

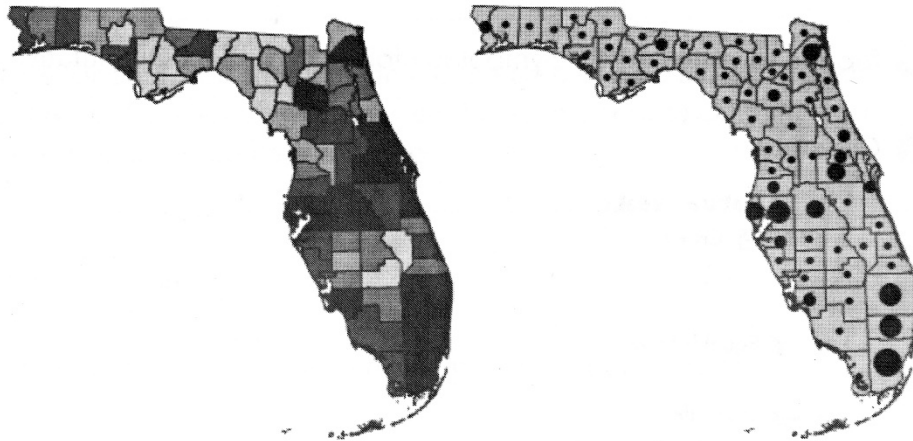
Exercise 3a: Symbolize GIS Data

Create several maps of the state of Florida using crime data. From these different maps, choose the map that best symbolizes the crime distribution.

In this exercise, you will:

- ✓ Apply quantitative symbology to GIS data.
- ✓ Evaluate quantitative classification methods.

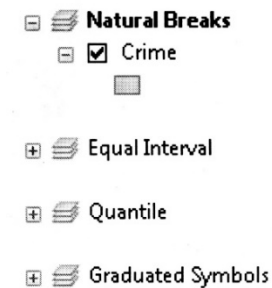
Florida crime levels
shown using
different quantitative
methods



Step 1: Evaluate attributes for symbology

Data attributes serve as the foundation for your map symbols. In this step, you will explore attributes and identify which could be used for quantitative display.

- a. Start ArcMap.
- b. In the ArcMap - Getting Started dialog box, under Existing Maps, click Browse for more.
- c. Browse to your .. \GEOG270 - Advanced Topics in GIS\Lab 3\Lab 3 Exercise Data\3a_Symbology folder and select Quantitative_Symbols.mxd.
- d. Click Open.



Your map opens with four data frames in the table of contents. The Natural Breaks data frame is currently active and is shown in a bold font.

- e. On the Tools toolbar, click the Full Extent button.

The Natural Breaks data frame has one layer named Crime. This is the layer currently shown on your map. You can think of each data frame as a separate map, each with its own layers and symbols.

To illustrate how each data frame represents a map, you will change your view in ArcMap to Layout View, which presents all your maps together on a virtual page.

- f. From the View Menu, choose Layout View.

The layout toolbar appears when you switch to Layout View.

- g. If necessary, move the toolbar so you can see all your maps. (Click the top of the toolbar to move it. You can also dock it to one of the edges of the ArcMap window.)

Each of the four data frames in your table of contents is shown as a separate map. These maps, along with their titles, have been positioned for you in the map document. You will make changes to each of these maps, and then use Layout View at the end of this exercise to compare your four maps.

h. From the View menu, choose Data View.

You can also change views by clicking the Data View and Layout View buttons at the bottom-left of your map display.

Prior to symbolizing your data, you should examine the type of data stored in each attribute field. Identifying the level of measurement for each attribute can help you determine how the attribute should be symbolized.

i. Open the attribute table for the Crime layer.

j. If necessary, resize your table window so that you can see all the attribute columns.

Several attributes are shown in the table. Many of these are automatically created and maintained by ArcGIS, including:

- ✓ OBJECTID
- ✓ Shape
- ✓ Shape_Length
- ✓ Shape_Area

The remaining attributes have been added to this feature class and are specific to the data. These include:

- ✓ STATE
- ✓ COUNTY
- ✓ POPULATION
- ✓ VEHICLE_THEFT

k. Right-click the COUNTY attribute field heading and choose Properties.

The Field Properties dialog box opens and shows the structure of this attribute.

1. What type of field is the COUNTY attribute?

l. Click Cancel to close the Field Properties.

