GST 102: Spatial Analysis

Lab 2 - Introduction to Geospatial Analysis

Objective – Understand Attribute Table Joins and Data Classification

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1. Introduction

GIS data comes in many formats. As you collect data from various sources on the internet, you will realize that the data you acquire will not always be spatially enabled. There may be a spatial component to the data, but it is not yet a GIS dataset. For example, you may have an Excel spreadsheet with county population statistics. The data has a spatial component, county designation, however, it is not data that is ready to be mapped. In this lab you'll learn how to perform a table join to attach data to the attribute table of an existing GIS dataset. You will then learn how to classify the data.

This lab includes the following tasks:

- Task 1 – Data Exploration and Joins
- Task 2 – Data Classification

2 Objective: Explore and Understand Geospatial Data Models

In this lab we will look at some tabular data and determine how to join it to an existing dataset. This is a common data preparation step before we begin an analysis.

Join – Appending the fields of one table, to those of another table, based on a common attribute. Typically, joins are performed to attach more attributes to the attribute table of a geographic layer.

Classification – the process of breaking up data values into meaningful groups.

3 How Best to Use Video Walk Through with this Lab

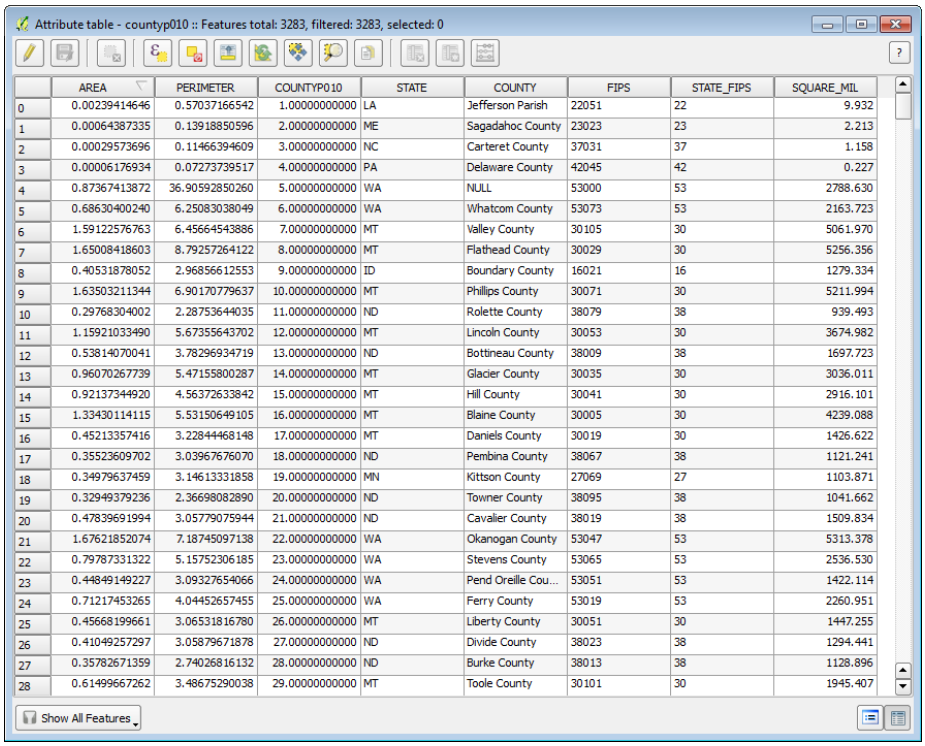
To aid in your completion of this lab, each lab task has an associated video that demonstrates how to complete the task. The intent of these videos is to help you move forward if you become stuck on a step in a task, or you wish to visually see every step required to complete the tasks.

We recommend that you do not watch the videos before you attempt the tasks. The reasoning for this is that while you are learning the software and searching for buttons, menus, etc. . . , you will better remember where these items are and, perhaps, discover other features along the way. With that being said, please use the videos in the way that will best facilitate your learning and successful completion of this lab.

