Hands-on Exercise 7: Visualising Geospatial Point Data

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1 Overview

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 hands-on exercise, you will learn how to create a proportional symbol map showing the number of wins by Singapore Pools' outlets using an R package called **tmap**.

1.1 Learning outcome

By the end of this hands-on exercise, you will acquire the following skills by using appropriate R packages:

- To import an aspatial data file into R.
- To convert it into simple point feature data frame and at the same time, to assign an appropriate projection reference to the newly create simple point feature data frame.
- To plot interactive proportional symbol maps.

2 Getting Started

Before we get started, we need to ensure that **tmap** package of R and other related R packages have been installed and loaded into R.

```
pacman::p_load(sf, tmap, tidyverse)
```

3 Geospatial Data Wrangling

3.1 The data

The data set use for this hands-on exercise is called *SGPools_svy21*. The data is in csv file format.

Figure below shows the first 15 records of SGPools_svy21.csv. It consists of seven columns. The XCOORD and YCOORD columns are the x-coordinates and y-coordinates of SingPools outlets and branches. They are in Singapore SVY21 Projected Coordinates System.

	NAME	ADDRESS	POSTCODE	XCOORD	YCOORD	OUTLET TYPE	Gp1Gp2 Winnings
1	Livewire (Marina Bay Sands)	2 Bayfront Avenue, #01-01 The Shoppes at Marina Bay Sand...	18972	30841.56	29598.56	Branch	5
2	Livewire (Resorts World Sentosa)	26 Sentosa Gateway #B1-208 Singapore 098138	98138	26703.87	26525.70	Branch	11
3	SportsBuzz (Kranji)	Lotus Lounge, Level 2, 1 Turf Club Avenue Singapore Racec...	738078	20117.93	44888.06	Branch	0
4	SportsBuzz (PoMo)	1 Selegie Rd PoMo #01-01 Singapore 188306	188306	29776.95	31382.18	Branch	44
5	Prime Serangoon North	Blk 542B Serangoon North Ave 3 #02-01 Singapore 552542	552542	32238.69	39518.76	Branch	0
6	Singapore Pools Woodlands Centre	1A Woodlands Centre Road #01-26 Singapore 731001	731001	21012.15	46987.32	Branch	3

3.2 Data Import and Preparation

The code chunk below uses *read_csv()* function of **readr** package to import *SGPools_svy21.csv* into R as a tibble data frame called *sgpools*.

```
sgpools <- read_csv("data/aspatial/SGPools_svy21.csv")
```

After importing the data file into R, it is important for us to examine if the data file has been imported correctly.

The code chunk below shows list() is used to do the job.

```
list(sgpools)
```

```
[[1]]
# A tibble: 306 × 7
   NAME                          ADDRESS POSTC…¹ XCOORD YCOORD OUTLE…² Gp1Gp…³
   <chr>                         <chr>     <dbl>  <dbl>  <dbl> <chr>     <dbl>
 1 Livewire (Marina Bay Sands)   2 Bayf…   18972 30842. 29599. Branch        5
 2 Livewire (Resorts World Sentos… 26 Sen…   98138 26704. 26526. Branch       11
 3 SportsBuzz (Kranji)           Lotus …  738078 20118. 44888. Branch        0
 4 SportsBuzz (PoMo)             1 Sele…  188306 29777. 31382. Branch       44
 5 Prime Serangoon North         Blk 54…  552542 32239. 39519. Branch        0
 6 Singapore Pools Woodlands Cent… 1A Woo…  731001 21012. 46987. Branch        3
 7 Singapore Pools 64 Circuit Rd … Blk 64…  370064 33990. 34356. Branch       17
 8 Singapore Pools 88 Circuit Rd … Blk 88…  370088 33847. 33976. Branch       16
 9 Singapore Pools Anchorvale Rd … Blk 30…  540308 33910. 41275. Branch       21
10 Singapore Pools Ang Mo Kio N2 … Blk 20…  560202 29246. 38943. Branch       25
# … with 296 more rows, and abbreviated variable names ¹POSTCODE,
#   ²`OUTLET TYPE`, ³`Gp1Gp2 Winnings`
```

Notice that the *sgpools* data in tibble data frame and not the common R data frame.

