Exercise 3: Introduction to Symbology and Cartographic Design

In this exercise you will learn how to created choropleth maps to symbolize quantitative data using different legend classification methods. It will also serve as an introduction to cartographic or map design. More advanced cartographic design will be explored in later exercises.

Topics covered in this exercise include:

1. Create a new project
2. Change the classification scheme for quantitative data
3. Select an appropriate classification scheme for quantitative data
4. Make a choropleth map
5. Make a graduated symbol map
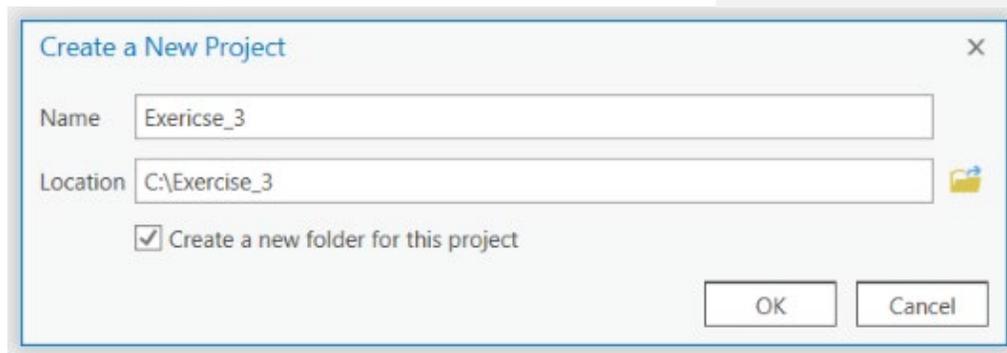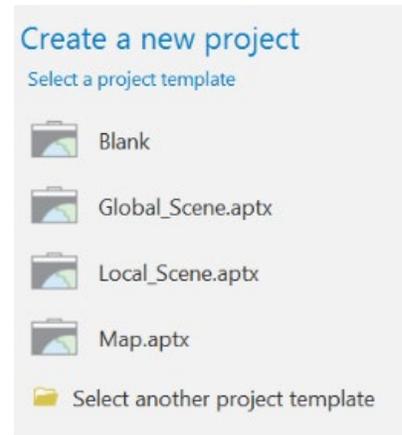6. Add map elements
7. Export maps to raster graphic files

Step 1. Create and Prepare a New Project

In contrast to the previous exercises, you will not be provided with a map project file. Instead, you will create a new project. This is a common first step when starting a new study or GIS project. You can use this method to create your own projects using your own data. For this lab you will still need to download the **"Exercise_3"** folder from the website.

To do this:

☐ Navigate to the Education tab on <u>http://www.wvview.org/</u>. All lab material is available under "Labs and Data" tab.
☐ Click on the "L3 Data" button to download the **Exercise_3.zip** file.
☐ You will need to extract the compressed files and save it to the location of your choosing.

☐ Open ArcGIS Pro. This can be done by navigating to All Apps followed by the ArcGIS Folder. Within the ArcGIS Folder, select ArcGIS Pro. Note that you can also use a Task Bar or Desktop shortcut if they are available on your machine.

☐ Once ArcGIS Pro launches, select Blank under Create a new project on the right side of the page.

☐ In the Create a New Project Dialog Box, name your new project **Exercise_3** and save it to your personal folder. You can leave "Create a new folder for this project" option selected.

Create a new project

Select a project template

▢ Blank

▢ Global_Scene.aptx

▢ Local_Scene.aptx

▢ Map.aptx

📁 Select another project template

Create a New Project ✕

Name | Exericse_3

Location | C:\Exercise_3

☑ Create a new folder for this project

OK   Cancel

You have now created a new project. However, there are no maps, scenes, or layouts yet. In the first part of this exercise, you will created maps for the state of Indiana. So, we will begin by creating a new map called Indiana.

☐ Under the Inset Tab select New Map. This will load a new map called Map with a topographic base map.

☐ Now, rename the map. Double-click on Map in the Contents Pane. This will open the Map Properties Window. In this window, change the name under the General Tab to Indiana.

☐ Click OK to accept the change.

New Map ▾
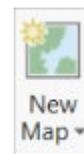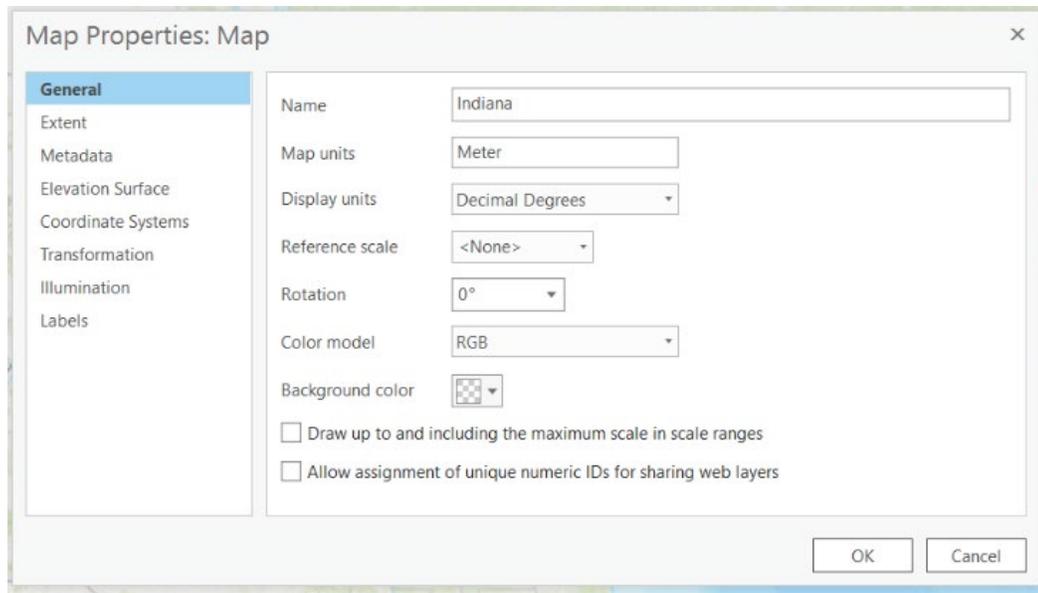
The name of the map should now be displayed as Indiana.

