

## 1.2. TIPS FOR USING ARCMAP

### 1.2.1 Importing Text Files to ArcMap

(1) You can access information about importing text files using the HELP Index by writing **delimited** in the window and clicking:

**delimited text files** → **Accessing delimited text file data**

(2) Among the most important information is the following:

ArcCatalog and ArcMap allow you to directly access data in delimited text files and work with them as tables. ArcCatalog, and the add data browser in ArcMap, lists files with a .txt, .asc, .csv, or .tab extension and assigns them a file type of Text File.

- a. Files with a **.txt**, **.asc** or **.csv** extension are interpreted as **comma delimited**, while files with a **.tab** extension are interpreted as **tab delimited**.
- b. If your text file is **tab delimited**, you should rename the extension as **.tab**.

**NOTE:** If the **.txt** file extension is hidden (as it is by default in the Lab) then you must *reveal* this extension by the following procedure.

- Open the directory containing the text file in “My Computer”, and in the main menu click:

**Tools** → **Folder Options** → **View**

- Now **uncheck** the box next to “Hide file extensions for known file types”.
  - You will then be able to see the **.txt** file extension and to rename this file with a **.tab** extension.
- c. If it is **comma delimited** you should make sure that all field names are in quotes( “name”).

**NOTE:** You must **NOT** start a field name with a **number**. Otherwise the file will not be properly read in either ArcMap or ArcCatalog. (This important detail is **missing** from the HELP files !!)

### 1.2.2 Changing Path Directories in Map Documents

When a red “!” appears where a map should be displayed, it usually means that your maps are in the wrong directory. To change all such maps with a single operation:

- (1) Left click on the red “!” next to the *first* file in the map document that has such a mark.
- (2) In the Data Source window that opens, select the appropriate data source file in the new directory.
- (3) Click “Add”, and the source directories of all files in the same directory as the first file will automatically be changed to the corresponding source file in the new directory (assuming that they exist).
- (4) If the map document contains source files in more than one directory, some files will still have a red “!”. So left click on any one of these, and repeat the above procedure.

### 1.2.3 Making a Column of Row Numbers in an Attribute Table

Here there are two procedures that one can use:

#### 1. Modify FID Numbers

If the FID column of string identifiers is present, and in the correct order, then you can simply construct a numerical field that adds “1” to each FID number as follows:

- (1) Open the Attribute Table and select **Options → Add Field**.
- (2) Set Name = “ROW” and leave all else as is. Click **OK**.
- (3) In the new column that appears (with zero values) right click on the ROW label and select **Calculate Values**. (Ignore any warnings)
- (4) In the **Field Calculator** that opens, fill in the window labeled “ROW =” with the phrase “[FID] + 1” (no quotes), and click **OK**. The column should now be filled with the desired row numbers.

#### 2. Construct an Independent Numbering Scheme

An alternative procedure that is more flexible is to use online procedure at:

<http://support.esri.com/en/knowledgebase/techarticles/detail/38517>

### 1.2.4 Masking in Arcmap

The following procedure is designed to construct a *masked area* around a map boundary which hides unwanted contour and raster edges when displaying the results of kriging or spline interpolations. This procedure will be developed in terms of boundary shape file **boundary.shp**. It is assumed that this file is a layer called “Boundary” in the current data frame activated in ARCMAP. It is also assumed that this data frame is part of a map document located in your home directory (so that it can be edited).

- (1) First use the “Fixed Zoom Out” tool to reduce the size of the map display of Boundary so that a large mask can be constructed, at least *twice* the size of Boundary. (This ensures that when the map is enlarged to fill the window, the edges of the rectangular mask will *not be seen*.)
- (2) Next be sure that the “Editor” toolbar is displayed (**View** → **Toolbars** → **Editor**), and click: **Editor** → **Start Editing** .
- (3) In the **Start Editing** window, double click on “Boundary”, and it should now appear in the **Create Features** window. Click on “Boundary” and a list should appear in **Construction Tools** at the bottom of the window. Be sure that “Polygon” is selected.
- (4) To create the mask, use the mouse to make a large “Box” around the map boundary. Just click at each successive corner, and then right click anywhere inside the Box and select **Finish Sketch** on the popup menu. The map should now be hidden under the colored Box. Click: **Editor** → **Stop Editing** → **Save Edits**.
- (5) If you open the Attribute Table for “Boundary” you will see that a new row (feature) has been added at the bottom, representing the polygonal Box just created. You will now create a new shapefile in which the complement of “Boundary” in the Box is also a feature.
  - a. First open **Arc Toolbox** and click:  
  
**Analysis Tools** → **Overlay** → **Union**
  - b. In the “Union” window that opens, set **Input Features** = “Boundary”.