3.3 Creating a **sf** data frame from an aspatial data frame

The code chunk below converts sgpools data frame into a simple feature data frame by using *st_as_sf()* of **sf** packages

```
sgpools_sf <- st_as_sf(sgpools,
                       coords = c("XCOORD", "YCOORD"),
                       crs= 3414)
```

Things to learn from the arguments above:

- The *coords* argument requires you to provide the column name of the x-coordinates first then followed by the column name of the y-coordinates.
- The *crs* argument required you to provide the coordinates system in epsg format. EPSG: 3414 is Singapore SVY21 Projected Coordinate System. You can search for other country's epsg code by refering to epsg.io.

Figure below shows the data table of *sgpools_sf*. Notice that a new column called geometry has been added into the data frame.

	NAME	ADDRESS	POSTCODE	OUTLET TYPE	Gp1Gp2 Winnings	geometry
1	Livewire (Marina Bay Sands)	2 Bayfront Avenue, #01-01 The Shoppes at Marina Bay Sand...	18972	Branch	5	POINT (30841.56 29598.56)
2	Livewire (Resorts World Sentosa)	26 Sentosa Gateway #B1-208 Singapore 098138	98138	Branch	11	POINT (26703.87 26525.7)
3	SportsBuzz (Kranji)	Lotus Lounge, Level 2, 1 Turf Club Avenue Singapore Racec...	738078	Branch	0	POINT (20117.93 44888.06)
4	SportsBuzz (PoMo)	1 Selegie Rd PoMo #01-01 Singapore 188306	188306	Branch	44	POINT (29776.95 31382.18)
5	Prime Serangoon North	Blk 542B Serangoon North Ave 3 #02-01 Singapore 552542	552542	Branch	0	POINT (32238.69 39518.76)
6	Singapore Pools Woodlands Centre	1A Woodlands Centre Road #01-26 Singapore 731001	731001	Branch	3	POINT (21012.15 46987.32)
7	Singapore Pools 64 Circuit Rd Branch	Blk 64 Circuit Rd #01-355 Singapore 370064	370064	Branch	17	POINT (33990.39 34355.53)
8	Singapore Pools 88 Circuit Rd Branch	Blk 88 Circuit Rd #01-961 Singapore 370088	370088	Branch	16	POINT (33847.38 33976.04)
9	Singapore Pools Anchorvale Rd Branch	Blk 308 Anchorvale Rd #01-05 Singapore 540308	540308	Branch	21	POINT (33909.93 41274.52)
10	Singapore Pools Ang Mo Kio N2 Branch	Blk 202 Ang Mo Kio Ave 3 #01-1662/1664 Singapore 5602...	560202	Branch	25	POINT (29246.06 38942.6)

You can display the basic information of the newly created sgpools_sf by using the code chunk below.

```
list(sgpools_sf)
```

```
[[1]]
Simple feature collection with 306 features and 5 fields
Geometry type: POINT
Dimension:     XY
Bounding box:  xmin: 7844.194 ymin: 26525.7 xmax: 45176.57 ymax: 47987.13
Projected CRS: SVY21 / Singapore TM
# A tibble: 306 × 6
   NAME                ADDRESS POSTC…¹ OUTLE…² Gp1Gp…³            geometry
 * <chr>               <chr>     <dbl> <chr>     <dbl>         <POINT [m]>
 1 Livewire (Marina B… 2 Bayf…   18972 Branch        5 (30841.56 29598.56)
 2 Livewire (Resorts … 26 Sen…   98138 Branch       11  (26703.87 26525.7)
```

```
 3 SportsBuzz (Kranji) Lotus …  738078 Branch        0 (20117.93 44888.06)
 4 SportsBuzz (PoMo)   1 Sele…  188306 Branch       44 (29776.95 31382.18)
 5 Prime Serangoon No… Blk 54…  552542 Branch        0 (32238.69 39518.76)
 6 Singapore Pools Wo… 1A Woo…  731001 Branch        3 (21012.15 46987.32)
 7 Singapore Pools 64… Blk 64…  370064 Branch       17 (33990.39 34355.53)
 8 Singapore Pools 88… Blk 88…  370088 Branch       16 (33847.38 33976.04)
 9 Singapore Pools An… Blk 30…  540308 Branch       21 (33909.93 41274.52)
10 Singapore Pools An… Blk 20…  560202 Branch       25  (29246.06 38942.6)
# … with 296 more rows, and abbreviated variable names ¹POSTCODE,
#   ²`OUTLET TYPE`, ³`Gp1Gp2 Winnings`
```

The output shows that sgppols_sf is in point feature class. It's epsg ID is 3414. The bbox provides information of the extend of the geospatial data.

