



Geographic Information System

Spatial Statistics II Lab Practice

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Outline

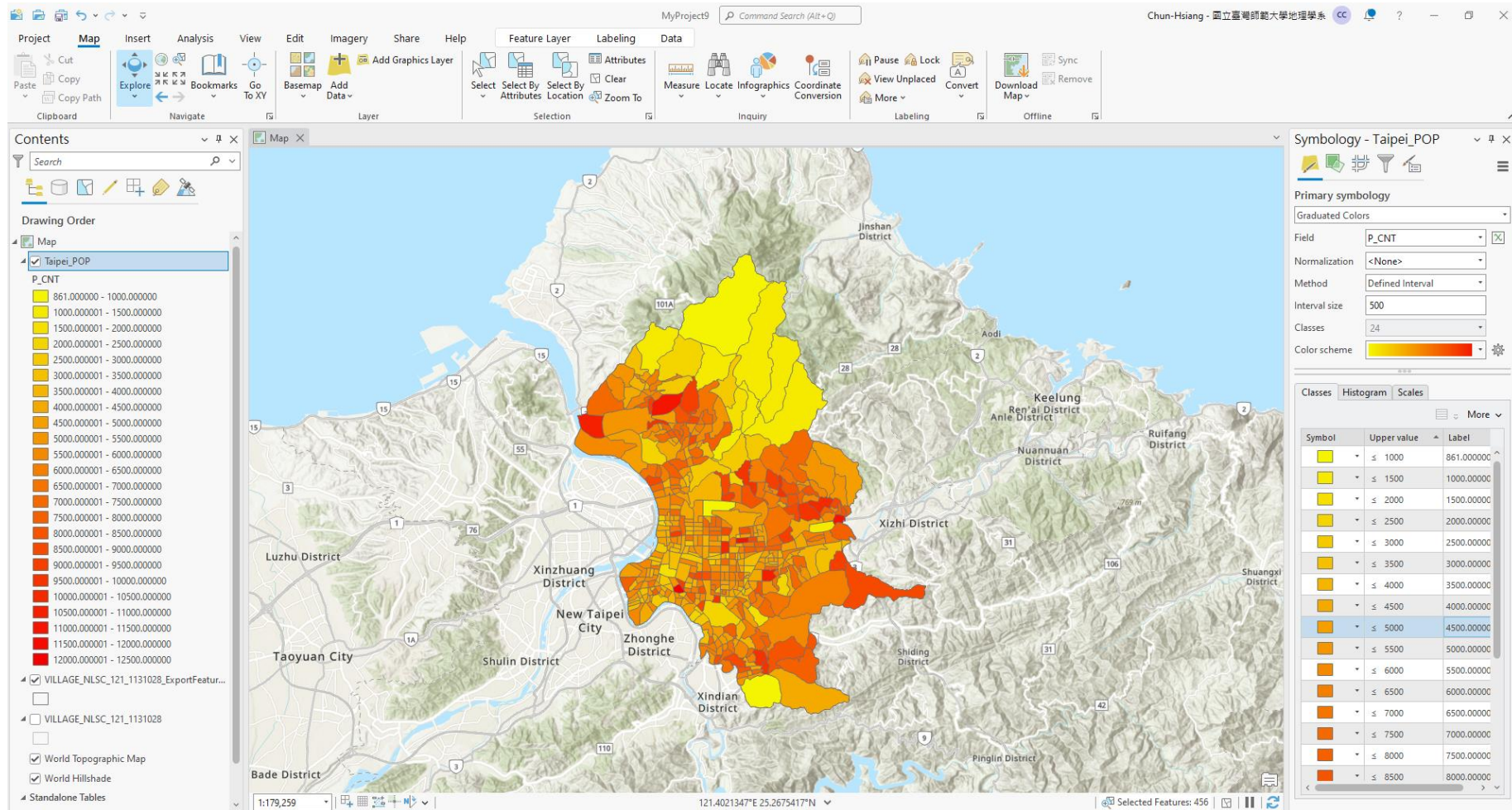
- **Identify the Spatial Distribution of Clusters**
- **Group the Village with Similar Demographic Attributes**



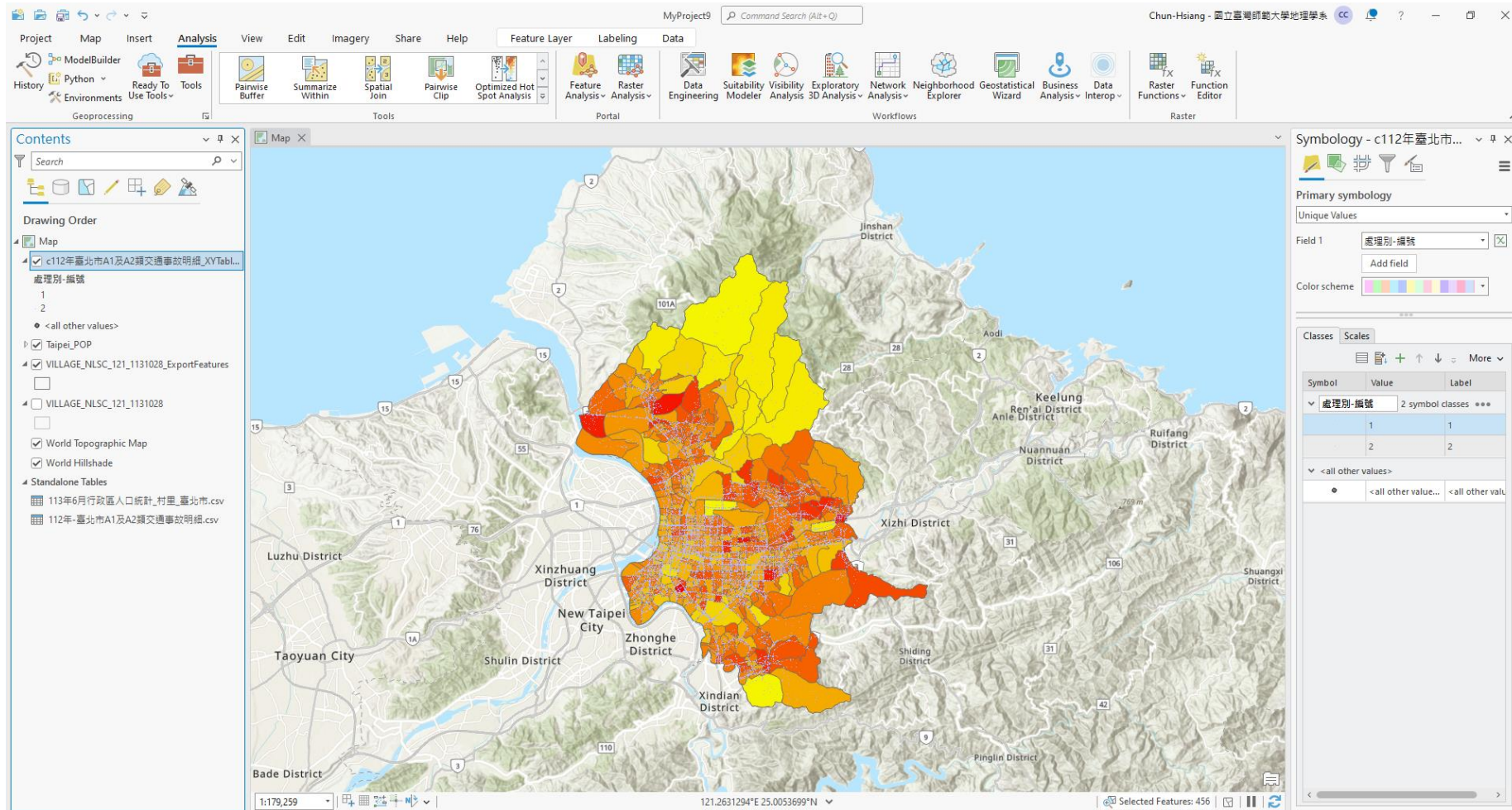
Initial Settings (...)

- 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 named “TrafficAccident_11201” and “TrafficAccident_11207”
- 7) Spatial Join Taipei traffic accident into Taipei_POP