- c. In the **Output Feature Class** window, browse to the directory where you want the **Mask** to appear, and name the output file, **Mask**. Click **OK** and the layer “Mask” should now appear in the Table of Contents.
- d. Now with only “Mask” being displayed, you should see both “Boundary” and the Box surrounding it. Now right click anywhere in the Box outside of “Boundary”, and in the list that opens click “Select Features”.
- e. Open the attribute table for “Mask” and observe the row selected (which should be the top row). Click on **Table Options** in the upper left of the window, and choose “Switch Selection”, so that all other rows are now selected.
- f. Now reopen the **Editor**, click “Start Editing”, and in the Main Menu of the Attribute Table choose “Delete Selected” (an X). All that should be left is the complement of “Boundary” in the Box. This constitutes the desired **Mask**.
- g. To clean up the original file, open “Boundary” again, select the row corresponding to the Box feature, and click **Remove**. Finally, click:

**Editor** → **Save Edits** , and **Editor** → **Stop Editing**.

- (6) To display the **Mask** in a proper form, double click on its colored box in the Table of Contents, set **Fill Color** = “White”, and set the **Outline Width** and **Outline Color** to whatever you like.
- (7) Once again display the “Boundary” layer and enlarge it with the “Fixed Zoom In” tool to fill the window. Be sure that the “Mask” layer is positioned above it in the Table of Contents.

⇒ Any raster or contour output from subsequent analyses of point data inside the map will now automatically be **clipped** at the boundary as long as those displays are positioned below the “Mask” layer in the Table of Contents.

### 1.2.5 Making Spline Contours in Spatial Analyst

- (1) Select a point-data layer with values “X” to be contoured.
- (2) On the Spatial Analyst tool bar Click:

**Spatial Analyst** → **Interpolate to Raster** → **Spline**

(3) Then in the **Spline Window** set:

- **Z value field** = X
  - **Spline Type** = Regularized
  - **Weight:** (0.1 = close fit to data → 5 = smoothed fit)
- All other settings are OK.

(4) If a **raster grid** of colors is OK, then you are done.

- Right click on the layer (which is only a temporary file) and click **Save as a Layer file** .
- To edit the displayed number of contours or their colors, right click on saved layer, click **Properties** → **Symbology**, and edit “Classes” or colors.

(5) If you want **contour curves** rather than a raster grid, you can now use the “Surface Analysis” tool as follows. Select the raster-grid layer and click:

**Spatial Analyst** → **Surface Analysis** → **Contour**

(6) In the **Contour Window** choose the **contour interval** size you want (and check the **Total number of contour values** below to see if the number is adequate, but not too dense).

- When you have made a contour map that is acceptable, right click on the layer (which is again a temporary file) and click **Save as a Layer file** .

### 1.2.6 Excluding Values from Map Displays

To exclude a range of values from the map display of a given variable (layer):

(1) Right click on the appropriate layer and click:

**Properties** → **Quantities** → **Classify** → **Exclusion**

(2) In the **Data Exclusion Properties** dialogue

- Double click on the variable (so that it appears in the text box)

- Specify the range to be excluded, such as:  
    “Variable” <= -100
  - Click **OK**
- (3) On the map, those features (points, choropleth areas) with value in this range will no longer be shown.