2. Is the COUNTY attribute a nominal, ordinal, interval, or ratio measurement?

m. Examine the attribute types for the POPULATION and VEHICLE_THEFT attributes.

3. What type of attributes are POPULATION and VEHICLE_THEFT?

4. Are POPULATION and VEHICLE_THEFT qualitative or quantitative?

5. What level of measurement are the POPULATION and VEHICLE THEFT attributes?

n. Close the Table window.

Step 2: Apply the Natural classification method

Now that you have examined your attributes, you are ready to begin classifying the data. When you classify data, you group the features into different categories based on map symbols. This allows you to visualize patterns, trends, and categories of features on your map. You can choose from several classification methods provided in ArcMap, or you can manually define your own custom class ranges.

In the remaining steps of this exercise, you will work with Florida crime data and compare several different quantitative classification methods to symbolize your maps. You will compare the results of the different methods and examine why one classification method may be preferred over another.

When displaying quantitative attributes, you need to choose a classification method. You also need to decide how many classes you will use to represent the data. The number of classes you choose will depend on how many symbols are necessary to effectively show spatial patterns.

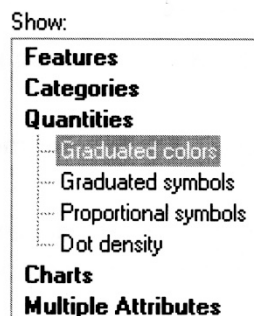
- Too few classes will result in an overly-simplified map.
- Too many classes will result in a map in which major patterns are difficult to recognize.

Having too many classes can also make it difficult to match the map symbols to their correct values in the legend. This could cause map readers to make incorrect decisions when reading the map.

- In the Natural Breaks data frame, double-click the Crime layer to open the layer properties.
- Click the Symbology tab.

Methods that you can use to symbolize your data are listed on the left. These are known as *renderers*.

- Click Quantities and confirm that the Graduated colors renderer is selected.

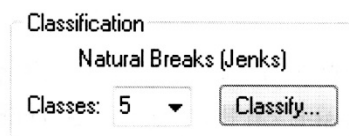


Next, you will choose which attribute field will be symbolized with graduated colors.

- Under Fields, for Value, choose VEHICLE_THEFT.

These are the number of vehicle thefts by county.

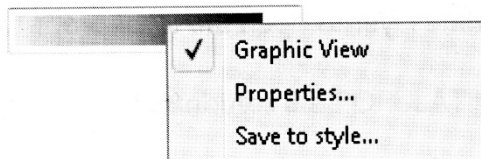
Under Classification, notice that the method is set to Natural Breaks (Jenks) and the number of classes is set to **5**.



This is the default method and number of classes when classifying quantitative attributes. This method is named after George Jenks, a professor of geography at the University of Kansas, who developed this method of showing spatial data distributions.

The Jenks method is often regarded as the best method for showing clusters of attribute values by using the breaks, or gaps, between symbols in the map legend.

e. Right-click the Color Ramp.



f. Click Graphic View to remove the check mark.

Turning off the graphic view allows you to view the color ramps by name. This can be helpful when you want to use a specific color ramp, or communicate which color ramp is used to symbolize your data.

g. Click the drop-down arrow and choose the Purple Bright color ramp.

h. Click OK.



Your map is now symbolized using a graduated colors renderer based on the VEHICLE_THEFT data. The number of thefts is represented by a range of colors that indicates a progression of numeric values. Values are grouped into classes according to the Natural Breaks classification

method and each class is displayed in the map as a different shade of the Purple Bright color ramp.

Do you think these results are meaningful? To help you answer this question, you will look at the population values of some of the polygons and compare them to the Crime attributes that you have just symbolized.

i. Open the layer properties for the Crime layer.

j. Click the Display tab.

k. Under Display Expression, for Field, choose POPULATION.

l. Check the box next to "Show MapTips using the display expression."

m. Click OK.

n. Pause your pointer over some of the polygons in your map..

As you pause over each county, the POPULATION value appears in a MapTip

o. Compare these values to the light and dark color values in your map.

6. Describe the relationship between the areas of high and low vehicle theft and the population shown by the MapTip.

Step 3: Apply the Equal Interval classification method

In this step, you will work with a classification method named Equal Interval.

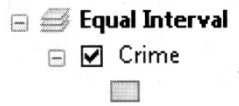
a. In the table of contents, collapse the Natural Breaks data frame.

b. Right-click the Equal Interval data frame and choose Activate.