4 Drawing Proportional Symbol Map

To create an interactive proportional symbol map in R, the view mode of tmap will be used.

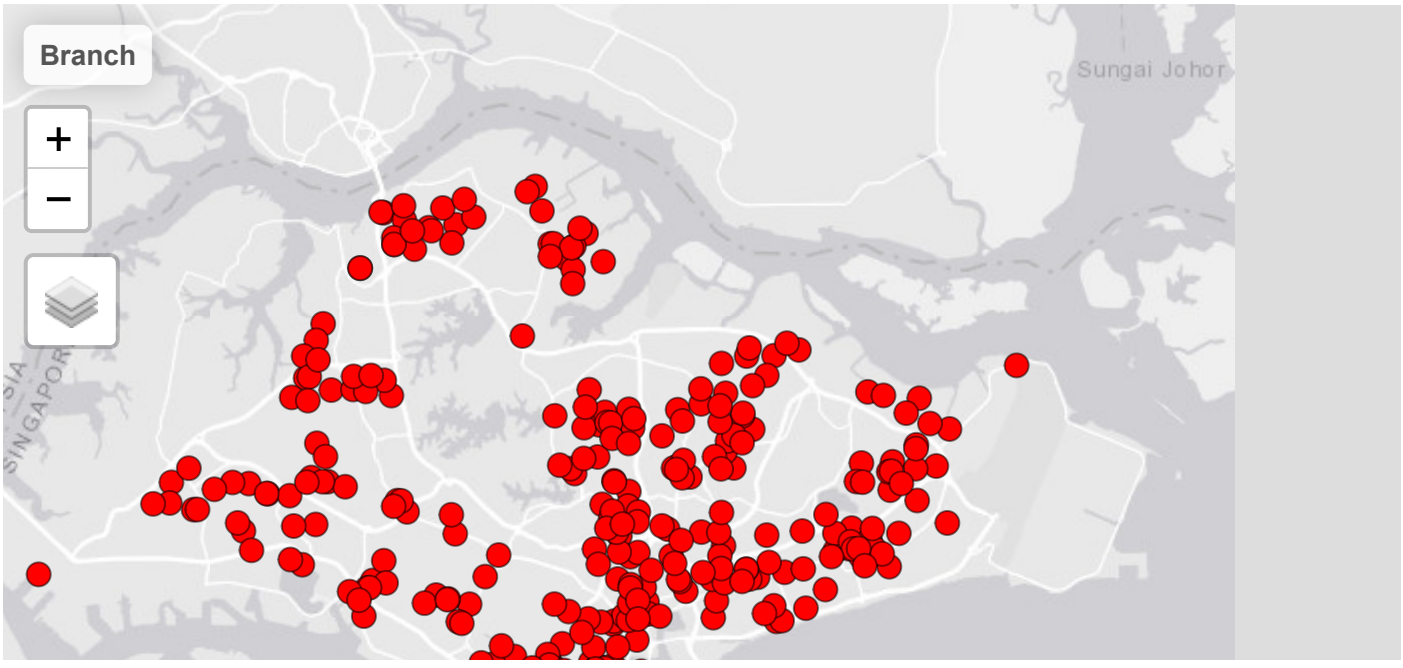
The code churn below will turn on the interactive mode of tmap.

```
tmap_mode("view")
```

4.1 It all started with an interactive point symbol map

The code chunks below are used to create an interactive point symbol map.

