



Geographic Information System

Spatial Statistics I Lab Practice

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Outline

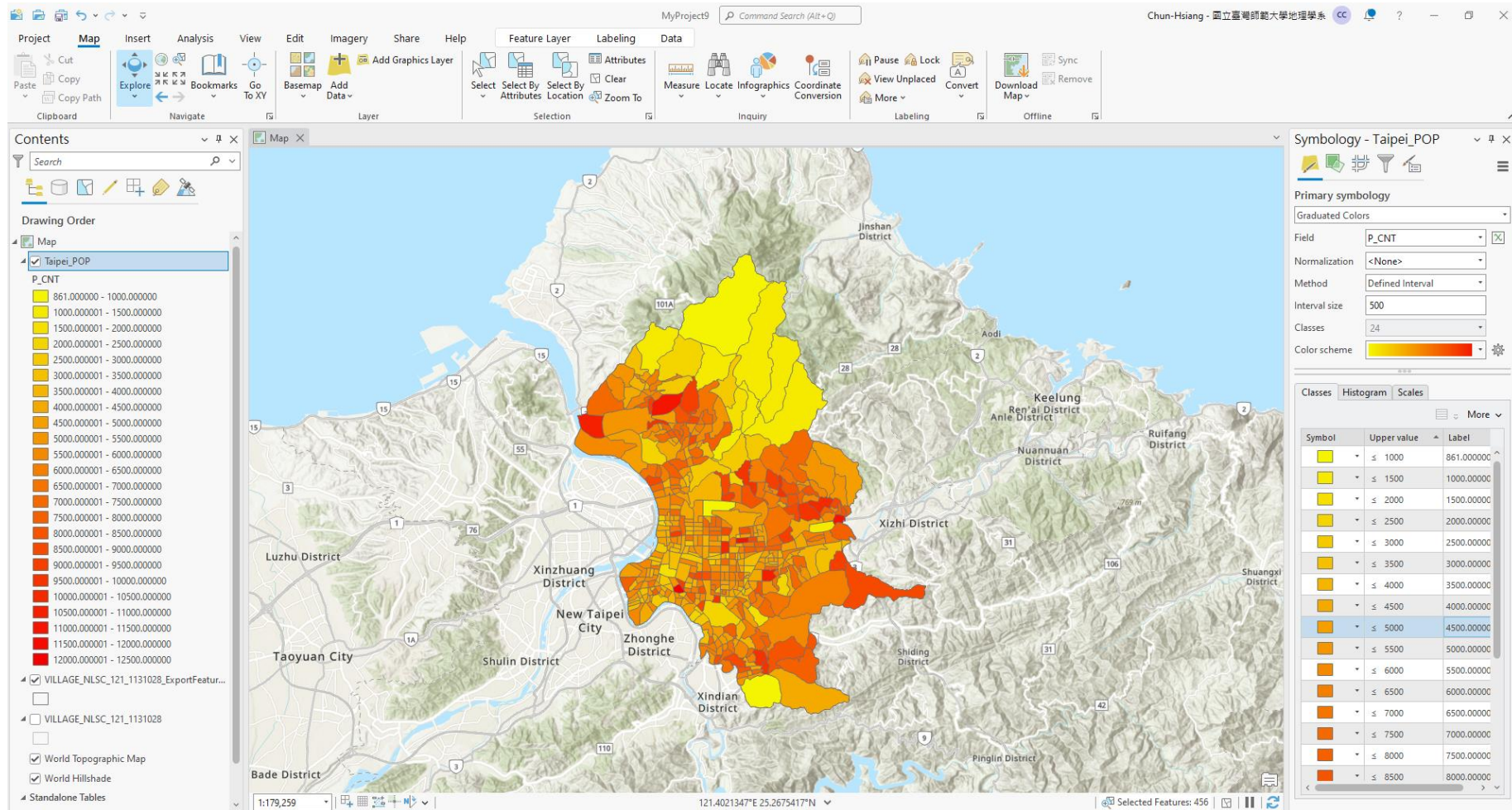
- **Observe the central tendency of Taipei traffic accident data between January and July**
- **Observe the average nearest neighbor of Taipei traffic accident data between January and July**
- **Observe the spatial pattern of Taipei population data**



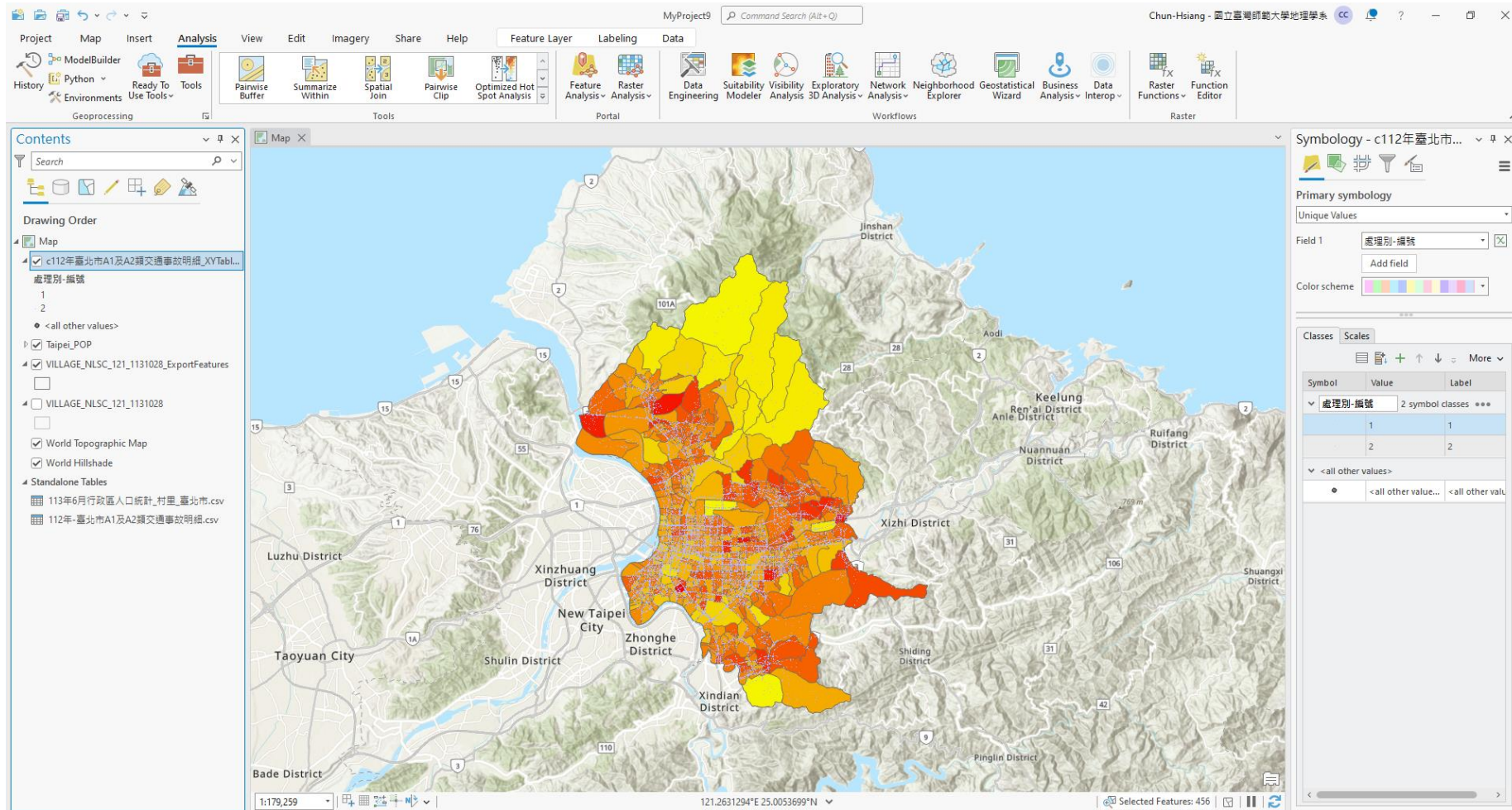
Initial Settings (...)

- 1) Set up the CRS of the map
- 2) Load Taipei Population Data, Taipei Traffic Accident Data, and Taiwan Village Data
- 3) Select all Taipei villages from the Taiwan village data and export as a new feature data named “Taipei_POP”
- 4) Join Taipei population into Taipei_POP
- 5) Use XY Table To Point to convert Taipei traffic accident data into Point data
- 6) Select 112/01 and 112/07 Taipei traffic accident and export as a new feature data, respectively, named “TrafficAccident_11201” and “TrafficAccident_11207”
- 7) Spatial Join Taipei traffic accident into Taipei_POP

