

Hands-on Exercise 4: GIS Mapping and Geovisualisation

In this exercise, you will learn how to prepare qualitative and quantitative thematic maps. You will also learn how to create a join table using the concept of georelational data model of GIS.

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1.0 Introduction

In this exercise, you will learn how to prepare qualitative and quantitative thematic maps using QGIS. You will also learn how to create a join table using the concept of georelational data model of GIS.

1.1 Learning Outcome

By the end of this session, you will be able to:

- prepare qualitative maps
- create proportional symbol map
- prepare choropleth map
- using

2.0 Data

For the purpose of this hands-on exercise, three data sets are provided. They are:

- `education` provides general information of public primary schools, secondary schools and junior colleges. This data set was downloaded from Data.gov.sg and geocoded by using SLA OneMap Api.
- `sgpools` provides information of SG Pools outlets and stores information.
- `POP2020` provides population by age group as at June 2020. It is downloaded from Department of Statistics (DOS), Singapore. The data set provides multiple years population data but for the purpose of this exercise, only 2020 data were extracted.

These three data sets are in csv file format. They can be found in `DataTables` of Hand-on-Ex04 folder.

Besides the above three data sets, you are required to download the following geospatial from public web sites:

- National Map Polygon from Data.gov.sg
- Master Plan 2014 Subzone Boundary (No Sea) from Data.gov.sg
- Road Section Line from LTA Data Mall

2.2 Data Preparation

*DIY: Using the steps you learned from previous hands on exercise, convert the education and SGPool data sets in `DataTables` folder into geospatial data layer and store them into an integrated database called `SG`. The geospatial database must be in **GeoPackage** format.*

DIY: Using the steps you learned from previous hands-on exercise, convert the geospatial data sets downloaded from Data.gov.sg and LTA Data Mall into the newly created `SG` database.

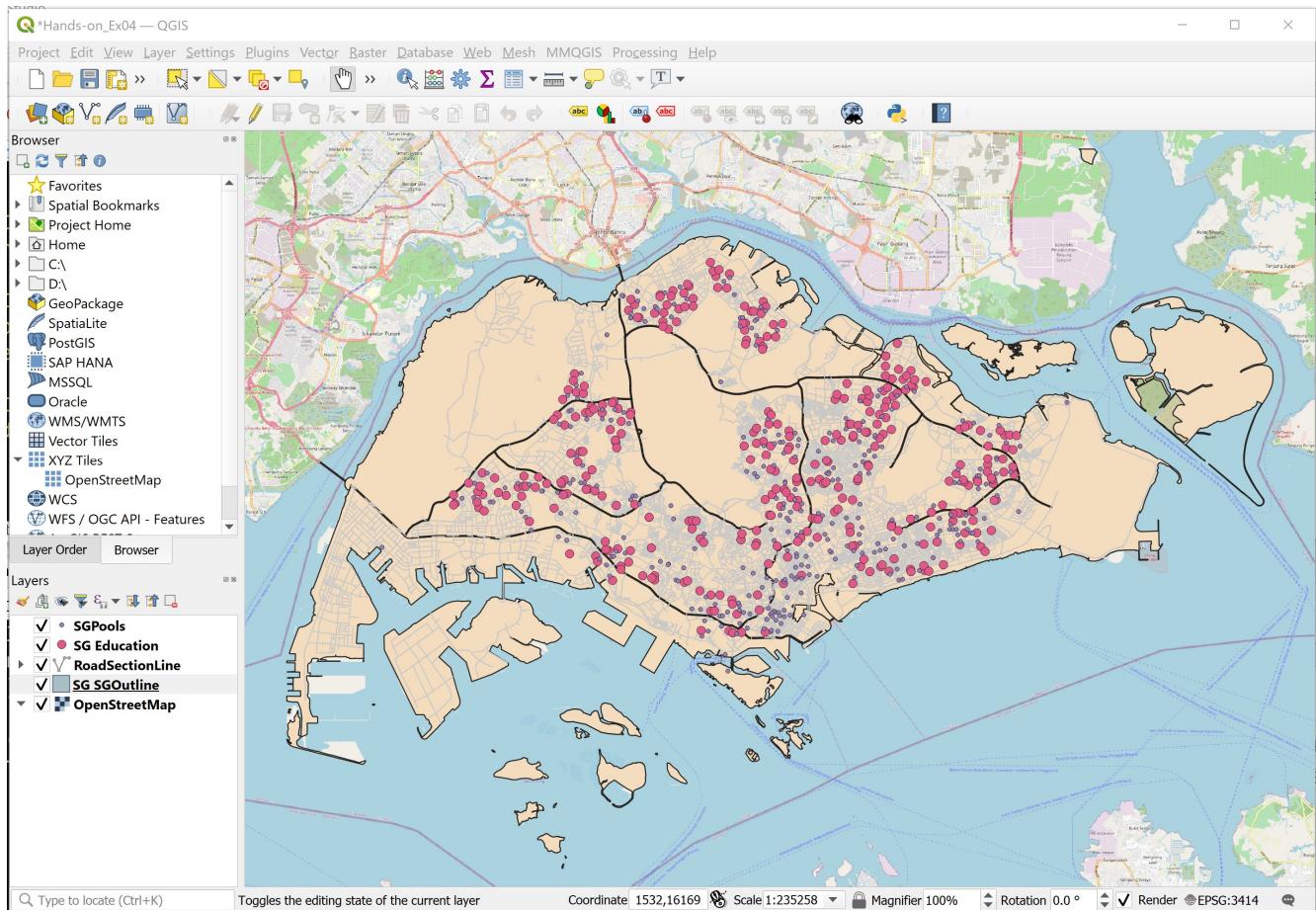
3.0 Getting Started

DIY: Launch QGIS. Created a new project call `Hands-on_Ex04`. Provide the project the correct referencing system.

DIY: Using the steps you learn from previous hands-on exercies, import all the geospatial data in `SG` database into the newly created QGIS project.

DIY: Using the steps you learn from previous hands-on exercises, add OSM map layer into Hands-on_Ex04 project.

Your screen should look similar to the figure below.



4.0 Symbolising Qualitative GIS Data Layers

In this section, you will learn how to symbolise GIS data layers by using their corresponding qualitative data values.

4.1 Symbolising education GIS layer

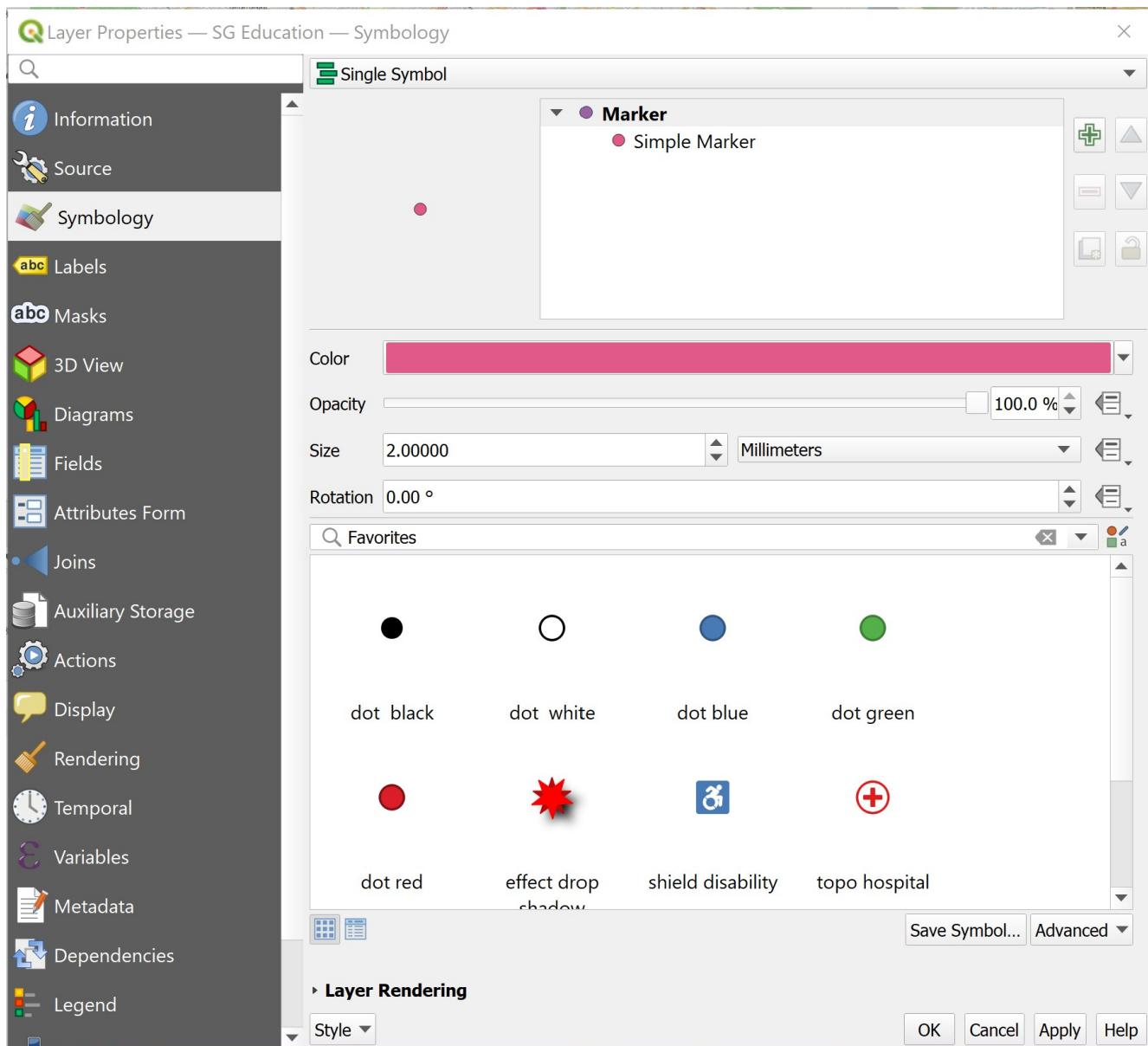
The `type_code` field of `Education` layer provides us the school type information. In this section, you will learn how to use this field to symbolise `education` layer.

- At **Layers** panel, click on `Education` layer to make it active.
- Right-click on `Education` and select **Properties** from the context menu.

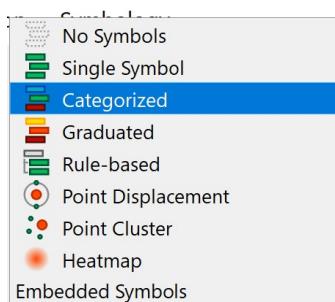
The **Layer Properties** dialog window appears.

- Click on the **Symbology** tab.

Your screen should look similar to the screenshot below.



- Select **Categorized** from the **Symbol** drop-down list.



- For **Value**, select *mainlevel_code* from the drop-down list.

Value	abc mainlevel_code
Symbol	123 fid
Color ramp	abc school_name 123 postal code



- Click on the **Classify** button.

Your screen should look similar to the screenshot below.