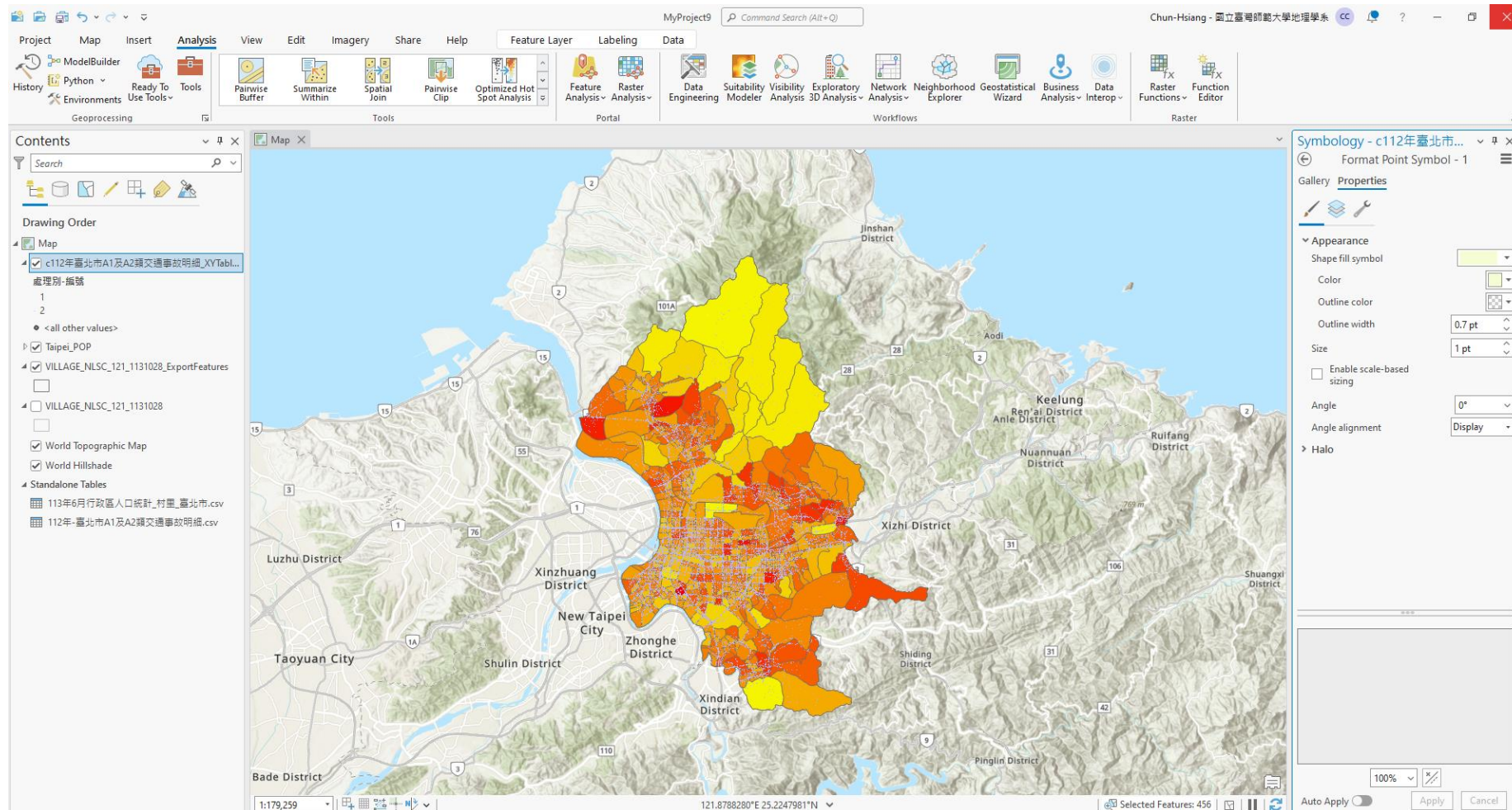
Taipei Population Data



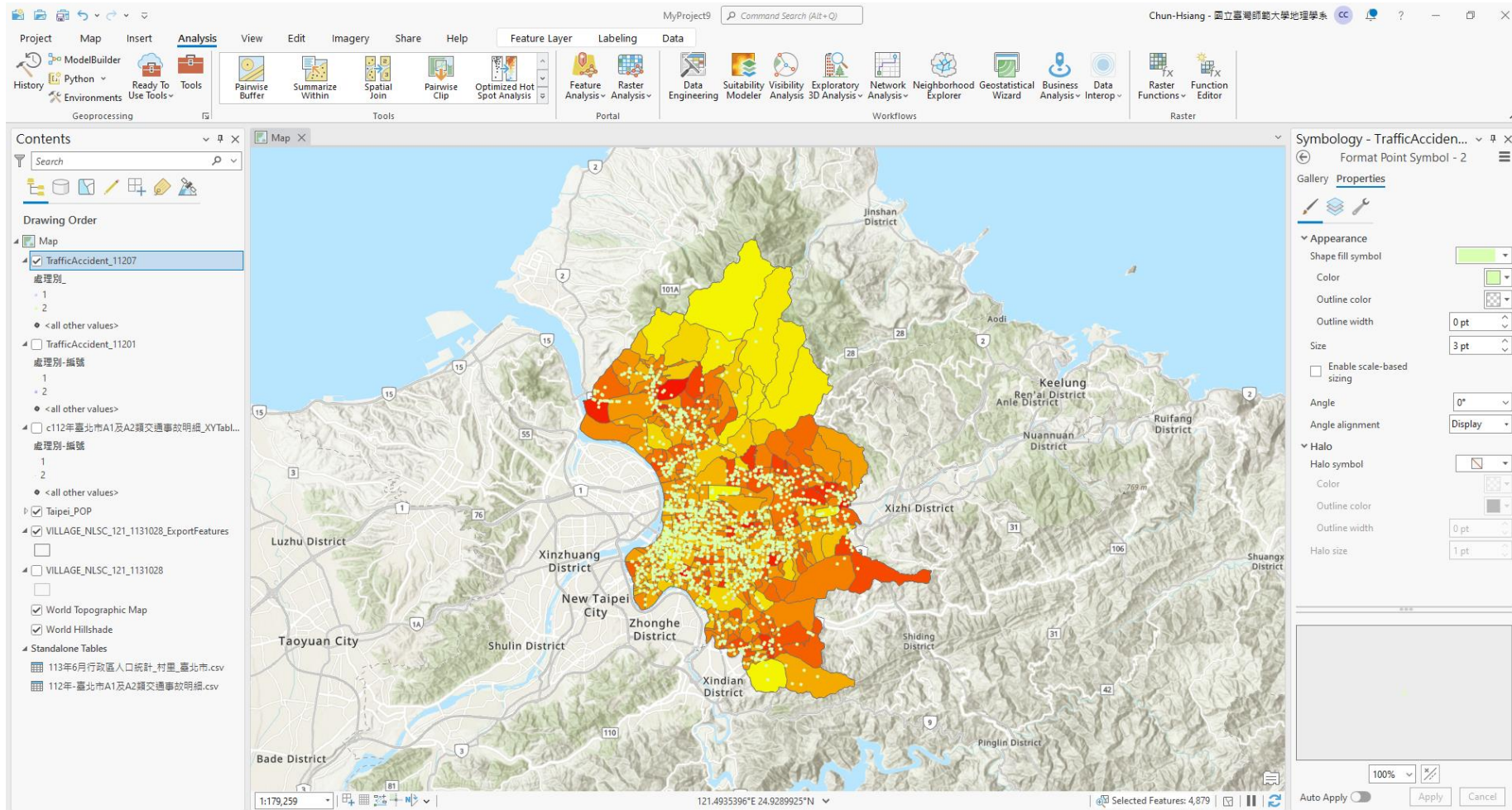
Overlay with Traffic Accident Data



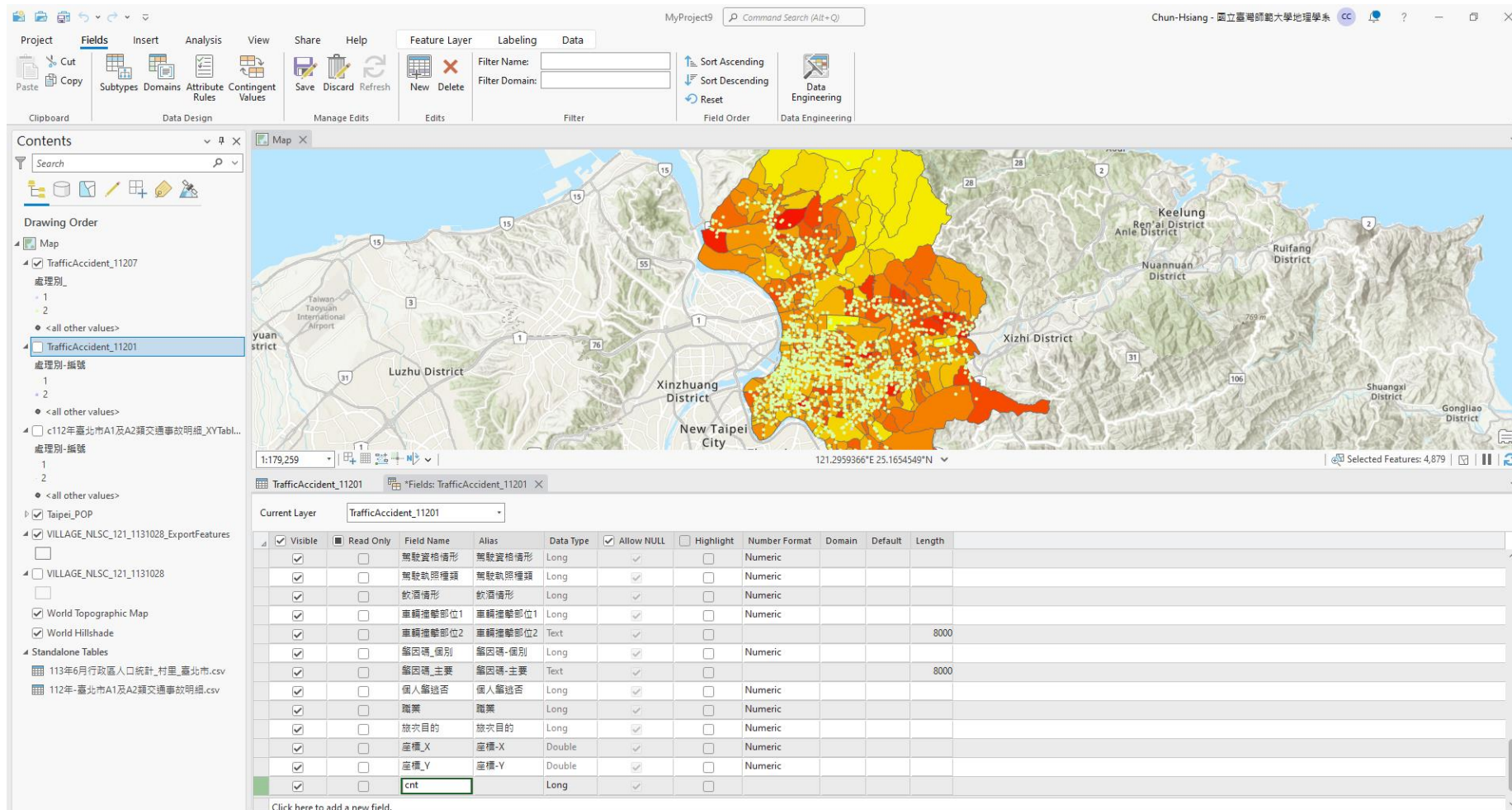
Overlay with Traffic Accident Data



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 geographic area with a heatmap overlay. The 'Contents' pane on the left lists several layers, with 'TrafficAccident_11201' selected. The 'Attribute Table' at the bottom shows the fields for this layer. The 'cnt' field is highlighted in green, indicating it is the field being added or modified.

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"/>	個人筆述否	個人筆述否	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 a concentration of red and orange points in the central urban area. The map includes labels for districts such as Keelung, Ren'ai, Nuannuan, Ruitang, Xizhi, and Xinzhuang. The interface includes a ribbon with various toolbars and a table view at the bottom.

The table view shows the following data:

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>

The context menu is open over the 'cnt' field, showing options: Sort Ascending, Sort Descending, Custom Sort (Ctrl+Shift+S), Fields, Hide Field, Freeze/Unfreeze Field, Calculate Field (highlighted), Calculate Geometry, Explore Statistics, Visualize Statistics, Summarize, and Delete. A tooltip for 'Calculate Field' is visible, stating: 'Set the values of this field by specifying a calculation expression. If any of the rows in the table are currently selected, only the values of the selected rows will be calculated.'

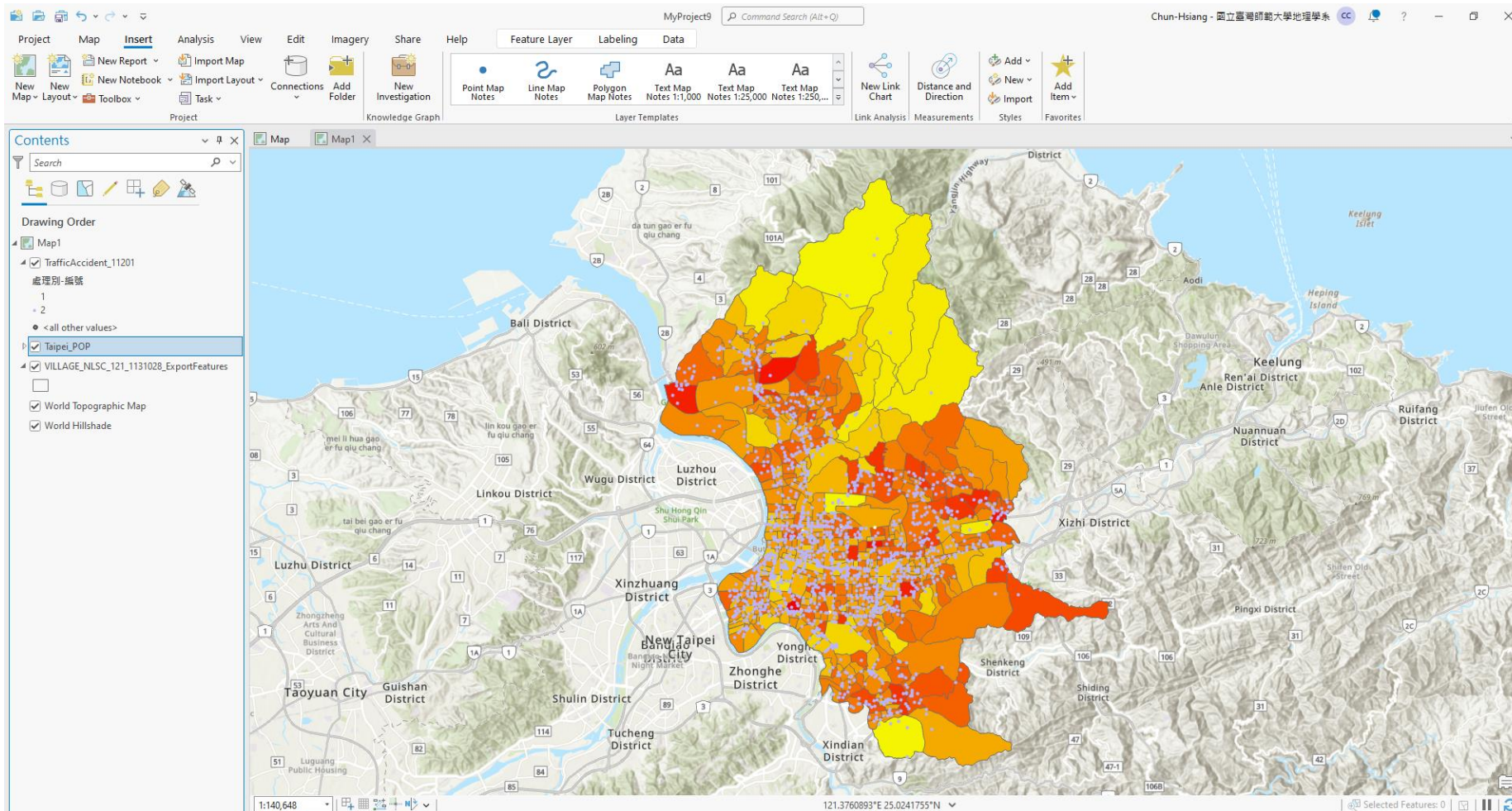
Fill 1 into “cnt” Field to both 11201 & 11207

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 District, Nuannuan District, Rulfang District, Xizhi District, Luzhu District, Xinzhuang District, and New Taipei City. The interface includes a ribbon with various toolbars and a table view at the bottom.

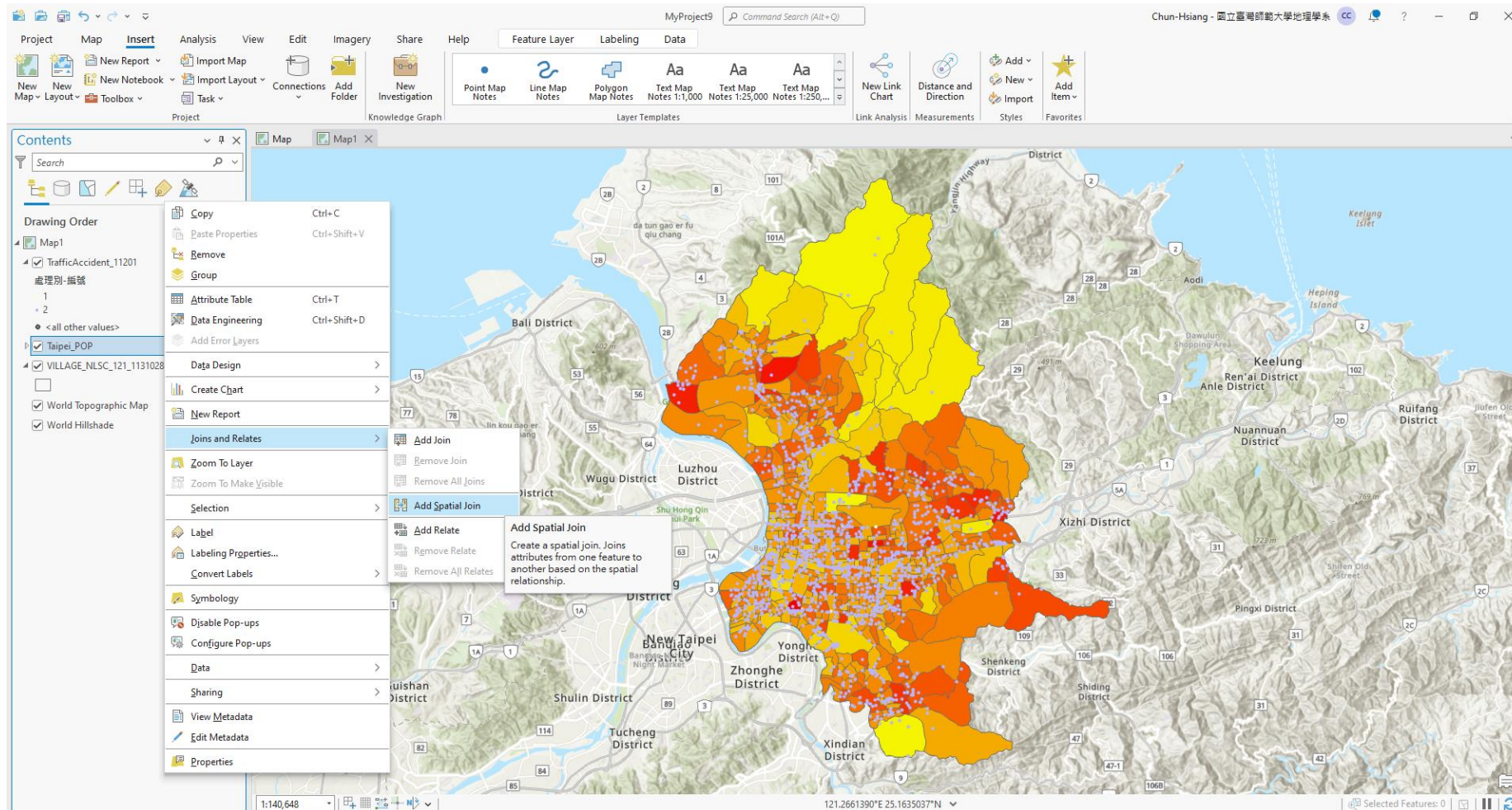
The table view shows the following data:

Field:	Add	Calculate	Selection:	Select By Attributes	Zoom To	Switch	Clear	Delete	Copy
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									

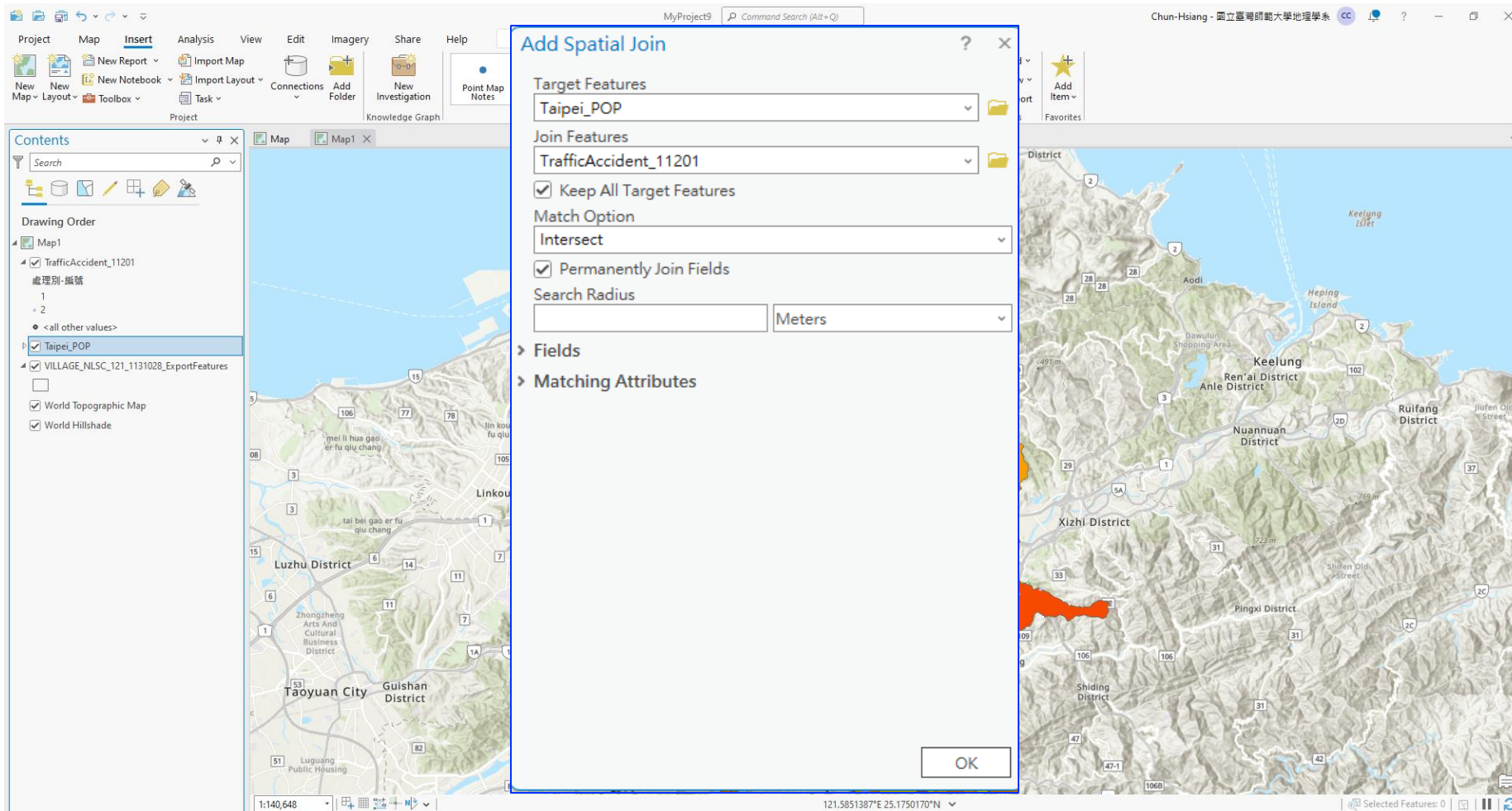
Spatial Join Taipei Traffic Accident Data



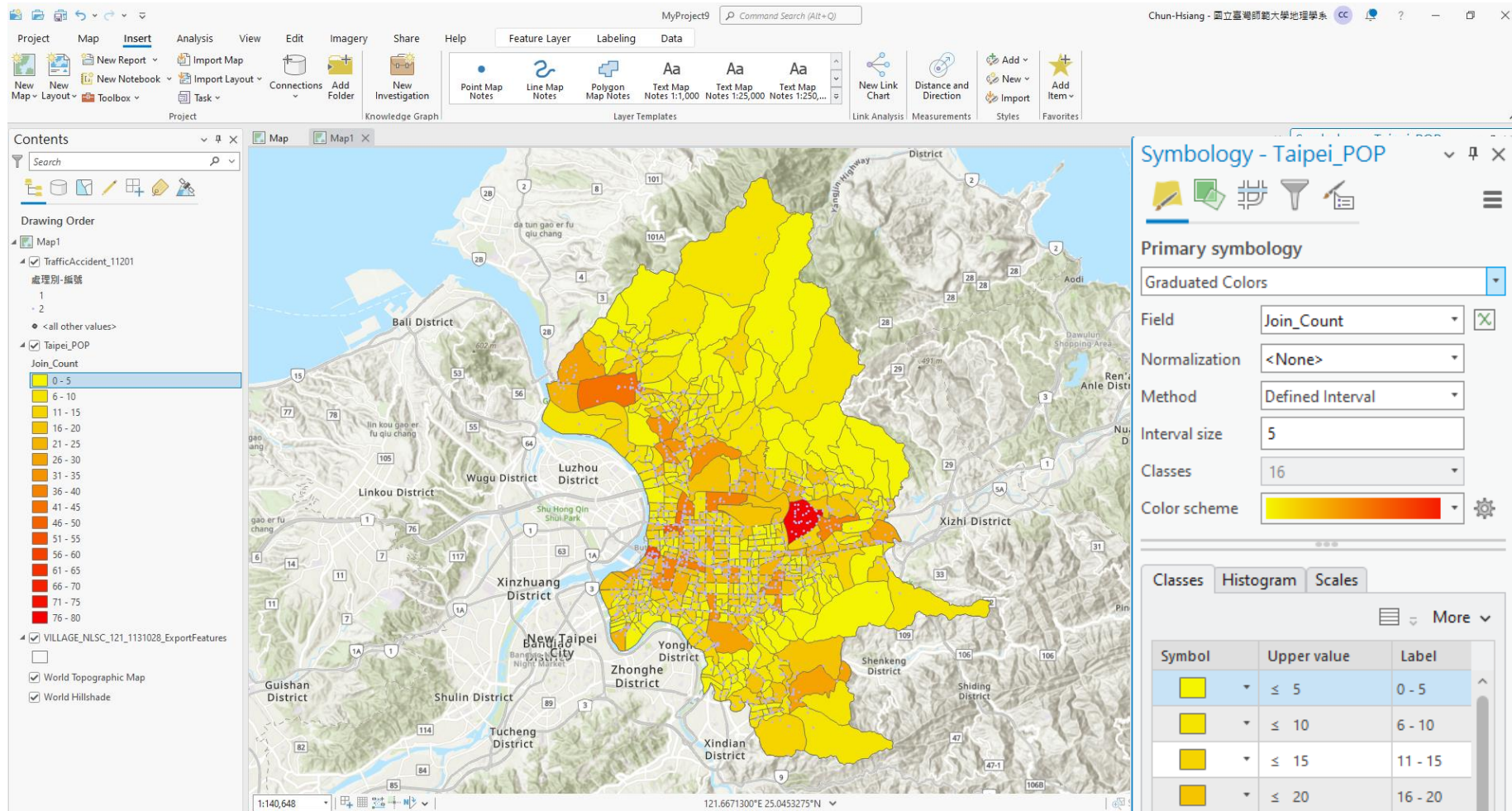
Spatial Join Traffic Accident Data into Village



Spatial Join Traffic Accident Data into Village



Spatial Join Traffic Accident Data into Village

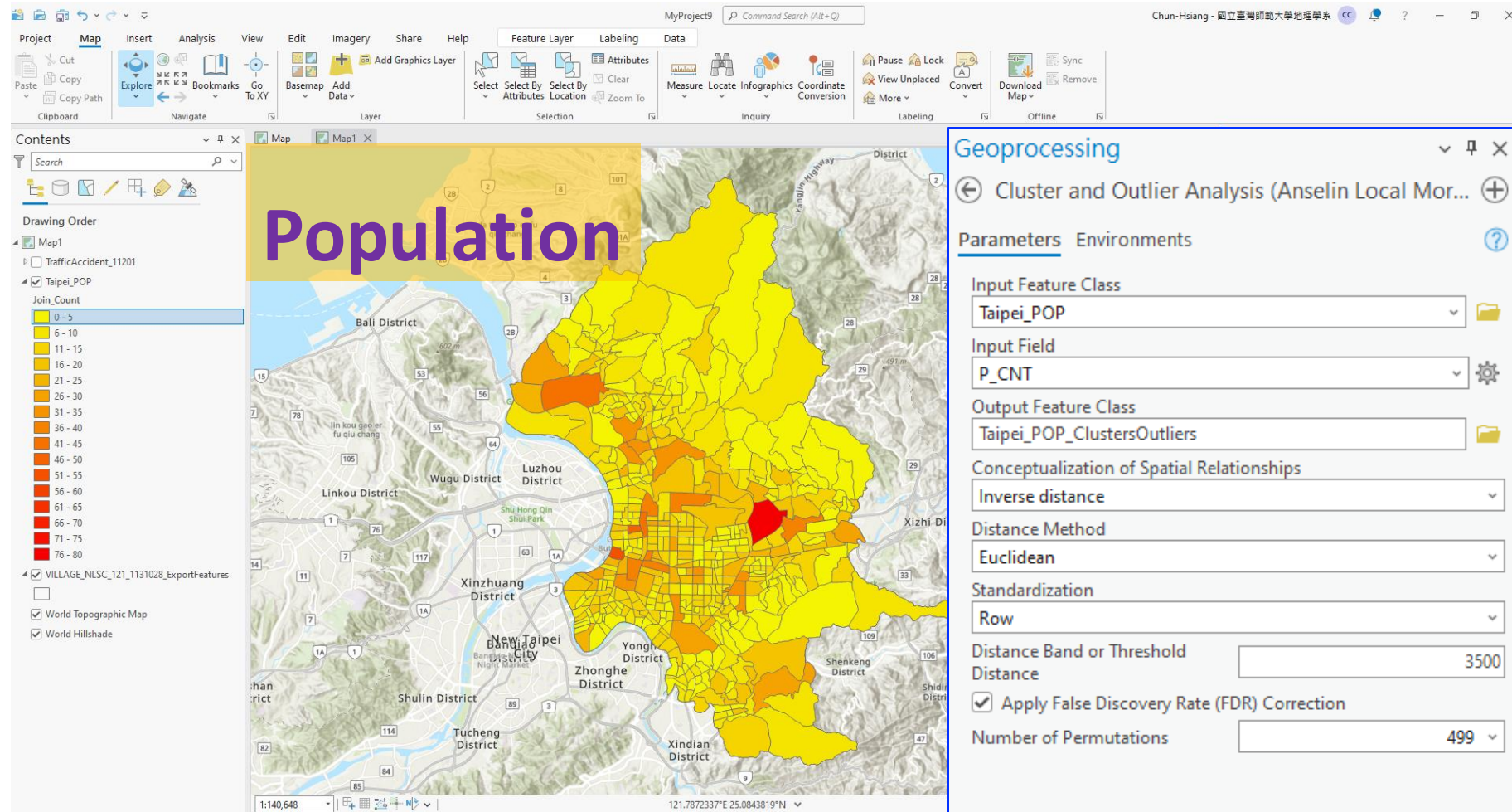


Spatial Statistical Analysis

Compute the following functions

- 1) Cluster and Outlier Analysis (Anselin Local Moran's I)
(Population & Traffic Accident)
- 2) Hot Spot Analysis (Getis-Ord G^*) (Population & Traffic Accident)
- 3) Spatial Outlier Detection (Traffic Accident)
- 4) Density-based Clustering (DBSCAN and OPTICS)
- 5) Multivariate Clustering (NumCluster: 5 and 10)

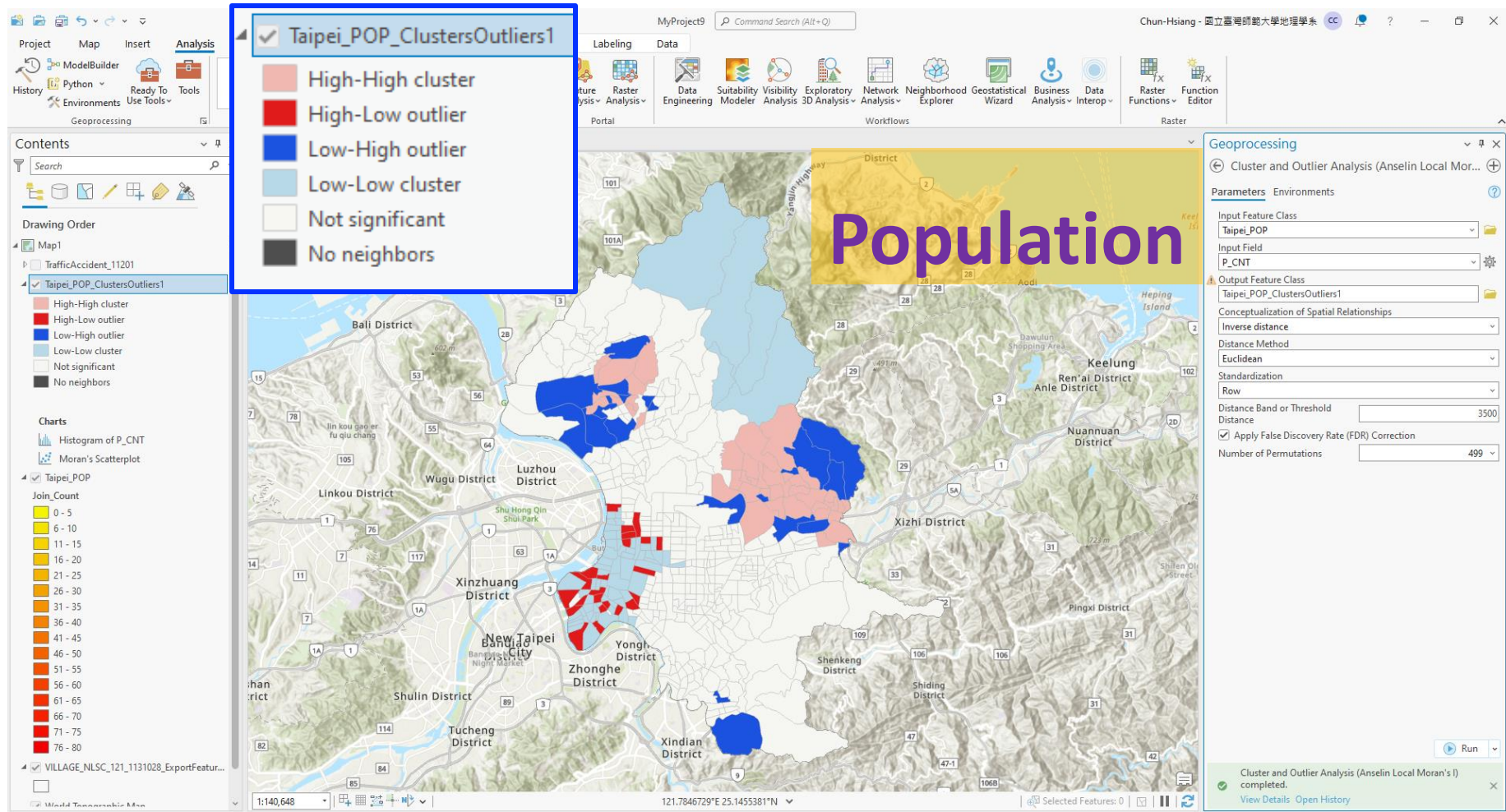
Cluster and Outlier Analysis (Anselin Local Moran's I)



