

GEOL 308L Natural Disasters

Lab 03: Hurricane Katrina

Additional Background

ArcGIS is a set of tools for collecting, storing, managing, analyzing, and representing geographic information. It is distributed at three levels.

Within ArcGIS there are three components:

1. **ArcMap** lets you make maps from multiple layers of geographic data. The ArcMap interface presents a Table of Contents (TOC) with currently available data layers as well as the current map and symbology. Users can alternate between a publication view of the map (called Layout View), to which legends and other map elements can be added, and a working view in which you can manipulate your data (called Data View).
2. **ArcCatalog** supports your connection to and browsing of spatial data. Through the tools associated with ArcCatalog you can access data on your computer and other systems to which your computer is connected and add it to your map. When using ArcGIS it is important to remember that a connection must be made to the location of your data (even your computer's main storage system) before you can add data from that location to your map; this is done using ArcCatalog. ArcCatalog is also the subsystem that provides access to metadata and allows you to update and edit information associated with the spatial data you are using.
3. **ArcToolbox** contains an extensive menu of tools for manipulating your spatial data, at the ArcInfo level you will access to advanced spatial analytic tools as well.

These components are interdependent. From ArcMap, the subsystem in which you are likely to be spending most of your time, you can start both ArcCatalog and ArcToolbox. Doing this automatically makes some tools from each component available in your menu. However, it is often useful to call up the entire component independently in order to reach more extensive tools.

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The data for this lab are on the network and the course website. Copy the zip file to your D drive (called "GEOL_308L_lab_04.zip"). Place it into a directory called "original_data" within a directory called "lab_04." Right click on the zip file and select "unzip here." This will place all the data from the zip file into your directory. There are a number of shapefiles and an MXD file. Remember, the MXD file is the ArcMap file.

Open the MXD file (double click on it, or open ArcMap and open the MXD file from ArcMap). The MXD file includes some shapefiles already added to the Table of Contents. Remember, one may add data by clicking on the "add data" icon (the yellow and black plus sign button).

