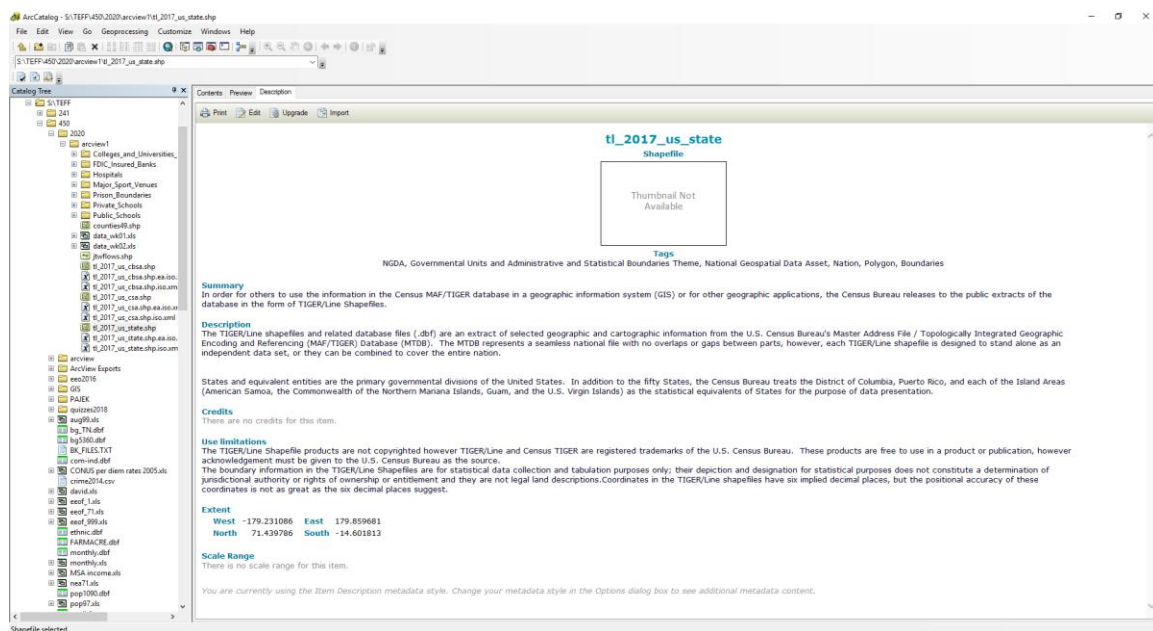


This first week we will learn how to bring [shapefiles](#) into ArcGIS, join these shapefiles with data from other sources, and produce meaningful maps.