### 1.2.7 Importing ArcMap Images to the Web

Arcmap images can be imported to the web by converting them to **.gif** files. One simple procedure for doing so is the following:

- (1) First export image from ARCMAP as an *Enhanced Meta File* (.emf)
- (2) Open the image in POWER POINT and edit in any way desired (you can even combine several images into one).
- (3) Save in POWER POINT to the Desktop as, say **image**, using **File → Save as Web Page**.
- (4) You will now see a file on the Desktop, **image.htm**, together with a folder, **image\_files**.
- (5) If you open the folder you will see one **.gif** file with a label something like **slide\_0001**. This is the file containing the desired image (open it to check).
- (6) Now copy this file to the same local directory where you keep the copy of your web page, and rename it as say **image.gif**.
- (7) You can then insert this into your web page by editing the page in Netscape using **File → Edit Page**, and then using **Insert → Image**.
- (8) In the “Image Properties” window that opens, just type in the name of the file, **image.gif**, and it will be inserted.
- (9) It is often easier to control the placement of the image by first creating a table in the web page using, **Table → Insert Table**, and then inserting **image.gif** into an appropriate cell of the table.
- (10) Finally, you can publish the web page in the usual way, by FTPing the image file to same directory on the server where your web page is kept.

### 1.2.8 Adding Areas to Map Polygons

1. Open the attribute table of the layer containing the polygons.
2. If there is no field for area values, add a new field for area by clicking the **Table Options > Add Field**. Name the field “Area” and set **Type** = Double.
3. Right click on the new column added, and select **Calculate Geometry** (and in the window that opens click **Yes**)
4. In the **Calculate Geometry** window that opens, select “Area” in the **Property** box, and click **OK**. The areas should now appear in the column.

**NOTE:** On some old boundary files (such as **lymph\_bnd.shp** in the Uganda example of Assignment 1) will yield a negative area, because the ordering of points is reversed. Here just change use the Field Calculator to change the sign with **Area = Abs([Area])**.

### 1.2.9 Adding Centroids to Map Polygons

The following instructions are basically the same as **1.2.8**:

1. Open the attribute table of the layer containing the polygons. You will make the X and Y coordinates in succession.
2. Add a new field by clicking **Table Options > Add Field**. Name the field “X” and set **Type** = Double.
3. Right click on the new column added, and select **Calculate Geometry** (and in the window that opens click **Yes**)
4. In the **Calculate Geometry** window that opens, select “X Coordinate of Centroid” in the **Property** box, and click **OK**. The areas should now appear in the column.
5. Finally, to make the “Y” coordinate, repeat steps 2 through 4, by replacing “X” with “Y”.

### 1.2.10 Adding Coordinate Fields to Attributes of Point Shapefiles

1. Open the attribute table of the layer containing the points. You will make the X and Y coordinates in succession.

3. Right click on the new column added, and select **Calculate Geometry** (and in the window that opens click **Yes**)
4. In the **Calculate Geometry** window that opens, select “X Coordinate of Point” in the **Property** box, and click **OK**. The areas should now appear in the column.
5. Finally, to make the “Y” coordinate, repeat steps 2 through 4, by replacing “X” with “Y”.

### 1.2.11 Converting Strings to Numbers in ARCMAP

To convert a column of numerical string-type data in an attribute table of ARCMAP to Double (precision) number:

1. First open the attribute table and select the column to be changed, say TRACT.
2. Now add a field to the table (**Options ► Add Field**). Give a new name to the field, say TRACT\_NUM, and specify the field as type ‘Double’. Leave all other options at their default settings, and click **OK**.
3. Now right click on the header of the new field and select **Calculate Values**.
4. To make the transformation you will use the Visual Basic function, **Cdbl()**, that converts **Strings** of numbers to **Double-valued** data. In the Field Calculator box labeled ‘TRACT\_NUM = ’ type:
 

**Cdbl([TRACT])**
5. Now click **OK**, and the new set of Double-valued data should appear in the column TRACT\_NUM of the attribute table.

