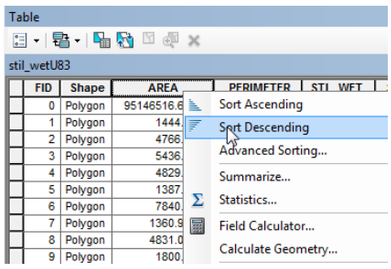
Basic Table Operation

1) Open a new ArcMap project, and **Add** the data layer *Stil_wetU83.shp* to a new, empty Project

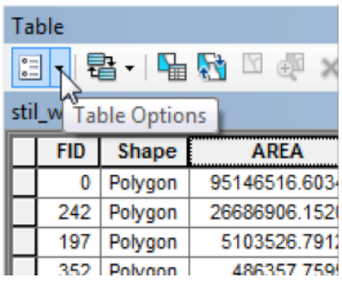
2) Right click on the *Stil_wetU83* layer in the table of contents, and then left click on **Open Attribute Table** in the dropdown menu.



3) Right click over the heading of the "Area" column and select **Sort Descending** (as shown right).

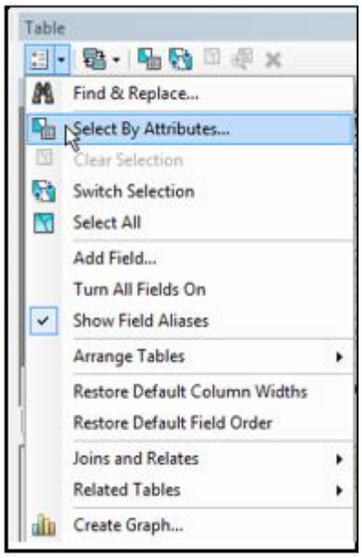
   Notice that the largest areas are coded "U", for uplands, and "Out", area outside the mapping jurisdiction for these data, in this case, in Wisconsin.

4) Left click on the sheet icon for table icons, in the upper left corner, below the word Table.

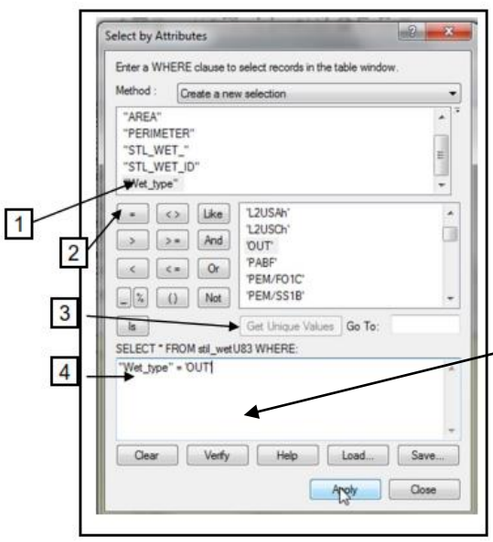


5) Then left click on **Select By Attributes** in the dropdown menu

6) Choose the selection method "Create a new selection"



7) In the Select by Attributes box,
   1. double click on the "Wet_type" field,
   2. single click on the = button,
   3. double click on the "Get unique Values" button,
   4. scroll to and double click on the "Out" value.

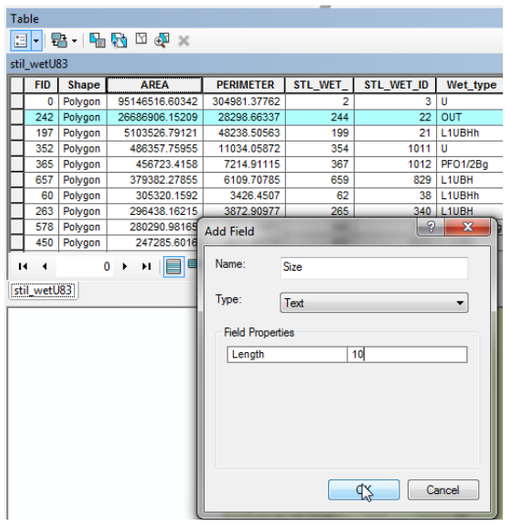


Your selection expression should appear as shown to the left

8) Click **Apply**. This selects all the records in the file that have the "Out" code. The selected records (rows) appear high lit in cyan, and the corresponding polygons are outlined in cyan in the data view.

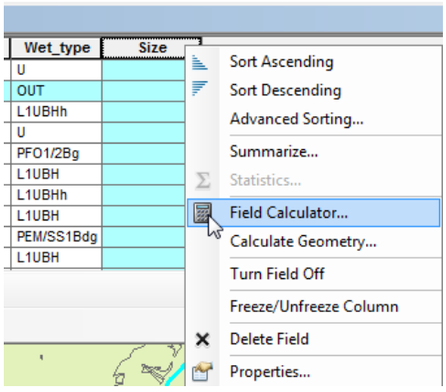
Now we will be classifying the polygons by their size, which is contained in the "Area" attribute.

9) Next click on the Table Options and select "**Add Field**". This will add a new empty field (column) to you file. Name the field "Size", select the Type as "Text" and change the Length to 10 (as shown at right). Left click on **Ok**

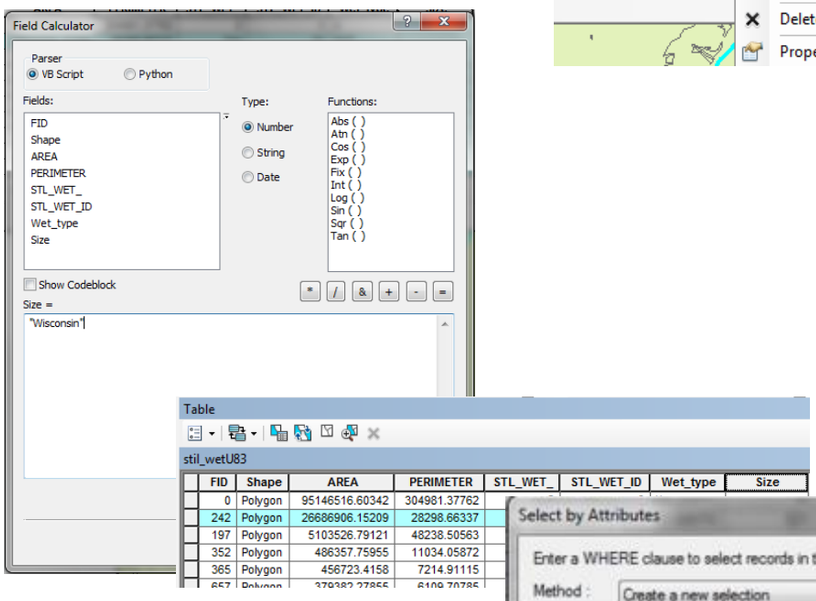


10) Now right click on the column heading of the "Size" field and Select **Field Calculator**. This will allow you to change the selected values in the "Size" column.

