Data Interpolation and Extraction

ArcGIS Desktop 10.1 Instructional Guide

RICE Fondren Library GIS/Data Center

Kim Ricker
GIS/Data Center Head
(713) 348-5691

Jean Niswonger
GIS Support Specialist
(713) 348-2595

This guide was created by the staff of the GIS/Data Center at Rice University and is to be used for individual educational purposes only. The exercises outlined in this guide require access to particular software and datasets which are available at Fondren Library.

Obtaining the Tutorial Data

Before beginning the tutorial, you will copy all of the required tutorial data onto your Desktop. Follow the applicable set of instructions below depending on the particular computer you are using.

Accessing tutorial data from Fondren Library using the *gistrain* profile

If you are completing this tutorial from a public computer in Fondren Library and are logged on using the *gistrain* profile, follow the instructions below:

1. On the Desktop, double-click the **Computer** icon → ***gisdata (\\fon-gis04) (O:)*** → ***Short_Courses*** → ***Manipulating_Data_In_ArcGIS_Series*** > ***Data_Interpolation_and_Extraction***.

1. To create a personal copy of the tutorial data, drag the ***InterpolationTutorialData*** folder onto the Desktop.

2. Close **all windows**.

Accessing tutorial data online using a personal computer

If you are completing this tutorial from a personal computer, you will need to download the tutorial data online by following the instructions below:

1. Using a web browser, go to the Data Manipulation and Extraction short course webpage at: http://library.rice.edu/gis-interpolation

2. At the bottom of the webpage, under the Resources section, click the **Data Interpolation and Extraction – Tutorial Data** link to download the tutorial data.

3. Unzip the ***InterpolationTutorialData*** folder.

4. Copy the unzipped ***InterpolationTutorialData*** folder to your Desktop or another location of your choice. Ensure that you note the file path of the location you have selected.

Any time throughout the tutorial that you see reference to the file path *C:\Users\gistrain\Desktop\InterpolationTutorialData*, you will need to substitute it with the file path you have just selected.

The following step-by-step instructions and screenshots are based on the Windows 7 operating system with the Windows Classic desktop theme and ArcGIS for Desktop 10.1 software with an Advanced license. If your personal system configuration varies, you may experience minor differences from the instructions and screenshots.

Scenario Description

Imagine that you work for an insurance agency and a hurricane has just hit Houston. You have gathered data on rain and wind from the National Oceanic and Atmospheric Agency (NOAA) in the form of rain gauge estimates of rainfall and a feature class depicting the peak average wind speeds when the hurricane landed. Your company has several policy holders claiming that damage was done to their homes during the course of the hurricane. Investigators have gone out to the houses to document the damage, but the company needs to know what the hurricane conditions were like at each house before awarding any claim money. However, none of the houses in question lie directly at a rain gauge or a hurricane wind speed line, so you must interpolate the data with the most accurate interpolation technique and extract the data so that it is in a convenient tabular format for your supervisor.

Preparing Data

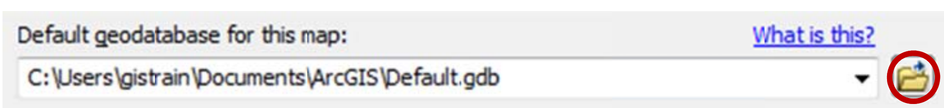
Setting up a map document

You will begin by opening ArcMap and creating a new map document.

1. On the Desktop, double-click the **ArcMap 10.1** icon.
2. In the 'ArcMap – Getting Started' window, ensure that **My Templates** and the **Blank Map** template are selected.

At the bottom of the window, notice the default geodatabase for this map is currently set to C:\Users\gistrain\Documents\ArcGIS\Default.gdb. The default geodatabase should be set to the geodatabase that will contain most of the data for the particular map document you are working on. In this case, you will want to use the geodatabase in your *InterpolationTutorialData* folder.

3. Next to the 'Default geodatabase for this map:' box, click the **Browse** button.



4. In the 'Default Geodatabase' window, click the **Connect To Folder** button.

5. In the 'Connect To Folder' window, select the ***InterpolationTutorialData*** folder located on the Desktop.

Ensure that the *InterpolationTutorialData* folder is highlighted in blue and not the *HurricaneData.gdb* geodatabase that appears inside it. You never want to connect directly to a geodatabase, as doing so will prevent you from being able to access any of the data contained inside of it.

6. For 'Folder:', verify that either the ***InterpolationTutorialData*** folder or the ***C:\Users\gistrain\Desktop\InterpolationTutorialData*** filepath is listed and click **OK**.

7. In the 'Default Geodatabase' window, select the ***HurricaneData.gdb*** geodatabase and click **Add**.

8. Ensure the 'Default geodatabase for this map:' box says "**C:\Users\gistrain\Desktop\InterpolationTutorialData \HurricaneData.gdb**" and click **OK**.

At this point, it is a good idea to save your map document and to continue saving regularly.

9. On the Standard toolbar, click the **Save** button.

10. In the 'Save As' window, use the 'Save in:' drop-down box to select your ***InterpolationTutorialData*** folder.

You will save the map document here, directly inside the *InterpolationTutorialData* folder, but NOT within the *HurricaneData* geodatabase.

11. For 'File name:', type "**HurricaneInvestigation**" and click **Save**.

Remember that, in order for your GIS project to open properly on other computers, you must tell the map document to store relative pathnames to its data sources and take your **entire project folder** containing all of your data and your map document with you.

12. Click the **File** menu and select **Map Document Properties…**.

13. Towards the bottom of the 'Map Document Properties' window, click the **checkbox** to 'Store relative pathnames to data sources' and click **OK**.

14. On the Standard toolbar, click **Save** again to store this setting in your map document.

Adding feature class data to your map document

1. On the right side of the ArcMap window, click the **Catalog** tab.

2. On the Catalog toolbar, click the **Go To Default Geodatabase** button, which will take you to the geodatabase you specified earlier.

