Online Supplement to *GIS and Public Health, 2nd Edition*
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GIS AND PUBLIC HEALTH EXERCISE 5 – MAPPING HEALTH INFORMATION (ArcGIS 9.3.1)

PREPARATION

Download the **exer5** folder you will need for this exercise from the online supplement.

All of the databases and files used in the exercise will be stored in various subfolders within the folder called **exer5**. The following instructions are written for this folder to be located on the **c:** drive. If the folder is located on another drive, the path names shown below should be modified accordingly. Some of the folders are empty. They have been included because you may need to save the results of an operation to one of these folders.

The map documents created using ArcGIS 9.3.1 reference the spatial databases and tables in the application based on the directories and paths where the data are stored. Changing the locations of databases in the system can prevent a GIS application from working properly.

Connecting to the Exercise Folder

Go to **Start** ⇒ **Programs** ⇒ **ArcGIS** ⇒ **ArcCatalog** to start ArcCatalog.

Find the button labeled **Connect to Folder** and click the button. Navigate to **c:\exer5** then click OK and look at the Catalog tree in the left window to see that the folder has been added.

Within the data folder, data can be organized in folders identifying the agency that produced the data and then by the format of the data. For these exercises, you will consider yourself to be working for the organization called “agency” that is creating the GIS.

As you work through the exercises, you will be retrieving data from and saving data to specific folders. Please make sure you understand the System Design for the exercises.

Use the **File** ⇒ **Exit** menu to close ArcCatalog.

PREPARING TO MAP DATA

Go to **Start** ⇒ **Programs** ⇒ **ArcGIS** ⇒ **ArcMap** to start ArcMap.

In the “ArcMap Start using ArcMap with” window, click the radio button labeled “A new empty map” and then click OK.

Rename the Layers data frame by right clicking the word Layers and selecting the **Properties** item in the menu. Then select the **General** tab and enter the name Mapping. Click OK. The name of the Data Frame in the Table of Contents window should now appear as Mapping.

Add a Database of Counties

To begin, add a database of counties in South Carolina. The database was downloaded from the U.S. Census Bureau TIGER® web site. Initially, a shapefile of South Carolina census tracts from the 2010 TIGER database was downloaded. Census tracts along the coast were deleted as were several coastal islands. Then, the census tracts were dissolved into counties and Census county attributes were added. Finally, the data were projected using NAD_1983_UTM_ Zone_17N (meters).

Find the button labeled **Add Data** and click the button. You should find the **c:\exer5** folder in your catalog. If not, please connect to the folder using the **Connect to Folder** button.

Navigate to **c:\exer5\data\agency\shapes** and add the **tl_2010_45_county10_Project.shp** shapefile.

This database is stored in the agency subfolder because it has been modified by the user and is no longer the same data downloaded from the Census Bureau site.

Note that the counties have been symbolized using a default fill color, line color, and line width.

Right click on the county shapefile, select **Open Attribute Table** from the menu, and explore the fields. The state FIPS code for South Carolina is 45. Each county also has a FIPS code. The GEOID10 field concatenates the state and county codes. Note that this is a text field.

The table also contains fields (ALAND10 and AWATER10) with data on the surface land and surface water areas in each county in square meters.

Add a Table of Population Data

To begin, add a table of population data for the counties of South Carolina. This table of data was prepared from data downloaded from the Census Bureau's American FactFinder web site for the purposes of this exercise. The data are from the 2010 Redistricting Data Summary File (P.L. 94-171), among the first data released from the 2010 census.

Many studies of health and health disparities investigate differences among racial groups. The data in this table provide information on the total population within different racial groups by county.

Find the button labeled **Add Data** and click the button.

Navigate to **c:\exer5\data\agency\textfile** and add the **PL_P1.txt** data table.

Use the **Save** button or go to **File ⇒ Save** to save your map document. Navigate to **c:\exer5\mapdocs** and save the file as **exer5.mxd**.

Right click on the PL_P1.txt table, select **Open** from the menu, and explore the fields as described in the table below.