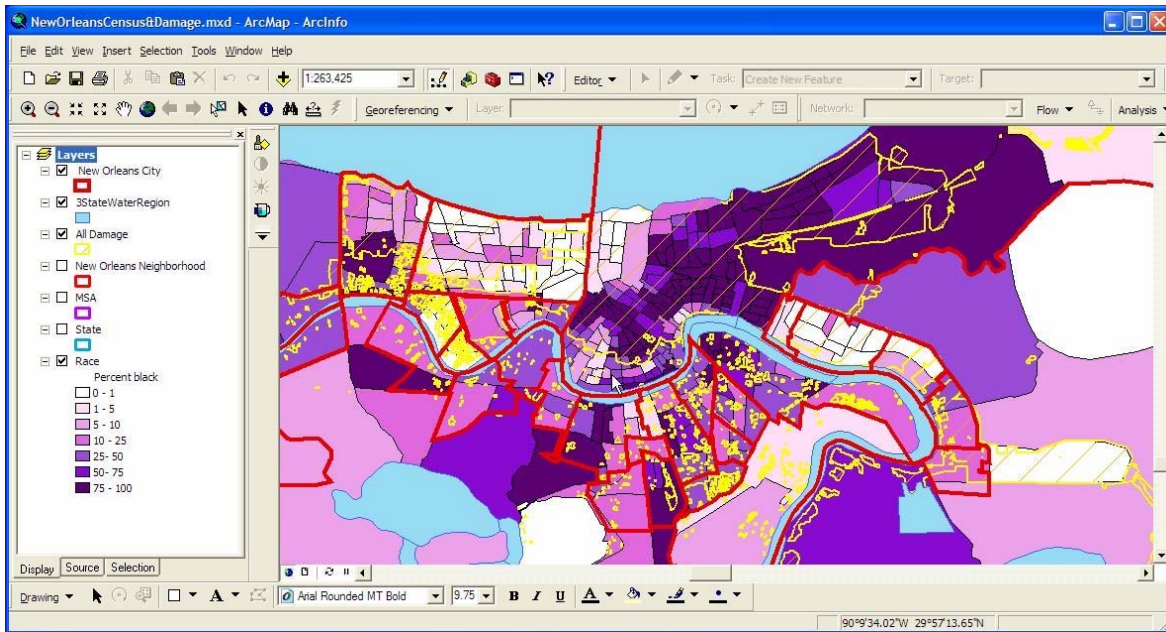


Each layer has been symbolized already. However, ArcMap may not know where the data are located. There is a simple solution. Click on the checkbox next to "3StateWaterRegion" (you might need to check it twice). A dialog menu will open so that one may locate the shapefile associated with this layer. Navigate to the directory and the 3StateWaterRegion.shp shape file. Select this file and click OK. Once this file has been located by ArcMap, the other data will be located automatically. This is a useful part of ArcMap. As long as one keeps data organized well, ArcMap can easily find it.

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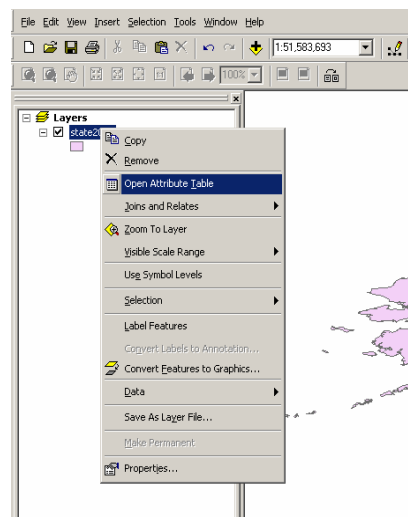
Here is something like what your ArcMap window should look like.



As in almost all Windows programs the right mouse click is a useful tool in ArcGIS.

One may right-click on either the word "Layer" or the individual layers in the menu (such as "Race"). Right click on Race for now and select Open Attribute Table.

In the window that appears you will find the variables that represent mappable information. This table is much like a data table in non-spatial data programs (excel, SPSS, Access, Dbase, etc.). Each row is a record, each column is a field. One feature that is not currently supported is the selection and copying of a column or record and pasting it into another program. But you can export the attribute data, and we will do this later after we've added a new variable.

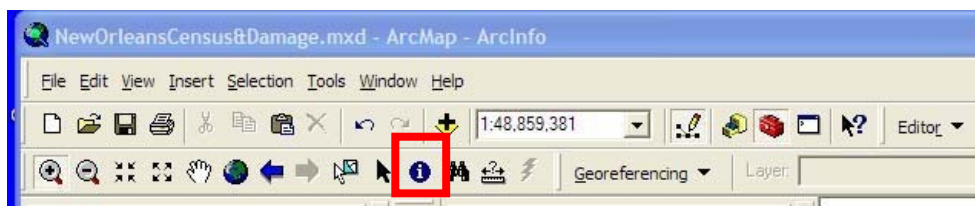


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Leave this window open or minimize it, we'll return to it shortly.

FID	Shape	ID	FIPS	TO_POP	TO_NHW_F	TO_NHB_F	TO_HSP_F	TO_ASN_F	TO_MIN
0	Polygon	1	28003960100	6170	5030	77	22	17	
1	Polygon	2	28003960200	6493	5399	108	47	20	
2	Polygon	3	28003960300	2606	3227	237	37	36	
3	Polygon	4	28136860100	4657	4036	487	32	4	
4	Polygon	5	28003960400	4751	4642	10	66	2	
5	Polygon	6	28033070100	5188	4018	737	324	66	
6	Polygon	7	28141960100	3157	3109	5	24	0	
7	Polygon	8	28093960200	7876	4947	2707	154	28	
8	Polygon	9	28033070630	2359	1768	461	43	31	
9	Polygon	10	28093960100	6803	3480	2276	63	12	
10	Polygon	11	28033070210	2821	2476	149	124	28	
11	Polygon	12	28009960100	6737	2838	2659	72	7	
12	Polygon	13	28033070420	5326	6026	90	143	26	
13	Polygon	14	28033070410	5811	4512	743	235	67	
14	Polygon	15	28033070610	8036	7322	382	193	91	
15	Polygon	16	28033070620	4088	3748	265	22	46	
16	Polygon	17	28033070710	3903	3212	634	36	13	
17	Polygon	18	28033070810	5946	5184	616	93	51	
18	Polygon	19	28033070321	11413	9082	1536	514	108	
19	Polygon	20	28033070310	2737	2423	188	66	33	
20	Polygon	21	28033070610	1585	1541	47	13	5	
21	Polygon	22	28033070330	2684	1768	148	66	11	

Another valuable tool for exploring the data on the map is the Identify Tool.



