Getting Started with ArcGIS

Background and Introduction

BACKGROUND ON ArcGIS SOFTWARE

ArcGIS is a set of tools for collecting, storing, managing, analyzing, and representing geographic information. It is distributed at three levels. **ArcInfo** is the most complete package, and it is available on campus and (for faculty) from home using VPN. Students cannot access ArcGIS from home, but through S4 they can receive a 1 year single user license of ArcGIS at the **ArcView** level.

Separate extensions of this software are available for **spatial analysis**, **3D analysis**, and **Geostatistics**.

Within ArcGIS there are three components**:**

> **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*).
>
> **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.
>
> **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.

INTRODUCTION TO ARCGIS: Adding Data

Begin by downloading some data from the S4 website and creating a connection to a location on your computer. Navigate to http://www.s4.brown.edu/S4/about.htm, select "Spatial Courses and Training" from the menu bar on the left. **A new page will**

appear. Across the top are several options, select S4tutorials. At the bottom of this page is a link to download a FacultyGIS zipped data file. Unzip the data. The files include a **map file (.mxd)** and several **shapefiles** (a data format that was created by the same company that makes ArcGIS and also a standard format for other spatial analysis software) which is composed of files with extensions like **.shp, .sbx. .dbf**, etc.

Map files are compilations of different types of data files that can be read by ArcGIS. A map file holds information about all the files and how they should be displayed. Note that even after a map file has been created it still needs all the individual data files in order to display the map.

Shapefiles are also in a special format, and they include several related subfiles. **The .shp file is the main record, the .sbx file is an index that contains additional information about each record in the main file, and the .dbf file is a database of non-geometric attributes of the file.**

The shapefiles that you downloaded include data at different scales for the United States, Louisiana, and New Orleans. We're going to start with a map file that shows the New Orleans area. It includes data files meant to display some of the impacts of Hurricane Katrina on the people of New Orleans. Later on we'll add some data for the US, then return to New Orleans for some additional exercises.

Work with Geographic Data in ArcGIS

Start ArcCatalog from the Start Menu at the lower left corner of your computer screen desktop; you'll have to navigate to All Programs, Instructional, and then ArcGIS, and then select ArcCatalog.

Start → All Programs → Instructional →ArcGIS → ArcCatalog.

Within ArcCatalog you can select "File" on the menu bar and see "connect folder" as an option. You'll also recognize the icon just below the menu on the toolbar. In either case you will see the same button  **.** Selecting "connect folder" will bring up a window that will show the various locations available to you. You can select any of these as "connection folders," and it is convenient to select a location as high up the hierarchy as possible (like the C: drive) rather than a specific subfolder within a drive. This way you can navigate within ArcGIS to any folder below that "connected" location and find data, rather than having to reconnect to a new location later. You should connect to the drive on which you stored and unzipped the data from the S4 drive. This drive should now appear in the left hand side of the ArcCatalog window.

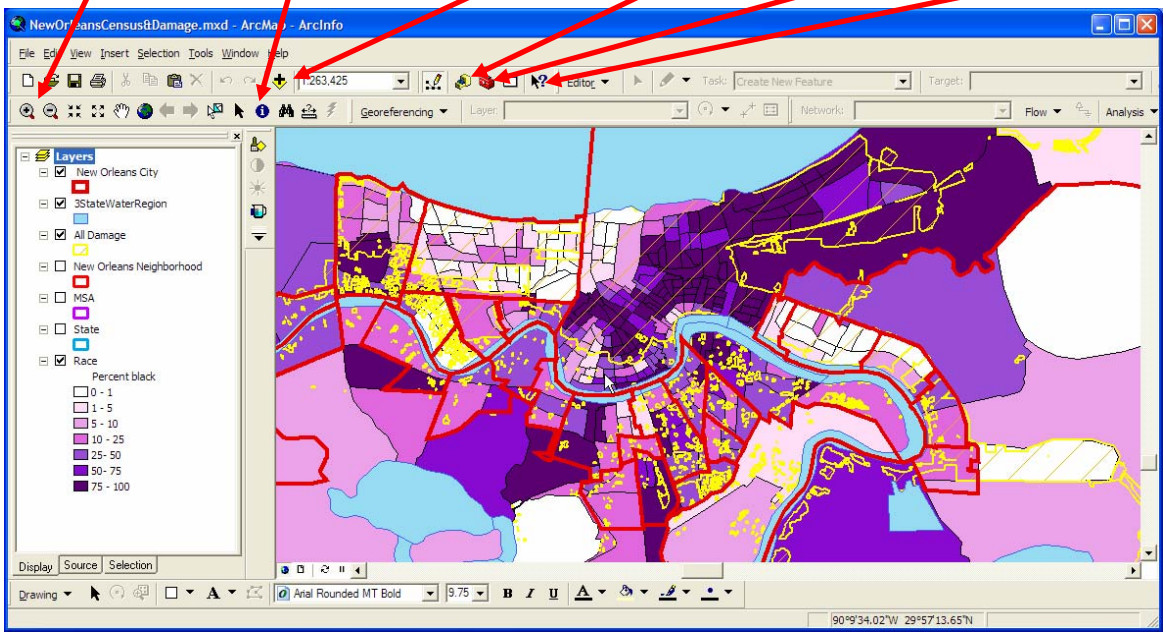
There are a variety of ways to open spatial data in ArcGIS:

- You can open a Map file that has already been created (which is what we'll do first).
- Or, you can add individual shapefiles to ArcMap. You can do this in one of two ways:
    - You can open ArcMap (either from the Windows start menu or from the toolbar in ArcCatalog (the small Earth with magnifying glass icon) and add data using the **add data icon** (see below).
    - if both ArcCatalog and ArcMap programs are open you can drag the data file from ArcCatalog to the display window of ArcMap.

Double click on the NewOrleansCensus&Damage.mxd map file. This will start up ArcMap and display an initial view of the data. Remember, this is a file on which considerable work has already been done; we are just using it here as an example.

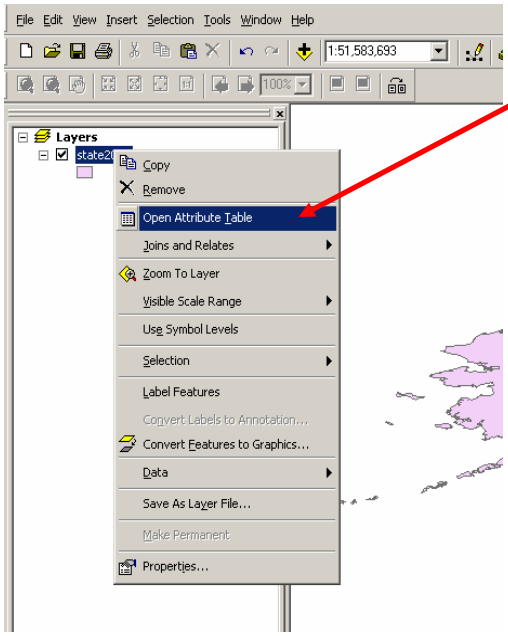
In the image below you see a file called "NewOrleansCensus&Damage" layer added as well as some of the tools and elements already mentioned.

