GIS Level 2: ArcGIS Pro Workshop Exercises

Exercise 1: Map projections

Map projections, also called Coordinate Reference Systems (CRS) can be viewed or changed using GIS software.

1. Examine the data in GIS_Level2_Data\workshop_exercise. Is there a projection file for each dataset?

Note that cambridge_dem is a raster dataset and uses a .tfw file (known as a "world" file), which contains the information needed to transform image coordinates to real-world coordinates. Shapefiles use a .prj file, which includes the coordinate system information.

2. Open ArcPro. Click the Map option under Blank Templates and save it to your working folder.

3. Add the following two data layers from GIS_Level2_Data\workshop_exercise

    a. MBTAbusroutes

    b. CambridgePlaygrounds

4. Right click on CambridgePlaygrounds and select Zoom to Layer.

    Do the playgrounds and bus routes seem to be in the correct locations?
    They should be since both layers had a defined projection (.prj) file.

5. Right click on CambridgePlaygrounds and select Properties.

6. Select the Source tab and expand Spatial Reference.

    What is the coordinate reference system?
    There are two, a projected coordinate system of NAD83 / Massachusetts Mainland (ftUS) and a geographic coordinate system of NAD 1983.

7. Do the same for the MBTAbusroutes data layer. What is the coordinate reference system?

8. Close the Properties box and select the Analysis tab and Tools.

9. Search for Project and open Project (Data Management Tools).

    We will use the Project tool to change the projection of the playgrounds so that it is the same as that of the bus routes. There is also a tool called Define Projection that is used to assign a projection to a data layer that does not already have one or has one that is incorrect. Our map projections appear to be correct so we do not need to use this tool.

    Although not always required, your analysis results may be more accurate if your data layers are in the same projection. If you want to calculate the proximity of playgrounds to bus routes, you would first want to make sure the projections of both data layers are the same.

10. Choose playgrounds as the Input Dataset.
    a. Save your output dataset in your working folder.

b. Click the Output Coordinate System dropdown menu and select MBTAbusroutes. ArcGIS Pro will automatically fill in the coordinate system of NAD_1983_StatePlane_Massachusetts_Mainland_FIPS_2001.

c. Click Run.

11. Add the data layer to your map if it was not added automatically.

Exercise 2: Access basic analysis tools

Tools can be accessed in a variety of ways in ArcGIS Pro:

- A subset of tools are located on the Analysis tab.
- Some tools are available by right clicking a layer.
- Click (Analysis > Toolbox) or (View > Geoprocessing) to see all available tools. You can search for a tool by name or click the Toolboxes tab and open a specific toolbox. This is a good way to see the different types of tools available to you.

1. Add MBTA_NODE to the map from GIS_Level2_Data\workshop_exercise.
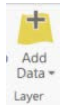
2. Click View > Geoprocessing and search for the buffer tool.

3. Open Buffer (Analysis Tools).

How do you know what each input and parameter should be or if you need it? Try clicking the question mark to learn more about this tool and its parameters.

4. Select the MBTA_NODE as your Input Features from the dropdown menu. Choose a location to save your buffers in the Output Feature Class box.

5. Enter a Distance of 1000 meters and Run the tool.

6. Turn off your buffers after you have looked at the layer.

The interface for all tools looks similar in ArcGIS Pro, with most requiring input data, an output location, required parameters, and optional parameters.

Exercise 3: Use raster tools

Different tools can be used with raster data versus vector data, although the output could be a vector, raster, or table, depending on the tools. There are also tools that allow you to convert from one data type to another.

1. Add the cambridge_dem.tif to your map. It may take a minute to load.
2. We will start by changing the symbology so it is easier to see, which you may remember from GIS Level 1.
   a. Right click on the cambridge_dem and select Symbology.
   b. Change the Primary Symbology dropdown to Stretch.

   c. Close the Symbology window when you are finished.
3. Open the Geoprocessing window if it is not already. Search for contour. Open Contour (Spatial Analyst Tools).
4. Select the dem as your Input raster and choose an output location.
5. Type 5 for the Contour interval. What are the units of this interval? How might you figure it out?
6. Click Run.

You will notice that the output is a vector line layer, which could then be exported to other programs or used as input for vector analysis tools.

Exercise 4: Use the spatial statistics toolbox

As mentioned above, toolboxes can be a good way to learn about the variety of tools available to you and to also find tools that are similar to others.

1. Add the file median_income_suffolk_ma to the map.

2. Click View > Geoprocessing to open the Geoprocessing window.

3. Click the Toolboxes tab and expand Spatial Statistics Tools > Mapping Clusters. Open Cluster and Outlier Analysis (Anselin Local Moran's I).

4. Choose median_income as the Input Feature Class. Use VALUE0 as the Input Field, which is the median income value. See the text file in the workshop_exercise folder for the attribute field information.

5. Choose an output name and location.

6. Leave the default values for now. In the future you have the option of changing the parameters to define neighborhoods in different ways. Run the tool.

7. At the bottom of the tool window, a box indicates that the tool ran with warning. Click the View Details link to read more about this. The warning indicates that the tool used a value of 2266 meters to define the neighborhood, which is determined to be optimal for our data based on the inverse distance relationship. Close the Detail window.

8. Where are there clusters of high and low income? The tool has also output a histogram and scatterplot that you can examine by double clicking on them. Turn off the income data layers when you are finished examining them.

The Moran scatter plot provides a classification of spatial association into four categories, corresponding to the location of the points in the four quadrants of the plot. These categories are referred to as High-High, Low-Low, Low-High and High-Low, relative to the mean, which is the center of the graph.

You can learn more about the statistics used in the Moran's I calculation here:

https://pro.arcgis.com/en/pro-app/tool-reference/spatial-statistics/h-how-cluster-and-outlier-analysis-anselin-local-m.htm