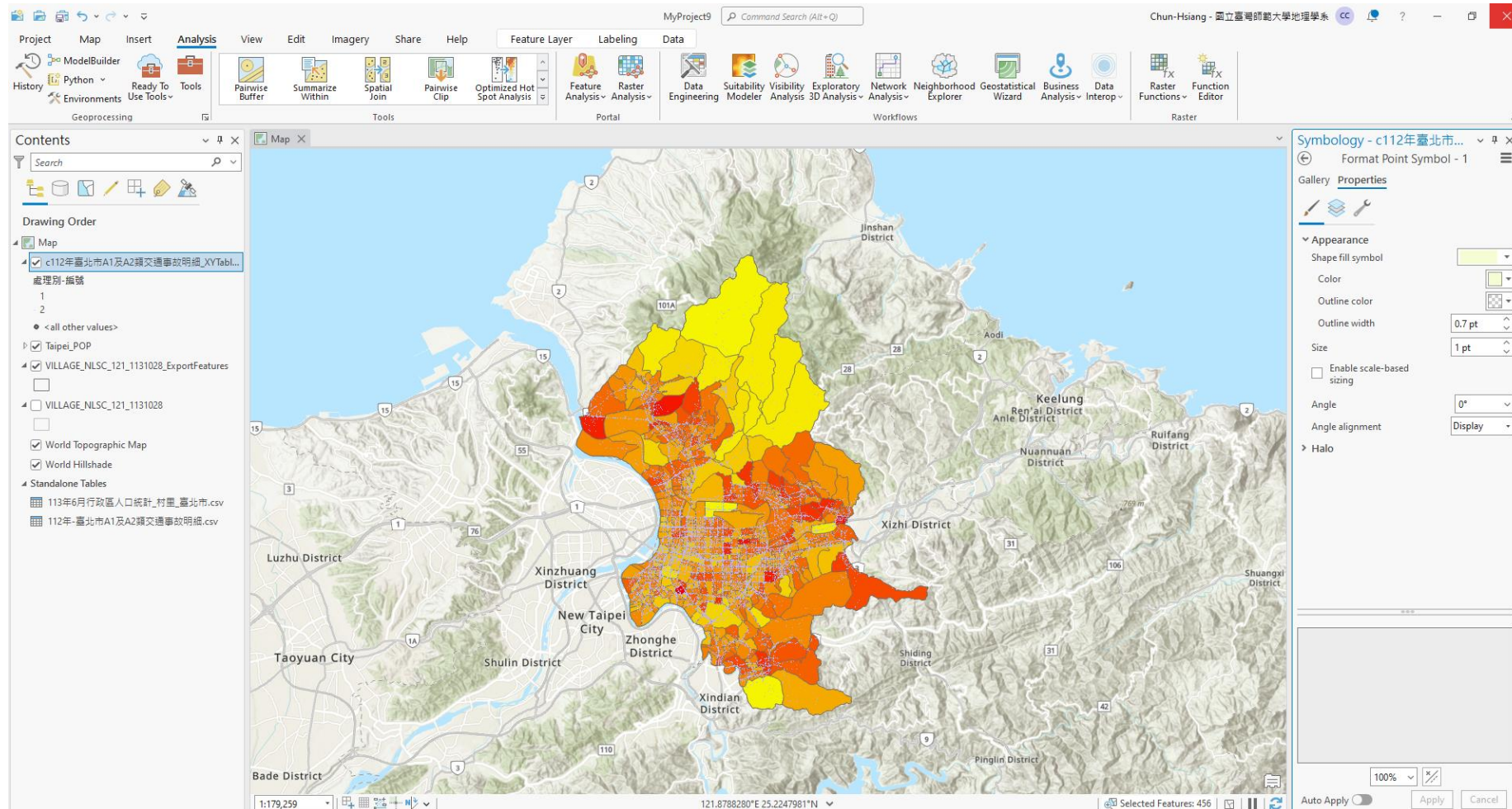
Taipei Population Data



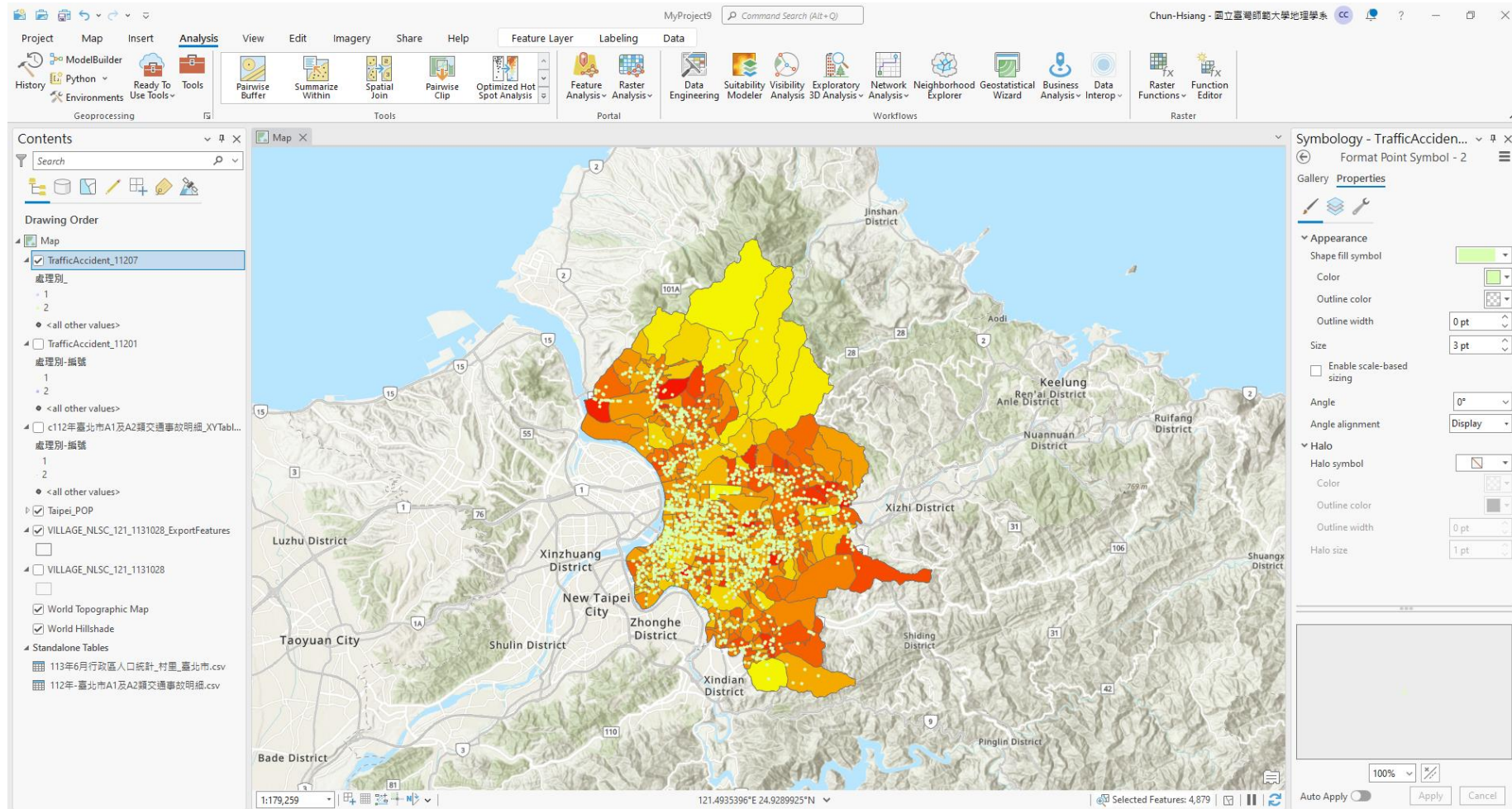
Overlay with Traffic Accident Data



Overlay with Traffic Accident Data



Overlay with Traffic Accident Data



Add a New Field "cnt" to both 11201 & 11207

The screenshot displays the ArcGIS Desktop interface. The main map shows a heatmap of traffic accidents in the New Taipei City area, with colors ranging from yellow to red. The 'Contents' pane on the left shows the layer 'TrafficAccident_11201' selected. The 'Attribute Table' at the bottom shows the fields for this layer, with the 'cnt' field highlighted in green. The 'cnt' field is a Long Integer type, with a length of 8000. The 'Current Layer' dropdown is set to 'TrafficAccident_11201'.

Visible	Read Only	Field Name	Alias	Data Type	Allow NULL	Highlight	Number Format	Domain	Default	Length
<input checked="" type="checkbox"/>	<input type="checkbox"/>	駕駛資格情形	駕駛資格情形	Long	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Numeric			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	駕駛執照種類	駕駛執照種類	Long	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Numeric			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	飲酒情形	飲酒情形	Long	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Numeric			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	車輛撞擊部位1	車輛撞擊部位1	Long	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Numeric			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	車輛撞擊部位2	車輛撞擊部位2	Text	<input checked="" type="checkbox"/>	<input type="checkbox"/>				8000
<input checked="" type="checkbox"/>	<input type="checkbox"/>	鑰匙碼-個別	鑰匙碼-個別	Long	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Numeric			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	鑰匙碼-主要	鑰匙碼-主要	Text	<input checked="" type="checkbox"/>	<input type="checkbox"/>				8000
<input checked="" type="checkbox"/>	<input type="checkbox"/>	個人筆迹否	個人筆迹否	Long	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Numeric			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	職業	職業	Long	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Numeric			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	旅次目的	旅次目的	Long	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Numeric			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	座標_X	座標-X	Double	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Numeric			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	座標_Y	座標-Y	Double	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Numeric			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	cnt		Long	<input checked="" type="checkbox"/>	<input type="checkbox"/>				

Fill 1 into “cnt” Field to both 11201 & 11207

The screenshot displays the ArcGIS Desktop interface. The main map shows a heatmap of traffic accidents in New Taipei City, with districts like Xinzhuang, Xizhi, and Keelung visible. The 'Contents' pane on the left shows the layer 'TrafficAccident_11207' selected. The 'Table' view at the bottom shows a data table with columns for accident details and a 'cnt' field. A context menu is open over the 'cnt' field, with the 'Calculate Field' option selected. The table data is as follows:

分組2	車道劃分-分組3	事故類型及型態	性別	年齡	受傷程度	主要傷處	保護裝置	行動電話	車輛用途	肇事者行動狀態	駕駛資格情形	駕駛執照種類	飲酒情形	車輛撞擊部位1	車輛撞擊部位2	肇因碼-個別	肇因碼-主要	cnt
1	5	2	9	1	34	2	9	1	1	7	9	1	10	2	14	<Null>	23	<Null>
2	5	2	9	1	24	3	10	4	5	8	16	8	20	10	16	<Null>	60	<Null>
3	5	2	12	1	48	3	10	1	1	7	7	1	8	1	2	<Null>	7	<Null>
4	5	2	12	1	22	2	7	1	1	7	7	1	10	1	14	<Null>	7	<Null>
5	5	2	12	2	22	2	8	4	5	7	21	8	20	10	15	<Null>	67	<Null>
6	4	2	17	2	27	2	9	3	4	7	9	1	10	2	12	<Null>	42	<Null>
7	4	2	17	1	63	4	11	3	4	7	10	7	19	11	15	<Null>	7	<Null>
8	5	2	11	1	22	2	9	1	1	7	9	1	10	2	11	<Null>	44	<Null>
9	5	2	11	1	64	3	10	1	1	7	5	1	4	2	6	<Null>	25	<Null>
10	5	1	12	1	52	3	10	1	1	7	6	1	4	2	5	<Null>	6	<Null>
11	5	1	12	2	56	2	9	1	1	7	9	8	20	2	16	<Null>	44	<Null>
12	5	2	12	1	33	2	9	1	1	7	9	1	10	2	12	<Null>	44	<Null>
13	5	2	12	1	49	3	10	1	1	7	5	1	8	2	4	<Null>	44	<Null>

Fill 1 into "cnt" Field to both 11201 & 11207

The screenshot shows the ArcGIS Desktop interface with the Calculate Field tool open. The tool is configured to modify the 'cnt' field in the 'TrafficAccident_11201' table. The expression type is set to Python, and the expression field contains the value '1'. The background map shows a geographic area with various districts and roads. A data table is visible at the bottom of the interface, showing columns for accident details and the 'cnt' field.

車禍標擊部位1	車禍標擊部位2	肇因碼-個別	肇因碼-主要	個人肇逃否	職業	旅次目的	座標-X	座標-Y	cnt
14	<Null>	23	<Null>	1	22	9	121.553042	25.037966	<Null>
16	<Null>	60	<Null>	1	22	9	121.553042	25.037966	<Null>
2	<Null>	7	<Null>	1	22	9	121.590862	25.064144	<Null>
14	<Null>	7	<Null>	1	22	9	121.590862	25.064144	<Null>
15	<Null>	67	<Null>	1	22	9	121.590862	25.064144	<Null>
12	<Null>	42	<Null>	1	22	9	121.518806	25.053082	<Null>
15	<Null>	7	<Null>	2	22	9	121.518806	25.053082	<Null>
11	<Null>	44	<Null>	1	22	9	121.594679	25.054392	<Null>
6	<Null>	25	<Null>	1	22	9	121.594679	25.054392	<Null>
5	<Null>	6	<Null>	1	22	9	121.537582	25.025825	<Null>
16	<Null>	44	<Null>	1	22	9	121.537582	25.025825	<Null>
12	<Null>	44	<Null>	1	22	9	121.529812	25.042606	<Null>
4	<Null>	44	<Null>	1	22	9	121.529812	25.042606	<Null>

Fill 1 into “cnt” Field to both 11201 & 11207

The screenshot displays the ArcGIS Desktop interface. The map shows a heatmap overlay on a geographic area, with colors ranging from yellow to red, indicating varying levels of density or intensity. The map includes labels for various districts such as Keelung, Ren'ai, Nuannuan, Rulfang, Xizhi, Xinzhuang, and New Taipei City. The interface includes a ribbon with various toolbars and a table view at the bottom.

The table view shows the following data:

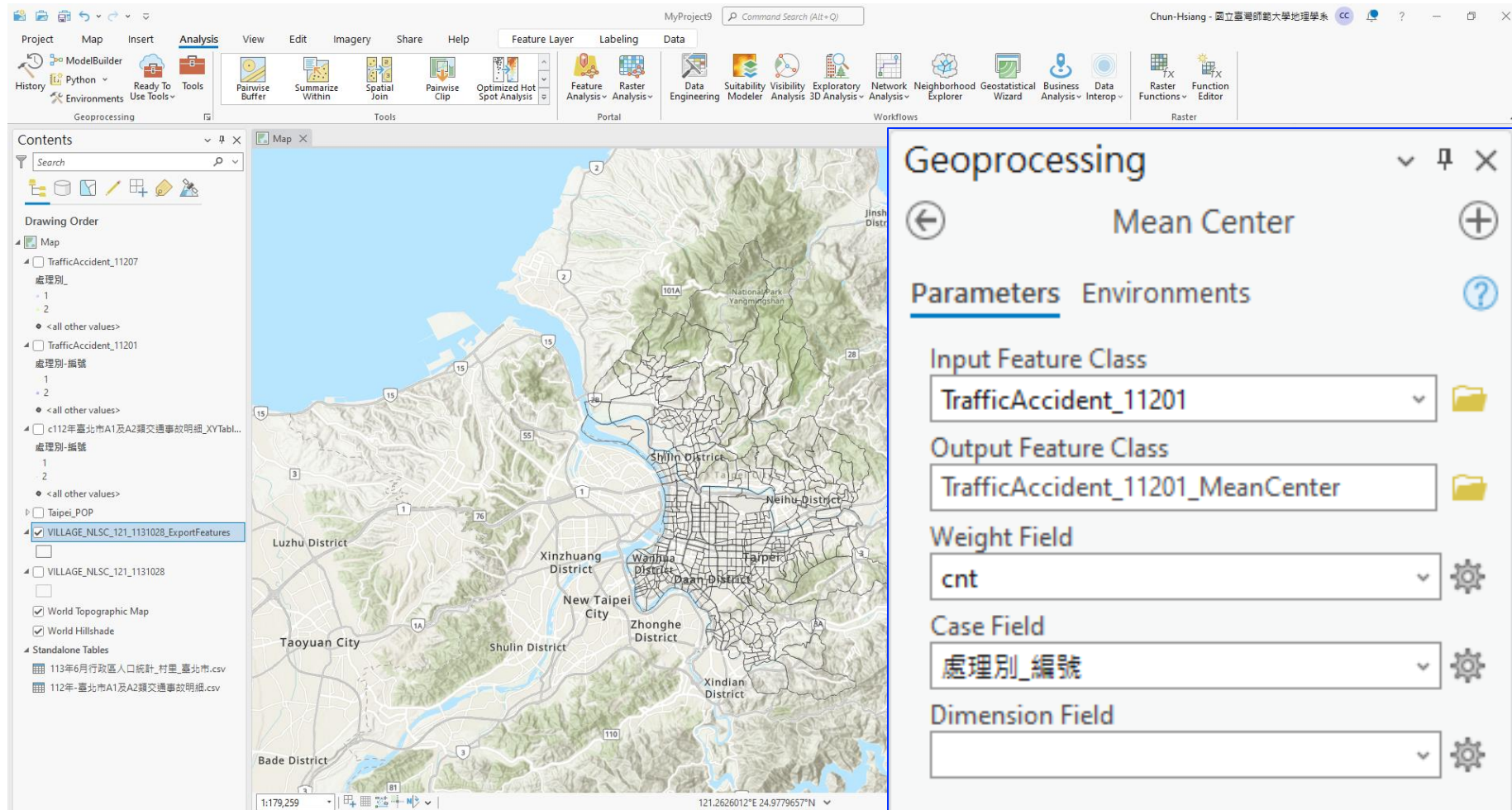
Field	Add	Calculate	Selection	Select By Attributes	Zoom To	Switch	Clear	Delete	Copy
1									
23	<Null>		1	22	9	121.553042	25.037966	1	
60	<Null>		1	22	9	121.553042	25.037966	1	
7	<Null>		1	22	9	121.590862	25.064144	1	
7	<Null>		1	22	9	121.590862	25.064144	1	
67	<Null>		1	22	9	121.590862	25.064144	1	
42	<Null>		1	22	9	121.518806	25.053082	1	
7	<Null>		2	22	9	121.518806	25.053082	1	
44	<Null>		1	22	9	121.594679	25.054392	1	
25	<Null>		1	22	9	121.594679	25.054392	1	
6	<Null>		1	22	9	121.537582	25.025825	1	
44	<Null>		1	22	9	121.537582	25.025825	1	
44	<Null>		1	22	9	121.529812	25.042606	1	
44	<Null>		1	22	9	121.529812	25.042606	1	