Field Name	Field Type	Description
GEOID	Text	Unique identifier for each county; a combination of the state and county FIPS codes for each county
NAME	Text	The name of the county
D001	Numeric	Total population
D002	Numeric	Total: Population of one race
D003	Numeric	Total: Population of one race: White alone
D004	Numeric	Total: Population of one race: Black or African American alone
D005	Numeric	Total: Population of one race: American Indian and Alaska Native alone
D006	Numeric	Total: Population of one race: Asian alone
D007	Numeric	Total: Population of one race: Native Hawaiian and Other Pacific Islander alone
D008	Numeric	Total: Population of one race: Some Other Race alone
D009	Numeric	Total: Two or More races

For the 2010 Census, individuals could identify themselves with one or more of six racial groups: White, Black or African American, American Indian and Alaska Native, Asian, Native Hawaiian and Other Pacific Islander, or Other. For this exercise, we will be using data on the total population (D001), the total population identifying themselves as being of one race alone (D002 through D008), and the total population identifying themselves as two or more races (D009). The values in D002 and D009 sum to the value in D001.

PERFORMING A TABLE JOIN

Right click the tl_2010_45_county10_Project.shp layer and select **Joins and Relates ⇒ Join** from the menu to open the "Join Data" window.

Select "Join attributes from a table" from the pull-down menu because we want to join population data from the PL_P1.txt table to the shapefile of counties.

Choose the **GEOID10** field from the pull-down list of fields in the attribute table of the tl_2010_45_county10_Project.shp layer.

Then choose the **PL_P1.txt** table from the pull-down list of tables as the table you wish to join to the county database.

Finally, choose the **GEOID10** field from the pull-down list of fields in the attribute table of the PL_P1.txt table as the join field.

Make sure the radio button "Keep all records" is selected. Then click OK.

Right click the tl_2010_45_county10_Project.shp layer and select **Open Attribute Table** from the menu. Scroll to the right. You should see that the table of population data has been joined to the shapefile. You should have 46 records in the shapefile with the joined attributes and there should be population values for every county (no null values).

Note that the names of the fields have been modified to show the table and field name [table.fieldname] so that you can identify the source of the field and the field name for every field in the attribute table resulting from the Join operation. You can use this technique to join more than one attribute table to the shapefile of counties.

Close the attribute table.

This join is temporary. In order to make the join permanent, right click the tl_2010_45_county10_Project.shp layer, and select **Data ⇒ Export Data** from the menu.

Save the output data file as **c:\exer5\data\agency\shapes\countypop.shp** and click OK.

Click Yes to add the exported data to the Data Frame.

Then, right click the countypop.shp layer and select **Open Attribute Table** from the menu. You should see that the field names are given without the table name from which the fields were joined. In addition, you will note that there is a GEOID10 field and a GEOID10_1 field. GEOID10 is the field from the tl_2010_45_county10_Project.shp layer and GEOID10_1 is the field from the PL_P1.txt table you joined. Field names must be unique within a table.

Finally, right click the tl_2010_45_county10_Project.shp layer and select **Joins and Relates ⇒ Remove Join(s) ⇒ Remove All Joins** from the menu. This will remove the joined attribute table. Note that you can choose to remove the join to an individual table or to all of the tables you have joined.

Use the **Save** button to save the map document.

MAPPING THE DATA

Now that you have population data to map, you can prepare a wide range of maps for counties of South Carolina.

Mapping Count Data Using Dot Density Maps

Right click the countypop.shp layer and select **Properties** from the menu. Click the **Symbology** tab in the "Layer Properties" window.

The population values for each county are quantities so click the **Quantities** label in the "Show:" window to the left.

The population data values are counts. Cartographers have pointed out a number of problems mapping counts for areas using Graduated colors. To map the total population of each county, click the Dot density option under **Quantities**.

Click the **D001** field in the "Field Selection" list to highlight it. Then click the > button to add a symbol and the field to the window on the right. A dot symbol will be used to represent population. By default, the software suggests a Dot Size of 2 and Dot Value of 4000. This means a dot of that size will represent 4000 people on the map. The required number of dots to represent the county's population will be placed randomly within each county. Note that you can modify the background line width of county boundaries and the background fill of the county areas, too.

Click Apply and OK to map the total population as a dot density map.

Mapping Population Density Using Choropleth Maps

Right click the countypop.shp layer and select **Properties** from the menu. Click the **Symbology** tab in the "Layer Properties" window, and click the **Quantities** label in the "Show:" window to the left.

This time, click the Graduated colors option under **Quantities**.

In the "Fields" window, select **D001** as the "Value:" field from the pull-down menu. Then, select **ALAND10** as the "Normalization:" field. This will normalize the total population count by the land area of the county producing a map of population density. Click Apply and OK to map total population density by county.

This map is one of numerous maps which can be made using the same data. You can change the number of classes, the method for determining the class intervals, and the color ramp of the map. By default, you used 5 classes and Natural Breaks to map the normalized data. Next, assess the impact of different methods for determining the class intervals.