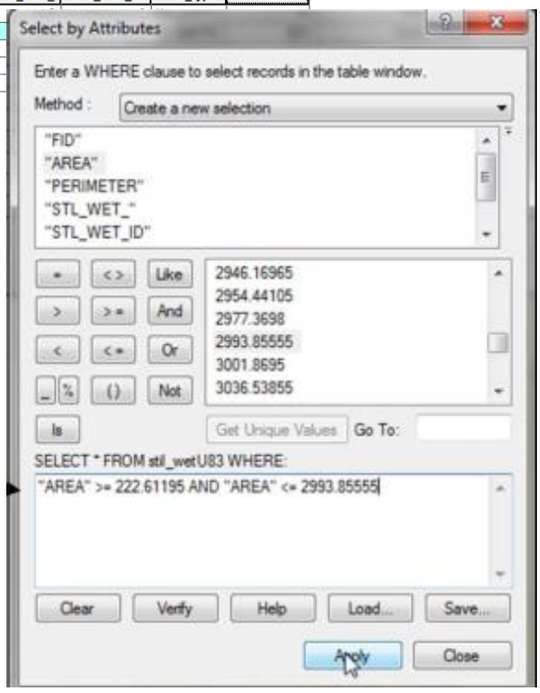
11) In the Field Calculator, there is an entry **window for expressions** in the bottom half, which should have Size= above the entry area. Type "Wisconsin", **with quotes** into the window, left click on **OK**



Your file should appear as right:



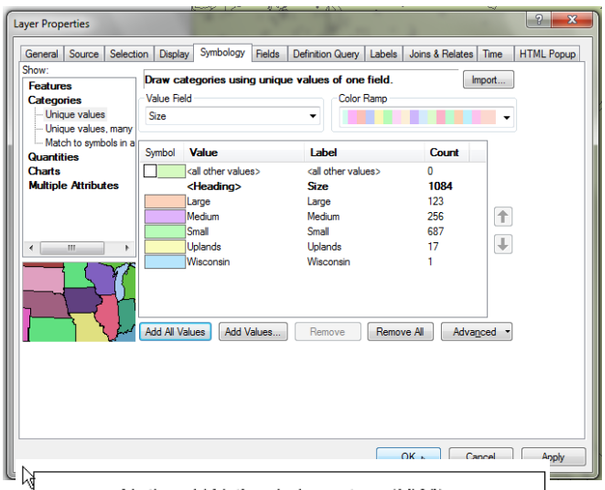
12) Now sort the file by the Area field, by:
- right clicking on the "Area" column heading in the wetlands attribute table, and -left clicking on **Sort Ascending**.
- Left click on the Options button at the upper left of the table, then **Select by Attributes**. Build the query to select the **areas between 222.61195 and 2993.85555, inclusive**, as shown in the bottom panel, at right.
- Left click on **Apply**, **Close**



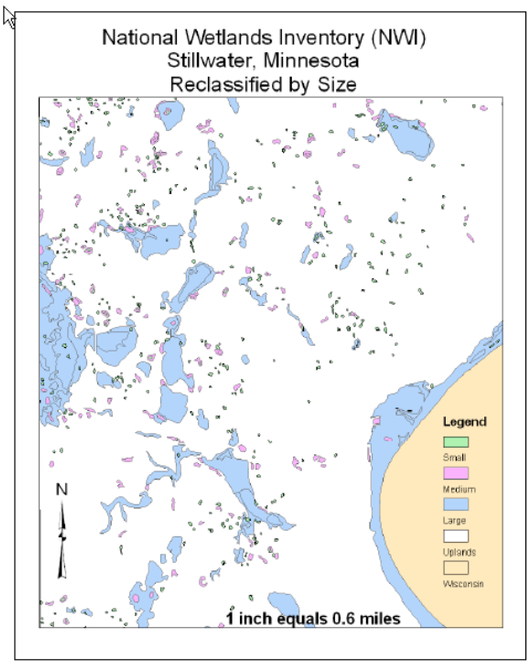
- Again, open the Field Calculator by right clicking on the “Size” column, and assign a “Size” values for the selected records to “Small”.
- Do the same steps as above for the "AREA" >= 3001.8695 AND "AREA" <= 9969.29615, use the Field Calculator to assign a value of “Medium” in the Size field for these records.
- Repeat the process for "AREA" >= 10076.1794 AND "AREA" <= 5103526.79121 OR “AREA” = 95146516.60342. Assign a value of “Large” to the Size field for the selected records.

13) Finally, with the data table still open, select **Options Select by Attributes**, select the Wet_type = “U**”** and use the **Field Calculator** to change that record’s value in the Size field to “Uplands”.

- **Clear Selected Features** (on the main ArcMap menu, under Selection).
- Close the Table.
- Open the **Properties - Symbology** of the *stil_wetU83* layer and left click in the Show box to display: **Categories** → **Unique values**. Change the Value Field to Size. Click on the **Add All Values** button and the then **Apply, OK**



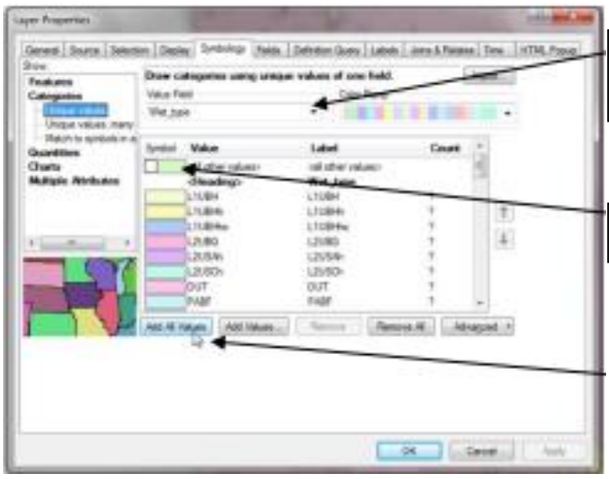
Create a map to display the modified wetlands data layer, similar to that found below, add appropriate title, legend, scale bar and north arrow; export as pdf.



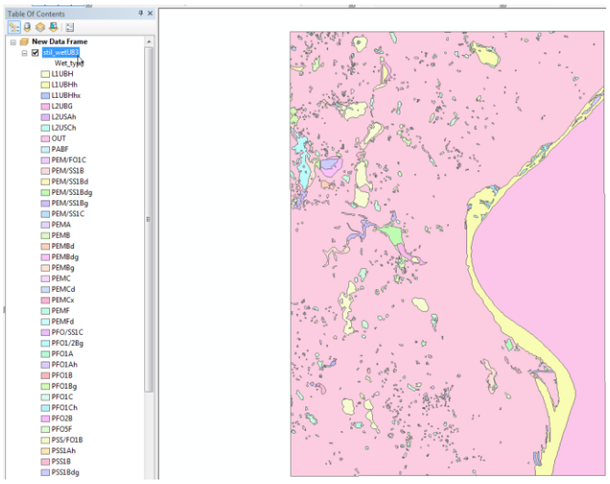
Wetlands Tables

We’ll now assign a new column to identify general wetland types, based on recurrent selections.