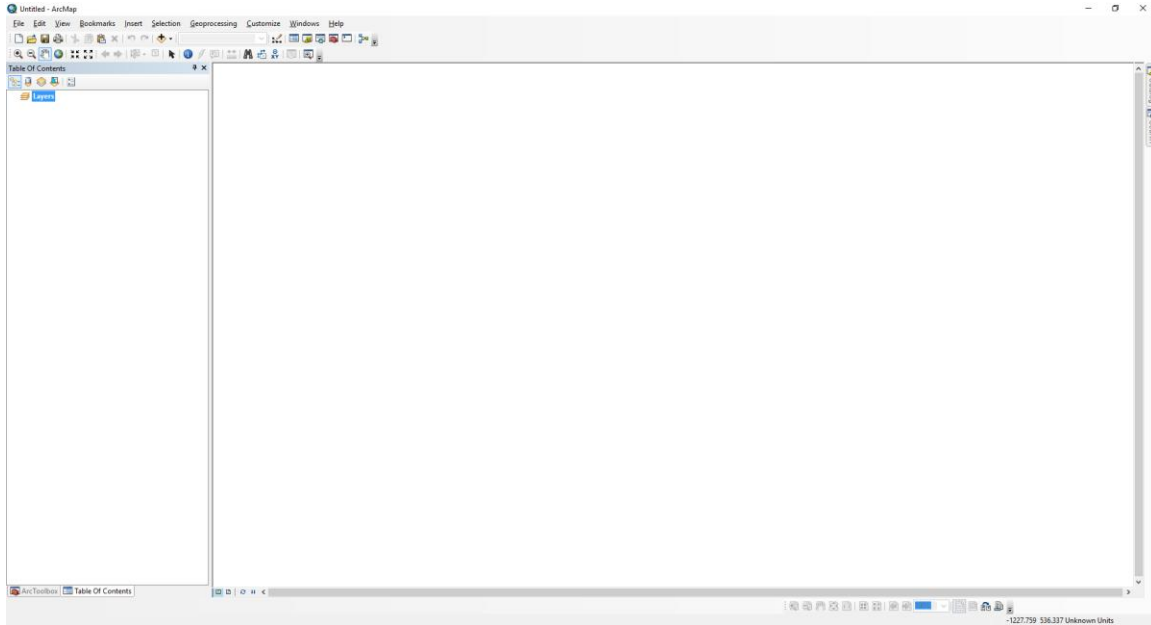
Open ArcCatalog. ArcCatalog allows one to browse through map files. There are two on-campus locations where this class can find map data for use in ArcGIS. The first is *s:\teff*. In the catalog menu on the left hand side of the screen, navigate to this directory, and open the folder for *450\2020\arcview1*. (If you don't see a link to the *s:* drive, you can activate one by writing "s:\") in the location box at the top.) Within the *s:\teff\450\2020\arcview1* folder, click on the shapefile *tl_2017_us_state.shp*. On the right hand side of the screen, note the three tabs: *Contents*, *Preview*, and *Description*. Click on each of these to see the information they provide; *Preview* gives a look at how the file will appear in ArcMap.

The other location with map data for this class is the drive *N:*. Browse for a few moments in this drive, to learn a little about its contents.

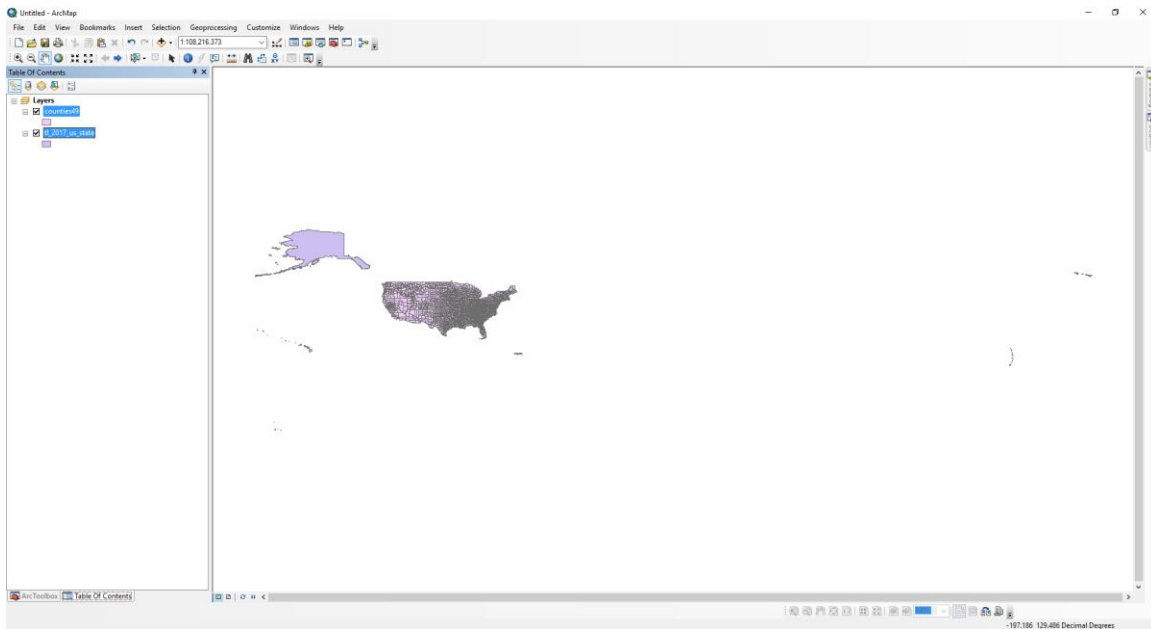


Now, open ArcMap by clicking the icon on the top menu that looks like a blue ball with a superimposed magnifying glass.

