



Geographic Information System

Vector Data – Part I

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Outline

- Display XY
- Join & Spatial Join
- Add Field & Data Types
- Select by Attribute
- Select by Location
- Calculate Geometry
- Calculate Field
- Symbology

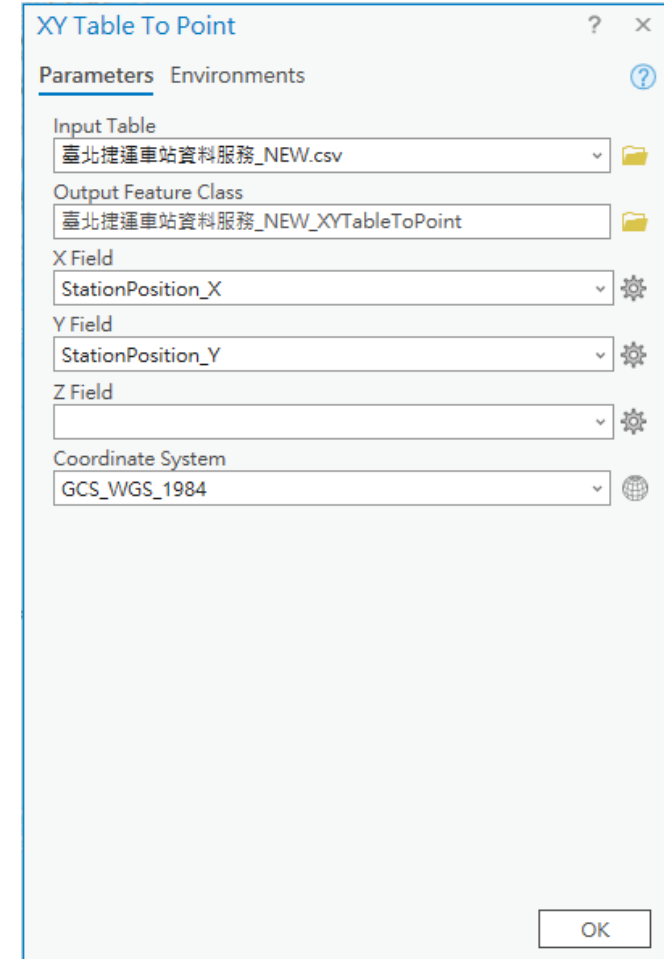


Procedure

- Today, we would like to demonstrate a case:
 - Show the relationship between population density and YouBike 2.0 rental data in Taipei City
- You will learn:
 - 1) Data integration: join and spatial join
 - 2) Calculation: calculate field and calculate geometry
 - 3) Data selection
 - 4) Symbology

Display XY

- **Display XY** is a technique to plot point data on the map.
- First of all, you need to define the X and Y column for geometry settings.



Join & Spatial Join

- **Join** is to merge two datasets together based on the **same value**.
- **Spatial join** is to merge two datasets based on the **same location**.

Add Join ? x

Input Table
youbike_immediate_XYTableToPoint

⚠ Input Field
sarea

Join Table
TOWN_MOI_1130718

Join Field
TOWNNAME

Keep all input records
 Index join fields

Validate Join

OK

Add Spatial Join ? x

Target Features
臺北捷運車站資料服務_NEW_XYTableToPoint

Join Features
VILLAGE_NLSC_121_1130807

Keep All Target Features

Match Option
Intersect

Permanently Join Fields

Search Radius
Decimal Degrees

> Fields

> Matching Attributes

OK

Add Field & Data Types

- Sometime, you want to calculate some indicators by combining two or more column value with a specific mathematical formula.
- Or you want to change the data type of the specific column.
- → You may use "add field" and do "calculate field."