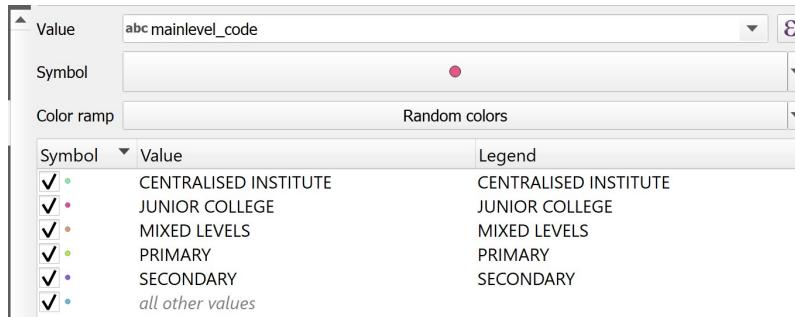
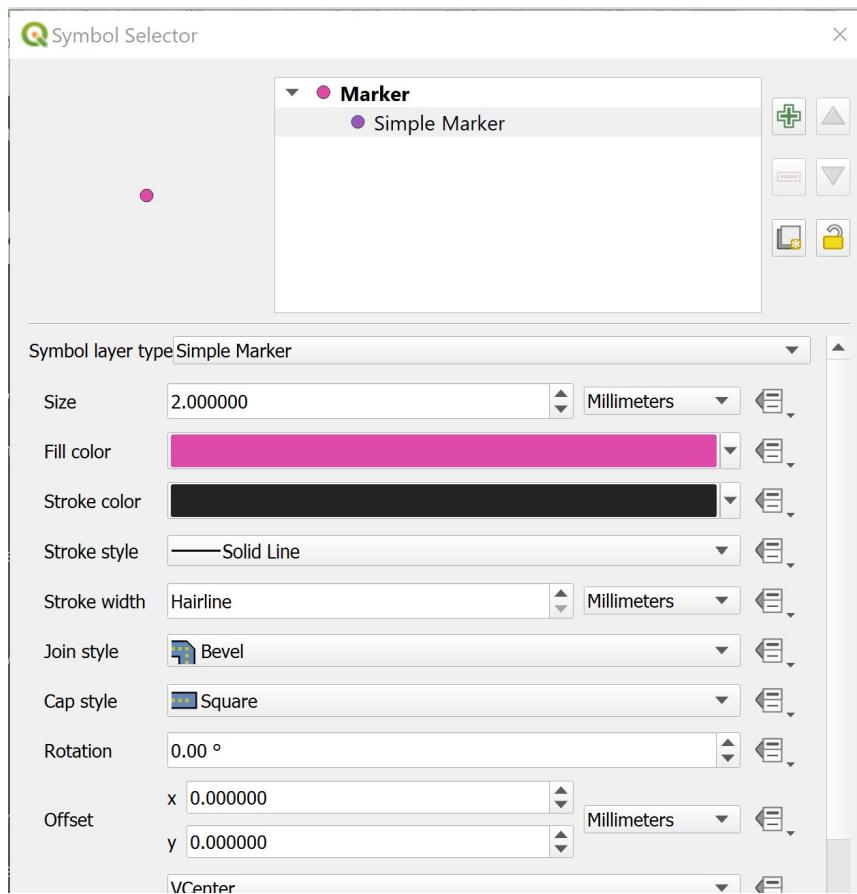


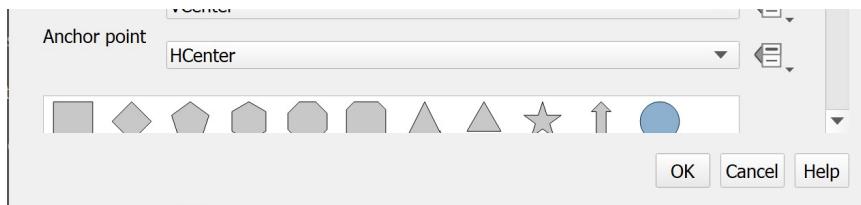
Figure above shows that Education layer has been categorized into five categories. They are, Junior College, Centralised Institute, Mixed Levels, Primary and Secondary.

Next, you will learn how to symbolise them by using the svg vector symbol set.

- Double-click on the marker in front of *JUNIOR COLLEGE*.

The **Symbol selector** dialog window appears.





- From **Marker**, click on **Simple marker**.
- For **Symbol layer type**, select **SVG maker** from the drop-down list.

Scroll down the dialog window until you can see the SVG Browser as shown below.



- From the **SVG Image**, scroll-down and click on .

DIY: Change the size value and fill colour and observe the differences.

- When you are done, click on the **OK** button.

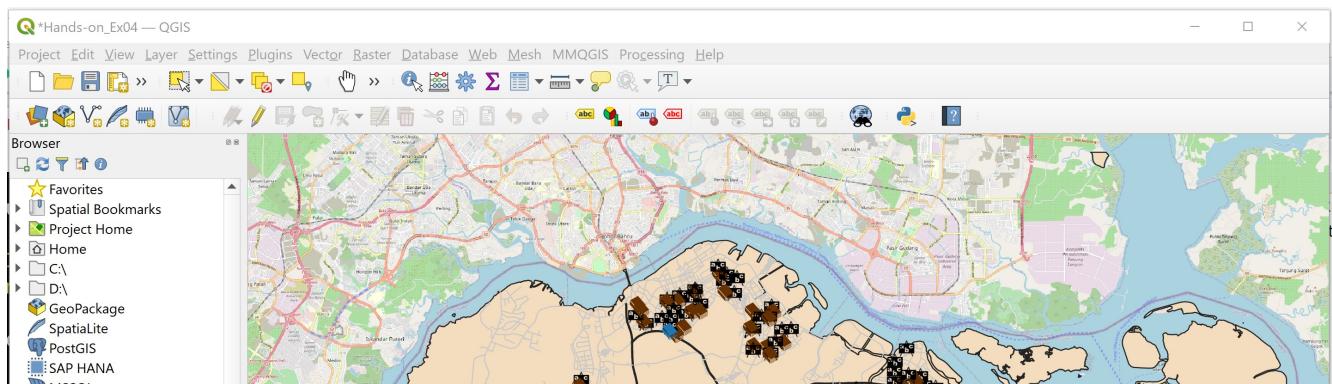
You will return to **Layer Properties** dialog window.

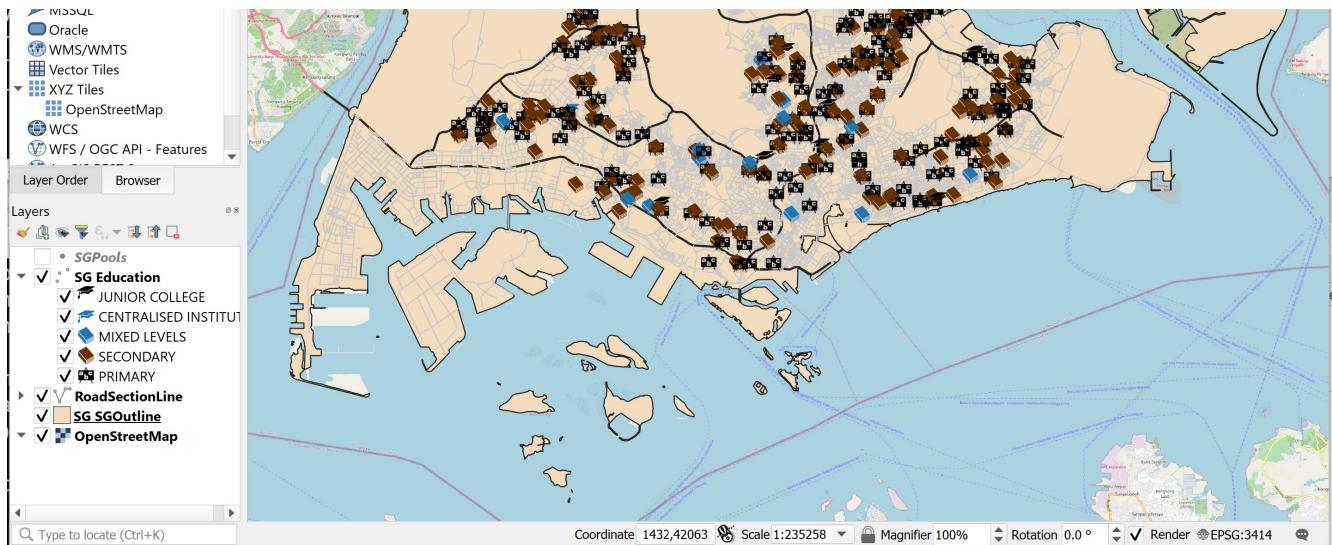
DIY: Using the step you had learned, change the symbols of the remaining four categories in mainlevel_code field.

When you are done.

- At the **Layer Properties** dialog window, click on **Apply** button to update the changes.
- To close the **Layer Properties** dialog window, click on **OK** button.

Your screen should look similar to the figure below.





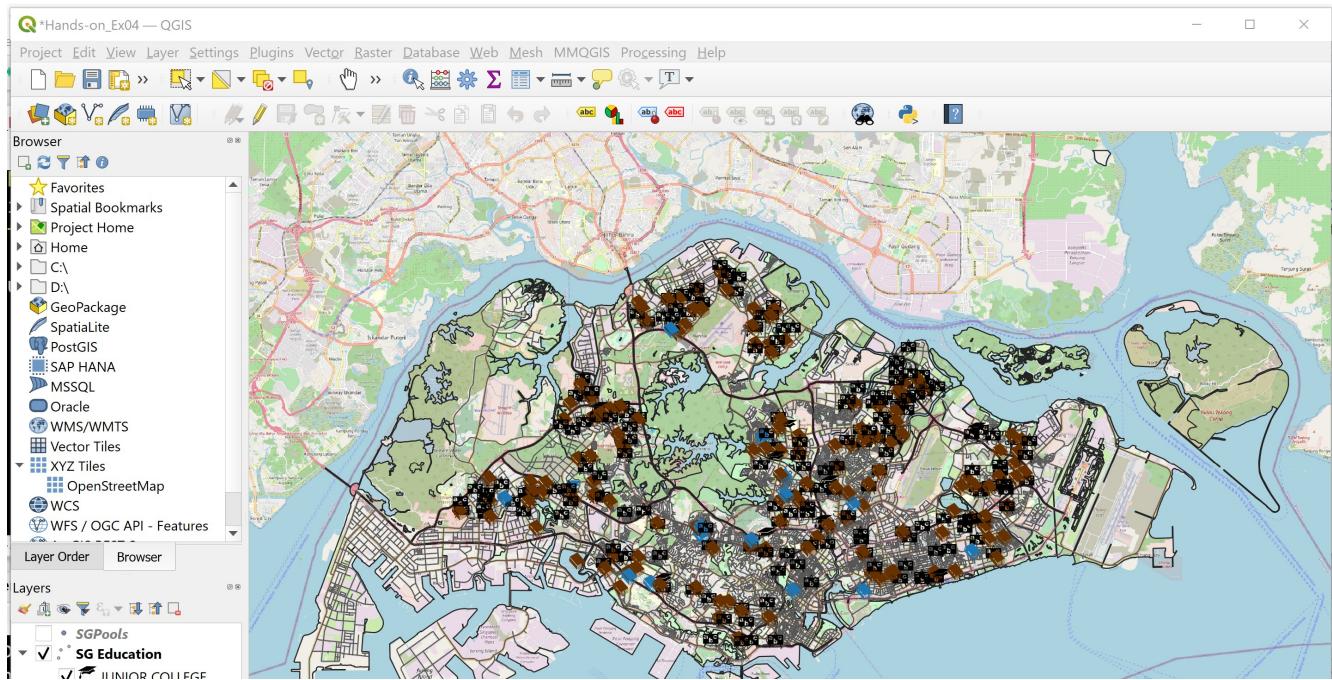
This map is popularly known as Point symbol map among the GIS and cartography communities. Prior to GIS era, this kind of map took more than a month to prepare. With GIS, it only needs less than 15 minutes to prepare. The advantage of GIS-based point symbol map is that the map can be changed easily with very little effort. GIS-based pointsymbol map is also highly interactive. You can navigate around the digital map and zooming in to view the distribution in greater details.

