Week 6 Cookbook: GIS Tutorial Chapter 3
## *GIS Outputs*

Week 6 Overview

1) Review: Custom Attribute Scales/Custom Classification
2) Your Turn: Chapter 3 of the GIS Tutorial
3) Map Making Suggestions
4) Lying with Maps

Chapter 3 takes you through a series of steps and tasks, aimed at showing you how to make better and more sophisticated maps with ArcGIS by using templates, adding reports, and adding graphs. Ultimately, a professional GIS map typically includes more than just a map. You can also show information using tables and graphs to supplement the information shown by the map.

This is important!

Often, the results of a GIS analysis are shown as tables or graphs – in addition to a map. Or, sometimes the map is merely a location map.

In addition, we will review choropleth maps and custom attribute scales/custom classifications this week.
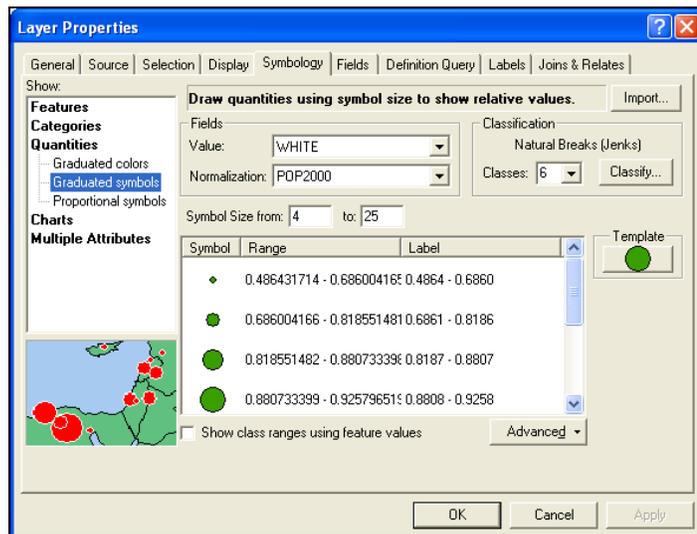
We have a fairly long review example to start this cookbook. I included a series of Jings that show you each step of the process in detail

Consider printing this cookbook for your convenience

1) Review: Custom Attribute Scales/Custom Classification

See: Page 57 – 61

This is perhaps the single most important GIS concept this semester. A GIS allows you to create choropleth maps = maps that show the color of a feature or the size of a feature as a function of the underlying feature attribute data.

➔ **Your choice of color, size, and underlying classification system is critical to create a truly meaningful map!**

Do NOT simply accept the defaults that ArcGIS provides to you!
Always create <u>your</u> own classification system that is appropriate, objective, and meaningful for <u>your</u> data <u>your</u> map, and your analysis!

Here is an example – please follow along in ArcGIS:

> There is a multi-part Jing in the Week 6 folder that you can play along as you work through this example. I suggested printing the cookbook and working along in ArcMap while viewing the Jing. Take your time with this example – it contains some important new skills.

1. If necessary, create a new folder on your USB flash drive: \garp0244\week6.

2. Start ArcCatalog and create two new folder connections:

   To your USB flash drive   To save the map
   To the C:\GIStutorial folder   To the location of the data

These two steps are very helpful to do at the start – create your folder and folder connections – that way things are easier and more convenient later on.

3. Start ArcMap and switch to the Layout View (View – Layout View). The default should be an 8.5 by 11 inch map in portrait orientation.

4. Add four guidelines 0.5 inch from each edge of the paper by clicking on the ruler and moving the guidelines as needed. Add two more guide lines at 5.5 inch and 6 inch vertical.

> This is important! Use the guidelines to size and align your data frames and map elements. Always add the four guidelines at least 0.5 inch from the paper margin. You should never have anything closer than 0.5 inch from the margin…otherwise the printer will most likely cut it off.

5. Re-size the Data Frame, so it fits in the upper 'box' created by the guidelines. Your data frame will be 7.5 inches wide and 4.5 inches tall.

6. Click on the Data Frame to select it, select Copy, and select Paste to add a second identical data frame to your map. Move the new data frame into position in the lower 'box' created by the guidelines.

7. Double-click on the top Data Frame.
   The selected Data Frame is highlighted in diagonal hash marks in the map window and the selected Data Frame is also highlighted in bold in the Table of Content.