The identify tool quickly lets you view a geographic feature's data. Click on the Identify tool. In the window that appears you need to select the layer of data for which you want results, choose Race for this example.

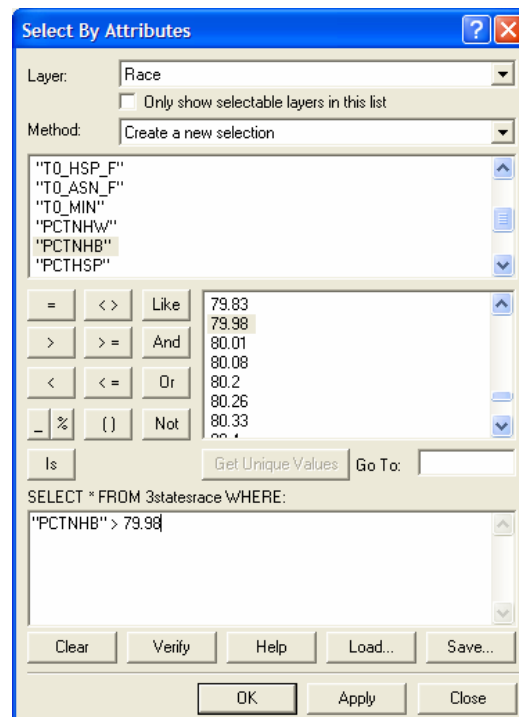
Now one can use the mouse to click on a census tract (the areas shown on the map) and view the raw data for individual tracts.

Click on Selection in the main menu and choose **Select by Attributes**.

In this window one can select the layer upon which you want to base your selection (Race), the variable of interest from that layer (in this case % Black has been selected) and the basis for the selection (those tracts that are more than 80% black).

After clicking OK the tracts meeting the selection criteria are highlighted on the map and in the attribute table.

These are simple but useful techniques for viewing and exploring spatial data in ArcGIS. Once a map is created, you can examine it interactively, looking at individual areas in detail, one at a time. Often one may discover which areas they want to inspect from clues on the map, such as tracts that appear very high or low on the mapped attribute, or tracts that are near a known geographic feature.



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Classifying Data

Now we're going to zoom out from New Orleans to the nation. We will learn some important mapping fundamentals and see how to classify data for mapping.

Use the Add data tool to add the 109th Congress layer (the 2004 House of Representatives districts) to ArcMap; one can click OK to any windows that come up regarding spatial extent, projection, or coordinate systems. These are potentially important, but this .shp file is already in the same coordinate system as the map base layer.

Right-click on 109congress and click on Zoom to Layer. This will take us from a map focused on New Orleans to a map of the US.

As we saw before, one can right-click on either the word "Layers" or use the "View/Data Frame Properties" menu. **Right click on Layer for now and select properties** (at the very bottom).

In the window that appears select the coordinate system tab.

The map we are viewing in ArcGIS right now is unprojected. That means the latitude and longitude coordinates from the Earth are being displayed in flat (Cartesian) X/Y space. This results in a map that doesn't look much like what the mapped space really looks like (on the Earth's surface). We're going to "project" the data so it looks a bit more realistic.