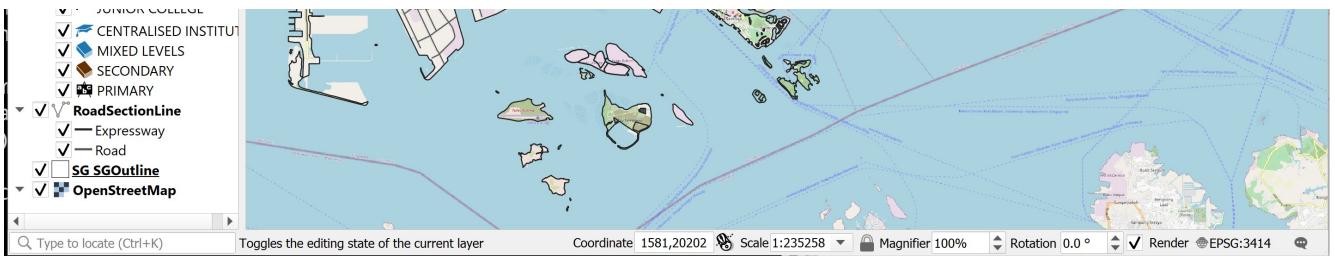
DIY: Use the steps you had learned from previous section, symbolise the

Challenge: Using the steps you learned in previous section, symbolise RoadSectionLine layer according to Expressway and Roads.

Challenge: Using the steps you learned in previous section, symbolise National Map Polygon layer to show the outlines only.

Your screen should look similar to the figure below.





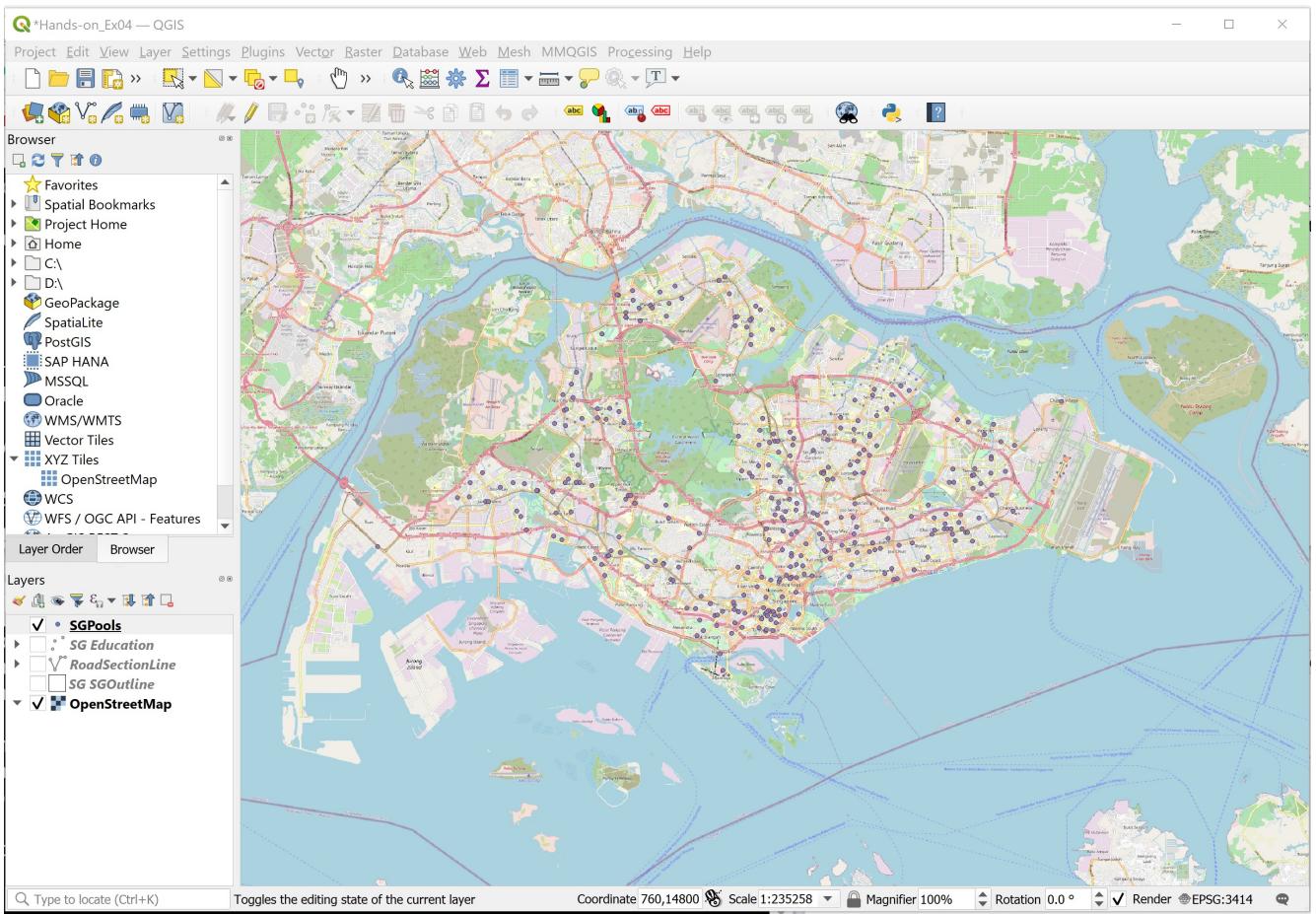
5.0 Creating Proportional Symbol Map

Proportional symbol maps (also known as graduate symbol maps) are a class of maps that use the visual variable of size to represent differences in the magnitude of a discrete, abruptly changing phenomenon, e.g. counts of people. Like choropleth maps, you can create classed or unclassed versions of these maps. The classed ones are known as **range-graded** or **graduated symbols**, and the unclassed are called **proportional symbols**, where the area of the symbols are proportional to the values of the attribute being mapped.

In this section, you will learn how to create a proportional symbol map showing the numbers of win by Singapore Pools' outlets.

DIY: Before we get started, let us switch off Education, RoadSectionLine and SGOutline layers.

Your screen should look similar to the figure below.



Before you start to prepare the proportional symbol map, you will take a look at the attribute table of SGPools layer.

- At the **Layers** panel, right-click on **SGPools** layer.
- Select **Open Attribute Table** from the context menu.

Your screen should look similar to the figure below.

SGPools — Features Total: 306, Filtered: 306, Selected: 0								
	fid	NAME	ADDRESS	POSTCODE	XCOORD	YCOORD	INGPOOLSBRANC	Gp1Gp2Winnings
1		15 Singapore Pools...	Blk 2 Balestier R...	320002	29061.585	34234.9389	1	9
2		69 Singapore Pools...	Blk 148 Potong ...	350148	31858.5602	34989.7343	1	9
3		87 Singapore Pools...	Blk 305 Woodla...	730305	21409.8301	45787.4386	1	9
4		117 Balestier Khalsa ...	297 Lor 6 Toa Pa...	319389	30030.789	34721.8429	0	9
5		261 Shop N Save Bu...	Blk 982 Buangko...	530982	33120.7976	40310.6194	0	9
6		113 7-Eleven Yishun	Blk 102 Yishun A...	760102	27493.0307	45816.0208	0	80
7		197 NTUC FP Dawson	Blk 57 Dawson R...	142057	25513.0007	30566.0075	0	8
8		198 NTUC FP Downt...	1 Pasir Ris Close ...	519599	41461.7117	39953.7992	0	8
9		216 NTUC FP Senja	Blk 628 Senja Rd...	670628	19864.8887	40782.5221	0	8
10		302 Woodlands Well...	1 Woodlands St ...	738597	22113.76635	46300.87918	0	8

You are going to use the values in the last filed (e.g *Gp1Gp2Winn*) to create a proportional symbol map.

- Close the table by clicking on the cross icon located at the upper right corner of the table.

Next, you are going to change the size of the point symbol by mapping the values in *Gp1Gp2Winn* field.

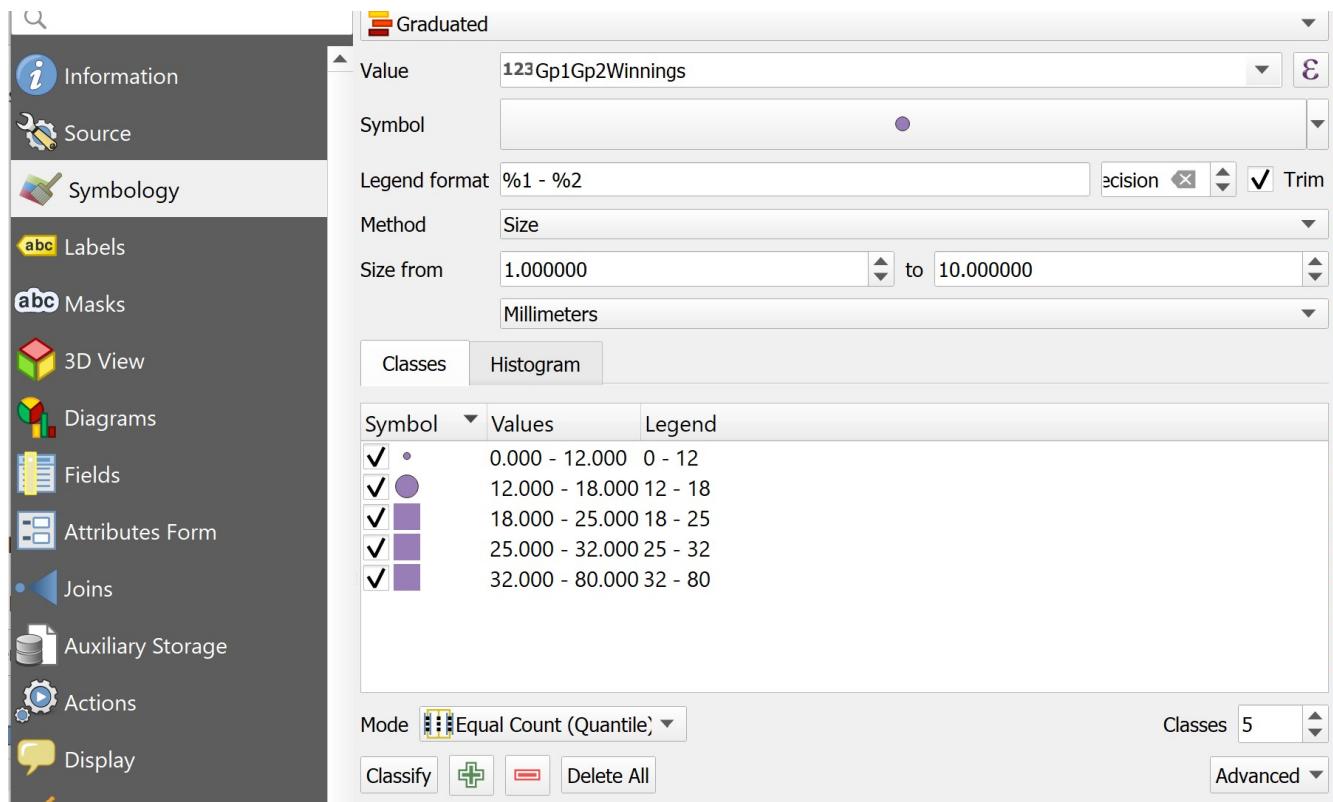
- At the **Layers** panel, right-click on **SGPools** layer.
- Select **Properties** from the context menu.