You will now add a new layer to this map.

☐ Click on the Add Data Button. Navigate to your copy of downloaded **Exercise_3** folder. Select the **Indiana.shp** file. Click OK to add it to the map.

Note: A shapefile is a standalone vector file that is not stored inside of a geodatabase. It is similar to a feature class, in that it stores vector data. However, shapefiles cannot be included in a geodatabase.

You will now change the map projection to NAD 1983 UTM Zone 16 North.

☐ Right-click on the Indiana map in the Contents Pane. Select Properties.

☐ In the Map Properties Window, navigate to the Coordinate Systems options.

☐ Find the NAD 1983 UTM Zone 16 North projection. It is under Projected Coordinate Systems → UTM → NAD 1983. The Name of the projection is NAD 1983 UTM Zone 16N.

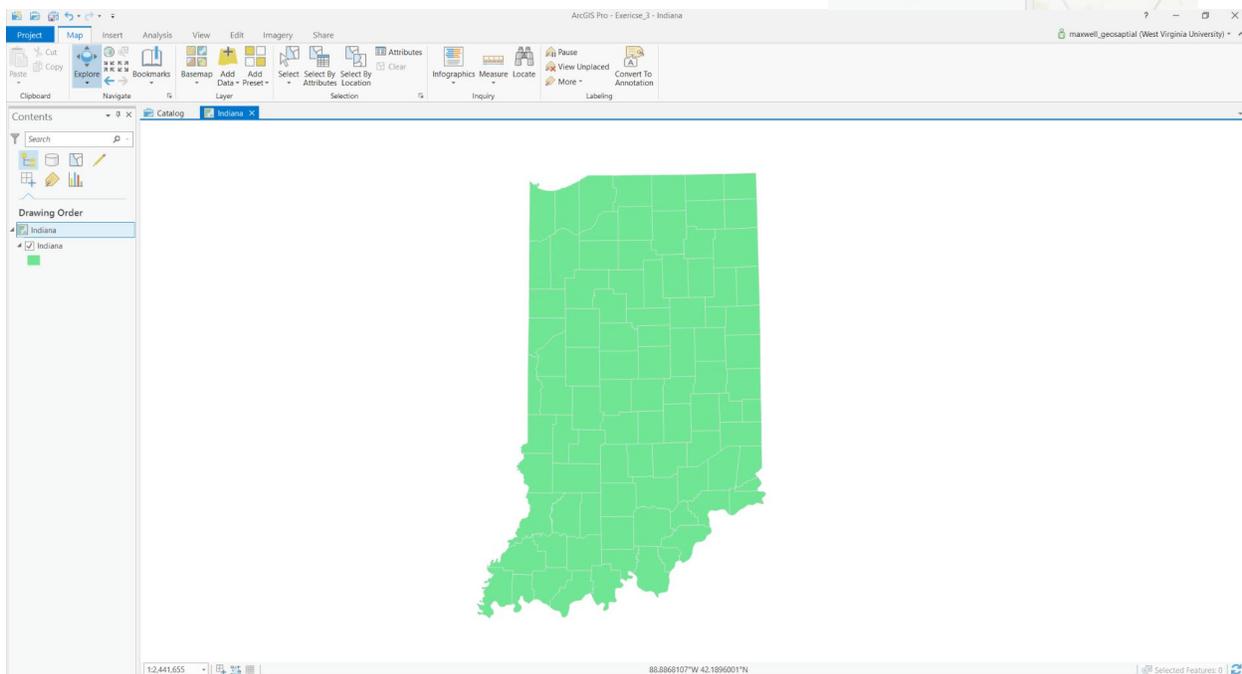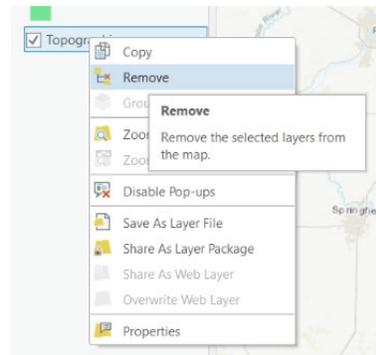☐ Click OK to change the projection.
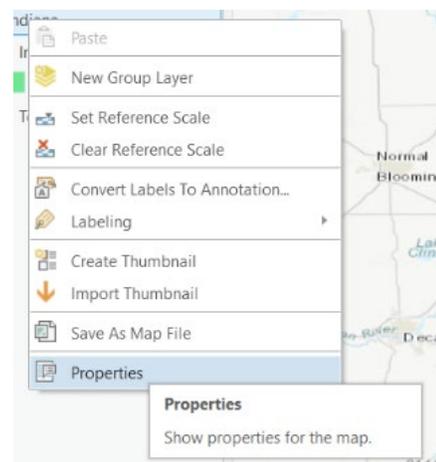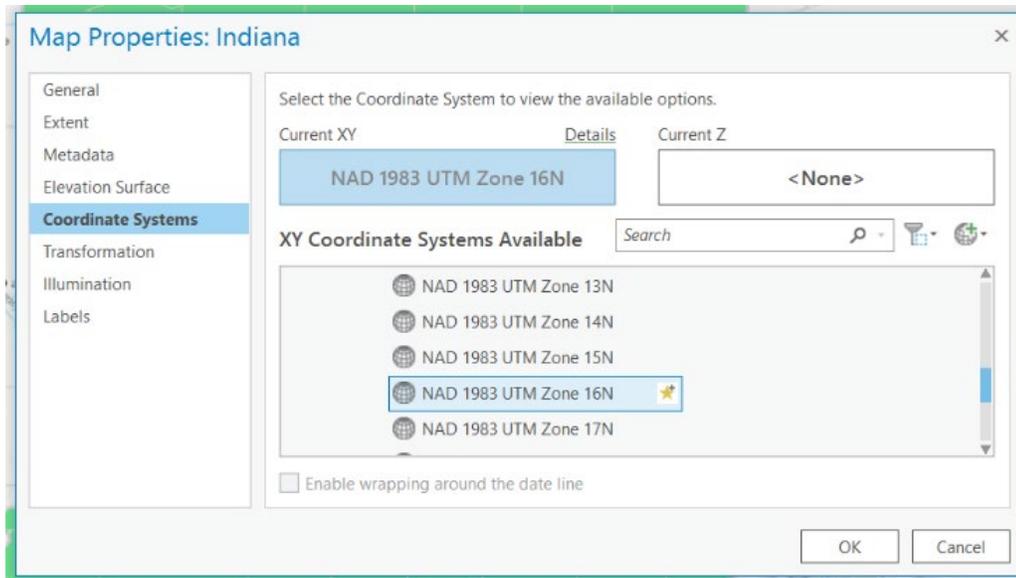
For this exercise, we will not need the base map. So, you will remove it from the Contents Pane and the map.

