

Lesson 6: Visualising Geographical Data

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What will you learn from this lesson?

- Introducing map
- Properties of geographical data
- Typology of map
- Thematic mapping techniques
- Alternative mapping techniques

What is a Map?

A map is a model of real world depict by a collection of cartographic symbols or/and visual abstraction.

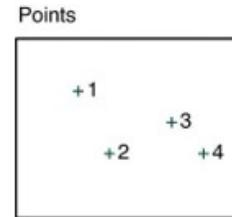


What is a Map?

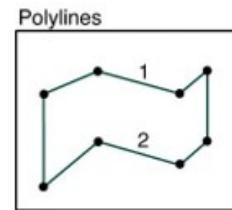
An interface between geographical data and map users.



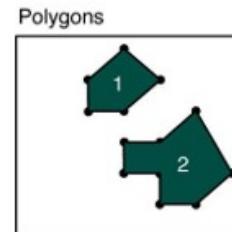
A Map and Geographical Data



Point number	(x,y) coordinates
1	(2,4)
2	(3,2)
3	(5,3)
4	(6,2)



Polyline number	(x,y) coordinates
1	(1,5) (3,6) (6,5) (7,6)
2	(1,1) (3,3) (6,2) (7,3)



Polygon number	(x,y) coordinates
1	(2,4) (2,5) (3,6) (4,5) (3,4) (2,4)
2	(3,2) (3,3) (4,3) (5,4) (6,2) (5,1) (4,1) (4,2) (3,2)

Types of geographical data

XCOORD	YCOORD	NAME
103.8589	1.2840	Livewire (Marina Bay Sands)
103.8574	1.2947	Singapore Pools Suntec City
103.8469	1.2835	Kis Store
103.8493	1.2829	Singapore Turf Club China Square
103.8521	1.2836	Tay Sui Lan Agency
103.8492	1.2861	7-Eleven Circular Rd
103.8440	1.2858	Singapore Pools People's Park Centre
103.8464	1.2850	Feng Yuen Agency Enterprise

Geospatial data

SUBZONE_C	TOTAL_POP	YOUNG
AMSZ01	4990	850
AMSZ02	30390	3950
AMSZ03	28650	3410
AMSZ04	24160	3260
AMSZ05	19190	2620
AMSZ06	24550	3050
AMSZ07	6860	1030
AMSZ08	8370	1200

Aspatial data

How location information are registered?

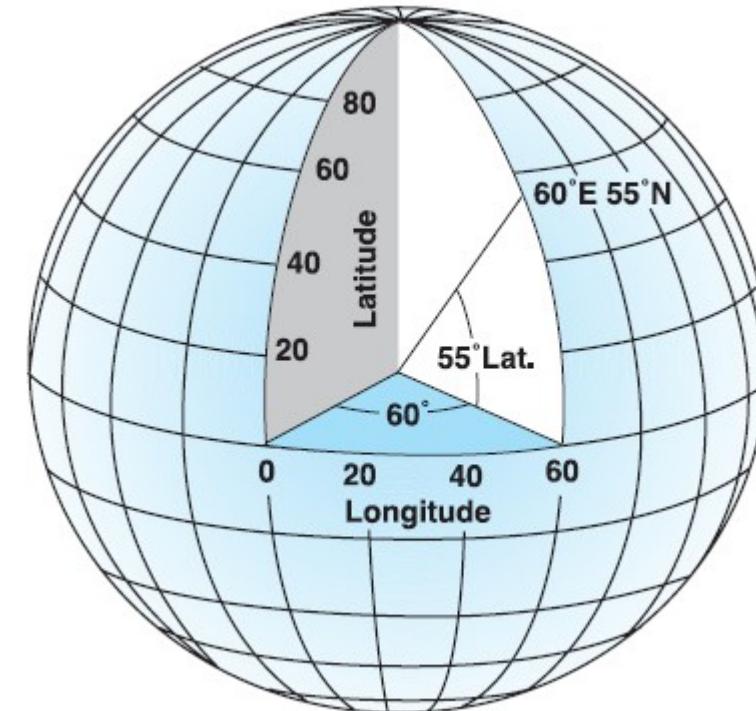
- Geographic Coordinates Systems
- Projected Coordinates Systems

How location information are registered?

Geographic Coordinates Systems

- A geographic coordinate system defines two-dimensional coordinates based on the Earth's surface. It has an angular unit of measure, prime meridian and datum (which contains the spheroid).
- For example, WGS84, NAD27 and NAD83.

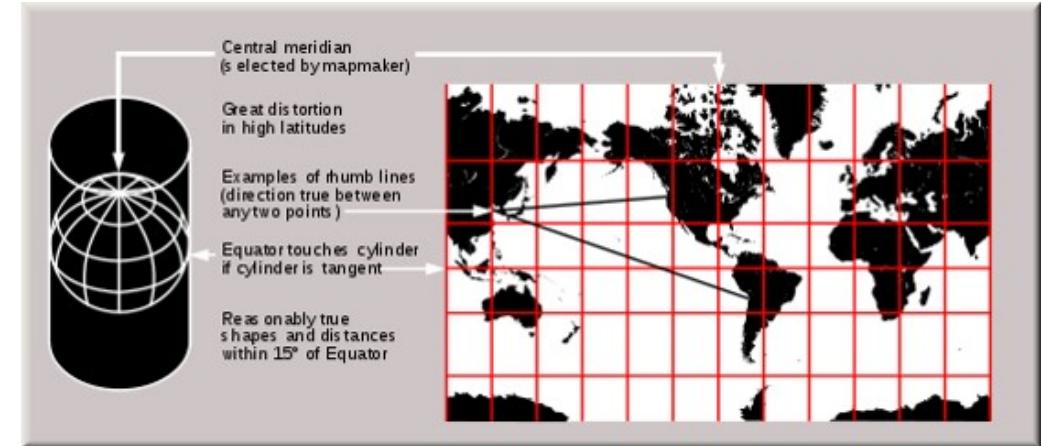
Source: https://en.wikipedia.org/wiki/Geographic_coordinate_system



How location information are registered?

Projected Coordinates Systems

- A projected coordinate system is defined on a flat, two-dimensional surface.
- A projected coordinate system, unlike a geographic one, has the advantage that lengths, angles, and areas are constant across the two dimensions. This is not true when working in a geographic coordinate system.
- A projected coordinate system is always based on a geographic coordinate system that can use a sphere or spheroid.



The Purpose of a Map

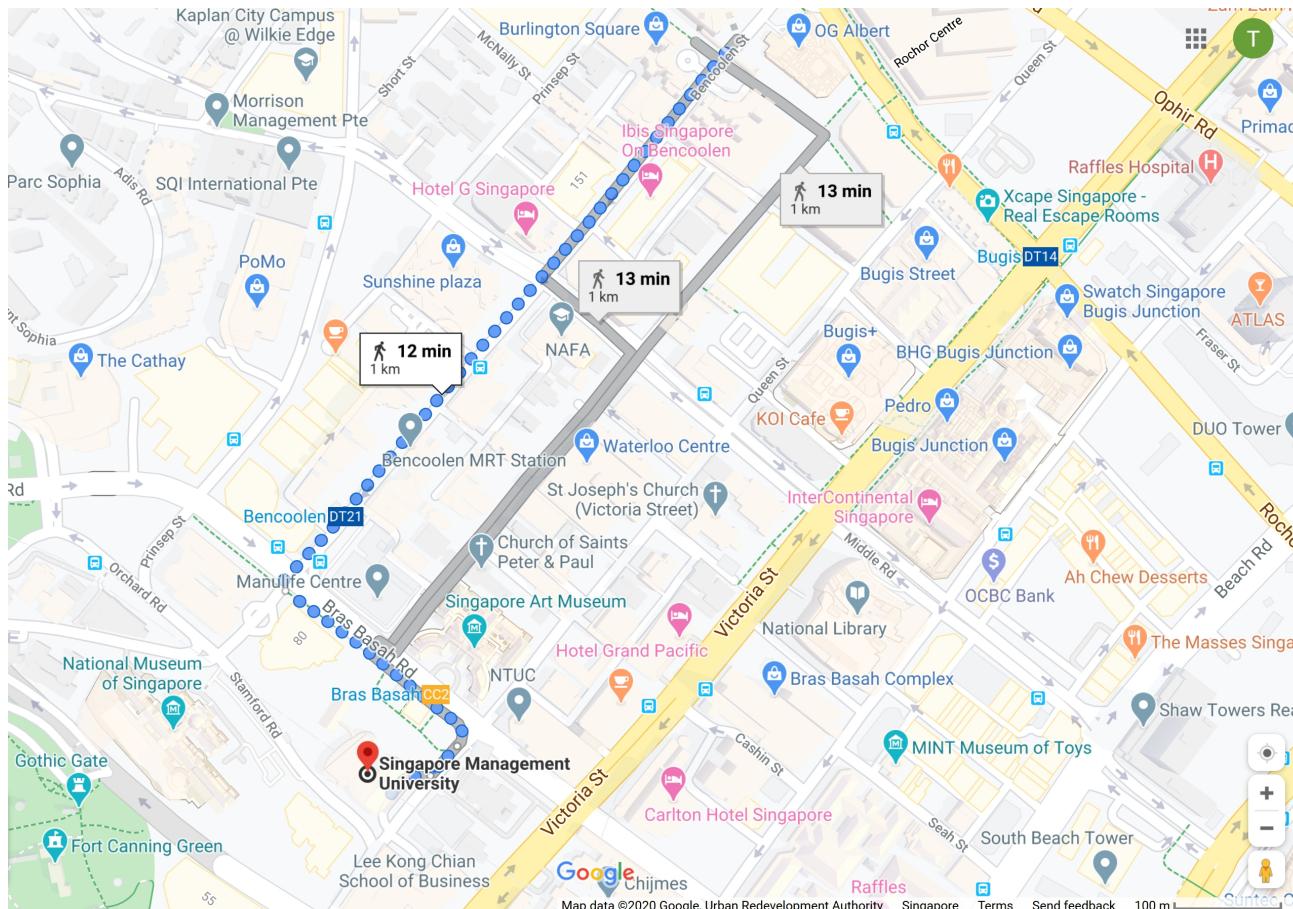
- To serve as a piece of historical archive