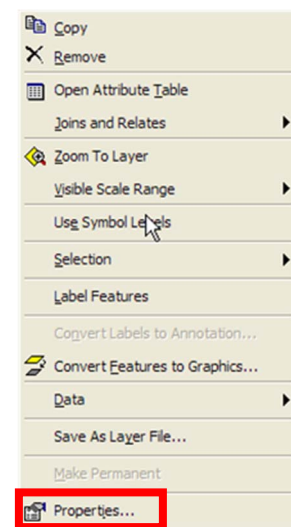
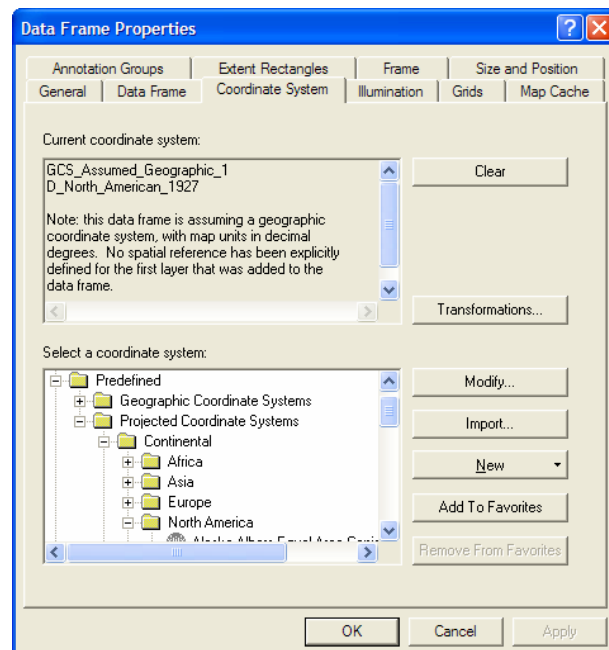
In the bottom half of the window one can select new coordinate systems, we're going to **select the Predefined>>>Projected>>>Continental>>North American projection.** Select "**North American Lambert Conformal Conic.**"

One can use the zoom-in tool to make the map a little bit bigger on the screen.

Right click on the box showing the color of the layer in the TOC and we can quickly change the color of the layer. **Right click on the layer name** ("109congress" in this case) and we are given access to several powerful tools:

- **"Open Attribute Table"** allows one to see the data associated with the layer. Once open one can edit the table, add data, and perform other data related tasks.
- **"Joins and Relates"** allows one to link external data to the map data.

Databases in text format, dbf, access, and some other formats can be "joined" to this data's attribute table. Once joined the data will appear as columns in the attribute table; it is important



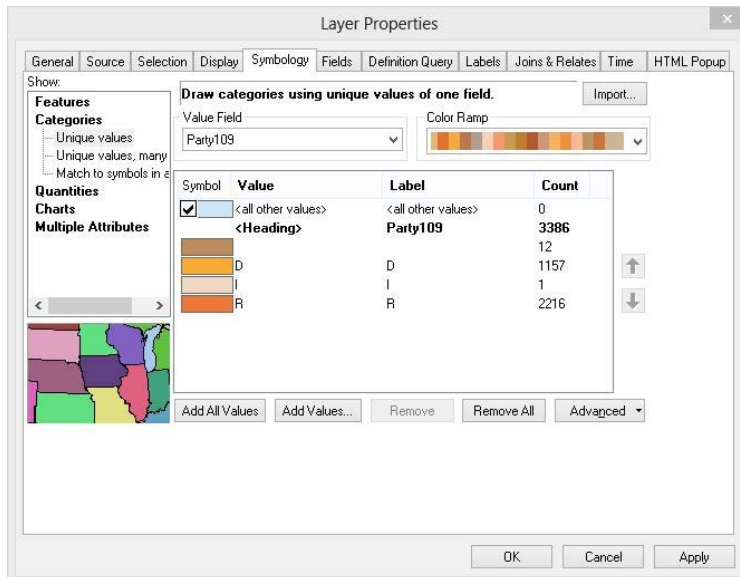
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to remember that in order to be joined both the attribute table of your map data and the external data one wants to join must have a field in common.

- The “**Properties**” option contains many pieces of information about the layer and offers several useful tools to the mapmaker. An example from the countries outline data is shown below.

Notice all the tabs across the top of this window; each contains important information and options related to the layer. **Select the “Symbology” tab.** It can be used to map data from the attribute table. The data we are using has a Party109 variable with which one can create a map of the 2004 Congressional Districts. One can map any variable for which they have data for each district (one could add the variable directly into the attribute table and then enter values or one could join an external data file).