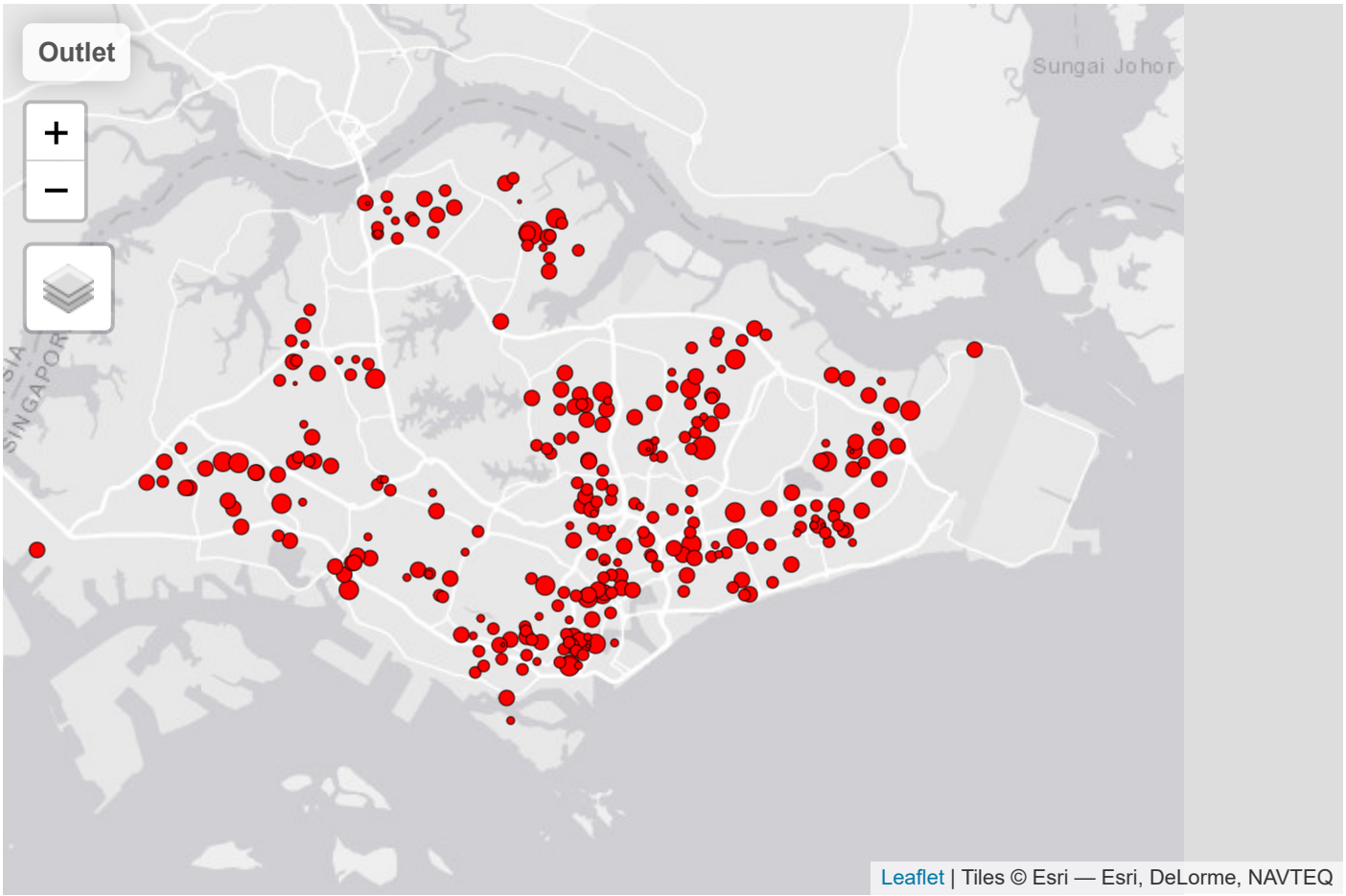
```
tm_shape(sgpools_sf)+
tm_bubbles(col = "red",
           size = 1,
           border.col = "black",
           border.lwd = 1)
```



4.2 Lets make it proportional

To draw a proportional symbol map, we need to assign a numerical variable to the size visual attribute. The code chunks below show that the variable *Gp1Gp2Winnings* is assigned to size visual attribute.