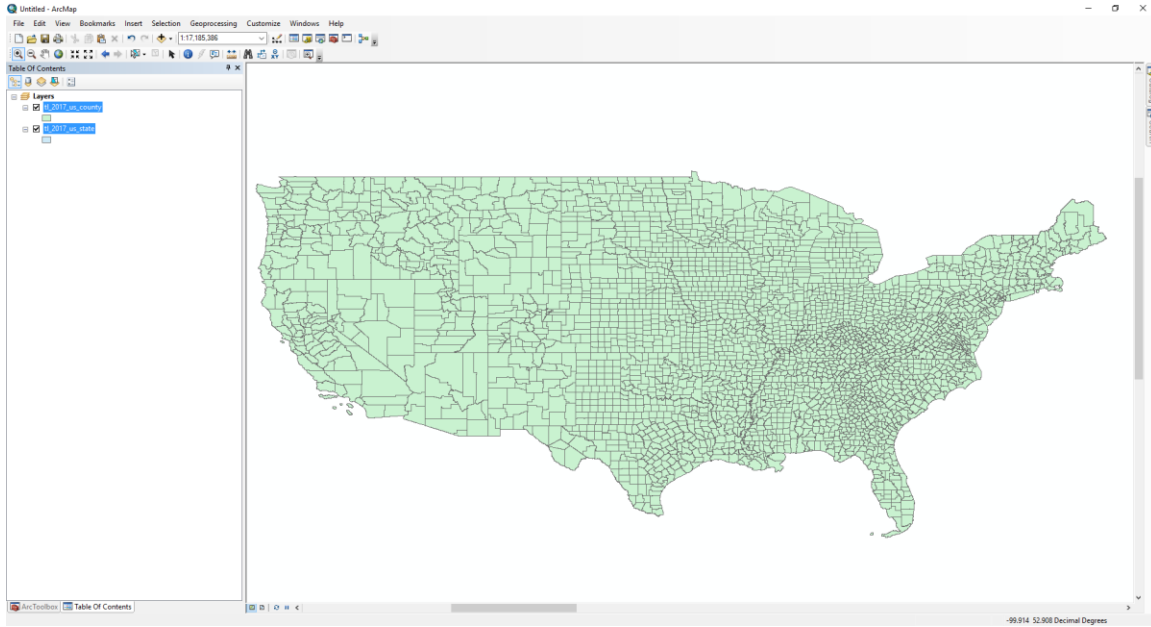
A dialogue box will open. Click *OK*.



Add data to the map by clicking on the icon at the top that looks like a black plus sign superimposed on a yellow diamond. Go to the directory `s:\teff\450\2020\arcview1` and select `counties49.shp`, and `tl_2017_us_state.shp`.