3. Double-click the ***HurricaneData*** geodatabase to expand its contents.

4. Drag the ***Texas*** feature class into the Map Display.

A rough outline of the state of Texas appears in your Map Display window.

5. Again, click the **Catalog** tab and drag the ***Hurricane*** feature class into the Map Display.

The rings represent the particular wind speed readings for the hurricane.

6. In the Table of Contents, right-click the ***Hurricane*** layer and select **Open Attribute Table**.

Notice that there is a *Windspeed* attribute that tells you the peak average wind speed along each ring when the hurricane landed. The wind speeds varied from 95 to 120 miles per hour.

7. Close the **attribute table**.

Adding tabular data to your map document

1. On the right side of the ArcMap window, click the **Catalog** tab.
2. Double-click the ***Houses*** Excel file to expand it and view its individual worksheets.

Remember that ArcMap can only add one worksheet within an Excel file at a time, so you will need to specify which worksheet you wish to add. In most cases, you will be interested in the first worksheet.

3. Under the *Houses* Excel file, drag the ***Sheet1$*** worksheet into the Map Display.

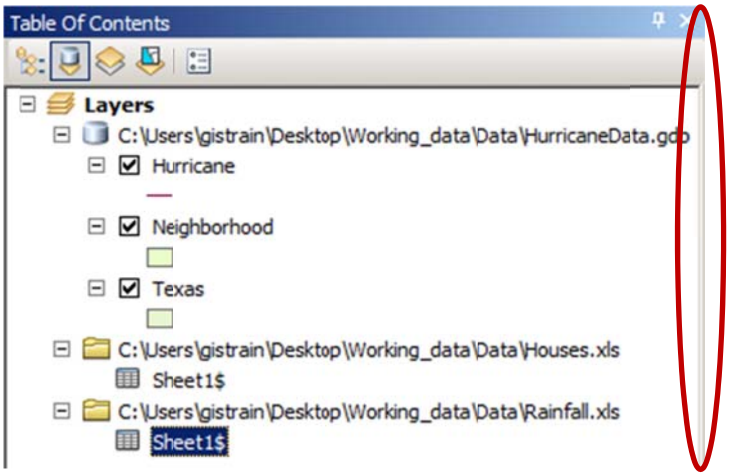
Notice at the top of the Table of Contents, the highlighted icon has switched from the first 'List By Drawing Order' button to the second 'List by Source' button. That switch is because the tabular data you just added does not have a graphic component, so it cannot yet be drawn and will not appear in the drawing order view. While the 'List by Drawing Order' button shows the names of the layers and allows you to reorder them, the 'List by Source' button must be selected in order to see tables.

4. Again, click the **Catalog** tab and double-click the ***Rainfall*** Excel file to expand it and view its individual worksheets.
5. Under the *Rainfall* Excel file, drag the ***Sheet1$*** worksheet into the Map Display.

Because both of the individual Excel worksheets were not renamed, they are both listed as Sheet1$ in the Table of Contents.

6. Hover over the **right edge of the Table of Contents** until your cursor turns into a double-sided arrow.

7. Click and drag the **right edge of the Table of Contents** to the right until you can see the full file paths, as shown below.



Now you can see the name of the Excel file from which each *Sheet1$* originated, but to avoid further confusion, you will rename the Excel worksheet layers. This action will not rename the worksheets in the actual Excel file, but only how they are listed in the Table of Contents in this particular map document.

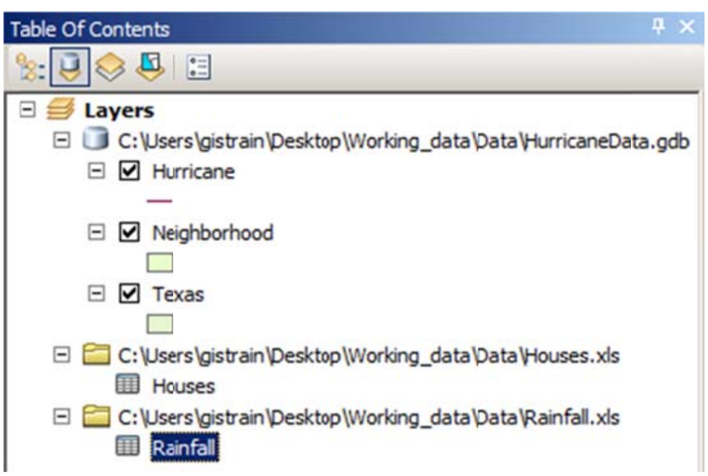
8. Underneath the *Houses.xls* file path, click the ***Sheet1$*** table to select it.

9. Click the ***Sheet1$*** table again to enable renaming and type "**Houses**".

10. Underneath the *Rainfall.xls* file path, click the ***Sheet1$*** table to select it.

11. Click the ***Sheet1$*** table again to enable renaming and type "**Rainfall**".

12. Ensure your Table of Contents appears as shown below.



Now you will examine what data is contained in each of the two tables.

13. Right-click the ***Houses*** table and select **Open**.

Note that the *Houses* table includes the longitude and latitude of each house that has filed an insurance claim.

14. Close the ***Houses*** table.

15. Right-click the ***Rainfall*** table and select **Open**.

Note that the *Rainfall* table includes the longitude and latitude of each rain gauge in the hurricane area, as well as the inches of rainfall collected in each gauge during the hurricane.

16. Close the ***Rainfall*** table.

Mapping XY Data

Both the *Houses* and *Rainfall* tables include coordinates for the longitude and latitude of each data point; however, in order to display this tabular data in a graphic format, you will need to map these points based on their XY coordinates.

1. In the Table of Contents, right-click the ***Rainfall*** table and select **Display XY Data…**.

2. For 'X Field:' select the ***Longitude*** field.

3. For 'Y Field:' select the ***Latitude*** field.

Notice in the 'Coordinate System of Input Coordinates' box, it defaults to the particular projection being displayed in our active data frame, which is currently GCS_North_American_1983, or the North American Datum 1983, commonly abbreviated as NAD 83. This is the particular geographic coordinate system of the original three feature classes you added to the map display.