"zoom in/out" Identify "add data" ArcCatalog ArcToolbox Help

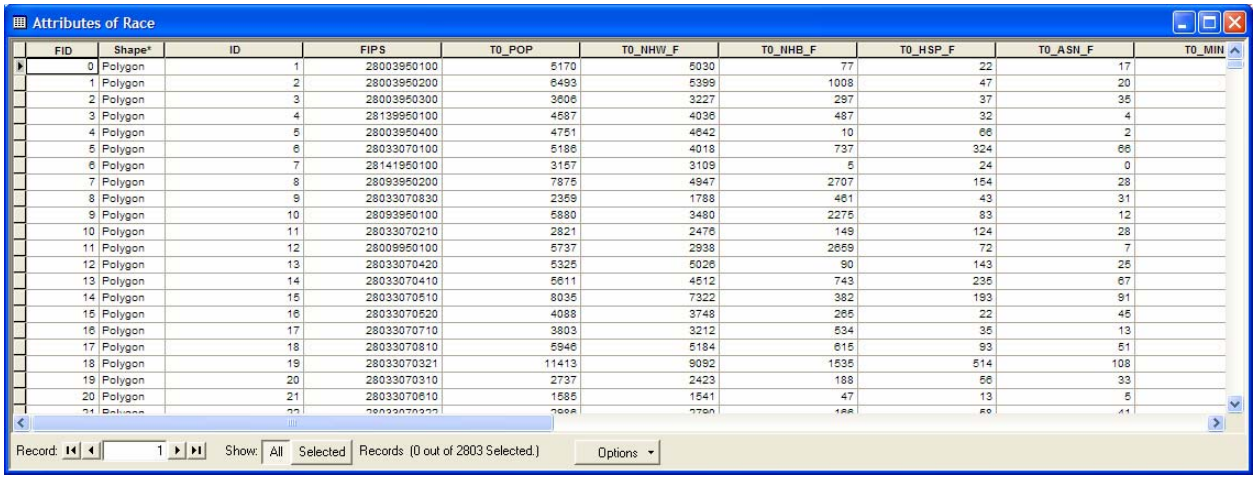


As in almost all Windows programs the right mouse click is a useful tool in ArcGIS.

You can **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** (the 3rd item from the top).



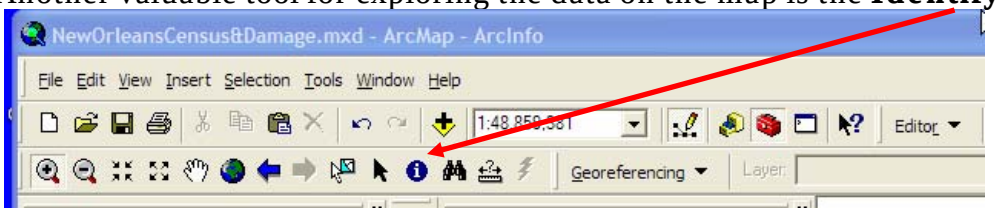
In the window that appears you will find the variables that represent mappable information. This table is much like a data table in non-spatial data programs (excel, SPSS, Access, Dbase, etc.). Each row is a case, each column is a variable. One feature that is not currently supported is the selection 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 and



FID	Shape*	ID	FIPS	T0_POP	T0_NHW_F	T0_NHB_F	T0_HSP_F	T0_ASN_F	T0_MIN
0	Polygon	1	28003950100	5170	5030	77	22	17	
1	Polygon	2	28003950200	6493	5399	1008	47	20	
2	Polygon	3	28003950300	3606	3227	297	37	35	
3	Polygon	4	28139950100	4587	4036	487	32	4	
4	Polygon	5	28003950400	4751	4642	10	66	2	
5	Polygon	6	28033070100	5186	4018	737	324	66	
6	Polygon	7	28141950100	3157	3109	5	24	0	
7	Polygon	8	28093950200	7875	4947	2707	154	28	
8	Polygon	9	28033070830	2359	1788	461	43	31	
9	Polygon	10	28093950100	5880	3480	2275	83	12	
10	Polygon	11	28033070210	2821	2476	149	124	28	
11	Polygon	12	28009950100	5737	2938	2659	72	7	
12	Polygon	13	28033070420	5325	5026	90	143	25	
13	Polygon	14	28033070410	5611	4512	743	235	67	
14	Polygon	15	28033070510	8035	7322	382	193	91	
15	Polygon	16	28033070520	4088	3748	265	22	45	
16	Polygon	17	28033070710	3803	3212	534	35	13	
17	Polygon	18	28033070810	5946	5184	615	93	51	
18	Polygon	19	28033070321	11413	9092	1535	514	108	
19	Polygon	20	28033070310	2737	2423	188	56	33	
20	Polygon	21	28033070610	1585	1541	47	13	5	

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

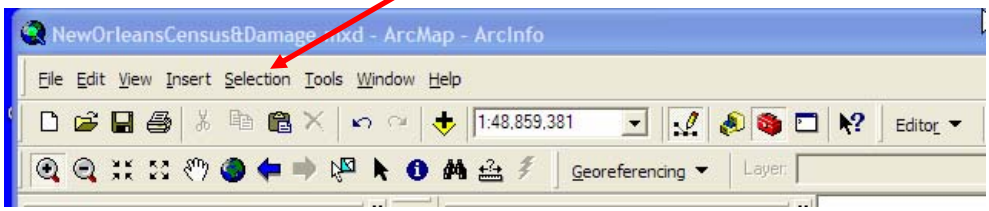
Another valuable tool for exploring the data on the map is the **Identify Tool.**