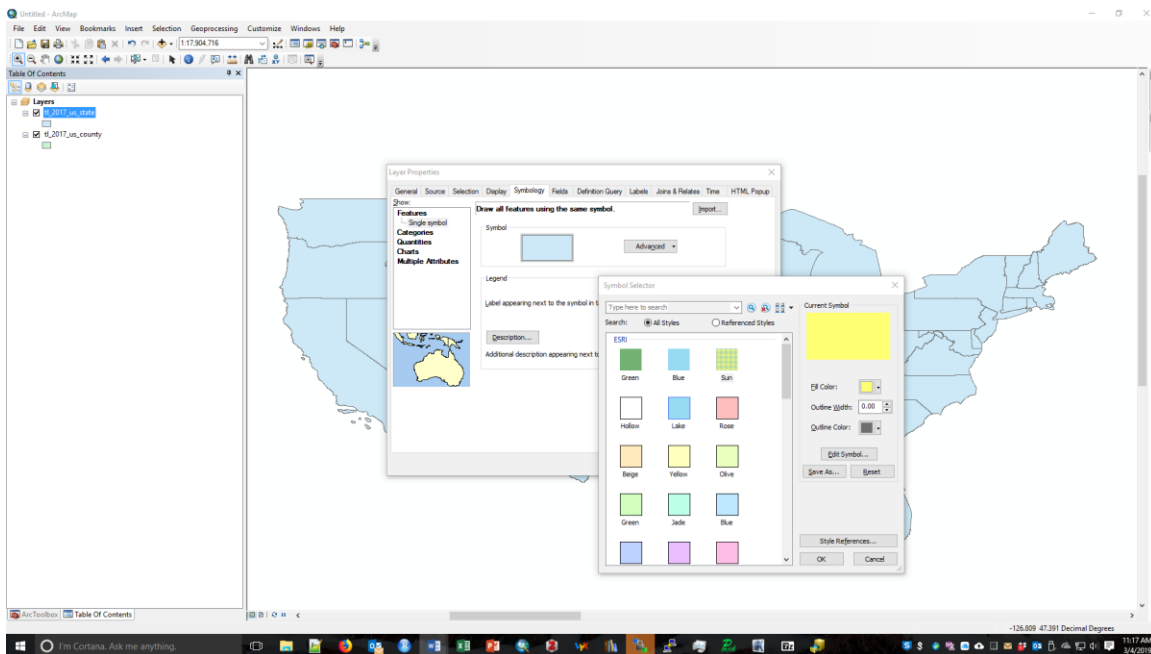


The data include the far-flung territories under American sovereignty. Zero in on the continental US by drawing a rectangle with the tool whose icon resembles a magnifying glass with a plus sign inside. You can return to the previous view by clicking on the blue left arrow icon.



To the left we see the *Table of Contents (ToC)*. There are two layers in the *ToC*: counties and states. Since counties are on top in the *ToC*, the county layer is on top in the map view. Try moving the county layer below the state layer in the *ToC*. Uncheck the box for *tl_2017_us_state.shp* to see the county layer below, then restore the checkmark.

Double-click on the *tl_2017_us_state* layer. A tabbed box called *Layer Properties* opens. Click along the tabs to see what each of them reveal. Click on the *Symbology* tab. Double-click on the *Symbol* shown toward the top center of the box.



Activate the drop-down menu for *Fill Color*, and select the option *No Color*. Next, in the drop-down menu for *Outline Color*, activate a color you like, click *OK*, and then *OK* again to close the *Layer Properties* box. The state outlines are now superimposed on the counties.

The screenshot shows the ArcMap interface with a map of North Carolina counties. The attribute table for the county layer is displayed, showing columns for various variables including area and water content.