Right click the countypop.shp layer and select **Properties** from the menu. Click the **Symbology** tab in the "Layer Properties" window.

Leaving the Value and Normalization fields the same and the number of class intervals at 5, modify the map by clicking on the Classify button in the "Classification" box.

Select Equal Interval from the "Method:" pull-down menu. Note that the "Break Values" change. Then click OK to close the "Classification" window, and click Apply and OK to map the data using the equal interval classification method. You should see only two counties in the highest class interval for population density based on equal interval classification.

Use the **Add Data** button and navigate to **c:\exer5\data\agency\shapes** and add a second copy of the **countypop.shp** shapefile to the Data Frame. Then click the **Save** button to save the map document.

Right click the countypop.shp layer you just added and select **Properties** from the menu. Click the **Symbology** tab in the "Layer Properties" window, and click the **Quantities** label in the Show: window to the left.

Click the Graduated colors option under **Quantities**.

In the "Fields" window, select **D001** as the "Value:" field from the pull-down menu. Then, select **ALAND10** as the "Normalization:" field as before.

Click on the Classify button in the "Classification" box and then select Quantile from the "Method:" pull-down menu and 5 as the number of classes. Then click OK to close the "Classification" window, and click Apply and OK to map the data using the quantile classification method. This method puts an equal number of counties within each of the 5 classes, unlike the equal interval method which creates equal ranges for each class interval.

Check and uncheck the box for the countypop.shp layer symbolized using quantiles to turn the layer visibility on and off so that you can compare the impact of choosing a different classification method on the pattern of population density.

Use the **Save** button to save the map document.

MAP LAYOUT

Once you have prepared a cartographic view of the data, you can use Layout View to design a map layout for publication.

Use the **Add Data** button and navigate to **c:\exer5\data\agency\textfile** and add the **scan0408.txt** data table. This is a table of data created using the South Carolina Community Assessment Network on-line data querying and mapping system of the South Carolina Department of Health and Environmental Control. The table contains five-year (2004-2008) infant deaths, infant mortality rate, and live births for each county. We are using five-year data because these data will be more reliable than single-year data for counties with low numbers of infant deaths. Over the time period, the county of birth was unknown for 18 births.

Right click on the scan0408.txt table, select **Open** from the menu, and explore the fields

Use the **Save** button to save the map document.

Turn off the layer visibility for all data layers in the Mapping Data Frame except the tl_2010_45_county10_Project.shp layer.

Right click the tl_2010_45_county10_Project.shp layer and select **Joins and Relates ⇒ Join** from the menu to open the "Join Data" window.

Select "Join attributes from a table" from the pull-down menu because we want to join population data from the scan0408.txt table to the shapefile of counties.

Choose the **NAME10** field from the pull-down list of fields in the attribute table of the tl_2010_45_county10_Project.shp layer.

Then choose the **scan0408.txt** table from the pull-down list of tables as the table you wish to join to the county database.

Finally, choose the **NAME** field from the pull-down list of fields in the attribute table of the scan0408.txt table as the join field.

Then click OK.

Right click the tl_2010_45_county10_Project.shp layer and select **Open Attribute Table** from the menu. Scroll to the right and check to see that the table join was executed properly. **Close** the attribute table.

In order to make the join permanent, right click the tl_2010_45_county10_Project.shp layer, and select **Data ⇒ Export Data** from the menu.

Save the output data file as **c:\exer5\data\agency\shapes\countyimr.shp** and click OK.

Click Yes to add the exported data to the Data Frame.

Finally, right click the tl_2010_45_county10_Project.shp layer and select **Joins and Relates ⇒ Remove Join(s) ⇒ Remove All Joins** from the menu.

Use the **Save** button to save the map document.

Use the techniques you have learned to symbolize the five-year infant mortality rates for counties.

Next, use the **Insert ⇒ Data Frame** menu to insert a new data frame. Right click the New Data Frame and select **Properties** from the menu, then click the **General** tab. Change the name of the New Data Frame to Region Inset. We will be adding a layer of South Carolina health regions as a map inset.

Use the **Add Data** button and navigate to **c:\exer5\data\agency\shapes** and add the **dhecregion.shp** shapefile to the Region Inset Data Frame.

Right click the Region Inset Data Frame and select **Activate** from the menu to make this the active data frame.

Click the rectangle symbol in the legend under the dhecregion.shp layer to open the “Symbol Selector” window. Select No Color from the “Fill Color” pull-down. Set the Outline Width to 1.0 and set the Outline Color to black. Then click OK.