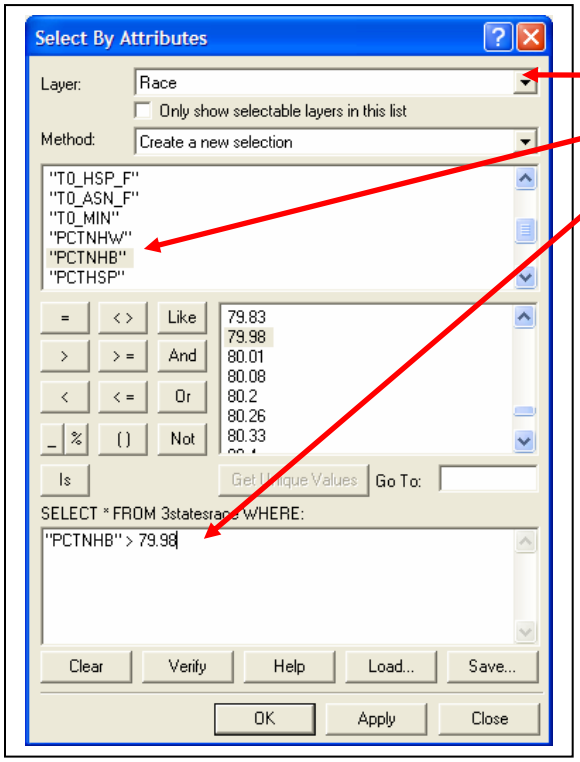
The identify tool quickly lets you view a geographic feature's data. **Click on the Identify tool.** In the window that appears you need to select the layer of date for which you want results, choose Race for this example.

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

Another useful tool is the **Selection tool,** with which you can interactively select records with specific characteristics.



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



In this window you 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).

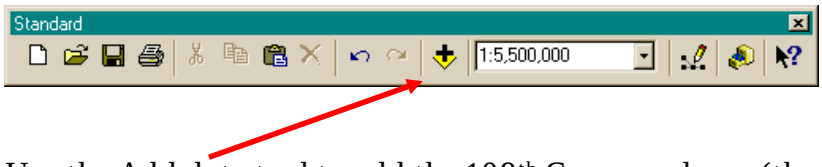
After clicking OK the tracts meeting the selection criteria are highlighted on the map and in the attribute table.

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 you discover which areas you 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.

In this example we have already calculated percentages. ArcGIS has a tool that allows you to create your own new variables based on values of others in the attribute table; we'll demonstrate this in the presentation.

Changing the Shape of the Map (map projections) & Classifying Data

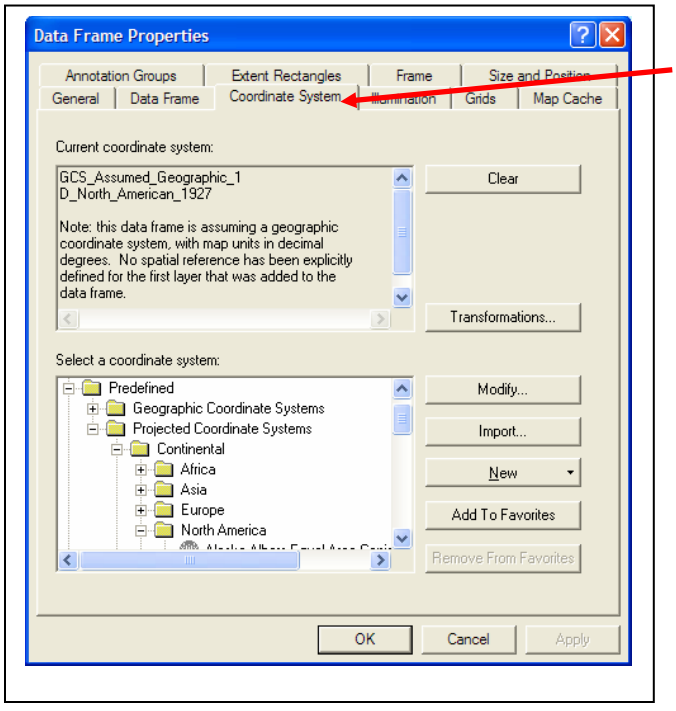
Now we're going to zoom out from New Orleans to the nation. We will learn some important mapping fundamentals and see how to classify data for mapping.