#### Procedure for Long Numbers

The above procedure will work for integers as long as you have no more than seven digits. If you have a long integer, like an STFID identification number for a Philadelphia city block, say “420171001021001” then you will *not* be able to reproduce this reliably as a number. The format “Double” only allow 7 places before the decimal (and “Long Integer” only allows 9 places). So it will be recorded in scientific notation, like “4.20171e+014”. These are not reliable for matching identifiers in join operations. So if the number displayed is in scientific notation, then the following additional steps can be used to correct this:

6. In the Table of Contents, right-click on the layer with the Attribute Table of

interest and select: **Properties → Fields.**

7. Suppose you are converting STFID to a numerical field called STFID\_NUM. Then in the “Layer Properties” window that opens, scroll down to the STFID\_NUM row, and in the “Number Format” column click on the gray button with 3 dots.
8. In the “Number Format” window that opens, select **Category** = “Custom”, and select **String Format** = “0”. Click **OK**, and in the Layer Properties window click **Apply** and then **OK**.
9. If you check the Attribute Table again, then the full digit number for STFID\_NUM should now be displayed.

**NOTE 1.** The same procedure can be used to convert integer strings to numerical integers by designate the data type of the column as ‘Short Integer’ and using the Visual Basic function **CInt(.)** in place of **Cdbl(.)**.

**NOTE 2.** There is also a VBA function **CStr(.)** which will convert numbers to strings. This may sometimes also be useful

### 1.2.12 Displaying Proper Distance Units

When boundary shapefiles are in unknown units, there is usually problem getting the distance measurement tool to show distance values in the same units as the unknown coordinates. To accomplish this:

1. Open the **Properties** of the given Data Frame, and select **Coordinate System**.
2. Under **Select a coordinate system**, choose **Layers** and select either the boundary layer for the data frame (i.e., with polygon features) or any layer with point features. Click **Apply** and **OK**.
3. Now reopen **Properties** and select **General**. In the **Units** window you should now see that both **Map** and **Display** are active.
4. First set **Display** to “Unknown Units” (top of the list) and then set **Map** to “Unknown Units”. Click **Apply** and **OK**.
5. In the map display, the **Distance Tool** should now be displaying the *same units* as the unknown coordinates.

### 1.2.13 Editing Point Styles in ARCMAP

For maximum flexibility in choosing colored points with or without borders, the following procedure is useful. For sake of concreteness, suppose you wish to enlarge a portion of a point pattern for an export display, and want to increase the size of dots and put a heavy black border around each for emphasis (so that they will print well in WORD).

1. Enlarge the desired portion in the window, and click **Properties → Symbology**.
2. Now in the **Layer Properties** window right click on any symbol and select **Properties for All Symbols**.
3. Select **Circle 2** (the filled circle) and choose the size you want.
4. Now click on **Properties**. In the window that opens you will see a display of **Layers** to the left. If you click on the border layer (hollow circle) you can set its properties.
  - (i) In the **Properties** section set **Type** = “Simple Marker Symbol”.
  - (ii) Set **Color** = “No Color”, check “Outline” and **Outline Color** = “Black”.
  - (iii) You will then see the border outline in the Preview window, and can reset both the **Size** and **Outline Size** to obtain a border with the desired thickness around the point.
5. Now click **OK** in each window, to get back to the **Layer Properties** window. Here you will see that points and borders have the right size, but not ramp colors.
  - (i) To apply ramp colors (if desired) right click on any symbol and choose **Ramp Colors**. The ramp color window should now display the same solid color as the points.
  - (ii) Click on the ramp color arrow and select the desired color ramp. These colors should now appear on the point symbols.
6. Click **Apply** and **OK**. You should then see these point styles in the map window.
7. Export this map, and close the map document **without saving it** (unless you want to keep these enlarged points as permanent choices).

### 1.2.14 Exporting Maps from ARCMAP to WORD

To export a map that is currently displayed in ARCMAP, use the command

**File → Export Map**

1. The single best format to use for exporting is **Enhanced Meta File (.emf)**. This will give you good reproduction quality and will allow you maximum flexibility in editing the image in WORD.
2. These images can be imported to WORD using **Insert → Picture → From File**.
3. Be aware that some printers will *not* have map marker fonts. If your map marker symbols are not coming out, or are completely different in appearance, the best approach is to re-export the map from ARCMAP using the Format Options. In the **Export Map** window click “Options” at the bottom, and open the “Format” tag. Now check the option: **Convert Marker Symbols to Polygons**. This will convert your symbols to graphic objects that can be printed without font sets.