The **Layer Properties** dialog window appears.

- Click on the **Symbology** icon.
- For **Value**, select *Gp1Gp2Winngs* from the dropdown liat.
- For **Method**, select **Size** from the drop-down list.
- For **Size to**, type *10*.
- Click on **Classify** button.

Your screen should look similar to the figure below.





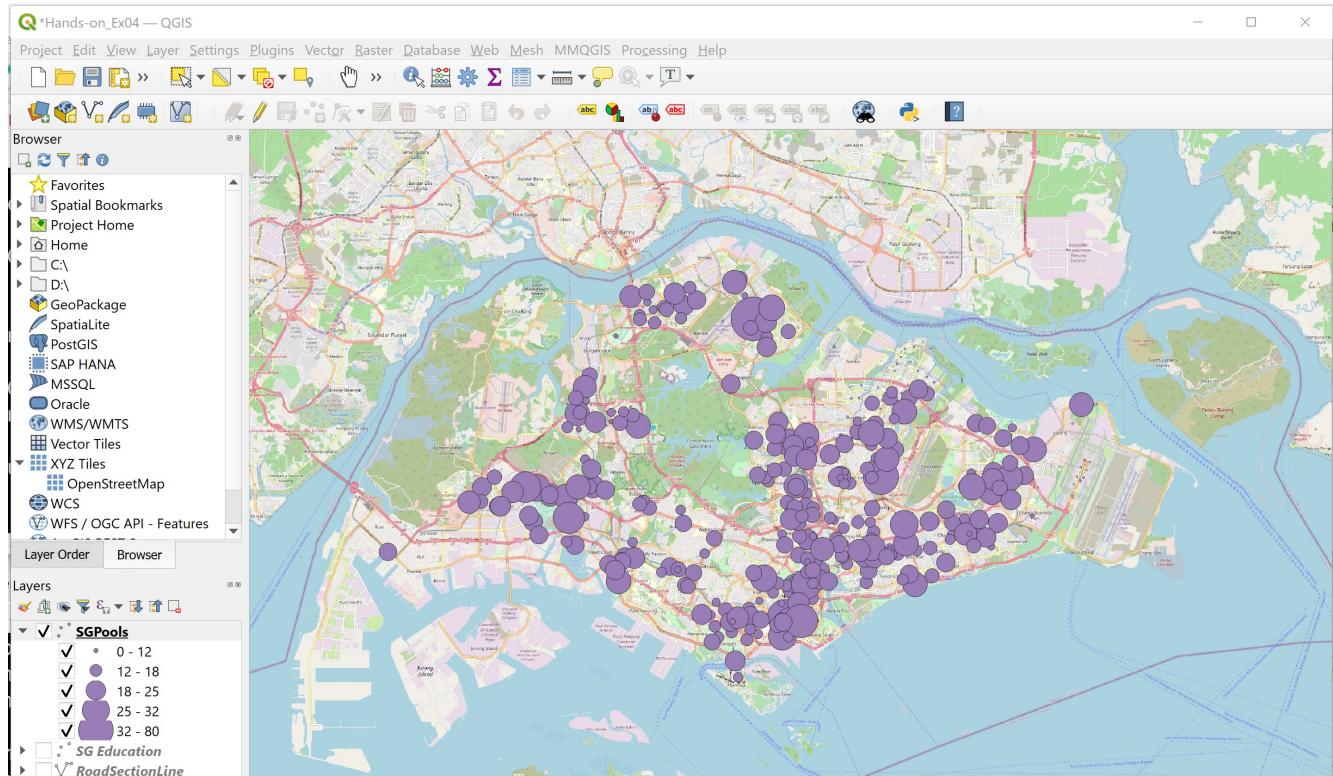
When you are ready,

- Click on Apply button to update the changes.

In order to view the changes, you need to close the dialog window.

- Click on **OK** to close the **Layer Properties** dialog window.

Your screen should look similar to the figure below.



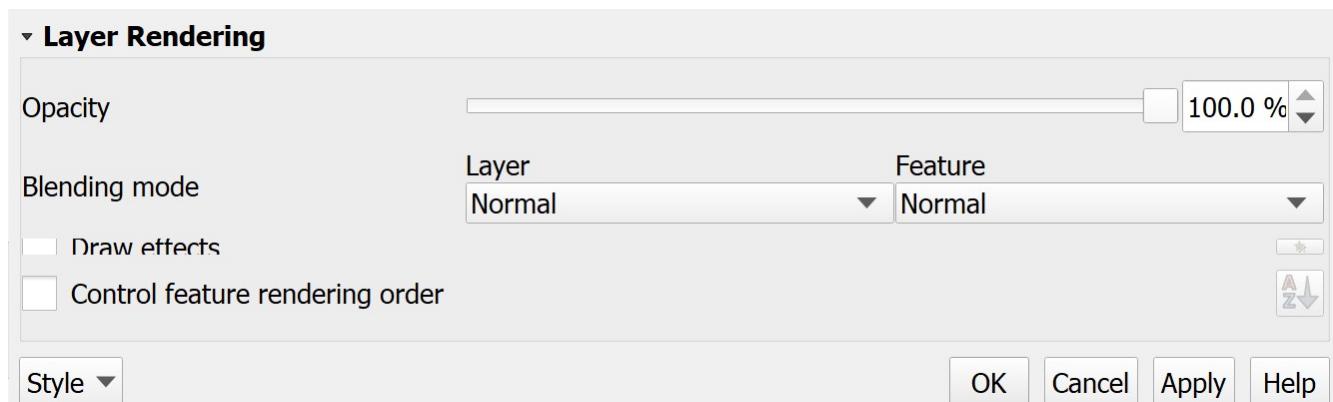


Notice that there are many proportional symbols were overlapping. Now, you will learn how to use the layer transparent feature of QGIS to improve the visualisation.

*DIY: Using the step you learned in earlier section, open the **Layer Properties** of SGPool1s.*

- At the **Layer Properties** panel, look for **Layer rendering** sub-panel located at the bottom of the dialog window.
- Click on the little triangle in front of **Layer rendering** sub-panel.

The Layer rendering sub-panel extended as shown in the figure below.



- For **Opacity**, type 80%, alternatively, you can use slider to slide toward the left until it reaches 80%.

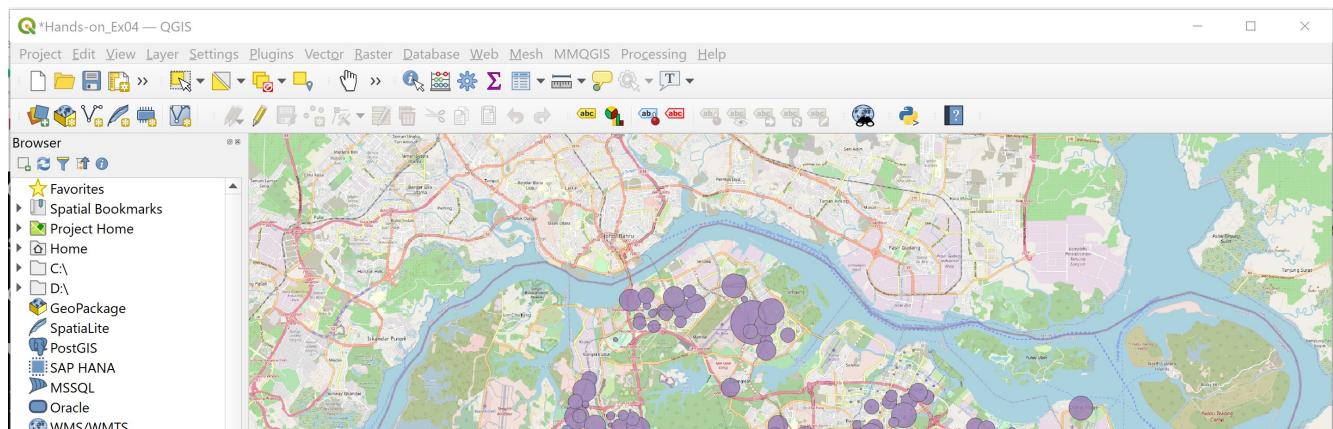
To update the changes,

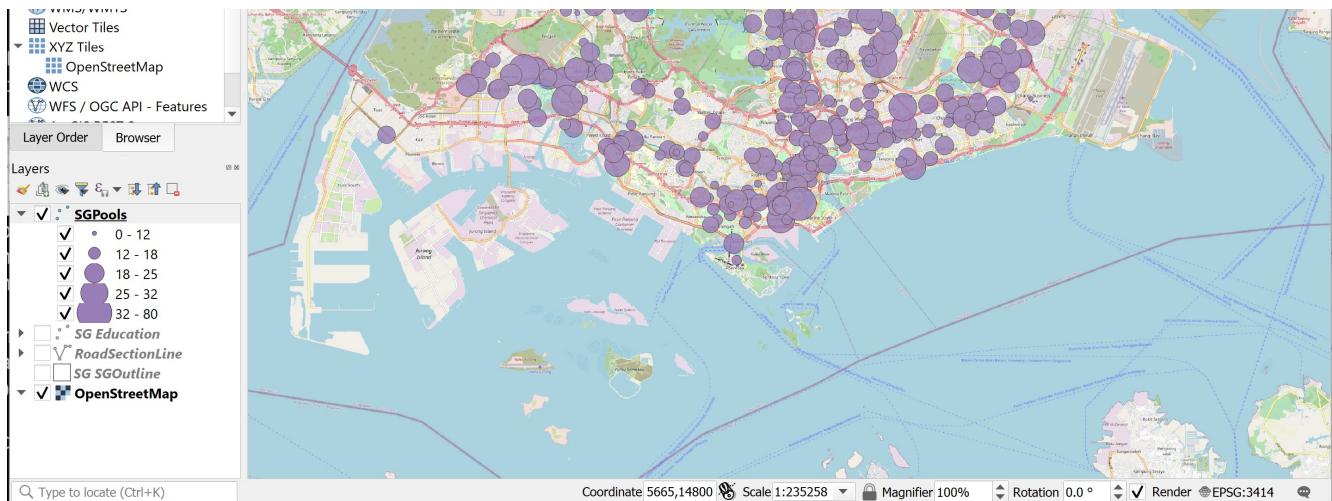
- Click on **Apply** button.