Use the Add data tool to add the 109th Congress layer (the 2004 House of Representatives districts) to ArcMap; you can click OK to any windows that come up regarding spatial extent, projection, or coordinate systems.

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 you saw before, you can **right-click on either the word "Layer"** or the individual layers in the menu (such as "109congress." Right click on **Layer** for now and select **properties** (at the very bottom).



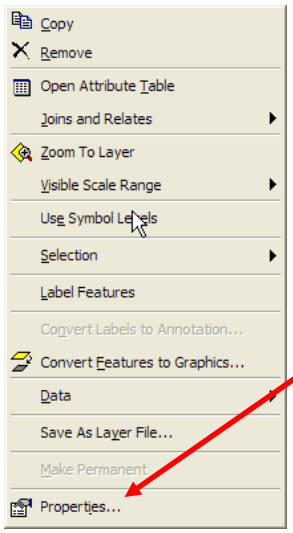
In the window that appears select the **coordinate system** tab.

The map you 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 you can select new coordinate systems, we're going to select a **Predefined→Projected→Continental→ North American** projection. Select "North American Lambert Conformal Conic."

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



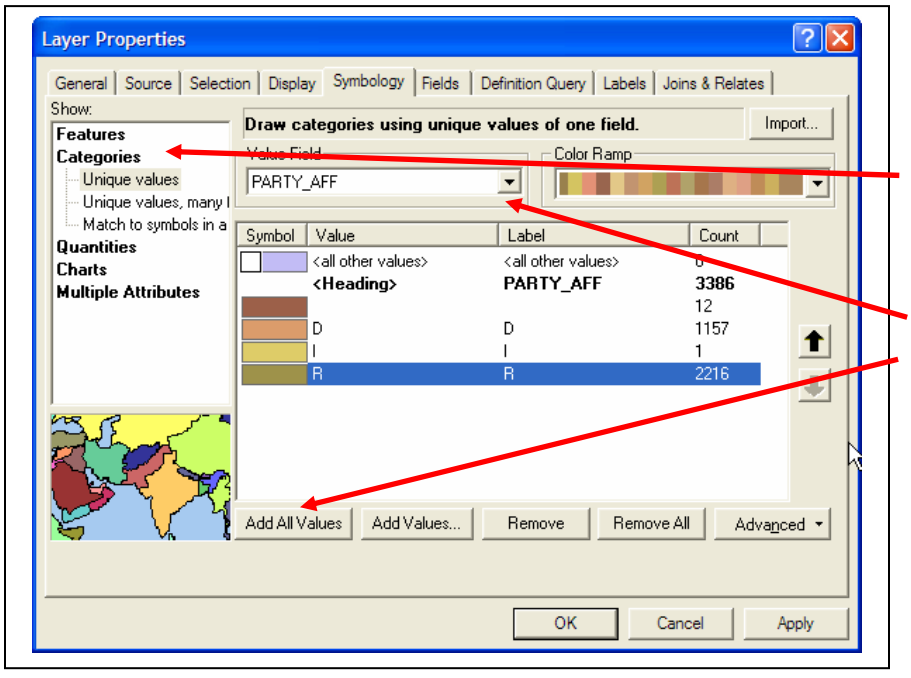
"Open Attribute Table" allows you to see the data associated with the layer. Once open you can edit the table, add data, and perform other data related tasks.

"Joins and Relates" allows you to link external data to your 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 to remember that in order to be joined both the attribute table of your map data and the external data you want to join must have a variable (column, attribute) in common (just like the "merge" function in SPSS).

The final option in the pull down window is the "Properties" tool.

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 you are using has a **Party109** variable with which you can create a map of the 2004 Congressional Districts. You can map any variable for which you have data for each district (you could add the variable directly into the attribute table and then enter values or you could join an external data file).