Type	Value	Meanings
short	-32768 to 32767	16-bit integer
long	-2147483648 to 2147483647	32-bit integer
float	-3.4E38 to 1.2E38	32-bit float
double	-2.2E308 to 1.8E308	64-bit float
text	string or characters	
date	datetime	

Add Field & Data Types

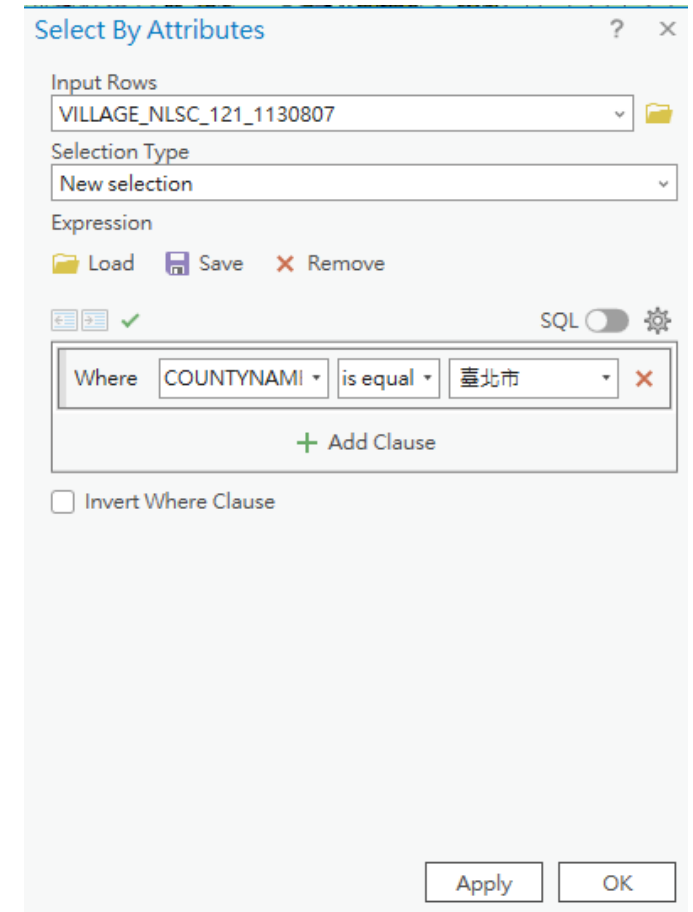
FID	Shape	TOWNID	TOWNCODE	COUNTYNAME	TOWNNAME	TOWNENG	COUNTYID	COUNTYCODE	
1	0	Polygon	V02	10014020	臺東縣	成功鎮	Chenggong Township	V	10014
2	1	Polygon	T21	10013210	屏東縣	佳冬鄉	Jiandong Township	T	10013
3	2	Polygon	P13	10009130	雲林縣	麥寮鄉	Mailiao Township	P	10009
4	3	Polygon	V11	10014110	臺東縣	綠島鄉	Lüdao Township	V	10014
5	4	Polygon	V16	10014160	臺東縣				
6	5	Polygon	N07	10007120	彰化縣				
7	6	Polygon	N19	10007170	彰化縣				
8	7	Polygon	T14	10013140	屏東縣				
9	8	Polygon	T05	10013050	屏東縣				
10	9	Polygon	K13	10005160	苗栗縣				
11	10	Polygon	J13	10004110	新竹縣				
12	11	Polygon	K14	10005110	苗栗縣				
13	12	Polygon	Q12	10010010	嘉義縣				

Precision is the number of digits in a number.
Scale is the number of digits to the right of the decimal point in a number.
Example: 124.82 → Precision: ? Scale: ?