Lastly,

- Click on **OK** button to close the dialog window.

Your screen should look similar to the figure below.





- Feel free to explore other configurations. When you are done, click on the OK button.

6.0 Choropleth map using GIS

Choropleth mapping involves the symbolization of enumeration units, such as countries, provinces, states, counties or census units, using area patterns or graduated colors. For example, a social scientist may need to use a choropleth map to portray the spatial distribution of aged population of Singapore by Master Plan 2014 Subzone Boundary.

The major concerns of choropleth mapping are the method of data classification, areal symbolization, and the overall map design. General rules for choropleth mapping are as follows:

- Use data that are assumed to be uniform throughout an enumeration unit.
- Because enumeration units vary in size, do not map totals. Use derived values, such as ratios, rates, proportions, or percentages.
- The best classing method depends on the data, the map reader and the purpose of the map.
- When classifying data, the full range of data must be included and class values should not overlap. No more than six classes are recommended.
- Class symbols (i.e. colors or patterns) must be easily distinguishable.

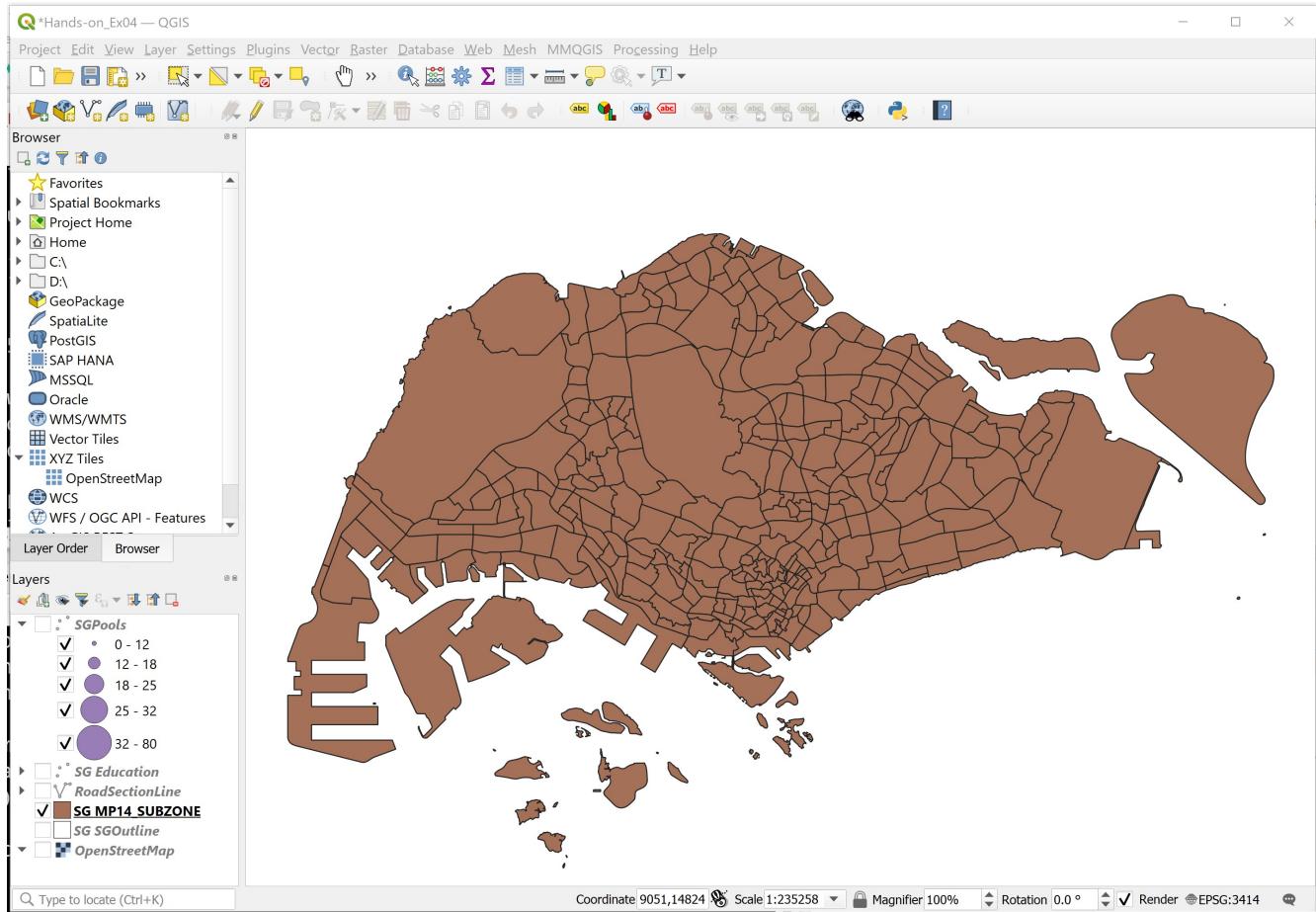
In this section of the hands-on exercise, you will learn how to use QGIS to prepare a choropleth map showing the distribution of population with age 65 and above in Singapore by URA's Master Plan 2014 subzone. You will also gain hands-on experience on the various data classification methods, symbolisation and map layout design techniques offered by QGIS.

6.1 Adding geoadministrative layer

DIY: Using the steps you had learned from previous section, add

Master Plan 2014 Subzone Area Boundary (No Sea) layer into QGIS.

Your screen should look similar to the figure below.



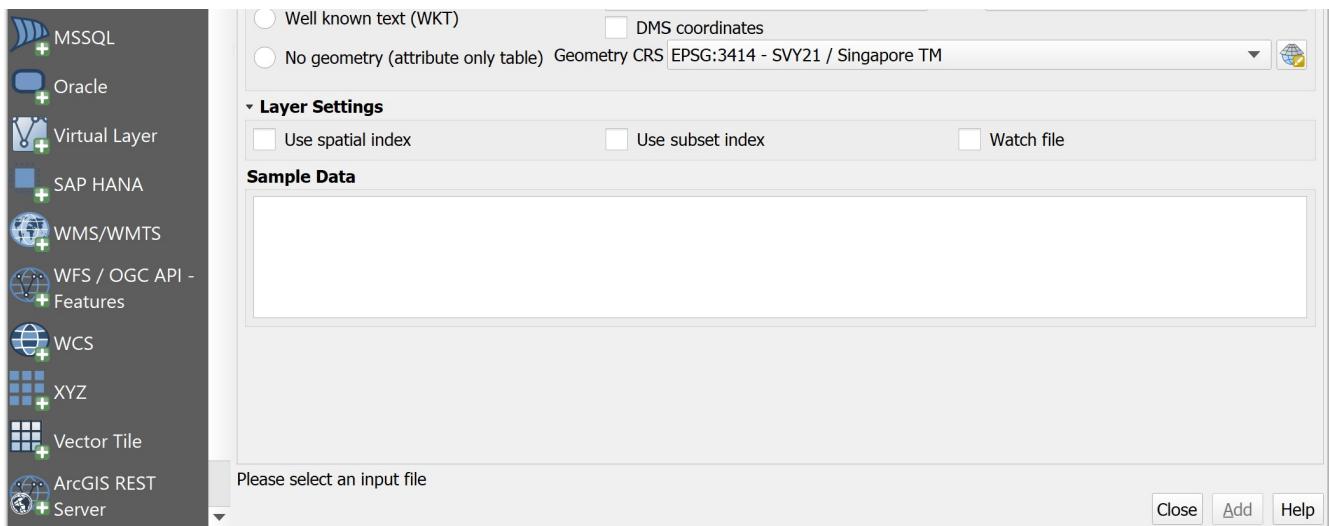
6.2 Adding an attribute table in QGIS project

Now, you will add the POP2020.csv table into the QGIS project. It is stored in `\Hands-on_EX04\DataTable` folder and is in csv format.

- From the **Layers** toolbar, click **Add Layer** -> **Add Delimited Text Layer**

The **Data Source Manager|Delimited Text** dialog window appears.

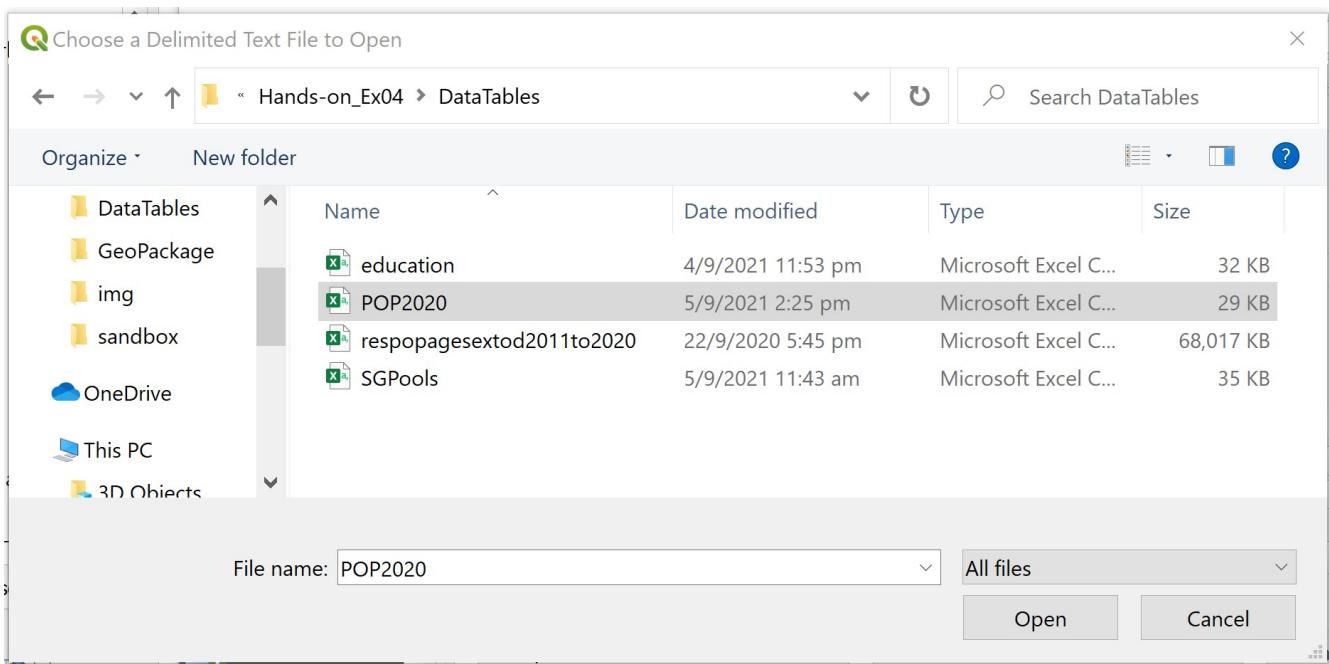




- At **File Name**, click on **Browse** button at the back.

