

4. Performing Operations on Geospatial Data in QGIS: Polsby-Popper Score

Overview

In this unit we will go over how to edit your layer's attribute table and perform basic operations on your data. We will begin again by thinking about map projections and how to choose one that is appropriate for your data and purposes. We will explore some of the functionality of QGIS to measure distance and area and from there we will learn how to edit a layer's attribute table using the Field Calculator by calculating the Polsby-Popper score for each US Congressional District. We will examine how the choice of shapefile and projection might influence the answers you get when performing operations on geospatial data.

Projecting Your Data

Over the past two weeks we have done our best to try and convince you of the value of choosing an appropriate map projection for your data. This is where it becomes most important. If you are interested in learning more about the impact of projection choice on various compactness scores, we suggest you take a look at [this](#) paper by Zach Schutzman and fellow VRDI alums Assaf Bar-Natan and Lorenzo Najt or [this](#) R package by MGGG collaborator Lee Hachadorian.

Task: Convert your shapefile to an appropriate projection

- Open the cds_cartographic.shp and navigate to Layer Properties → Information.
 - What is the CRS? Is this a projected or geographic coordinate system?
- Project this map layer into a projected coordinate system
 - Select the congressional district layer. Right click and hit Export - Save Features As
 - Give your file a new name: "cds_cartographic_albers"
 - Use the globe button to search for a new CRS
 - In "Filter" type "us albers"
 - Select "EPSG:102003- USA_Contiguous_Albers_Equal_Area_Conic" and continue
 - Make sure to "Add layer to map"
- Add the cds_tiger.shp file to your map document and repeat the process.

Census Mapping Files

The US Census provides several different series of mapping files: Partnership, TIGER/Line, and Cartographic Boundary files. In your project, you have shapefiles for the 116th US Congressional Districts from both the TIGER/Line and Cartographic Boundary programs. Toggle back and forth between the two shapefiles using the checkmark in the Layers Panel. What do you notice about the difference between the two? Try adding a basemap (see yesterday's handout). To read more about the different spatial data available from the Census, visit the [Geography Program](#) section of their website.

Measuring Perimeter and Area

One functionality that QGIS has is the Measure Tool which allows you to measure lines, areas, and angles. This can be accessed either from the Attributes Toolbar or by navigating to View → Measure.

Task 1: Measure Wyoming's at-large district using the Measure Tool

- Navigate to Wyoming's at-large congressional district (hint: it's a big rectangle)
- Open the Measure Line tool and change the unit to miles.
- Find the perimeter of Wyoming and write it down!
- Now open the Measure Area tool and change the unit to miles.

- Find the area of Wyoming and write it down!

Now that you've found a rough approximation of Wyoming's area and perimeter, we are happy to inform you that there is a better way to do this!

Task 2: Calculate the area and perimeter for each US Congressional District

- Open Project → Properties → General and change the “Units for distance measurement” and “Units for area measurement” to miles and square miles respectively.
- Now navigate to the attribute table for your cds_cartographic layer and open the Field Calculator.
- Name your new field “AREA” and change the “Output field type” to “Decimal Number (Real).” Increase the precision to 5.
- In the expression box type “\$area” and click “OK.” This will give you a new field with the area of each feature in square miles.
- Open a new Field Calculator and name your new field “PERIM” and change the “Output field type” to “Decimal Number (Real).” Increase the precision to 5.
- In the expression box type “\$perimeter” and click “OK.” This will give you a new field with the perimeter of each feature in miles.
- Toggle off the pencil icon and be sure to save the changes you made to your shapefile.
- Compare the area and perimeter for Wyoming that you got from the Measure Tool versus the results from the Field Calculator. How different are they?
- Repeat this process for your cds_tiger layer.

Calculating Polsby-Popper

As you have probably heard by now, Polsby-Popper is a very common (if flawed) metric for compactness. It measures the ratio of the area of a district to the area of a circle with the same perimeter. The formula

for this is $4\pi \frac{A}{P^2}$.

Task: Calculate Polsby-Popper Score for 116th US Congressional Districts

- For your cds_cartographic layer, open the Field Calculator and name your new field “PolsPop” and change the “Output field type” to “Decimal Number (Real).” Increase the precision to 5.
- In the expression box type: $4 * \pi * (\text{“AREA”} / \text{“PERIM”}^2)$ and click “OK.”
- Repeat this for the cds_tiger layer.
- Save the edits to your layer.
- Open the attribute table for each layer and explore your “PolsPop” fields.
 - Find the 10 least compact districts for each layer.
 - Are they the same? If not, why might they be different?

Challenge:

- If you have the data for YourState, try using what we learned from this exercise to calculate population density and then visualize it using a choropleth map. If you haven't been able to download the data for YourState, we can help you!