Choropleth Mapping with GIS

In this lab you will be generating four choropleth maps of the data you downloaded and processed earlier. You will make your maps in ArcGIS using three different methods of classing your data, and a fourth map showing the "Blanket of Error" of your Natural Breaks (Jenks' method) classification. To begin, copy the folder labeled **ca_census** from the Handouts folder in "thu_labs/" on 'nubar' (L:)" directory to your hard drive.

Step 1 – exporting your data from Excel.

1. Open the data table you downloaded and prepared in the first portion of the lab into Excel. The data should only contain the US Census variables, not the chart.
2. Make sure you have a column labeled "Polid" or "County"
3. Make sure that the column of data that you are going to use (standardized data) has a column header that describes what it is. (i.e. PCT_ASIAN)
4. Make sure that none of your header labels have spaces in them (see above the underscore for the PCT_ASIAN example)
5. Go to the Save menu, and change the file type at the bottom to read "Text (Tab Delimited)(.txt)"
6. Save your file inside your ca_census folder, by naming it "*myname*.tab" (yes, including the "", where *myname* is a label you choose, and the quotes mean that we force Excel to add the file extension .tab
   ArcGIS will also read attribute data in .DBF file format. We will work with plain ASCII text files, as they are more versatile. Your TA's will also show you how to work with .DBF files.
7. **Close the text file** you just saved without quitting Excel, you'll need it again later

Step 2 – import tabular data into ArcGIS

We are now going to join the data file you downloaded with the attribute table of the California county map in ArcMap.

1. Double click the file **ca_census.mxd** in ca_census directory
2. With the **ca_census.mxd** window active, right click on the data layer labeled "counties." Select the menu "Joins and Relates."
3. Click on "join"
4. Make sure that the option "join attributes from a table" is selected at the top.
5. For option 1, select the option "POLID"
6. For option 2, click on the folder icon to the right and find your .tab file, then select it.
7. Once it is properly selected, it will appear in the white box.
8. For option 3, select the item labeled "POLID". Click "OK"
9. Now, right click on the "counties" layer again and select "Properties"

10. Select the tab labeled "symbology"
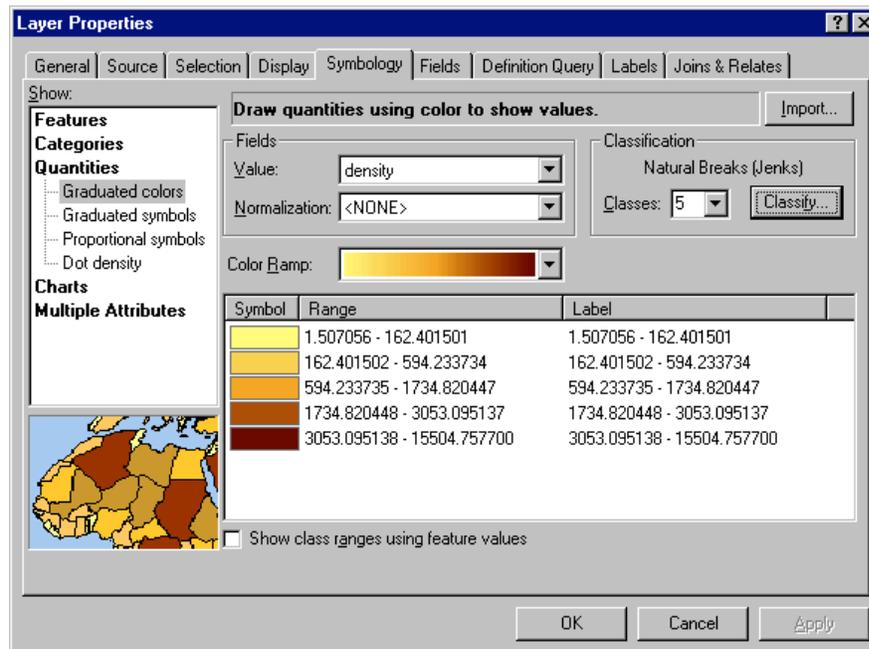
11. In the box labeled "Show" select "quantities". You will use this and the following selections for all your maps
12. Select the option "Graduated Colors" under "Quantities"
13. In the "Fields" option, select the name of the standardized variable that you downloaded.
14. Click OK. (The selections should look something like the picture above).
15. Take the number of natural breaks that you decided were in you data in the first portion of the lab (open the EXCEL chart you prepared if necessary), and add 1 to input the number of classes.
16. Put this number in the box labeled "Classes" at the top right.
17. The main box at the bottom will change to reflect this new number.