To map a variable (Party109) you need to select the correct type of data. In this case we will map political party. **Choose Categories>>Unique values.** Then one must **select the right variable (party109).**

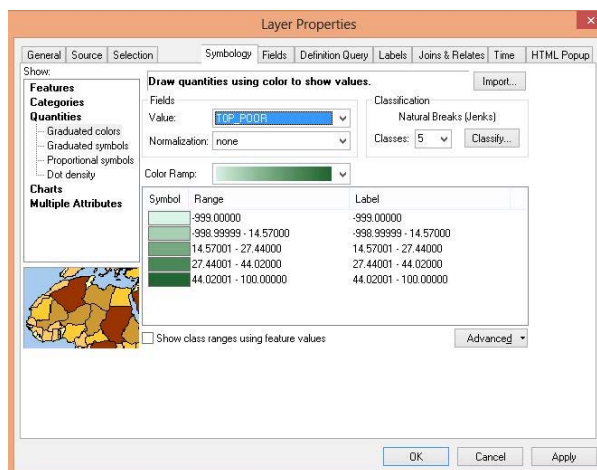
Click on Add All Values. You can double click the colored box next to each variable level to change the color (D for democrat, R for Republican, I for Independent).

Classifying and Mapping Other Types of Data

We will now return to New Orleans to create new maps. One can remove the US congressional data (right-click the layer name and choose Remove or just un-check it).

Add the laraceandpoverty.shp layer from the data we unzipped when we started. **Right-click the layer name and choose Zoom to Layer.** These data represent race and poverty variables for census tracts in New Orleans; one can see the raw data in the attribute table. At the end of this document (in the appendix) one will find a list of the variables.

Use this layer to explore the symbology tab in more detail. For instance, in the symbology tab one can choose to map quantities (such as the percent poor in each tract) with graduated colors. There are many map characteristics that can be manipulated here; these are generally found in the Classification area of this window (notice the default is a 5 class natural breaks classification). Click on Classify... to enter this area.



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One can also edit several features of your final map in this window. Selecting the values under Label allows one to set (edit) the range of values that will be displayed in the legend of your map. For instance, one might change -999.00000 to “missing values” or round off “19.23001 – 36.88000” to “20 – 40.” One can also use the selection tool to select census tracts that meet multiple criteria (over 80% black and more than 30% Poor, for instance, or over 80% black and less than 10% poor).

Calculating Distances

Many analyses require the calculation of distances. In this example we will calculate the distance from each census tract (the center of the tract) to the nearest school (we provide a point file for schools based on their addresses). Because ArcGIS can only measure distances from points to other points (or lines) the first step is to create center points for each census tract. The Feature to Point tool is located in the ArcToolBox under Data Management Tools and Features. The layer named “Race” is the census shapefile. Create a point shapefile using this tool. Navigate and name this shapefile something cool like “census_points.shp.”