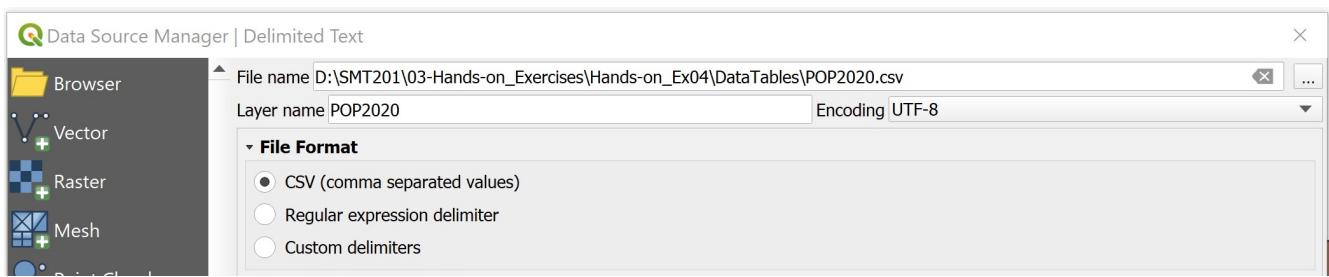
The **Choose a Delimited Text File to Open** dialog window appears.

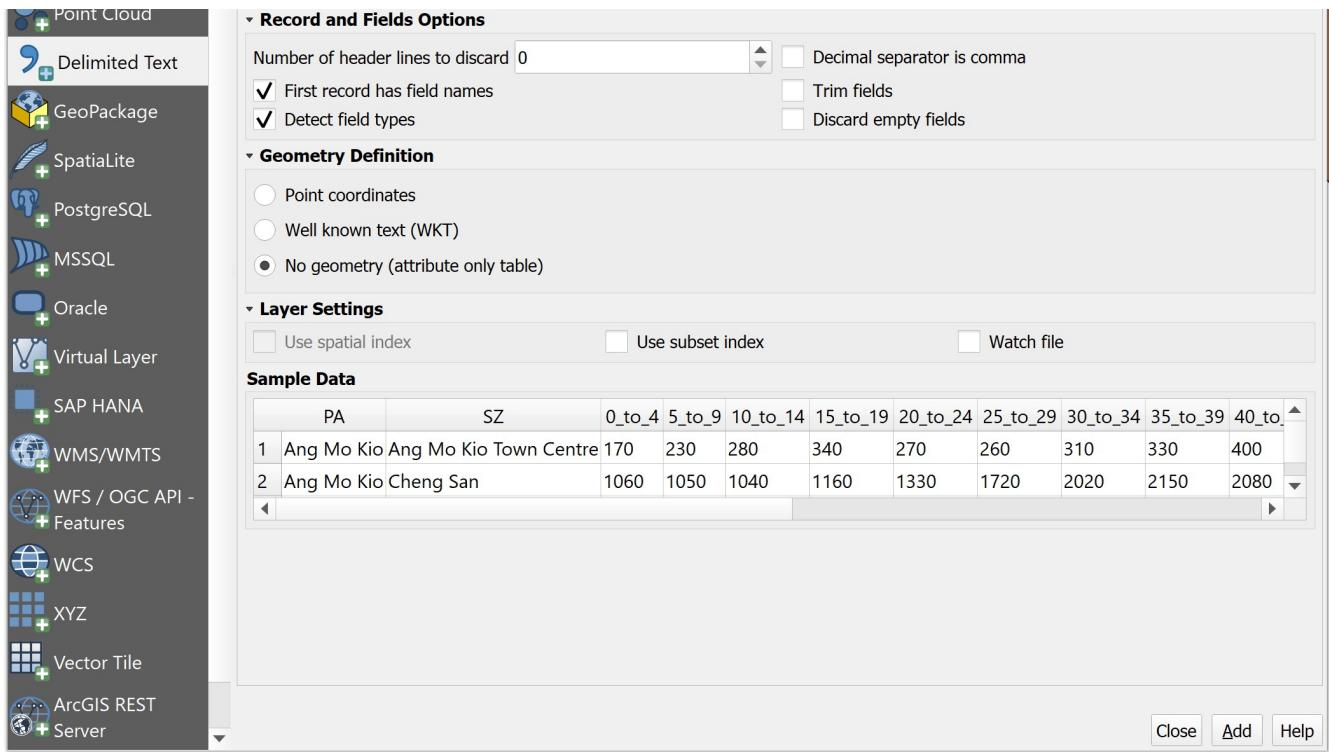
- Navigate to -on_Ex04sub folder.



- Click on **POP2020**.
- Click on the **Open** button.

You will return to **Data Source Manager|Delimited Text** dialog window.





Notice that the dialog window is completed with many information and a preview table.

- For **Geometry definition**, click on the radio button in front of **No geometry (attribute only table)**.
- Click on **Add** button.

Notice that a new data layer called `POP2020` has been added in the **Layers** panel.

We will close **Data Source Manager|Delimited Text** dialog window.

- Click on **OK** button.

Next, you will examine the structure of the data.

- Right-click on `POP2020`, select **Open Attribute Table**.

The Attribute table dialog window appears.

	PA	SZ	0_to_4	5_to_9	10_to_14	15_to_19	20_to_24	25_to_29	30_to_34	35_to_39	40_to_44	45_to_49	50_to_54	55_to_59	60_to_64	65_to_69	70_to_74	75_to_79	80_to_84	85_to_89	90_and_over
1	Ang Mo Kio	Ang Mo Kio Town...	170	230	280	340	270	260	310	330	400	480	380	310	290	250	240	130	100	30	10
2	Ang Mo Kio	Cheng San	1060	1050	1040	1160	1330	1720	2020	2150	2080	2200	2050	2130	2110	2180	1750	960	650	340	170
3	Ang Mo Kio	Chong Boon	850	850	1020	1070	1310	1610	1890	1720	1810	1820	1900	2100	2150	2100	1800	1120	800	430	220
4	Ang Mo Kio	Kebun Bahru	680	800	960	1010	1170	1410	1420	1440	1630	1810	1720	1800	1780	1710	1450	830	630	350	150
5	Ang Mo Kio	Sembawang Hills	210	320	400	450	500	500	340	300	370	550	540	550	480	410	360	230	150	100	60
6	Ang Mo Kio	Shangri-La	560	570	640	700	860	970	1030	980	1010	1190	1200	1390	1280	1200	970	630	430	250	130
7	Ang Mo Kio	Tagore	200	300	390	460	590	680	500	330	430	580	580	660	720	560	390	210	190	110	70
8	Ang Mo Kio	Townsville	670	870	930	830	890	1310	1410	1420	1640	1580	1370	1570	1650	1530	1430	890	700	360	190
9	Ang Mo Kio	Yio Chu Kang	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	Ang Mo Kio	Yio Chu Kang East	160	180	210	260	300	320	240	250	260	320	290	340	390	270	200	120	80	50	30
11	Ang Mo Kio	Yio Chu Kang N...	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	Ang Mo Kio	Yio Chu Kang W...	740	950	1190	1340	1470	1520	1400	1500	1720	1910	1850	1950	1900	1820	1380	650	480	250	100
13	Bedok	Bayshore	340	490	480	440	360	310	350	550	770	860	650	520	400	360	290	130	90	50	50
14	Bedok	Bedok North	2700	3090	3450	4000	4760	5630	5290	5120	5680	5970	6030	6940	6590	5990	4940	2560	1750	980	540
15	Bedok	Bedok Reservoir	1090	1270	1400	1510	1500	1600	1850	1900	2090	2120	1920	1840	1790	1540	1040	470	330	170	100
16	Bedok	Bedok South	1440	1720	2150	2310	2750	3150	2930	2710	3080	3500	3450	3740	3730	3380	2830	1660	1240	750	410

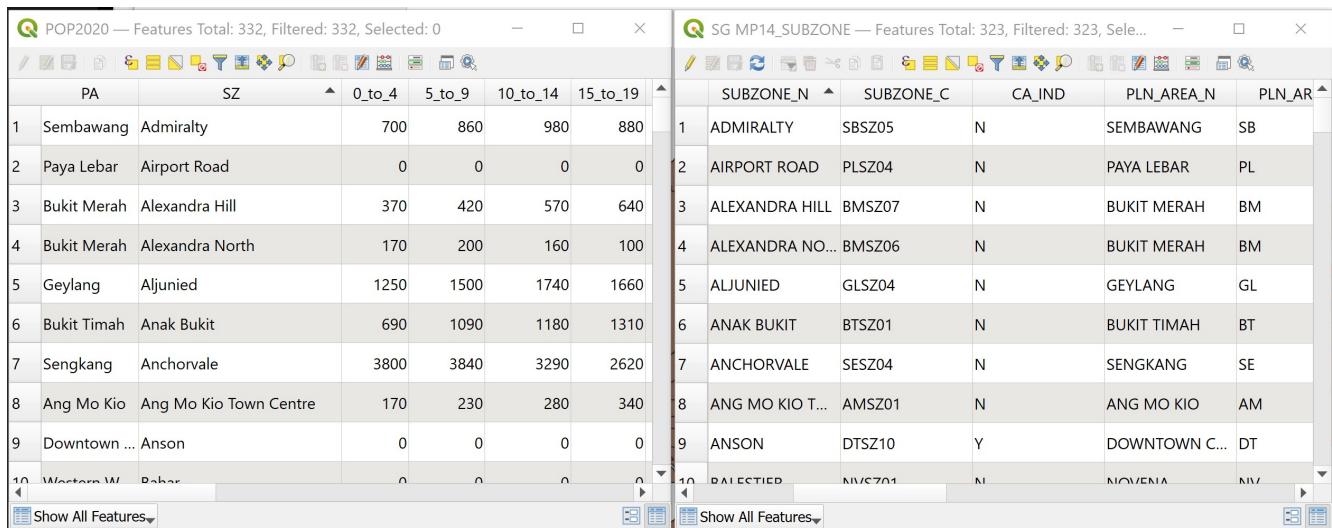
17	Bedok	Frankel	1460	2070	2070	1820	1810	2040	2000	2360	2960	3180	2500	2280	2110	1880	1610	850	750	470	290
18	Bedok	Kaki Bukit	1200	1250	1580	1940	2520	3150	2840	2290	2280	2470	2460	3230	3500	2760	1910	820	580	270	180
19	Bedok	Kembangan	1390	1360	1490	1800	2010	2620	2810	2530	2310	2520	2650	2930	3240	2760	2180	1270	850	520	340
20	Bedok	Siglap	160	250	250	310	360	400	360	320	430	520	450	460	500	430	480	300	250	140	70

6.2 Creating relational join

Now you are ready to perform relational join between the MP14_SubZone GIS layer and the POP2020 attribute layer.

In order to join the attribute table of a geospatial data and an aspatial attribute table, we need to identify the common key or popularly known as **unique identifier** between these two datasets.

DIY: Using the steps you had learned, open the attribute table of MP14_SubZone and POP2020.



The screenshot shows two attribute tables side-by-side. The left table, titled 'POP2020 — Features Total: 332, Filtered: 332, Selected: 0', has columns PA, SZ, and five numerical columns (0_to_4, 5_to_9, 10_to_14, 15_to_19). The right table, titled 'SG MP14_SUBZONE — Features Total: 323, Filtered: 323, Selected: 0', has columns SUBZONE_N, SUBZONE_C, CA_IND, PLN_AREA_N, and PLN_AR. Both tables have a toolbar at the top with various icons for editing and querying.