Task 1 Data Exploration and Joins

The data for this lab includes two shapefiles: U.S. State boundaries (statep010.shp) and U.S. County boundaries (countyp010). Both layers cover only the lower 48 contiguous states. There are also two tabular datasets: crime (Crimes_county.dbf) and U.S. Census data (ce2000t.dbf) for counties. In order to map the data in the two tables we will need to join them to the county shapefile. In order to perform such a join there needs to be a common attribute between the table and the shapefile.

2. Open QGIS Desktop 2.2.0 and add the County shapefile.
3. Open the attribute table and examine the contents (figure below).



	AREA	PERIMETER	COUNTYP010	STATE	COUNTY	FIPS	STATE_FIPS	SQUARE_MIL
0	0.00239414646	0.57037166542	1.00000000000	LA	Jefferson Parish	22051	22	9.932
1	0.00064387335	0.13918850596	2.00000000000	ME	Sagadahoc County	23023	23	2.213
2	0.00029573696	0.11466394609	3.00000000000	NC	Carteret County	37031	37	1.158
3	0.00006176934	0.07273739517	4.00000000000	PA	Delaware County	42045	42	0.227
4	0.87367413872	36.90592850260	5.00000000000	WA	NULL	53000	53	2788.630
5	0.68630400240	6.25083038049	6.00000000000	WA	Whatcom County	53073	53	2163.723
6	1.59122576763	6.45664543886	7.00000000000	MT	Valley County	30105	30	5061.970
7	1.65008418603	8.79257264122	8.00000000000	MT	Flathead County	30029	30	5256.356
8	0.40531878052	2.96856612553	9.00000000000	ID	Boundary County	16021	16	1279.334
9	1.63503211344	6.90170779637	10.00000000000	MT	Phillips County	30071	30	5211.994
10	0.29768304002	2.28753644035	11.00000000000	ND	Rolette County	38079	38	939.493
11	1.15921033490	5.67355643702	12.00000000000	MT	Lincoln County	30053	30	3674.982
12	0.53814070041	3.78296934719	13.00000000000	ND	Bottineau County	38009	38	1697.723
13	0.96070267739	5.47155800287	14.00000000000	MT	Glacier County	30035	30	3036.011
14	0.92137344920	4.56372633842	15.00000000000	MT	Hill County	30041	30	2916.101
15	1.33430114115	5.53150649105	16.00000000000	MT	Blaine County	30005	30	4239.088
16	0.45213357416	3.22844468148	17.00000000000	MT	Daniels County	30019	30	1426.622
17	0.35523609702	3.03967676070	18.00000000000	ND	Pembina County	38067	38	1121.241
18	0.34979637459	3.14613331858	19.00000000000	MN	Kittson County	27069	27	1103.871
19	0.32949379236	2.36698082890	20.00000000000	ND	Towner County	38095	38	1041.662
20	0.47839691994	3.05779075944	21.00000000000	ND	Cavalier County	38019	38	1509.834
21	1.67621852074	7.18745097138	22.00000000000	WA	Okanogan County	53047	53	5313.378
22	0.79787331322	5.15752306185	23.00000000000	WA	Stevens County	53065	53	2536.530
23	0.44849149227	3.09327654066	24.00000000000	WA	Pend Oreille Cou...	53051	53	1422.114
24	0.71217453265	4.04452657455	25.00000000000	WA	Ferry County	53019	53	2260.951
25	0.45668199661	3.06531816780	26.00000000000	MT	Liberty County	30051	30	1447.255
26	0.41049257297	3.05879671878	27.00000000000	ND	Divide County	38023	38	1294.441
27	0.35782671359	2.74026816132	28.00000000000	ND	Burke County	38013	38	1128.896
28	0.61499667262	3.48675290038	29.00000000000	MT	Toole County	30101	30	1945.407