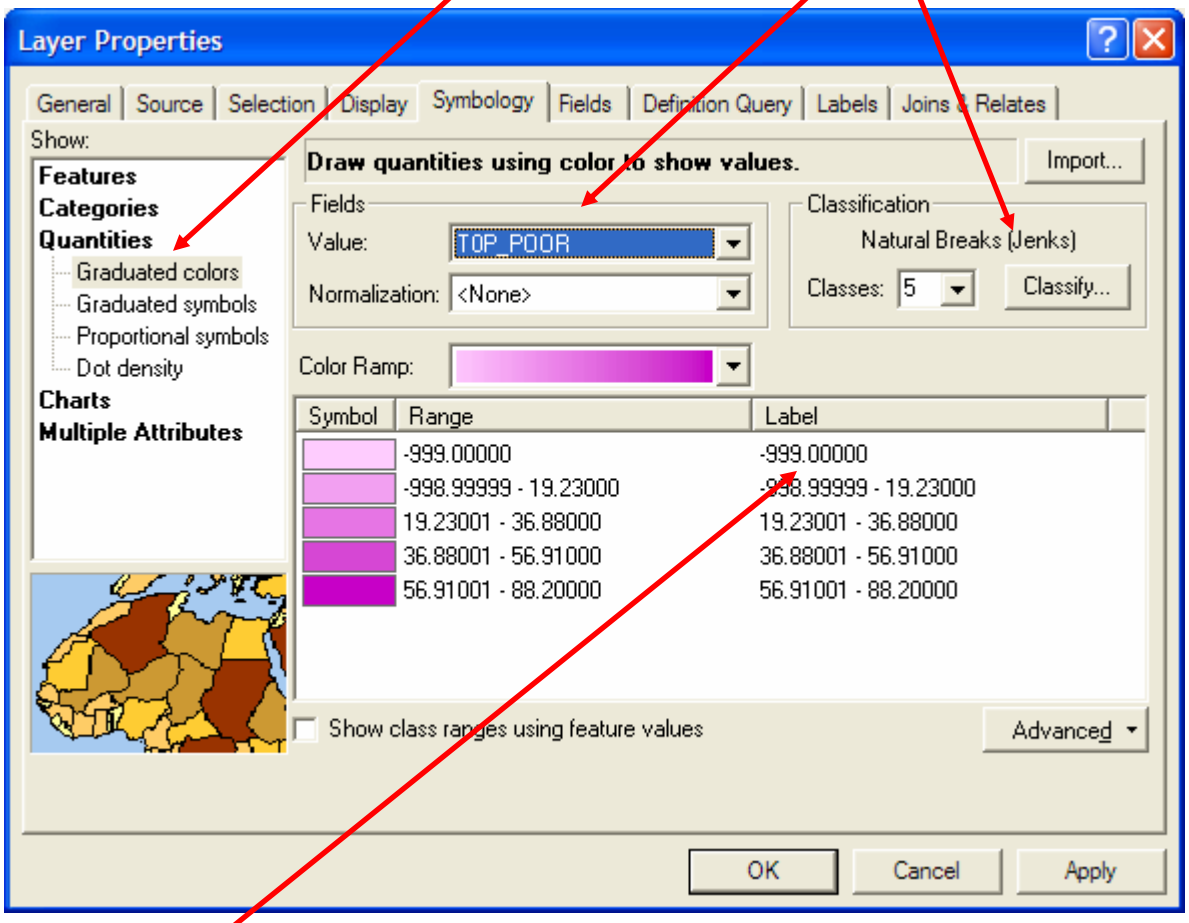
To map a variable (Party109) you need to select the correct type of data. In this case we will map political party. Choose **Categories→Unique values.** Then you must select the right variable (party109). **Click on Add All Values.** You can double click the colored box next to each variable level to 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. You can remove the US congressional data (right-click the layer name and choose **Remove** or just un-check it).

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

Use this layer to explore the symbology tab in more detail. For instance, in the **symbology** tab you can choose to map **quantities** (such as the percent poor in each tract) with graduated colors. There are many map characteristics that can 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.

