The Fifth International Workshop on GIS Technology and Application

Statistical Analysis on Urban Land Use

Mengyi Zhang SuperMap Software Co., Ltd.



Statistical Analysis in GIS









Land Use Distribution

Land Use Summary

Road Density



Statistical Analysis in GIS

Extract hidden information in spatial and non-spatial data by applying traditional and spatial statistical analysis methods.



Statistical Analysis Methods in GIS

Attribute Statistics Histogram Area Line Bubble Scatter

Spatial Statistics



Application of GIS Statistics



Relationship between Poverty and Education



Spatial Distribution of Clinics

Urban Planning Statistics in GIS



- Basic statistics
- Road density
- Directional distribution of land categories
- Relations between demographics and land use
-



Land Use Summary

What's the land use type for each piece of land? Which is the category that takes the most area? Which is the category made by numerous small pieces of land?

Get to Know Your Data



Visualize land use type



2 Summarize basic statistics

| N_Land | TotalArea |
|--------|------------------------------------------------------|
| 117 | 17,366,060 |
| 163 | 5,516,028 |
| 46 | 3,437,436 |
| 21 | 1,313,744 |
| 273 | 27,457,810 |
| 64 | 4,447,780 |
| 197 | 38,685,100 |
| | N_Land 117 163 46 21 273 64 197 |

Visualize statistic results

3



Create Thematic Map

- Connect to data source UrbanLand.udbx
- Add dataset LandUse into map window
- Select LandUse layer in Layer Mananger → right click → Create Thematic Map
- Unique Value Map \rightarrow Default



Create Thematic Map



- Expression: LU_ABV
- Select a proper color scheme



Statistical Summary: SQL Query

- Spatial Analysis → SQL Query
- Select: LandUse.LU_ABV,Count(Land Use.LU_ABV) as N_Land,Sum(LandUse.AREA) as TotalArea,Avg(LandUse.AREA) as AvgArea
- Group By: LandUse.LU_ABV

| QL Query | | | | | × |
|------------------|------------|--------------------|---------------|-------------------------------------------------------------|-----------------------------------------|
| Select Dataset: | | | Query Mode: | O Geometry and Attributes | Attributes Only |
| - 🗇 Untitled Wor | rkspace | | Operator: | > • | Get Unique Value |
| 🗄 🔂 Datasour | rces | | Function: | Aggregate 💌 | |
| | andUse | | | Mathematical 💌 | |
| R/ | load | | | String | |
| | | | | String | |
| | | | | Date 🔻 | Find: |
| | | | Select: | LandUse.LU_ABV,Count(LandU as TotalArea,Avg(LandUse.ARE, | Jse.LU_ABV) as N_Land,Sum(LandUse.AREA) |
| | | | Whore | | × . |
| | | | where. | | ^ |
| Fields: | | Hide System Fields | Group Byr | | ~ |
| Field Alias | Field Name | Field Type | Croup by: | LandUse.LU_ABV | |
| × | × | All | Sort By: | | |
| SmUserID | SmUserID | Int | | | |
| AREA | AREA | Single | | | |
| PERIMETER | PERIMETER | Single | CL D 11 | | |
| LANDUSECOV | LANDUSECOV | Int | Show Result | S | |
| LU_GEN | LU_GEN | Short | ✓ Browse | Attribute Table Highlight in | Map Highlight In Scene |
| LU_ABV | LU_ABV | Wide Char | Save Resu | ults | |
| LU_CODE | LU_CODE | Single | Datasource: | 🔜 UrbanLand | • |
| | | | | 10000 | |
| | | | Dataset: | LandUse_stat | |
| Set Associated F | ïeld | Import Export | Auto close wł | hen finish | Query Clear Close |

Statistical Summary: Change Attribute Type

- The type of statistic result field is the same as the original field
- Select LandUse_stat in Workspace Manager → right click → Properties
- N_Land Type: Wide Char \rightarrow Int, click Apply

| No | LU_ABV | N_Land | TotalArea | AvgArea |
|----|--------|--------|------------|-----------|
| 1 | AGR | 117 | 17,366,060 | 148,427.9 |
| 2 | COM | 163 | 5,516,028 | 33,840.66 |
| 3 | IND | 46 | 3,437,436 | 74,726.88 |
| 4 | OPS | 21 | 1,313,744 | 62,559.22 |
| 5 | RES | 273 | 27,457,810 | 100,578.1 |
| 6 | TNS | 64 | 4,447,780 | 69,496.55 |
| 7 | VAC | 197 | 38,685,100 | 196,371.1 |