4. In the 'Coordinate System of Input Coordinates' box, click **Edit…**.

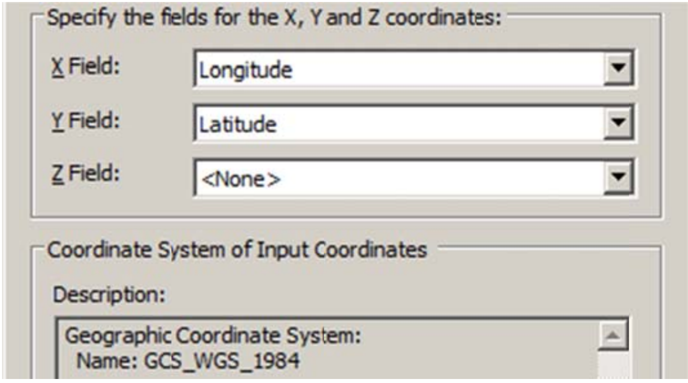
5. In the 'Spatial Reference Properties' window, scroll down to the **bottom of the list of projections**.

Because the coordinates are in the form of latitude and longitude in decimal degrees, you know you will need to select a geographic coordinate system, rather than a projected coordinate system. While the data could theoretically be in any geographic coordinate system, you will select the World Geodetic System of 1984, commonly abbreviated WGS 84, because this is the reference coordinate system used by the Global Positioning System (GPS). Under most circumstances, this will be the best coordinate system to select when mapping latitude and longitude coordinates.

6. Double-click the **World** folder.

7. Select **WGS 1984** and click **OK**.

8. Ensure your window matches that below and click **OK**.



A warning message appears to let you know that the functionality of your data will be limited until you export the data to a new layer.

9. Click **OK**.

Your Map Display now shows the location of each rain gauge as a point feature.

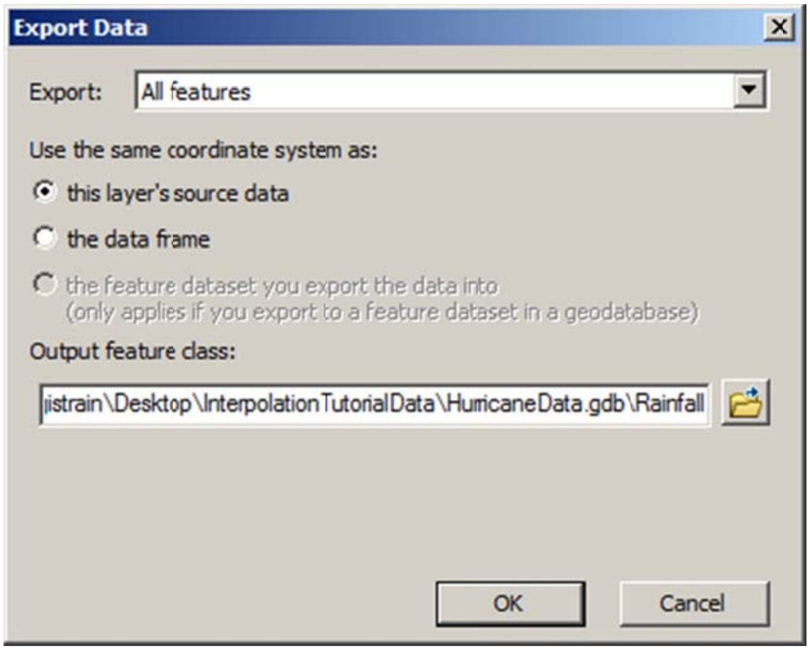
The locations of the points in the *Rainfall* table are currently stored in a temporary layer called *Sheet1$ Events*. Since the points appear to be in reasonable locations, you will want to export the temporary layer into a new permanent feature class in your default geodatabase. Exporting to a feature class will allow you to manipulate these points and reuse them in other future map documents without having to go through the display XY data process each time.

10. In the Table of Contents, right-click the ***Sheet1$ Events*** layer and select **Data** > **Export Data…**.

Notice that the output feature class defaults to your default geodatabase (C:\Users\gistrain\Desktop\InterpolationTutorialData\HurricaneData.gdb).

11. For 'Output feature class:', scroll to the end and rename the feature class from "Export_Output" to "**Rainfall**".

12. Ensure your 'Export Data' window appears as shown below and click **OK**.



13. Click **Yes** to add the exported data to your map as a layer.

Since you have now created a permanent feature class, you may remove your temporary events layer and the corresponding Excel table.

14. In the Table of Contents, right-click the ***Sheet1$ Events*** layer and select **Remove**.

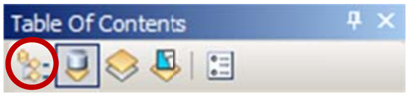
15. In the Table of Contents, right-click the ***Rainfall*** table and select **Remove**.

Now you will repeat the same process to create a permanent point feature class for the *Houses* data table.

16. Repeat **steps 1 - 15** using the ***Houses*** table. Rename the exported feature class "**Houses**" and then remove the ***Houses*** table from the Table of Contents.

Your Map Display now shows the locations of all of the houses filing insurance claims due to the hurricane and you have all the necessary layers added into your map document.

17. At the top of the Table of Contents, click the **List by Drawing Order** icon.



18. Click and drag the **right edge of the Table of Contents** back to the left, so that it is only wide enough to display the short layer names.

Interpolating Data

Interpolation allows you to estimate the values of new data points based on the values of existing data points. In this case, you would like to estimate the rainfall values at each of the house locations based on the rainfall values recorded at each of the rain gauge locations. The following section will teach you several methods of interpolating both point and line vector data into raster datasets, which provide estimated values of the data variables across the entire region. You will see how these different interpolation techniques lead to varying resulting raster datasets. It is important to select an interpolation technique best suited to your existing data and your desired analysis.