☐ Right-click on the Topographic layer in the Contents Pane. Select Remove.

You should now have a map that shows the Indiana county boundaries and is projected to the NAD 1983 UTM Zone 16 North projection.

Step 2. Changing Layer Symbology to Generate a Choropleth Map

By default, the county boundaries are all displayed using the same color. However, you would like to symbolize each county using a color that shows the percent poverty, as estimated by the 2010 US Census. So, you would like to create a choropleth map that show a quantity, percent poverty rate, using colors.

- ☐ Right-click on the Indiana layer that shows the counties then select Symbology.
- ☐ In the Symbology Pane, change the symbology to Graduated Colors.
- ☐ Change the field to "per_pov."
- ☐ You can change the color scheme if you'd like.
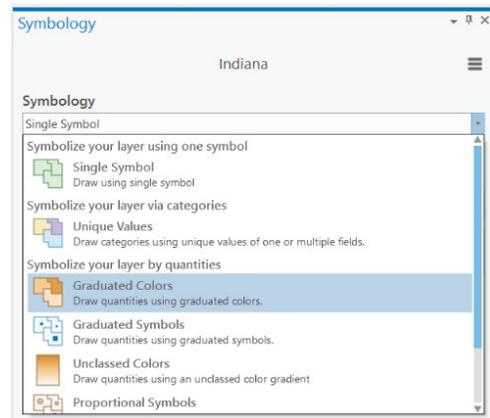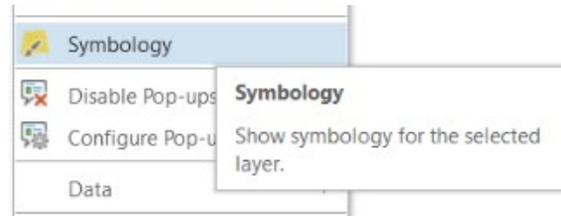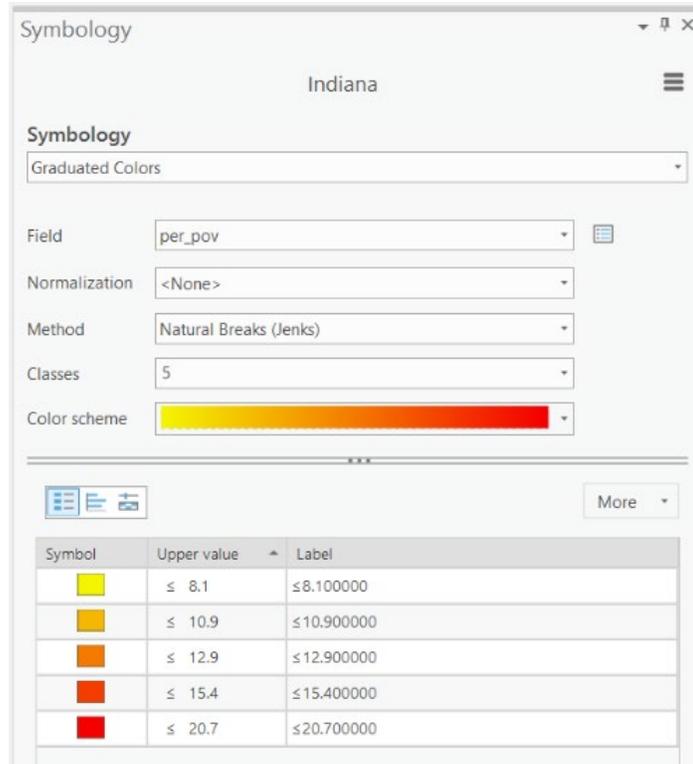
Now, the map is symbolized using different colors to represent different ranges of percent poverty. The range of values in each "bin" has been defined using Natural Break (Jenks).