Statistics Visualization: Diagrams

Start → Diagrams → Pie



| Diagrams | | # X |
|-------------------------------------------------------------------|----------------|-----|
| Parameter Settings | Style Settings | |
| – Data Settings – | | ^ |
| Datasource: | 🔜 UrbanLand | • |
| Dataset: | 🛅 LandUse_sta | t 🔻 |
| Filter: | | |
| Statistic Field | | |
| + 🗇 | | |
| Item | Alias | |
| TotalArea | TotalArea | |
| | | |
| Agregation T | Sum | |
| Aggregation T | Sum | × |
| Aggregation T | Sum | |
| Aggregation T Group Field Group Field 1: | Sum LU_ABV | |
| Aggregation T Group Field Group Field 1: Group Field 2:5 | Sum LU_ABV | |
| Aggregation T Group Field Group Field 1: Group Field 2: | Sum LU_ABV | |

| [| Diagrams | | | џ > |
|---|-----------------------|-------------|-----------|------------|
| P | arameter Settings Sty | le Settings | | |
| | View: | Pie | | • |
| | Style: | Default | | • |
| | Title Settings | | | |
| | Caption: | Land Use P | roportion | |
| | Font: | Segoe UI | | • |
| | Font Size: | 16 | | • |
| | Pie Settings | | | |
| | Display Subtitle | | | |
| | As Percent | | | |
| | Show Lable | | | |
| | Label Position | Outside o | f Diagram | • |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Т | oolbox Catalog Manag | er Diagra | ms Prop | erties |

Statistics Visualization: Diagrams

Start → Diagrams → Combo



| Diagrams | т х |
|--------------------------|------------------------|
| Parameter Settings Style | e Settings |
| Data Settings | |
| Datasource: | UrbanLand 🔻 |
| Dataset: | 🛅 LandUse_stat 🔻 |
| Group Field | LU_ABV 🔹 |
| Filter: | |
| Y Axis 1 | |
| Statistic Field | N_Land 🔻 |
| View: | Column |
| Y Axis 2 | |
| Statistic Field | AvgArea 🔻 |
| View: | Line 💌 |
| Color Scheme: | • |
| 🗹 Display Legend | |
| | |
| | |
| | |
| Toolbox Catalog Manage | er Diagrams Properties |

| Diagrams | | | | д | × |
|------------------------|--------|--------------|------|--------|---|
| Parameter Settings Sty | rle Se | ettings | | | |
| View: | Co | mbo | | • | ^ |
| Style: | Lig | Jht | | • | |
| Title Settings | | | | | |
| Caption: | Lan | ıd Use Summ | ary | | |
| Font: | Seg | goe UI | | • | |
| Font Size: | 16 | | | • | |
| X Axis Settings | | | | | |
| Caption: | Lan | id Use Categ | ory | | |
| Font: | Seg | goe UI | | • | |
| Font Size: | 8.2 | 5 | | • | |
| Y Axis 1 Settings — | | | | | |
| Caption: | Lan | d Pieces | | | |
| Font: | Seg | goe UI | | Ŧ | |
| Font Size: | 8.2 | 5 | | - | |
| Custom Extremum: | | | | | |
| Min: | 0 | | | | ~ |
| Toolbox Catalog Manag | jer | Diagrams | Prop | erties | 5 |



Road Density

Traditional statistics based on spatial relationship.