Reference: http://en.wikipedia.org/wiki/Battle_of_Singapore

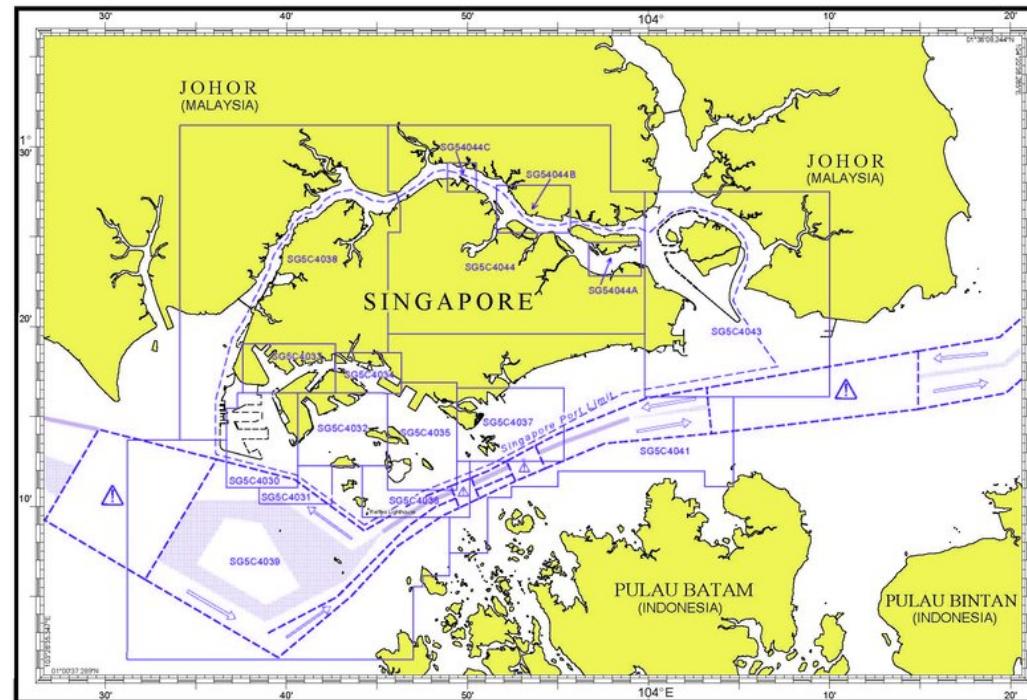
The Purpose of a Map

- To support navigation (i.e. Google Map)



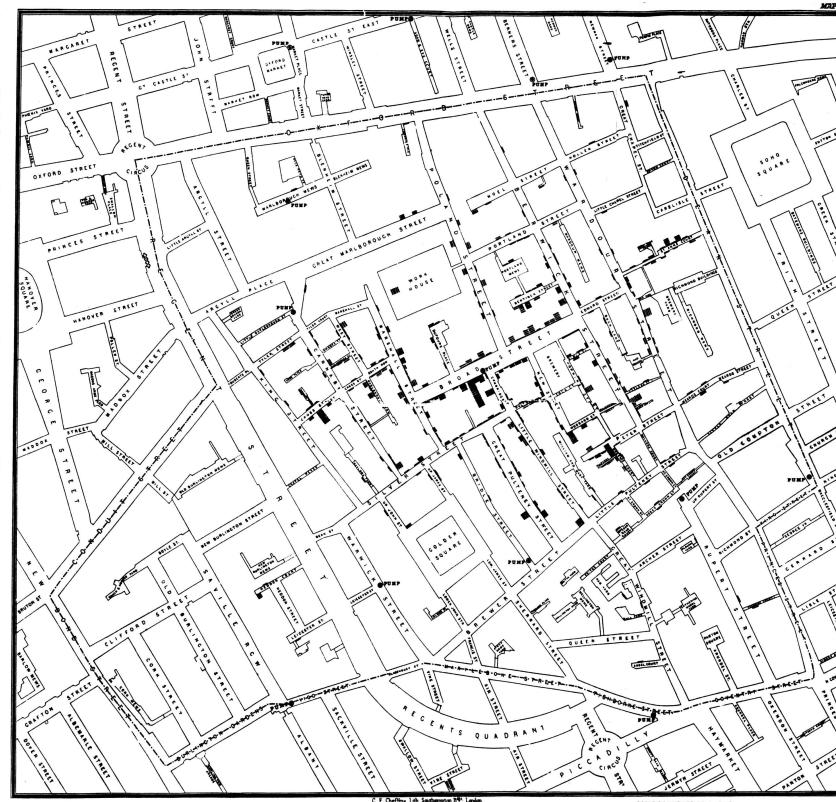
The Purpose of a Map

- To support navigation (i.e. sea chart of Singapore)



The Purpose of a Map

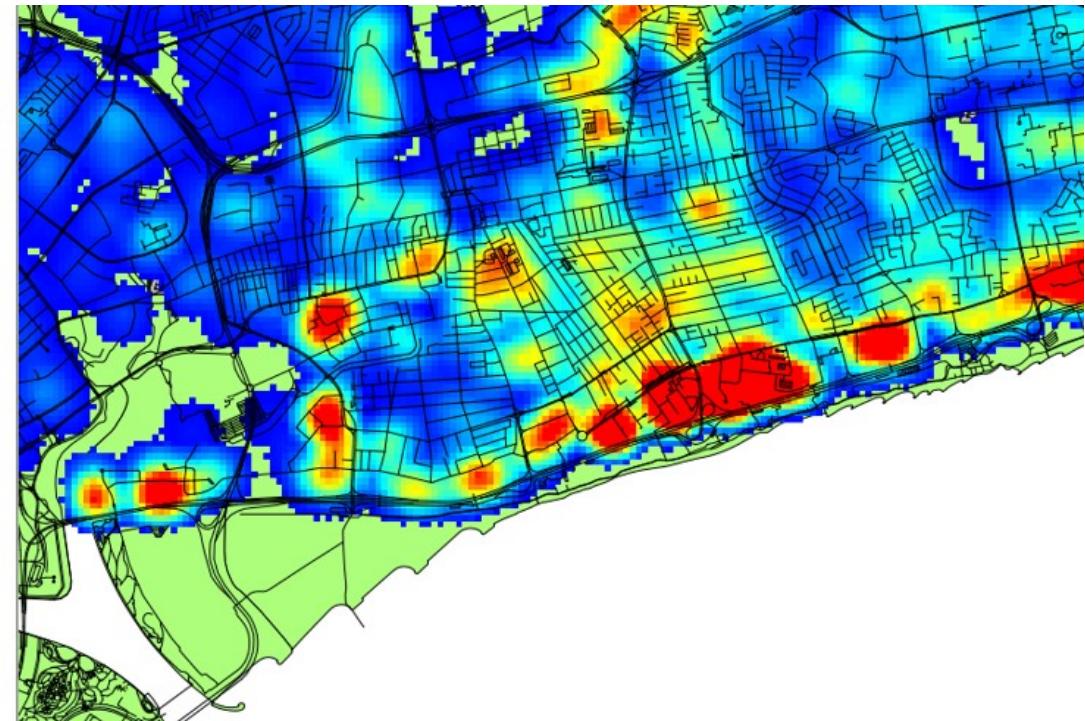
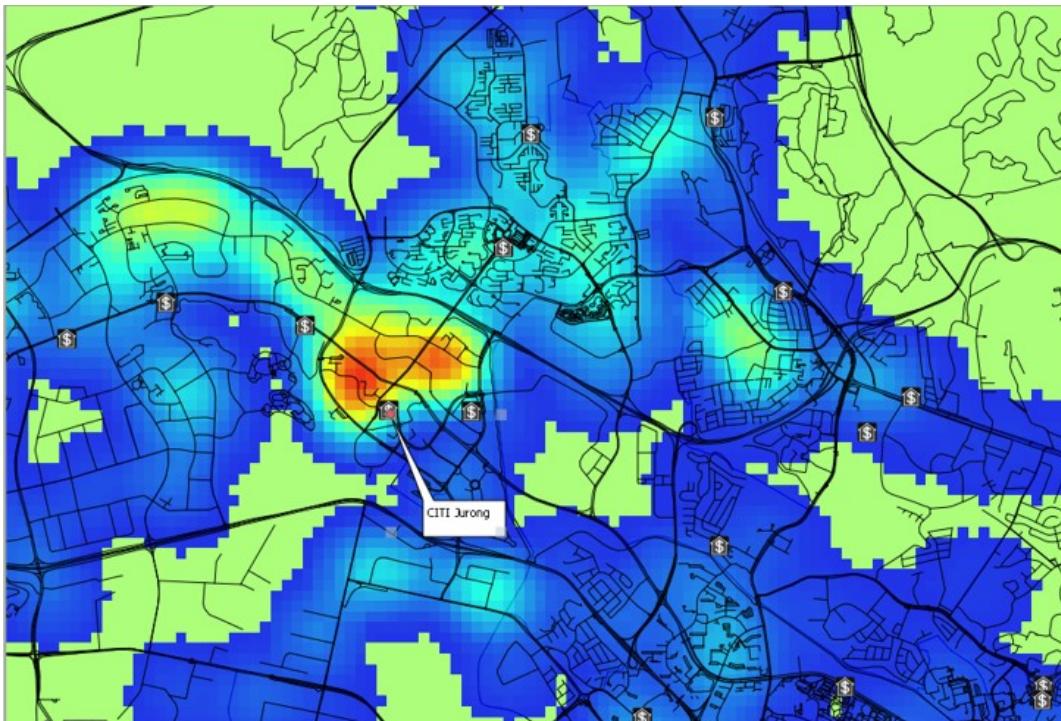
- To reveal spatial patterns.