Central Tendency Analysis

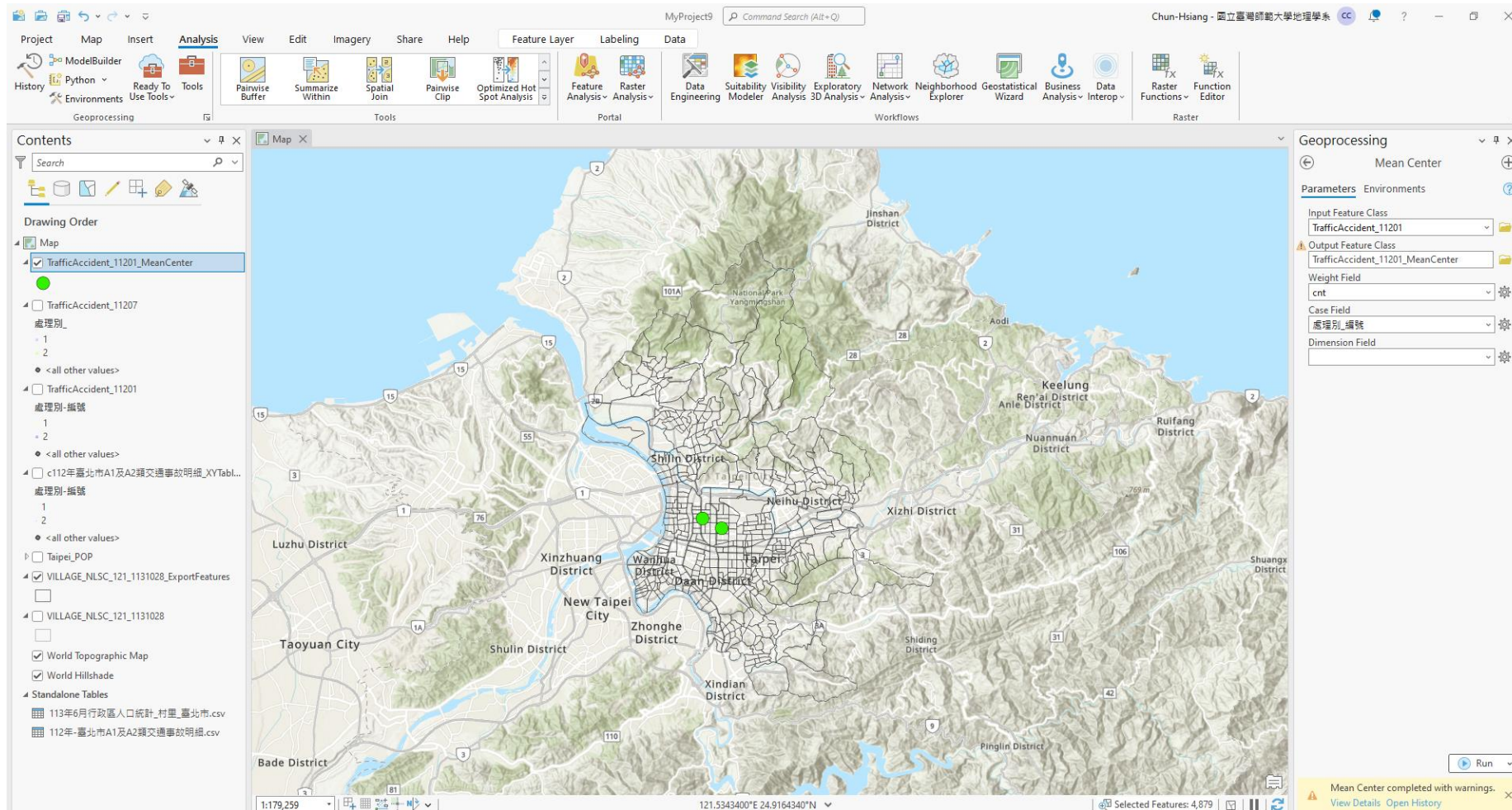
Compute the following functions with both TrafficAccident_11201 and TrafficAccident_11207

- 1) Mean Center
- 2) Median Center
- 3) Standard Distance
- 4) Central Feature
- 5) Directional Distribution