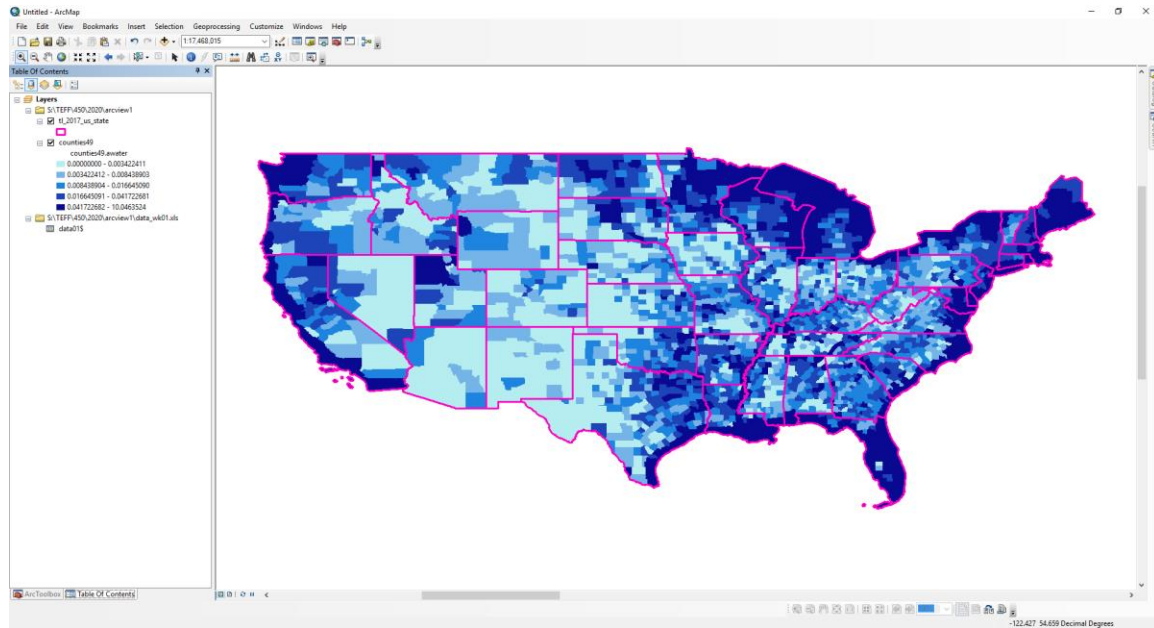
FID	Shape	STATEFP	COUNTYFP	COUNTYNS	COORD	NAME	NAMESAD	LSAD	CLASSFP	MTFCC	CSAFP	CBSAFP	MEDYVP	FUNCTYP	ALAND	AWATER	INTPLAT	INTPLON	geom_2
1	Polygon	37	01020341	21039	Comig	Cumby County		00	W1	G4000					1677641638	10171530	-8418138551	10963001188	31039
2	Polygon	35	01513275	53069	Wanhokum	Wahatauck County		00	W1	G4000					6005056787	61588406	-8462048377	-1234244583	53069
3	Polygon	35	01003054	36011	De Baca	De Baca County		00	W1	G4000					6616761640	20147345	-843602729	-1043608961	36011
4	Polygon	31	01002076	31100	Lancaster	Lancaster County		00	W1	G4000	339	30750			2190205408	22087961	-84353424	-2066608064	31100
5	Polygon	31	01005086	31129	North	North County		00	W1	G4000					1480445100	1715484	-8401784918	-2080440422	31129
6	Polygon	32	01004052	72005	Las Piedras	Las Piedras Municipio		13	W1	G4000	490	41880			37442063	20589	-811817483	-20658111880	72005
7	Polygon	46	01205772	46009	Minerals	Minerals County		00	W1	G4000					2080951699	18186005	-8433617423	-2066762761	46009
8	Polygon	46	01305949	46327	Marion	Marion County		00	W1	G4000					2236227620	615559	-808843021	-20998030616	46327
9	Polygon	06	02071310	06094	Sage	Sage County		00	W1	G4000					2400046406	23299112	-830702022	-12325219028	06094
10	Polygon	21	00516873	21053	Clinton	Clinton County		00	W1	G4000					1100642564	21164151	-8387272577	-20551306977	21053
11	Polygon	39	01074844	39065	Hancock	Hancock County		00	W1	G4000	240	22200			1376216232	9908037	-841802471	-2053800338	39065
12	Polygon	46	01305080	46189	Polk	Polk County		00	W1	G4000					2862108431	246670	-844864264	-1916220879	46189
13	Polygon	01	00181539	01027	Clay	Clay County		00	W1	G4000					1564263513	5283223	-832703999	-20588032524	01027
14	Polygon	46	01303791	46011	Armstrong	Armstrong County		00	W1	G4000	100	11100			2334401675	52178627	-844864760	-19133006303	46011
15	Polygon	39	01074015	39063	Allen	Allen County		00	W1	G4000	338	30620			1042470995	11266164	-840778274	-20843061632	39063
16	Polygon	13	00040794	13109	McDuffie	McDuffie County		00	W1	G4000					690813913	23119020	-8334796231	-20824707231	13109
17	Polygon	14	01001115	14011	Fauquier	Fauquier County		00	W1	G4000	167	17060			7919006406	40113371	-8444796909	-20861601000	14011

Right-click the county layer in the *ToC*, and select the option *Open Attribute Table*. Each row in the Attribute Table is a county, and each column is a variable that will have a value for each county. In this shapefile, there are no interesting variables except perhaps *ALAND* and *AWATER* (area, in square meters, of land and water respectively). Close the attribute table.