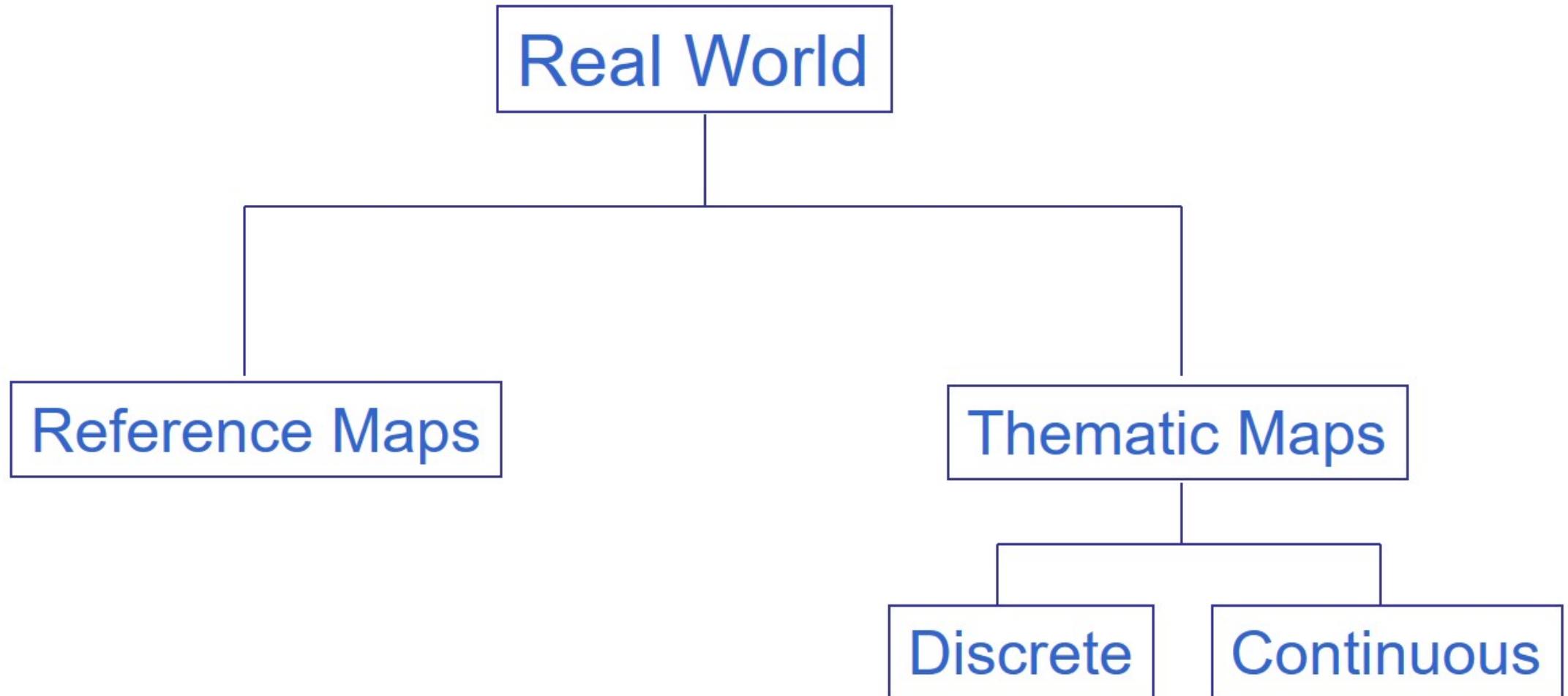
Reference: https://en.wikipedia.org/wiki/John_Snow

The Purpose of a Map

- To describe spatial relationship.

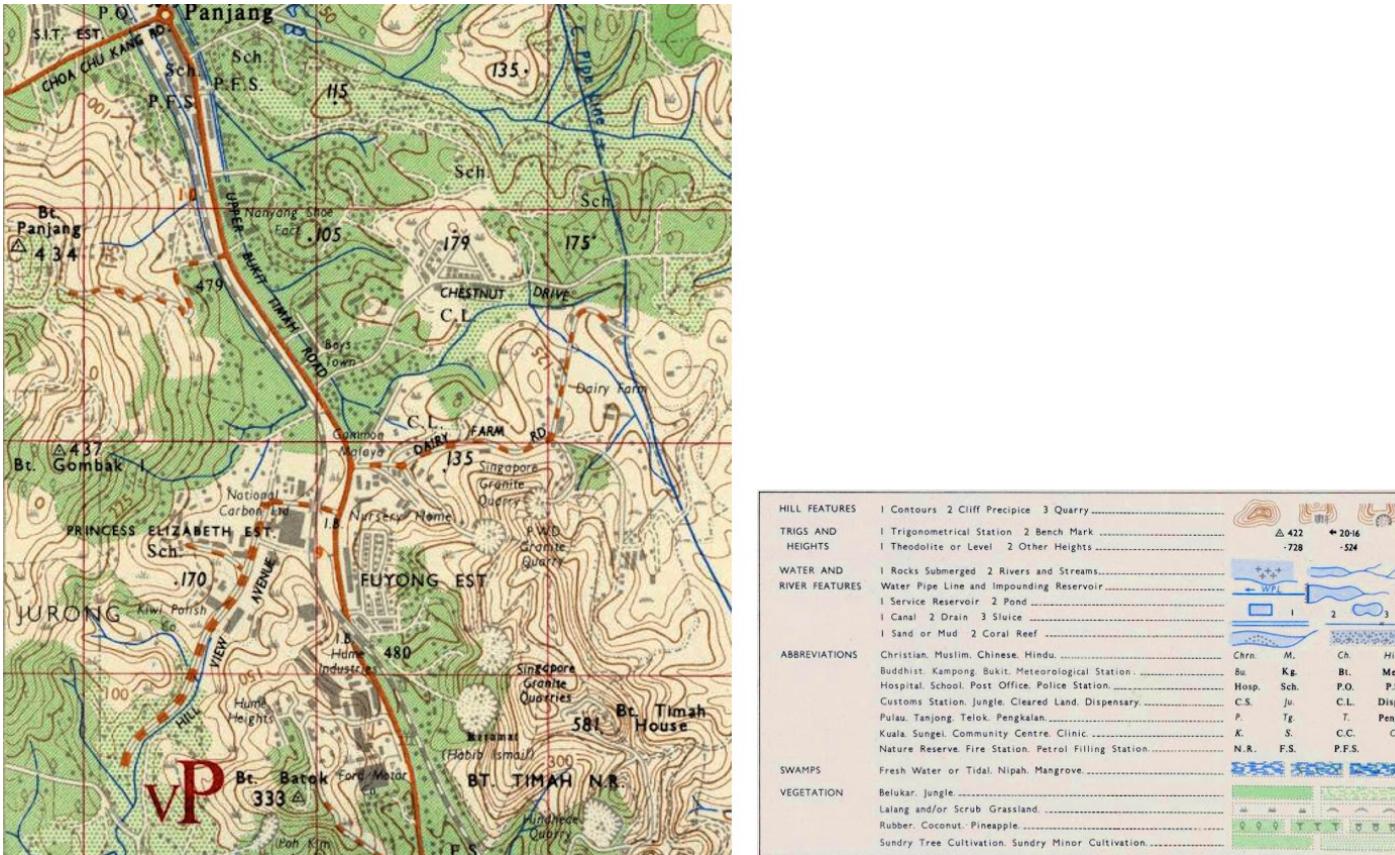


Typology of Maps



Reference maps

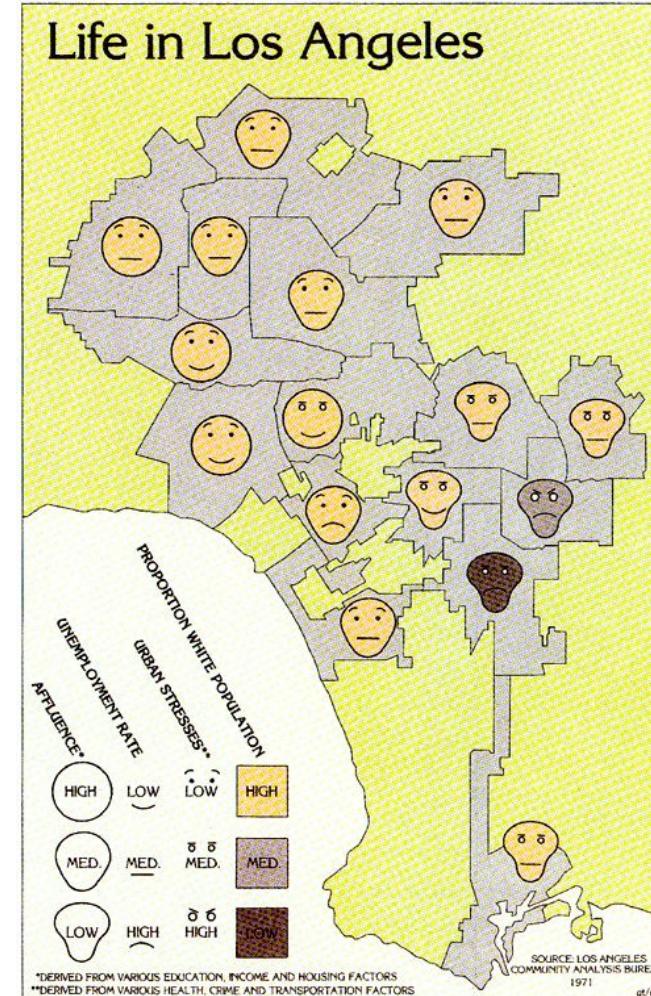
- Reference maps emphasize the location of spatial phenomena, such buildings, roads, vegetations, rivers, etc. Some of popular reference maps are **topographical map** and internet map such as Google map.



Thematic Map

- Thematic maps emphasize the spatial pattern of geographic attributes or statistics about places and relationships between places such as Life in Los Angeles.

