Lab: Gerrymandering: *Louisiana v. Voting Rights Act*

Government legislatures in the United States are composed of representatives elected from geographic districts. The United States Constitution requires reapportionment, in which each state draws new U.S. House of Representative district boundaries after each 10-year census. With GIS technology, the temptation to gerrymander—to manipulate these boundaries to achieve desired election outcomes—is too high for politicians to resist.

Louisiana started the 2020 redistricting process with a map (HB1) used for 2022 elections and found to violate the Voting Rights Act in *Robinson v. Landry*. The Legislature opened an emergency session in January 2024 to replace HB1 with legally permissible districts. In that session, the *Robinson* plaintiffs (Black voters) proposed alternative districts (SB4) that failed to pass, while the Legislature enacted other districts (SB8) in Act 2. White voters subsequently suited and a district court found the new SB8 districts to be a racial gerrymander in *Calais v. Landry*. The case awaits a final U.S. Supreme Court decision, which may undermine remaining power of the Voting Rights Act with regards to preventing gerrymandering.

The question for this lab is: Were Louisiana's SB4 congressional districts less gerrymandered than HB1 and SB8 based on a) compactness of shape, b) political representation, and c) minority representation?

Purpose

- Practice solving area-weighted re-aggregation (AWR) problems with workflows and implementation
- Use GIS to assess legislative districts for evidence of political gerrymandering
- Contribute evidence for testimony to the *Calais v. Landry* Supreme Court case involving Louisiana's districts.

Outcomes

For each congressional district in Louisiana, you are to find the following:

- ❑ Polsby-Popper compactness score for compactness of each congressional district
  `400 * pi * area / perimeter^2`
- ❑ Percentage of votes for Democrat candidate for president in 2024, excluding minority party candidates
  `[Democrat Votes] / ([Democrat Votes] + [Republican Votes]) * 100`
- ❑ Percentage of voting-age population that is African American / Black
  `[Voting Age Black] / [Total Voting Age Population] * 100`

The final result should be a single map of legislative districts with a table:

District	Area	Perimeter	Compactness
1	27,646,678,853	1,264,475	21.73
2	9,149,868,659	833,060	16.57
3	29,454,697,932	1,331,047	20.89
4	34,572,528,468	1,235,492	28.46
5	27,295,258,586	1,884,834	9.65
6	7,519,955,104	682,887	20.26

District	Voting-Age Population (Total)	Black Voting-Age Population (Total)	Black Voting-Age Population (%)	Democrat Votes (Total)	Republican Votes (Total)	Democrat Votes (%)
1	604,976	94,248	15.6	120,237	221,938	35.1
2	598,879	294,920	49.2	200,111	115,536	63.4
3	586,407	100,522	17.1	75,697	251,599	23.1
4	596,380	183,553	30.8	108,153	215,884	33.4
5	590,024	298,504	50.6	169,051	151,104	52.8
6	593,882	94,764	16.0	93,621	252,444	27.1

DATA

`census.gpkg`

- **Title**: Louisiana 2020 Census Public Law Redistricting Data
- **Responsible Party**: U.S. Census
- **Spatial Coverage**: Louisiana
- **Coordinate Reference System**: `EPSG:4269` NAD 1983 geographic coordinate system
- **Spatial Representation Type**: Polygons
- **Spatial Resolution**: Block
- **Temporal Coverage**: 2020 census
- **Lineage**: You are to download this data from the U.S. Census API `"pl"` public law summary file using `tidycensus` in R
- **Distribution**: U.S. Census API
- **Constraints**: Public Domain data free for use and redistribution.
- **Variables**:
  - `GEOID`:
  - code to uniquely identify tracts
  - `P4_001N:` Total Population, 18 years or older
  - `P4_006N:` Total: Not Hispanic or Latino, Population of one race, Black or African American alone, 18 years or older

`Congress_-_SB4_Original_(Price).shp`

- Title: Louisiana 2024 (Act 2) Districts, enacted
- Responsible Party: Louisiana State Legislature
- **Spatial Coverage**: Louisiana
- **Coordinate Reference System**: `EPSG:4269` NAD 1983 Geographic Coordinate System
- **Spatial Resolution**: U.S. Congressional Districts with simplified coastal boundary
- **Spatial Representation Type**: Polygon
- **Temporal Coverage**: Districts approved in January 2024 for the November 2024 elections. Districts are still in effect as of April 2026.
- **Lineage**: Proposed by Price and Duplessis in an emergency session of the Louisiana State Legislature in January 2024, but not enacted. This map was preferred by the *Robinson v. Landry* plaintiffs.
- **Distribution**: Data available in esri shapefile format from the Louisiana State Legislature redistricting website at https://redist.legis.la.gov/
- **Constraints**: Public Domain data free for use and redistribution.
- **Variables**:
  - `DISTRICT_I: integer:` U.S. Congressional District Number
  - `NAME: text: District name`

