Lab Assignment 8 – 3D in ArcGIS Pro, QGIS, GeoDa and GIS Modeling

Due Date: 11/06/2020

Part I – 3D in ArcGIS Pro

ArcGIS Pro has an integrated 2D-3D environment. It allows the users to work with data, maps, and scenes along wide one another, switching between maps and scenes as well as link them together for a synchronized viewing experience.

Launch ArcGIS Pro. Add the data from "Raster" folder.

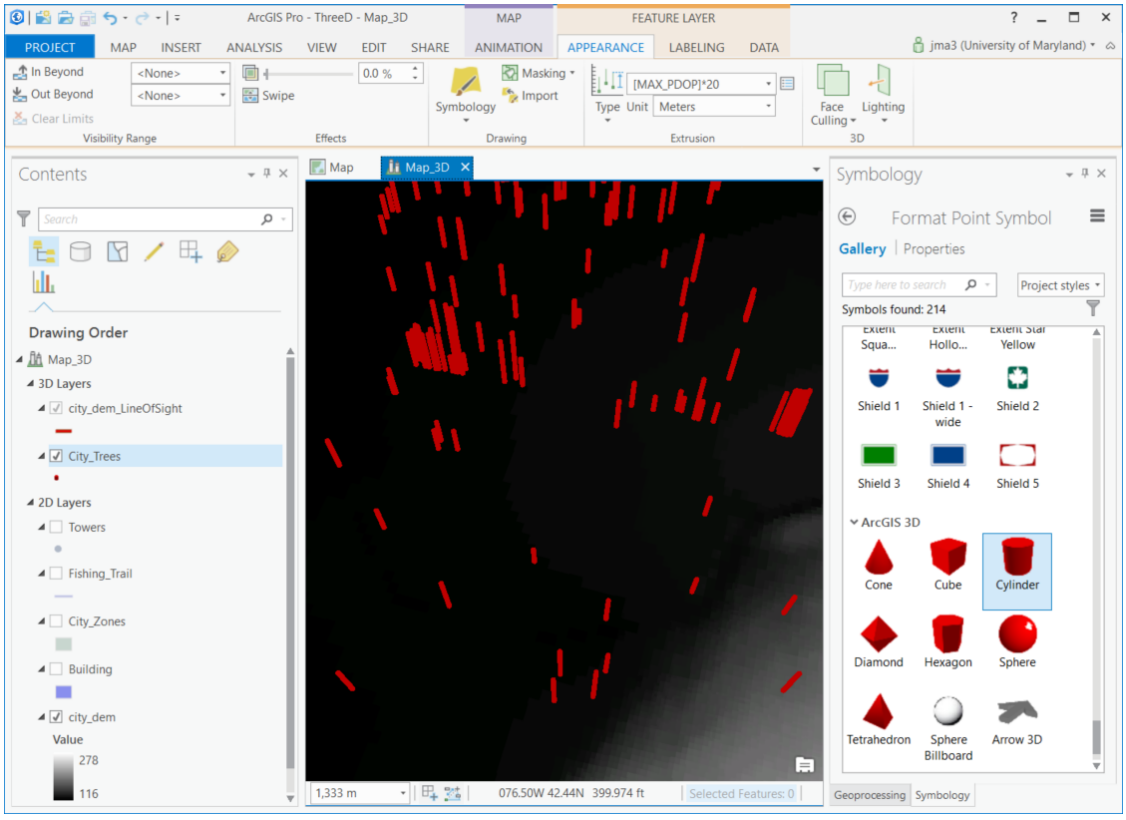
Extrude the trees into 3D.

Follow these steps to extrude features:

- Select the feature layer you want to extrude in the Contents pane.
- Under Feature Layer, on the Appearance tab, in the Extrusion group, click the Type drop-down arrow. Choose a feature extrusion type.

You will create something similar to the screen shot below. However, you can be creative on color or symbols.

[1] Make a screen shot of ArcGIS Pro displaying the 3-D map and include in report.



Next task is to create a photorealistic 3D visualization.

Remove the extrusion setting for trees.