Question 1. Explain the concept behind the Natural Breaks method. You may need to consult your class notes. (4 Points)

Now, experiment with the different classification methods available to see how it changes the symbology.

- ☐ Back in the Symbology Pane, change the Method to Equal Interval.
- ☐ Change it to Quantile.
- ☐ Change it to Standard Deviation.
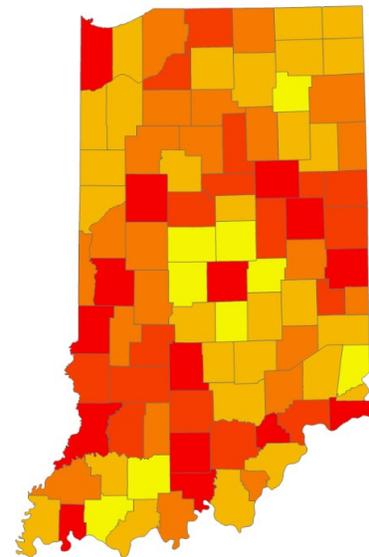
Question 2. Explain the difference between the Equal Interval and Quantile classification methods. You may need to consult your class notes. (4 Points)

Question 3. Explain how the Standard Deviation method works. (4 Points)

Question 4. Which method do you think is most appropriate for these data? Please explain your reasoning. (4 Points)

Step 3. Creating and Saving a Map Layout

You will now create a map layout for your choropleth map with all necessary map elements. Before you begin, change the symbology back to Natural Breaks and make sure 5 classes are defined.

- ☐ Before you begin, change the symbology back to Natural Breaks and make sure 5 classes are defined.
- ☐ Feel free to change the color ramp.

Within the symbology window, you can also change how the labels are displayed.

- ☐ In the label column, add percentage signs and round off the labels to one decimal place. You can do this by simply typing into the fields.

This should change the symbols in the Contents Pane.
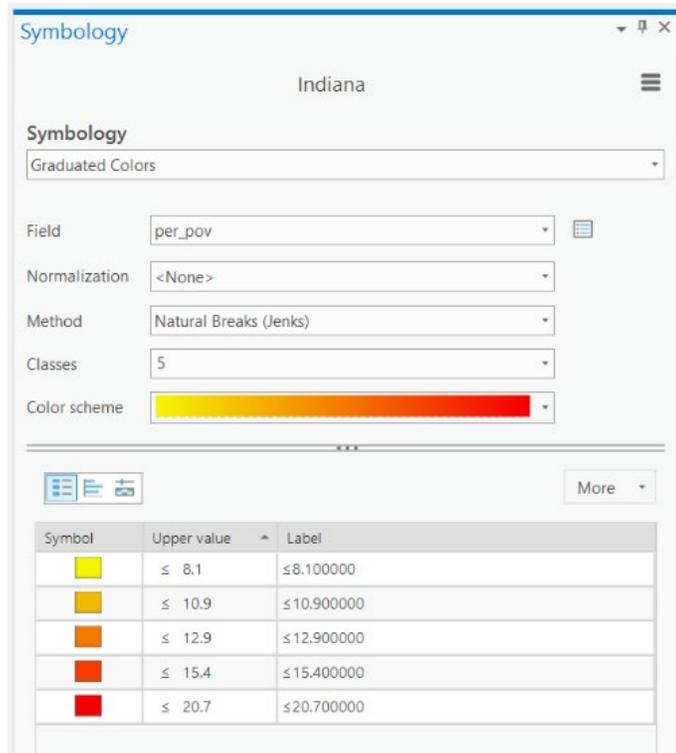
In order to design a map, you will need to add a layout to the project.

☐ Under the Insert Tab and in the Project area, select New Layout. If you click once, a window should load with available layout dimensions. Select ANSI Portrait 8.5" x 11" (this should be the first option). A new, blank layout should be added to the project as a new tab.

☐ To add the Indiana map to the layout, select Map Frame under the Insert Tab and in the Map Frame area.