Figure 1: Counties Attribute Table

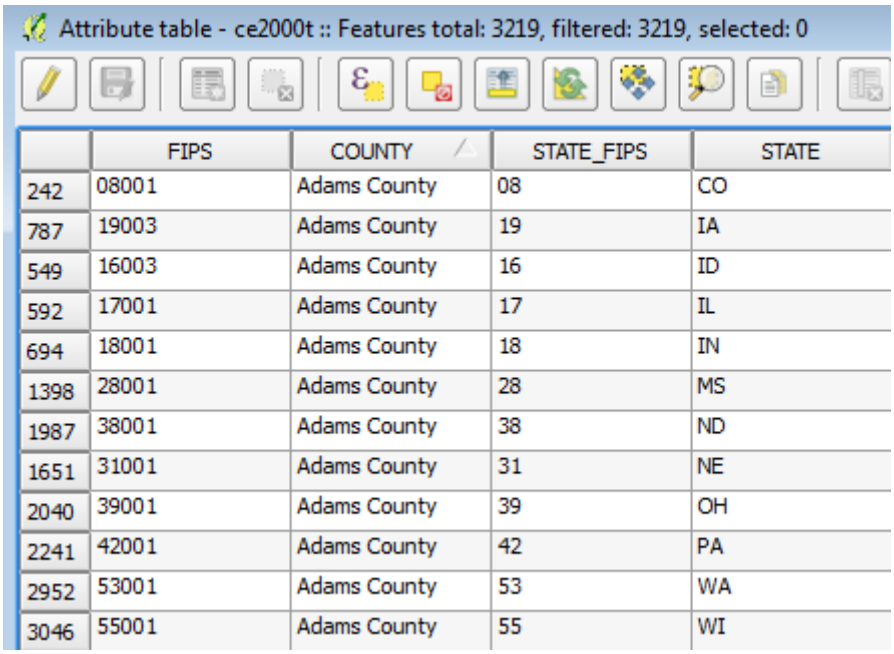
4. You can see that there are 3,283 records in the table. What kind of attributes does this data set have? The Area and Perimeter fields are created as part of the file format (shapefile). These represent the area and perimeter of each feature in map units. Since this dataset is in the Geographic Coordinate System these units are in decimal degrees. This is a difficult unit to work with so these don't add much information. The Square_Mil field at the far right is much more useful. This holds the area of each polygon in square miles. CountyP010 is an unique ID. Then there are fields for State abbreviation, County name and FIPs codes.

FIPS stands for Federal Information Processing Standards. They are unique codes for census designations. Each state has a FIPS code and each county has a FIPS code. This data set has a column for the State_FIPS but not the county fips alone. The first two digits in the FIPS column are the State FIPS code. The last three digits in the FIPS column are the County FIPS code. Combining both State and County FIPS codes provides a unique ID for each county in the U.S.

With this data you can identify the state and county names and the size of each county that is it. Now you will examine one of the standalone tables.

5. Close the Attribute table.
6. To add a table click the Add Vector Data button and browse to the lab data folder. Set the file type filter to All Files (*)(.*). Select the ce2000t.dbf file and add it to QGIS Desktop.
7. Right click on the table and choose Open Attribute Table from the context menu. Examine the attributes.
8. This table contains many fields of socioeconomic data such as total population, population by age, population by gender etc.
9. What field can be used to join this to the Counties attribute table? At first you might think the County column would work. Click the County column header so that an upward facing arrow appears. Remember that this allows you to toggle back and forth between an ascending and descending sort of the data. Notice that there are numerous Adams County entries from several states (figure below). Therefore, County name is not a unique ID. However, the FIPS column is a unique ID that will be used to join to the FIPS column in the shapefile.

10. Close the table.
11. Right click on the countyp010 layer and choose Properties from the context menu.
12. Click on the Joins tab. This is where you configure joins for the layer. Click the Add Join button  .



