7600.0	12900.0	16700.0	6700.0	21140.0	11280.0	2540.0	4.0	5.0
4	WOODLANDS	NORTH REGION	1.436897	103.786216	3900.0	40000.0	12800.0	9100.0	26000.0	29300.0	6200.0	28450.0	14780.0	3140.0	1.0	10.0
4	CHOA CHU KANG	WEST REGION	1.385317	103.744325	5000.0	27200.0	9400.0	5000.0	14600.0	23300.0	6300.0	21740.0	10860.0	2470.0	2.0	8.0
4	YISHUN	NORTH REGION	1.429384	103.835028	3600.0	25400.0	7500.0	9700.0	22400.0	25500.0	5300.0	28260.0	15960.0	3420.0	4.0	8.0