8. Go to Data Frame Properties by right-clicking on the Data Frame in the Table of Contents, select Properties, select the General Tab, and change its name to: Cities in MA.

9. Repeat Step 8 for the lower Data Frame and name it: Cities in CT.

This was merely the prep work for our map. We created the folder connections and the two data frames we need for our map. It is always a good idea to spend some time setting up the map and data frames before you start adding data.
➔ Always rename the data frames in the Table of Content – give them a name that describes what they show. Now we are ready to add data to each Data Frame.

This is important!

When you *single-click* on a data frame…
- The data frame is selected and gets the 8 little squares around its margin.
- Now you can move and resize the data frame.
- Move the mouse over the data frame, right-click, and you can select the Properties of the data frame.

When you *double-click* on a data frame…
- The data frame is now surrounded by short, diagonal hash marks.
- This makes the data frame <u>active</u> and it is shown in bold in the Table of Content.
- Now you can change the symbology, create definition queries, change the classification, etc.

Thus: Single-clicking allows you to change the way a data frame looks…
Whereas: Double-clicking allows you to work with the GIS data shown in the data frame

There can be only one active data frame – shown in bold in the Table of Content. Always activate whatever data frame you want to work on by double-clicking first!

Now: add data to each data frame and create choropleth maps:

10. Double-click on the Data Frame Cities in MA (to make it active) and add two shape files from the C:\GIStutorial\UnitedStates folder: States.shp and Cities.shp.

11. Use the Definition Query function to display only the cities in MA and zoom in as much as possible into Massachusetts and Connecticut.

12. Repeat Steps 10 and 11 for the Data Frame Cities in CT, except use the Definition Query function to display only the cities in CT.

13. Use Symbology – Quantities – Graduated symbols, select WHITE as Value, and click OK. Repeat for both Data Frames.

You get a choropleth map in each data frame where the size of the circles is a function of the number of white people in each city. By default, ArcGIS classified the data into 5 classes, using the Natural Breaks classification system.
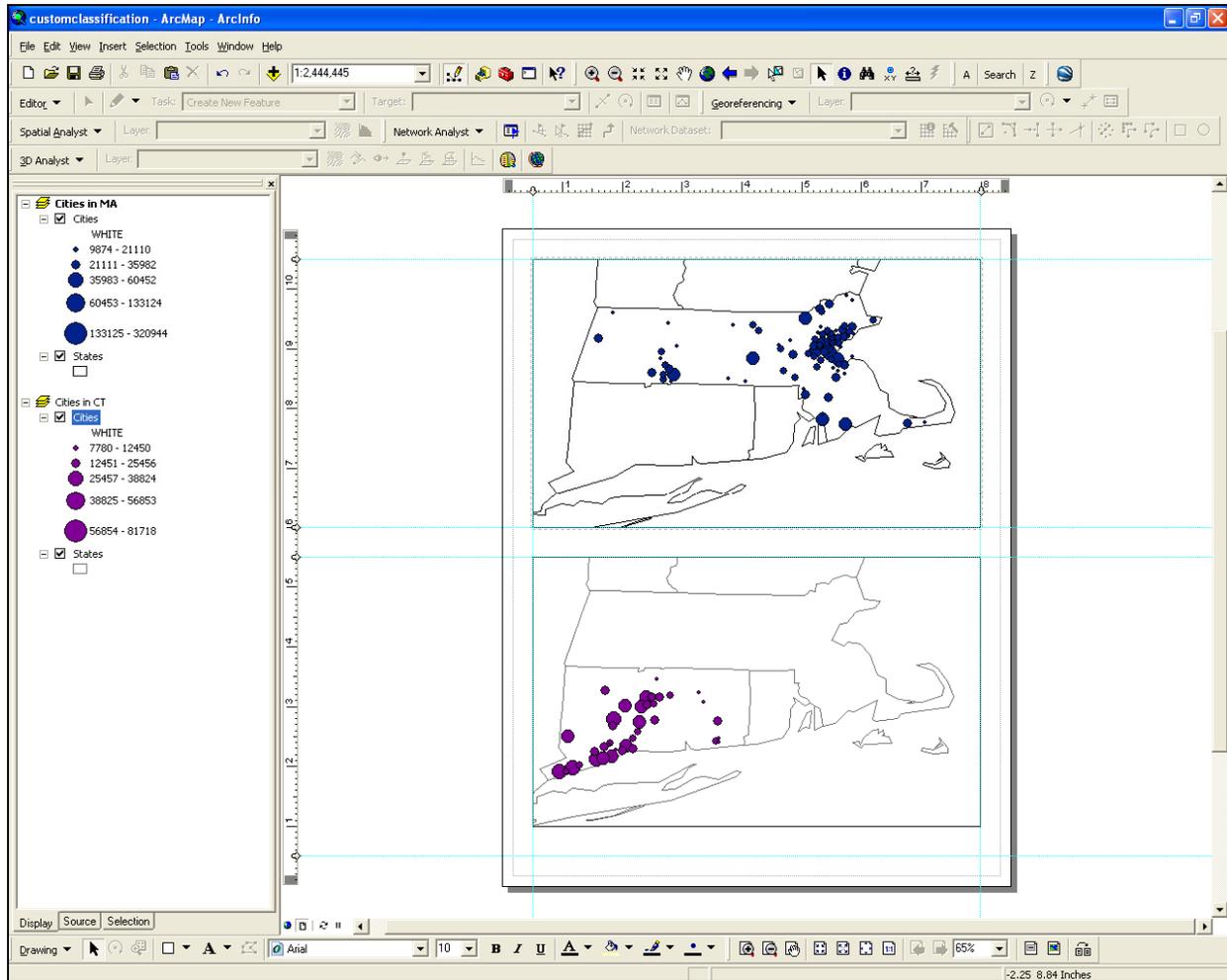
It is important that you end up with a map that looks like the one shown above – even though your colors may be different. If necessary: review the definition query section of the Week 5 cookbook and view the associated Jings again as a refresher.