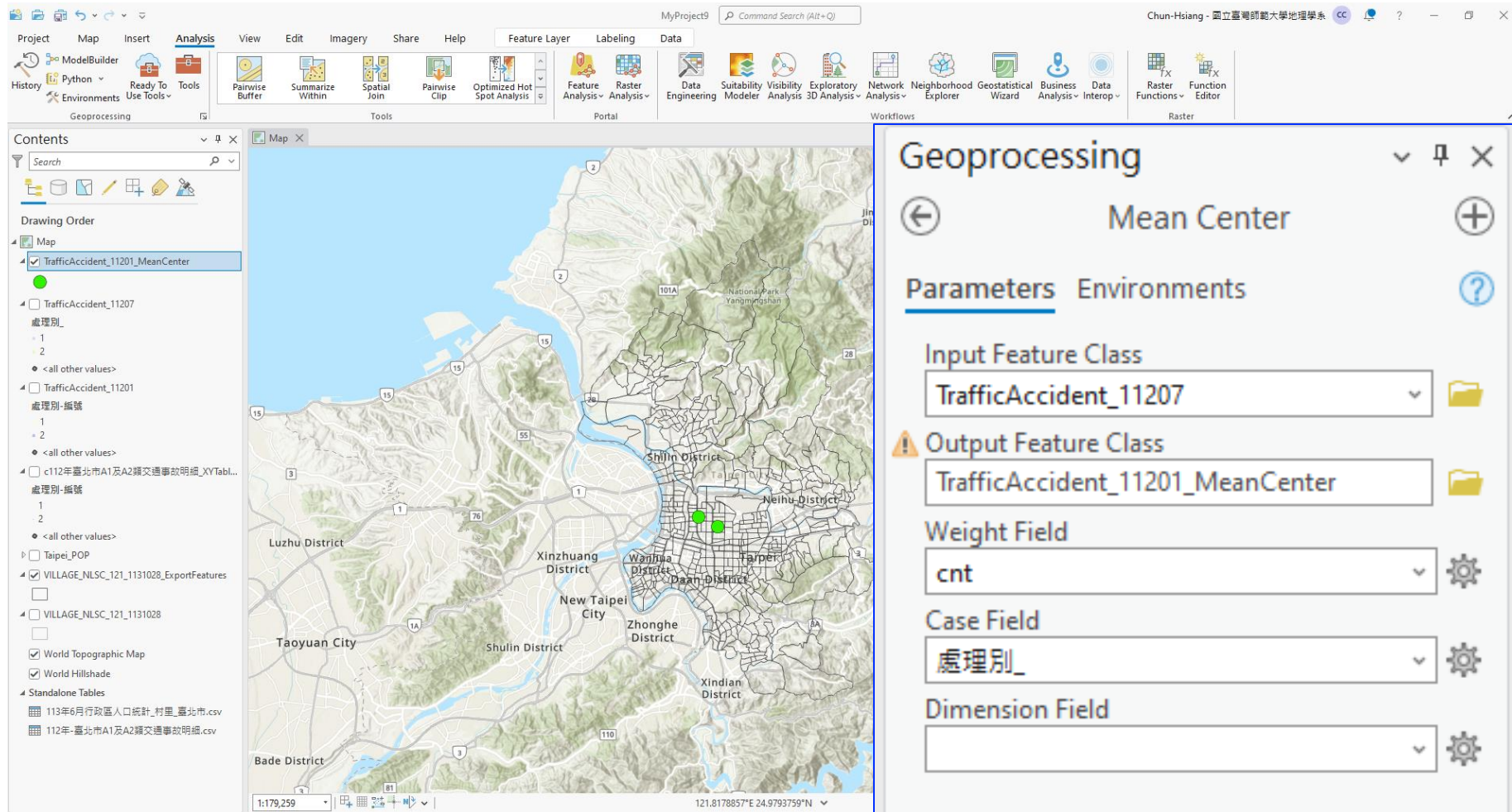
Mean Center



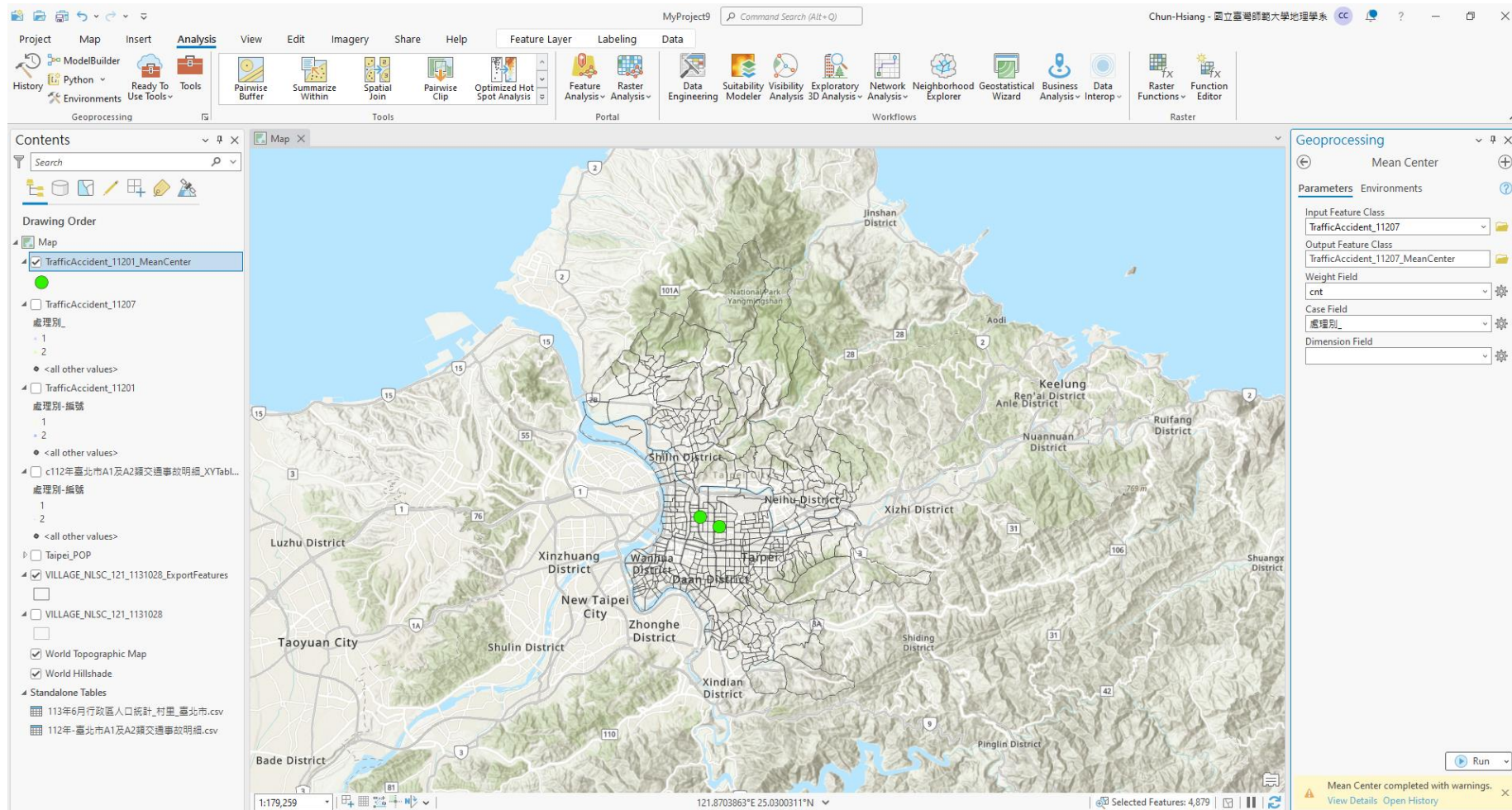
Mean Center



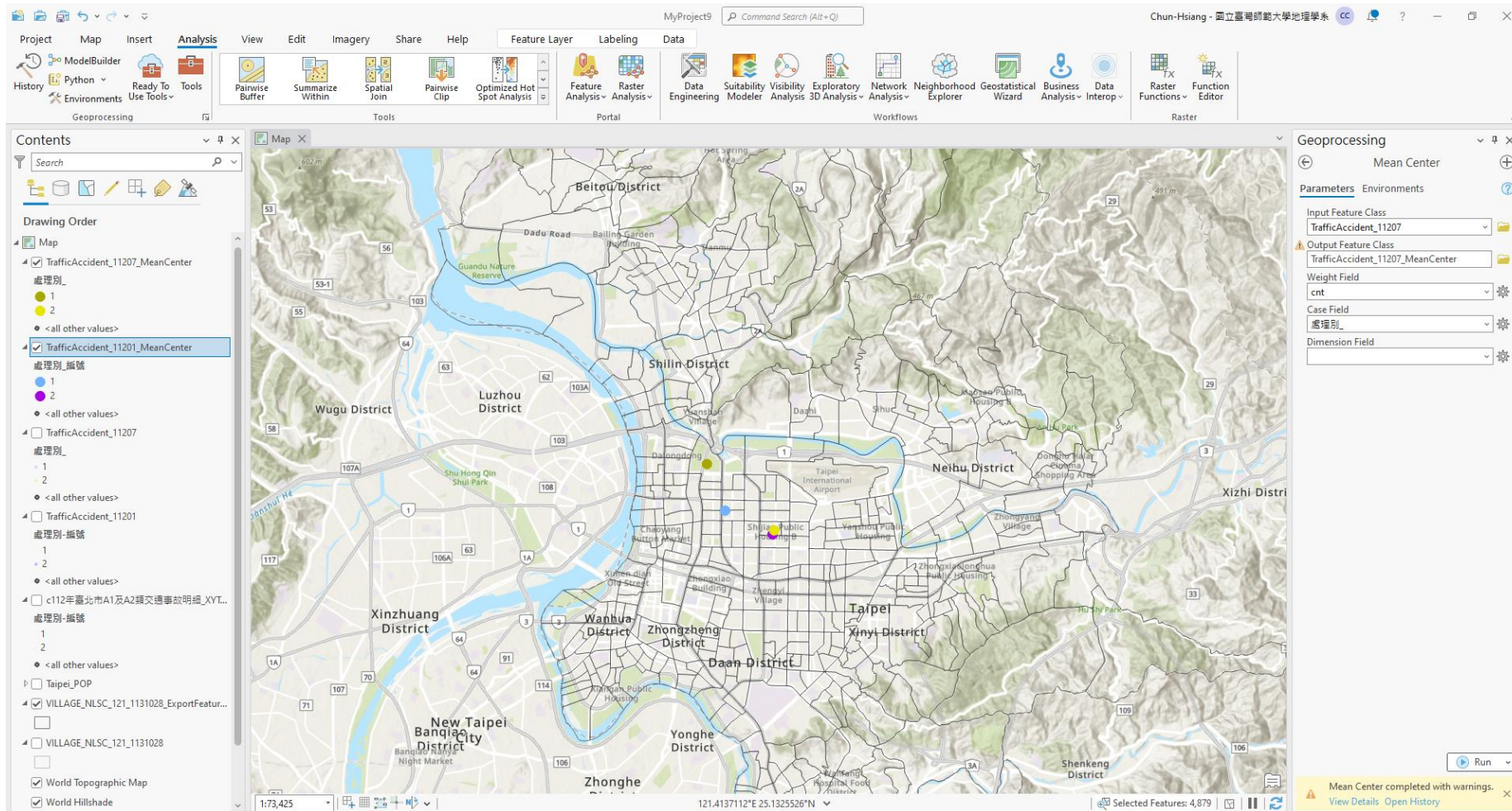
Mean Center



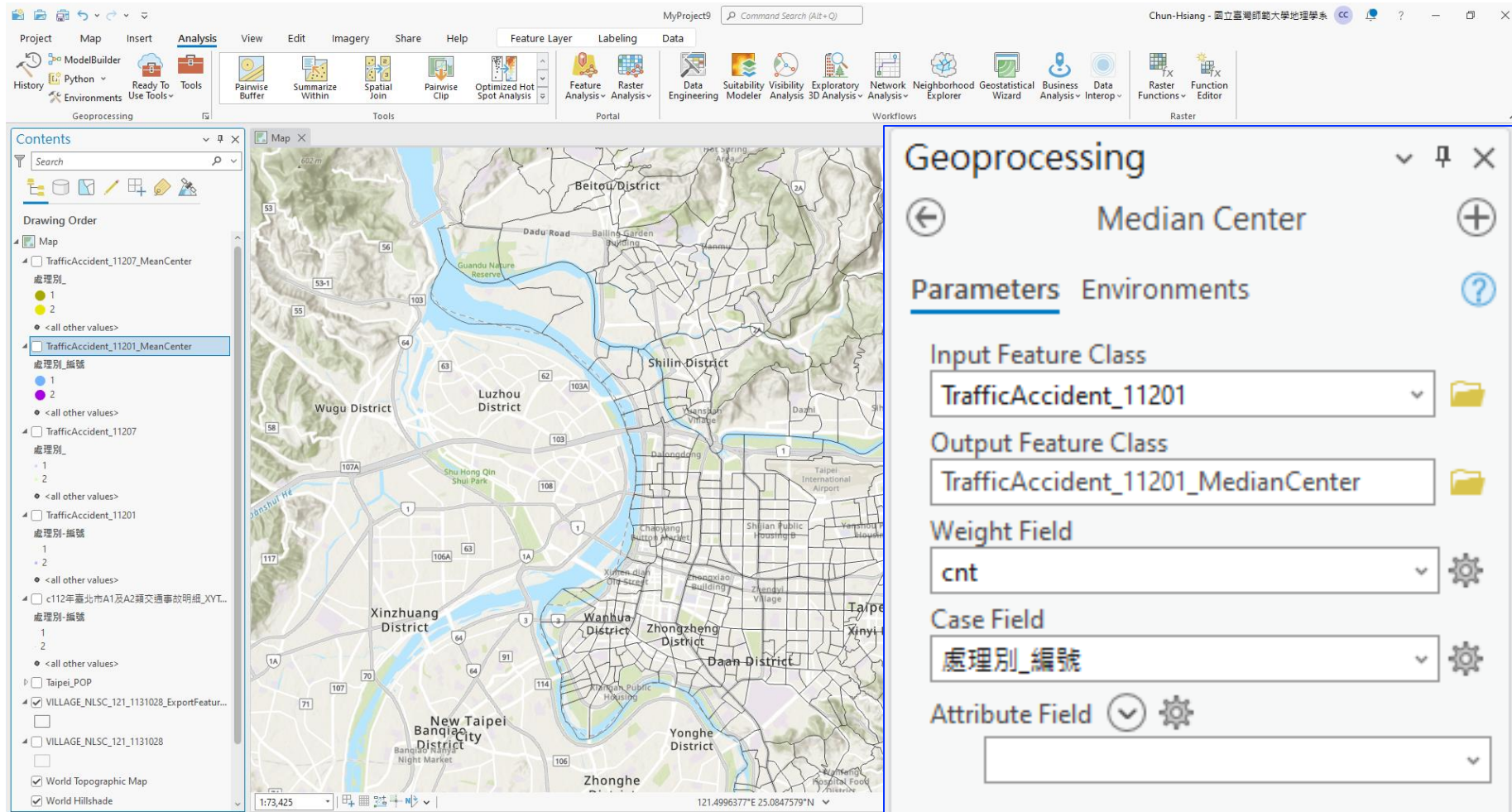
Mean Center



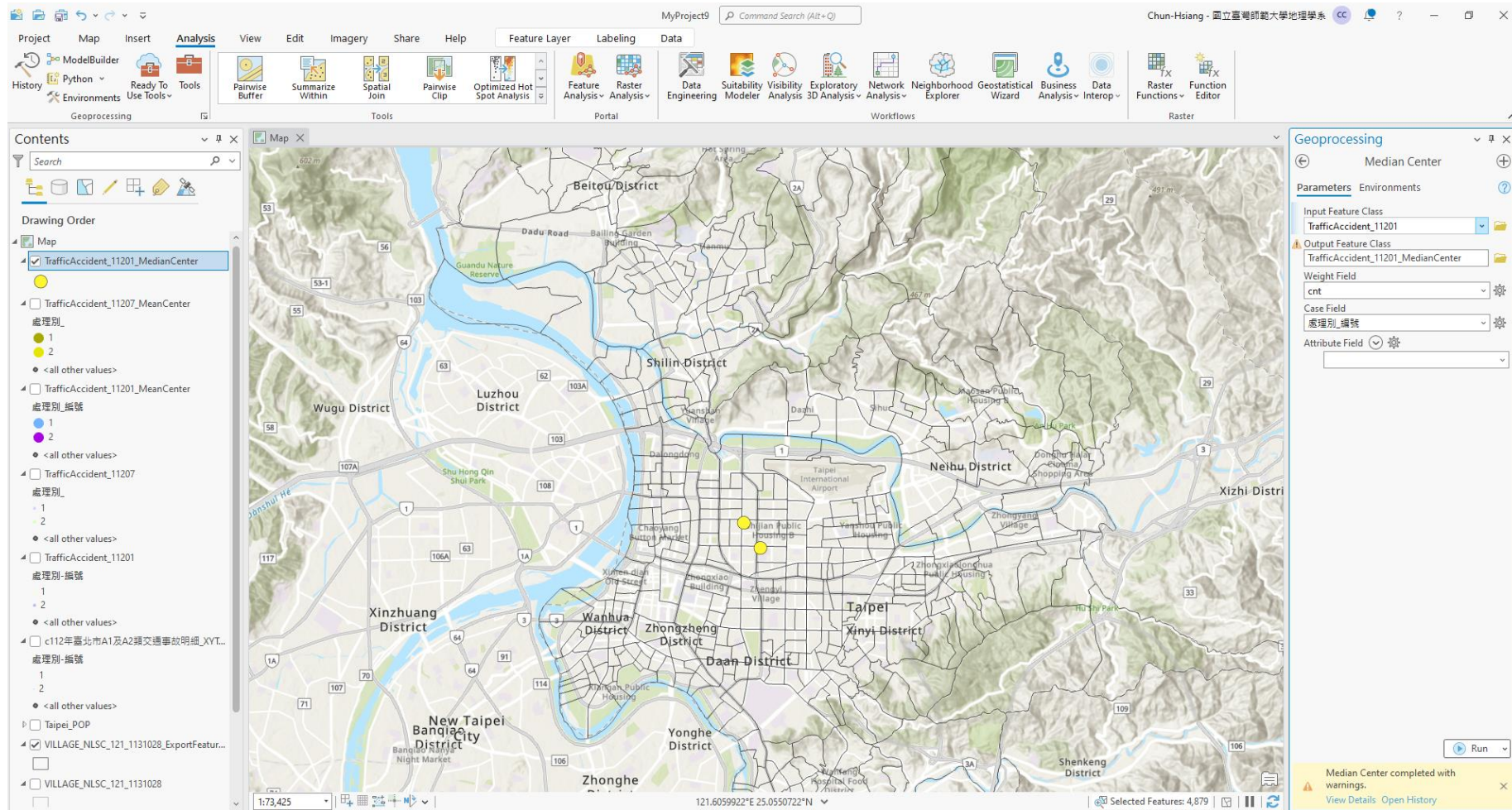
Mean Center :: Symbology



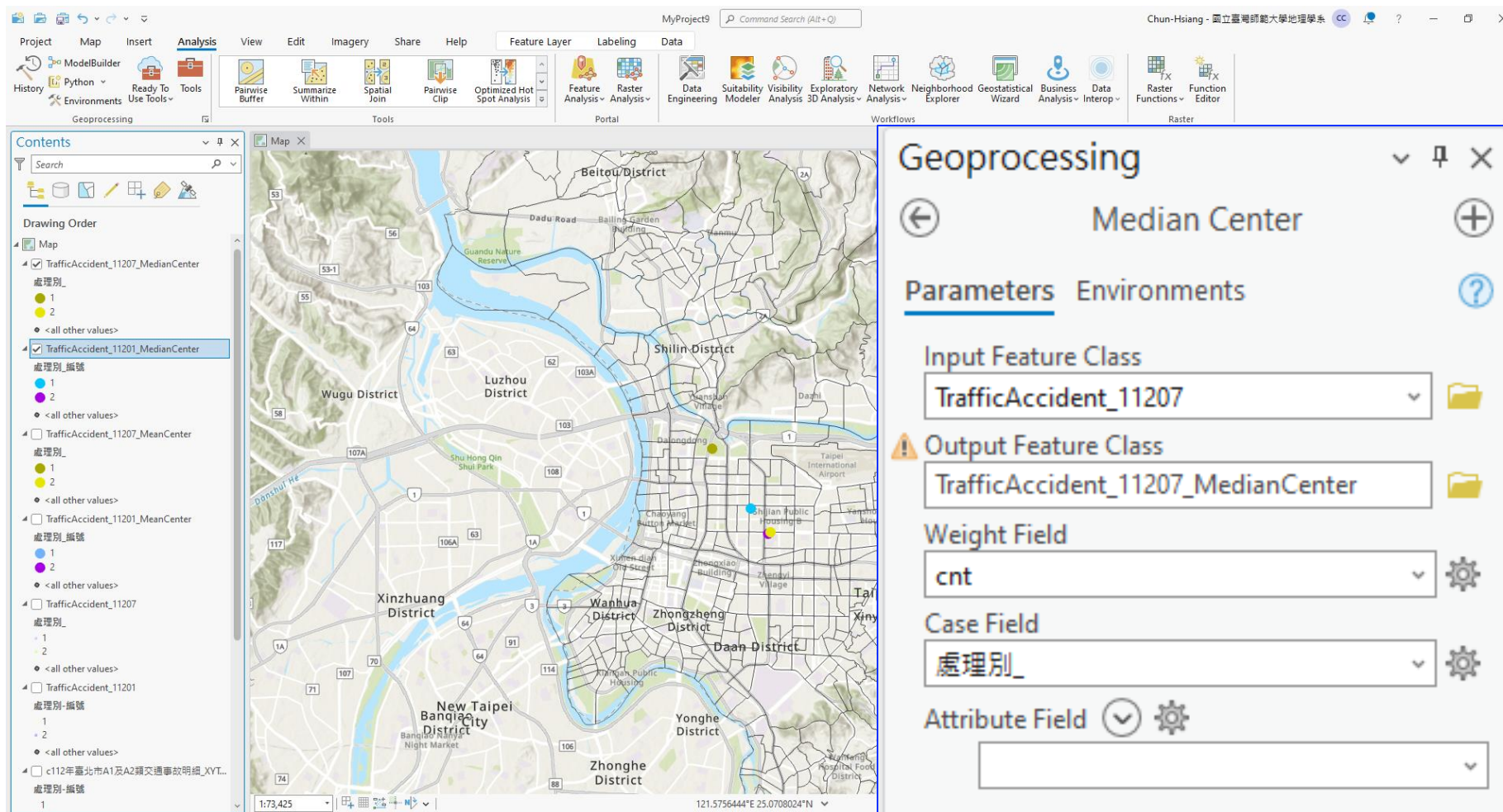
Median Center



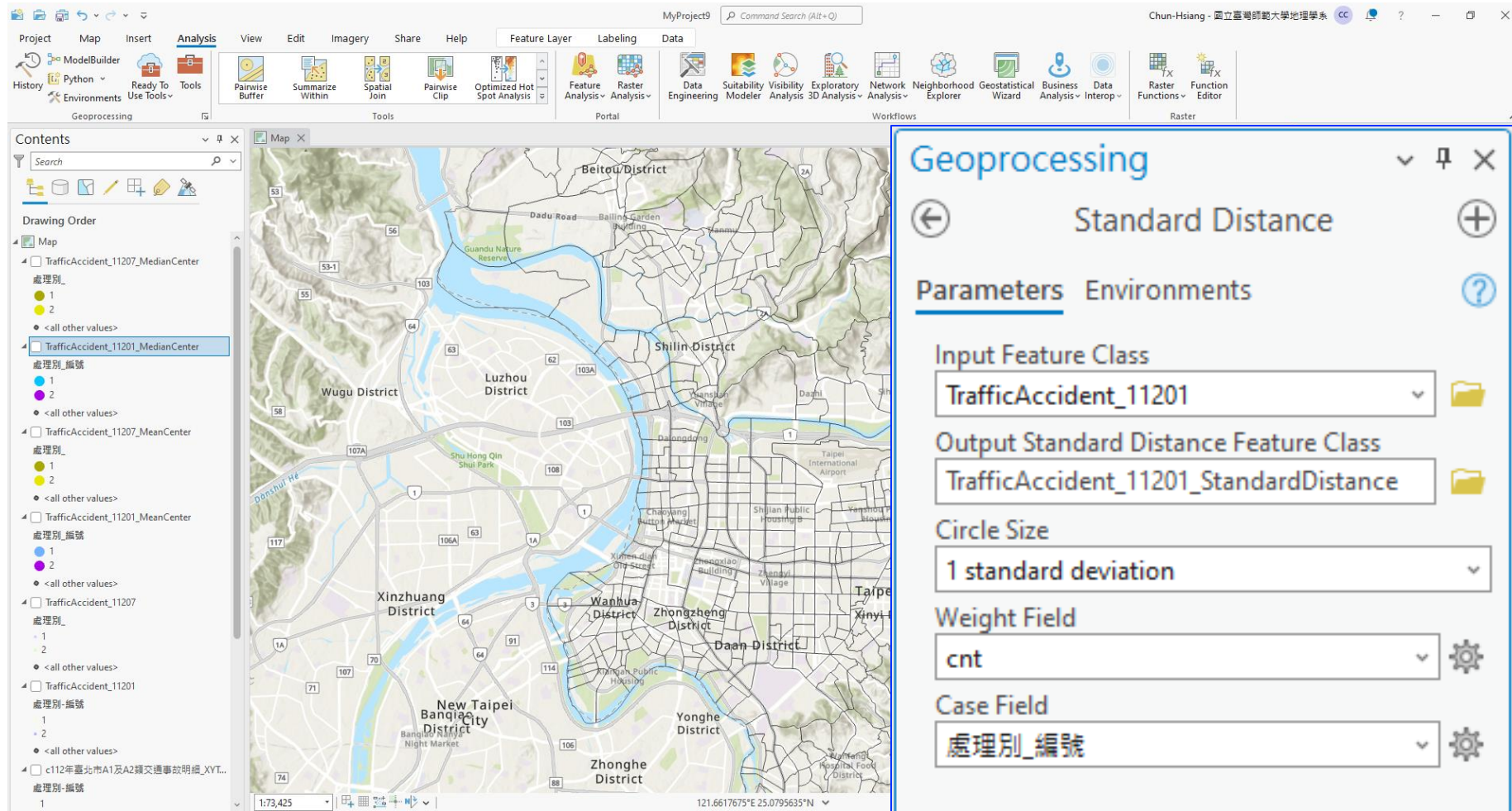
Median Center



Median Center :: Symbology



Standard Distance



Standard Distance

The screenshot shows the ArcGIS Pro interface with the Standard Distance tool open. The map displays a city area with two overlapping purple circles representing standard distance buffers. The tool parameters are set to use 'TrafficAccident_11201' as the input, 'TrafficAccident_11201_StandardDistance' as the output, a circle size of '1 standard deviation', and 'cnt' as the weight field. The case field is set to '處理別_編號'.