Spatial Relationship between Roads and Land Piece



Divide Roads by Land Boundaries: Overlay

- Spatial Analysis → Overlay Analysis
- Uncheck "Keep Single Object"

| Overlay Analysis | | | × |
|------------------|------------------|----------------------------------------------------------|----------|
| Clip | – Source Data – | | |
| Merge | Datasource: | 🔜 UrbanLand | • |
| Erase | Dataset: | 🛹 Road | • |
| Intersect | Overlay Datase | | |
| Identity | - Overlay Datase | | |
| XOR | Datasource: | UrbanLand | – |
| Update | Dataset: | 🛆 LandUse | - |
| | Result Settings | | |
| | Datasource: | 🔜 UrbanLand | • |
| | Dataset: | Road_divided Set Fields | |
| | Tolerance: | 0.017692293702924 m | |
| | Compare Re | sults Keep Single Object 🔞 🗌 Supports self-overlapping r | egi |
| | | | |
| | | OK Cancel | |

Feature Length: Attribute Calculation

- Browse attribute table of Road_divided
- Attribute Table \rightarrow Calculate Geometric Attribute

| 3D Data Spat | ial Analysis Traffic An | alysis Processing Automation View Online Attribute Table | | Calcu |
|------------------------|-------------------------|-------------------------------------------------------------|---|--------------------|
| ZA↓ Sort Descending | Filter | Hide Column Show Hidden Column Attribute Calculate Geometri | c | Select N Update |
| | Browse | Structure Attribute | | Geome |
| | | | | Length |
| | | | | Area U |
| | | | | Coordi |
| | | | | |
| | | | | |
| | | | | |

| Calculate Geometric Attribute | | | | | | |
|-------------------------------|----------------------------|---|--|--|--|--|
| Select Mode: | Update Geometry Attributes | | | | | |
| Update Field: | LENGTH | - | | | | |
| Geometry Property: | Geodesic Primeter | r | | | | |
| Length Unit: | m | r | | | | |
| Area Unit: | m² 🗸 | - | | | | |
| Coordinate: | NAD_1983_UTM_Zone_11N | r | | | | |
| | OK Cancel | | | | | |

Total Length of Roads by Land Piece: Dataset Attribute Update

• Data \rightarrow Dataset Attribute Update

| Dataset Attributes Upd | ate | | | | | | |) |
|-------------------------------------------------|-----------------|---|---------|-------------------|------------|--------------|------------|------|
| Data with attirbutes offere | ed | | - Field | l Settings | | | | |
| Datasource: | 🔜 UrbanLand | • | | 🗹 🖳 | | | | |
| Dataset: | ✓ Road_divided | • | | Source field | Field Type | Target Field | Field Type | ^ |
| | | | 4 | CLASS | Short | | | |
| - Target Data | | | 5 | CLASS_DESC | Wide Char | | | |
| Target Datasource: | 📷 UrbanLand | * | 6 | BUS_RT | Double | | | |
| Target Dataset: | 🛆 LandUse | - | 7 | L_ADD_FR | Int | | | |
| | | | 8 🗌 | L_ADD_TO | Int | | | |
| Save Statistic Info | LU_GEN | | 9 | R_ADD_FR | Int | | | |
| Filter: | | | | R_ADD_TO | Int | | | |
| Update Attributes of S | elected Objects | | | PRE_DIR | Wide Char | | | |
| | | | | STR_NAME | Wide Char | | | |
| Parameter Settings | | | | STR_TYPE | Wide Char | | | |
| Spatial Relation: | Within | - | | SUF_DIR | Wide Char | | | |
| | Contain Royder | | ☑ | LENGTH | Double | LENGTH | Double | |
| Boundary Processing: | Contain Border | | | | | | | ~ |
| Get Value: | Sum | - | | nore system field | | | | |
| | | | | | | 0 |)K Can | ncel |

Road Density: Update Field

Attribute Table → Update Field

| Traffic Anal | ysis Processing Automation View C | Online At | tribute Table | | | | |
|-----------------|-----------------------------------------------------------------------------|-------------------------------|----------------------------------|------------------|------------|-----------------|--------------------------------|
| exadecimal • | Hide Column Show Hidden Column Hide Row Show Hidden Row | (i) Attribute Structure | Calculate Geometric Attribute | Delete Record | Add Record | Update Field | ∽ Undo ∂ Redo ✿ Settings |
| Browse | | | | Editing | 1 | | |

| Update Field forLandUse@UrbanLand | | | | | | |
|-----------------------------------|-------------------------------|---------------------------|--------|--|--|--|
| Update Field: | Density | • | Double | | | |
| Apply To: | Whole Field | O Update Selected Records | | | | |
| Operation M | Double-Field | ▼ Revers | se | | | |
| Operation Fiel | LENGTH | | Double | | | |
| Operator: | 1 | • | | | | |
| Operation Fiel | AREA | ¥ | Single | | | |
| Expression: | LENGTH / cast(AREA as Double) | | | | | |
| | | | | | | |
| | | Apply | Close | | | |