☐ If you need to move or resize the extent of the map, you can make it active by right-clicking in the map area on the layout then selecting Active. Take some time to position and scale the map on the page.
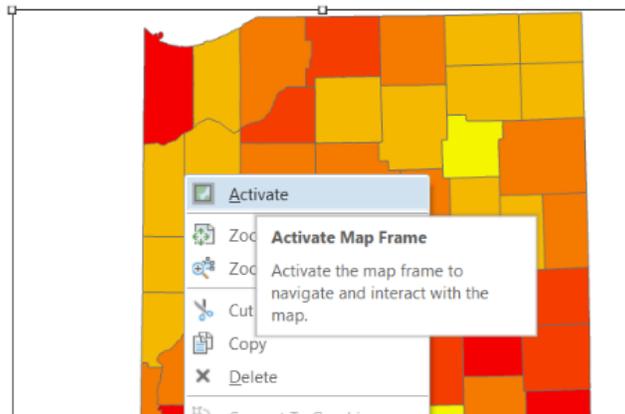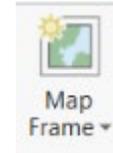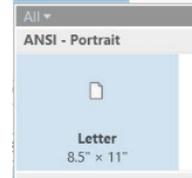
Note: When a map layout is being displayed, you can use the tools in the Layout Tab to navigate around the layout on the screen or to select map elements. You may want to experiment with features on this screen.

Let's remove the black boarder around the map frame.

☐ Click in the map space on the layout. This should load the Format Map Frame Pane.

☐ Click on small arrow next to the blue Map Frame text. From the drop down list, select Border.

☐ Navigate to the Properties options (as opposed to the Gallery, which is the default).

☐ Change the color to No Color.

☐ Click Apply to accept the changes.
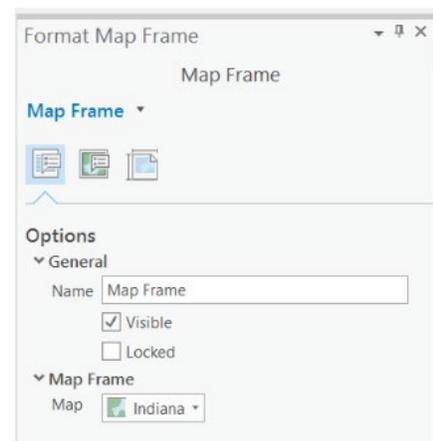
There should be no frame around the map now.

Next, let's add a north arrow.

- [ ] In the Insert Tab and in the Map Surrounds area, click on North Arrow once. This should open a window of available north arrows. Select a north arrow of your choosing to add it to the layout.
- [ ] Click on the north arrow on the layout. Move it to your desired position and resize if necessary. Do not make the north arrow too large, as it is an ancillary map element and should not draw too much attention.
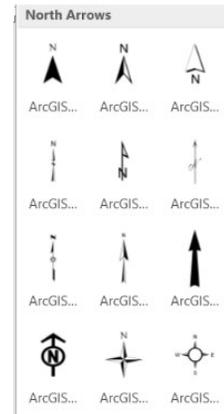
Now, let's add a scale bar.

- [ ] In the Insert Tab and in the Map Surrounds area, click on Scale Bar once. This should open a window of available scale bars. Select a scale bar of your choosing to add it to the layout.
- [ ] Click on the scale bar on the layout. Move it to your desired position and resize if necessary.

Note: There are many options available to edit our north arrows and scale bars. We will investigate these options in a later lab in more detail. Our goal here is to simply create a map layout with the desired map elements.

One thing we would like to do to edit the scale bar is to change the font type and size.

- [ ] Click on the scale bar in the map layout. This should load the Format Scale Bar Pane.
- [ ] Click on Text Symbol (as opposed to scale bar, which is loaded by default).
- [ ] Under the Appearance options, change the font to Calibri and the font size to 12 pt.
- [ ] Click Apply to accept the changes.
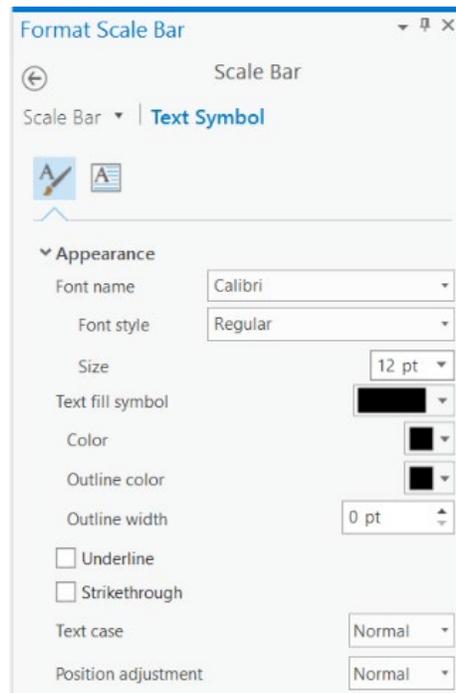
You will now add a legend.

☐ In the Insert Tab and in the Map Surrounds area, click on legend. This will activate a cursor that allows you to place the legend. Place the legend on the map space. If you don't like the chosen position, you can move it again.