Geoprocessing

Standard Distance

Parameters Environments

Input Feature Class
TrafficAccident_11201

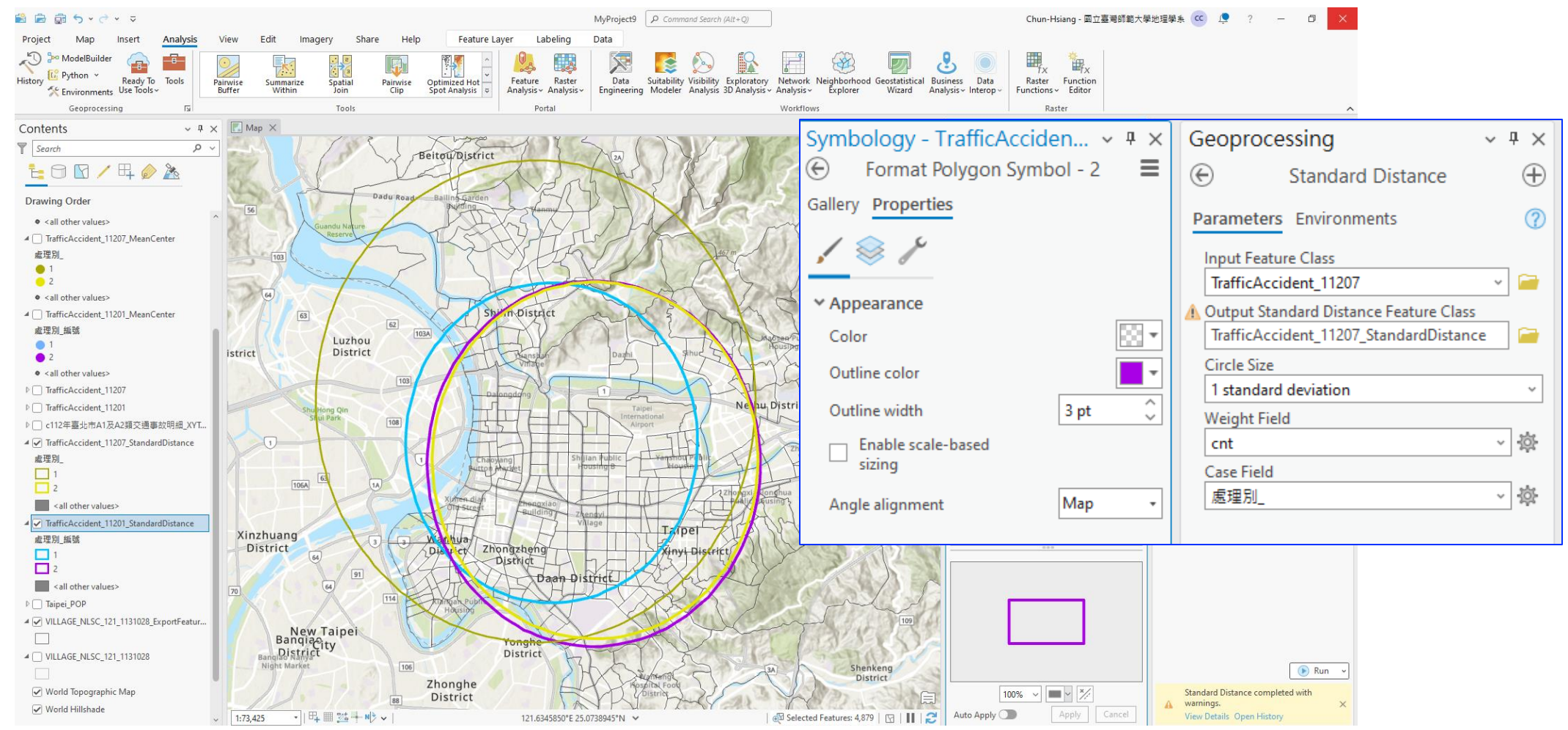
Output Standard Distance Feature Class
TrafficAccident_11201_StandardDistance