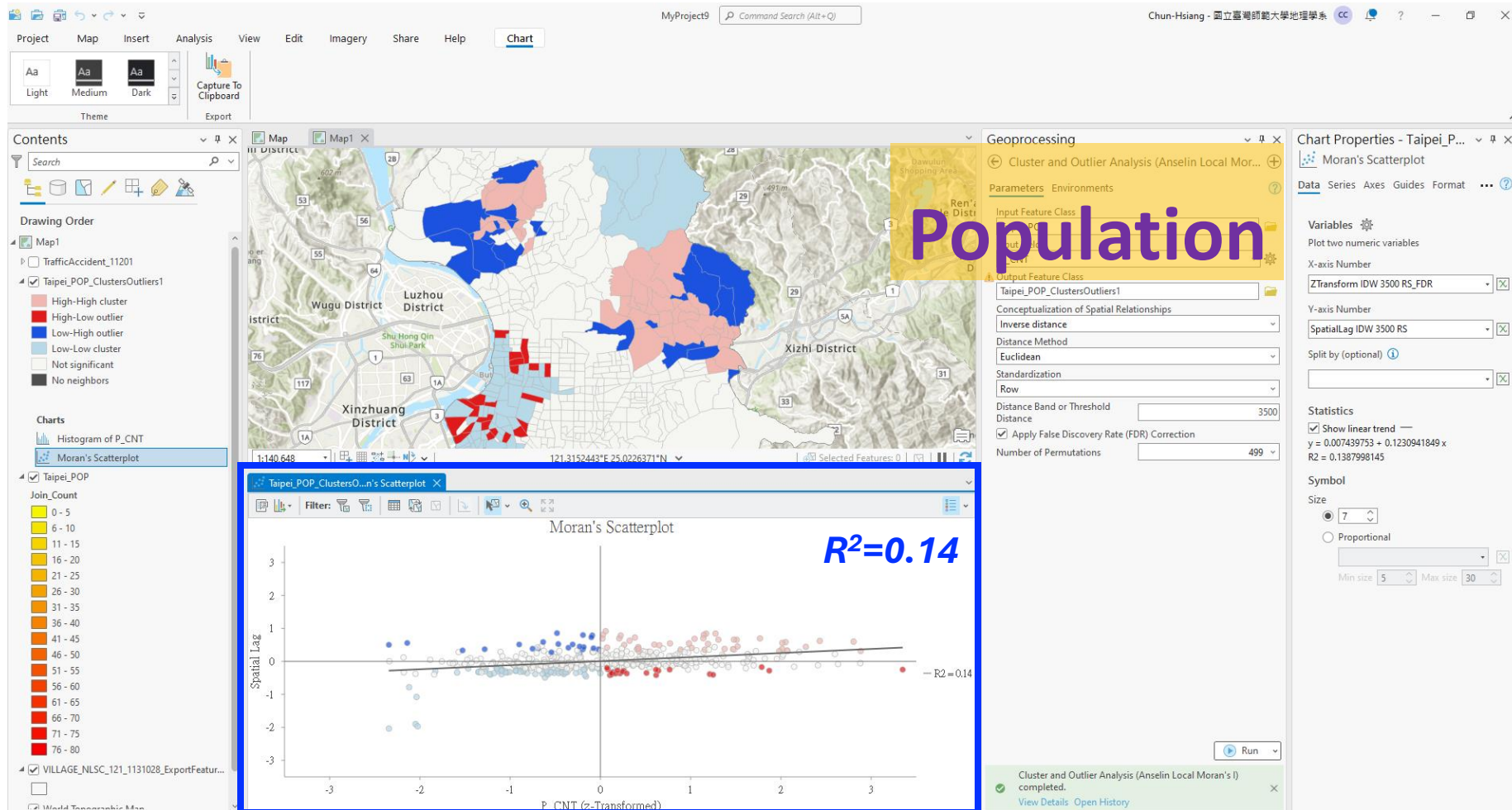
The screenshot displays the ArcGIS Pro interface. The main map shows a heatmap of Taipei, Taiwan, with population density represented by a color scale from yellow (low) to red (high). The word "Population" is overlaid on the map in a large purple font. The Geoprocessing tool interface is open on the right, showing the following parameters:

- Cluster and Outlier Analysis (Anselin Local Moran's I)**
- Parameters**
- Input Feature Class:** Taipei_POP
- Input Field:** P_CNT
- Output Feature Class:** Taipei_POP_ClustersOutliers
- Conceptualization of Spatial Relationships:** Inverse distance
- Distance Method:** Euclidean
- Standardization:** Row
- Distance Band or Threshold Distance:** 3500
- Apply False Discovery Rate (FDR) Correction**
- Number of Permutations:** 499

Cluster and Outlier Analysis (Anselin Local Moran's I)



Cluster and Outlier Analysis (Anselin Local Moran's I)



Cluster and Outlier Analysis (Anselin Local Moran's I)

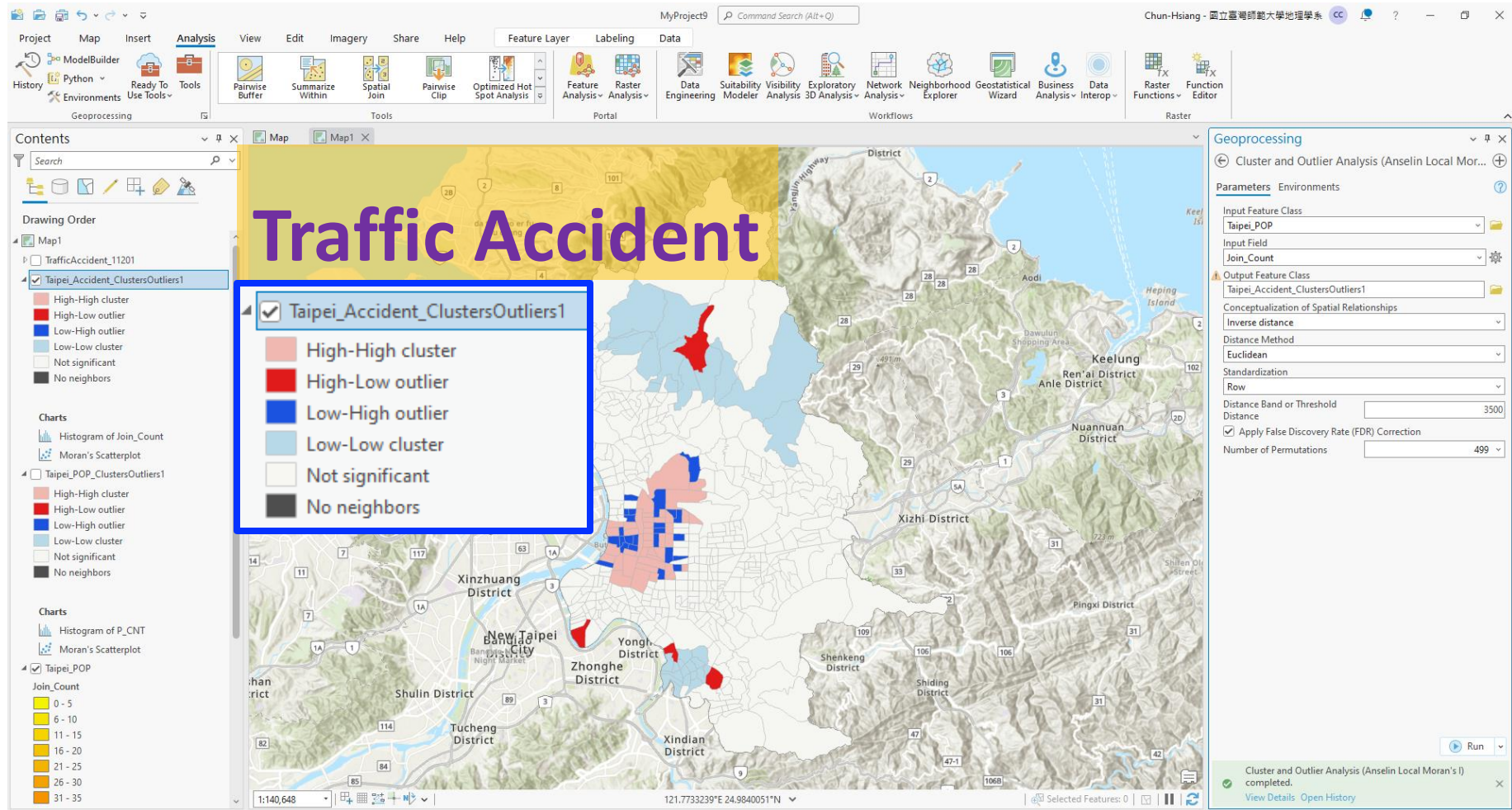
The screenshot displays the ArcGIS Pro interface. The main map shows a traffic accident distribution in Taipei, with a large purple text overlay reading "Traffic Accident". The map is color-coded by accident count, with a legend on the left showing a scale from 0-5 (yellow) to 76-80 (dark red). A red polygon highlights a specific area in the central part of the city. The "Geoprocessing" pane on the right is open to the "Cluster and Outlier Analysis (Anselin Local Moran's I)" tool. The tool's parameters are as follows:

- Input Feature Class: Taipei_POP
- Input Field: Join_Count
- Output Feature Class: Taipei_Accident_ClustersOutliers1
- Conceptualization of Spatial Relationships: Inverse distance
- Distance Method: Euclidean
- Standardization: Row
- Distance Band or Threshold Distance: 3500
- Apply False Discovery Rate (FDR) Correction
- Number of Permutations: 499

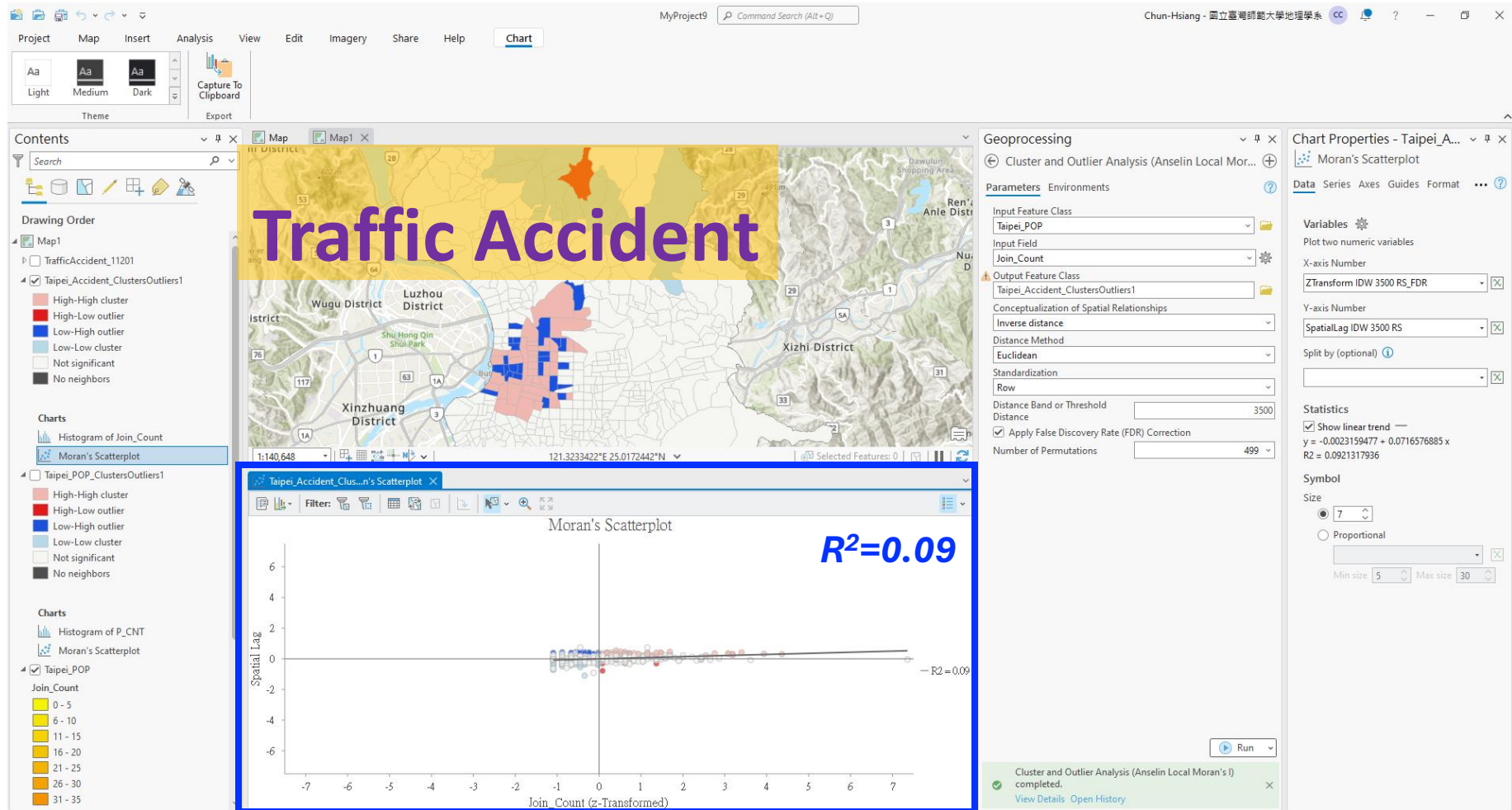
The Contents pane on the left shows the following layers and charts:

- Map1
 - TrafficAccident_11201
 - Taipei_POP_ClustersOutliers1
 - High-High cluster
 - High-Low outlier
 - Low-High outlier
 - Low-Low cluster
 - Not significant
 - No neighbors
- Charts
 - Histogram of P_CNT
 - Moran's Scatterplot
- Taipei_POP
 - Join_Count
 - 0 - 5
 - 6 - 10
 - 11 - 15
 - 16 - 20
 - 21 - 25
 - 26 - 30
 - 31 - 35
 - 36 - 40
 - 41 - 45
 - 46 - 50
 - 51 - 55
 - 56 - 60
 - 61 - 65
 - 66 - 70
 - 71 - 75
 - 76 - 80
- VILLAGE_NLSC_121_1131028_ExportFeatur...
- World Topographic Map

Cluster and Outlier Analysis (Anselin Local Moran's I)



Cluster and Outlier Analysis (Anselin Local Moran's I)



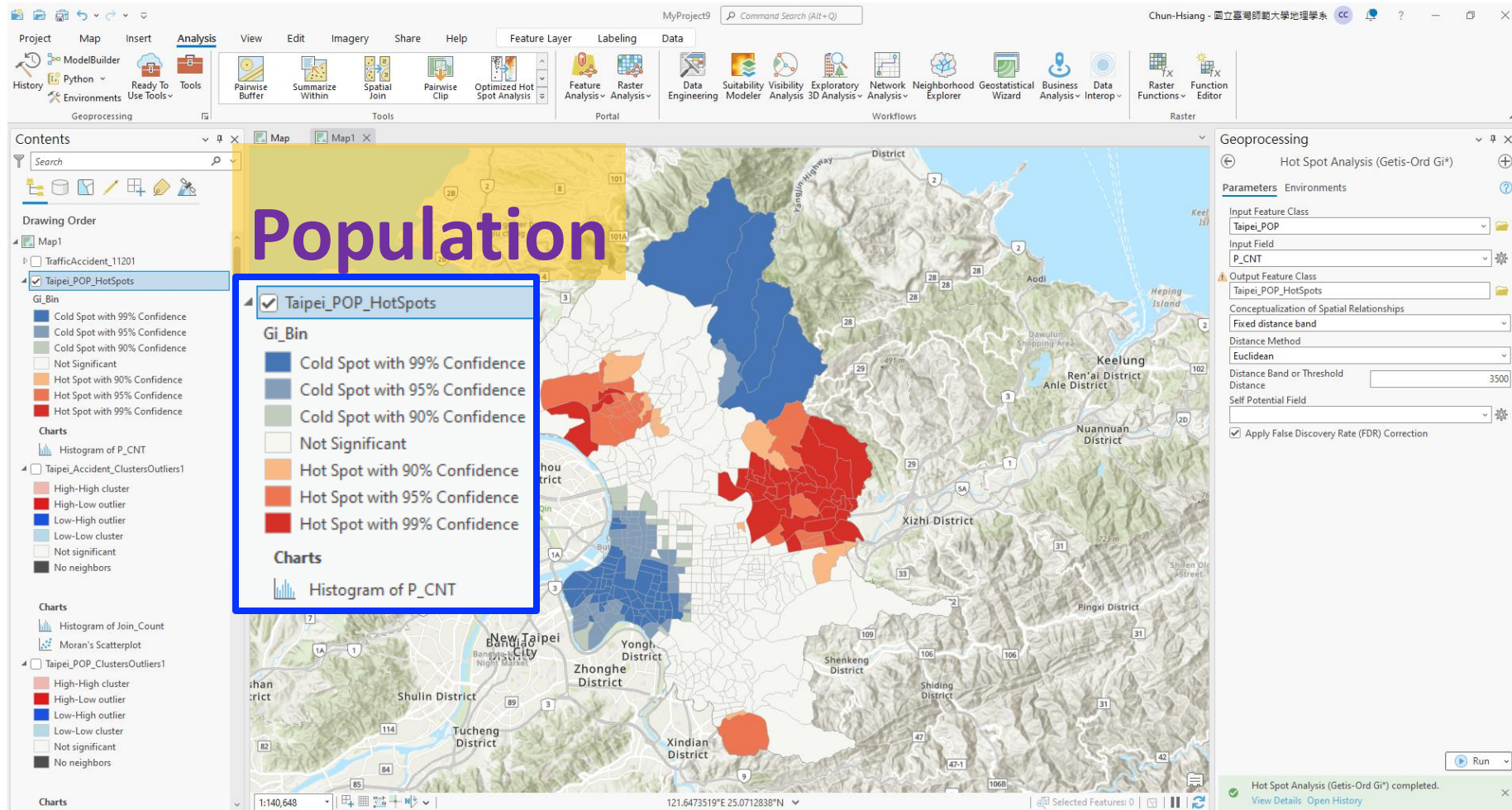
Hot Spot Analysis (Getis-Ord G^*)

The screenshot displays the ArcGIS Pro interface for a Hot Spot Analysis (Getis-Ord G_i^*) tool. The main map shows a population density map of Taipei, Taiwan, with a color scale from yellow (low) to red (high). A large purple text overlay on the map reads "Population". The tool's parameters are visible in the right-hand pane:

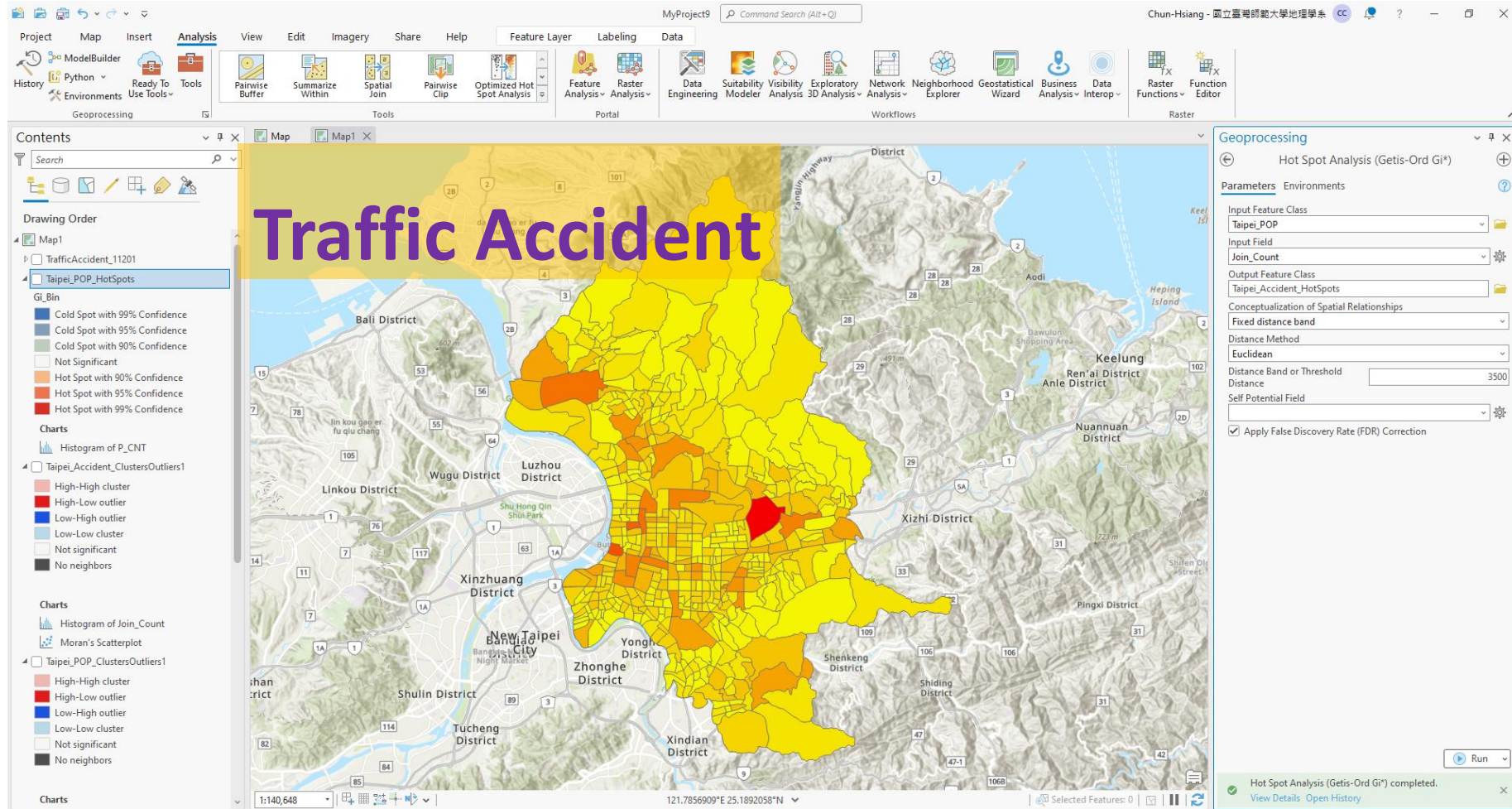
- Input Feature Class:** Taipei_POP
- Input Field:** P_CNT
- Output Feature Class:** Taipei_POP_HotSpots
- Conceptualization of Spatial Relationships:** Fixed distance band
- Distance Method:** Euclidean
- Distance Band or Threshold Distance:** 3500
- Self Potential Field:** (Empty)
- Apply False Discovery Rate (FDR) Correction**

The left-hand pane shows the Contents window with several layers, including "Join_Count", "Moran's Scatterplot", and "Taipei_POP". The "Join_Count" layer is selected, and its legend shows a color scale from 0-5 (yellow) to 31-35 (dark orange).

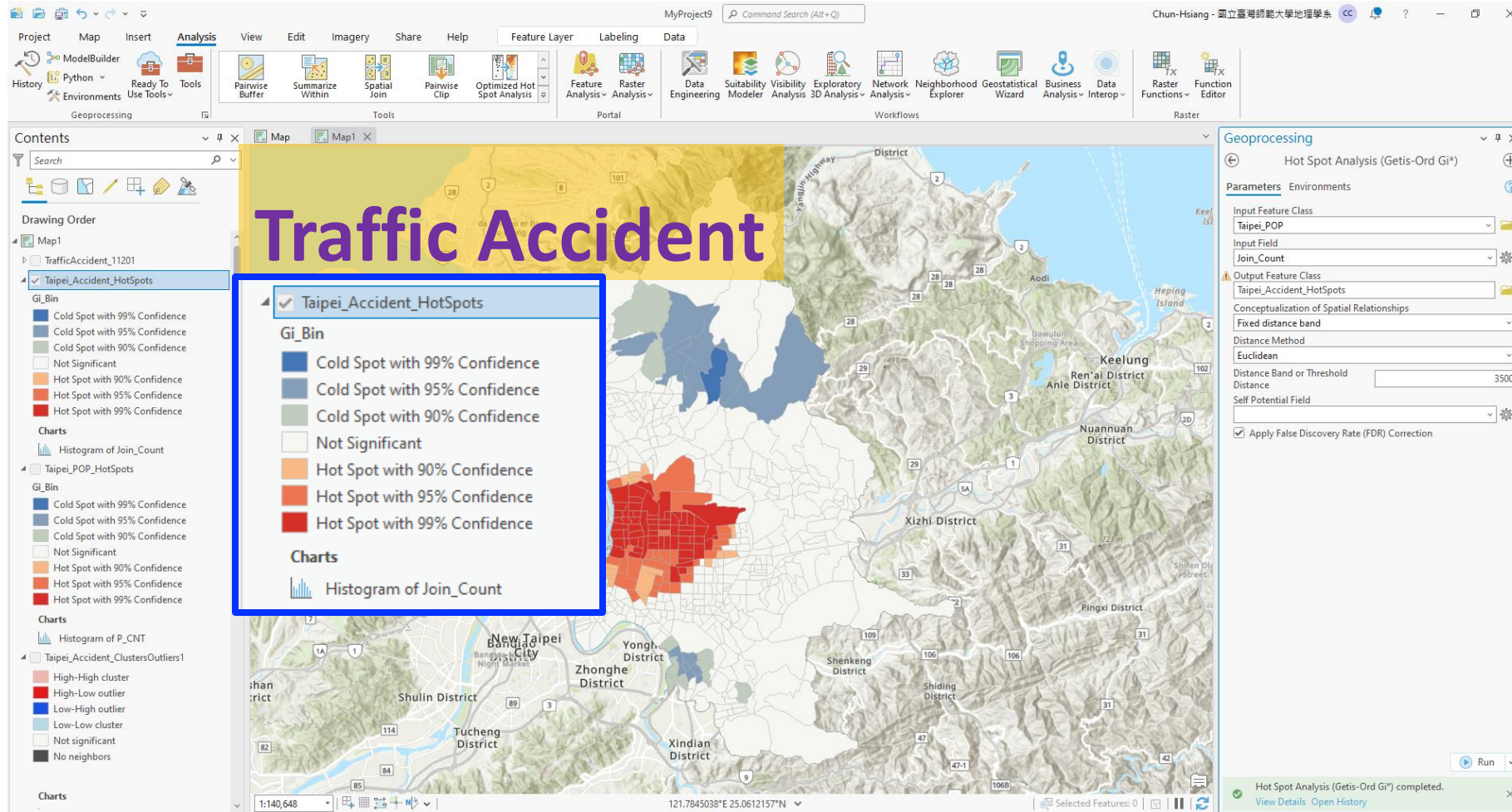
Hot Spot Analysis (Getis-Ord G^*)