Statistics Visualization: Thematic Map

- Add dataset LandUse into map window
- Select LandUse layer in Layer Mananger → right click → Create Thematic Map
- Ranges Map \rightarrow Default



Statistics Visualization: Thematic Map



- Expression: Density
- Method: Quantile Interval
- Range Precision: 0.0001





Land Use Distribution

Where is the mean center of each land use category? What are the spatial distribution features for varied land use category?

Geographic Distribution of Land Pieces



Geographic Distribution: Directional Distribution

- Spatial Analysis → Spatial Statistical Analysis → Measuring Geographic Distributions → Directional Distribution
- Group By: LU_ABV
- Weight Field: AREA

| Directional Distri | bution | | | | | | × |
|---------------------------------------|------------------------|---|------|------------|------------|------------|--------|
| Source Data | | | – Me | an Center | | | |
| Datasource: | 🔜 UrbanLand | • | | Field Name | Field Type | Statistics | Type |
| | 40100 | | | SmUserID | Int | Max | |
| Dataset: | 🛆 LandUse | • | | AREA | Single | Max | |
| - | | | | PERIMETER | Single | Max | |
| Parameter Setting | JS | | | LANDUSECOV | Int | Max | |
| Group By: | LU_ABV | - | | LU_GEN | Short | Max | |
| Weight Field: | ΔΡΕΔ | Ţ | | LU_ABV | Wide Char | First Obje | ct |
| weight Field. | ARLA | _ | | LU_CODE | Single | Max | |
| Ellipse Size: | One Standard Deviation | - | | LENGTH | Double | Max | |
| | | | | Density | Double | Max | |
| Result Data | | | | | | | |
| Datasource: | 📊 UrbanLand | • | | | | | |
| Dataset: | ResultDirectional | | | | | | |
| | | | | | | ОК | Cancel |

Data Visualization: Create Thematic Map



- Expression: LU_ABV_Group
- Change Style: opacity 50%

| Change Style | | | | | | × | | | | | |
|-------------------|----------------------|-----------------|------------------|------------------------|------------------------|-----------------|----------|--------------------------|---------------|-------------|---|
| Marker Style | Fill Symbol Selector | | | | | | Search i | n Symbol Lib | orary (Ctrl) | ; q_∣ ⊒r | × |
| Marker Symbol | Root Group | | Null | | | | P | review | | | ٦ |
| Rotation | Sasic Fill | System0 | System 1 | System2 | System3 | System4 | | | | | |
| Line Style | | System5 | System6 | System7 | Extinct lake | Stone land | | | | | |
| Line | • | | | | | | | | | | _ |
| Fill Style | _ | Mangled land | Sandbeatch | Sand and grave land | Rock foreshore | Coral foreshore | F | oreground: | | | |
| Fill Symbol | | | | | | | B | ackground: ansparent: | | | |
| Transparency | | Mud flat | flat | beach | Shellfish culture | Sandbank | s | ymbol: | | | |
| Gradient Offset X | | Lake shoal | Beach in water | Passable | Impassable | Projecting | C | pacity: | 50 | • % | |
| | | | | SS | | 1 1 | 7 | Gradient F | ill Linear | ~ | |
| | _ | High-rise house | Damaged house | Open quarry | Random digging site | Outcrop land | 0 | Offset X: | 0 | • % | 1 |
| | | | X | 84 A | | | ~ | Offset Y: | | ▶ % | × |
| | | | | | | Γ | ОК | Cance | el Ar | pply | 1 |

Data Visualization: Category Visibility in Thematic Map





Retrospect: Unique Thematic & Traditional Statistics



Retrospect: Relationship between Roads and Land Pieces



Overlay Attribute Calculation Update Field



Retrospect: Categories with Similar Distribution Pattern



THANK YOUK