- Create an ArcMap project, and add the shapefile *Stil_wetU83*.
- Right click on *Stil_wetU83* in the TOC, and left click on **Open Attribute Table**.
- The field, or item, named “Wet_type” contains the wetland classification used by the US Fish and Wildlife Service. A complete list is found at the end of this lab exercise.
- Close the table.
- Open the **Properties** > **Symbology** tab for the wetlands data.
- Select **Categories – Unique values** for the symbology type in the box on the left labeled “Show”.



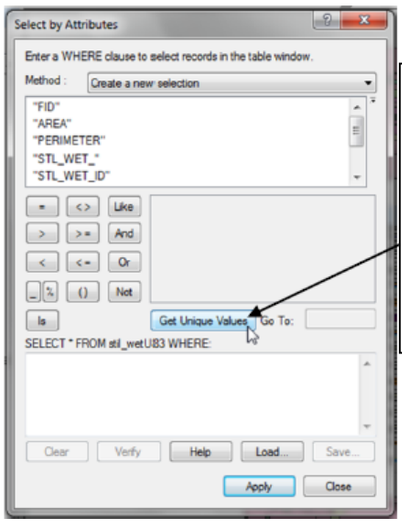
Left click on **Apply and OK.** Your display should appear something like that below:



For simplicity, we will aggregate wetland classes to a few main categories. We will reclassify the detailed classes into five groups, aggregating the detailed wetland types into their "parent" categories.

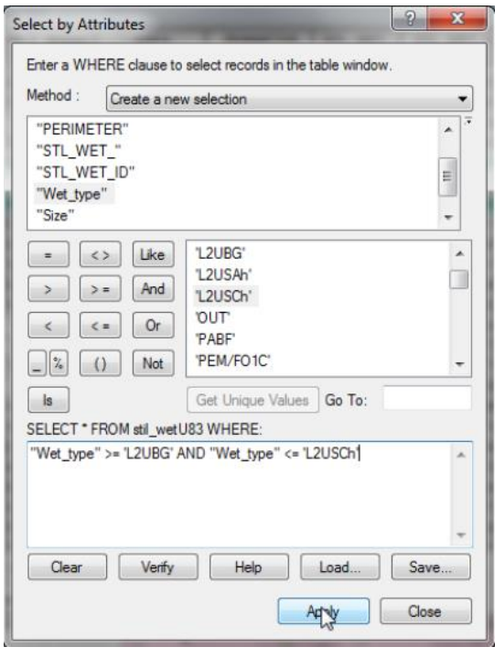
Note that there are several numbers and letters together in a string in the wetland type column, e.g., L1UBHh. These give the wetland System-Subsystem-Class-Subclass and any modifiers. The first letter is for the system (L=Lacustrine, P=Palustrine, etc.), the second is for the subsystem (defined for each system) the third is for Class, etc.

- Open the attribute table and select the Table Options in the upper left of the window, then left click on Add Field
- Add a field with a convenient name e.g. "reclassed", with "Text" type and length 10.
- Select Table Options in the upper left of the table window
- Left click on Select by Attribute
  Now we need to select records to reclassify. You build a series of expression from the variables and operators in the "Select by Attributes window".
- Double-left click the field named Wet_type on the left, then single-left click the <= operator in the middle, and then double-click the "L1UBHhx" value on the right.

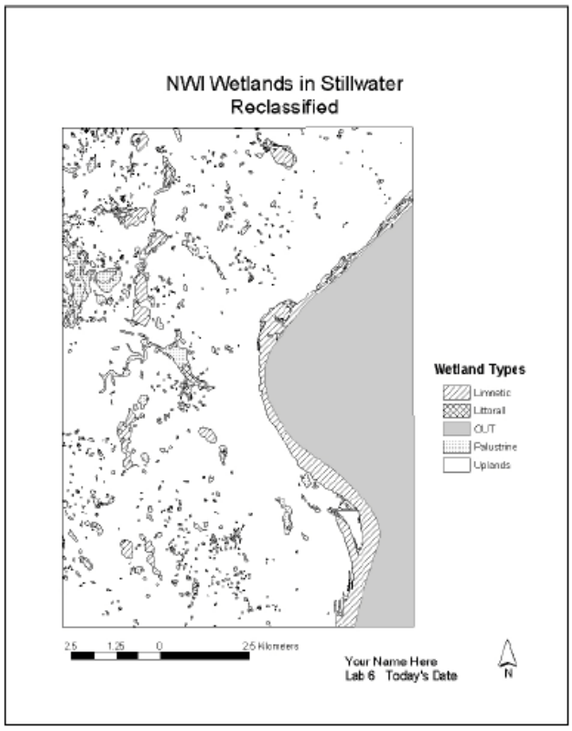


To display the actual values with in a field (such as 'attribute'), left click to highlight the item, then left click on the Get Unique Values button. This will allow you to pick your selection values from a complete list of data values.

(This expression selects all the polygons in the system/subsystem L1. If you don't have a correct expression, a syntax error window may pop up. If so, clear the expression and try again.)



- Right click on the "Reclassed" column, and left click on the Field Calculator in the dropdown menu.
- Enter the code you want to assign to the selected variable and records. Here we will use the 1st two positions of the detailed classification, "L1"
- **Click OK**. If records are selected, the assignment only occurs for these selected records. Verify that "L1" appears for only the selected records.
- Now repeat the process for the next group of items (those with "Wet_type" fields starting with "L2". This is a bit trickier because it is a compound selection, so we'll have to use the AND operation in building our formula.)
- Assign the value "L2" to the Reclassed field, using Field Calculator as described above.
- Repeat this selection/assignment until Reclassed values have been assigned for each record (five categories, L1, L2, P, U, and OUT).
- Prepare a Choropleth map similar to the followings:



Basic Table Operation - 2

This Lab provides more practice with tabular data management in ArcMap. In this Lab, we will view, select, re-order, and update tabular data.

Data: are in the \Tableoperation2 directory, with:

- Census data demographics.shp in decimal degree coordinates, and
- soils.shp in UTM Zone 17, NAD83 coordinates, and the units are meters.

Background:

Most spatial data in a GIS consist of at least two types of data:

- Data depicting the location and shape of objects, and
- Text or numerical data describing the objects.

These text and numerical data are most often contained in tables, and most GIS packages have some way of creating and editing these data tables. ArcMap provides a rich set of tools for viewing and displaying attribute data. However, you don't have as many options for manipulating and saving new data, as with a full-featured database manager, so we'll do some rather simple operations in this lab.

Exercise 1: Joining Two Existing Tables and Crate Maps

This is a common operation in GIS analyses. We often want to combine data from different sources.