	PA	SZ	0_to_4	5_to_9	10_to_14	15_to_19
1	Sembawang	Admiralty	700	860	980	880
2	Paya Lebar	Airport Road	0	0	0	0
3	Bukit Merah	Alexandra Hill	370	420	570	640
4	Bukit Merah	Alexandra North	170	200	160	100
5	Geylang	Aljunied	1250	1500	1740	1660
6	Bukit Timah	Anak Bukit	690	1090	1180	1310
7	Sengkang	Anchorage	3800	3840	3290	2620
8	Ang Mo Kio	Ang Mo Kio Town Centre	170	230	280	340
9	Downtown ...	Anson	0	0	0	0
10	Western ...	Bukit	0	0	0	0

	SUBZONE_N	SUBZONE_C	CA_IND	PLN_AREA_N	PLN_AR
1	ADMIRALTY	SBSZ05	N	SEMBAWANG	SB
2	AIRPORT ROAD	PLSZ04	N	PAYA LEBAR	PL
3	ALEXANDRA HILL	BMSZ07	N	BUKIT MERAH	BM
4	ALEXANDRA NO...	BMSZ06	N	BUKIT MERAH	BM
5	ALJUNIED	GLSZ04	N	GEYLANG	GL
6	ANAK BUKIT	BTSZ01	N	BUKIT TIMAH	BT
7	ANCHORAGE	SESZ04	N	SENGKANG	SE
8	ANG MO KIO T...	AMSZ01	N	ANG MO KIO	AM
9	ANSON	DTSZ10	Y	DOWNTOWN C...	DT
10	BALESTIER	MVSZ01	N	NOVENA	NV

With reference to the tables above, the **SZ** field of **POP2020** and **SUBZONE_N** field of **MP14_SUBZONE** can be used as the unique identifier field. However, if you examine the data carefully, there is a problem we should be noted, that is strings in **SUBZONE_N** are all uppercase. On the other hand, strings in **SZ** field are made up of upper- and lowercases.

In view of this problem, we will create a new few to change strings in **SZ** into uppercase. We will call the output field **SUBZONE**.

- At the **POP2020 Feature Table**, click on **Open field calculator** icon 

The **Field Calculator** dialog window appears.

- For **Output field name**, type **SUBZONE**.
- For **Output file type**, select **Text(string)** from the drop-down list.
- At the Expression panel, type as shown below.

POP2020 — Field Calculator

Only update 0 selected features

Create a new field

Create virtual field

Output field name: SUBZONE

Output field type: Text (string)

Output field length: 0 Precision: 3

Update existing field

Expression Function Editor

Icon bar: 

Code preview: `upper("SZ")`

Best practice: This is always a good practice to check the preview to ensure that the result is inline to what you want.

- Click on **OK** button when you are ready.

Notice that a new field called SUBZONE has been added into POP2020 data table the strings are all in uppercase.

	55_to_69	70_to_74	75_to_79	80_to_84	85_to_89	90_and_over	SUBZONE
1	560	370	240	160	100		30 ADMIRALTY
2	0	0	0	0	0		0 AIRPORT ROAD
3	1070	950	540	420	280		160 ALEXANDRA HILL
4	60	40	30	20	10		0 ALEXANDRA NO...
5	2620	2080	1170	970	580		400 ALJUNIED
6	1410	1090	640	490	270		140 ANAK BUKIT
7	1740	1210	630	340	150		90 ANCHORVALE
8	250	240	130	100	30		10 ANG MO KIO T...
9	0	0	0	0	0		0 ANSON
10	0	0	0	0	0		0 BAHAR

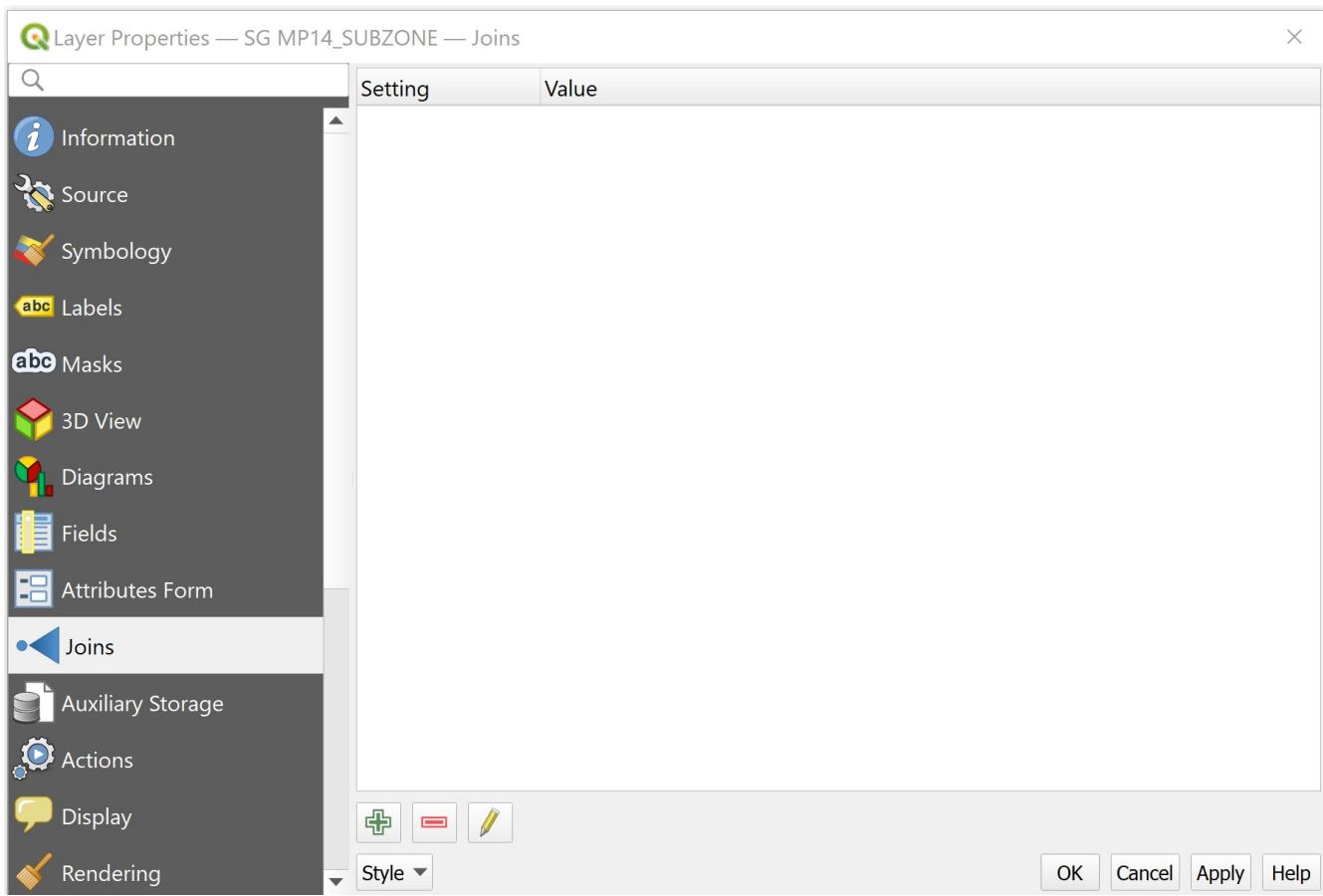
You are ready to join both tables now.

- From the **Layers** panel, double-click on **MP14_SubZone** vector layer.

The **Layer Properties** dialog window appears.

- From the **Tab** menu, click on the **Joins** tab.

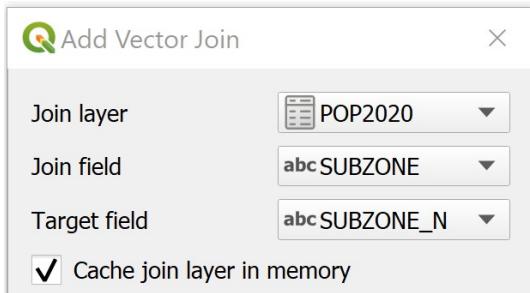
Your screen should look similar to the figure below.



- Click on Add new join icon

The **Add Vector Join** dialog window appears.

- For **Join Layer**, select **POP2020** from the drop-down list.
- For **Join field**, select **SUBZONE** from the drop-down list.
- For **Target field**, select **SUBZONE_N** from the drop-down list.



- Click on **OK** button to perform the relational join.

You will return to the **Layer Properties** dialog window.

Notice that a relational joined between **POP2020** attribute table and the attribute table of **MP14_SubZone** has been created.

- At the **Layer Properties** dialog window, click on the OK button.

Strange, it seems that nothing had happen!

- At the **Layers** panel, right click on MP14_SubZone layer and select **Open Attribute Table** from the context menu.

You will notice that the table now contains additional fields from POP2020 attribute layer.

	_to_24	POP2020_25_to_29	POP2020_30_to_34	POP2020_35_to_39	POP2020_40_to_44	POP2020_45_to_49	POP2020_50_to_54	POP2020_55_to_59	POP2020_60_to_64	POP2020_65_to_69	POP2020_70_to_74
1	800	830	990	1210	1230	1310	970	920	820	560	370
2	0	0	0	0	0	0	0	0	0	0	0
3	800	870	850	730	740	970	960	1090	1130	1070	950
4	90	130	240	330	330	300	180	130	100	60	40
5	1930	2840	3000	2980	2990	3260	2860	3100	3130	2620	2080
6	1430	1670	1310	1260	1360	1640	1610	1590	1740	1410	1090
7	2040	2470	4700	5250	4520	4160	2670	2380	2280	1740	1210
8	270	260	310	330	400	480	380	310	290	250	240
9	0	0	0	0	0	0	0	0	0	0	0
10	1620	2010	2430	2400	2530	2750	2410	2320	2230	1900	1630
11	1510	1900	1580	1240	1340	1550	1730	2200	2030	1460	970
12	0	0	0	0	0	0	0	0	0	0	0
13	360	310	350	550	770	860	650	520	400	360	290
14	4760	5630	5290	5120	5680	5970	6030	6940	6590	5990	4940
15	1500	1600	1850	1900	2090	2120	1920	1840	1790	1540	1040

Remember that this join is temporary. It is not part of the attribute table of MP14_SubZone layer, but is just linked dynamically to the POP2020 attribute layer. If you want to permanently join the attributes, you must save it as a new layer.

6.3 Creating a choropleth map

In this section, you will learn how to create a choropleth map showing the distribution of population age 65 and above by URA's Master Plan 2014 subzone area.

First, you will create a new field called Age65+ and compute its value by using the calculator function of QGIS.