Source: <https://mapdesign.icaci.org/2014/12/mapcarte-353365-life-in-los-angeles-by-eugene-turner-1977/>



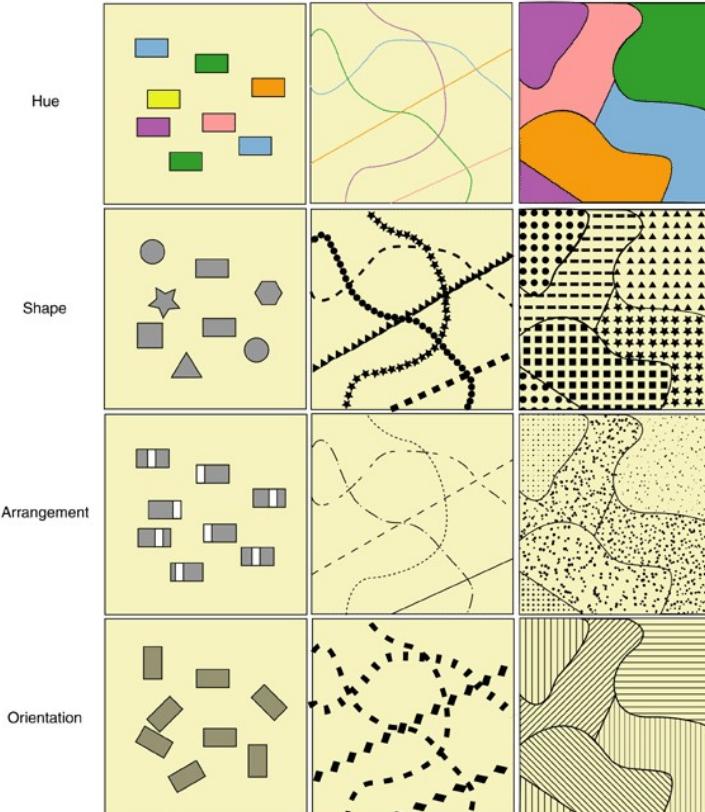
Thematic Mapping

- Displaying
 - Qualitative data
 - Quantitative data
- Choosing -Appropriate classification method for displaying data
 - Appropriate number of classes
- Techniques in data analysis
 - Using the classification histogram
 - Normalizing data

Qualitative Thematic Maps

Visual Variables and Cartographic Symbols

- Qualitative visual variables are used for nominal scale data.
- The goal of qualitative visual variables is to show how entities differ from each other.
- The visual variables that do a good job of showing ordinal differences are: colour value, colour saturation, size and texture/grain.
- Figure on the right for examples of these four ordinal visual variables used each in point, linear and areal symbols.



Qualitative Thematic Map

Point symbol map

- Different point symbols are used to represent school types



Qualitative Thematic Map

Line symbol map

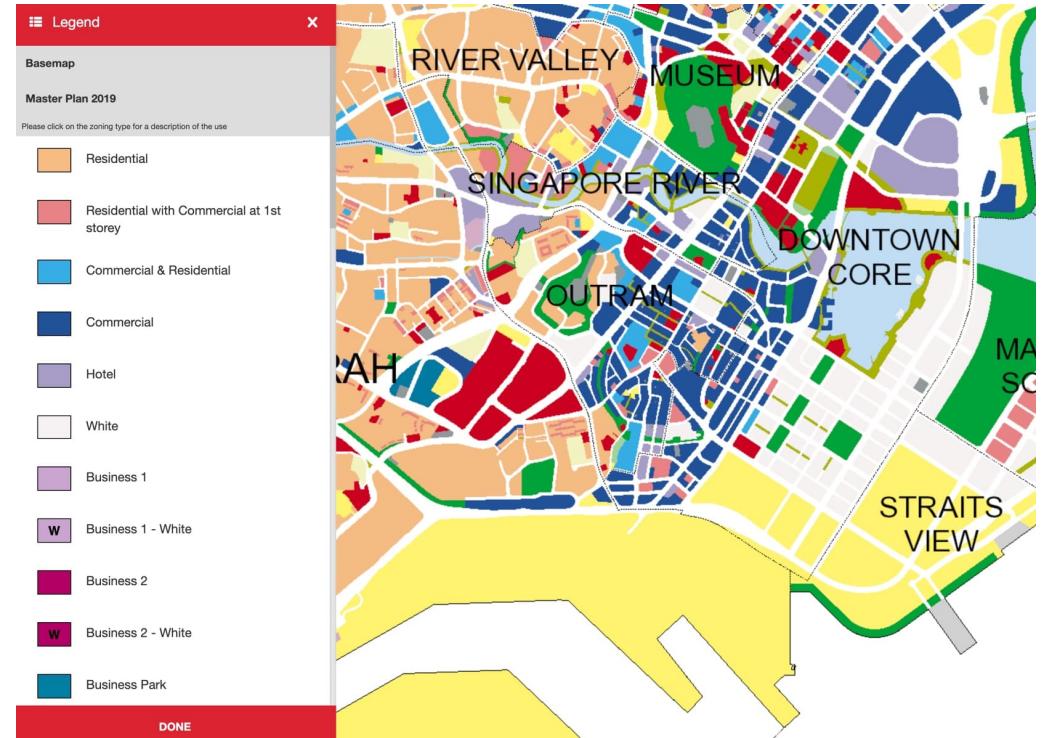
- A road map is an example of a thematic map. It shows the road network of an area. In this map, lines with different colour intensity and tickness are used to differentiate hierarchy of roads.



Qualitative Thematic Map

Area map

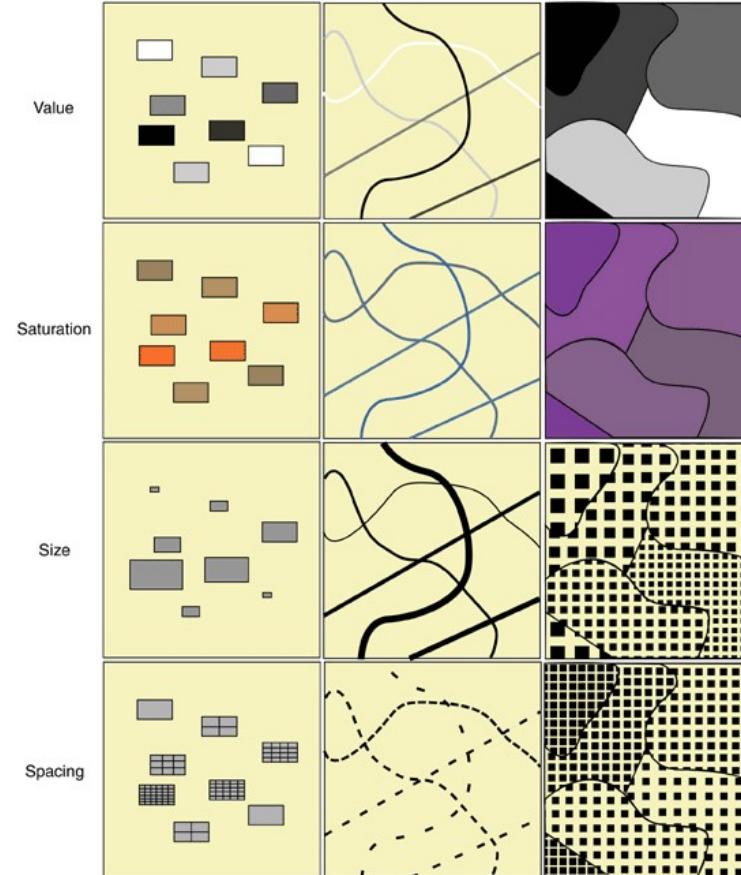
- Land use map below is a good example of a discrete thematic map. In this map, different colours are used to represent different land use types.



Quantitative Thematic Map

Visual Variables and Cartographic Symbols

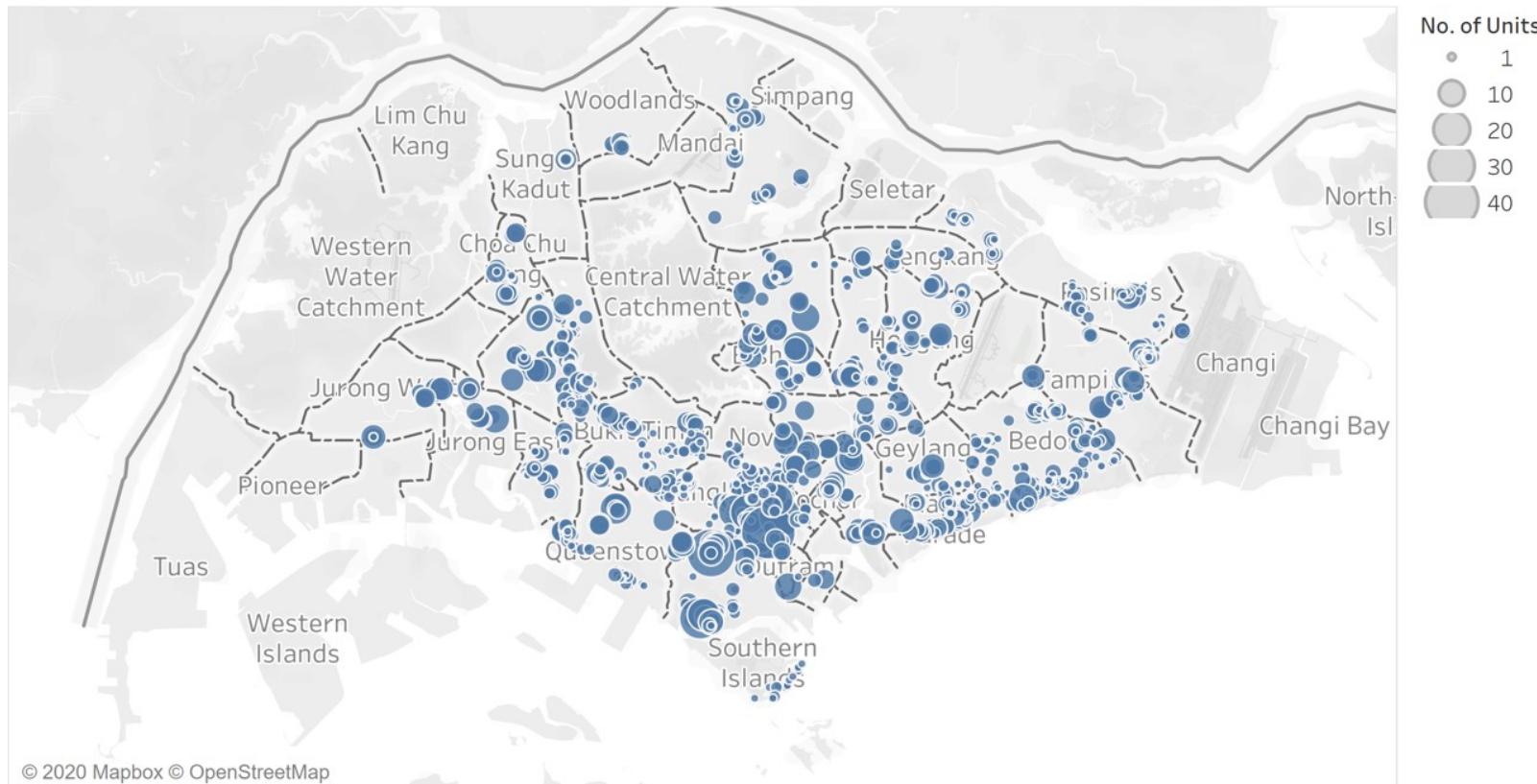
- Quantitative visual variables are used to display ordinal, interval or ratio scale data.
- The goal of the quantitative visual variable is to show relative magnitude or order between entities.
- The visual variables that do a good job of showing ordinal differences are: colour value, colour saturation, size and texture/grain.
- Figure on the right shows of these four ordinal visual variables used each in point, linear and areal symbols.