	FIPS	COUNTY	STATE_FIPS	STATE
242	08001	Adams County	08	CO
787	19003	Adams County	19	IA
549	16003	Adams County	16	ID
592	17001	Adams County	17	IL
694	18001	Adams County	18	IN
1398	28001	Adams County	28	MS
1987	38001	Adams County	38	ND
1651	31001	Adams County	31	NE
2040	39001	Adams County	39	OH
2241	42001	Adams County	42	PA
2952	53001	Adams County	53	WA
3046	55001	Adams County	55	WI

Figure 2: Table sorted by County

13. The Add vector join window opens. The Join layer is the table you will join to the shapefiles attribute table. Since you only have one table in your Table of Contents there is only one choice: ce2000t. Since you've previewed both the county layer attribute table and ce2000t you know that the Join field is FIPS and the Target field is also FIPS (figure below).

NOTE: In this example both join fields have the same name. However, this is not a requirement. Both fields do need to have the same data type. For example, they need to both be text fields or both integer fields.

14. Click OK.
15. You will see the join show up in the Join window (figure below). The join has now been created.

16. Click OK on the Layer Properties window to close it.
17. Re-open the countyp010 attribute table. You will see all the additional fields appended to the right side.
18. This join exists only within this QGIS Desktop document. In other words the data haven't been physically added to the shapefile. However, within this map document the new fields will act as all the others.

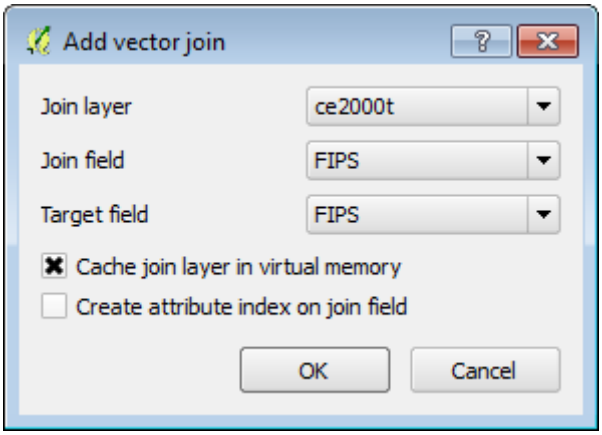


Figure 3: Add vector join

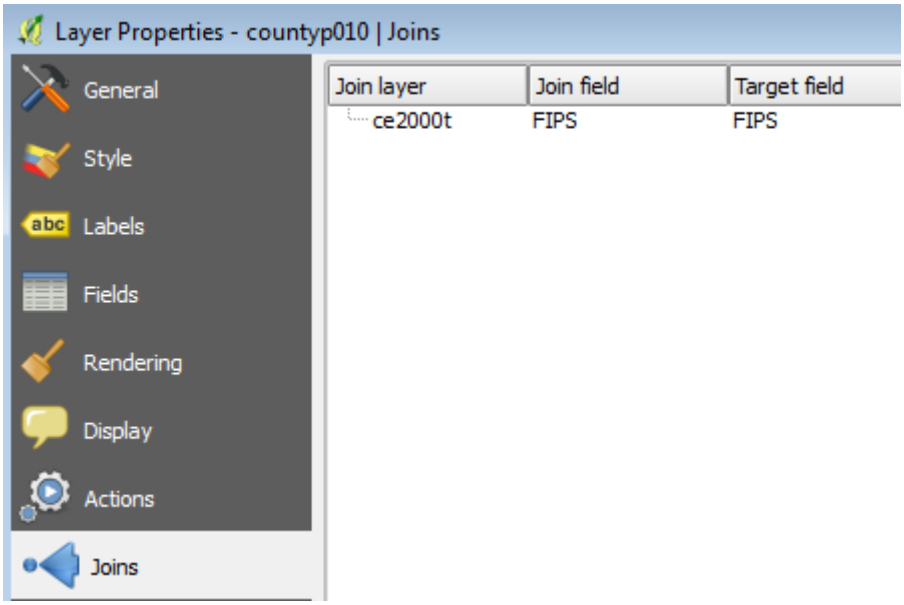


Figure 4: Join established

19. To make the join permanent simply right click on the layer and choose Save as... This will allow you to save a new copy of the countyp010 shapefile with the new attributes included. Name the new shapefile countyp010_census.shp (figure below).