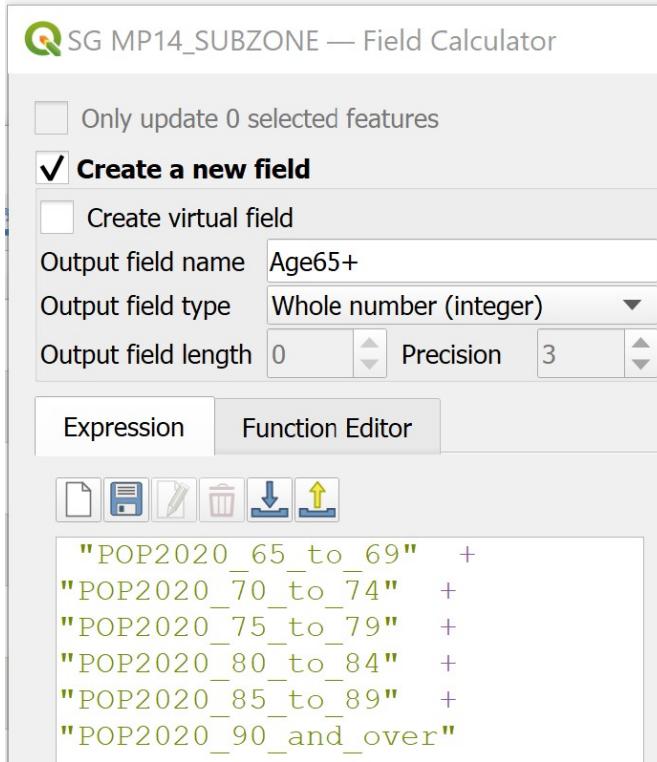
- From **Layers** Panel, right-click on MP14_SubZone, select **Open Attribute Table** from the context menu.

The MP14_SubZone attribute table appears.

- Click on **Open Field Calculator** icon

The Field calculator dialog window appears.

- Keep **Create a new field** box check.
- For **Output filed name**, type *Age65+*.
- For **Output field type**, select *Whole number (integer)* from the drop-down list.
- At the **Expression** panel, build a formula as shown below.



Gentle reminder: Check the preview to ensure that the result is what you want.

To perform the computation,

- Click on the **OK** button.

Notice that a new field called Age65+ has been added into the attribute table of MP14_SubZone table.

SG MP14_SUBZONE — Features Total: 323, Filtered: 323, Selected: 0									
123fid	=	123	Update All	Update Selected					
1	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0
3	480	410	360	230	150	100	60	1310	
4	720	560	390	210	190	110	70	1530	
5	1280	1200	970	630	430	250	130	3610	
6	1900	1820	1380	650	480	250	100	4680	
7	1650	1530	1430	890	700	360	190	5100	
8	1780	1710	1450	830	630	350	150	5120	

9	2110	2180	1750	960	650	340	170	6050
10	2150	2100	1800	1120	800	430	220	6470

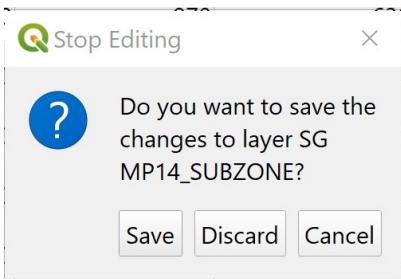


Show All Features 

Before you end this session, you need to save the results into the attribute table permanently.

- From the icon bar, click on the Toggle editing mode icon .

The Stop Editing dialog appears.



- Click on **Save** button.
- Close the attribute table of `MP14_SubZone` layer.

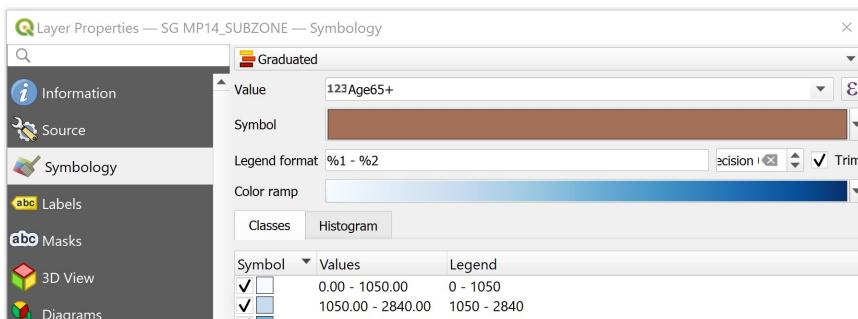
You are ready to prepare the choropleth now.

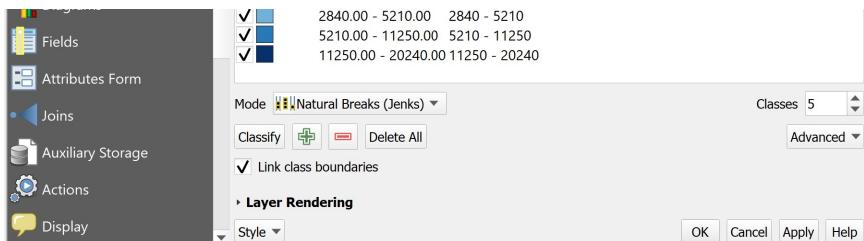
- From the **Layers** panel, double-click on **MP14_SubZone** layer.

The **Layer Properties** dialog window appears.

- Click on **Symbology** tab.
- At **Symbol** selection drop-down list, select **Graduated** from the drop-down list.
- For **Value**, select *Age65+* from the drop-down list.
- For **Classes**, keep it as *5*.
- For **Color ramp**, choose *Blues* or any colour of your choice from the drop-down list.
- For **Mode**, choose **Natural Breaks (Jenks)** from the drop-down list. • Click on **Classify** button.

Your screen should look similar to the figure below.

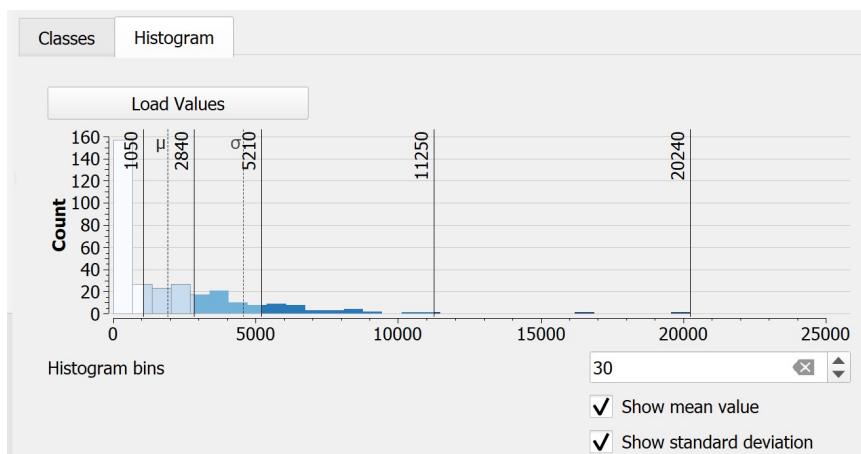




You can review the statistical distribution of the classification in histogram.

- Click on the **Histogram** tab.
- Click on **Load values** button.

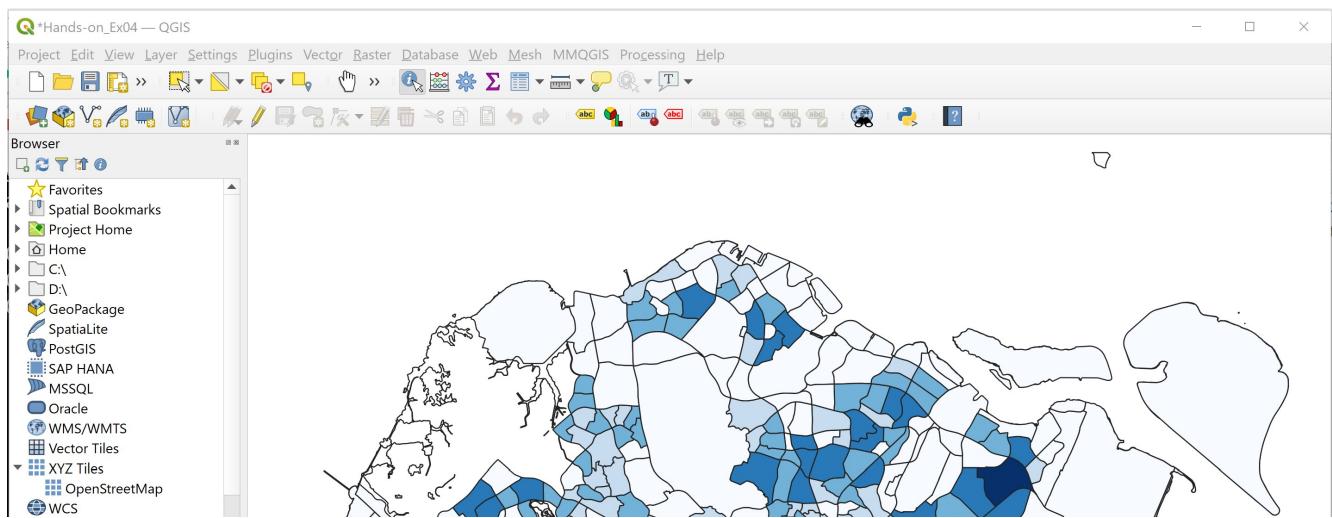
Your screen should look similar to the figure below.

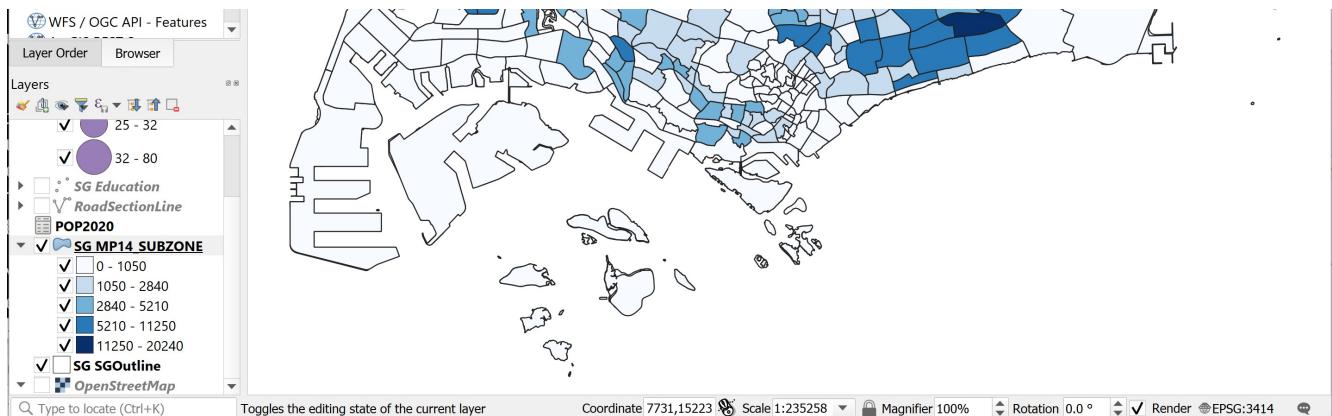


This feature is very useful for casual data analyst because the histogram helps us to understand the differences of each classification method.

- Click back **Classes** tab.
- Click on **Apply** button.
- Click on the **OK** button.

Your screen should look similar to the figure below.





Challenge: Study the distribution reveals by the choropleth map. Can you identify planning subzones with high concentration of population with age 65 and above? Are these subzone tend to clusters together or randomly distributed?

DIY: Use the steps you had learned from previous sections, create a choropleth maps of percentage of population age 65 and above.

Challenge: Compare the two choropleth maps prepared, what conclusion can you draw from the maps?