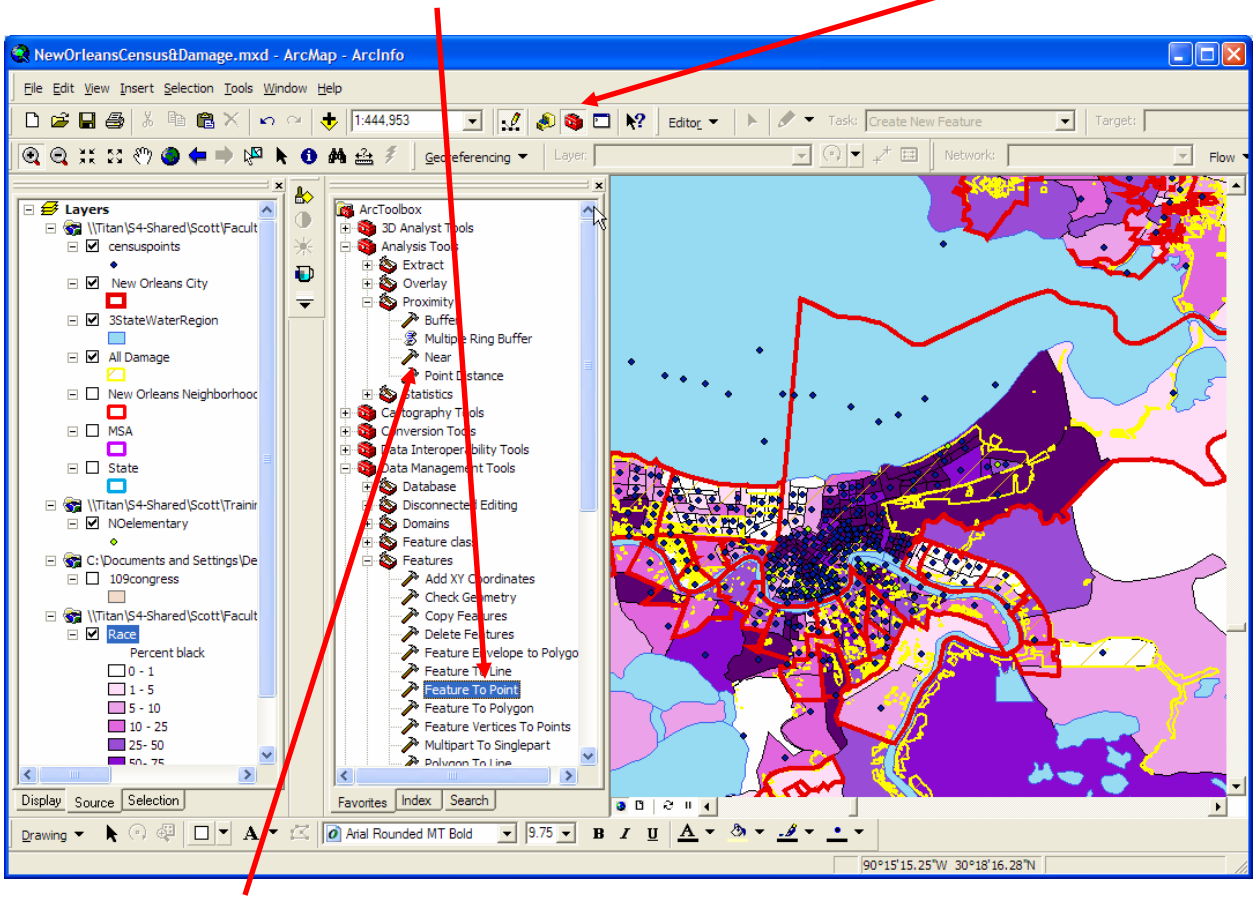


You can also edit several feature of your final map in this window. Selecting the values under **Label** allows you to set (edit) the range of values that will be displayed in the legend of you map. For instance, you might change -999.00000 to "missing values" or round off "19.23001 – 36.88000" to "20 – 40." You 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 you 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.**



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.

Sometimes you may want to use this variable in an analysis in another program. To do this, simply export the file in Dbase format that can be read by most non-GIS data programs. In the attribute table select **Options** at the bottom of the window; click on **Export.**

Appendix: NOracePOVTracts 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	
T0_PV1	Total number of persons below poverty aged 0-17
T0_PT1	Number of persons for whom poverty was determined
M0_PV1	Total number of minority persons below poverty aged 0-17
M0_PT1	Total number of minority persons aged 0-17 for whom poverty was determined
TOP_POOR	Percent total population below poverty
M0P_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	