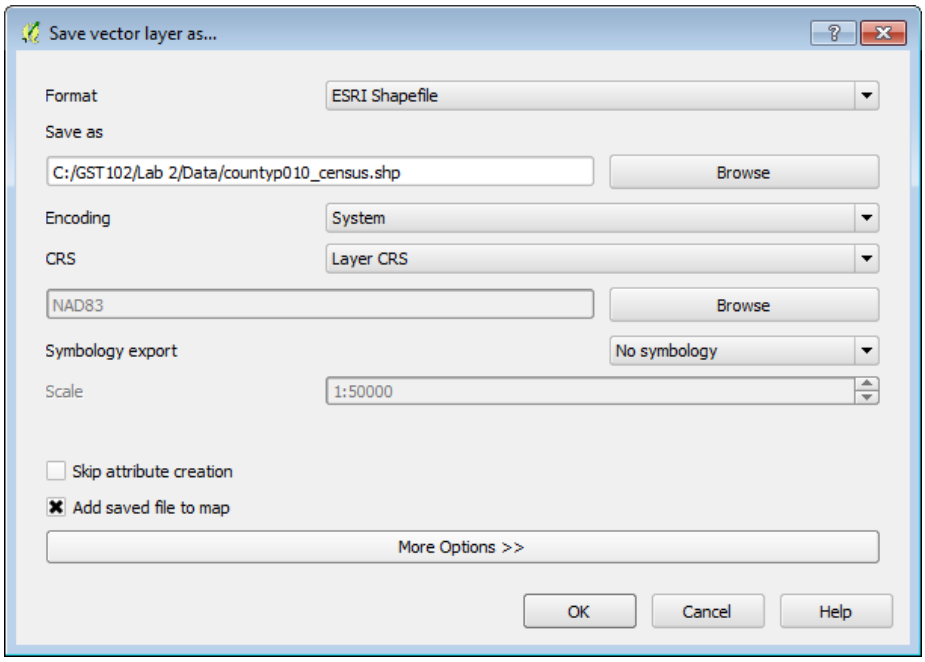


Figure 5: Save vector layer as...

20. You can now remove the original county layer from the map. Right click and choose Remove.
21. Save the project as Lab 2.qgs

Task 2 Classification

Now that you've joined data to the counties layer you will explore different ways to symbolize the data based on the new attributes.

1. Open QGIS Desktop 2.2.0 and open Lab 2.qgs if it is not already open.
2. From the menu bar choose Project -> Project Properties, click on the CRS tab and ensure that Enable 'on the fly' CRS transformation is checked.
3. In the Filter window type 5070. This is the EPSG code for the Albers Equal Area projection for the continental U.S. Select the NAD83/CONUS coordinate systems for the map and click OK.