**1.2.15 Making Legends for Exported Maps**

1. The procedure in ARCMAP for composing maps with legends, north arrows, etc. is their “Layout View”. However a more flexible procedure (in my view) is simply to export each component as a “map” and arrange them using the Picture and Drawing toolbars in WORD.
2. Activate the data frame in ARCMAP containing the desired map and click: **View → Layout View**. You may still see many different images in the map frame shown. But that is no problem. Simply click: **Insert → Legend**.
3. In the “Legend Wizard” that opens select each unwanted item in the “Legend Items” window and click on the “<” button that is activated. This will remove that item from the list. When only the desired map layer remains, click **Next** and you will encounter many editing options. Just start by clicking all the way through and check to see whether the displayed legend is acceptable. (I have never used any of these editing options.)
4. Assuming that the desired legend is what you want, simply copy-and-paste it to the desired WORD document (it is the only item selected, so nothing else will be copied). When it is imported to WORD you can resize it, crop it, and relocate it next to your map.

**1.2.16 Making Voronoi Tessellations in ARCMAP as Shapefiles**

1. In the point file to be tessellated, you must first change the “Primary display field” to a unique integer or string field. The Object ID field (FID or OID) will usually work. Select the point file and Click:

**Properties → Fields**

and reset the Primary display field.

2. Next you must be sure that this file is a shape file. If not, right click on layer file and click:

**Data → Export Data**

and save as a shape file, say **Points.shp**, in the same directory. From now on we use this shape file.

3. Before constructing the Voronoi tessellation, observe that this tessellation will extend only to the smallest rectangle containing all points. If the points are inside a boundary, say **Boundary.shp**, and you want to extend the tessellation to the boundary, the best way is to edit the point file, adding four points at the corners of a box containing the desired boundary. (More “fictitious” point may be used as desired.) To do so,

- Create a new copy of **Point.shp**, say **Temp.shp** which can be edited. Now display **Temp.shp** instead of **Point.shp**.
- In the Editor toolbar click: **Editor → Start Editing** .
- Then set **Task** = “Create New Feature” and set **Target** = “Temp.shp”. (In the map window, the mouse arrow should now appear as a colored circle.)
- Click on the positions of the desired points (such as the corners of a large box containing the boundary in **Boundary.shp**), and these new point features will appear as new rows in the Attribute Table of **Temp.shp**.
- To stop, click: **Editor → Stop Editing → Save Edits**

4. Next, to construct the Voronoi tessellation, Click:

**Spatial Analyst → Distance → Allocation**

Be sure the point field is selected, and leave the “Maximum distance” blank. The resulting “temp” file will be a raster display of the Voronoi cells.

5. To convert this to vector form, select the raster layer and click:

**Spatial Analyst → Convert → Raster to Features**

Save the resulting file as shapefile, say **Voronoi.shp**, in the same directory.

6. To use **Voronoi.shp** as an overlay, double click on the icon below the layer name in the Table of Contents, and set **Fill Color** = “No Color”. You can also set the outline width and color in the same box.
7. When **Voronoi.shp** is overlaid onto **Point.shp**, it will usually stretch beyond the original boundary for **Point.shp** (and **Temp.shp**). You can clean up this discrepancy by using the “Clip” feature in ARCMAP. To do so, open **ArcToolbox** and click:

**Analysis → Extract → Clip**

The ‘Input Features’ (layer to clip) should be **Voronoi.shp**, and the ‘Clip Features’ (polygon clip layer) should be **Boundary.shp**.

8. Save this clipped form as a new shape file, say **Voronoi\_cells.shp**, and you are done. The temporary files, **Temp.shp** and **Voronoi.shp**, can now be deleted.

**1.2.17 Running Local  $G^*$  Tests of Concentration in ARCMAP**

There is an option in ARCMAP for testing spatial concentration using *local  $G^*$ -statistics* (denoted here by  $G_i^*$ ). The following notes illustrate the application of this test to the *Eire Blood Group Data*, and compare it with the corresponding MATLAB results. The testing tool in ARCMAP offers a number of weight-matrix options, but most importantly, allows one to import *any* weight matrix in the right format. So a second objective of these notes is to show how to construct matrices in the right format using MATLAB.