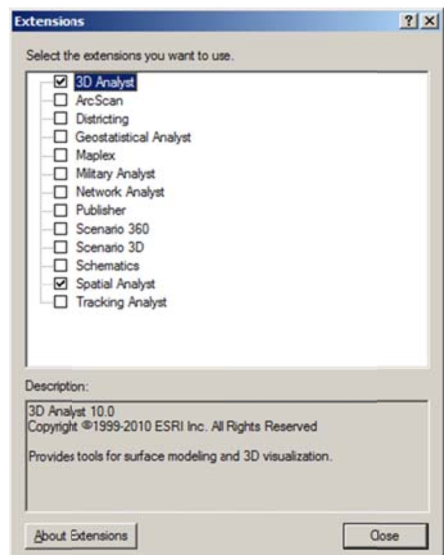
Activating ArcGIS Extensions

Many of the tools you will be using in this section require the use of the 3D Analyst and Spatial Analyst extensions in ArcGIS. By default, these extensions are not activated, so you will need to activate them before you can make use of their functionality.

1. **Click the Customize menu and select Extensions….**

2. **Check 3D Analyst and Spatial Analyst to enable the functions of those two extensions.**

3. **Ensure your 'Extensions' window appears like that to the right and click Close.**



Point Interpolation

First you will interpolate the rainfall data, because point data is usually easier to interpolate to raster data than line or polygon data. In this section, you will interpolate the rainfall data using the Inverse Distance Weighted, Spline, Natural Neighbors, and TIN interpolation methods.

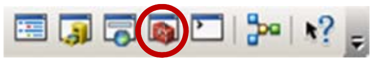
Since you are only interpolating the rainfall data at this point, you will temporarily turn off some of the other layers.

1. **In the Table of Contents, uncheck the *Houses* and *Hurricane* layers so that they are no longer visible.**

At this point, only the *Rainfall* and *Texas* layers should be visible.

Inverse Distance Weighted Interpolation Method

1. On the Standard Toolbar, click the **ArcToolbox window** button.



2. In ArcToolbox, double-click the **Spatial Analyst Tools** toolbox.

3. Double-click the **Interpolation** toolset

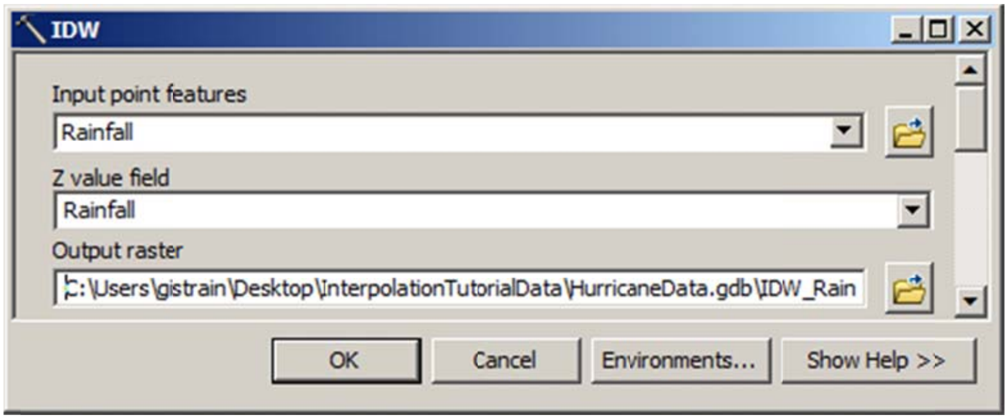
4. Double-click the **IDW** (Inverse Distance Weighted) tool.

5. In the 'IDW' window, use the 'Input point features' drop-down box to select the ***Rainfall*** layer, which contains your rain gauge data points.

6. Use the 'Z value field' drop-down box to select the ***Rainfall*** field that contains the values you wish to interpolate.

7. For 'Output raster', rename the exported raster from "Idw_Rainfall1" to "**IDW_Rain**".

8. Leave the other fields with their default settings, ensure your 'IDW' window appears as shown below, and click **OK**.



It will take several seconds for the tool to begin running, at which point you will see the name of the tool in blue text scrolling across the bottom right portion of the ArcMap window in a white box. When the tool has finished running, another gray box will pop up in the same corner with the name of the tool and a green checkmark.

9. When the IDW tool has completed, close **ArcToolbox**.

Currently, you cannot see most of the newly interpolated raster layer, because it is beneath the Texas layer.

10. Drag the ***IDW_Rain*** layer to the top of the Table of Contents window, above the *Houses* layer, so that it is fully visible.

Now you cannot see the interpolation points, because they are beneath the new raster layer. To make them visible, you will make the raster layer transparent.

11. **In the Table of Contents, double-click the *IDW_Rain* layer.**

12. **At the top of the 'Layer Properties' window, click the Display tab.**

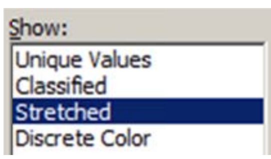
13. **For 'Transparency' type "40" and click Apply.**

Notice that you can now see the other layers beneath the raster layer in the Map Display window.

The raster layer is currently symbolized using nine classes; however, the values of the cells in the raster are actually more continuous in nature, so you will symbolize them continuously, rather than in classes.

14. **At the top of the 'Layer Properties' window, click the Symbology tab.**

15. **On the left, for 'Show:' select Stretched.**



16. **Use the 'Color Ramp:' drop-down box to select a blue color ramp and click OK.**

You can now see the continuously interpolated raster containing rainfall values that were generated using the data collected at the specific rain gauge points. Notice how this IDW method results in distinct rings around each input data point.