Visible	Read Only	Field Name	Alias	Data Type	Allow NULL	Highlight	Number Format	Default	Precision	Scale	Length
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	FID	FID	Object ID	<input type="checkbox"/>	<input type="checkbox"/>	Numeric		0	0	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Shape	Shape	Geometry	<input type="checkbox"/>	<input type="checkbox"/>			0	0	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	TOWNID	TOWNID	Text	<input type="checkbox"/>	<input type="checkbox"/>			0	0	8
<input checked="" type="checkbox"/>	<input type="checkbox"/>	TOWNCODE	TOWNCODE	Text	<input type="checkbox"/>	<input type="checkbox"/>			0	0	12
<input checked="" type="checkbox"/>	<input type="checkbox"/>	COUNTYNAME	COUNTYNAME	Text	<input type="checkbox"/>	<input type="checkbox"/>			0	0	12
<input checked="" type="checkbox"/>	<input type="checkbox"/>	TOWNNAME	TOWNNAME	Text	<input type="checkbox"/>	<input type="checkbox"/>			0	0	12
<input checked="" type="checkbox"/>	<input type="checkbox"/>	TOWNENG	TOWNENG	Text	<input type="checkbox"/>	<input type="checkbox"/>			0	0	39
<input checked="" type="checkbox"/>	<input type="checkbox"/>	COUNTYID	COUNTYID	Text	<input type="checkbox"/>	<input type="checkbox"/>			0	0	3
<input checked="" type="checkbox"/>	<input type="checkbox"/>	COUNTYCODE	COUNTYCODE	Text	<input type="checkbox"/>	<input type="checkbox"/>			0	0	8
<input checked="" type="checkbox"/>	<input type="checkbox"/>	Area		Double	<input type="checkbox"/>	<input type="checkbox"/>					

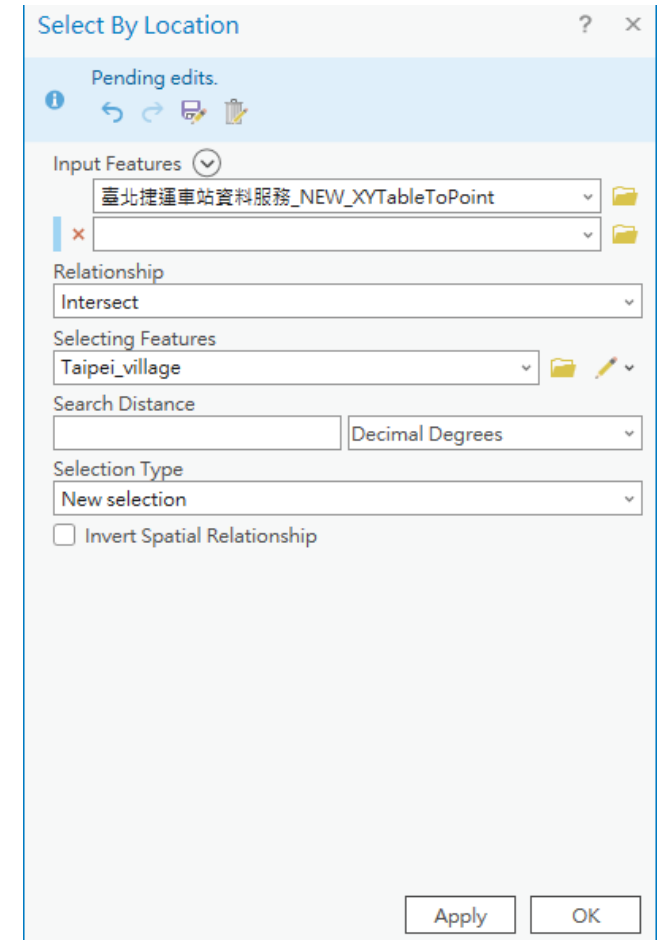
Select by Attribute

- The functionality of “select by attribute” could be regarded as a filter by using conditions, which are based on column values.
- For example, you want to select all villages of Taipei cities from a village shapefile of the entire Taiwan.



Select by Location

- However, "select by attribute" cannot always fulfill your objectives, since the shapefile does not have the specific column that could be used as a filter.
- In this case, you may try "select by location" to select your data by using other shapefile.