We can make a map where we plot the ratio of water to land area. Double-click on the county layer in the *ToC*, go to the *Symbology* tab, and click *Quantities—Graduated colors* in the box to the left. In the drop-down box for *Value*, click *AWATER*, and in the drop-down box for *Normalization*, click *ALAND*. This creates the ratio of water to land area for each county.

To the right, the drop-down box for *Classes* allows you to pick the number of categories you wish to display. The *Classify* button allows you to change the classification algorithm: usually the best is to use either standard deviations or the Jenks method. For this particular map, use the quantile method. Once you are ready, click *OK* and the data will display.

The map looks messy, because the county outlines take up so much room, clouding the view in the East, where counties are small. Double-click the county layer in the *ToC*, go to the *Symbology* tab, and right-click one of the Symbol boxes, then select the option *Properties for All Symbols*. Set the *Outline Width* equal to zero, then click *OK*.



A good map is one that immediately conveys relevant information. There are three take-aways from what we just did.

- Zero-in on the area of interest. Avoid uninformative or distracting white-space.
- Apply reference points to help the viewer understand the area she is viewing. In this case we applied state outlines to guide the viewer.
- Avoid making the map too busy or confusing. In this case, we removed the county outlines to make the underlying colors easier to see.

Save your session

ArcGIS sometimes locks up or produces undesirable results that cannot be undone. If you have loaded a lot of data and everything looks correct, it's a good idea to save your work in a **.mxd* file (*File* on the top menu, *Save* in the drop-down menu). That way, if your machine locks up, you can restart ArcGIS and continue working without having to reload everything. These files don't actually contain data, they contain links to the data you loaded, as well as the instructions for the formatting you did in your ArcGIS session. So they are not portable – you cannot take your **.mxd* file to a new machine, you can only use it on the same machine.

Adding data

One of the most useful things to do with a GIS is to **join** data—that is, to take data that you have collected elsewhere, and merge it with a GIS layer so that you display it. File formats suitable for joining are *.dbf, *.xls, and *.csv. We will join the file *s:\teff\450\2020\arcview1\data_wk01.xls* to the layer *counties49.shp*. First add *s:\teff\450\2020\arcview1\data_wk01.xls* to the *ToC* (use the icon with the plus sign on top of a yellow diamond). You will be prompted to select the worksheet within the workbook – select *data01\$*. Place the cursor on *counties49.shp* in the *ToC* and right-click. Choose the option *Joins and Relates* and then the option *Join*. Use the field *geoid* as the join field in the county shapefile, and use the field *geoid* as the join field in the *data01\$* file.

Join Data

Join lets you append additional data to this layer's attribute table so you can, for example, symbolize the layer's features using this data.

What do you want to join to this layer?

Join attributes from a table

1. Choose the field in this layer that the join will be based on:

geoid

2. Choose the table to join to this layer, or load the table from disk:

data01\$

Show the attribute tables of layers in this list

3. Choose the field in the table to base the join on:

geoid

Join Options

Keep all records

All records in the target table are shown in the resulting table. Unmatched records will contain null values for all fields being appended into the target table from the join table.

Keep only matching records

If a record in the target table doesn't have a match in the join table, that record is removed from the resulting target table.