Note:

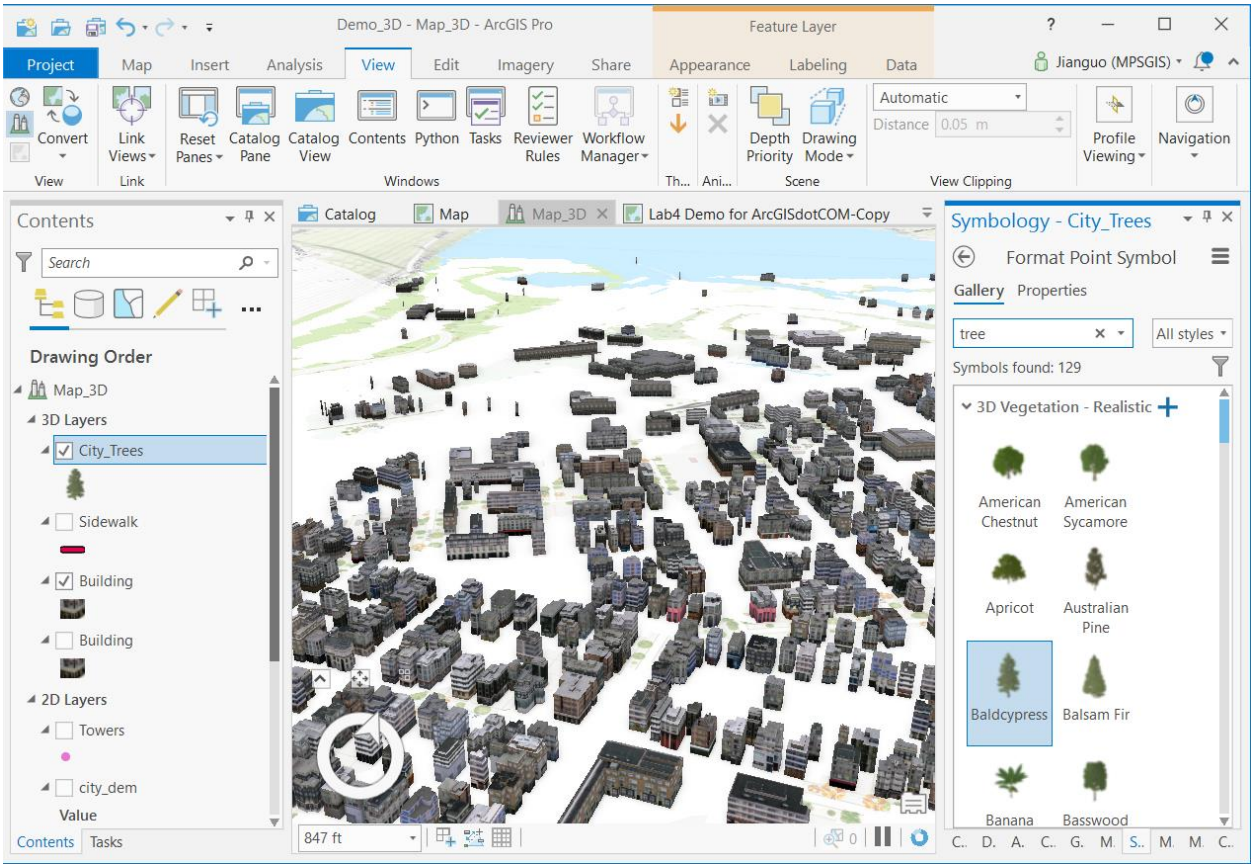
- Combining extrusion and realistic 3D symbols does not work in desktop ArcGIS and ArcGIS Pro.

Click on the symbol to change the symbology.

Search “Tree” in the Gallery. See the screenshot below.