Task 1: Join Tables

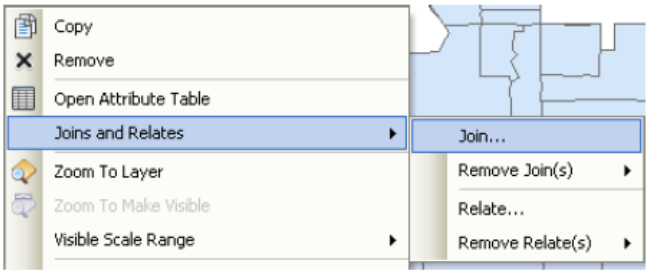
- Start ArcMap, and a new map, and Add the theme demographics.shp.
- Open the Attribute Table. Note the fields, especially one called Blkgrp.
- Add the data table name more_data.dbf, using Add Data (as you would add a layer).
- Right click on more_data.dbf in the TOC, and left click on Open. Notice that more_data.dbf also has an item named Blkgrp. Use the scroll bars at the bottom of each table to look at all the variables (columns) in each table and answer the following questions:
  - Are the variables ordinal, nominal, or interval/ratio?
  - Which variables are found in both tables?
  - Which variables might serve as keys for the table, and which would be inappropriate as **keys**

Note

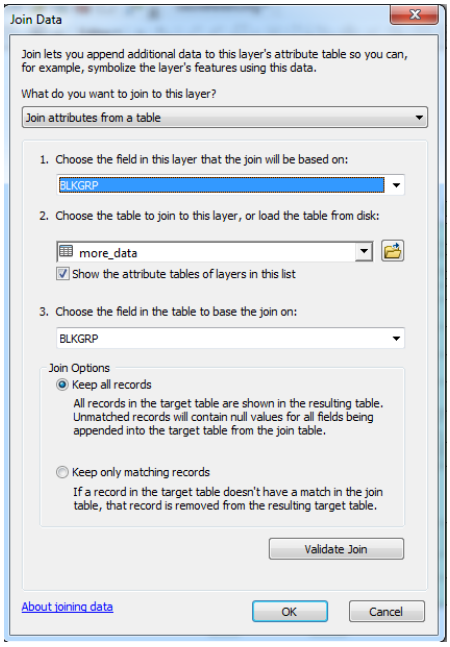
Each record (row) in each table corresponds to each polygon in this US Census Bureau demographic data, displayed in **demographics.shp**. This data uses a variable named **Blkgrp** as **unique identifiers**, typically for groups of city blocks used to summarize census data. Each record in the tables corresponds to a block group.

The file **more_data.dbf** includes populations at various dates for each block group polygon, e.g., Hh80=population in 1980, Hh90= population in 1990, etc.

- Right click on the demographics.shp layer in the TOC
- Select **Joins and Relates** and then **Join**



Basic Table Operation - 2



This opens a **Join Data** window, where you identify the:

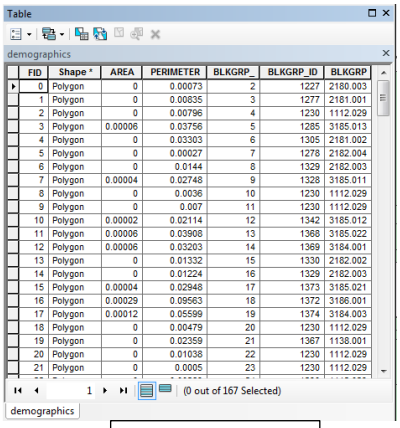
- field in the target layer (the current table) used to match records (rows)
- (source) table you wish to join to the current table
- field in the source table that you will use to match records.

This field is almost always a key Make sure you are joining demographics to the more_data file and using the field Blkgrp, not a field called Blkgrp_

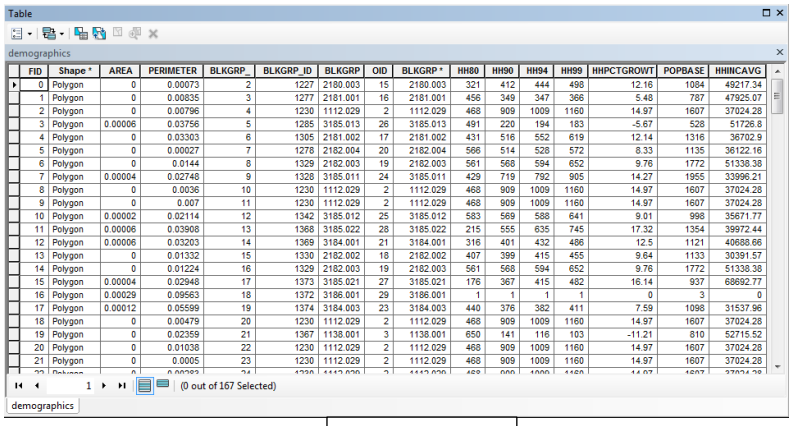
- ✧ Left click on OK to join the tables.
- ✧ You may get a warning asking if you wish to create an index.
- ✧ Click yes to index the join.

Now reexamine the demographics.shp attribute table. Notice the demographics.shp table has the more_data fields append to the end of each record.

You've just connected the two tables, matching the records in one table to the records in another table that have the same value for BLKGRP.



Before Joining



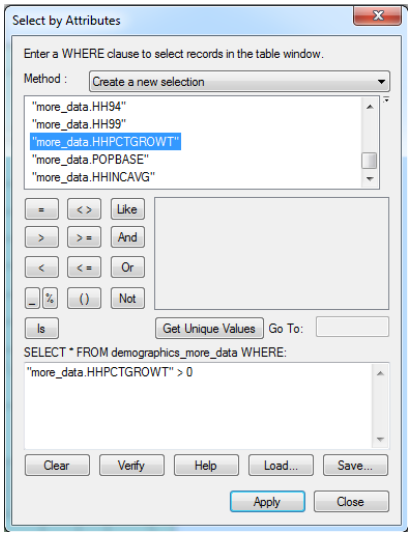
After Joining

Note

This is a temporary join; the original files/data have not been modified. ArcMap keeps track of joins within a project, and how to display the various joined files. If you were to display these data sets in another project, they would not appear joined. The data are not copied to a new, combined, file. Rather, this join tells ArcMap to display these two data sets within this particular view, matching each row by the join variable.

Basic Table Operation - 2

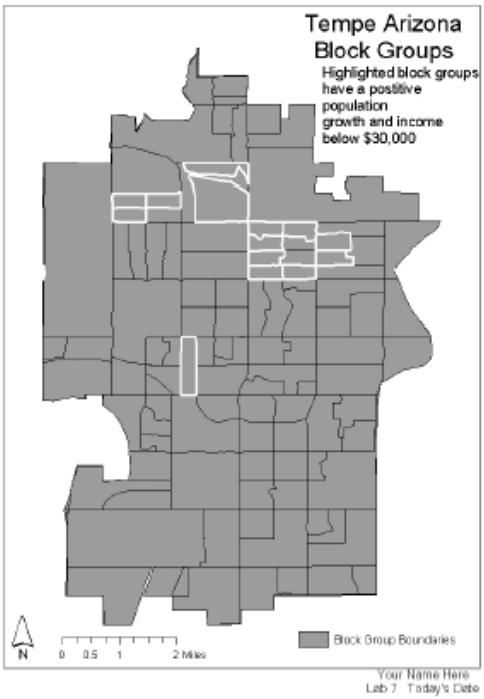
<u>Task 2:</u> Selecting on a Joined Table (selecting items based on the joined tables)



- Open the Attributes Table of demographics. It should display both the original data plus the data from more_data.dbf.
- Left click on **Table Options** tool  at the upper left of the table window and from the drop-down menu choose **Select by Attributes**
- From the popup window (see right), enter the selection equation "more_data.Hhpctgrowt "> 0 and left click on **Apply**

Examine your selected block groups on the map. Also notice the data are simultaneously selected in both the attributes table and the view of the theme. You have just identified all the block groups with positive population growth.