Validate Join

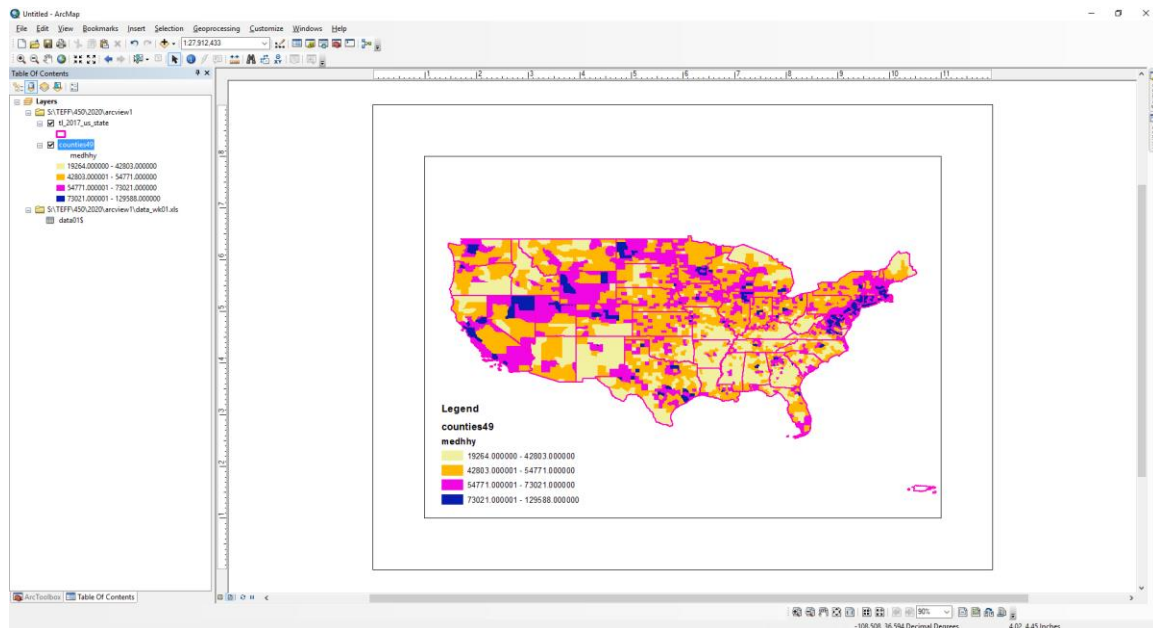
[About joining data](#)

OK Cancel

The data in *s:\teff\450\2020\arcview1\data_wk01.xls* come from the [American Community Survey](#), which is the main way in which the United States Bureau of the Census collects and disseminates demographic and housing data. The variables in the file are described in the descriptions tab of *s:\teff\450\2020\arcview1\data_wk01.xls*. We will make a map of the variable *medhhy* (Median Household Income). Double-click on the county layer in the *ToC*, click on the *Symbolology* tab, click on *Quantities—Graduated colors*, set *Value* equal to *medhhy*, and set *Normalization* equal to none.

Suppose that you want to show this map in a PowerPoint presentation to your top management. To make it fully intelligible you will need a legend. Click on *View* in the top menu, and then click on *Layout View*. The initial layout will be unsatisfactory. We will need to eliminate whitespace and add the legend.

You should have a *Layout Toolbar* with icons. (If not, go to *Customize* on the top menu, click *Toolbars*, and then click *Layout*.) Look for the icon with an arched arrow connecting two pages – this is the *Change Layout* icon. Click on this, select “ARCH A Landscape.mxd,” and click *Finish*. Next, go to the top menu and click on *Insert*, then *Legend*. Use the wizard that pops up to format your legend – since the map colors are for county attributes, keep only the county shapefile in the *Legend Items* box.



The next step is to export this image as a **.png* or **.jpg file*, which can be imported into PowerPoint or Word. Go to *File* on the top menu, and select *Export Map*. Pick the location and format and save.

The final step is to find the story behind your map. Looking at the distribution of median household income across our country; what kind of factors do you think can explain this pattern?

Your assignment for next week is to produce five maps that say something meaningful and important about the spatial population distribution of the U.S. I will be disappointed if all groups come up with something too similar, so make sure that a couple of your maps are perhaps a bit off-beat.

The maps should be good looking: avoid whitespace, avoid clutter, and apply reference points.

Your maps should tell a story, and you should know what that story is.

Next Monday, your group will display the maps in a PowerPoint presentation. You should be prepared to explain what your maps mean and take some questions from the class.