4. The data should now resemble the figure below.

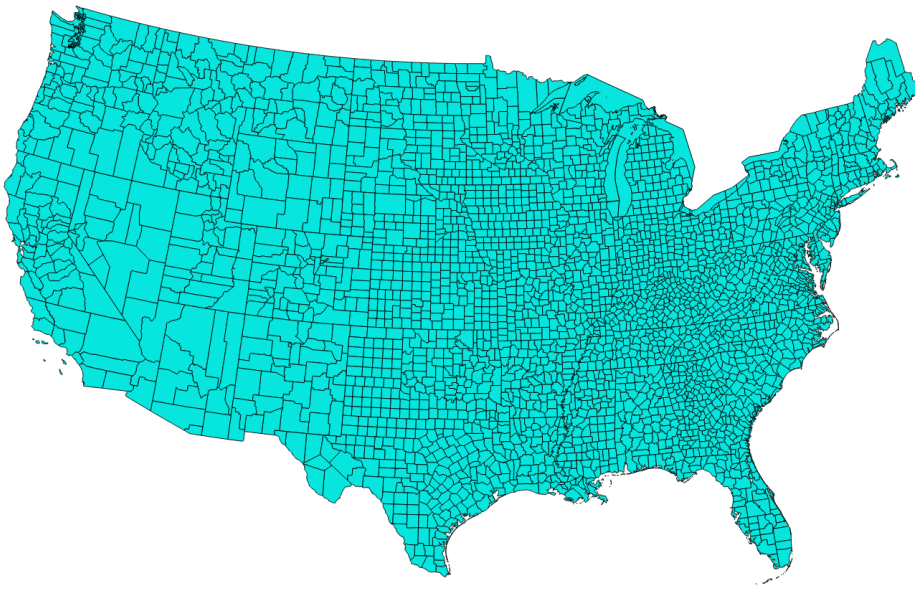


Figure 6: Map in Albers Equal Area

5. Open the Layer Properties for the county_010_census layer and click on the Style tab.
6. Instead of the default Single Symbol renderer choose the Graduated renderer. This allows you to choose a numeric field and classify the data into categories.
7. Choose ce2000t_PO as the Column. This field has the total population in 2000. Take all the defaults (in the figure below) and click OK.

8. The color ramp may differ but your map should resemble the figure below. QGIS has divided the data values into 5 groupings, and applied a color ramp across the categories. This first classification does not tell much of a story.

9. Open up the Layer Properties -> Style tab again. The default classification Mode used was Equal Interval. This default mode attempts to create classes with the equal data value intervals. Change the Mode to Natural Breaks (Jenks). Notice the data values change. This is an algorithm that calculates natural groupings of a series of data values. Click OK.