There are three issues with your map:

- Showing the absolute number of white people in each city is not very meaningful, since that depends on the total number of people living in each city.
- Your classification scales are different between the two data frames: A circle of a given size does not mean the same thing in both data frames.
- Your zoom level or scale is different between the two data frames.

These three issues MUST be fixed in order to create a meaningful map in which you can compare the cities in Massachusetts and in Connecticut in terms of their population.

More meaningful:

Show the number of white people as a function of total population – that is show as a percentage.
In Lingo: Normalize whites by total population.

14. Use Symbology – Quantities – Graduated symbols, select WHITE as Value, and POP2000 as Normalization. Repeat for both Data Frames.

Now your map is more meaningful and shows the size of the circles is a function of the <u>percentage</u> of white people in each city. By default, ArcGIS classifies the data into 5 classes, using the Natural Breaks classification system.
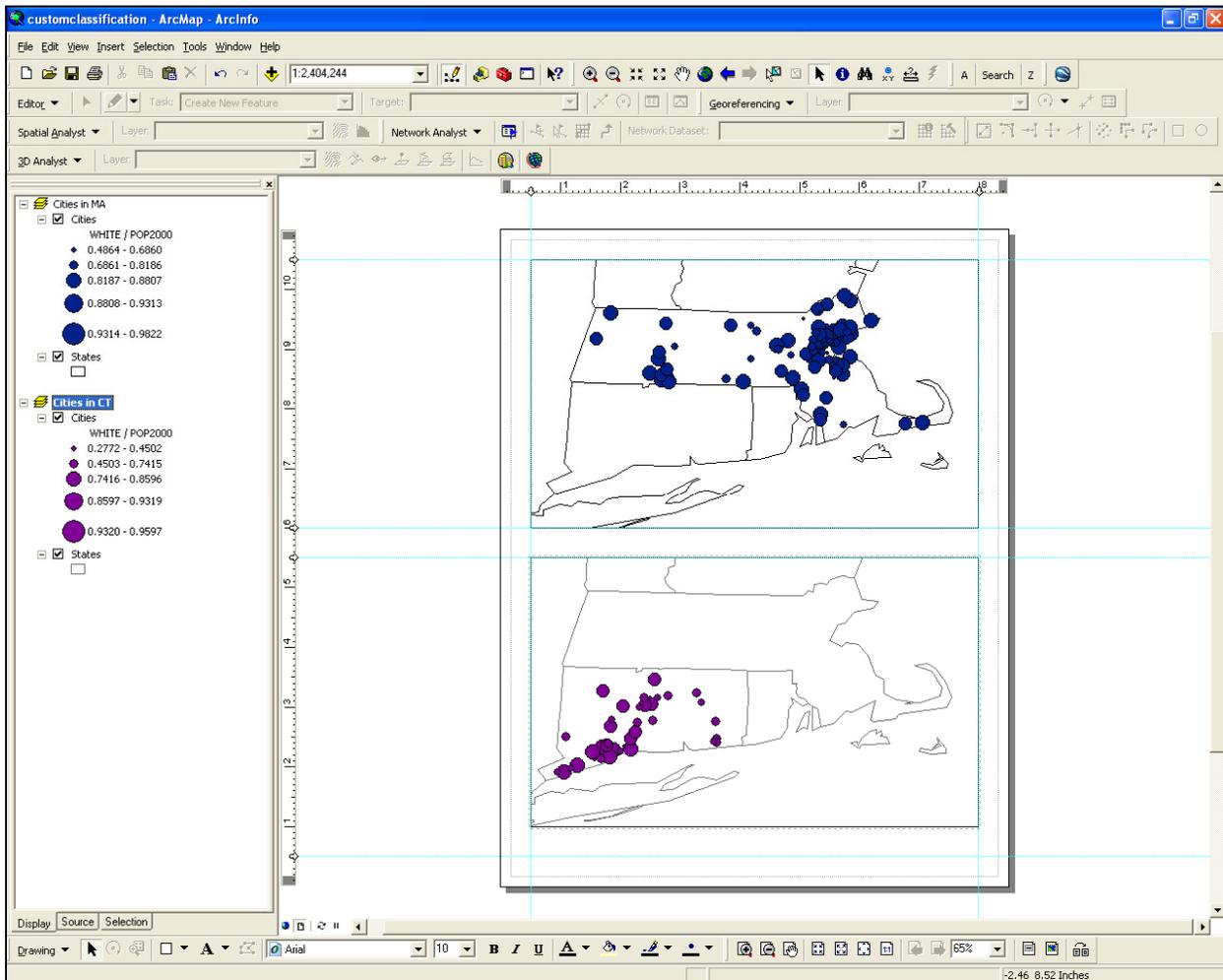

Please note:

• You should take this default classification system only as a first start – and modify it to suit your specific need or to make the map easier to understand.
• In this case, you MUST have the same classification system in both data frames, otherwise you create an incorrect impression when comparing the cities of Massachusetts and Connecticut.