Circle Size
1 standard deviation

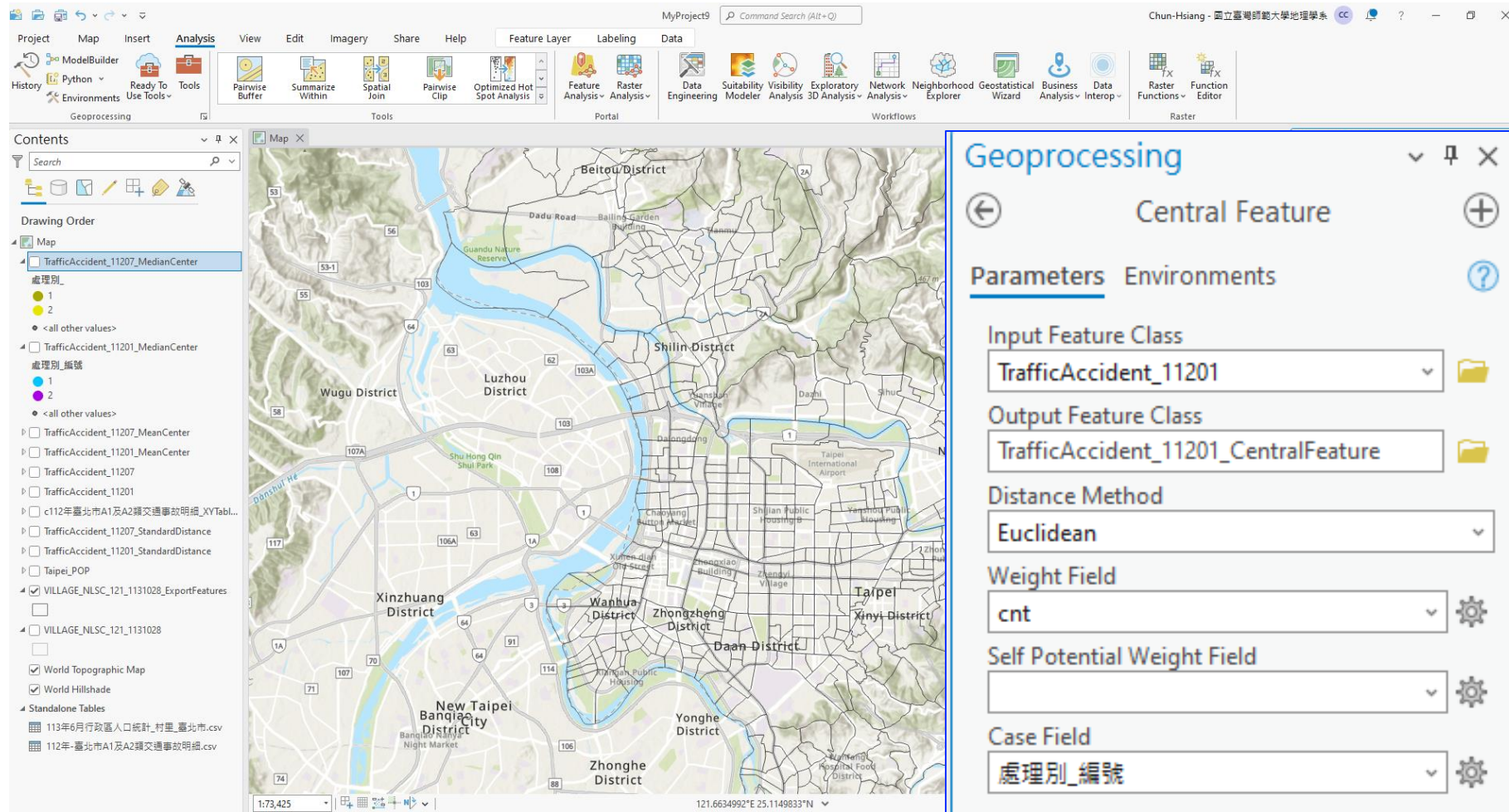
Weight Field
cnt

Case Field
處理別_編號

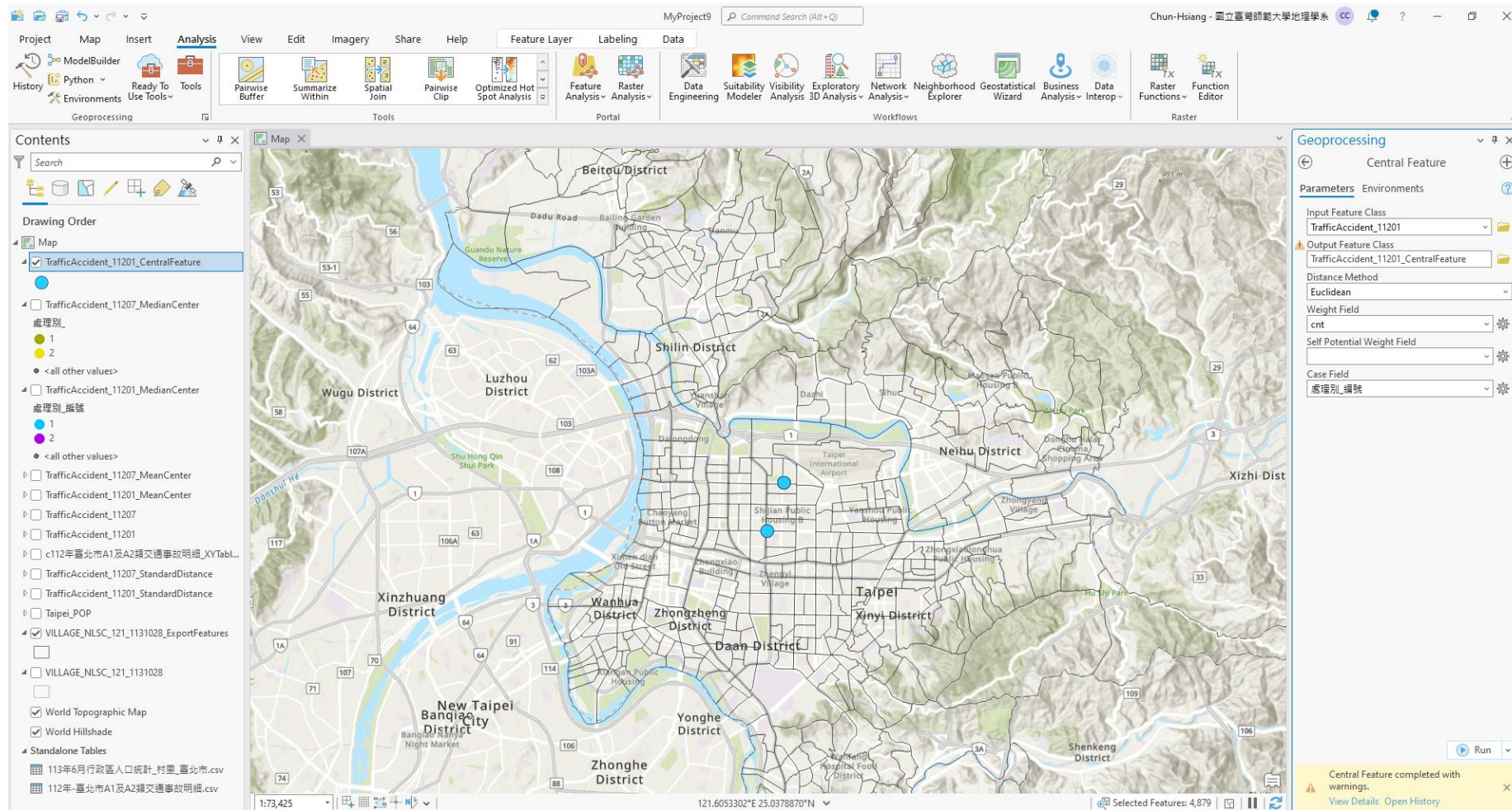
Standard Distance :: Symbology



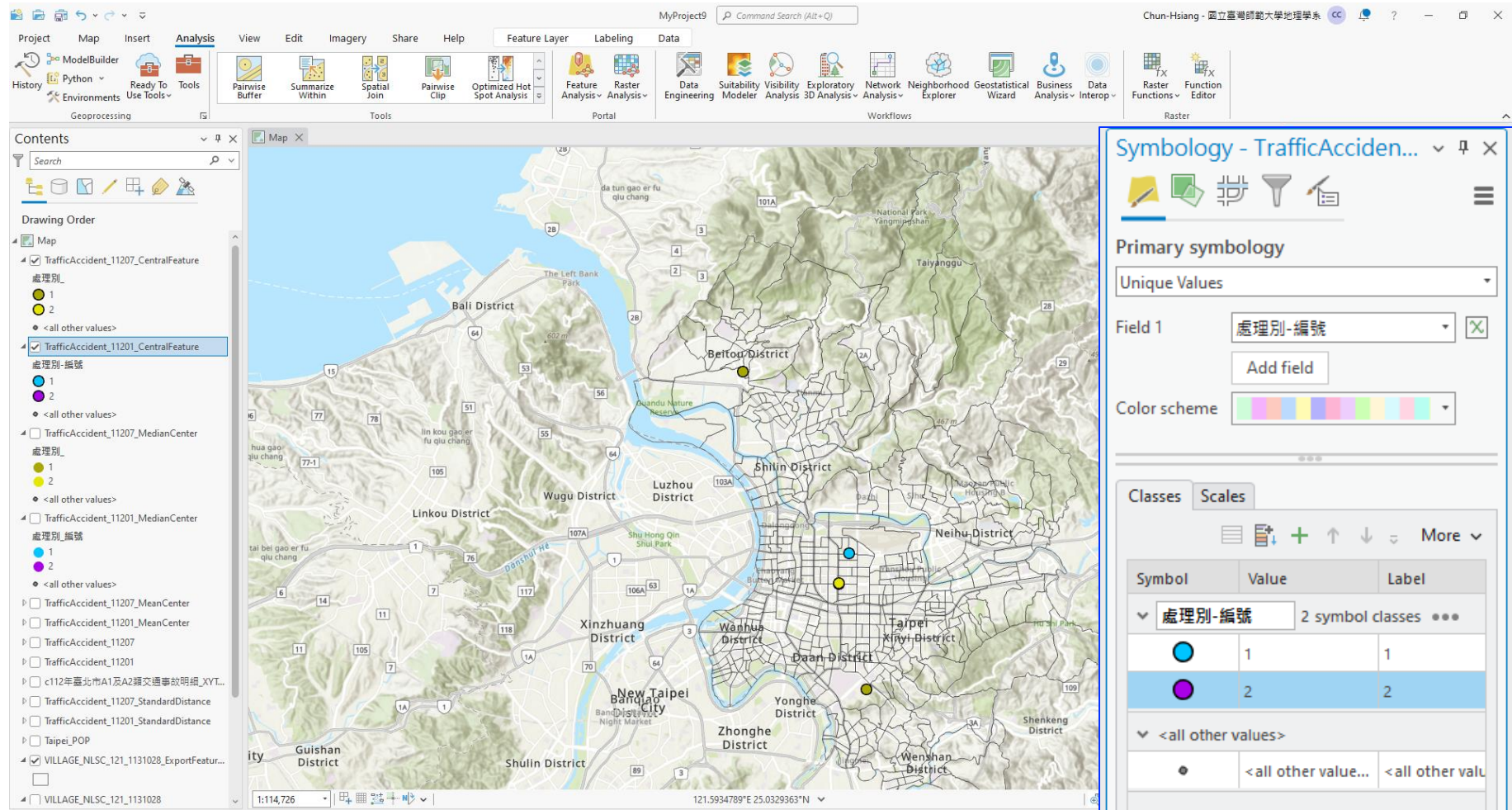
Central Feature



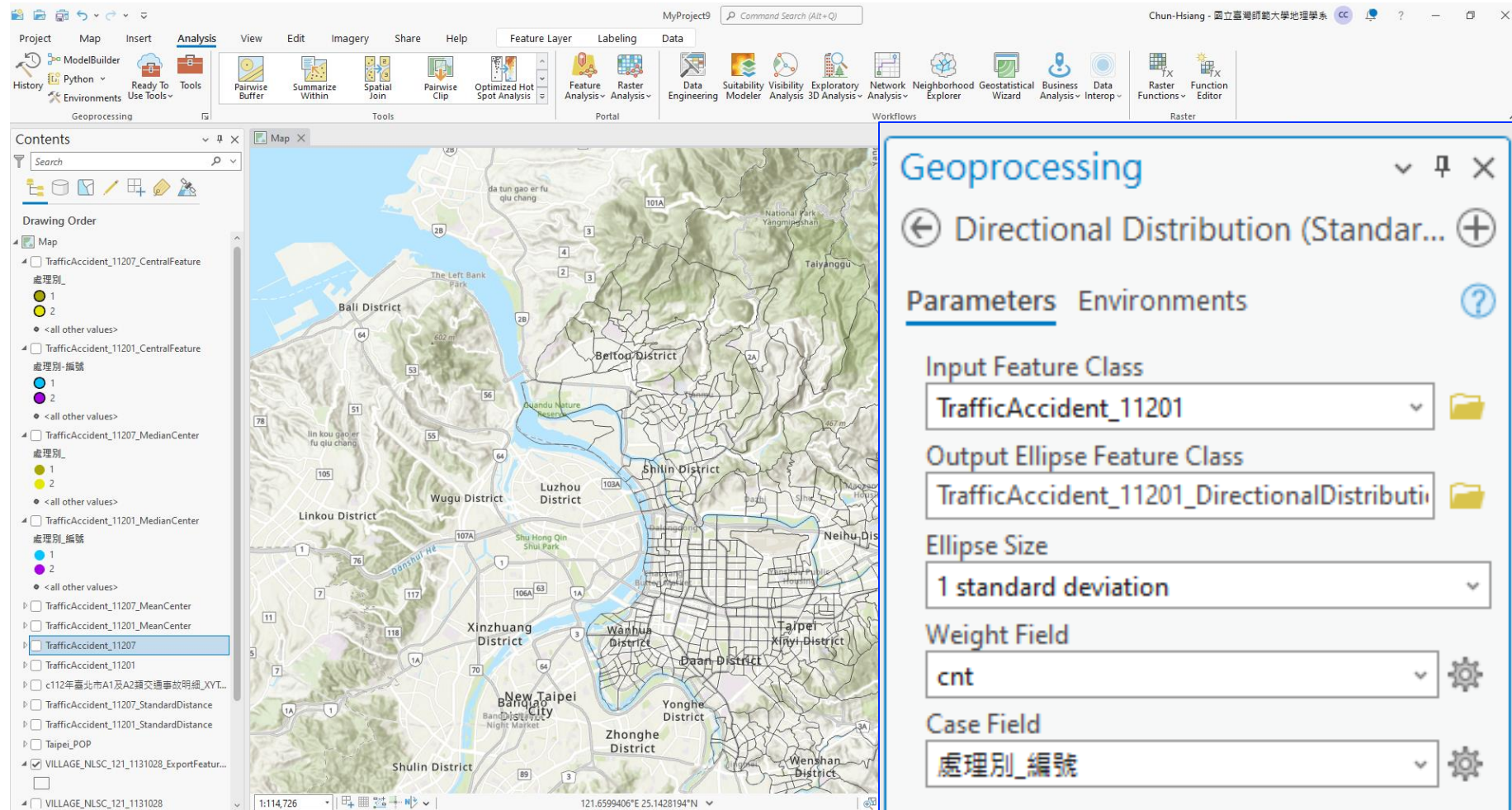
Central Feature



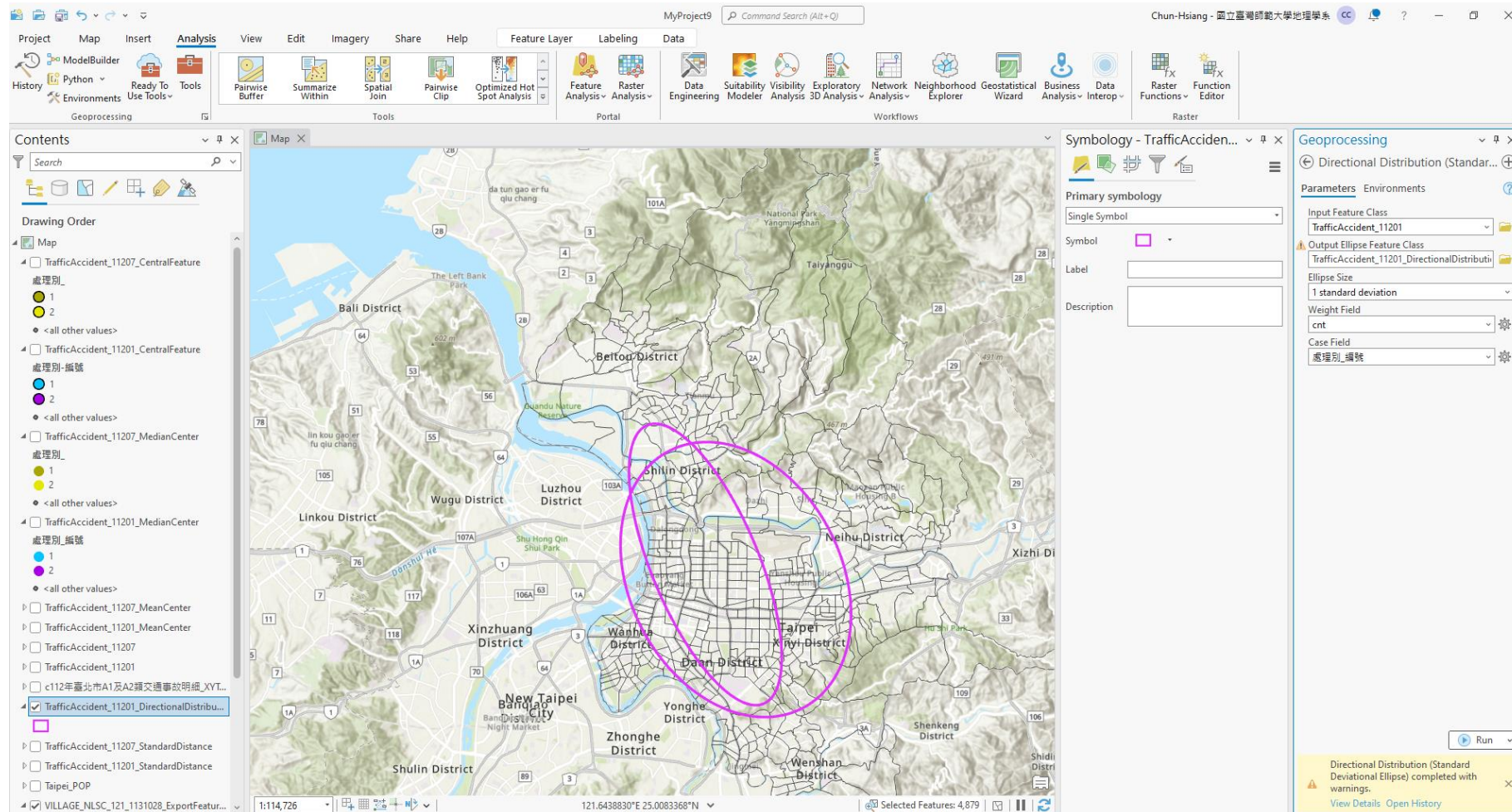
Central Feature :: Symbology



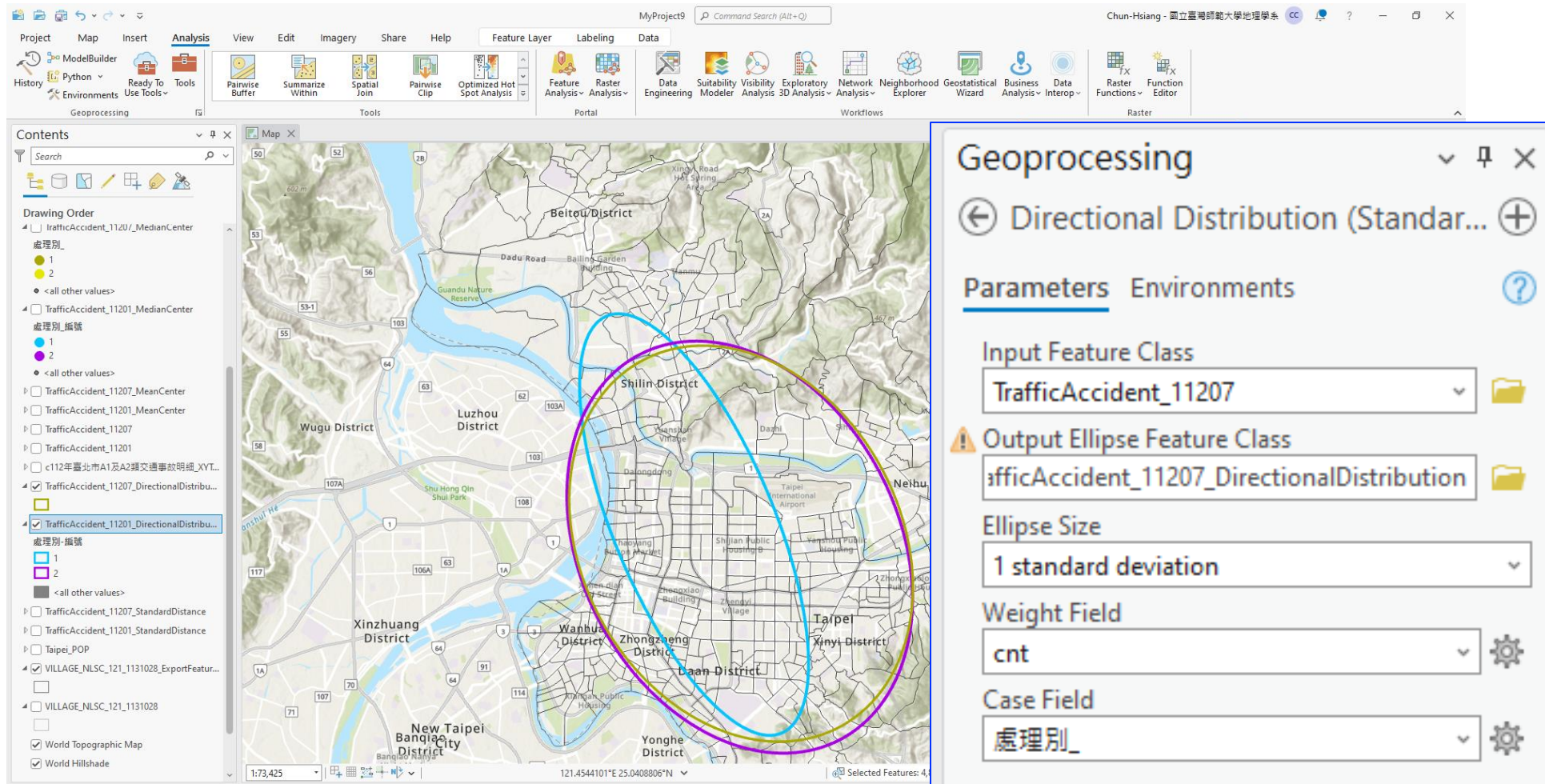
Directional Distribution



Directional Distribution



Directional Distribution :: Symbology



Spatial Statistics Analysis

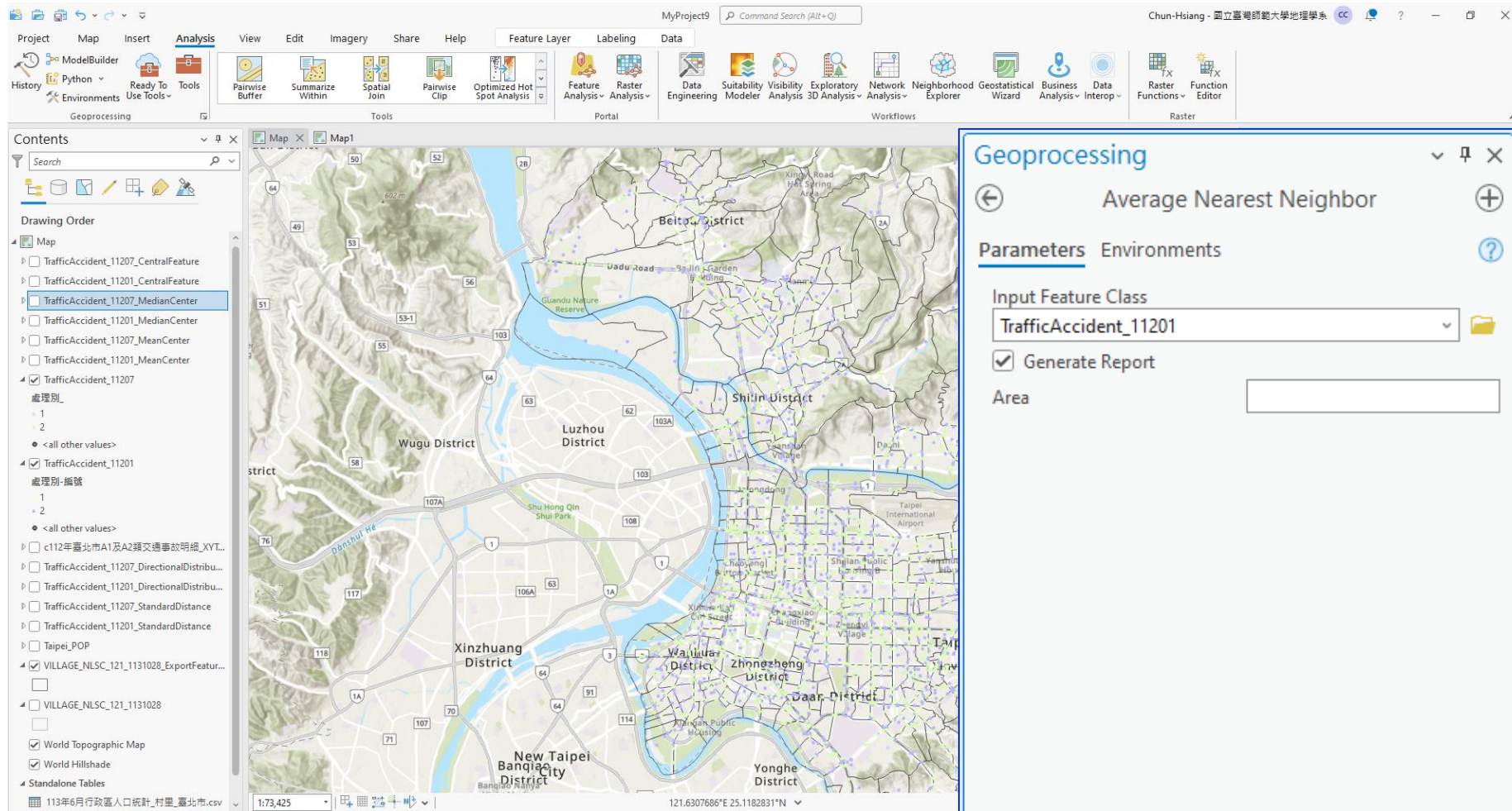
Compute the following function with both TrafficAccident_11201 and TrafficAccident_11207

- 1) Average Nearest Neighbor

Compute the following functions with the population data from Taipei POP data.

- 1) Incremental Spatial Autocorrelation
- 2) High/Low Clustering (Getis-Ord General G)
- 3) Repley's k -function
- 4) Spatial Autocorrelation (Global Moran's I)

Average Nearest Neighbor



Average Nearest Neighbor

Average Nearest Neighbor (Spatial Statistics Tools)

Started: Today at 上午 04:08:11
 Completed: Today at 上午 04:08:12
 Elapsed Time: 1 Second

WARNING 001605: Distances for Geographic Coordinates (degrees, minutes, seconds) are analyzed using Chordal Distances in meters.

Parameters Environments Messages (4)

Start Time: 2024年11月13日 上午 04:08:11

WARNING 001605: Distances for Geographic Coordinates (degrees, minutes, seconds) are analyzed using Chordal Distances in meters.

Average Nearest Neighbor Summary

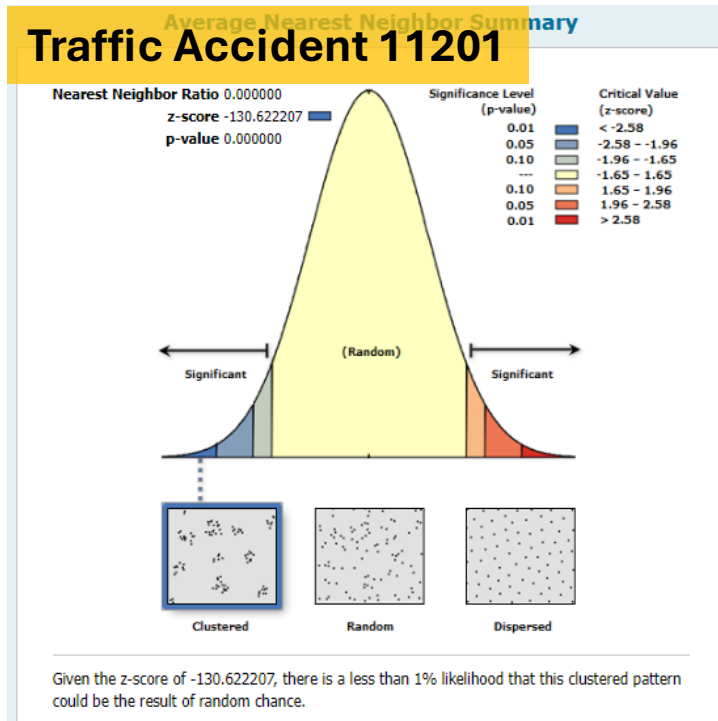
Observed Mean Distance	0.000000
Expected Mean Distance	134.911242
Nearest Neighbor Ratio	0.000000
z-score	-130.622207
p-value	0.000000

Distance measured in meters
 Writing html report...
D:\TooDou\GIS\W08\MyProject9\NearestNeighbor_Result_53124_20400
 Succeeded at 2024年11月13日 上午 04:08:12 (Elapsed Time: 1.79 seconds)

Geoprocessing: Average Nearest Neighbor
 Input Feature Class: TrafficAccident_11201
 Generate Report:
 Area:

Average Nearest Neighbor completed with warnings.

Average Nearest Neighbor

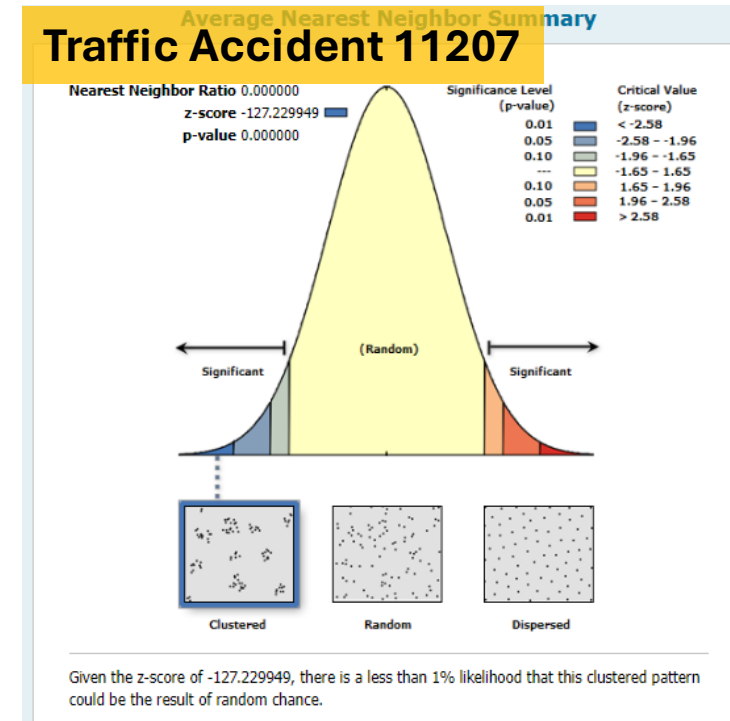


Average Nearest Neighbor Summary

Observed Mean Distance	0.0000 meters
Expected Mean Distance	134.9112 meters
Nearest Neighbor Ratio	0.000000
z-score	-130.622207
p-value	0.000000

Dataset Information

Input Feature Class:	TrafficAccident_11201
Distance Method:	EUCLIDEAN
Study Area:	339413055.219921
Selection Set:	False



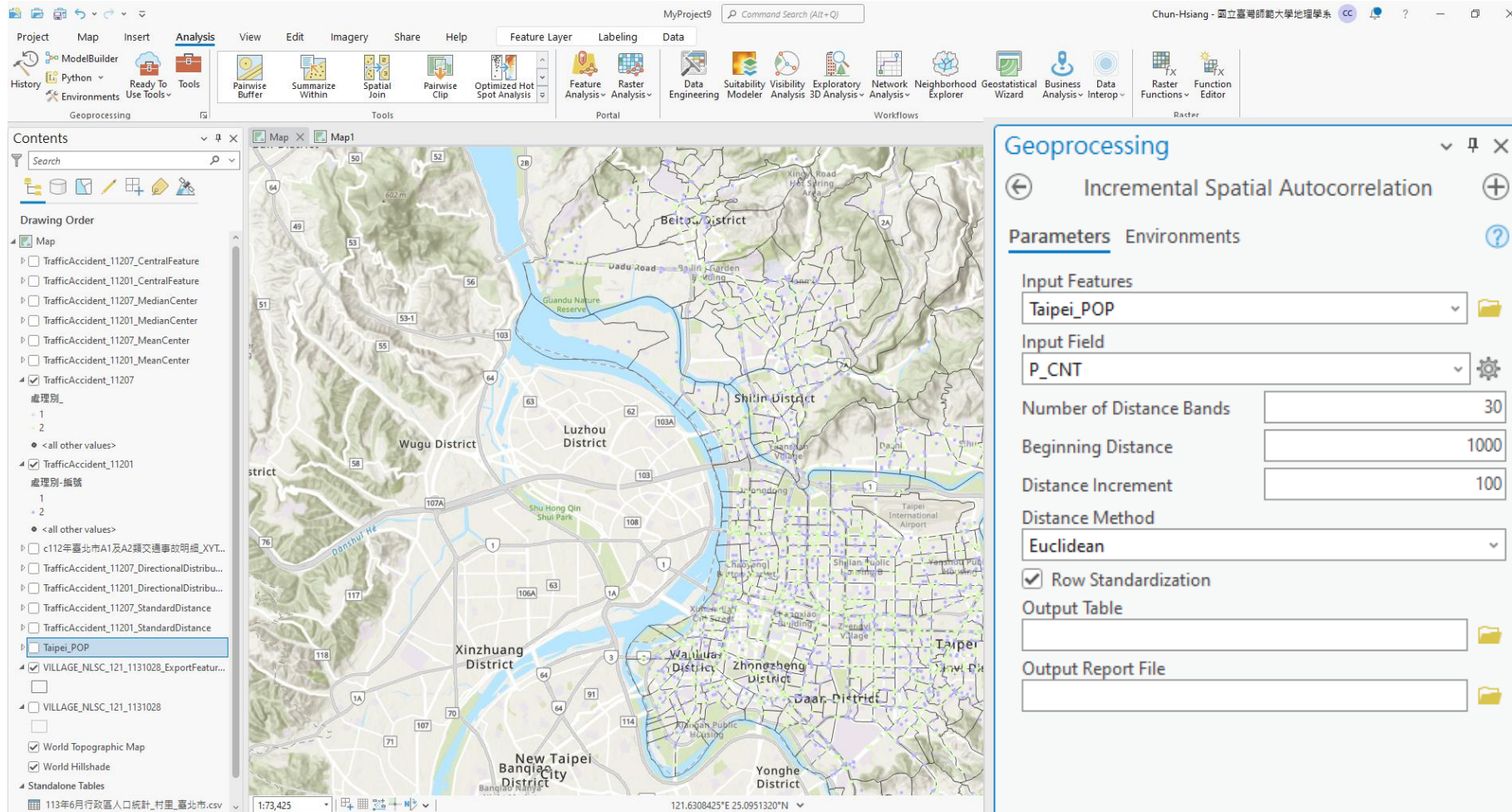
Average Nearest Neighbor Summary

Observed Mean Distance	0.0000 meters
Expected Mean Distance	137.7066 meters
Nearest Neighbor Ratio	0.000000
z-score	-127.229949
p-value	0.000000

Dataset Information

Input Feature Class:	TrafficAccident_11207
Distance Method:	EUCLIDEAN
Study Area:	335495527.346745
Selection Set:	False

Incremental Spatial Autocorrelation



Incremental Spatial Autocorrelation