Calculate Geometry

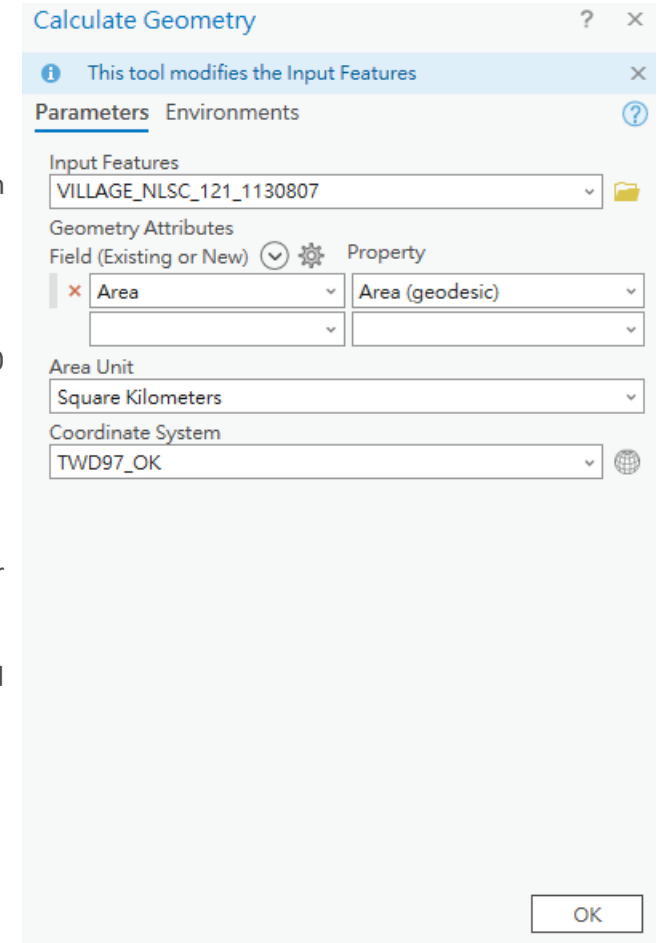
- As a GIS software, it may also calculate several geometric attributes.

- **Area**—An attribute will be added to store the area of each polygon feature.
- **Area (geodesic)**—An attribute will be added to store the shape-preserving geodesic area of each polygon feature.
- **Centroid x/y/z-coordinate**—An attribute will be added to store the centroid x/y/z-coordinate of each feature.
- **Centroid m-value**—An attribute will be added to store the centroid m-value of each feature.
- **Central point x/y/z-coordinate**—An attribute will be added to store the x/y/z-coordinate of a central point inside or on each feature. This point is the same as the centroid if the centroid is inside the feature; otherwise, it is an inner label point.
- **Central point m-value**—An attribute will be added to store the m-value of a central point inside or on each feature. This point is the same as the centroid if the centroid is inside the feature; otherwise, it is an inner label point.
- **Number of curves**—An attribute will be added to store the number of curves in each feature. Curves include elliptical arcs, circular arcs, and Bezier curves.
- **Number of holes**—An attribute will be added to store the number of interior holes within each polygon feature.
- **Minimum x/y/z-coordinate**—An attribute will be added to store the minimum x/y/z-coordinate of each feature's extent.
- **Maximum x/y/z-coordinate**—An attribute will be added to store the maximum x/y/z-coordinate of each feature's extent.
- **Length**—An attribute will be added to store the length of each line feature.
- **Length (geodesic)**—An attribute will be added to store the shape-preserving geodesic length of each line feature.
- **Length (3D)**—An attribute will be added to store the 3D length of each line feature.
- **Line bearing**—An attribute will be added to store the start-to-end bearing of each line feature. Values range from 0 to 360, with 0 meaning north, 90 east, 180 south, 270 west, and so on.
- **Line start x/y/z-coordinate**—An attribute will be added to store the x/y/z-coordinate of the start point of each line feature.
- **Line start m-value**—An attribute will be added to store the m-value of the start point of each line feature.
- **Line end x/y/z-coordinate**—An attribute will be added to store the x/y/z-coordinate of the end point of each line feature.
- **Line end m-value**—An attribute will be added to store the m-value of the end point of each line feature.
- **Number of parts**—An attribute will be added to store the number of parts composing each feature.
- **Number of vertices**—An attribute will be added to store the number of points or vertices composing each feature.
- **Perimeter length**—An attribute will be added to store the length of the perimeter or border of each polygon feature.
- **Perimeter length (geodesic)**—An attribute will be added to store the shape-preserving geodesic length of the perimeter or border of each polygon feature.
- **Point x/y/z-coordinate**—An attribute will be added to store the x/y/z-coordinate of each point feature.
- **Point m-value**—An attribute will be added to store the m-value of each point feature.
- **Point x- and y-coordinate notation**—An attribute will be added to store the x- and y-coordinate of each point feature formatted as a specified coordinate notation.

