GEOG 5201 Geovisualization
Lab 4: Visualizing Uncertainty

Part 1: Guided Exercise

Uncertainty is a concept that emerged from research on geospatial data quality. The objective of this exercise is to visually explore the uncertainty of voting-age population in the 2015-2019 American Community Survey (ACS) 5-Year Estimates using various visualization methods. We will focus on the maps combined method, and we will depict uncertainty using both extrinsic and intrinsic visual variables. You are also expected to share your work on ArcGIS Online to showcase your visualizations of uncertainty.

Activities

1. Loading data into ArcGIS Pro
    a. Add the ACS data ("*ACS_2019_5YR_TRACT_39_OHIO*")
    b. Open the Attribute Table of the ACS data. The following are descriptions of some key attributes:
        i. *Total_Population*: tract-level total population
        ii. *Voting_Age_Est*: Estimated number of citizens aged 18 years and over
        iii. *Voting_Age_MOE*: The margin of error for the number of citizens aged 18 years and over

2. Intrinsic uncertainty visualization I: transparency
    a. Right-click Map in the Contents pane, and click New Group Layer. Rename the created new group layer as "*Intrinsic: Transparency*", and move the ACS data layer under this group layer
    b. Right-click the ACS data, and click Symbology. In the Symbology pane, change Primary Symbology to Graduated Colors
        i. For Field, choose *Voting_Age_Est*
        ii. For Normalization, choose *Total_Population*
        iii. For Method, accept Normal Break (Jenks)
        iv. For Classes, accept 5
        v. For Color scheme, choose one as you see fit
        vi. Click More under the Classes tab, and click Format all symbols. Go to Properties tab, set Outline color to Arctic White, and click Apply
    c. In the Symbology pane, go to Vary symbology by attribute tab, and expand Transparency
        i. For Field, choose *Voting_Age_MOE*
        ii. For Normalization, choose *Total_Population*
        iii. Set the Transparency range from 70% (High values) to 0% (Low values)

3. Intrinsic uncertainty visualization II: saturation
    a. Right-click Map in the Contents pane, and click New Group Layer. Rename the created new group layer as "*Intrinsic: Saturation*"
    b. Right-click the ACS data, and click Copy. Right-click the new group layer that is just created, and click Paste
    c. Right-click the pasted ACS data, and click Symbology
    d. In the Symbology pane, change Primary Symbology to Bivariate Colors
        i. For Field 1, choose *Voting_Age_MOE*
        ii. For Field 2, choose *Voting_Age_Est*
        iii. For both Normalization 1 and Normalization 2, choose

Total_Population

iv. For Method, accept Quantile
v. For Color scheme, choose one as you see fit
vi. Click Template, go to Properties tab, set Outline color to Arctic White, and click Apply

e. In the Symbology pane, go to Vary symbology by attribute tab, and expand Transparency
   i. For Field, choose <*None*>

4. Extrinsic uncertainty visualization: dot density
   a. Right-click Map in the Contents pane, and click New Group Layer. Rename the created new group layer as "*Extrinsic: Dot Density*"
   b. Right-click the ACS data in (3), and click Copy. Right-click the new group layer that is just created, and click Paste
   c. Right-click the pasted ACS data, and click Symbology. In the Symbology pane, change Primary Symbology to Graduated Colors
      i. For Field, choose *Voting_Age_Est*
      ii. For Normalization, choose *Total_Population*
      iii. For Method, accept Normal Break (Jenks)
      iv. For Classes, accept 5
      v. For Color scheme, choose one as you see fit
      vi. Click More under the Classes tab, and click Format all symbols. Go to Properties tab, set Outline color to Arctic White, and click Apply
   d. Copy and paste another ACS data layer under the same group layer. Right-click the pasted ACS data, and click Symbology. In the Symbology pane, change Primary Symbology to Dot Density
      i. For Fields, click Set an expression, and input "*$feature.Voting_Age_MOE/$feature.Total_Population * 100*" in the Expression box
      ii. Set Dot Size to 2 pt, and Dot Value to 1
      iii. Click More besides the Color scheme, and click Format all symbols. Go to Gallery tab, and select Square 2

5. Share the three groups of uncertainty visualizations on ArcGIS Online. Make sure the web map is publicly viewable

Note that both the estimated data and the MOE are standardized by total population because choropleth maps are not suitable for visualizing raw (unstandardized) data.

Assignment

Note: Submit your responses to the following questions on the course website. Be sure to have all your answers and file(s) ready before starting your submission. You are allowed only one attempt to submit your responses.

1. (5 pts) Describe the spatial patterns of data uncertainty in this application.

2. (5 pts) Which of the three visualization methods do you think best depicts the patterns of uncertainty in this application? Explain.

3. (5 pts) Input the link to your web map here.

Part 2: Unguided Exercise

In this exercise, you will design a **dashboard** to visualize the uncertainty information in the 2015-2019 American Community Survey (ACS) 5-Year Estimates. The ACS data contain the most popular social, economic, housing, and demographic variables for different geographic areas, and you are expected to select **one (1)** variable to visualize it as well as its margin of error. You will find more about the variables details in the metadata.

Activities

Select **one (1)** variable from the 2015-2019 American Community Survey (ACS) 5-Year Estimates. Visualize the variable and its margin of error using **at least one (1)** uncertainty visualization method and publish your map(s) in a dashboard. Please see Lab 3's guided exercise for instructions on how to create a dashboard using ArcGIS Dashboards.

- You may consider a variety of strategies for displaying uncertainty, such as maps compared, bivariate choropleth maps with varying saturation, combining proportional symbols/dot density and choropleth maps, and probability cones with varying transparency

- Make sure that your dashboard includes the following:
  - At least one map with title, action (zoom in/out, set extent), and legend
  - At least one chart showing the statistical distribution of the data and the associated uncertainty you choose to visualize
  - Rich text indicating the topic of your dashboard, the data source, and credits

- Make sure your dashboard is viewable by everyone (public)

Example dashboards

1. COVID-19 Dashboard
2. City Cancer Challenge impact map
3. Crime Data Dashboard – Douglas County, Colorado
4. USA Severe Weather Reports

Assignment

Note: Submit your responses to the following questions on the course website. Be sure to have all your answers and file(s) ready before starting your submission. You are allowed only one attempt to submit your responses.

1. (5 pts) Describe the following items in 200 words: your selected variable, how you create the dashboard, and your findings from the visualization.

2. (5 pts) Input the link to your dashboard here.