- Clear your selection (from the Main ArcMap menu, Selection →Clear Selected Features), or use the toolbar icon
- Use the Select by Attributes tool again on this same table, selecting blocks that have both population growth greater than 0 and income less than $30,000. This requires entering the following equation in the SELECT FROM portion of the:
  ("more_data.Hhpctgrowt">0) AND ("more_data.Hhincavg"<30000).
- Click on Apply and examine your selection.
- Activate the Show Selected Records button  to only focus on your selected features. Were 17 of 167 records selected? If not re-check your equation.
- Produce a map (as a .pdf) of the view with this compound selection ([Hhpctgrowt]>0) and ([Hhincavg] <30000), with only those block groups meeting both criteria highlighted white and those not meeting the criteria with dark boarders. Remember to include a title, descriptive legend, name, scale bar, and north arrow.



Basic Table Operation - 2

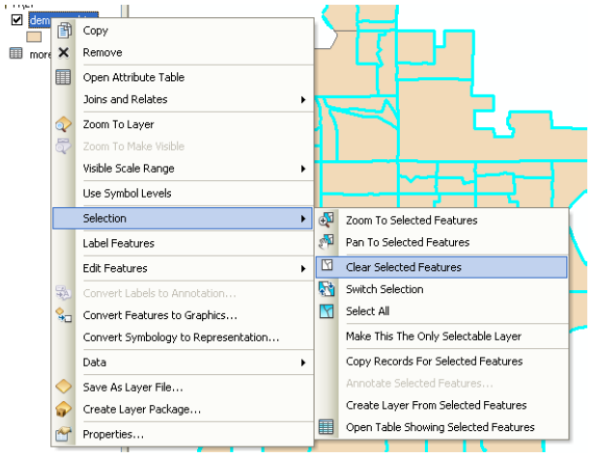
Task 3: Saving a Copy of a Joined Layer and Table

- Right click on the demographics.shp layer in the TOC.

  Note

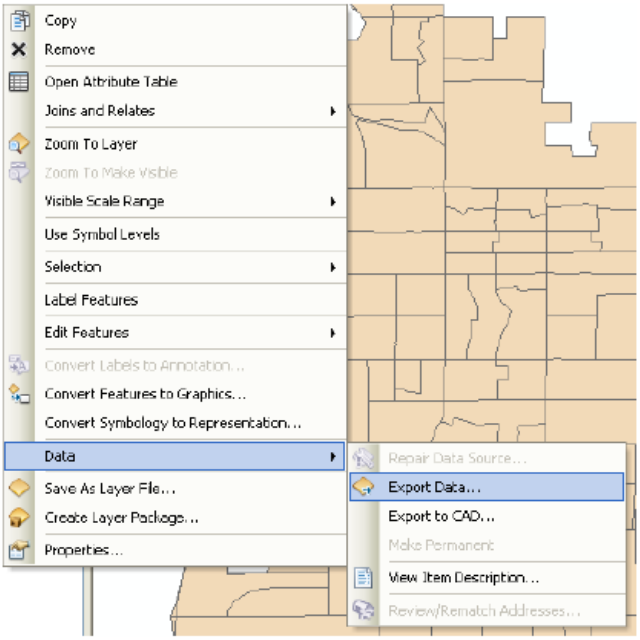
  Many operations will default to acting only upon the selected records, if there is a selected subset. Failure to clear means the operation will on produce partial results.

- Left click on Selection about half-way down the dropdown menu, and then Left click on Clear Selected Features.



- Right click on demographics.shp in the TOC To Export/Save your joined data sets to a new data layer
- Left click on Data
- Left click on Export Data and save the joined file to your data drive.

  Notice the default name for the saved file is Export_Output.shp. Change the name to something like Tablejoin.shp. This step copies the data in your temporary join to permanent storage, as a shapefile. All items from the joined tables are saved to a new, usually larger table, with associated polygons (or points or lines).
- Do not add this layer to your current map when asked, just save and close this project

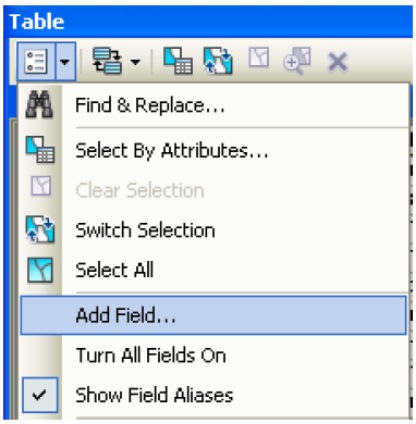


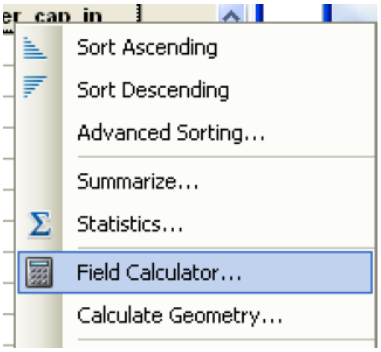
Basic Table Operation - 2

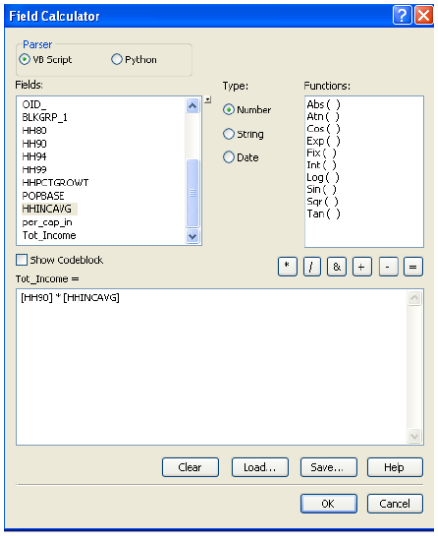
<u>Task 4:</u> Calculating into New Columns

We wish to know per capita income. We calculate this by multiplying the average household income by the number of households, and then dividing the result by population.

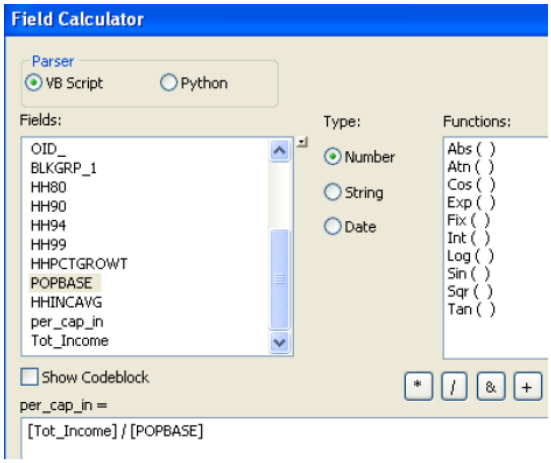
- Create a new ArcMap project and add the Tablejoin.shp layer that you created to your ArcMap project.
- Right click the Tablejoin.shp layer, open the attribute table and left click on Table Options
- Select Add Field.
- Name the field Tot_Income (no spaces, no more than 10 characters), Make the Type: "Float", Precision: 12, Scale: 2 then left click on OK
- Now Add a second field, call it per_cap_in, with a Type of "Float", Precision: 12, Scale: 2.
- Now **Start Editing** the file Tablejoin.shp.
- Right click on the column heading for the field Tot_Income, and select **Field Calculator**.
- Calculate the total income as HH90 * HHINCAVG, and click OK (see below)







- Right click on the column heading for the field per_cap_in and select the Field Calculator. Calculate the per capita income as Tot_Income / POPBASE (see figure at right)
- Again, check the results, this time in per_cap_in.
- Save the edits, and stop editing.
- Create a Choropleth Map using the field per_cap_in. Use a 7-classes classification scheme.