Calculate Geometry

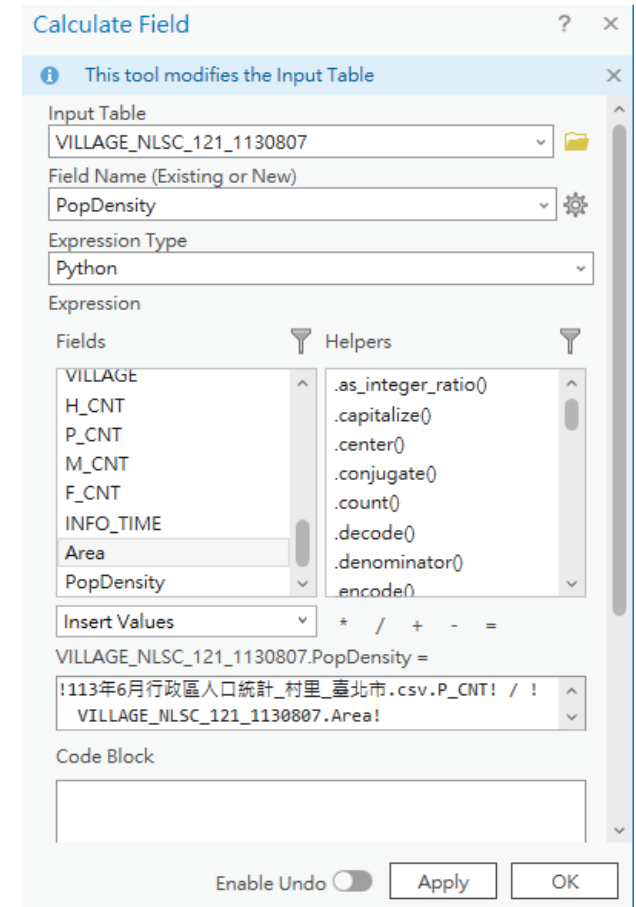
- But, ...

- **Area (geodesic)**—An attribute will be added to store the shape-preserving geodesic area of each polygon feature.
- **Centroid x/y/z-coordinate**—An attribute will be added to store the centroid x/y/z-coordinate of each feature.
- **Central point x/y/z-coordinate**—An attribute will be added to store the x/y/z-coordinate of a central point inside or on each feature. This point is the same as the centroid if the centroid is inside the feature; otherwise, it is an inner label point.
- **Minimum x/y/z-coordinate**—An attribute will be added to store the minimum x/y/z-coordinate of each feature's extent.
- **Maximum x/y/z-coordinate**—An attribute will be added to store the maximum x/y/z-coordinate of each feature's extent.
- **Length (geodesic)**—An attribute will be added to store the shape-preserving geodesic length of each line feature.
- **Line bearing**—An attribute will be added to store the start-to-end bearing of each line feature. Values range from 0 to 360, with 0 meaning north, 90 east, 180 south, 270 west, and so on.
- **Line start x/y/z-coordinate**—An attribute will be added to store the x/y/z-coordinate of the start point of each line feature.
- **Line end x/y/z-coordinate**—An attribute will be added to store the x/y/z-coordinate of the end point of each line feature.
- **Number of parts**—An attribute will be added to store the number of parts composing each feature.
- **Number of vertices**—An attribute will be added to store the number of points or vertices composing each feature.
- **Perimeter length (geodesic)**—An attribute will be added to store the shape-preserving geodesic length of the perimeter or border of each polygon feature.
- **Point x/y/z-coordinate**—An attribute will be added to store the x/y/z-coordinate of each point feature.
- **Point x- and y-coordinate notation**—An attribute will be added to store the x- and y-coordinate of each point feature formatted as a specified coordinate notation.