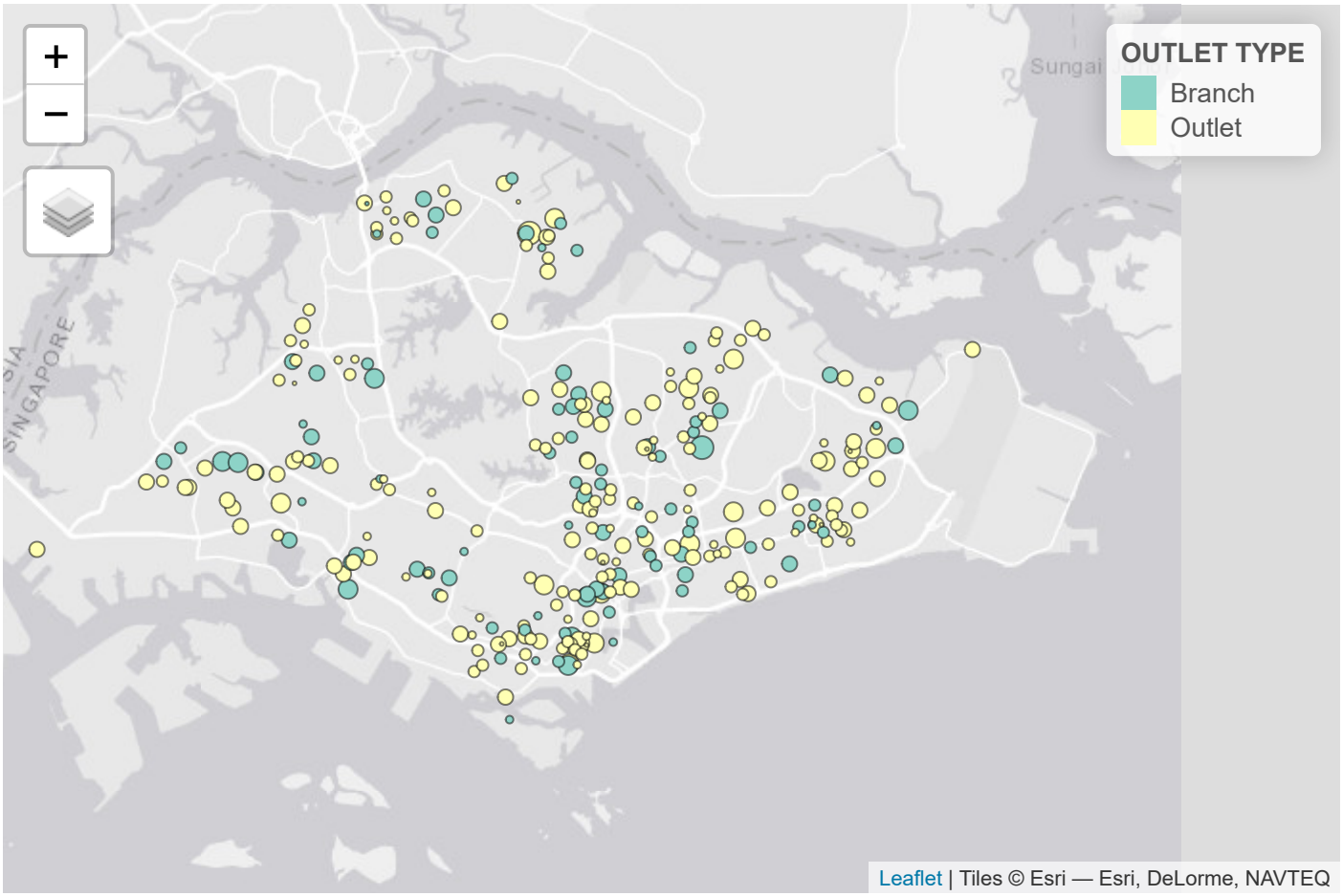
```
tm_shape(sgpools_sf)+
tm_bubbles(col = "red",
           size = "Gp1Gp2 Winnings",
           border.col = "black",
           border.lwd = 1)
```



4.3 Lets give it a different colour

The proportional symbol map can be further improved by using the colour visual attribute. In the code chunks below, *OUTLET_TYPE* variable is used as the colour attribute variable.