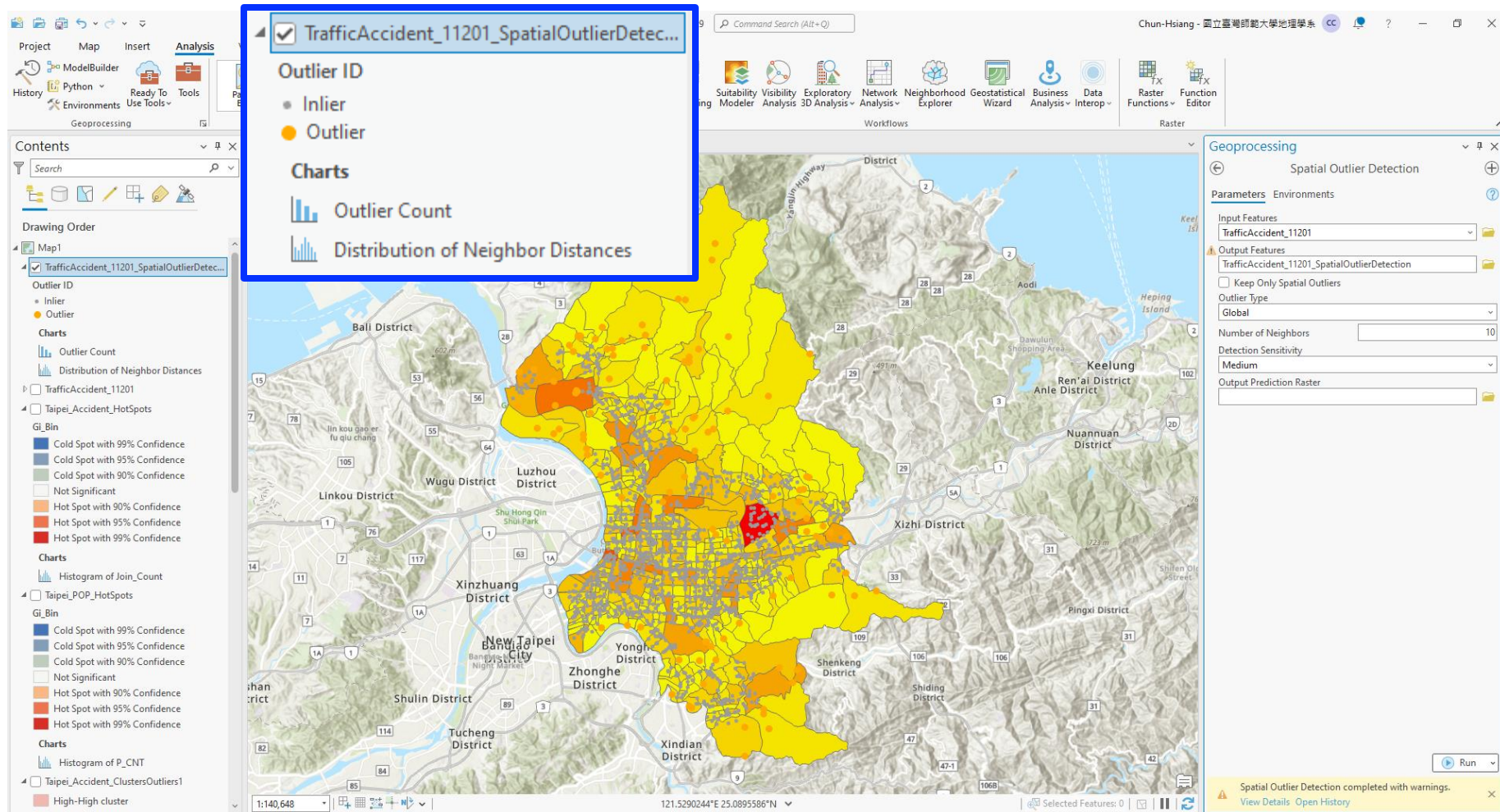
Hot Spot Analysis (Getis-Ord G^*)



Hot Spot Analysis (Getis-Ord G^*)



Spatial Outlier Detection



Density-based Clustering :: DBSCAN

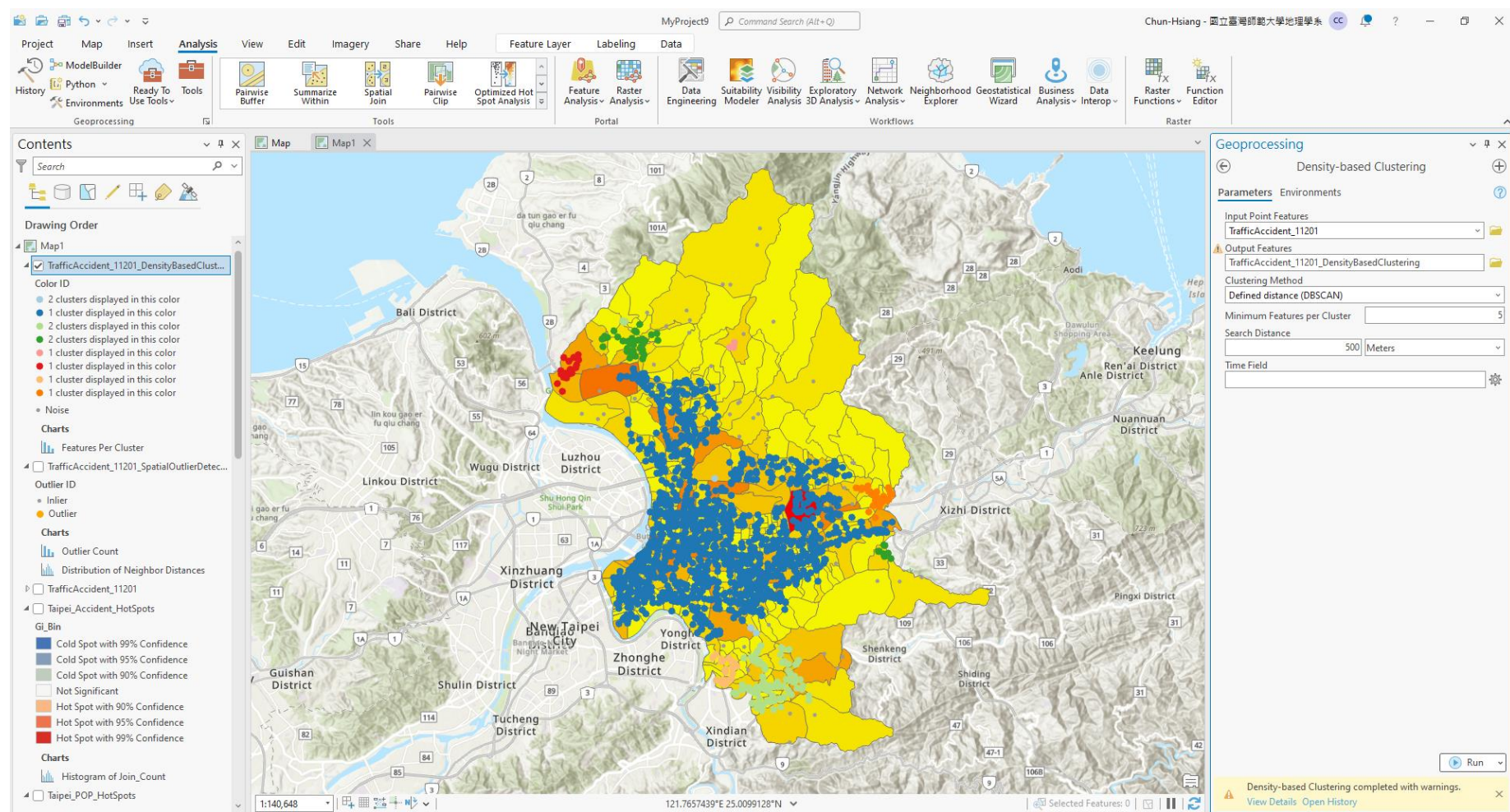
MinPt: 5; SearchDist: 500

The screenshot displays the ArcGIS Pro interface with a map of Taipei, Taiwan, showing the results of a DBSCAN clustering analysis on traffic accident data. The map is color-coded by density, with red indicating high-density clusters and yellow indicating lower-density areas. The interface includes a ribbon with various toolsets, a Contents pane on the left showing the project structure, and a Geoprocessing pane on the right. The Geoprocessing pane is highlighted with a blue border and shows the following configuration for the 'Density-based Clustering' tool:

- Input Point Features:** TrafficAccident_11201
- Output Features:** TrafficAccident_11201_DensityBasedClustering
- Clustering Method:** Defined distance (DBSCAN)
- Minimum Features per Cluster:** 5
- Search Distance:** 500 Meters
- Time Field:** (Empty)

Density-based Clustering :: DBSCAN

MinPt: 5; SearchDist: 500



Density-based Clustering :: OPTICS

MinPt: 5; SearchDist: 500

The screenshot displays the ArcGIS Pro interface with the Density-based Clustering (OPTICS) tool open in the Geoprocessing pane. The tool is applied to a map of New Taipei City, showing clusters of traffic accidents. The map is color-coded by cluster, with a legend in the Contents pane. The Geoprocessing pane shows the following parameters:

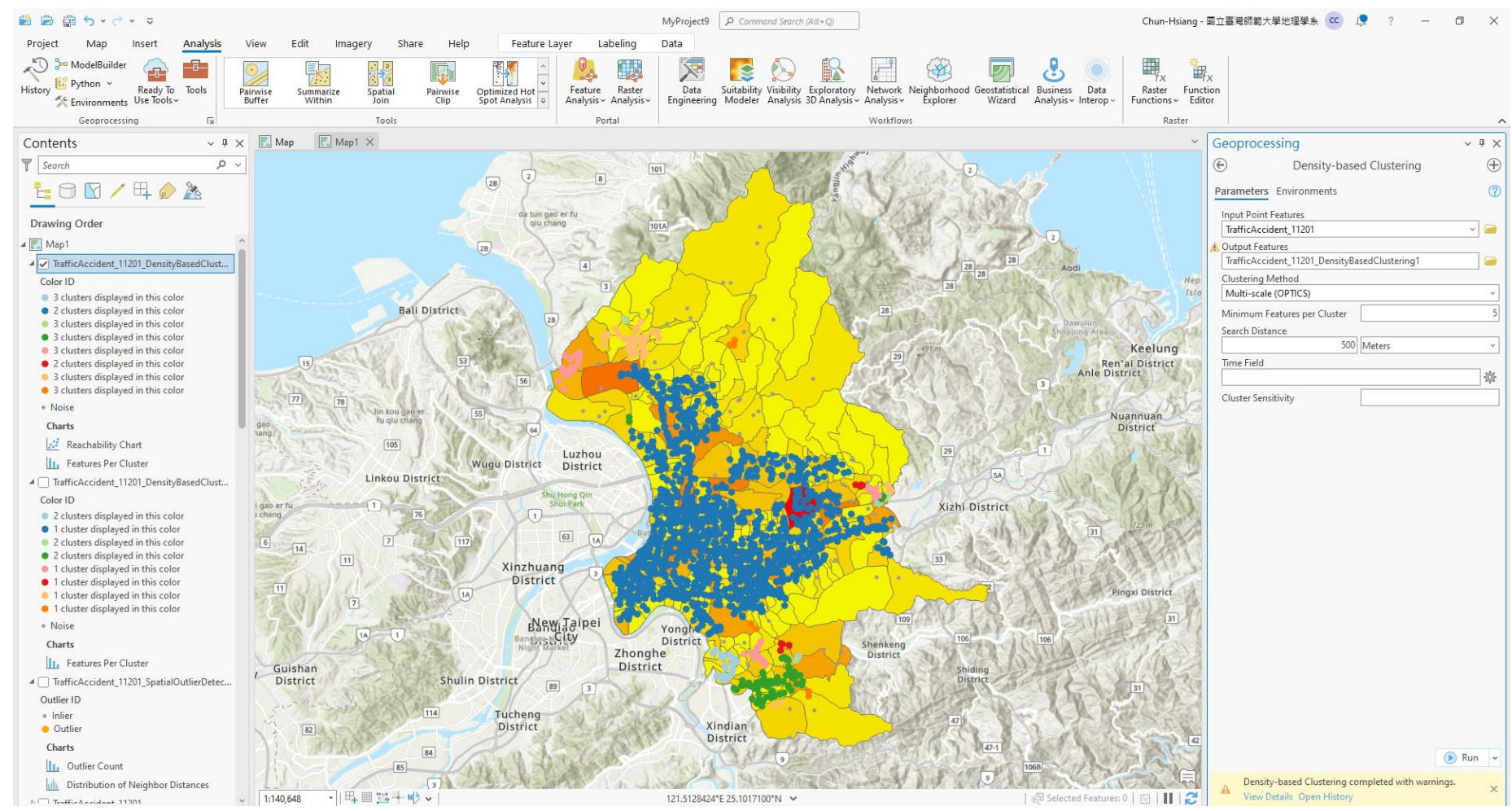
- Input Point Features: TrafficAccident_11201
- Output Features: TrafficAccident_11201_DensityBasedClustering1
- Clustering Method: Multi-scale (OPTICS)
- Minimum Features per Cluster: 5
- Search Distance: 500 Meters
- Time Field: (empty)
- Cluster Sensitivity: (empty)

The Contents pane shows the following layers and their properties:

- TrafficAccident_11201_DensityBasedClust...
 - Color ID
 - 2 clusters displayed in this color
 - 1 cluster displayed in this color
 - 2 clusters displayed in this color
 - 1 cluster displayed in this color
 - 1 cluster displayed in this color
 - 1 cluster displayed in this color
 - 1 cluster displayed in this color
 - Noise
 - Charts
 - Features Per Cluster
- TrafficAccident_11201_SpatialOutlierDetec...
 - Outlier ID
 - Inlier
 - Outlier
 - Charts
 - Outlier Count
 - Distribution of Neighbor Distances
- TrafficAccident_11201
- Taipei_Accident_HotSpots
 - GI_Bin
 - Cold Spot with 99% Confidence
 - Cold Spot with 95% Confidence
 - Cold Spot with 90% Confidence
 - Not Significant
 - Hot Spot with 90% Confidence
 - Hot Spot with 95% Confidence
 - Hot Spot with 99% Confidence
 - Charts
 - Histogram of Join_Count
- Taipei_POP_HotSpots