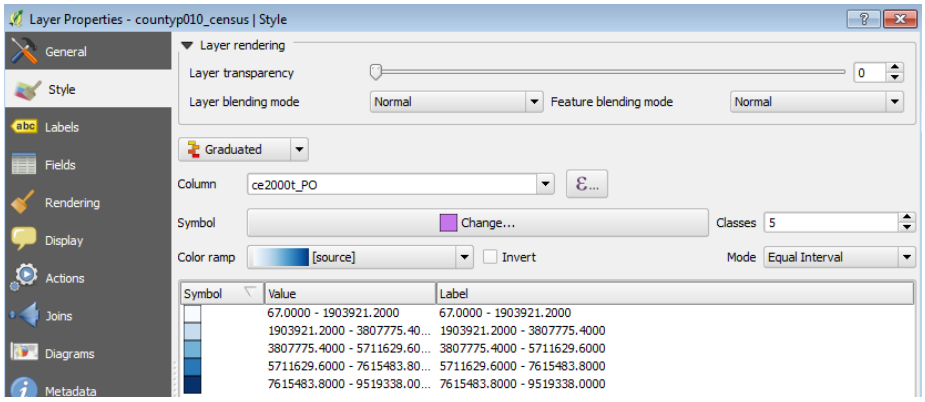


Figure 7: Graduated Styling Settings

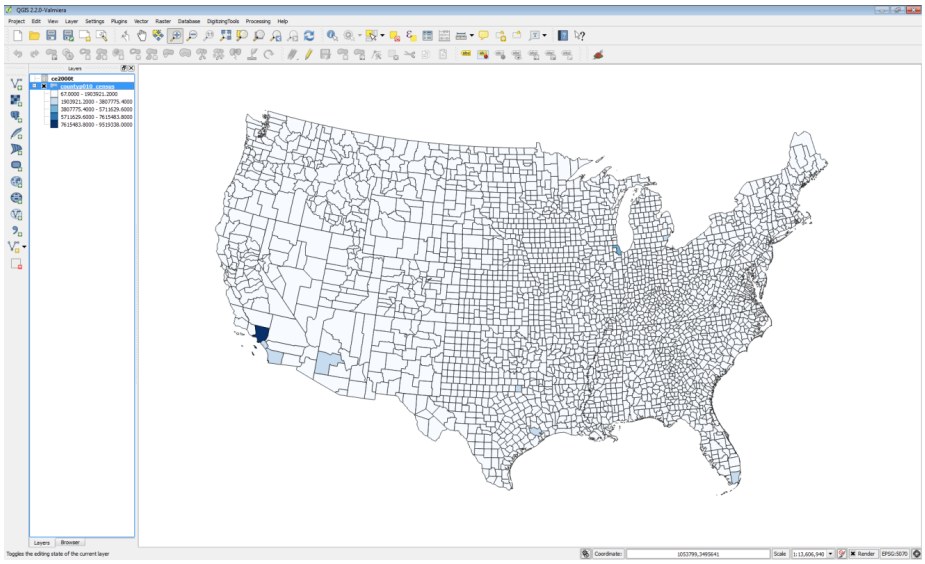


Figure 8: Counties Classified by total population

10. This is a more informative portrayal of the data. There large population centers are more visible now (figure below).

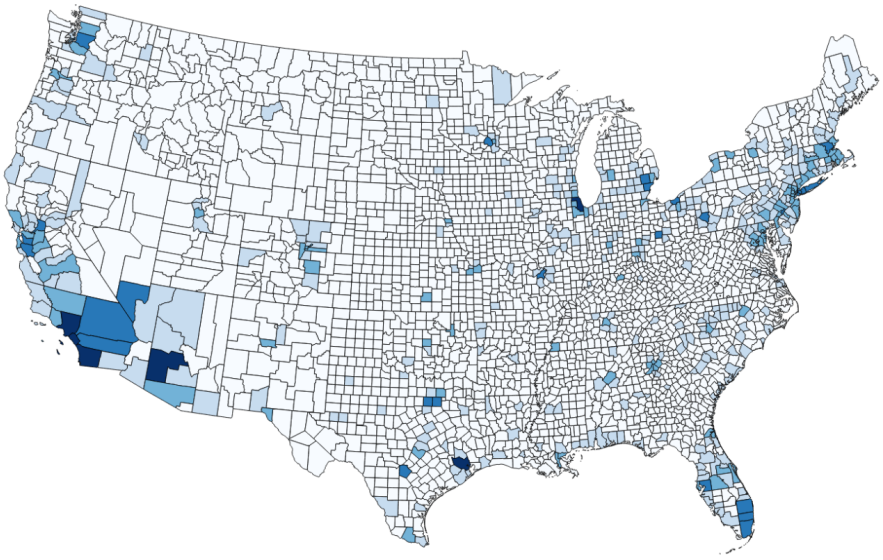


Figure 9: Total Population via the Natural Breaks Mode

11. Open up the Layer Properties -> Style tab again. Change the Mode to Quantile (Equal Count). Notice the data values change. This is an algorithm that attempts to put the same number of features into each class. Click OK.
12. This is a much more informative depiction of total population (figure below).

NOTE: When a map is presenting data values it is called a chloropleth map.

13. Open up the Layer Properties -> Style tab again. In addition to changing the mode, you can change the number of classes. Change the number of classes to 4 and click Apply.
14. You can also change the Color ramp. Click the drop down arrow to the right of Color ramp and choose RdBu  then click on one of the symbols to have the new color ramp applied. Click Apply. This highlights rural counties with a red color (figure below).