For example, here we (may) want 6 classes: less than 50%
50 to 60%
60 to 70%
70 to 80%
80 to 90%
90% and greater
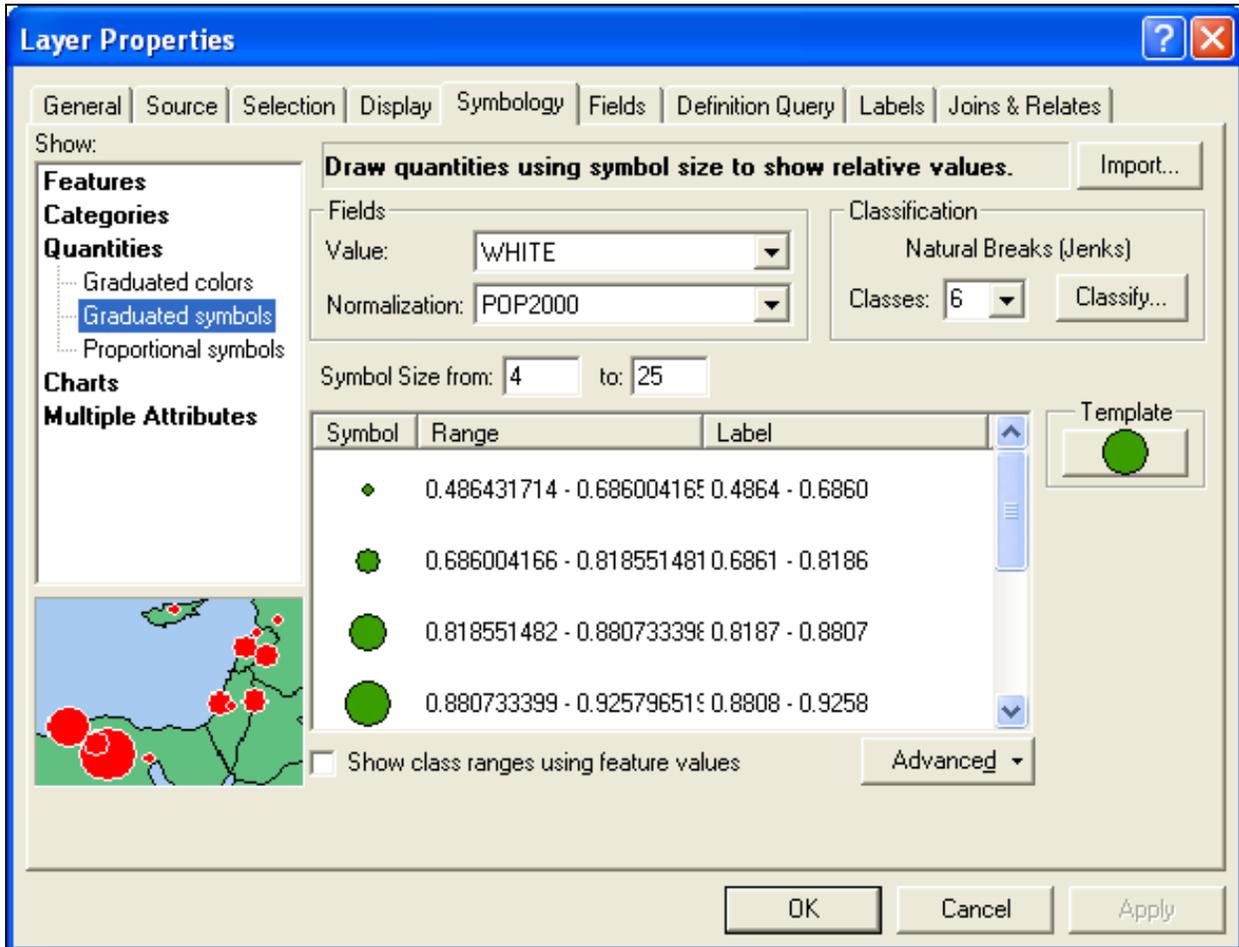
Symbol Size	Defines the smallest and largest size and assigns intermediate sizes depending on the number of classes.
Label	Defines how each class/range is labeled.
Classify	Defines the actual classes/ranges.

Changing the symbol size or label does NOT change the actual underlying classification!
The only way to change the actual underlying classification is to 1) click the 'Classify…' button, 2) change the Classification Method to 'Manual' and 3) change the Break Values.

15. Use Symbology, change the number of classes to 6, change the Classification to Manual and enter the new Break Values suggested above. Repeat for both Data Frames.

16. Now you can modify your labels, your symbol size range, your specific symbol size, and symbol color to give you a more understandable map. Repeat for both Data Frames.

➔ If you want to show another state (e.g. Vermont), you should use the exact same classification method, break values, symbol sizes, symbol colors, etc. to avoid misleading the map user.

Whow – now you have a meaningful choropleth map! You have two data frames with the same custom classification system and the same map scale. You are showing your data as percentages, no as absolute values.

2) Your Turn: Chapter 3 of the GIS Tutorial

Chapter 3 takes you through a series of steps and tasks, aimed at showing you how to make better and more sophisticated maps with ArcGIS, for example:

1. Using Templates and Layouts
2. Adding Reports (i.e. tables) to your map.
3. Adding Graphs (crucial!) to your map.
4. Exporting Data (crucial!)
5. Exporting your map in various formats.

Make sure you save all your maps, layers, reports, templates, etc. throughout this chapter to your USB flash drive into the garp0244\week6 folder.

Part I: Map Templates (Page 78 to 83)
A map template is essentially a simple file that controls how a map is displayed and printed. A template is not a map – just a 'container' to present a map. You can use the same map template for many different maps. ArcGIS contains a wide range of map templates to make good-looking maps – fast!

*   Save the map as instructed on Page 82, but to your USB flash drive into the garp0244fall\week6 folder.
*   Complete the 'Your Turn' box on Page 82 and save the map to your USB flash drive into the garp0244\week6 folder.
*   If you can: print both maps.

Part II: Custom Map Templates and Map Series (Page 84 to 89)
Sometimes you may want to create a series of maps with the same basic design, each of them showing a different attribute of the feature. In this example, each map will display population of a different racial or ethnic group – you'll use the same numerical scale for each map to facilitate comparison.