Step 3 – calculating the blanket of error in excel
1. Switch back to Excel and reopen your previously saved file
2. Select the rows whose data falls between the numbers given for the class breaks in ArcMap.
3. Color code these rows so that you can tell where your classes are (see illustration below)

For the "Blanket of Error" we need to know the mean for each class and how each observation deviates from the class mean. Let's first compute the class means.

a) Select an empty cell to the right at the top of the first class
b) Type in the formula "=AVERAGE(" – without the quotes but with the opening parenthesis) then drag the mouse from the first cell in the class block to average to the last cell. Excel will automatically complete the formula (see example above, e.g. formula in cell F44, averaging cells from E44 to E51).
c) Hit enter, and the result will be the average of the data in your class
d) repeat this step with all the other classes

4. Now we calculate how each observation deviates from the class mean (e.g. obs-class mean).
   a) In a new column, further to the right from the class mean column, starting at the top row of EACH class, enter the formula "=X00-Y$00" where X is the column containing your data, Y is the column where your average is, and 00 is the row that the average value is in (e.g. Error = E44 –F$44, at top of class in orange block).
   b) Drag the box at the bottom right of this cell to all the other cells in the column that are in the same class.
   c) Label this new column "Blanket" in the first row
   d) Save this file and rename it blanket.tab (like you did in Step 1, 5 & 6) Make sure to close the file, before continuing.
   e) Join this table like you did in Step 2 (3-10)
   f) You can remove the first table you joined if you like

Ok, now that you have an attribute table with your variable and a calculated blanket of error, you can map out your data. Return to the Symbology Tab of the Properties dialog box in ArcMap. Save your work.

Making the maps

Apply the mapping skills you learned during the ArcMap tutorial earlier. Consult the tutorial handout again if you wish. Choose your graduated color scheme appropriately (check out the

Appendix for further information) to be also clearly legible if you print in black and white. You will make **four maps**. The color scheme and the number of classes must not change, so that you can visually compare the results of the different partitioning schemes.

You will map your data with the **Natural Breaks (Jenks), Equal Interval,** and **Quantiles** classing schemes, with the same number of classes as you identified in the first portion of this lab. The classing scheme can be changed by clicking the button labeled "Classify" at the top right in above dialog box.
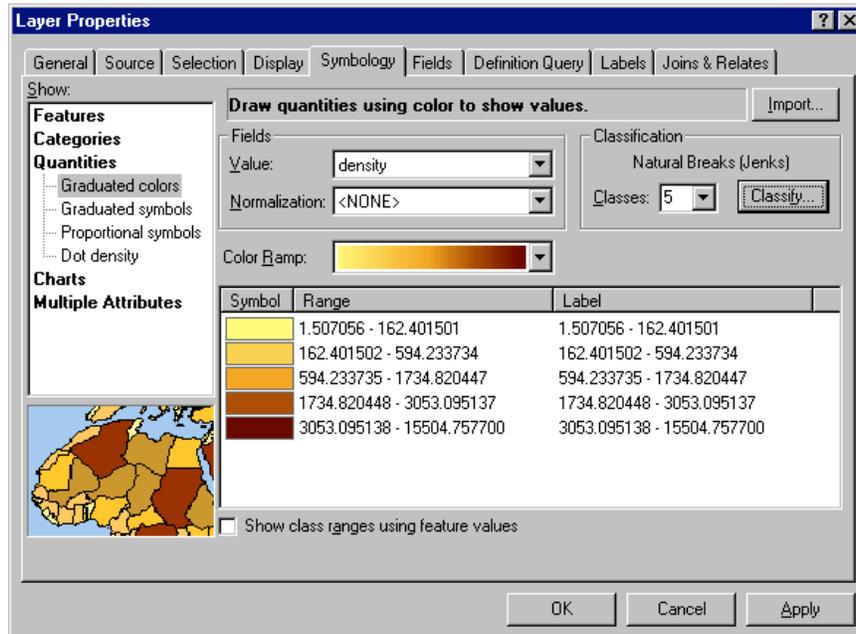
Under the box "Method" you can choose how you want to classify your data.
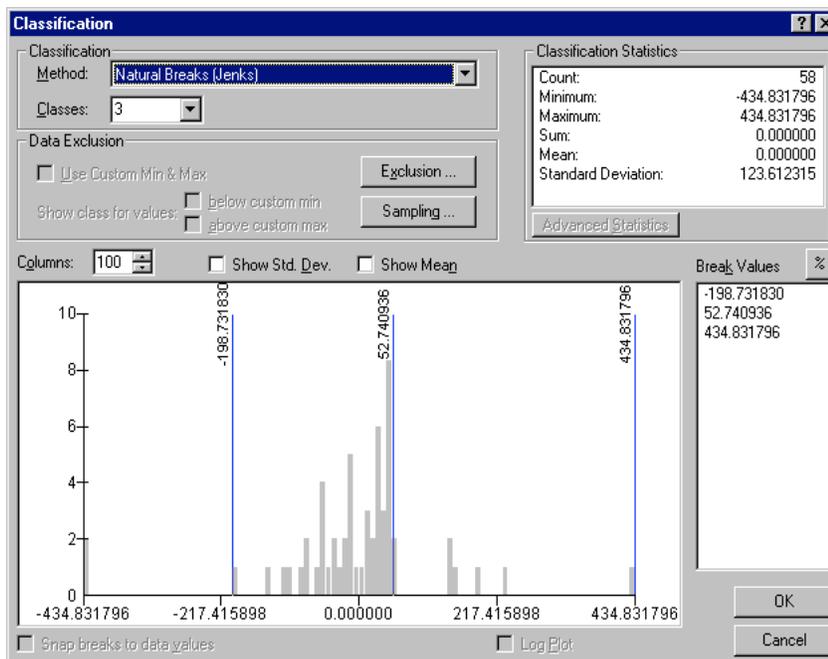
You will make a fourth map with the **Blanket of Error** you computed earlier. This map shows the residuals (or classification error) of the optimized classification scheme by Jenks (e.g. called Natural Breaks in ArcMap). It is customary to use **three** classes for this map: extreme positive, nearly zero and extreme negative residuals (e.g. deviations from the class means). Change the colors manually so that they are not ramped from light to dark. A neutral color is best for the middle class (e.g., gray), and distinctly different hues are best for the other two classes (e.g., purple for positive, and green for negative values). Don't forget to save your work.