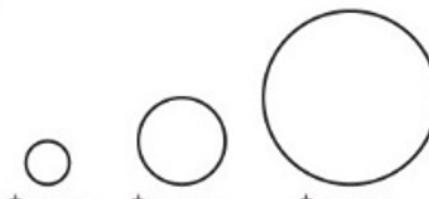
Proportional Symbol Map

- The proportional symbol technique uses symbols of different sizes to represent data associated with different areas or locations within the map.

Distribution of resale units of condominium sold in 2019



How to size circles incorrectly and correctly?



These are **wrong**

Each circle isn't double the size the previous one, but four times its size. What the designer did was to double the diameter, but that *quadrupled* the area.



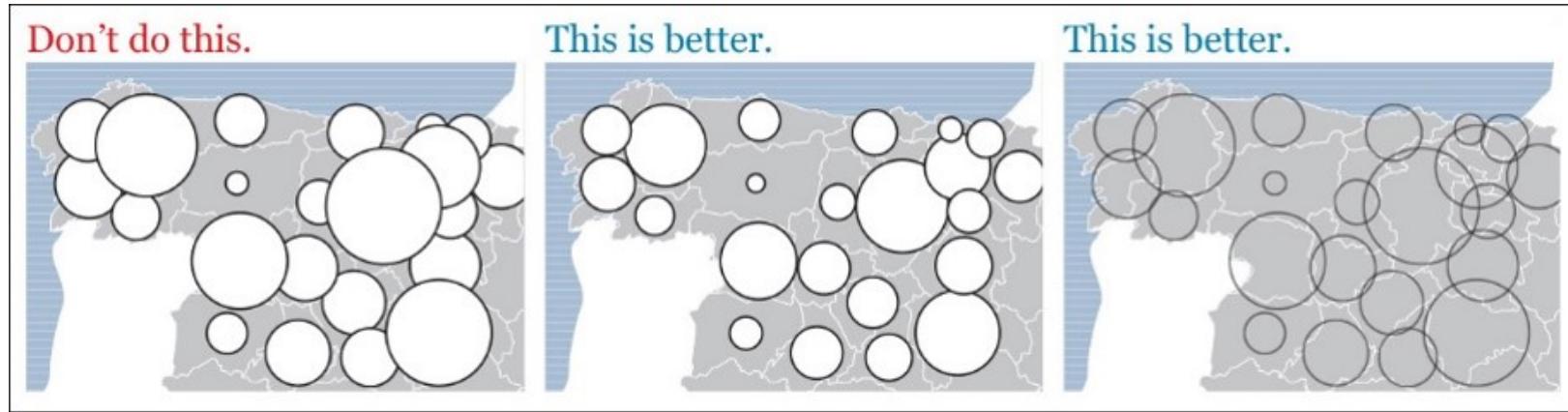
These are **right**

In this case, each circle has double the area of the previous one.

Imagine that the largest circle on a map of monthly household income equals \$2,600. The radius of this circle (R_1) is 1.1 inches. How to calculate the radius (R_2) of a circle representing \$1,100?

$$R_2 = \sqrt{\frac{\text{New value (1,100)}}{\text{Largest value (2,600)}}} \times R_1 \rightarrow R_2 = \sqrt{0.42} \times 1.1 = 0.71 \text{ inches}$$

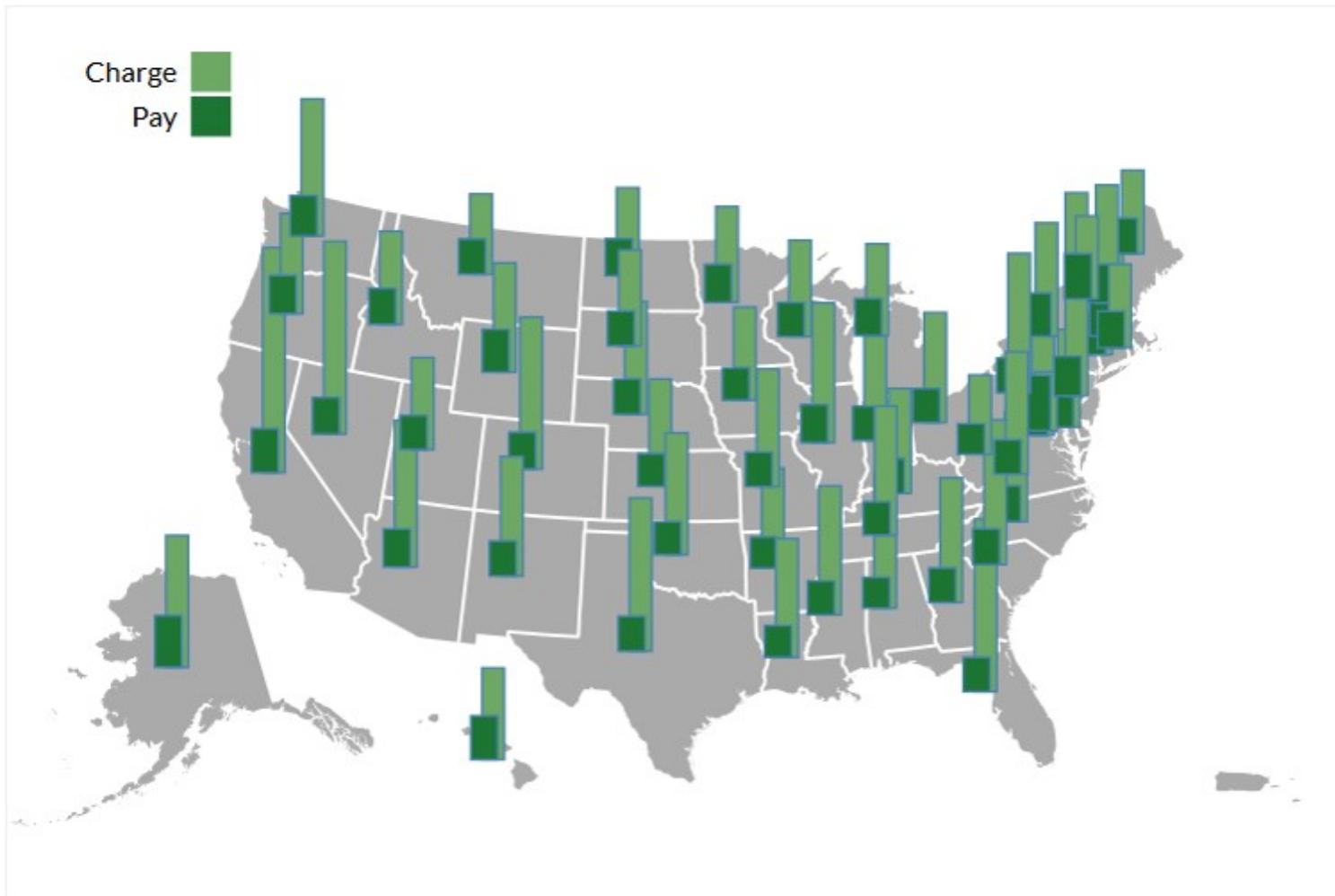
How to make proportional symbol maps clearer?