17. **In the Table of Contents, uncheck the *IDW_Rain* layer.**

Spline Interpolation Method

1. **On the Standard Toolbar, click the ArcToolbox window button.**

2. **In the Interpolation toolset, double-click the Spline tool.**

3. **Repeat steps 5-16 above in the *Inverse Distance Weighted Interpolation Method* section on pages 11 and 12, but rename the raster output "Spline_Rain".**

Compare the result of the Spline interpolation to the result of the IDW interpolation by turning each layer on and off in the Table of Contents. Since the layers are transparent, you need to ensure that only one raster is turned on at a time. Notice how the Spline interpolation tries to reduce the sharp edges and sudden jumps in data and does not exhibit the distinct rings around the input points, as the IDW method does. The Spline interpolation process assumes that, overall, there is a smooth transition in the data and tries to mirror that effect in its output.

4. **In the Table of Contents, uncheck the *Spline_Rain* layer and any other raster layers you turned on.**

Natural Neighbors Interpolation Method

1. **On the Standard Toolbar, click the ArcToolbox window button.**

2. **In the Interpolation toolset, double-click the Natural Neighbor tool.**

3. **Repeat steps 5-16 above in the *Inverse Distance Weighted Interpolation Method* section on pages 11 and 12, but rename the raster output "NN_Rain".**

Compare the result of the Natural Neighbors interpolation to the results of the previous two interpolation methods. Note that it is smooth everywhere except for the distinct highs and lows directly around the data points, though even at the data points it is smoother than in the IDW interpolation method. Note also that the interpolation is limited to the area covered by the input points, rather than a rectangle of the same extent.

4. **In the Table of Contents, uncheck the *NN_Rain* layer and any other raster layers you turned on.**

TIN Interpolation Method

Using the Create TIN tool, you can create a TIN based on an existing feature class.

1. **On the Standard Toolbar, click the ArcToolbox window button.**

2. **Double-click the Spatial Analyst Tools toolbox to collapse it.**

3. **Double-click 3D Analyst Tools > Data Management > TIN > Create TIN.**

4. **For 'Output TIN', type "TIN_Rain" and click elsewhere to update the text field.**

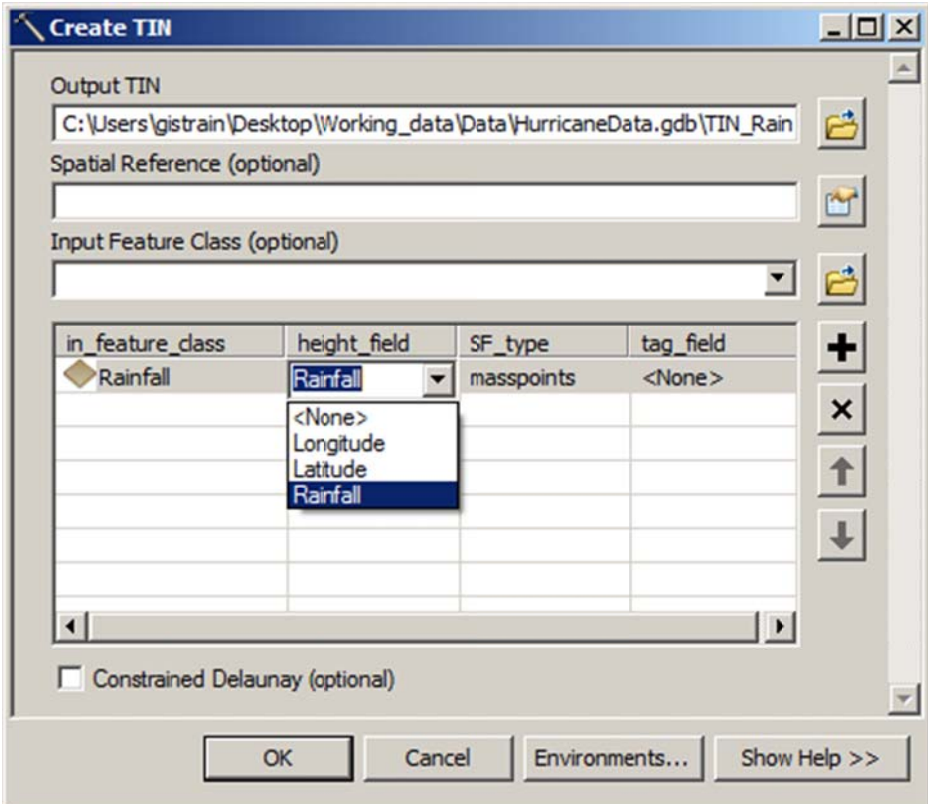
Note that the output TIN is automatically located in your default geodatabase.

5. **Ensure the 'Output TIN' box says "C:\Users\gistrain\Desktop\InterpolationTutorialData\HurricaneData.gdb\TIN_Rain".**

6. **Use the 'Input Feature Class' drop-down box to select the Rainfall feature class.**

7. **In the new *Rainfall* feature class row, use the 'height_field' drop-down box to select the Rainfall field as shown below.**

8. Ensure your ‘Create TIN’ window appears as shown below and click **OK**.



This method interpolates the rainfall data points by defining the vertices of each triangle in the TIN and interpolating across each triangle. From here, it is very simple to convert the TIN to a raster, so that it is in the same format as your other interpolation layers.

