GIS III: GIS Analysis
Module 1: Spatial Analyst

*** Files needed for exercise: MN_ozone_monitors.xls, MN_tracts_2000sf1.shp

Goals: To learn how to use the Spatial Analyst toolset, specifically interpolation and zonal tools, to perform GIS analyses.

Skills: After completing this exercise, you should be familiar with raster based analyses and the Spatial Analyst toolset.

Mapping point level data:
1. Open ArcMap.
2. Add the table MN_ozone_monitors.xls > sheet 1.
3. Open the table. These are ozone monitoring stations. We can see that they have latitude and longitude, as well as a mean ozone value.

4. Map the monitor stations by right clicking on the table on choosing Display XY Data. The Latitude and Longitude fields should be filled in for you. For the coordinate system choose Geographic Coordinate Systems > North America > NAD 1983. Click ok to get a restricted functionality error, and click ok to map the data.
5. Now add `MNtracts_2000sf1.shp`. Change the coordinate system of the data frame to match that of the shapefile.

6. Export the `Sheet1$Events` layer to a permanent shapefile by right clicking and choosing **Data > Export Data** and saving it to your folder. Name the permanent shapefile something logical like `MN_ozone_monitors.shp`.

7. We now have ozone values at 16 points across the state. However, we want a continuous surface of values so that we can get a value for ozone anywhere in the state.
Interpolation:

1. First, make sure the Spatial Analyst Extension is turned on by going to Customize > Extensions and checking Spatial Analyst.

2. In ArcToolbox, find the Spatial Analyst Tools and click Interpolation. We are going to use the IDW tool, which stands for Inverse Distance Weighted. This is one of many interpolation techniques.
3. In the IDW dialog box, the input point features should be our *MN_ozone_monitors*. The Z value field is the field that contains the value that we would like to interpolate. In this case, it is called **MEAN_OZONE**. In the Output raster box, choose a location and name for your raster. Keep in mind that raster names can only be 13 characters long.

![IDW dialog box](image)

4. Leave the other fields alone for now and click the **Environments** button on the bottom of the dialog box. Click on **Processing Extent** and change the Extent to be the same as the *MN_tracts*. This ensures that the whole state will be covered.

![Environment Settings](image)
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5. Click OK twice to run the tool. A surface is produced. You can change the look and color of this surface in the symbology tab of the raster. We now have an estimated ozone value for every location in Minnesota. You can find the value at any point by using the Query tool and clicking to find the pixel value.

Using Zonal Statistics:
1. Now let’s find the mean ozone value for each census tract in Minnesota. In the Zonal tab of the Spatial Analyst tools, find the Zonal Statistics tool.
2. The Input raster or feature zone data is the layer that contains the zones we want to use. In this case, it is our tracts.
3. The Zone field needs to be a unique ID for each zone we want to use. Since we want each tract to be its own zone, use the FID, which is unique for every tract.
4. The Input value raster is our ozone surface. Choose an output path and name.
5. Make sure the Extent is set to the same as MN_tracts in the Environments window.
6. Finally, choose MEAN for the statistics type (or another type if you prefer).

(zone field in below graphic should read FID)
If you have time...
Try out some other interpolation methods like kriging or spline and see how they change the results.