Proportional Symbol Map: Pie Chart Map



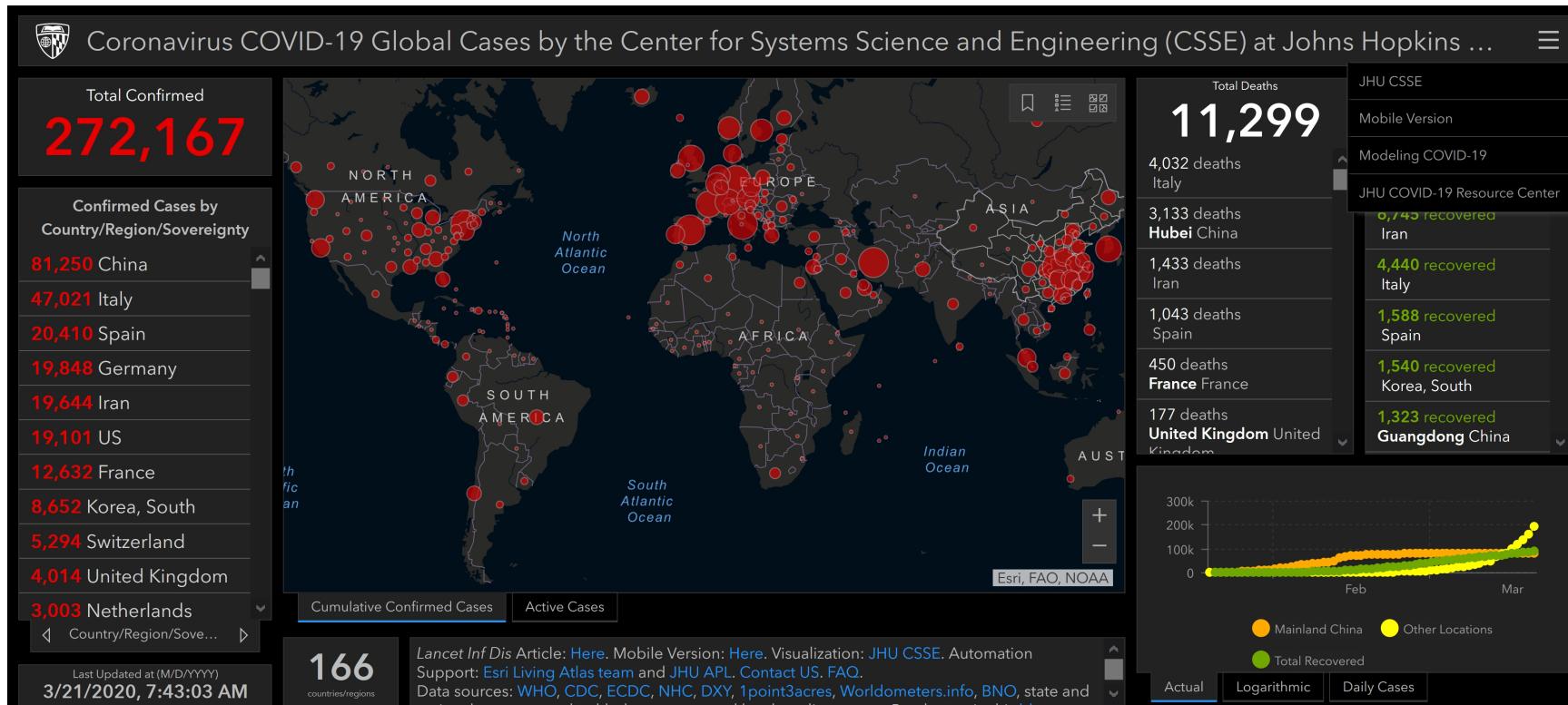
Proportional Symbol Map: Bar Chart Map



Proportional Symbol Map

Avoid Junk Map

<https://gisanddata.maps.arcgis.com/apps/opsdashboard/index.html#/bda7594740fd40299423467b48e9ecf6>



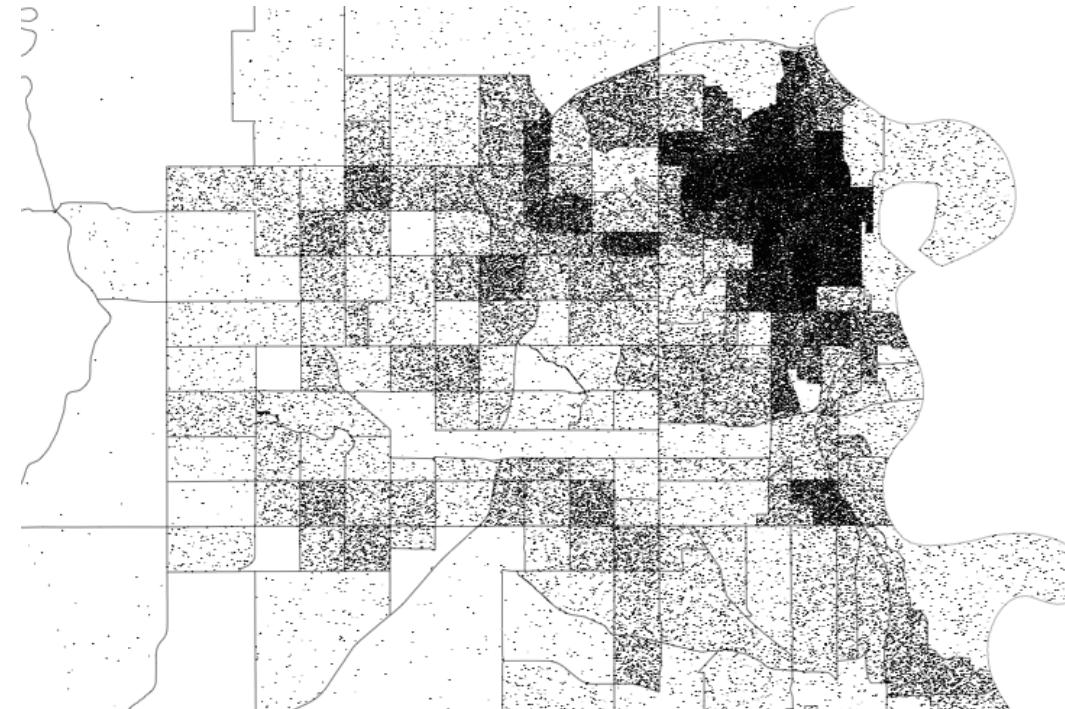
Alternative of Proportional Symbol Map: Bricks Map



Source: http://www.perceptualedge.com/articles/visual_business_intelligence/building_insight_with_bricks.pdf and <http://www.encodingpano.com/>

Dot Density Map

- A dot-density map is a type of thematic map that uses dots or other symbols on the map to show the values of one or more numeric data fields. Each dot on a dot-density map represents some amount of data.

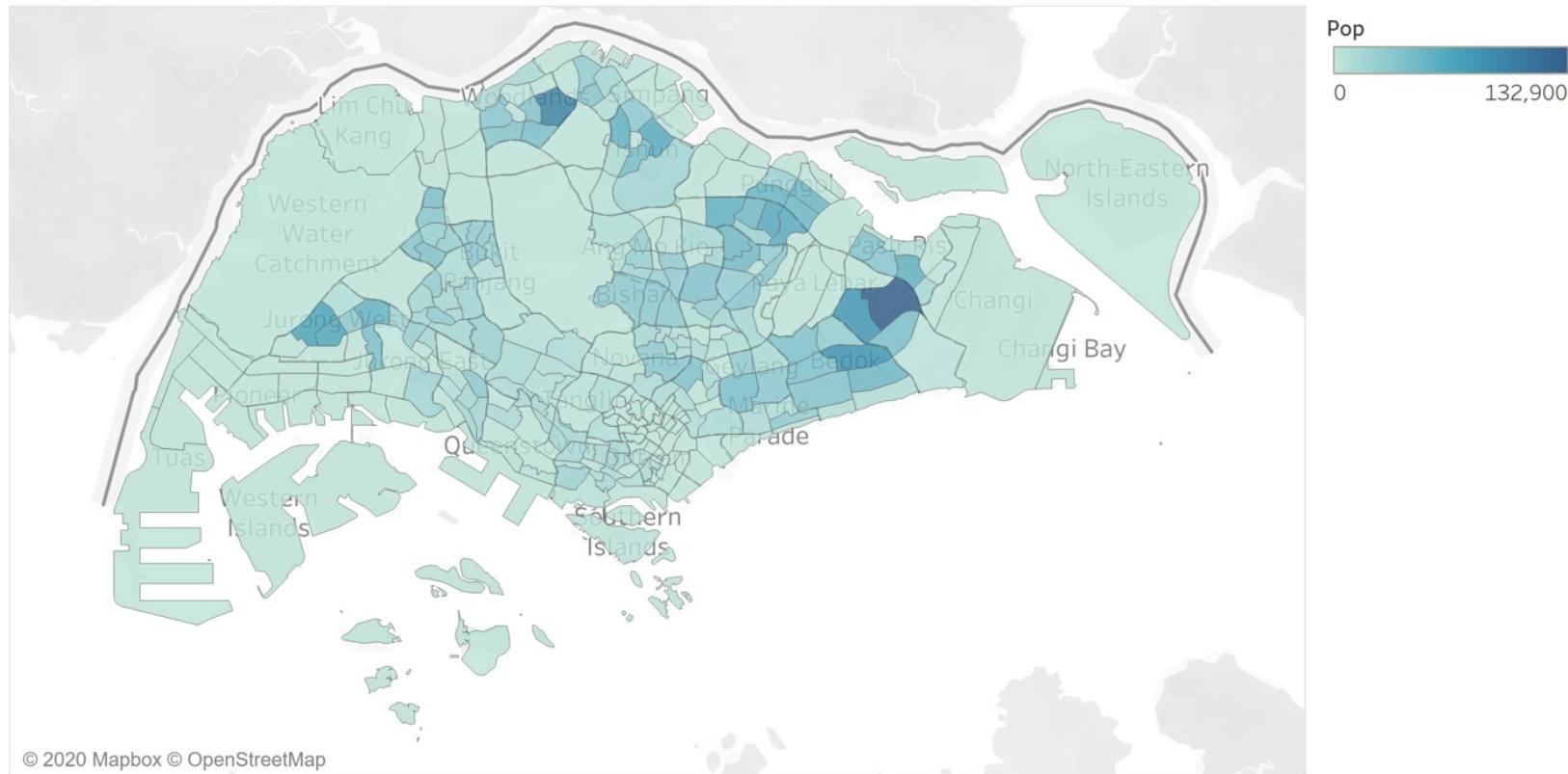


one dot represent 100 households

Choropleth Map

- A choropleth map is a type of thematic map in which areas are shaded or patterned in proportion to a statistical variable that represents an aggregate summary of a geographic characteristic within each area, such as population or per-capita income.