Basic Table Operation - 2

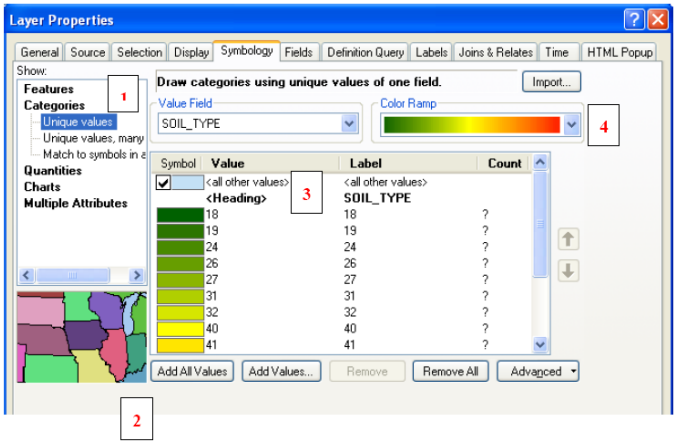
Exercise 2: Creating New Tables

Creating a table and joining it to existing tables is a common operation. Often, this join involves a **one-to-many relationship** between tables. Each record in one table matches many records in the second table. For example, a typical county may have approximately 80 different soil types, but over 100,000 different soil polygons of these types. Therefore, we may have properties for each of the 80 different types, e.g., crop productivity, engineering properties, moisture characteristics. We may format these in a table, and join this table to existing county data layer. The repeated properties aren't copied, just displayed for the appropriate polygon.

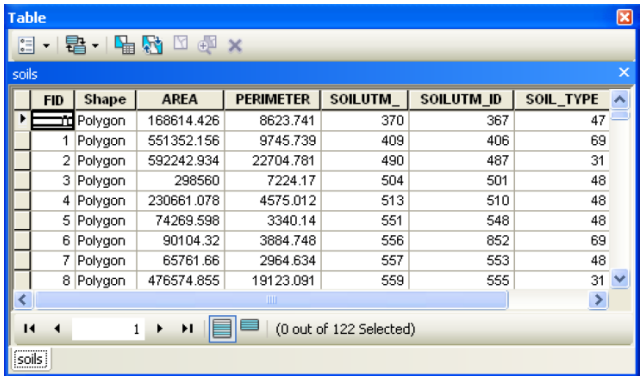
Task 1:

Create a new Map with a Blank Document.

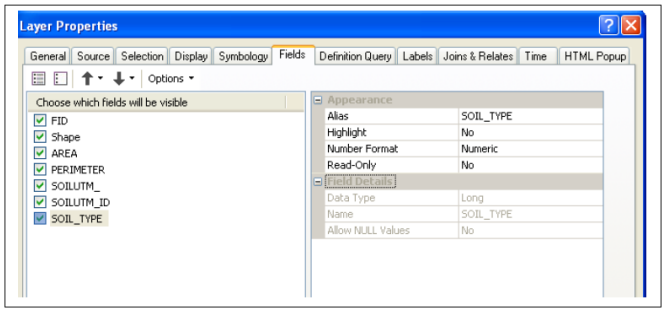
1. Add the soils.shp data layer, set the Layer Properties→Symbology to Categories, Unique-Values based on the item soil_type.
2. Add All Values
3. Uncheck the "all other values", so this won't appear in the legend.
4. Select a Color Ramp, and then left click Apply and OK.



Open the soils.shp attribute table and review the layer attributes. The soil_type attribute contains a code corresponding to the soil type of each individual polygon. Notice there are 15 different soil types designated by numbers between 18 and 69. There are 122 different soil polygons. Our job is to create a new table, enter important information for each of the 15 different soil types, and join this data with the soils data layer.



In this exercise you will use the "soil_type" variable in the soils shapefile as the join item, or join column. This is the "key" variable that will be used to match the rows from **the new soil** properties table you will create to the soil polygon data in soils.shp. The join item must be defined the same in both tables, with the same type (long or short integer, text, etc.)

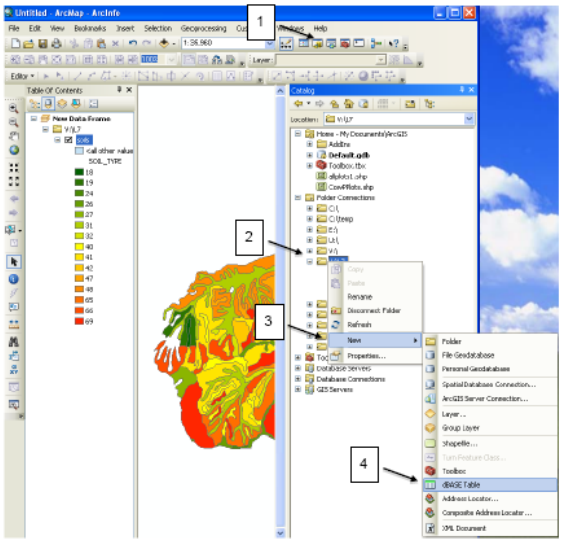


Let's examine the "key" or join column in the target table. Do this by a right click on soils.shp file in the Table of Contents window, then left clicking on Properties > Fields tab. This should display the window below. Left click on the soil_type item, and note the type and other properties of the soil_type item.

Basic Table Operation - 2

Now we need to create the new data table we'll be joining to soils.shp (instructions below, and figure on the following page).
From the main menu bar in ArcMap,

1) Left click on the **ArcCatalog** icon
2) Right click on the directory you're working in (here, \Tableoperation2 directory)
3) Left click **New** from the dropdown menu,
4) Left click **dBASE Table** from the next dropdown menu create a new dbase table a named soilprops.dbf.



Note:
You may inadvertently double click, and add the new table without giving yourself a chance to rename it. You can right-click on a data layer in the ArcCatalog window, and rename a layer, although sometimes ArcCatalog will not re-fresh the window with the new name until you remove the data layer from the Table of Contents, and re-add it.

5) Open the soilprops.dbf table (right click in the TOC, then Open)
6) Add the following fields (remember via the table tools icon, and then Add Field):
7) Note the drop-down lists to select types, and the table cells for some types are editable by clicking in them.
    a. soil_type, long integer (we got this from inspecting the soil type item in the soils data layer
    b. name, text, length of 20
    c. fert_class, double, with a precision of 10 and scale of 0
    d. drain_clas, double, precision10, scale 0.