Activating the data frame displays its layers in the map.

c. Click the Full Extent button.

d. Expand the Equal Interval data frame to see the Crime layer.



e. Open the layer properties for the Crime layer.

f. On the Symbology tab, click Quantities and confirm that the Graduated colors renderer is selected.

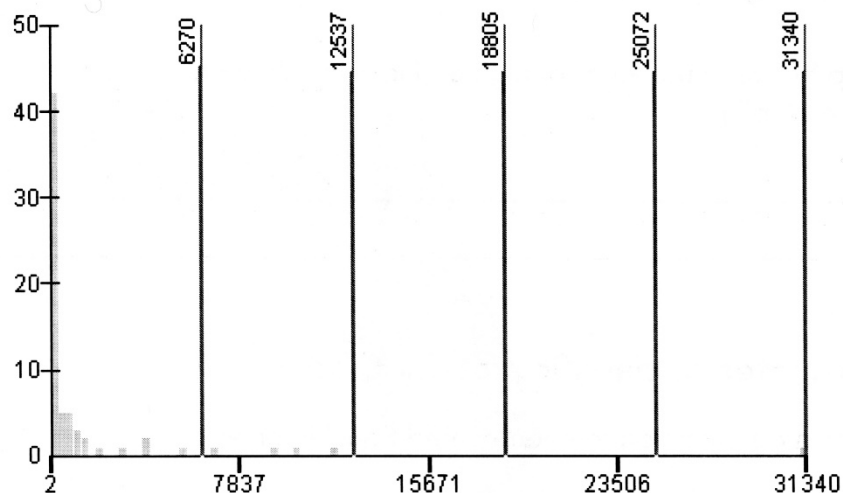
g. For Value, choose VEHICLE_THEFT.

Notice that the default classification is set to Natural Breaks (Jenks), with five classes.

h. Click Classify.

At the top of the Classification dialog box, for Method, choose Equal Interval from the list of options.

i. Review the histogram at the bottom of the dialog box.



The histogram shows the distribution of the VEHICLE_THEFT attribute values along the x-axis and the number of features along the y-axis.

Viewing the histogram is one way to examine your data for trends in the distribution and to identify possible outlier values, which you may choose to show or exclude from your map. Use the histogram when using the Equal Interval method to ensure that all your legend categories have values. Empty categories are confusing and misleading to your map reader.

7. Based on the class breaks currently shown in the histogram, what potential problems might you encounter when you create a map legend?

As you can see from the histogram, the Equal Interval classification method does not consider how your data values are distributed. This can result in empty classes, which will create legend categories that have no corresponding features on the map.

k. Change the number of classes and review the histogram until you do not have any empty classes.

8. For Equal Interval to have at least one feature in each class, how many classes should you use?

Using the Equal Interval method with four or more classes will result in some classes with no features. Three classes is the maximum number that can be used with this attribute. Other attributes may allow for more classes to be shown. Always check the histogram to make sure.

l. Set the number of classes to **3**.

m. Click OK.

n. If necessary, choose the same Purple Bright color ramp.

Hint: Right-click the color ramp to turn off the graphic view.

o. Click OK to close the layer properties and examine your map.



Because you only have three categories, you have a very generalized map. It is difficult to recognize trends with only three classes because the data representation is overly generalized. In this map, almost all the features are in the lowest category and the middle and highest categories each only have one feature. With this data, Equal Interval would not be a good choice of classification method.

Step 4: Apply the Quantile classification method.

In this step, you will use the Quantile method to classify the VEHICLE_THEFT data. With the Quantile method, each class has the same number of features. One benefit of using this method is that, like Natural Breaks, the map will not have any empty classes. Also, because the same number of features are in each class, the symbology of your map will be evenly distributed throughout, which can enhance the map's appearance.

- a. Collapse the Equal Interval data frame.
- b. Activate and expand the Quantile data frame.

Use a keyboard shortcut to activate the data frame:

➤ **Press the Alt key while clicking the data frame in the table of contents.**

- c. Click the Full Extent button.
- d. Open the layer properties for the Crime layer.

- e. On the Symbology tab, click Quantities and confirm that the Graduated colors renderer is selected.
- f. For Value, choose VEHICLE_THEFT.
- g. Click Classify.
- h. For Method, choose Quantile.
- i. Review the histogram and notice the distribution of the class breaks. Also, look at the Break Values on the right side of the Classification dialog box.