1. The first task is to open **F:\sys502\arcview\projects\eire\Eire.mxd** in ARCMAP, and check that the Attribute Table of the shapefile, **Eire.shp**, contains a field that identifies counties with the corresponding row numbers of these counties in MATLAB data. This Attribute Table already has a field called “ID” that contains these numbers. (For other applications you will need to construct such an identifier field, say “ID”. To do so, use the “Add Field” option in the Attribute Table. Set **Name** = “ID” and **Type** = “Short Integer”. Finally use the “Calculate Values” option and set  $ID = [FID] + 1$ .)
2. The next task is to convert the *exponential weight matrix* used in Assignment 6 to ARCMAP format in order to construct a comparable test to that of Assignment 6. The following instructions for forming this matrix are essentially the same as in

Assignment 6: Open MATLAB and import the file **F:\sys502\matlab\eire.txt**. You should now have a  $26 \times 7$  matrix, **eire**, in the workspace.

1. Define the *centroid locations*, **L**, and *blood-group percentages*, **x**, by:

```
» L = eire(:,1:2);
» x = eire(:,3);
```

2. Now make an exponential weight matrix by writing:

```
» OUT = dist_wts(L,4,10,1);
» W = OUT{1};
```

Here the argument **4** denotes the “exponential-weight-matrix” option, **10** denotes the exponent value, and **1** denotes the “include-diagonal-terms” option.

3. We now convert this weight matrix, **W**, to ARCMAP format using the MATLAB program **arcmap\_wt\_matrix.m**. Here the appropriate command is:

```
>> W_list = arcmap_wt_matrix(W);
```

The matrix, **W\_list**, is actually a “list” form of **W**. To see this, display the first four rows of **W\_list** by writing:

```
>> W_list(1:4,:)
```

```
ans =
     1     1    0.30159
     1     2    0.0036059
     1     3    0.0051854
     1     4    0.0056317
```

For example, the third line says that the (row-normalized) exponential weight of County 1 with County 3 is **0.0051854**. This can also be verified by displaying the (1,3) element of **W** as:

```
>> W(1,3)
```

```
ans =
0.0051854
```

4. We next save this file and convert it to a format that can be read by ARCMAP as follows. First save **W\_list** as a text file using

>> **save W\_list.txt W\_list –ascii**

Next we need to “clean” this file in EXCEL. Open **W\_list.txt** in EXCEL and use

**Format → Cells → Number**

to format the first two columns as integers (**Decimal places = 0**) and the third column as, say, a 4-digit decimal (**Decimal places = 4**). Save as file as a tab delimited text file, **W\_list.txt** in your home directory, which we shall assume to be **S:\Home\eire**.

- Finally, recall from (1) above that ARCMAP needs to match the ID numbers in the first two columns of **W\_list.txt** with a field numbering the Counties in **Eire.shp**. Since there is such a field, “ID”, we shall use this field. Open **W\_list.txt** as a text file and add “ID” as a top line to this file, so that the first few lines now read:

<b>ID</b>		
<b>1</b>	<b>1</b>	<b>0.3016</b>
<b>1</b>	<b>2</b>	<b>0.0036</b>
<b>1</b>	<b>3</b>	<b>0.0052</b>

- With this text file completed, we are now ready to carry out **Gi\*** tests in ARCMAP. To do again open the map document file **F:\sys502\arcview\projects\eire\eire.mxd** in ARCMAP, and also open **ArcToolBox**. Then navigate to:

**Spatial Statistics Tools → Mapping Clusters  
→ Hot Spot Analysis (Getis-Ord Gi\*)**

- In the window that opens, set

**Input Feature Class** = “Eire.shp”,  
**Input Field** = “BLOOD\_GRP”  
**Output Feature Class** = “Eire\_G\_Arcmap.shp”

- To use the custom weight matrix above, set:

**Conceptualization of Spatial Relationships** = “Get Spatial Weights from File”  
**Distance Band** = “0”  
**Weights Matrix File** = “S:\Home\eire\W\_list.txt”

where it is assumed that the last line contains the proper path to **W\_list.txt**. Leave all other options as is and click **OK**.