There are a couple of features about this legend that we would like you to change. First, we would like the font to be changed to Calibri and 14 pt. We would also like you to change the legend title to "Percent Poverty" and remove the per_pov label. We will now step you through the required steps to make these changes.
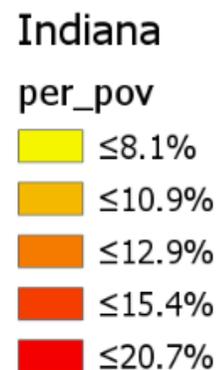
☐ Click on the legend in the map layout. This should load the Format Legend Pane.
☐ Under the Legend options, change the Title to "Percent Poverty" (without the quotes) and select show.

☐ In the Contents Pane, click the small arrow next to Legend to expand the legend elements. Click on Indiana. This should load the Format

Legend Item Pane. In this pane and under show, uncheck layer name and heading.

- ☐ Click on Legend in the Contents Pane again to re-load the Format Legend Pane.
- ☐ In the Format Legend Pane, navigate to Text Symbols. Under appearance, change the font to Calibri and the font size to 14 pt.

You will now convert the legend to a graphic to edit it further.

- ☐ Right-click on the legend in the map layout and select Convert to Graphic.
- ☐ Next, right-click on the legend again, which is now a graphic, and select Ungroup.
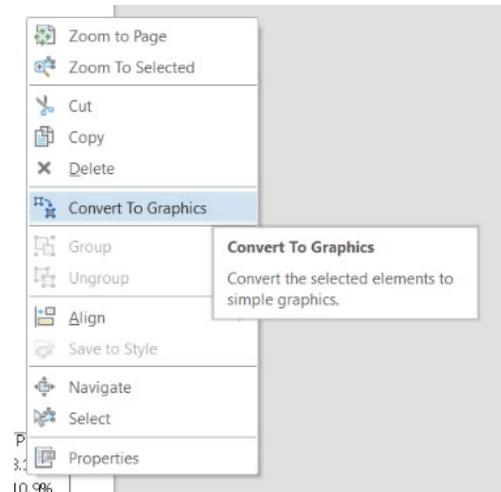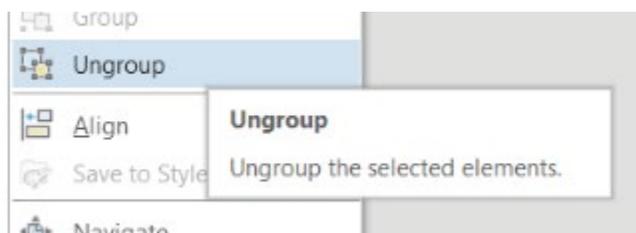
This separates the legend from the legend title. You will now make the legend title a larger font size.

- ☐ Click on the legend title. This should open the Format Text Pane.
- ☐ Navigate to the Text Symbol options in the Format Text Pane.
- ☐ Under Appearance, change the font size to 18 pt.

Now, you will add a title.

- ☐ In the Insert Tab and in the Text area, click on Text. This should activate a new cursor that allows you to positon the text box. Place it near the top of the page. You can move it later if necessary.
- ☐ In the new text box, type "Percent Poverty by County for Indiana" (without the quotes).
- ☐ You will likely need to make the text bigger. Click on the text box to open the Format Text Pane. Navigate to the Text Symbol options. Under appearance, change the font to Calibri and the font size to 24 pt.
- ☐ Click Apply to accept the change.
- ☐ You may need to reposition the text box.

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It is always important to cite your data sources. So, you will need to cite the US Census. You should also add text to cite yourself as the author.

- ☐ Add a new text box to cite the US census. It should state: "Data from 2010 US Census." The font should be Calibri and the size should be 12 pt.
- ☐ Add a new text box to name yourself as the author. It should state: "By: YOUR NAME HERE." The font should be Calibri and the size should be 12 pt.

Once you are satisfied with your map layout, you can lock all of the layers so that they cannot be changed.

- ☐ Click on all of the lock symbols in the Contents Pane to lock the map elements to that they can no longer be edited.

As mentioned in a previous lab, you should not turn in your final map as a project file. Instead, you should export the map to a graphic file. In this class, we prefer you to turn in your maps in PDF format. Here, we will show you how to export your layout to a PDF file.