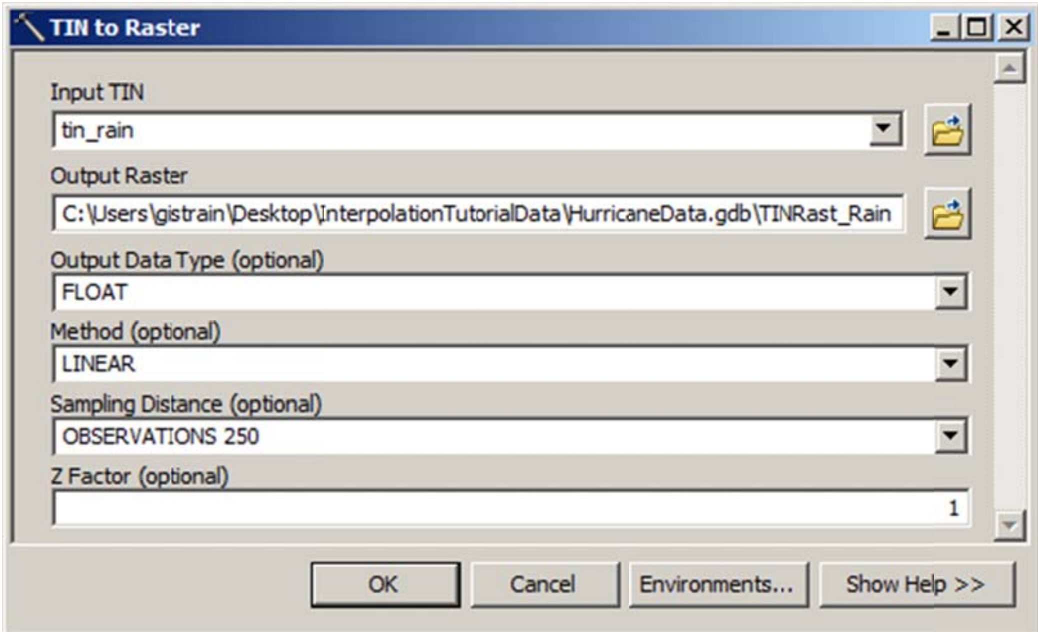
9. In ArcToolbox, double-click the **Data Management** toolset to collapse it.

10. In the 3D Analyst Tools toolbox, double-click **Conversion** > **From TIN** > **TIN to Raster**.

11. Use the ‘Input TIN’ drop-down box to select the **tin_rain** TIN.

12. For ‘Output raster’, rename the exported raster from “tin_rain_Tin” to “**TINRast_Rain**”.

13. Ensure your 'TIN to Raster' window appears as shown below and click **OK**.



14. When the TIN to Raster tool has completed, close **ArcToolbox**.

15. In the Table of Contents, uncheck the ***tin_rain*** layer to view the new raster layer created from the TIN.

16. Repeat **steps 11-16** above in the *Inverse Distance Weighted Interpolation Method* section on page 12 to symbolize the *TINRast_Rain* layer as you did the other raster layers.

Compare the results of the TIN interpolation to the results of the previous three interpolation methods. Note that the triangulation method results in defined and continuous ridges and valleys, which makes sense, because TIN files are most commonly used to represent land elevation.

Now you have explored four methods for interpolating the rainfall data, so you will turn off the layers you have generated in this *Point Interpolation* section.

17. In the Table of Contents, uncheck **all layers**, except for the *Texas* layer.

Line Interpolation

You will now try interpolating the *Hurricane* line feature class using the same TIN-based method you just used to interpolate the rainfall point data. Recall that the *Hurricane* feature class contains a *Windspeed* field in its attribute table, which tells you the peak average wind speed along each line at the time the hurricane landed.

1. In the Table of Contents, check the ***Hurricane*** layer to make it visible.

2. On the Standard Toolbar, click the **ArcToolbox window** button.

3. In ArcToolbox navigate to **3D Analyst Tools** > **Data Management** > **TIN** > **Create TIN**.

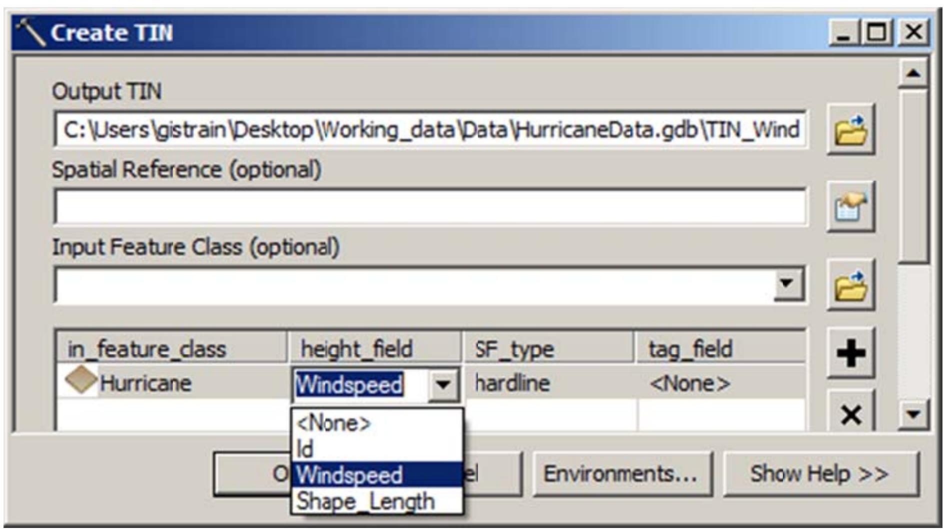
4. For 'Output TIN', type "**TIN_Wind**" and click **elsewhere** to update the text field.

5. Ensure the 'Output TIN' box says "**C:\Users\gistrain\Desktop\InterpolationTutorialData\HurricaneData.gdb\TIN_Wind**".

6. Use the 'Input Feature Class' drop-down box to select the **Hurricane** feature class.

7. In the new *Hurricane* feature class row, use the 'height_field' drop-down box to select the **Windspeed** field as shown below.

8. Ensure your 'Create TIN' window appears as shown below and click **OK**.



Again, you need to convert the TIN to a raster, so that it is comparable to the other interpolation layers.

9. Repeat **steps 9-16** above in the *TIN Interpolation Method* section on pages 14 and 15, but select **tin_wind** for the input TIN and name the output raster "**TINRast_Wind**".