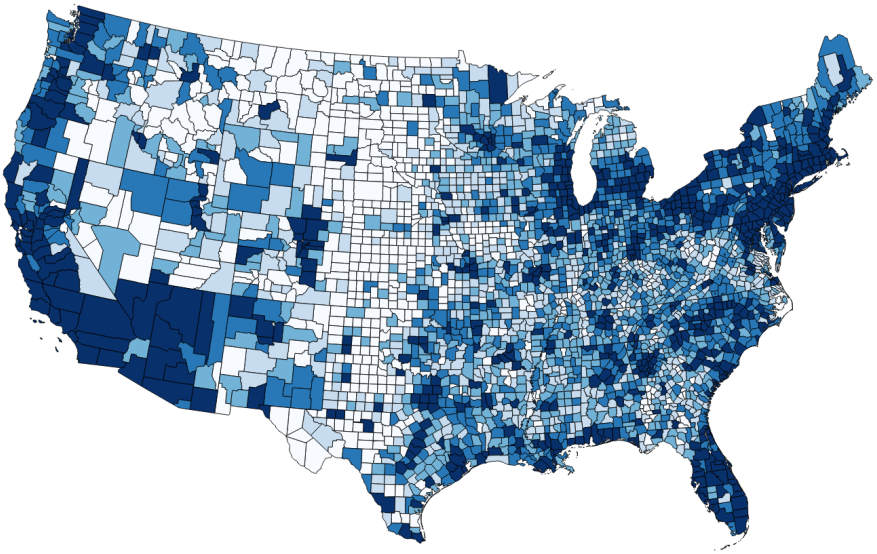


Figure 10: Total Population via the Quantile Mode

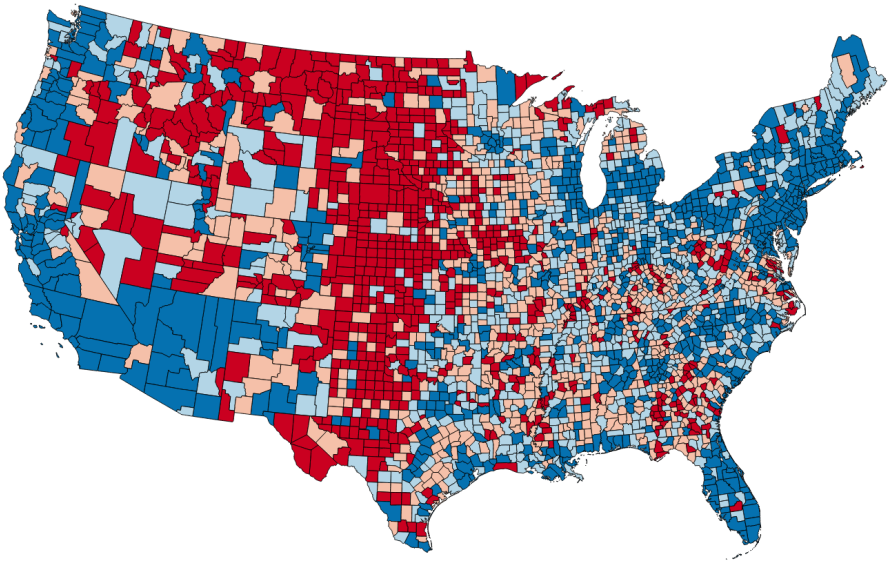


Figure 11: Total Population via the Quantile Mode 4 Classes and a Red Blue Color Ramp

15. You can also click the Invert option to have the color ramp reversed. NOTE: Sometimes you need to change to another color ramp, and back to the one you want to use, to have the Inversion take effect.
16. Finally, you can change the Labels. Instead of the bottom class having values of 67-11566.75, you can double click on the label text for a class and change it. For example, you could change the least populated class label to 'Rural'.

5 Conclusion

In this lab, you learned to join tabular data with a spatial component to a shapefile. Once that was complete, you were able to classify the data and produce different renderings of that data. Between the various classification modes, choosing the number of classes and the color ramp you have endless possibilities for displaying numeric data. The key is to remember what data pattern you are trying to share with the map reader. Then you must find a classification theme that will tell the story. These are common techniques for dealing with numeric data on maps.

6 Discussion Questions

1. Describe the use of a join in GIS?
2. Why might you want to preserve a join outside of a QGIS map document by exporting the joined layer, versus just working with the join in the map document?
3. Why would you classify data?

7 Challenge Assignment

There are several more datasets in C:/GST102/Lab 2/Data/ChallengeData. There is a World_Countries shapefile and two tabular datasets: CO2_Readings_World.xls and RenewableEnergy_Percentages.dbf. Both of these tabular formats can be brought into QGIS Desktop as tables. Identify the fields by which these two tables can be joined to the World_Countries shapefile. NOTE: You can add additional joins to a shapefile by just repeating the process in Task 1

Once you have joined the data make two maps: 1) Showing CO2 readings by country and 2) RenewableEnergy_Percentages by country.