Make a nice layout including all four maps. Use the design guidelines posted on the SPACE web page as a reference. You will need to copy the map several times and resize the copies to get them all on the same layout. Add your name and the source information of your data on the layout. Include any other relevant information you feel is necessary.

Map analysis

Last step, now. Study your maps for a while. Try to decide what is the advantage or disadvantage of each map-classing scheme. Look at the Blanket of Error map too, and identify which counties are grossly over or under-estimated by the Jenks classing scheme. Why did the errors happen where they did, what geographic reasons can you think of to explain? What do you know now about the geography of your variable that you did not know before?

Optional: working with different states

In the prepared exercises for this workshop, we have just been working with data from California. We realize that this is not going to be the location of interest for everyone in the lab, so we have written a tutorial to create files to work with data from other states.

To map data from different states the main step is to create an ArcMap data layer with the spatial data for the area that you want to map. Here we will provide the steps for this:

1. Open ArcMap
2. Add the states.shp file from the ESRI data –> USA folder on the computer (this is the set of data that comes with the ArcView installation disk, and is most likely located in C:\esri\esridata – if it is not there, your workshop assistant can help find the folder for you). We made a copy of a US county dataset, including a ArcMap project file located in the folder "thursday/usa_counties" on 'nubar'. Copy this folder to your local hard drive.
3. In ArcMap, right click on the layer name and open the attribute table.
4. Select your state of interest by clicking in the gray area to the left of the record - when you do this, the entire record will be highlighted. If you wanted to select multiple states, you would hold down the Control key when clicking on additional records. When your record(s) is/are selected, you can close the attribute table.
5. In the data view, your selected regions should be highlighted as well. This confirms that the spatial data has been selected as well as the attribute data.
6. Now right click on the States.shp layer name, select Data -> Export Data.
7. In the Export Data window make sure the Export: setting is "Selected features." Name your new shapefile, and save it to your personal folder.
8. You can now add your new shapefile, and remove the States shapefile.

With the shapefile for your area of interest created, you can simply follow the steps in the "Downloading map data from the WWW, processing and classifying" and "Choropleth Mapping with GIS" exercises.

Appendix

	numerical	ordinal	nominal	visual isolation	visual levels
location	G	G	G	G	P
size	G	G	P	G	G
focus	P	G[a]	P	G[a]	G[a]
color value	M	G	P	G	G
color saturation	M	G	P	M	G[b]
color hue	M[e]	M[c]	G	G	M[c]
texture	M	M	G[d]	G	G
orientation	M[e]	M[e]	G	G	P
arrangement	P	P	M[f]	M[f]	P
shape	P	P	G	P	P

G = good,   M = marginally effective,   P = poor

from: MacEachren, A., 1994. *Some Truth with Maps.* Assoc. of American Geographers, Washington DC.: 33.