- ☐ Navigate to the Share Tab. Click Layout.
- ☐ Navigate to the folder in which you want to save the map layout.
- ☐ Name the file **Indiana_Choropleth_YOUR_NAME_HERE**.
- ☐ Save it as a PDF.
- ☐ Set the Resolution (DPI) to 300.
- ☐ Hit Export to save the file.
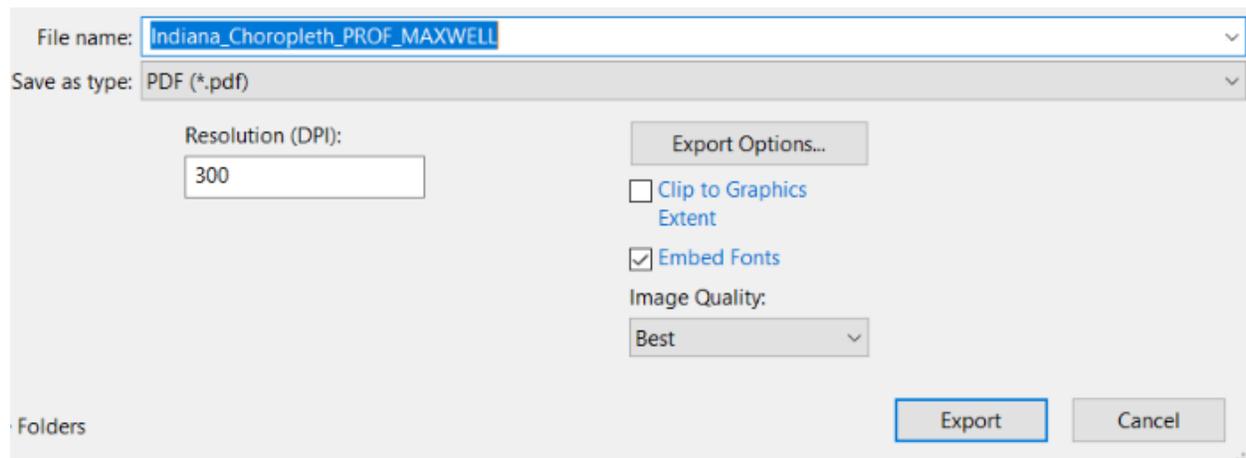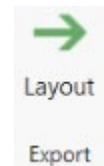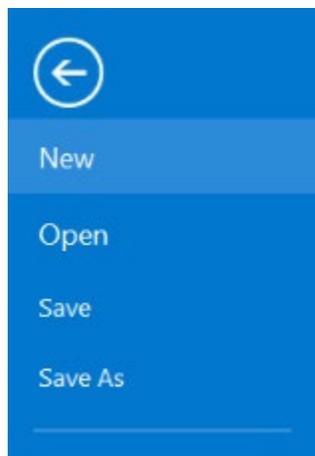
Deliverable 1 (20 Points)

Submit this map as a PDF file. It will be graded as follows:

1. White space has been minimized and elements have been intentionally placed (2 points)
2. A legend has been provided that has no file names. It should have percentage signs included in all the labels, and values should be rounded to 1 decimal place (4 points)
3. A north arrow and scale bar have been provided. The north arrow should not be large or take up a lot of space on the layout (2 points)
4. Your name has been provided (2 points)
5. The US Census has been cited (2 points)
6. The correct title has been provided (2 points)
7. The map is overall very neat and well organized. Space is utilized well, and the data are well presented (6 Points)

Our example map is shown in the next page. Yours may look slightly different, but it should have the same map elements.

Now would be a good time to save your project if you have not done so already.

☐ To save changes you have made to the project, navigate to the Project Tab and select Save. You should save often so as not to lose your work.

Percent Poverty by County for Indiana

Percent Poverty
≤8.1%
≤10.9%
≤12.9%
≤15.4%
≤20.7%

0   25   50   100 Kilometers

By: Prof. Maxwell

Data from 2010 US Census

Step 4. Making a Proportional Symbol Map

Color is not the only property that can be used to show values or quantities. Another option is size. For example, proportional symbol and graduated symbols use the size of the symbol to show a quantity. You will now produce a graduated symbol map of median income by county, also using the Indiana data.

Before you start, we will have you produce a copy of the map. This isn't really necessary; however, it offers an efficient means to begin creating a new map layout.

- ☐ Navigate to the Catalog Tab.
- ☐ In the Catalog Tab, click on Maps.
- ☐ Currently, you only have one map available, Indiana.
- ☐ Right-click on the Indiana map and select Copy.
- ☐ Click the back arrow just below the Catalog Tab to return to the project directory.
- ☐ Right-click on Maps again then select paste.
- ☐ Clicking on Maps again, you can see that a copy of the Indiana map has been produced: Indiana1. We will use this map to create the proportional symbol map. Double-click on Indiana1 to open the map.
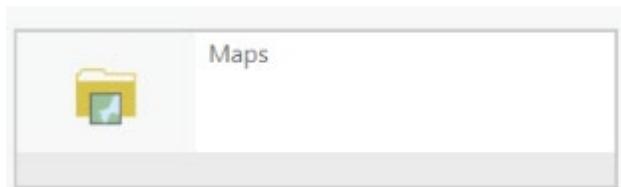
Now, you will change the symbology from a choropleth map to a graduated symbols map.