`la_2024_gen_all_prec.shp`

- **Spatial Coverage**: Louisiana
- **Coordinate Reference System**: `EPSG:32615 (WGS 84 UTM zone 15N)`
- **Spatial Representation Type**: Polygons
- **Spatial Resolution**: voting precincts
- **Temporal Coverage**: voting precincts used for tabulating the 2024 election
- **Lineage**: Provided as downloaded from the Redistricting Hub.
- **Distribution**: Data available in esri shapefile format at Redistricting Data Hub at https://redistrictingdatahub.org/state/louisiana/
- **Constraints**: Permitted for noncommercial and nonpartisan use only.

- **Variables**:
  - `VTDST20:` Voting district ID
  - `GEOID20:` unique geographic ID
  - `G24PRERTRU:` total votes for Trump in 2024 (Republican candidate)
  - `G24PREDHAR:` total votes for Harris in 2024 (Democratic candidate)

Methods (Planning)

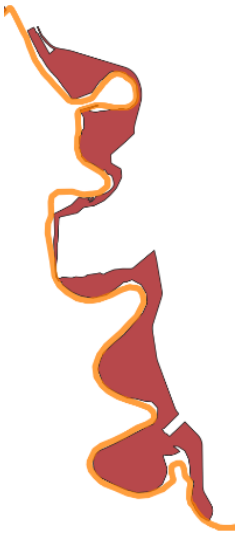
❑ Complete the Central Falls tutorial videos on Area-weighted Re-aggregation.
You should continue to save outputs as geopackage layers.

❑ Read the instructions in full.

❑ DO NOT start GIS analysis without a workflow.
Some solutions are difficult or impossible to implement because of the volume of data.

❑ Develop a workflow, taking into account the following methods and hints:

- The congressional districts were constructed from census blocks and census blocks are therefore theoretically nested within congressional districts. Due to line generalization, the block polygons are not completely contained inside the congressional district boundaries (illustrated to the right). However, if blocks polygons are converted into points that are inside the blocks, then those points *are* guaranteed to be contained inside the correct congressional district.
- The proposed SB4 district boundaries often cross through voting precincts.
- For the purposes of this analysis, we can assume that voters are evenly distributed within voting precincts.
- For the purposes of calculating geometric attributes like area and perimeter, the projected coordinate system used for voting precincts is appropriate (UTM Zone 15N)



❑ Before you start area-weighted re-aggregation of **voting** data, fill in the blanks below:

- What is the polygon layer containing the attribute data that I need? *source layer(s)*:
- What are the source attributes that I need? *source field(s)*
- Do the *source fields* represent **totals** (as opposed to rates, percentages, or densities)?
- Can you assume that the source data totals are evenly distributed within the source feature polygons?
- What polygon layer of geographic units do I need my final results in? *target layer*:
- Which attribute field *uniquely identifies* the target features? *target group field*:
- Are the source features and target features stored in the same projected coordinate system, and is the CRS reasonable for calculating areas?

Methods (Implementation)

❑ Implement the workflow with these cautions:

- Census blocks contain a large volume of data. It will take time for the computer to download, open the attribute table, and analyze the data, draw the data on a map, etc.
- While testing this lab, I encountered the "unknown CRS" problem while saving geopackage layers again. If this happens, try re-running the previous step with the output as a temporary layer. Then, **export** the features of the temporary layer and save as a geopackage layer.

❑ While you implement AWR, keep track of the source attribute field **sums** to make sure they remain consistent throughout:. Write them into the table below.

Step of Analysis	Source field 1: (sum)	Source field 2: (sum)
Prior to AWR in source features		
AW estimate in Fragments		
AWR estimate in target features		

Interpretation

Note: See results for HB1 and SB8 in the results folder of your GIS project.

1. Overall, which set of districts is most compact in shape? Least compact in shape?

2. Measures of compactness have been criticized for being sensitive to bona fide natural boundaries like meandering rivers, jagged or sinuous coastlines, islands, or mountain ridgelines. Do you think this is a valid concern for our analysis here? Why or why not?

3. Across the sets of districts, do you find any examples of gerrymandering by cracking?

4. Across the sets of districts, can you find any examples of gerrymandering by packing?

5. Which set of districts seems best for a healthy democracy? Why?

6. In this case, was AWR necessary, or were voting precincts nested within legislative districts?

Am I Done?

❑ Check your results for the proposed SB4 districts
❑ Load results for 2022 (HB1), the enacted SB8 districts for comparison
❑ Write answers to interpretation questions
❑ Back up work to W:\ drive