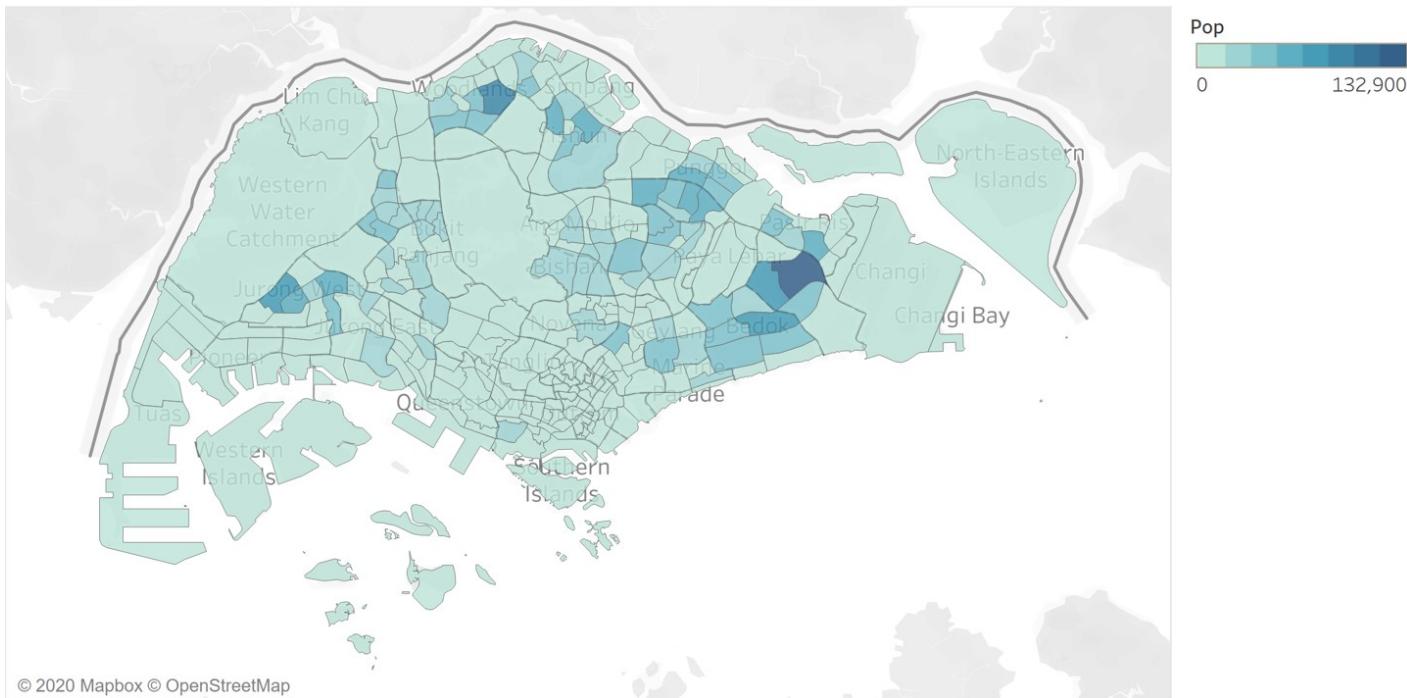
Distribution population by planning subzone, 2019



Classified choropleth map

- Choropleth maps can be either classified or unclassified.
- A **classed choropleth map** combines areal units into a smaller number of groups. Interval levels may vary, but typically 4 to 7 are used in a map. There are different classification techniques used to divide up the intervals.

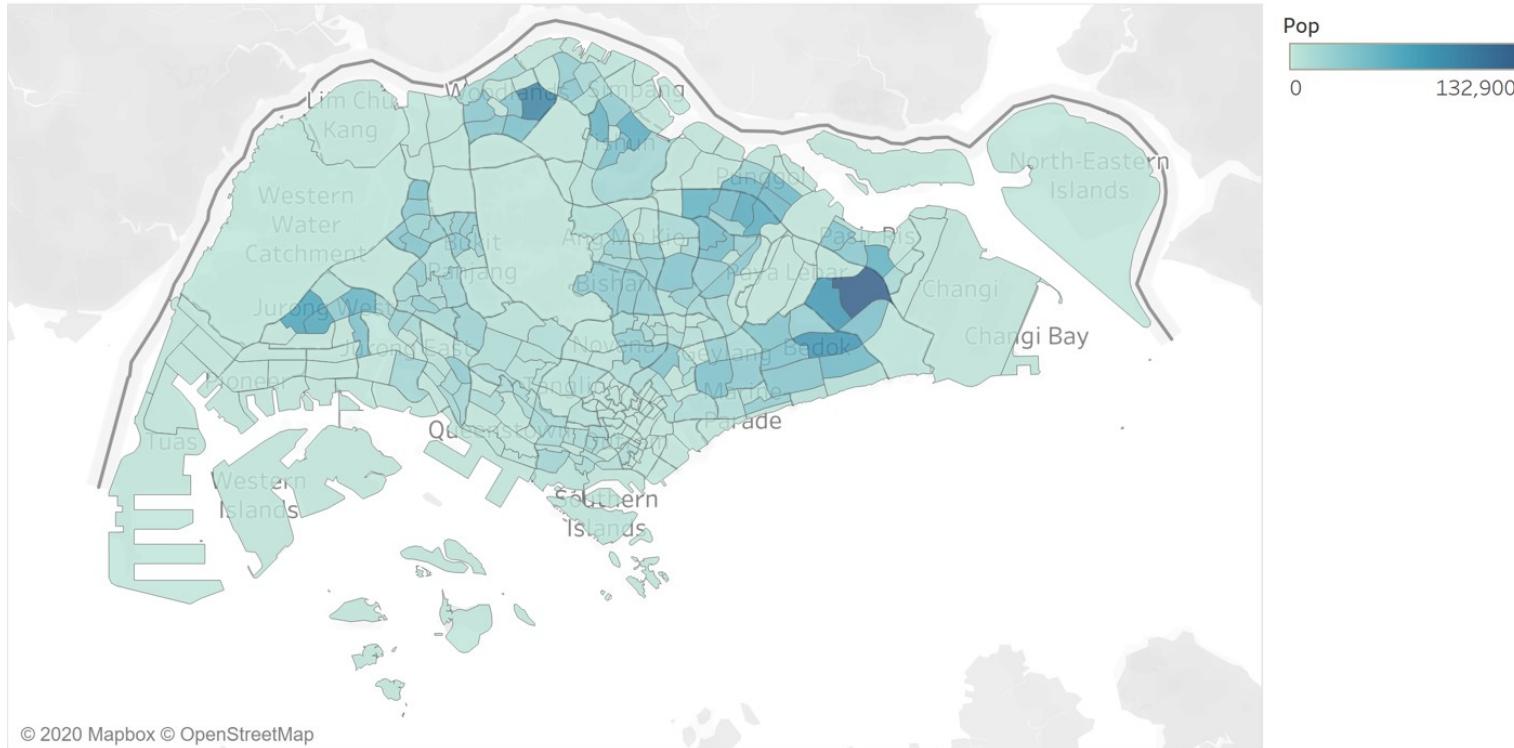
Distribution population by planning subzone, 2019



Unclassified choropleth map

- **Unclassified choropleth** maps are similar to classed choropleth maps; however, unclassed choropleth maps do not have an averaged statistic towards each particular colour.

Distribution population by planning subzone, 2019



Choropleth map

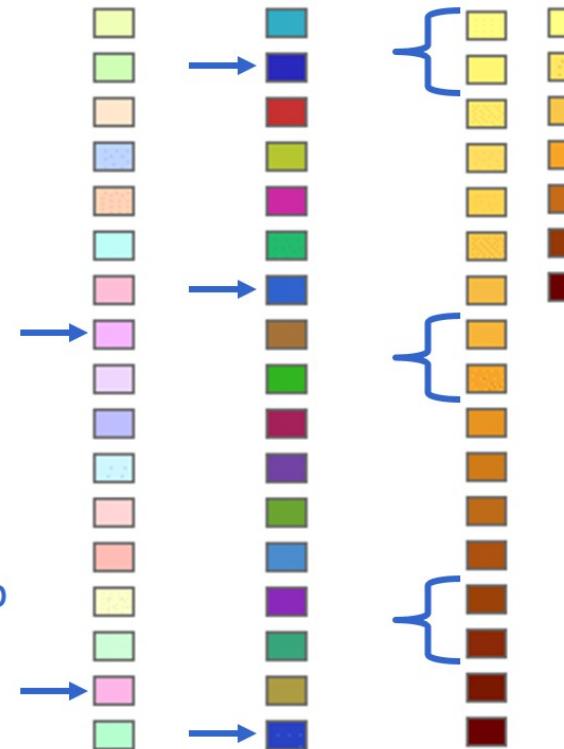
Choosing an appropriate number of classes

- Sturges' formula

$k = 1 + 3.32 * \log n$
n = number of values
k = number of classes

If n = 36
 $k = 1 + 3.32 * \log n$
k = 6 approx.

Example



- Number of intervals?
 - Not less than 4
 - To avoid an overly generalized map
 - Not more than
 - 12 colors
 - 7 or 8 shades of the same color

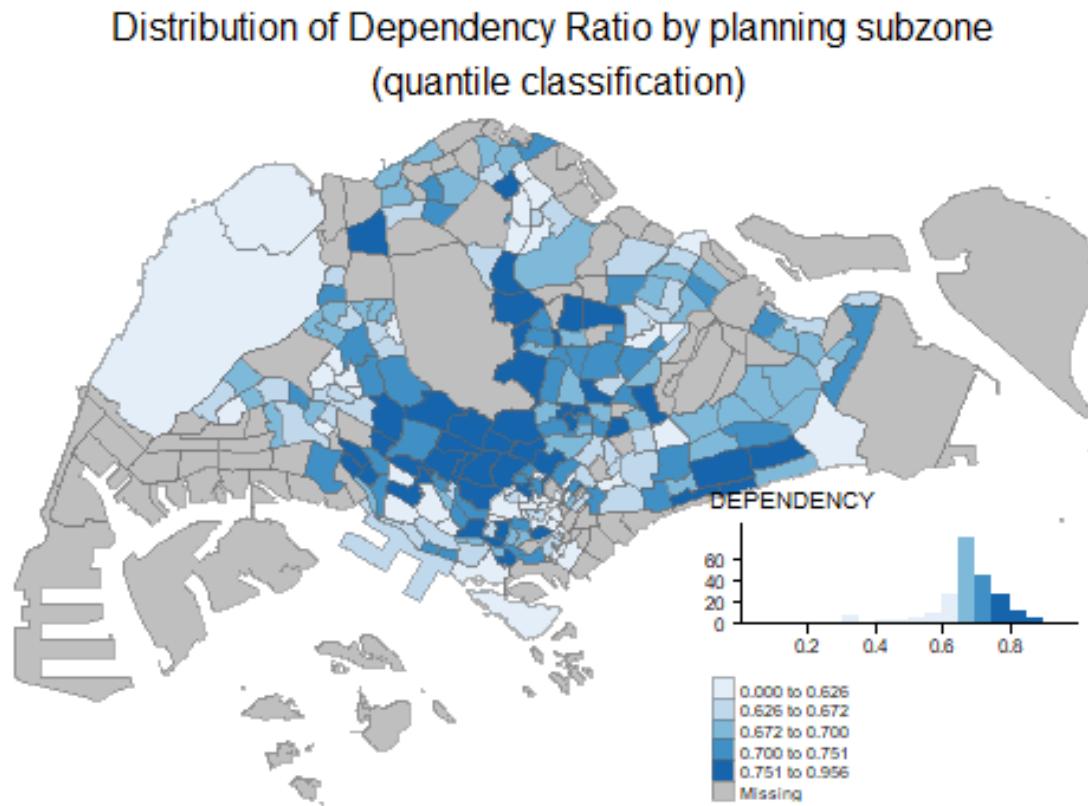
Choropleth map

Methods of choosing classes

- Based on the nature of the distribution
 - quantile, equal interval, natural breaks, standard deviations, defined interval
- Arbitrary
 - Can be based on round numbers.
 - Examples: Grouping according to age or census housing categories
 - Can result in empty categories