The screenshot displays the ArcGIS Pro interface with the Incremental Spatial Autocorrelation tool (Spatial Statistics Tools) running. The tool window shows the following parameters:

- Input: TrafficAccident_11207
- Environment: None
- Distance: 2500.00
- Output: Incremental Spatial Autocorrelation (Spatial Statistics Tools)

The results window displays the Global Moran's I Summary by Distance table:

Distance	Moran's Index	Expected Index	Variance	z-score	p-value
1000.00	0.156133	-0.002358	0.000587	6.540334	0.000000
1100.00	0.148698	-0.002315	0.000511	6.680377	0.000000
1200.00	0.144717	-0.002304	0.000426	7.126809	0.000000
1300.00	0.131357	-0.002288	0.000366	6.983066	0.000000
1400.00	0.144805	-0.002252	0.000362	7.730975	0.000000
1500.00	0.149426	-0.002237	0.000339	8.234156	0.000000
1600.00	0.149717	-0.002232	0.000282	9.046065	0.000000
1700.00	0.153383	-0.002222	0.000263	9.603903	0.000000
1800.00	0.154396	-0.002222	0.000223	10.479539	0.000000
1900.00	0.141141	-0.002222	0.000197	10.216261	0.000000
2000.00	0.133924	-0.002222	0.000176	10.261348	0.000000
2100.00	0.123267	-0.002222	0.000159	9.945561	0.000000
2200.00	0.123097	-0.002222	0.000144	10.448059	0.000000

Summary statistics from the results window:

- First Peak (Distance; Value): 1200.00; 7.126809
- Max Peak (Distance; Value): 3500.00; 12.731467
- Distance measured in meters
- Succeeded at 2024年11月13日 上午 04:21:45 (Elapsed Time: 0.28 seconds)

High/Low Clustering (Getis-Ord General G)

The screenshot shows the ArcGIS Desktop interface with the Geoprocessing tool 'High/Low Clustering (Getis-Ord General G)' open. The tool parameters are configured as follows:

- Input Feature Class: Taipei_POP
- Input Field: P_CNT
- Generate Report:
- Conceptualization of Spatial Relationships: Inverse distance
- Distance Method: Euclidean
- Standardization: Row
- Distance Band or Threshold Distance: 3500

High/Low Clustering (Getis-Ord General G)

High/Low Clustering (Getis-Ord General G) (Spatial Statistics Tools)

Started: Today at 上午 04:23:01
 Completed: Today at 上午 04:23:01
 Elapsed Time: 0.83 Seconds

Parameters Environments Messages (3)

Start Time: 2024年11月13日 上午 04:23:01

General G Summary

Observed General G	0.002239
Expected General G	0.002198
Variance	0.000000
z-score	6.009102
p-value	0.000000

Distance measured in meters
 Writing html report...
D:\TooDou\GIS\W08\MyProject9\GeneralG_Result_53124_20400_.html
 Succeeded at 2024年11月13日 上午 04:23:01 (Elapsed Time: 0.38 seconds)

High-Low Clustering Report

Observed General G 0.002239
 z-score 6.009102
 p-value 0.000000

Significance Level (p-value)

0.01	< -2.58
0.05	-2.58 - -1.96
0.10	-1.96 - -1.65
0.10	-1.65 - 1.65
0.05	1.65 - 1.96
0.01	1.96 - 2.58
0.01	> 2.58

Critical Value (z-score)

Significant Random Significant

Low-Clusters Random High-Clusters

Given the z-score of 6.009101810492872, there is a less than 1% likelihood that this high-clustered pattern could be the result of random chance.