- A new layer, “Eire\_G\_Arcmap”, will now appear in the Table of Contents. If you open the Attribute Table you will see that the last field is labeled “GiW\_list”. The values in this column are standardized **Gi\*** values, i.e., z-values of the form:

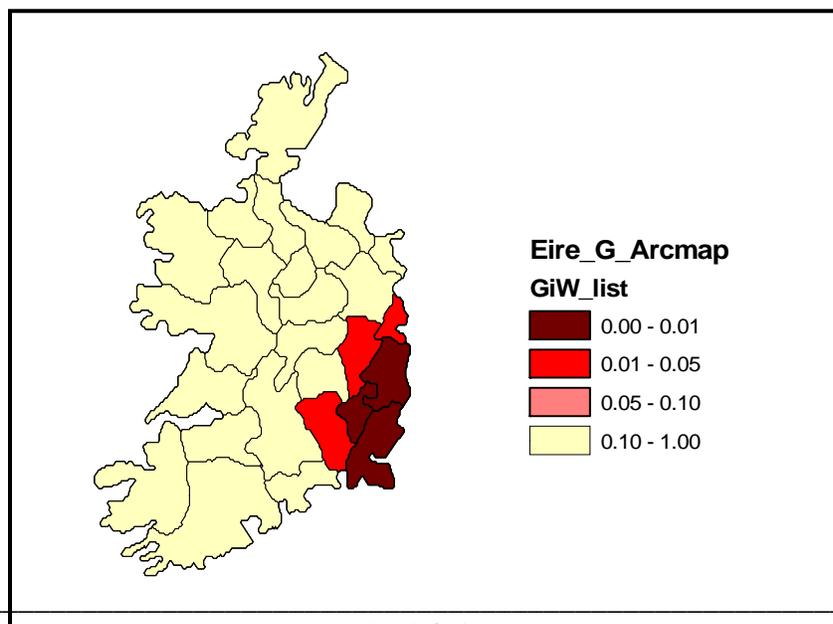
$$Z_i = (G_i^* - E(G_i^*)) / \text{std}(G_i^*)$$

[where exact expressions for the mean,  $E(G_i^*)$  and standard deviation,  $\text{std}(G_i^*)$  can be found in the Getis-Ord paper listed in the reserve section of the class web page.] To see the relevance of these values, recall that under the null hypothesis of the random permutation test, the underlying  $x$ -values (in this case “Blood Group A” percentages for each county) are assumed to be typical random permutations of these values among counties. Ord has shown that under this hypothesis, the  $Z_i$ -values above are *asymptotically normally distributed* for large sample sizes,  $n$ . [Here there are only  $n = 26$  counties, so this asymptotic assumption is questionable at best. But nonetheless, it will be seen below that this test provides very reasonable results in the present example.]

10. To display the results of this test in a manner that is comparable to the random permutation test, `g_perm_loc.m`, in MATLAB, recall that this is a *one-sided test* focusing only on significant concentration levels. The appropriate  $z$ -values corresponding to one-sided significance levels in this case are given by:

<b>P-value</b>	<b>0.10</b>	<b>0.05</b>	<b>0.01</b>
<b>z-value</b>	<b>1.28</b>	<b>1.65</b>	<b>2.33</b>

Hence to display these  $z$ -values (“`GiW_list`”) use a classification with **Classes** = “4”, **Method** = “Manual”, and values “1.28”, “1.65”, “2.33”, and “**max**” (where in this case, **max** = 3.295240). Finally right-click on the values and select “Reverse Sorting”, so that the most significant values will be on the top. You can then set the display labels to be the corresponding p-values, listed from top to bottom as “0.00 – 0.01”, “0.01 – 0.05”, “0.05 – 0.10”, “0.10 – 1.00”. [You should also use darker colors for the more significant categories.] The results of this procedure are plotted below, with the legend we have just constructed shown to the right.