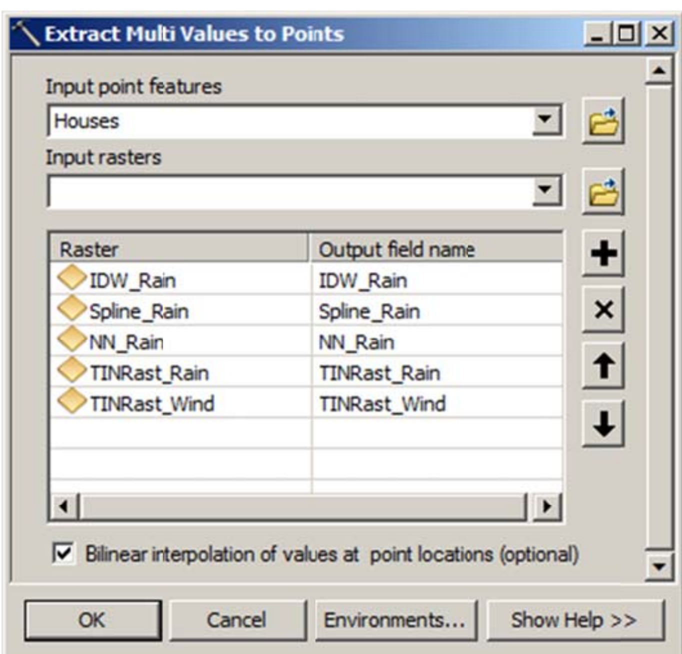
10. In the Table of Contents, click the **minus sign** next to **all of the raster and TIN layers** to collapse their symbologies.

Extracting Data

All of the raster interpolations you have created for wind and rain provide continuous value estimates over the entire hurricane area, but you are only interested in the data values at the particular locations of the individual houses filing insurance claims. You will extract point data for each of the house locations from each of the five raster layers you just created in a database-compatible format for the insurance company to use. Extracting data is one of the most important aspects of data manipulation, since interpolation is useless if the results cannot be taken out of GIS and used for other procedures.

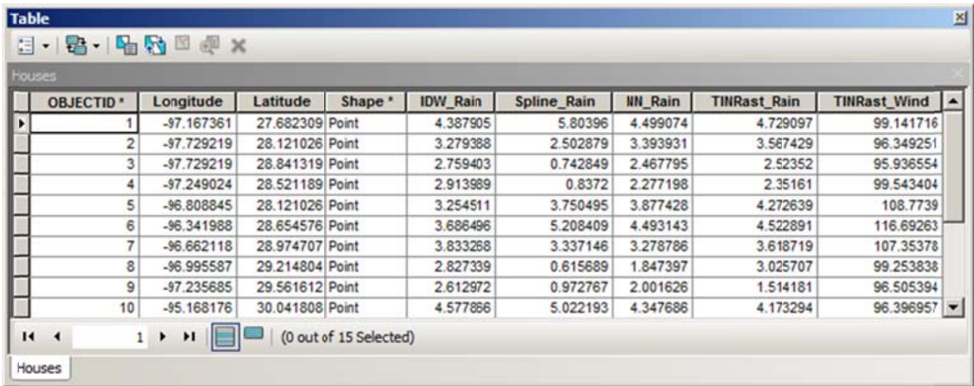
Extracting Multi Values to Points

1. On the Standard Toolbar, click the **ArcToolbox window** button.
2. In ArcToolbox, double-click the **3D Analyst Tools** toolbox to collapse it.
3. Double-click **Spatial Analyst Tools** > **Extraction** > **Extract Multi Values to Points**.
4. Use the 'Input point features' drop-down box to select the ***Houses*** layer.
5. Use the 'Input rasters' drop-down box to select all five interpolation rasters you created earlier one at a time: ***IDW_Rain***, ***Spline_Rain***, ***NN_Rain***, ***TINRast_Rain*** and ***TINRast_Wind***. The order in which the rasters are listed is the same order in which the extracted value columns will appear in the output feature class attribute table.
6. Check **Bilinear interpolation of values at point locations**.
7. Ensure your 'Extract Multi Values to Points' window appears as shown below and click **OK**.



The Extract Multi Values to Points tool simply adds a field for the value of each raster to the end of your existing *Houses* attribute table, which is why you were not asked for an output location.

8. In the Table of Contents, right-click the ***Houses*** layer and select **Open Attribute Table**.



OBJECTID *	Longitude	Latitude	Shape *	IDW_Rain	Spline_Rain	NN_Rain	TINRast_Rain	TINRast_Wind
1	-97.167361	27.682309	Point	4.387905	5.80396	4.499074	4.729097	99.141716
2	-97.729219	28.121026	Point	3.279388	2.502879	3.393931	3.567429	96.349251
3	-97.729219	28.841319	Point	2.759403	0.742849	2.467795	2.52352	95.936554
4	-97.249024	28.521189	Point	2.913989	0.8372	2.277198	2.35161	99.543404
5	-96.808845	28.121026	Point	3.254511	3.750495	3.877428	4.272639	108.7739
6	-96.341988	28.654576	Point	3.686496	5.208409	4.493143	4.522891	116.69263
7	-96.662118	28.974707	Point	3.833268	3.337146	3.278786	3.618719	107.35378
8	-96.995587	29.214804	Point	2.827339	0.615689	1.847397	3.025707	99.253838
9	-97.235685	29.561612	Point	2.612972	0.972767	2.001626	1.514181	96.505394
10	-95.168176	30.041808	Point	4.577866	5.022193	4.347686	4.173294	96.396957

Notice the five new fields added to the end of the existing attribute table which contain the values of each of the five rasters at each house location. Notice also the differences in rainfall estimates resulting from the four different interpolation techniques. At many house locations, the value of the Spline interpolation is the most different from the other interpolation method values.

9. Close the **attribute table**.

You are now ready to export the data table into a format that can be used by the insurance company without having to use ArcGIS software.

10. At the top left of the Attribute Table, click the **Table Options** button  and select **Export…**.

Exporting from the attribute table will export only a data table, rather than a complete feature class, as you exported previously from the Table of Contents.

11. Use the 'Export;' drop-down box to select **All records**.

The output table location defaults to you default geodatabase, but a table saved inside a geodatabase will not be accessible without ArcGIS, so you will need to save the table inside your *InterpolationTutorialData* folder, but outside your *HurricaneData* geodatabase.