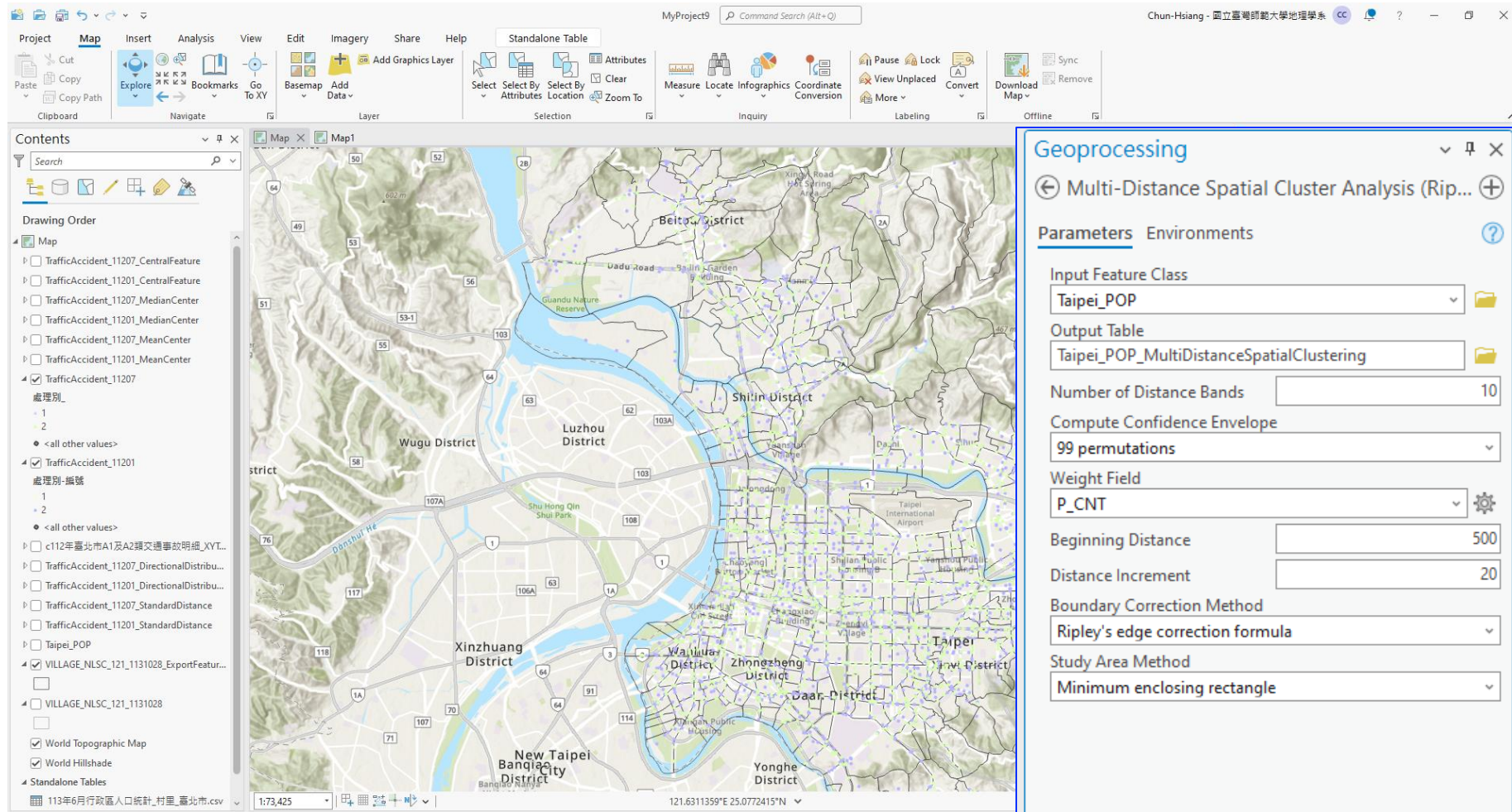
General G Summary

Observed General G	0.002239
Expected General G	0.002198
Variance	0.000000
z-score	6.009102
p-value	0.000000

Dataset Information

Input Feature Class:	Taipei_POP
Input Field:	P_CNT
Conceptualization:	INVERSE_DISTANCE
Distance Method:	EUCLIDEAN
Row Standardization:	True
Distance Threshold:	3500.0000 meters
Weights Matrix File:	None

Repley's k -function



The screenshot displays the ArcGIS Pro interface. The main map shows a geographic area including Taipei and surrounding districts like Beitou, Shilin, Luzhou, and Xinzhuang. The Geoprocessing tool is open on the right, showing the following parameters:

- Multi-Distance Spatial Cluster Analysis (Ripley's k -function)**
- Parameters** | Environments
- Input Feature Class:** Taipei_POP
- Output Table:** Taipei_POP_MultiDistanceSpatialClustering
- Number of Distance Bands:** 10
- Compute Confidence Envelope:** 99 permutations
- Weight Field:** P_CNT
- Beginning Distance:** 500
- Distance Increment:** 20
- Boundary Correction Method:** Ripley's edge correction formula
- Study Area Method:** Minimum enclosing rectangle

Repley's k -function

Multi-Distance Spatial Cluster Analysis (Ripley's K Function) (Spatial Statistics Tools)

Started: Today at 上午 04:24:36
Completed: Today at 上午 04:24:42
Elapsed Time: 6 Seconds

Parameters Environments Messages (1)

Start Time: 2024年11月13日 上午 04:24:36

k-Function Summary

Distance	L(d)	Diff	Min L(d)	Max L(d)
500.00	724.22	224.22	730.80	779.68
520.00	758.74	238.74	763.84	810.98
540.00	788.67	248.67	791.18	844.55
560.00	836.27	276.27	837.16	886.88
580.00	877.88	297.88	880.22	931.42
600.00	914.08	314.08	913.96	966.10
620.00	948.26	328.26	950.56	999.25
640.00	979.03	339.03	980.76	1034.15
660.00	1009.66	349.66	1008.92	1064.39
680.00	1051.54	371.54	1048.34	1106.18

Distance Measured in meters
Succeeded at 2024年11月13日 上午 04:24:42 (Elapsed Time: 5.50 seconds)

Geoprocessing

Multi-Distance Spatial Cluster Analysis (Ripley's K Function)

Parameters Environments

Input Feature Class: Taipei_POP

Output Table: Taipei_POP_MultiDistanceSpatialClustering

Number of Distance Bands: 10

Compute Confidence Envelope: 99 permutations

Weight Field: P_CNT

Beginning Distance: 500

Distance Increment: 20

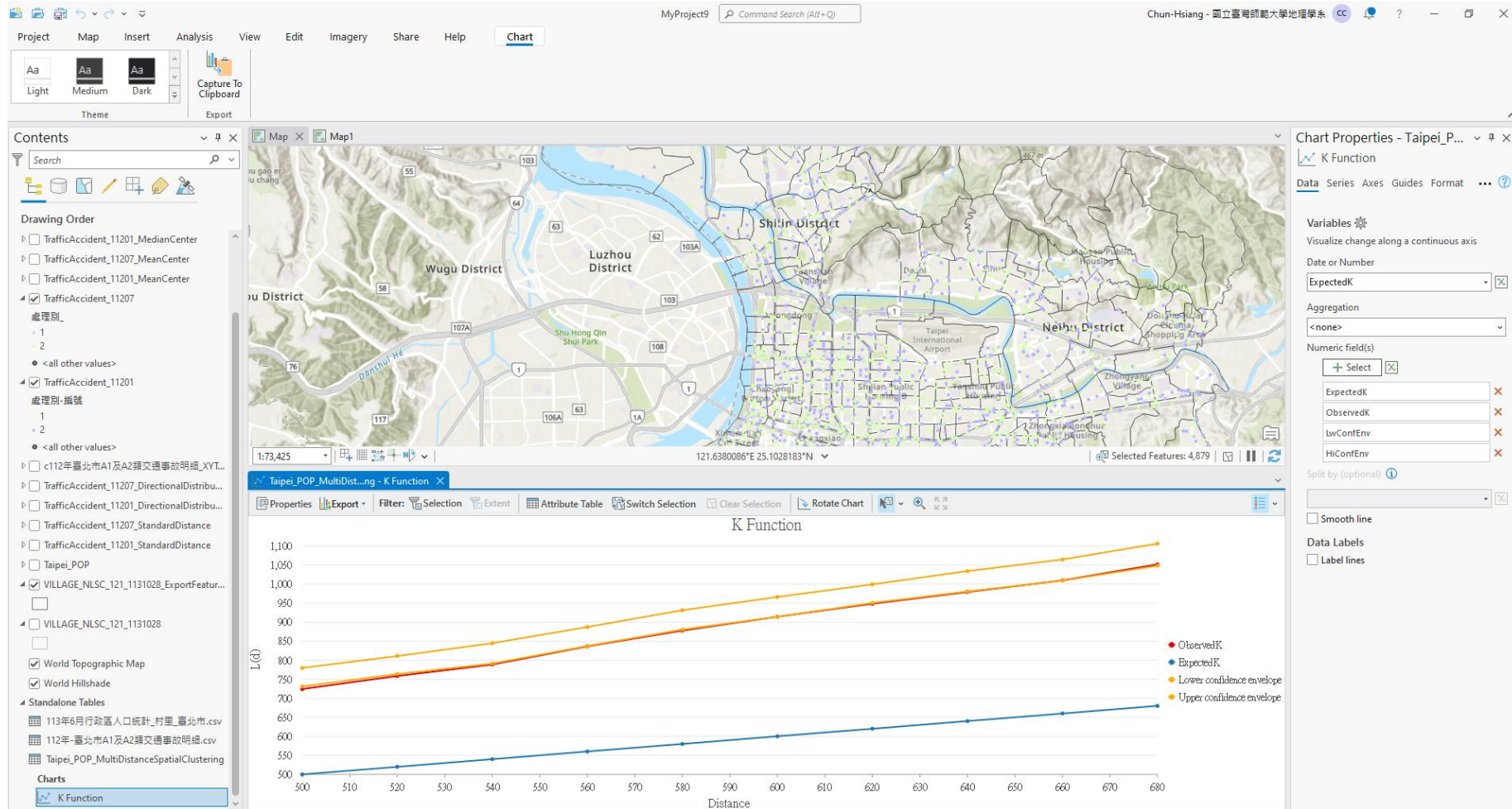
Boundary Correction Method: Ripley's edge correction formula

Study Area Method: Minimum enclosing rectangle

Run

Multi-Distance Spatial Cluster Analysis (Ripley's K Function) completed.

Repley's k -function



Spatial Autocorrelation (Global Moran's I)

The screenshot displays the ArcGIS Pro software interface. The main map area shows a topographic map of Taipei, Taiwan, with various districts labeled: Beitou District, Shilin District, Wuzhou District, Luzhou District, Xinzhuang District, Wala District, Zhongzheng District, Daan District, New Taipei City, and Yonghe District. The map is overlaid with a grid and a layer of points representing traffic accidents. The Geoprocessing tool is open on the right side of the screen, showing the following parameters:

- Tool:** Spatial Autocorrelation (Global Moran's I)
- Parameters:**
 - Input Feature Class: Taipei_POP
 - Input Field: P_CNT
 - Generate Report
 - Conceptualization of Spatial Relationships: Inverse distance
 - Distance Method: Euclidean
 - Standardization: Row
 - Distance Band or Threshold Distance: 3500

The Contents pane on the left shows a list of layers, including TrafficAccident_11207_CentralFeature, TrafficAccident_11201_CentralFeature, TrafficAccident_11207_MedianCenter, TrafficAccident_11201_MedianCenter, TrafficAccident_11207_MeanCenter, TrafficAccident_11201_MeanCenter, TrafficAccident_11207, and TrafficAccident_11201. The TrafficAccident_11207 layer is selected and expanded to show sub-layers for different processing steps.

Spatial Autocorrelation (Global Moran's I)

Spatial Autocorrelation (Global Moran's I)
(Spatial Statistics Tools)

Started: Today at 上午 04:26:26
Completed: Today at 上午 04:26:26
Elapsed Time: 0.89 Seconds

Parameters Environments Messages (3)

Start Time: 2024年11月13日 上午 04:26:26

Global Moran's I Summary

Moran's Index	0.123094
Expected Index	-0.002198
Variance	0.000088
z-score	13.368464
p-value	0.000000

Distance measured in meters
Writing html report....
[D:\TooDou\GIS\W08\MyProject9\MoransI Result 53124 20400 .html](#)
Succeeded at 2024年11月13日 上午 04:26:26 (Elapsed Time: 0.38 seconds)

Spatial Autocorrelation Report

Moran's Index 0.123094
z-score 13.368464
p-value 0.000000

Significance Level (p-value)

0.01	< -2.58
0.05	-2.58 - -1.96
0.10	-1.96 - -1.65
0.10	1.65 - 1.96
0.05	1.96 - 2.58
0.01	> 2.58

Critical Value (z-score)

Significant (Random) Significant

Dispersed Random Clustered

Given the z-score of 13.368464, there is a less than 1% likelihood that this clustered pattern could be the result of random chance.

Global Moran's I Summary

Moran's Index	0.123094
Expected Index	-0.002198
Variance	0.000088
z-score	13.368464
p-value	0.000000

Dataset Information

Input Feature Class:	Taipei_POP
Input Field:	P_CNT
Conceptualization:	INVERSE_DISTANCE
Distance Method:	EUCLIDEAN
Row Standardization:	True
Distance Threshold:	3500.0000 meters
Weights Matrix File:	None



The End

Thank you for your attention!

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