Finally when these results are compared with the p-value display obtained from an application of **g\_perm\_loc** using the same weight matrix, **W**, and **999** simulations, it turns out that the representations are *identical*. Hence with respect to these p-value classes, the results are in perfect agreement. As a rule, however, the actual p-values for the asymptotic approximation in ARCMAP will tend to be somewhat *smaller*. For example, the smallest possible p-value for a random permutation test with **sims = 999** is of course **0.001**. However, the smallest p-value for the ARCMAP results above corresponds to the z-value, **max = 3.295240**, which is approximately **0.0005**.

### 1.2.18 Joining Point Data to Polygon Shape Files in ARCMAP

When adding point data (in a DBF or ASCII file) to a polygon shape file, there are some key pointers to keep in mind:

- (1) The files must both be projected or an error message will occur. Also the numerical coordinates in the point file must be in the right projection.
- (2) Assuming that the polygon file, say POLYGON, is already in the map document, a good way to proceed is to project the point data, say POINTS, at the same time it is being entered. To do so:
  - (a) First be sure that the POINTS file to be added (either a DBF file or a Tab-Delimited TEXT file) has Column Labels with proper format for ARCMAP (single strings of not more than 8 symbols, with no punctuation symbols other than “\_”). Also, if you label the coordinates as “X”, “Y”, or as “X\_coord”, “Y\_coord”, then these will be recognized by ARCMAP as the coordinate columns.
  - (b) Add the POINTS file to the map document. (If it won’t come in, check the label formats again. This is usually the problem.)
  - (c) Right click on the POINTS file in the Table of Contents and select “Display XY Data...”. If you have chosen coordinate labels as above, then they should show already be selected in the “Display XY Data” window that opens. Also you should see that a new file, “POINTS Events”, has been added to the Table of Contents.
  - (d) In the **Description box** you should see “Unknown Coordinate System”. This is what needs to be changed. To do so, click the **Edit** button.

- (e) You need to define a geographic coordinate system and a projection. It will be assumed here that you have Philadelphia data. So first click “Select” and go to:

**Geographic Coordinate Systems**

→ North America

→ North American Datum 1983.prj

- (f) Now click “Select” again, and this time go to:

**Projected Coordinate Systems**

→ State Plane

→ NAD 1983 (Feet)

→ NAD 1983 StatePlane Penn. South FIPS 3702 (Feet).prj

- (g) Click **Add**; then click **Apply** and **OK**. In the Description box you should now see both the Projected Coordinate system and the Geographic Coordinate system listed. Click **OK** again.

- (h) Finally, you should save the “POINTS Events” file as a shapefile by right-clicking on this file and selecting:

**Data → Export Data**

- (j) Save this file as, say POINTS.shp. You can then join this to the polygon file by right clicking on the POLYGON file and selecting:

**Joins and Relates → Join**

- (k) Here the best procedure for joining points to polygons is to change the “What do you want to joint to this layer?” option to read

**Join data from another layer based on spatial location**

### 1.2.19 Saving Map Documents with Relative Paths

When saving map documents it is useful to save only *relative paths*, so that projects can be moved to new directories without changing all paths to shapefiles, etc. This option can be set in ARCMAP by clicking:

**File → Document Properties**

Then at the bottom of the “Properties” window click:

**Data Source Options... → Store Relative Path Names**

Finally, if you check “Make relative paths the default” then this option will be used for all future map documents as well.

### 1.2.20 Increasing Unique Values for editing Raster Outputs (in Version 9.3)

When you use the command **Spatial Analyst** → **Interpolate to Raster** → **Spline** to interpolate a set of point measurements (like temperatures at weather station locations in South America), you will obtain a default “class” representation of the interpolation (as with older versions). But when you right click on properties and try to edit this representation (change the number of classes or colors, etc.) it says:

"Unique histogram does not exist. Do you want to compute values?"

When you try to do this, it will tell you that there are too many unique values. This can be fixed by increasing the bound on unique values as follows:

- (1) In the main menu click: **Tools** → **Options** → **Raster**
- (2) In the raster window you will see an additional set of tabs about half way down. Click “Raster Attribute Table”
- (3) Here change the upper bound on unique values to, say, 500000. This should be enough.

Now when you are asked if you want to compute unique values say “Yes”. The computation takes a few seconds, and then the desired editing window opens up.