Density-based Clustering :: OPTICS

MinPt: 5; SearchDist: 500



Multivariate Clustering :: *k*-means

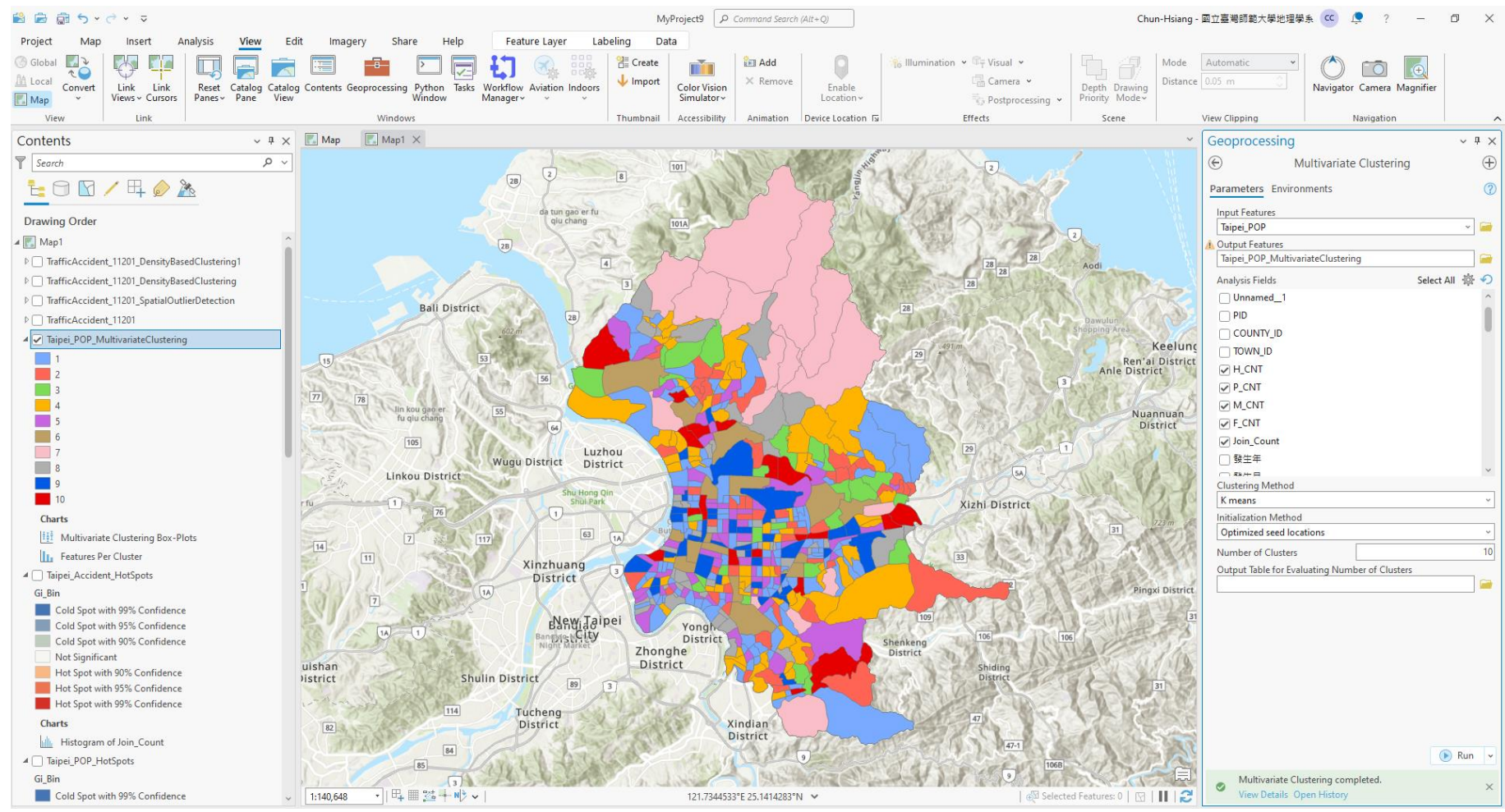
NumCluster: 10

The screenshot displays the ArcGIS Pro interface with a map of Taipei, Taiwan, showing the results of a multivariate clustering analysis. The map is divided into 10 distinct clusters, color-coded in shades of yellow and orange. The Geoprocessing pane on the right is open, showing the 'Multivariate Clustering' tool. The parameters are as follows:

- Input Features: Taipei_POP
- Output Features: Taipei_POP_MultivariateClustering
- Analysis Fields: PID, COUNTY_ID, TOWN_ID, H_CNT, P_CNT, M_CNT, F_CNT, Join_Count, 發生年, 發生月
- Clustering Method: K means
- Initialization Method: Optimized seed locations
- Number of Clusters: 10
- Output Table for Evaluating Number of Clusters: [Empty field]