Break Values
34
147
262
1098
31340

These numbers correspond to the blue break lines in the histogram.

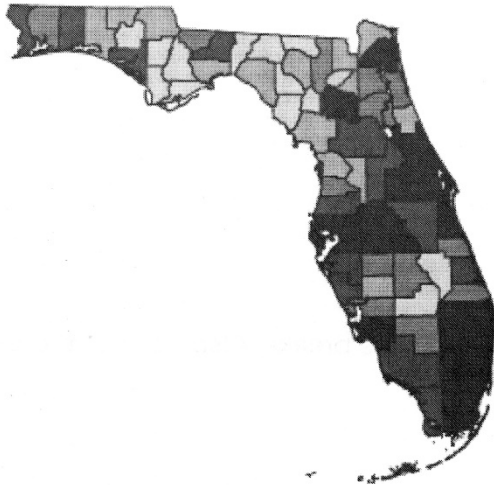
The highest category has very different values in the same class. Also, there are similar values which should be grouped together, but occur in different classes. These are both limitations of using the Quantile method.

Notice the difference in numeric ranges among the classes. When you choose the Quantile classification method, you are choosing to create a map with an equal distribution of features in each category. This will often result in a legend that may have very different numeric ranges and be difficult to understand. The map can be misleading with similar features placed in adjacent classes or features with widely different values put in the same class.

When using the Quantile method, you can minimize the difference in values within each class by increasing the number of classes.

- j. Confirm that the number of classes is set to 5.
- k. Click OK.
- l. Confirm that the Purple Bright color ramp is selected.

m. Click OK to apply your changes.



Your map is now symbolized according to the Quantile classification method. All the symbols in the legend occur an equal number of times in your map.

Step 5: Display graduated symbols

All the previous maps have used the graduated colors renderer to show quantitative differences. In this step, you will use a different renderer known as graduated symbols. Instead of using a series of graduated colors, a map of graduated symbols uses a point symbol, within each polygon, sized according to the magnitude of the quantity that it represents.

- a. Collapse the Quantile data frame.
- b. Activate and expand the Graduated Symbols data frame.
- c. Click the Full Extent button.
- d. Open the Layer Properties for the Crime layer.
- e. On the Symbology tab, click Quantities.
- f. Select the Graduated symbols renderer.

g. For Value, choose VEHICLE_THEFT.

Symbol	Range
•	2 - 750
●	751 - 2857
●	2858 - 6733
●	6734 - 11776
●	11777 - 31340

Notice that your symbols are now shown as a series of graduated circles rather than colors. You will accept the default classification method (Natural Breaks) and number of classes (5).

h. Under Template, click the point symbol.

This is the symbol that will be displayed within each polygon. The size of the symbol will represent the magnitude of vehicle thefts.

i. In the Symbol Selector, click the Circle 1 symbol.

j. For Color, click the color sample and choose a dark purple color from the color palette.

k. Click OK.

Symbol	Range	Label
•	2 - 750	2 - 750
●	751 - 2857	751 - 2857
●	2858 - 6733	2858 - 6733
●	6734 - 11776	6734 - 11776
●	11777 - 31340	11777 - 31340

l. Under Background, click the fill symbol.

m. For Fill Color, choose a light purple from the color palette.

n. Click OK.

In the Symbol Size section, your symbols range in size from 4 points to 18 points. You will now change this to increase the contrast in the symbol sizes. The smallest symbols are too small to be seen clearly and should be increased in size. The largest symbols will also need to be increased in order to ensure there is adequate size difference among your symbols.

- o. Change the point size of the smallest symbol to 8 and the largest symbol to 32.
- p. Click OK to close the layer properties.



Your map is now symbolized using a graduated symbols renderer (with values grouped into classes according to the Natural Breaks classification method). The size of each county's point symbol is relative to the number of vehicle thefts in that county.

Depending on your map scale, you may wish to increase or decrease the size of your symbols to achieve results that look similar to the previous map.

When using graduated symbols, make sure that your smallest symbols are large enough to see clearly. Your symbols should also have a large enough difference in size that they can easily be matched to their corresponding symbol in the map legend. They should not be so large, however, that they overlap other symbols or make it difficult to see each symbol's associated polygon.

Step 6: Compare quantitative maps

- a. In this step, you will look at all your maps and compare their symbology.

If necessary, maximize your ArcMap window to fill your screen.

- b. Change your view to Layout View.