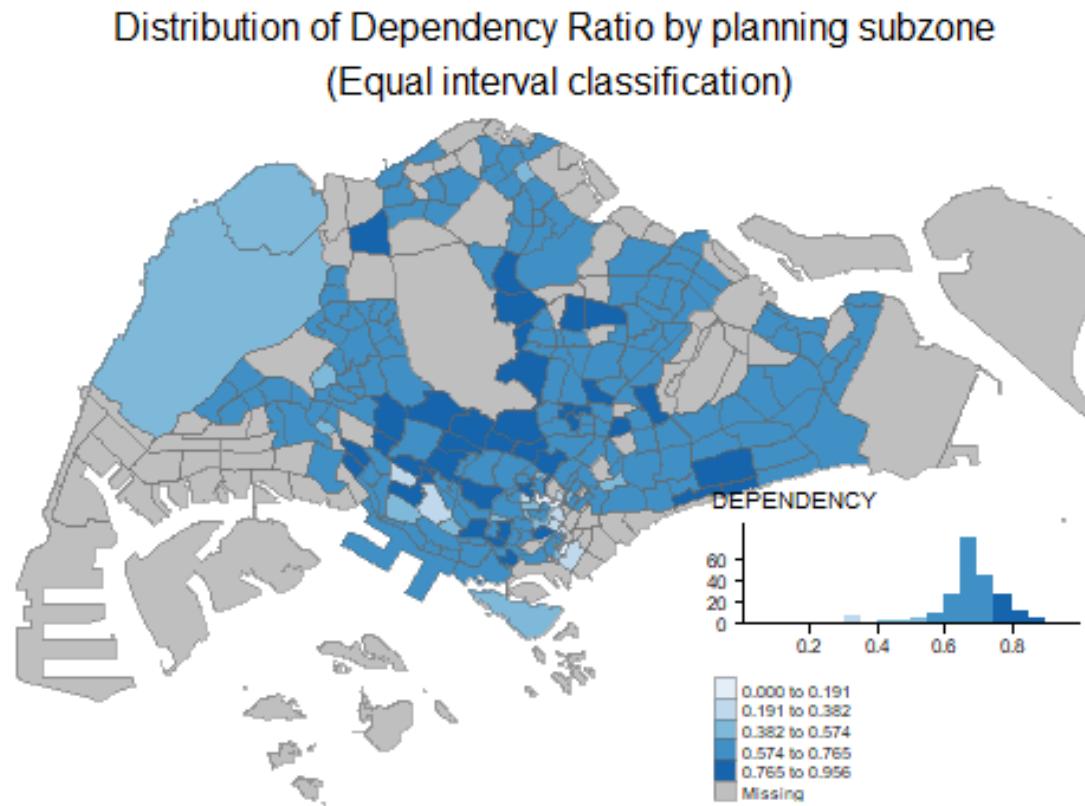
Data classification method: Quantile

- Same number of features per class.



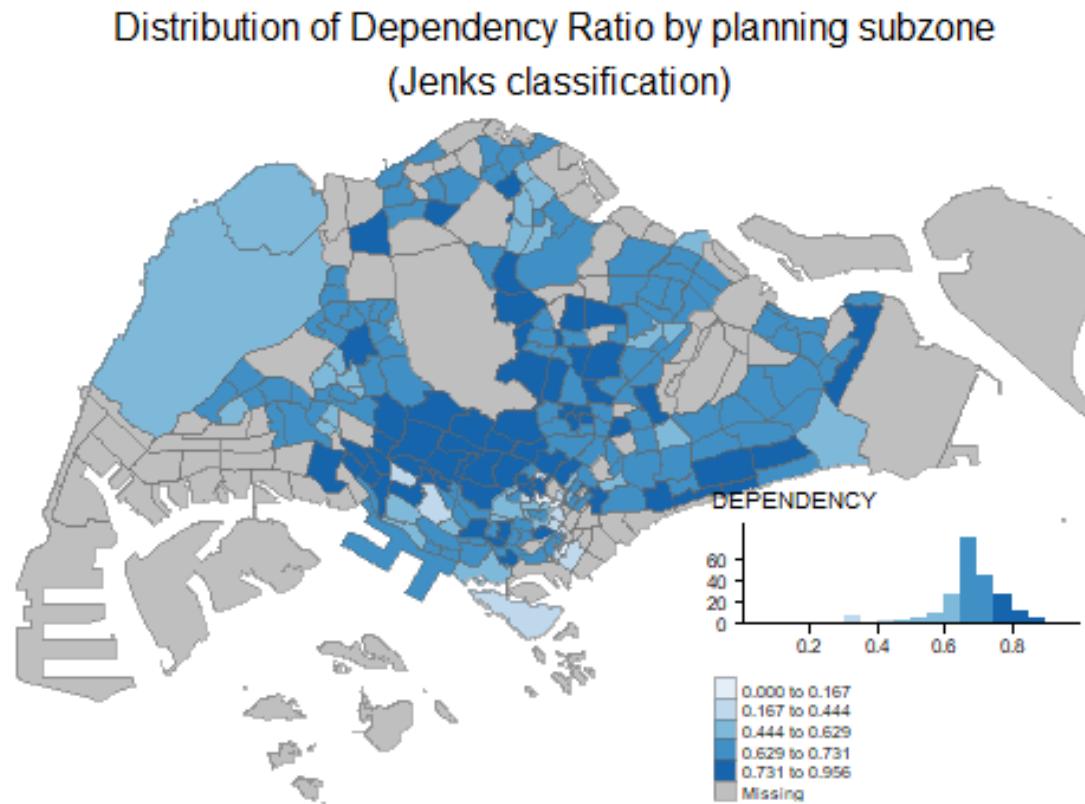
Data classification method: Equal interval

- Divides the range of attribute values into equally sized classes.



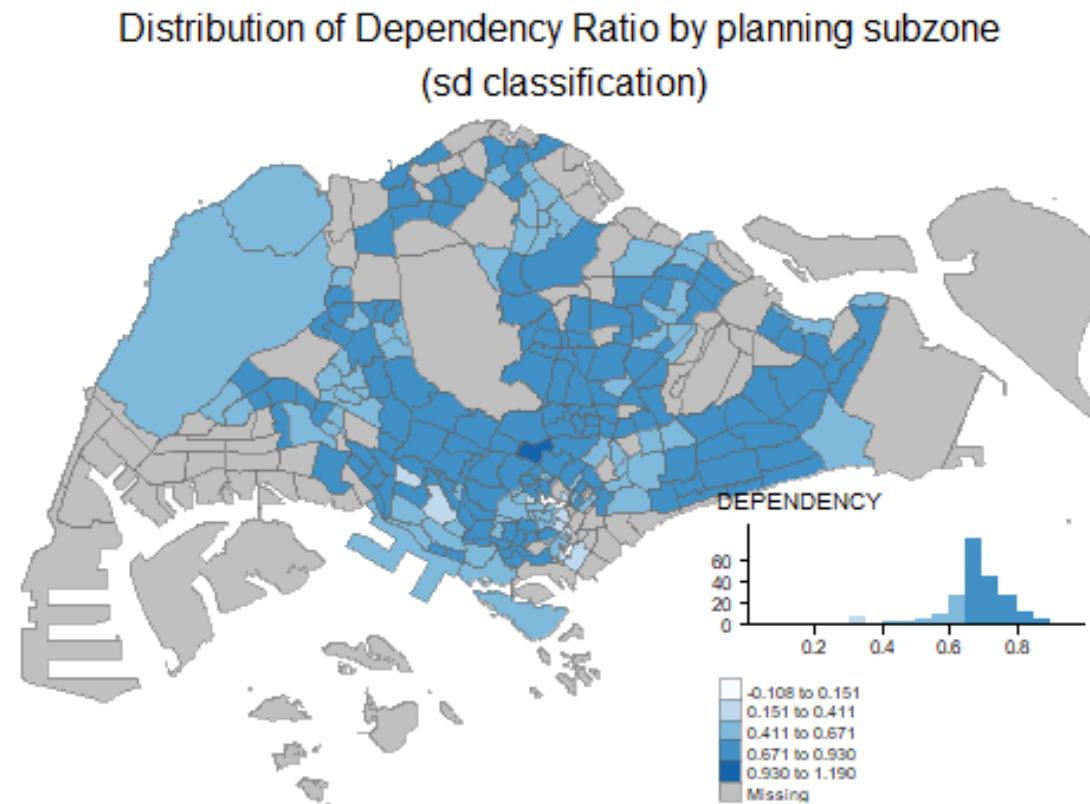
Data classification method: Jenks (also known as Natural breaks)

- Default Jenk's statistical optimization
- Finds natural groupings in the data



Data classification method: Standard deviation

- A measure of dispersion.
- Use if the distribution approximates a normal distribution (bell-shaped curve)



Choropleth map - Colour scheme

ColorBrewer is an online tool designed to help people select good color schemes for maps and other graphics.