- ☐ In the Contents Pane for the Indiana1 map, right-click on the Indiana layer then select Symbology. The Symbology Pane should load.
- ☐ Change the symbology to Graduated Symbols. Use the "med_income" field.
- ☐ Change number of classes to 6.
- ☐ Feel free to change the symbol (Template) and background color (Background).
- ☐ Add dollar signs and commas to the labels.
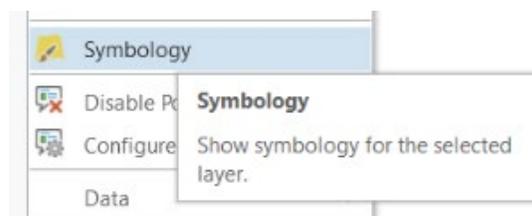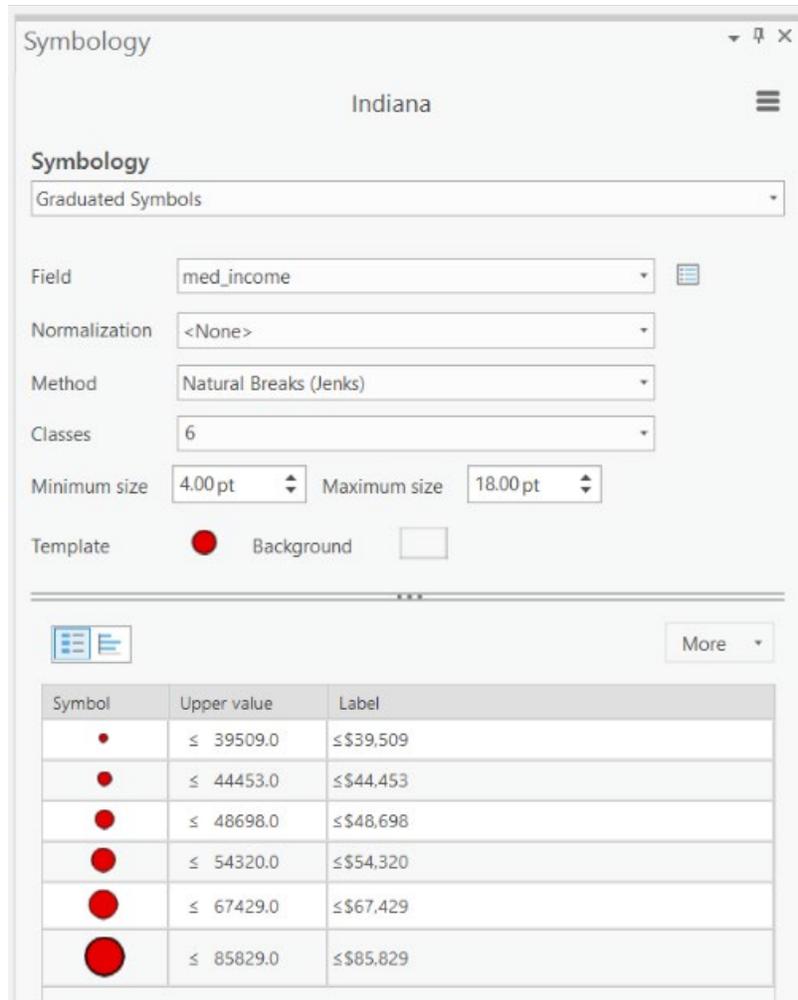
You will now need to create a new map layout.

□ Add a new layout to your project. Use ANSI Portrait Letter 8.5" x 11" again.

You will now design a second map to deliver. Remember to export it to a PDF and save your work.

Deliverable 2 (20 Points)

Submit this map as a PDF file. It will be graded as follows:

1. White space has been minimized and elements have been intentionally placed (2 points)
2. The border around the map frame has been removed (1 point)
3. A legend has been provided that has no file or field names but does include dollar signs and commas. (2 points)

4. The Legend tile has been changed to "Income" (2 points)
5. A north arrow and scale bar have been provided. The north arrow should not be large or take up a lot of space on the layout (2 points)
6. Your name has been provided (1 points)
7. The US Census has been cited (1 points)
8. The classification scheme uses 6 bins (2 points)
9. The map title has been changed to "Median Income by County" (2 points)
10. The map is overall very neat and well organized. Spaced is utilized well, and the data are well presented (4 Points)

Step 5. Final Map

Lastly, we would like you to make a map of the entire United States that shows the percentage of the population in the county that is over 55 years old. Note that these data were also provided by the 2010 US Census. This data can be found within the **"Exercise_3"** folder you downloaded, a file named **Counties.shp** has been provided. This file contains an attribute called "per_gt55b" that provides the percentage of the population over 55. Specifically, we would like you to create a choropleth map.

Before you start making your map layout you will need to do the following:

☐ Add a new map to the project.
☐ Change the projection to Lambert Conformal Conic. We would suggest using the USA Contiguous Lambert Conformal Conic projection. It is located at: Projected Coordinate Systems → Continental → North America.
☐ Change the symbology to Graduated Colors.
☐ Pick a classification method.

Question 5. Which classification method did you choose to use for this map? Why did you choose this method? (4 Points)

☐ Add percentage signs and round the labels to one decimal place.

Next, you will need to create a new layout.

☐ This time, use a landscape layout. We would suggest ANSI Landscape Letter 8.5" x 11"

Deliverable 3 (20 Points)

Submit this map as a PDF file. It will be graded as follows:

1. Map uses Lambert Conformal Conic projection for the United States. The projection information is provided as text on the map layout (2 points)
2. The map layout is in landscape orientation (2 points)
3. A choropleth symbology has been used (2 points)
4. A north arrow and scale bar have been added. The north arrow should not be large or take up a lot of space on the layout (2 points)
5. A textbox is used to credit the US Census (2 points)
6. Your name and a descriptive title are provided (2 points)
7. A legend is provided that does not have file names present (2 points)
8. Values in the legend have percentage symbols and are rounded to one decimal point (2 points)
9. The map is overall very neat and well organized. Spaced is utilized well, and the data are well presented (4 Points)

Make sure to turn in all three of your map layouts as PDF files.

END OF EXERCISE