Hint: Remember the buttons below your map that allow you to change views.

c. On the Layout toolbar, click the Zoom Whole Page button

All the quantitative maps that you symbolized display in the layout.

d. While pressing the Ctrl key, click to expand the Natural Breaks data frame in the table of contents.

This expands all the data frames in the table of contents.

e. Compare the Natural Breaks, Equal Interval, and Quantile maps.

Notice how they are all different in terms of the distribution of their symbols. All three maps represent your data by grouping values differently. Notice the difference in class breaks among the three corresponding map legends.

f. Compare the Graduated Symbols map to the other maps.

Do the graduated symbols present the data in a more or less meaningful way compared to the graduated colors? (Recall that the Graduated Symbols map uses the Natural Breaks classification method.)

Which classification method do you believe is more effective at presenting the story of the map? The Natural Breaks and Quantile methods are much better than Equal Interval. However, the Natural Breaks shows the higher values more clearly than the Quantile method.

Finding the best renderer for your data often requires experimenting with different classification methods and number of classes.

Step 7: Normalize data

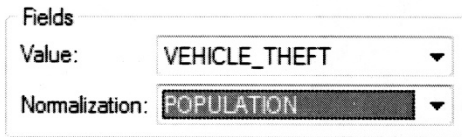
So far, all your maps symbolize the raw, or non-normalized, values. In this step, you will normalize your data and see how your map display changes.

a. Change the map view to Data View.

b. Activate the Natural Breaks data frame.

c. Create a copy of the Crime layer in the data frame. (Right-click the layer, choose Copy, and then right-click the data frame and choose Paste Layer.)

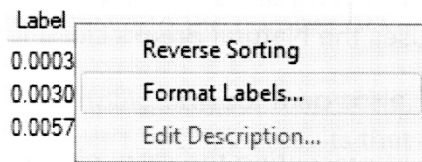
- d. Change the name of the top layer to **Crime - Normalized**.
- e. Open the layer properties for the Crime - Normalized layer.
- f. Click the Symbology tab.
- g. Under Fields, for Normalization, choose the POPULATION field.



Notice that the values in the Label column changed. For each county, you have divided the number of vehicle thefts by the total population.

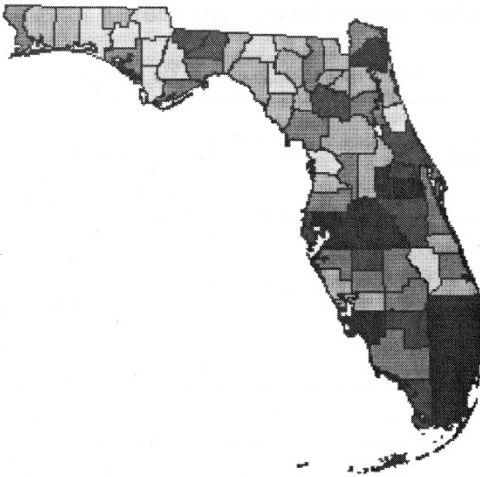
You will format the labels in the Label column to make the values more meaningful.

- h. Click the Label column heading and choose Format Labels (as shown).

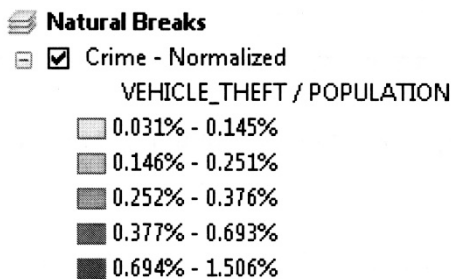


- i. In the Number Format dialog box, under Category, click Percentage.
- j. Choose the option, "The number represents a fraction."
- k. Click Numeric Options.
- l. Under Rounding, set the number of decimal places to 3.
- m. Check the box next to Pad with zeros.

n. Click OK in all open dialog boxes to see the changes in your map.



o. Notice that the legend in the table of contents changed based on how you formatted the labels.



The legend heading also indicates that you have normalized the data.

p. Turn the Crime - Normalized layer off and on to compare it to the original Crime layer.

Notice how your map has changed. You have a much more usable map because the normalization has allowed your data to be distributed in a more meaningful way. Many counties that were previously shown with a low quantity, are now shown with a higher quantity symbol, indicating that the likelihood of a vehicle theft is greater than your original map seemed to indicate. You would see similar results with the other classification methods as well (e.g., Equal Interval and Quantile).

q. Save your map document and close ArcMap.

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