    Note:
    You can delete the example field called Field1 only after you have entered new fields and saved the file. Do not delete or alter the OID field. If you make a mistake on a field name or type, correct it before you hit Apply. After the field is created by the Apply button you cannot edit the field name, you must delete the field and try again; in short- you cannot change existing field names.

8) Click Apply and OK to finish. Close the ArcCatalog window
9) In ArcMap, Add the soilprops table if it isn't already in your TOC.
10) Start Editor/Start Editing (This may open the Soils data layer editing window, if so, close it)
11) Open the soilprops table; this will display the column headings and a blank row.

    Note that you simply enter (type in) data into the appropriate columns, and a new row is automatically added at the end of the table.

Basic Table Operation - 2

12) Add the records shown at right. Ignore the OID Field, values will be generated as you add data, they may be different from the figure. These automatically generated values won't affect your work here.
13) When you are finished entering data, Save and Stop Editing.

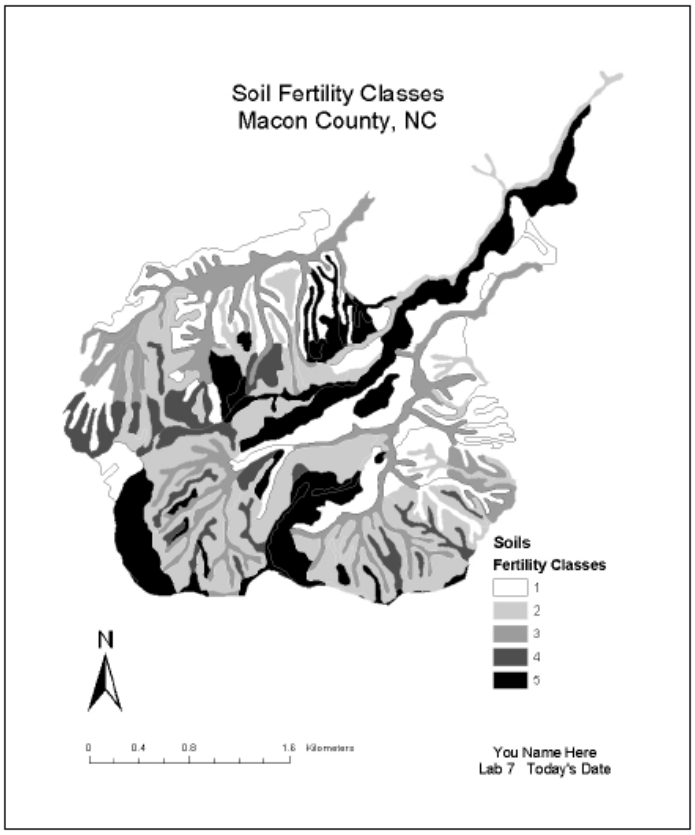
Table

soil_props

OID	SOIL_TYPE	NAME	FERT_CLASS	DRAIN_CLAS
0	18	Eve	4	90
1	19	Cecil	3	40
2	24	Coweet	3	90
3	26	Sille	5	90
4	27	Clive	1	27
5	31	Hyck	3	10
6	32	Dvill	1	56
7	40	Chero	4	84
8	41	Snob	2	33
9	42	Glick	5	70
10	47	Redv	2	60
11	48	JJil	1	2
12	65	Johns	2	39
13	66	Demp	4	67
14	69	Still	5	78

1 (0 out of 15 Selected)

14) Select the soils layer and join it to the soilprops table (common field soil_type)
15) Create a map using the new soils table. Display soils by fertility class. Recolor the map with a different color or shade of grey for each of the five fertility classes.
16) Set the fertility classes as categories (Properties – Symbology – Categories- Unique Values, then select the value field and Add All Values, and then Apply).



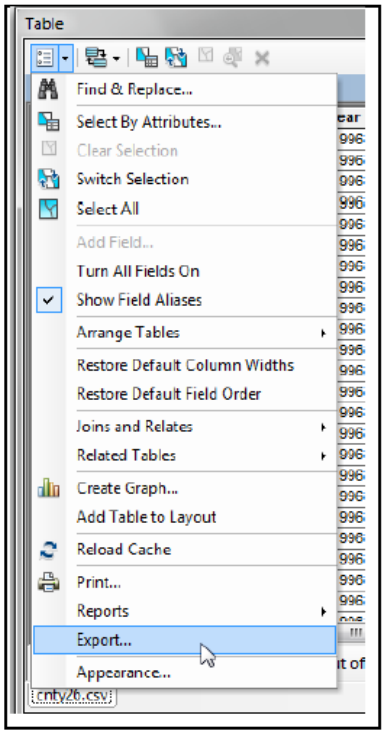
Basic Table Operation - 3

Adding a Text Table, Joining to a Shapefile

This project introduces something quite common, joining ASCII tabular data with a shapefile. Here, we will combine a text file on corn production for US counties with a county shapefile. First of all, we import a text file, convert it to a ArcMap compatible table, and edit the table, deleting columns, creating join items, and combining rows before joining it with a polygon shape file.

- ✧ Start ArcMap, and add *lwr48.shp* from the L8\Project2\ subdirectory. Now add the text file cnty26.csv to this data view, and open the table for viewing. This file contains 1996 seed corn production, in bushels (= 1.24445608 cubic feet = 35.24 liters), for counties in the United States. We are most interested in the columns:
  - **Stfips:** the state Federal Information Processing System (FIPS) code,
  - **CoFips:** county FIPS code
  - **Harvested:** the acres harvested for a given yield category in a county
  - **Yield:** Bushels per acre harvested for the yield category,
  - **Production:** Total bushels produced (yield times harvested) for the given yield level.

Unfortunately, we can't directly edit the .csv file, so we must convert it to a dbf file (also called dBase table).



- ✧ In the Attributes of cnty26.csv window, select the Table Options dropdown
- ✧ Export in the dropdown menu, and save all records to the Project2 subdirectory, name it "raw_corn_dat".
- ✧ Select dBase table as the "Save as Type". Answer "yes" to add the raw_corn_dat.dbf to your table to the current map, and then remove the cnty26.csv from the data frame
- ✧ Open the raw_corn_dat attribute table, and delete all the columns except the following: OID, Stfips, CoFips, Harvested, Yield, and Production.

We now want to join this data with the county shapefile, lwr48.shp. Unfortunately, there are two problems. First, we don't have a ready-made key for the join. There is no column that maps cleanly from the raw_corn_dat.dbf file to the lwr48.dbf file.

- ✧ Open the data table for the lwr48 shapefile.