Calculate Field

- ArcGIS Pro not only can calculate the geometric metrics, but also can calculate several mathematical indicators.
- For example, you may use "population" and "area" to calculate the "population density."



Symbology

- Geographic visualization is an important approach to demonstrate the distribution of a specific feature in space domain.
- In ArcGIS Pro, it allows various combination of visualization methods.
- Due to the time limitation, we only introduce the single and graduated illustration.

Symbology

Graduated Colors

The screenshot displays the ArcGIS Desktop interface. The main map area shows a topographic map of Taipei, Taiwan, with a graduated color symbology applied to the 'available_rent_bikes' field. The symbology uses a color scale from yellow (low density) to red (high density) to represent the number of available rent bikes. The map is divided into districts, including Jinshan District, Keelung, Ren'ai District, Anle District, Nuannuan District, Xizhi District, Xinzhuang District, New Taipei City, Zhonghe District, Shulin District, Xindian District, Shiding District, and Pinglin District.

The Symbology pane on the right shows the following settings:

- Primary symbology: Graduated Colors
- Field: sno
- Normalization: available_rent_bikes
- Method: Natural Breaks (Jenks)
- Classes: 5
- Color scheme: [Yellow to Red gradient]

The Contents pane on the left shows the following layers:

- Map
- Taipei_MRT
- youbike_immediate_XYTableToPoint (Selected)
- 臺北捷運車站資料服務_NEW_XYTableToP...
- Taipei_village
- Taipei_town
- TOWN_MOL_1130718
- VILLAGE_NLSC_121_1130807
- World Topographic Map
- World Hillshade
- Standalone Tables
- 臺北捷運車站資料服務_NEW.csv

The Symbology pane also includes a table showing the class ranges and labels:

Symbol	Upper value	Label
Yellow circle	≤ 38470231.0...	7248000 - 38...
Orange circle	≤ 71445583.4...	38480000 - 7...
Red circle	≤ 125028263.0...	71460000 - 1...
Dark red circle	≤ 250059546.5	125100000 - ...
Dark red circle	≤ 500119094	250200000 - ...

Symbology

Graduated Colors

The screenshot displays the QGIS interface with a map of Taipei. The map is color-coded by population density, with the highest density areas in red and the lowest in yellow. The Symbology panel for the 'Taipei_village' layer is open, showing the 'Graduated Colors' method with 10 classes and a red-to-yellow color scheme. The Contents panel shows the 'Taipei_village' layer selected.

Symbol	Upper value	Label
Yellow	≤ 4926.550804	0.000000 - 4...
Light Yellow	≤ 11426.561635	4926.550805...
Yellow-Orange	≤ 17152.344537	11426.56163...
Orange	≤ 22249.743864	17152.34453...
Light Orange	≤ 28290.268458	22249.74386...
Orange-Red	≤ 35032.585006	28290.26845...
Red-Orange	≤ 42800.388306	35032.58500...
Red	≤ 52522.947208	42800.38830...
Dark Red	≤ 68843.193602	52522.94720...
Dark Red	≤ 106570.603362	68843.19360...



The End

Thank you for your attention!

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