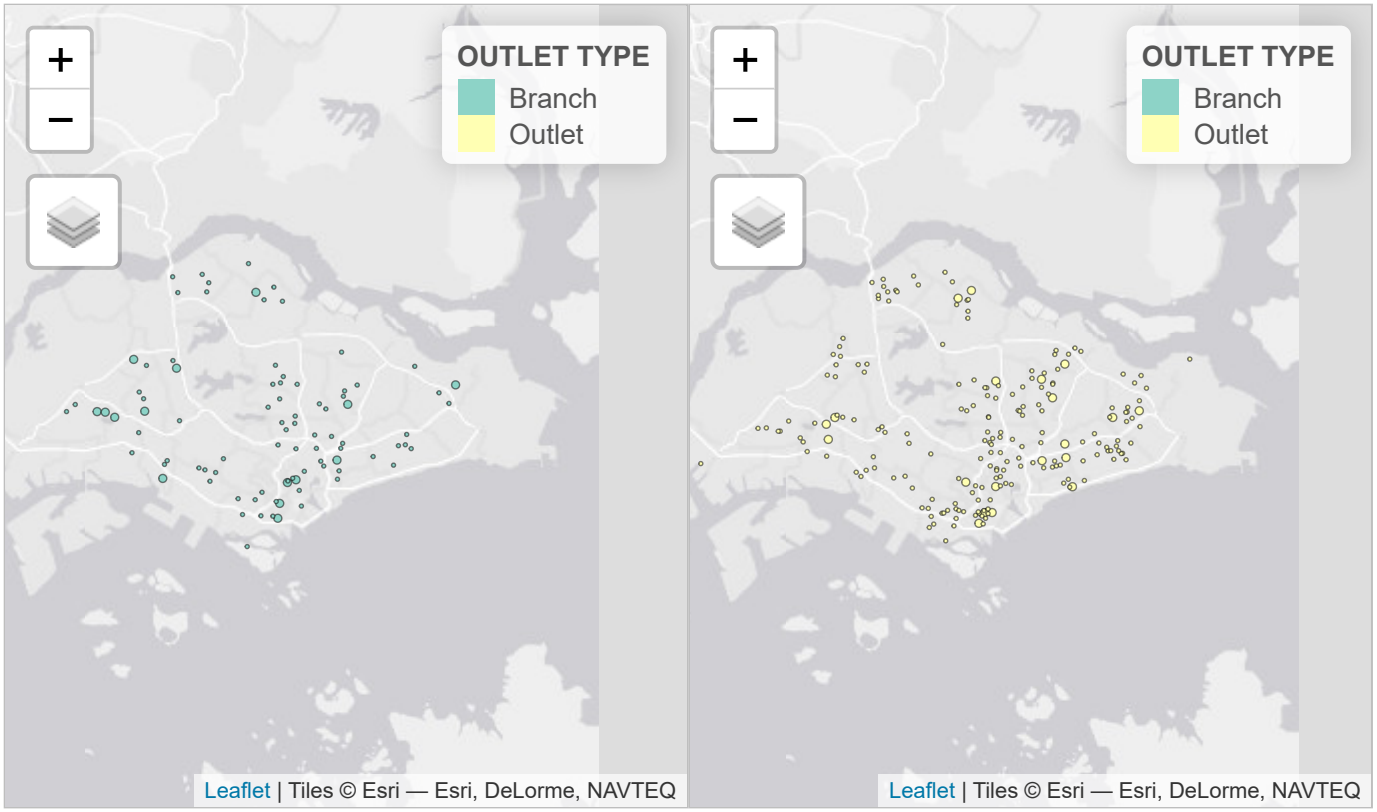
```
tm_shape(sgpools_sf)+
tm_bubbles(col = "OUTLET TYPE",
           size = "Gp1Gp2 Winnings",
           border.col = "black",
           border.lwd = 1)
```



4.4 I have a twin brothers :)

An impressive and little-know feature of **tmap**'s view mode is that it also works with faceted plots. The argument *sync* in *tm_facets()* can be used in this case to produce multiple maps with synchronised zoom and pan settings.

```
tm_shape(sgpools_sf) +
  tm_bubbles(col = "OUTLET TYPE",
           size = "Gp1Gp2 Winnings",
           border.col = "black",
           border.lwd = 1) +
  tm_facets(by= "OUTLET TYPE",
            nrow = 1,
            sync = TRUE)
```



Before you end the session, it is wiser to switch **tmap**'s Viewer back to plot mode by using the code chunk below.

```
tmap_mode("plot")
```

5 Reference

5.1 All about **tmap** package

- tmap: Thematic Maps in R
- tmap
- tmap: get started!
- tmap: changes in version 2.0
- tmap: creating thematic maps in a flexible way (useR!2015)
- Exploring and presenting maps with tmap (useR!2017)

5.2 Geospatial data wrangling

- sf: Simple Features for R
- Simple Features for R: StandardizedSupport for Spatial Vector Data
- Reading, Writing and Converting Simple Features

5.3 Data wrangling

- dplyr
- Tidy data
- tidyr: Easily Tidy Data with ‘spread()’ and ‘gather()’ Functions