Right click the dhecregion.shp layer and select **Label Features** from the menu. This will label each region with the region number.

Then, right click the Mapping Data Frame and select **Activate** from the menu to make it the active Data Frame.

Use the **Save** button to save the map document.

Use the **View ⇒ Layout View** menu or the button at the bottom of the View Frame to change from Data View to Layout View. You will see what looks like a page of paper with two rectangles. Each rectangle is associated with one of the Data Frames in your map document. One has the map of infant mortality rates; the other has the map of health region boundaries.

In general, it is probably better to edit and take care of annotation in Data View while you are in data view and to take care of layout and moving elements around while you are in Layout View. **If you select and delete the Data Frame rectangle in the layout in Layout View, you have**

deleted the Data Frame from your application. You would have to insert a new Data Frame and then fill it with layers.

Periodically **Save** the map document as you are working.

Set Up the Page

First, complete the Page Setup. Right click in the margin of the layout area (**not** in one of the Data Frame rectangles) and select **Page and Print Setup** from the menu. Then set the page size, orientation, and printer.

If you right click in the margin of the layout area, you can adjust the Rulers, Guides, Grid, and Margins settings. Choosing the **Options** menu allows you to refine some of these settings.

Layout Interface

Explore the controls of the Layout View tools for panning and zooming
The toolbar now has a set of controls enabled that support panning and zooming in the layout. These controls look similar to the panning and zooming controls used in Data View. Explore the use of these controls and remember which tools to use to pan and zoom the data and which tools to use to pan and zoom the layout.

Select and position the Data Frames
Use the Select Elements button to select the Data Frame containing the DHEC region boundaries. Move and resize this Data Frame to place it as a small map inset in one area of your map.

Insert key map elements
Use the **Insert** menu to select and place key map elements in the Layout View. You can follow the order of the dropdown menu to create a title, neatlines, a north arrow, and scale.

Use the **Select Elements** tool to select, reposition, and resize the various elements you are adding to your map.

Convert legend to graphics
After you have the legend placed where you want it, you can convert the legend to graphics and then ungroup the graphics to edit the legend text, if desired. Use the **Select Elements** tool to select the legend. When it is selected, right click in the legend and select **Convert to Graphics** from the menu. Then right click and select **Ungroup** from the menu. You can modify text or other elements in the legend using the available tools. Note that once you have converted a legend to graphics, it is no longer linked to the Data Frame. If you change the symbolization of the infant mortality map, the legend will not change and you will have to re-insert the legend.

Add text
Use the **New Text** tool in the Draw controls at the bottom of the interface and drag a rectangle in the Layout View to add a text box. Double click the text box to open the **Properties** window and add text including the author of the map, the date and place of publication, the source of the data, and a note indicating that county of birth could not be ascertained for 18 births. You can change the default font and size of the text if you wish. If the Draw toolbar is not present, use **View ⇒ Toolbars** and check the Draw toolbar to enable it.

Use ArcGIS Desktop Help to read more about using these tools.

Print your map
When you have the map the way you want it, print a copy of the map to use as an example.

WORKING WITH TEMPLATES

Using ArcGIS Templates

To assist users in map preparation, ArcGIS 9.3.1 includes templates that can be used for map layout. Map templates are ArcMap documents that ArcMap recognizes as templates. Map templates have the file extension .mxt to differentiate them from map documents (.mxd).

You can modify existing maps or templates and save them as new templates, or you can create new maps from scratch and save them as templates. When you use a template, ArcMap reproduces the template in a new map document and keeps the original template document intact.

Creating and Saving a User Template

When you created your layout, you started with the "Normal.mxt" as your base template. You then added and arranged map elements. If you wish to save your layout as a template, you can do so.

Click the **File** menu and click **Save As**.

Navigate to **c:\exer5\templates** where you can store all of the .mxt files you create for the project.

Click the "Save as type" dropdown arrow and click **ArcMap Template** to save this as an .mxt file. Type a filename **exer5.mxt**.

Click Save.

Save and **Close** the ArcMap document.

When we first started ArcMap at the beginning of the training, we started with a blank template. Afterwards, we reopened our saved map document in ArcMap. To start an ArcMap project with a template:

Start ArcMap from the desktop.

Click the **File** menu and click **New**.

Click the **My Template** tab and navigate to **c:\exer5\templates** and click the **exer5.mxt** template you saved, then click **OK**.

You can remove existing data layers and add new data layers that will be used with the template you saved.

Use the **Save** button to save the map document and then use the **File ⇒ Exit** menu to close ArcMap.