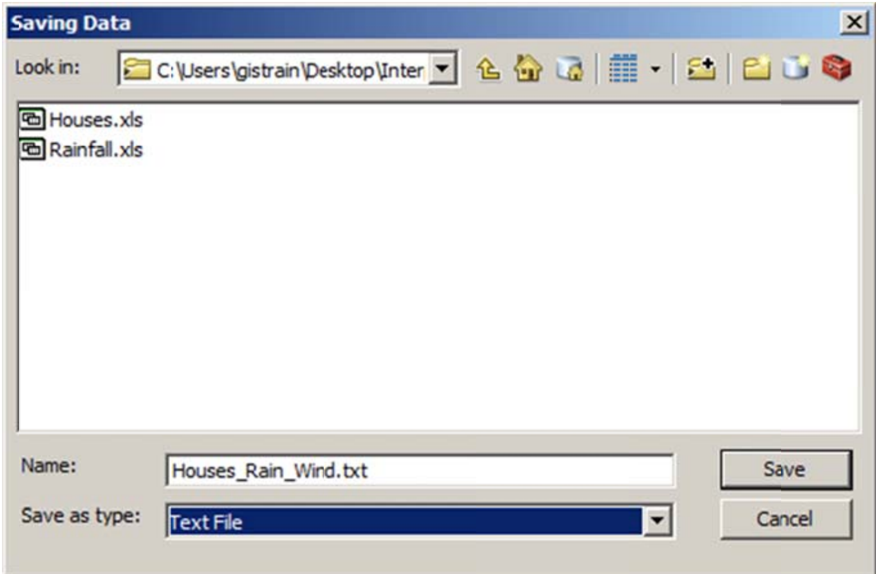
12. For 'Output table:', click the **Browse** button.

13. Use the 'Look in:' drop-down box to select your ***C:\Users\gistrain\Desktop\InterpolationTutorialData*** folder.

14. For 'Name:', replace "Export_Output" with "**Houses_Rain_Wind**".

15. Use the 'Save as type:' drop-down box to select **Text File**.

16. Ensure your 'Saving Data' window looks like that shown below and click **Save**.



17. Click **OK**.

18. When asked if you want to add the new table to the current map, click **No**.

Now you have what the insurance company is looking for: a single text file containing the locations of the houses in question, as well as the corresponding rainfall and wind speed estimates to use in completing a damage quote for your customers.

19. Close the ***Houses*** attribute table.

Note that if you simply wanted a table containing the values of multiple rasters at each point and did not care about symbolizing or working with the points any further in the ArcMap environment, you could have used the Sample tool which outputs a separate table, rather than adding the values to the end of your existing feature class attribute table.

Raster Calculations

Your final project involves working with the raster calculator. The raster calculator performs calculations on a cell-by-cell basis and outputs the calculation results in a new output raster. You will perform a simple calculation using the raster calculator, but the raster calculator can perform many functions, such as adding or subtracting one raster from another, multiplying a raster by a constant, or removing a predetermined "null" value.

For this example, you have learned that the rainfall data collected from the rain gauges had a common discrepancy. Each gauge misrepresented the rainfall amount by two inches uniformly across the state. There are several ways you could approach this problem, but you will add two inches uniformly across the interpolated rain raster to practice using the raster calculator.

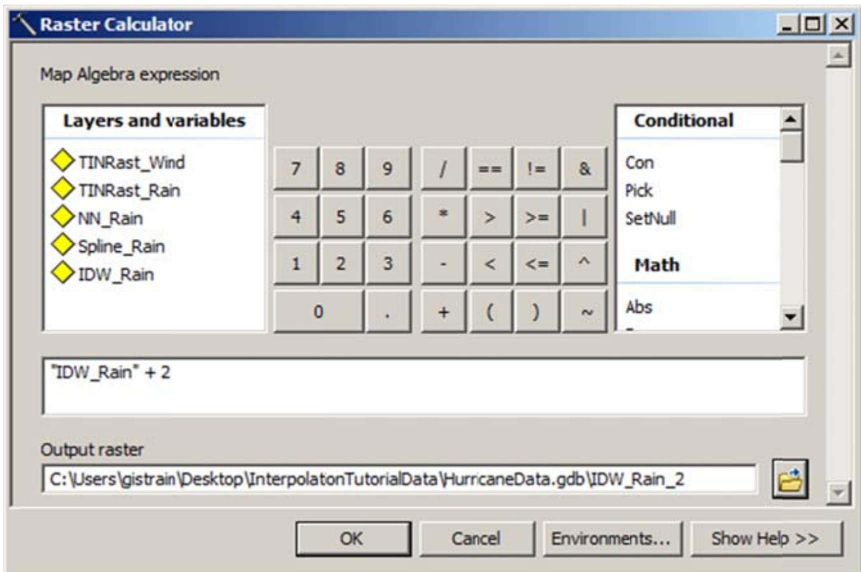
1. In ArcToolbox, in the **Spatial Analyst Tools** toolbox, double-click **Map Algebra** > **Raster Calculator**.

2. Under 'Layers and variables', double-click the **IDW_Rain** layer. (You may need to stretch the 'Raster Calculator' window to be wider to see all options.)

3. Click the **+ 2** (plus two) buttons.

4. For 'Output raster', rename the exported raster from "rastercalc" to "**IDW_Rain_2**".

5. Ensure your 'Raster Calculator' window looks like that shown below and click **OK**.



The new raster will be added to the map.

6. In the Table of Contents, check the **IDW_Rain** layer to turn it on.

7. On the Tools toolbar, click the **Identify** tool.

8. In the Map Display, click **anywhere within the raster layer**.

9. In the 'Identify' window, use the 'Identify from:' drop-down box to select **<Visible layers>**.

10. Again, in the Map Display, click **anywhere within the raster layer**.

In the 'Identify' window, notice that the value of the *IDW_Rain_2* raster is approximately two greater than the value of the *IDW_Rain* raster. Click a few more points to confirm this is true across the raster.

You have now learned multiple methods of interpolating point and line data into raster data and extracting raster data at point locations. You have also reviewed skills from other short courses, including mapping XY data.

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