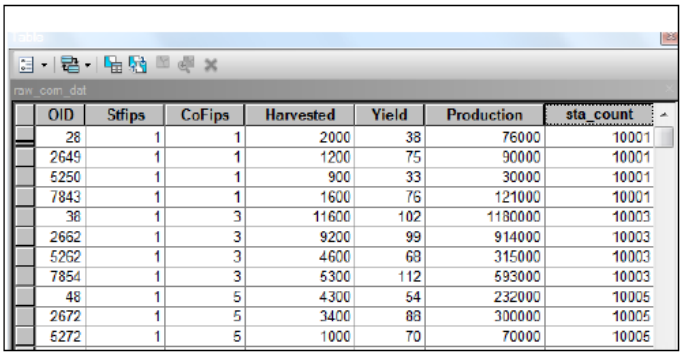
Note

Notice that lwr48.shp also has the county and state FIPS codes, in the COUNTY and STATE columns, respectively. Each state has a unique FIPS code, and each county within a STATE has a unique code. If we combine the STATE-COUNTY codes, we can create a unique ID for each county in the country.

Basic Table Operation - 3

- Add a column to the lwr48 data table. Make this field a long integer, with at least 8 columns (precision), and name it something like sta_count.
- Use the field calculator to assign sta_count a value according to the formula:
  [STATE] * 10000 + [COUNTY], which creates a unique 5-digit code, with the value for STATE in the first two digits, and the value for COUNTY in the next three digits.
- Open the raw_corn_dat.dbf file, add a sta_count column similar to the one in lwr48, and create a value for a new column using the field calculator, according to:
  [Stfips] *10000 + [CoFips]

- Sort the raw_corn_dat table in ascending order by right clicking in the sta_count column.

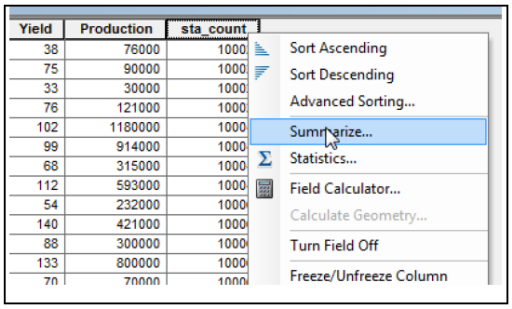


raw_corn_dat

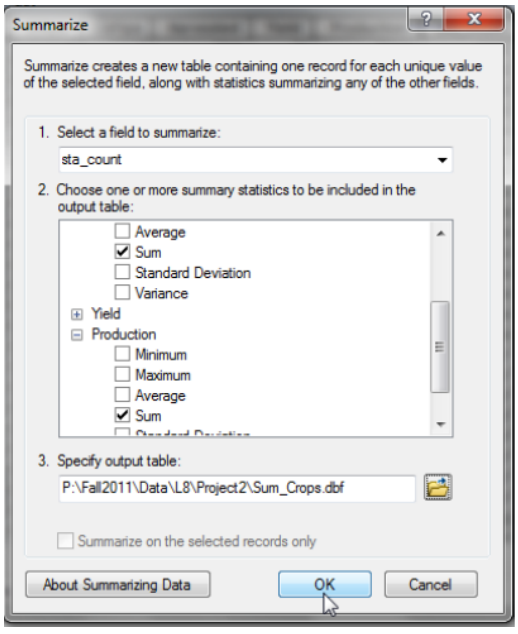
OID	Stfips	CoFips	Harvested	Yield	Production	sta_count
28	1	1	2000	38	76000	10001
2649	1	1	1200	75	90000	10001
5250	1	1	900	33	30000	10001
7843	1	1	1600	76	121000	10001
38	1	3	11600	102	1180000	10003
2662	1	3	9200	99	914000	10003
5262	1	3	4600	68	315000	10003
7854	1	3	5300	112	593000	10003
48	1	5	4300	54	232000	10005
2672	1	5	3400	88	300000	10005
5272	1	5	1000	70	70000	10005

We can now see the second problem with this data set. There are multiple entries for sta_count, each state/county combination. This is because yield was reported at various levels for each county. We must aggregate the rows before we join this table to the lwr48 shapefile. A join matches the rows by a key. If we don't somehow summarize the multiple rows that have the same sta_count value, then we can't be sure which will be chosen for the join.

Fortunately, ArcMap provides a tool for aggregating rows.

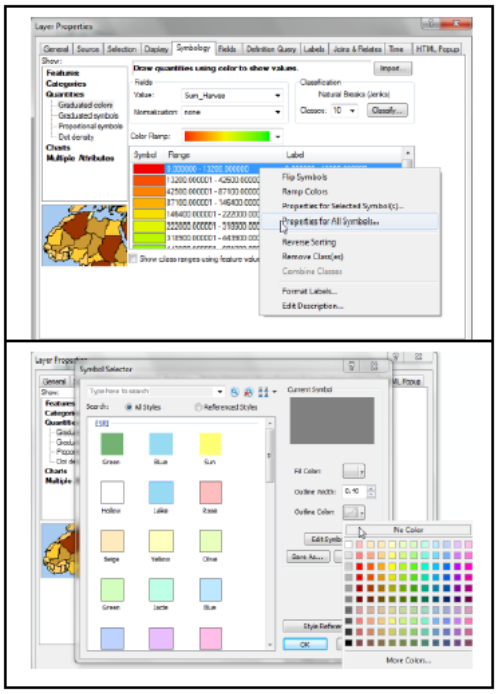


- Right click on the column heading for sta_count in the *raw_corn_dat.dbf* table. Left click on the **Summarize** option in the dropdown menu.
- In the *Select a field to summarize* window, verify that the sta_count field is selected
- In the next sub-window, left click on the +/- to the left of each item and request the Sum statistic for the Harvested and Production variables.
- Specify the L8\Project2\ subdirectory as an output location, with a filename something like "*Sum_crops.dbf*". Make sure the "save as type" is .dbf, if asked.
- Left click OK, and when asked, add the data to the view.
- Remove the *raw_corn_dat.dbf* from the data frame.
- Open the output *Sum_crops* file, sort ascending by sta_count, and verify that sta_count with a value of 10001 has a Sum_Harvested of 5700, and a Sum_Production of 317000.
- Now, join the *Sum_crops* file to the *lwr48.shp* file (right click on *lwr48.shp* in TOC > **joins and relates > Join**, then select appropriate columns in the tables.



Basic Table Operation - 3

- Right click on the lw48.shp in the TOC, then left click Data > Export Data, and name and save the file appropriately, something like US_corn.shp
- Add this new file to your data frame, and remove the lwr48 file and summary production tables.
- Now prepare a Layout.
  - First, change the data frame projection:
    - right clicking on the data frame name in the TOC, then Properties>Coordinate System>Projected>Continental>North America> USA_Contiguous_Albers_Equal_Area_Conic.
  - Symbolize the US_corn.shp file, using the Quantities, Graduated colors.
  - Use Sum_Harvest as the Value, with a gradient color ramp between two distinct colors (below from red to green).
  - Specify about 10 classes in a Natural Breaks scheme.
  - Right click on the first range and select Properties for all Symbols, then NO COLOR for the Outline Color, shown to the right. Select Ok and Apply.



- Refine the display of the labels of the Quanties of Sum_Harvest by again by right clicking on the first range then selecting Format Labels, see right. Select Ok, Apply and OK to complete the changes to your symbology.
- Add the states.shp with a hollow symbology and dark outline color. Create an appropriately annotated layout, with title, north arrow, name, legend, and other descriptive elements, and produce and submit a pdf of the layout.