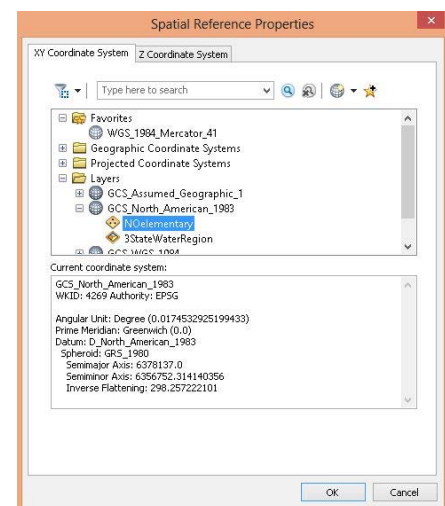
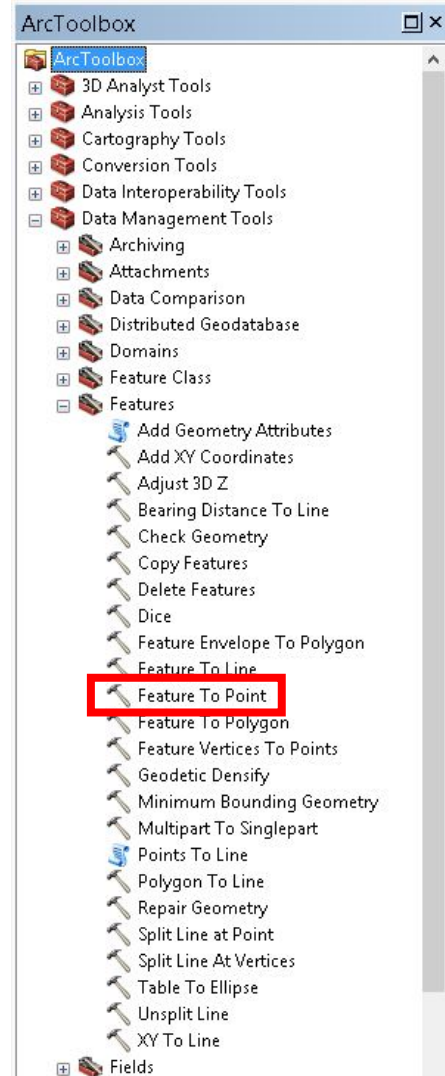
We need to project the census data to match the coordinate system used for NOelementary. Use the “Data Management>>Projections and Rasters>>Project” tool. Navigate and create a cool name for your new shapefile, something like “census_points_GCS>shp.” For the Spatial Reference Properties, single left-click the “Layers” option, then single left-click the GCS_North_American_1983 option, and finally highlight NOelementary. Click OK.

We can use the Near tool once the point file is created. It is located in the ArcToolBox under Analysis Tools and Proximity.

Once you’ve selected the Near tool you will specify the layer for which you want to identify the nearest schools, in this case the census tract point file, and the layer from which the nearest school will be selected and measured (NOelementary).

The result is the addition of two new fields to the census centroid attribute table. These data fields indicate which feature (elementary school) was nearest to each census tract and the distance to that feature.

Make a map that displays the distance to the nearest elementary school. Export this map and email it to the instructor.



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Appendix: Income and Poverty Variables

FID	
Shape ID FIPS	
TO_POP	Total Population
TO_NHW_F	Total number of non-Hispanic white persons
TO_NHB_F	Total number of non-Hispanic black persons
TO_HSP_F	Total number of Hispanic persons
TOASN_F	Total number of Asian persons
TO_MIN	Total number of minority persons
PCTNHW	Percent non-Hispanic white persons
PCTNHB	Percent non-Hispanic black persons
PCTHSP	Total number of Hispanic persons
PCTASN	Percent Asian persons
PCTMIN	Percent minority persons STATEFIPS
SHAPE_AREA	
SHAPE_LEN FID_1	
ID_1 FIPS_1	
TO_PV1	Total number of persons below poverty aged 0-17
TO_PT1	Number of persons for whom poverty was determined
MO_PV1	Total number of minority persons below poverty aged 0-17
MO_PT1	Total number of minority persons aged 0-17 for whom poverty was determined
TOP_POOR	Percent total population below poverty
MOP_POOR	Percent minority population below poverty
TO_PV2	Total number of persons below poverty aged 18-64
TO_PV3	Total number of persons below poverty aged 65-74
TO_PV4	Total number of persons below poverty aged 75 and older
MO_PV2	Total number of minority persons below poverty aged 18-64
MO_PV3	Total number of minority persons below poverty aged 65-74
MO_PV4	Total number of minority persons below poverty aged 75+
TO_PT2	Total number of persons aged 18-64 for whom poverty
TO_PT3	Total number of persons aged 56-74 for whom poverty
TO_PT4	Total number of persons aged 75 and older for whom
MO_PT2	Total number of minority persons aged 18-64 for whom
Mo_PT3	Total number of minority persons aged 65-74 for whom
MO_PT4	Total number of minority persons age 75 and older
TOP_PV17	Percent of total population aged 0-17 below poverty
TOP_PV65	Percent of total population aged 65 and older below poverty
MOPPV17	Percent minority aged 0-17 below poverty
MOPpv65	Percent minority aged 65 and older below poverty STATEFIP_1
SHAPE_AR_1	
SHAPE_LE_1	
FIPS2	