Map #1   Population of Native Americans
Map #2   Population of Asian Americans

*   Save the maps, layer files, and map template to your USB flash drive into the garp0244fall/week6 folder.
*   Skip the 'Your Turn' box on Page 89.
*   If you can: print both maps.

Part III: Custom Map Templates for Multiple Maps (Page 90 to 91)
Here you combine both maps from Part II on one single map.

- Save the map to your USB flash drive into the garp0244fall/week6 folder.
- If you can: print the map.

Part IV: Reports (Page 92 to 96)
Reports allow you to include data/information on your map in a table format to emphasize a particular aspect of your analysis in a table. Some type of information is best shown as a table, rather than a map or a graph. The Report tool is great, but a bit tedious…so please be careful!

- Save the map and report to your USB flash drive into the garp0244\week6 folder.
- Skip the 'Your Turn' box on Page 96.
- If you can: print the map.

Part V: Add Graphs to a Layout (Page 97 to 101)
You can make simple graphs directly in ArcMap, but ArcMap does not allow you many design options. Therefore, it is often better to export the data into Microsoft Excel, perform whatever calculations are needed, create a graph in Microsoft Excel, and paste the Microsoft Excel graph into your ArcMap layout.

- Save the map, data, and Microsoft Excel spreadsheet report to your USB flash drive into the garp0244\week6 folder.
- If you can: print the map.

Part VI: Export Maps as Files (Page 102)
This allows you to export your map in many different file formats for use in other software applications. We already know how to do this, so this is just a refresher.

JPG (*.jpg)   Useful for Microsoft Word, Microsoft PowerPoint, or websites.
PDF (*.pdf)   Useful for "stand-alone" maps

3) <u>Map Making Suggestions</u>

Overarching Themes

- Data Organization: Use dedicated folders! The key is to start organized – it is very difficult to organize a mess afterwards.
- Always save your map with relative pathnames.
- Project Documentation: Document your analysis steps!

Think about your finished map before you start mapping!

- Adjust your map size immediately. Most of your maps will be 8.5 by 11 inches, but some of the maps for your projects will be 18 by 24 inches or even larger.
- Leave at least 0.5 inch (large maps: 1 inch) margins around all map elements.
- Create your data frames immediately before you start adding data.

Think about classifications and colors!

- Don't just accept the ArcGIS defaults! You are making a deliberate choice here – make sure your classification is meaningful and consistent between the data frames.
- Choose your colors and/or symbol sizes carefully.

Details Matter!

- Use titles for each data frame, and a title for the map as a whole.
- Include a scale bar, legend, north arrow for each data frame.
- Use consistent font sizes.
- Align your data frames map elements using guide lines.
- Finishing touch: add a border (= neat line) around all map elements.

Avoid typos, sloppy alignments, and other mistakes. Print your map and proof-read!

4) 'Lying with Maps'

Next week we will work on the *Lying with Maps* Project.

The best way to learn how to make a good, objective, and meaningful map is to do just the opposite:

How can we create a really bad, deceptive map?

Mark Monmonier's paper is an excellent, well-written review of deliberate and accidental mistakes in map making, which create a distorted perception of reality.

The paper is in the Week 6 folder.

Along the same lines I have also added Jerry's Crime Mapping Tips – a great summary of common mistakes in map making and how to avoid them.

More good stuff can be found at his website:

http://www.jratcliffe.net/

Lying with Maps

Mark Monmonier

Abstract. Darrell Huff's *How to Lie with Statistics* was the inspiration for *How to Lie with Maps*, in which the author showed that geometric distortion and graphic generalization of data are unavoidable elements of cartographic representation. New examples of how ill-conceived or deliberately contrived statistical maps can greatly distort geographic reality demonstrate that lying with maps is a special case of lying with statistics. Issues addressed include the effects of map scale on geometry and feature selection, the importance of using a symbolization metaphor appropriate to the data and the power of data classification to either reveal meaningful spatial trends or promote misleading interpretations.

Key words and phrases: Classification, deception, generalization, maps, statistical graphics.

Jerry's top ten crime mapping tips

Jerry Ratcliffe, PhD
Department of Criminal Justice
Temple University
Philadelphia