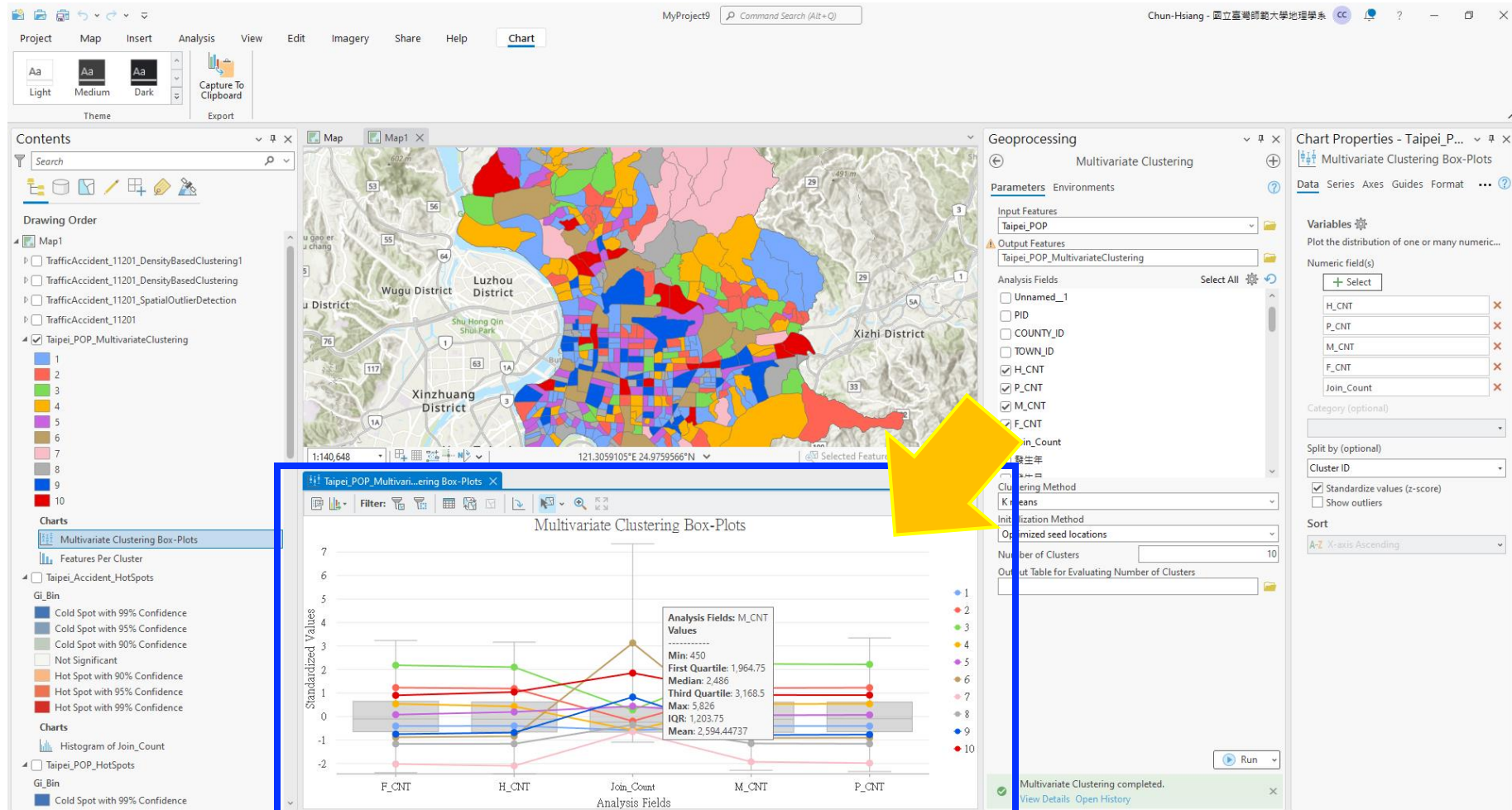
Multivariate Clustering :: *k*-means

NumCluster: 10



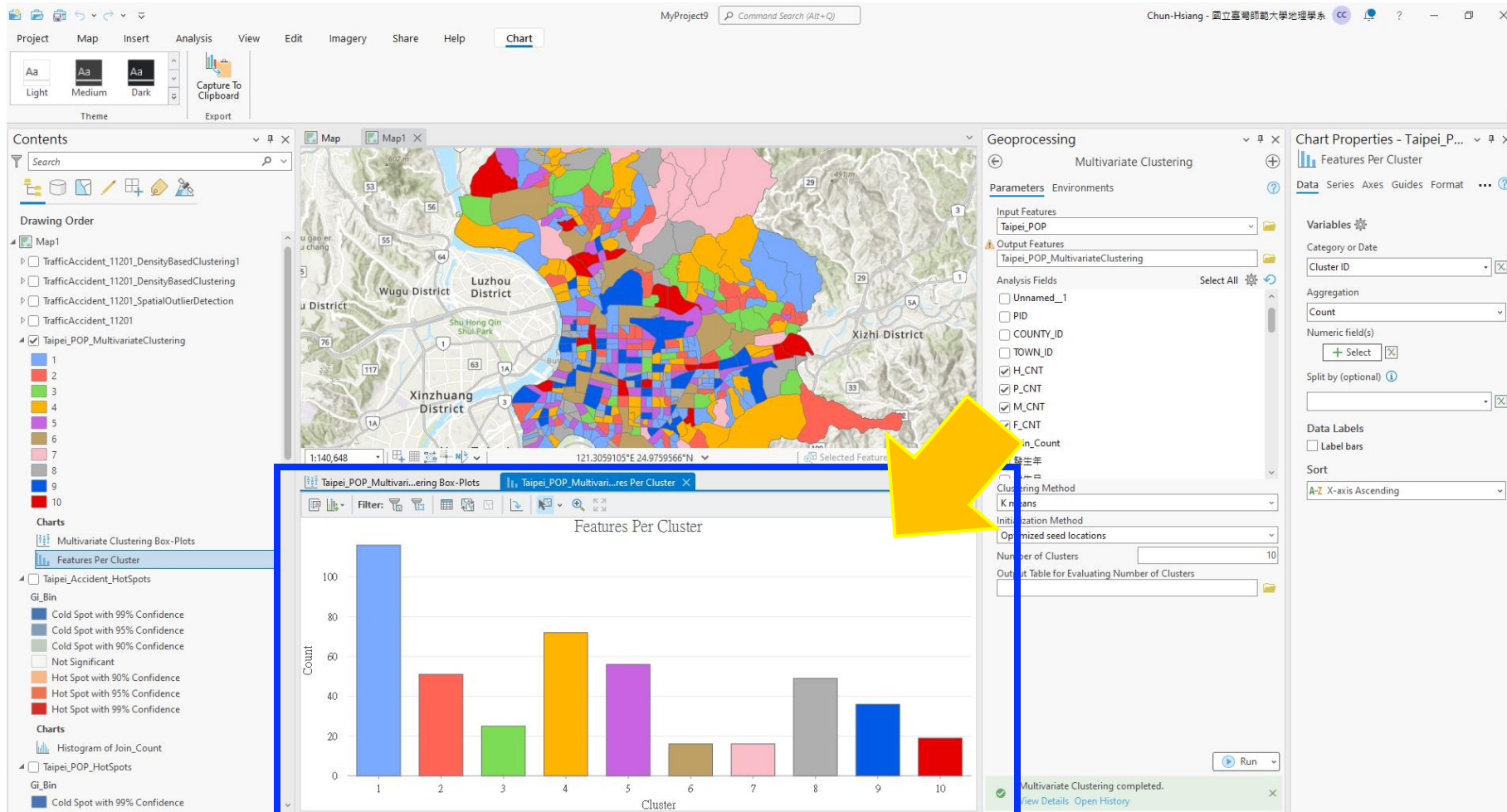
Multivariate Clustering :: *k*-means

NumCluster: 10



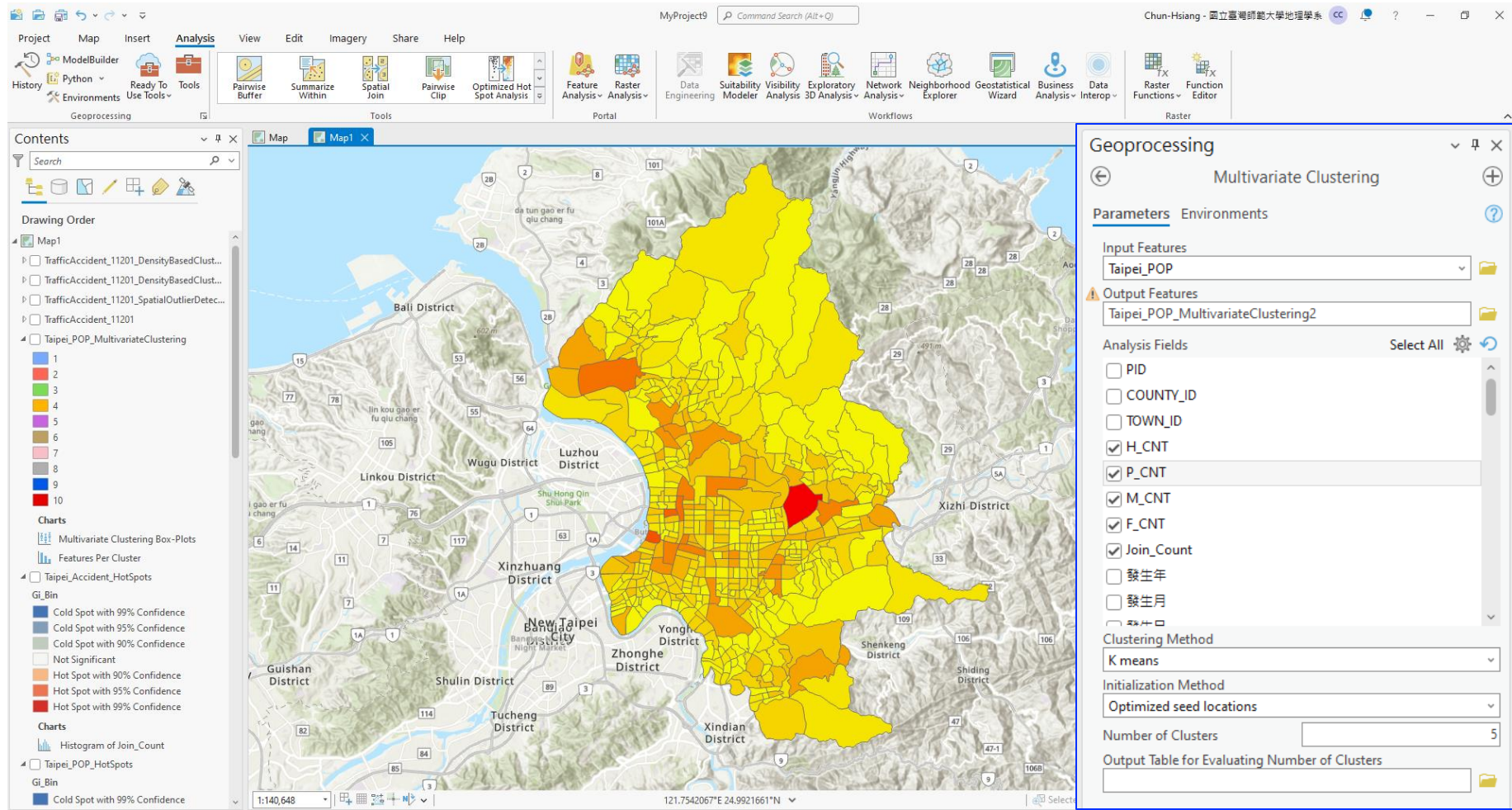
Multivariate Clustering :: *k*-means

NumCluster: 10



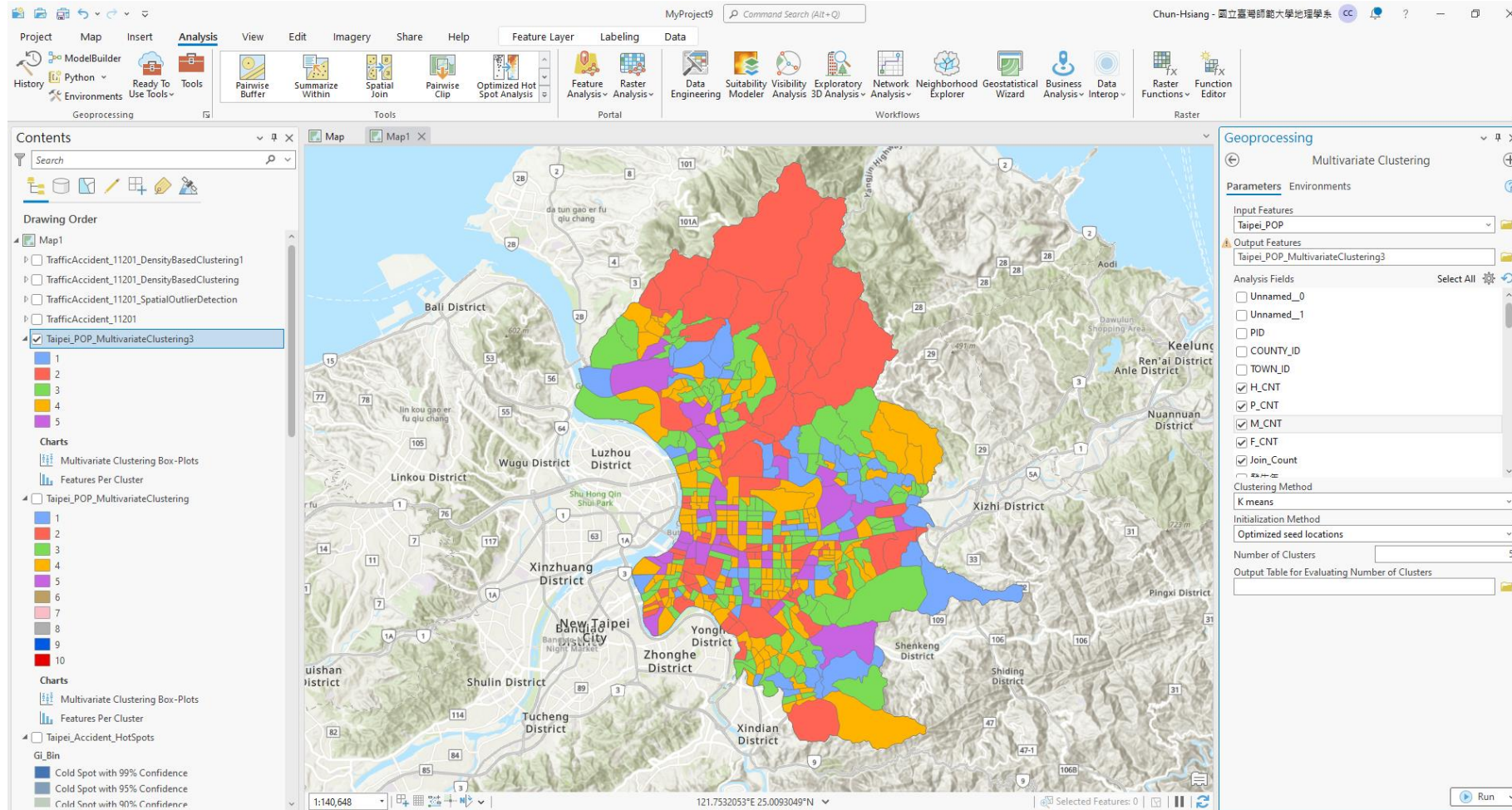
Multivariate Clustering :: *k*-means

NumCluster: 5



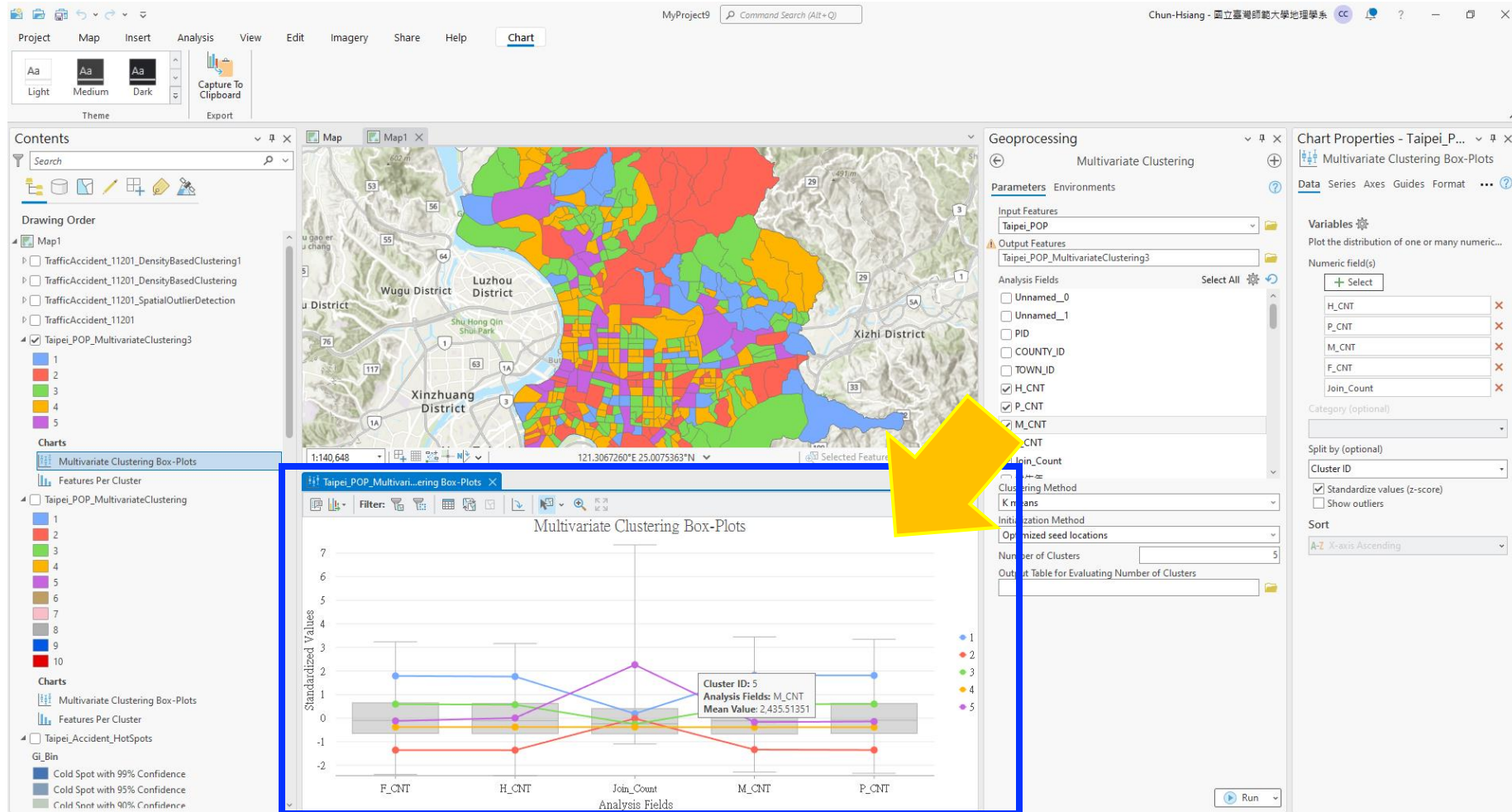
Multivariate Clustering :: *k*-means

NumCluster: 5



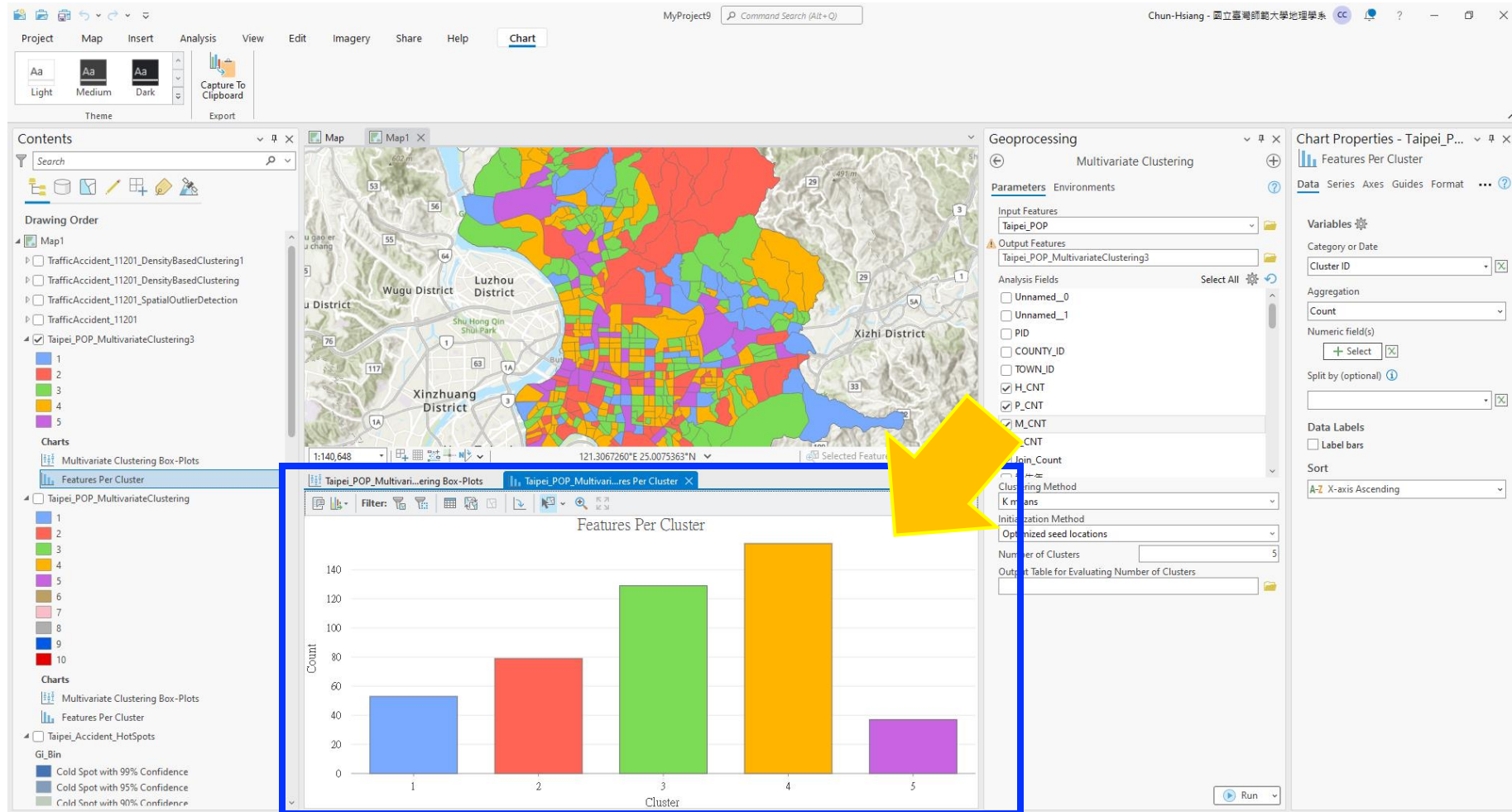
Multivariate Clustering :: *k*-means

NumCluster: 5




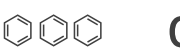



Multivariate Clustering :: *k*-means

NumCluster: 5



Notice

- You have to explain the meanings of the results point-by-point.
- For example...
 - We found that  district exhibited a statistically significant cold spot, whereas , , and  districts demonstrated statistically significant hot spots. Because the population of  was relatively low; however, the neighboring districts at least had an average population.
 - ...



The End

Thank you for your attention!

| Email: chchan@ntnu.edu.tw
Web: toodou.github.io