Note:

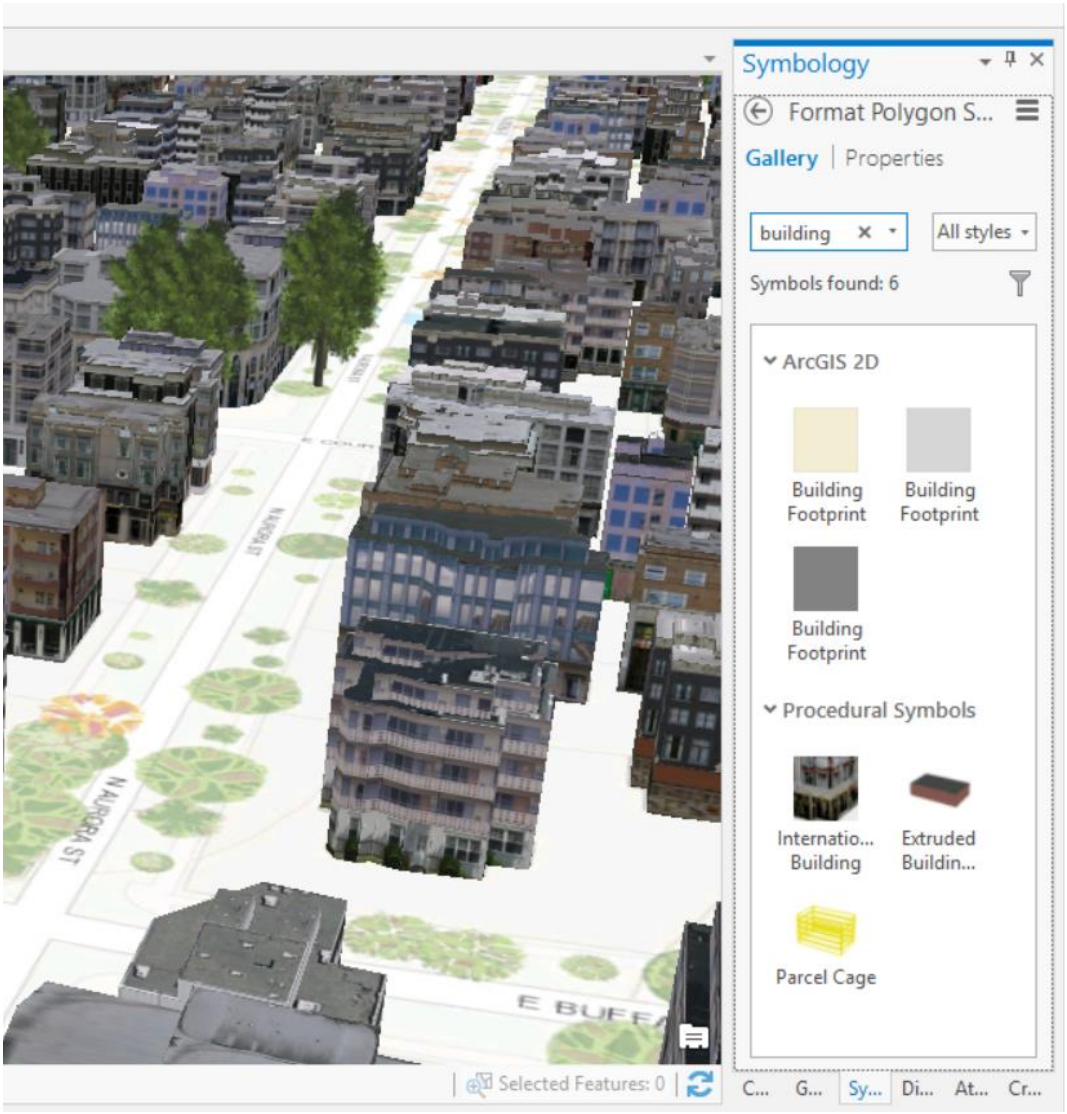
- Make sure you type exactly “tree”, not “trees” when doing this search. Otherwise, the 3D symbols are thematic, not realistic.



Now, continue to work on the building data.

Add it to 3D layers.

Then, change the symbology. Choose “All styles” and then search by using the keyword “building”.



Select “International Building”. You should get a similar result as shown in the image above.

[2] Make a screen shot of ArcGIS Pro displaying the 3-D map and include in report.

If not clear, you can refer to the demos in lab session video archive. And if you want to learn more about making 3D scene, you can read more through this link - http://pro.arcgis.com/en/pro-app/help/mapping/map-authoring/scenes.htm

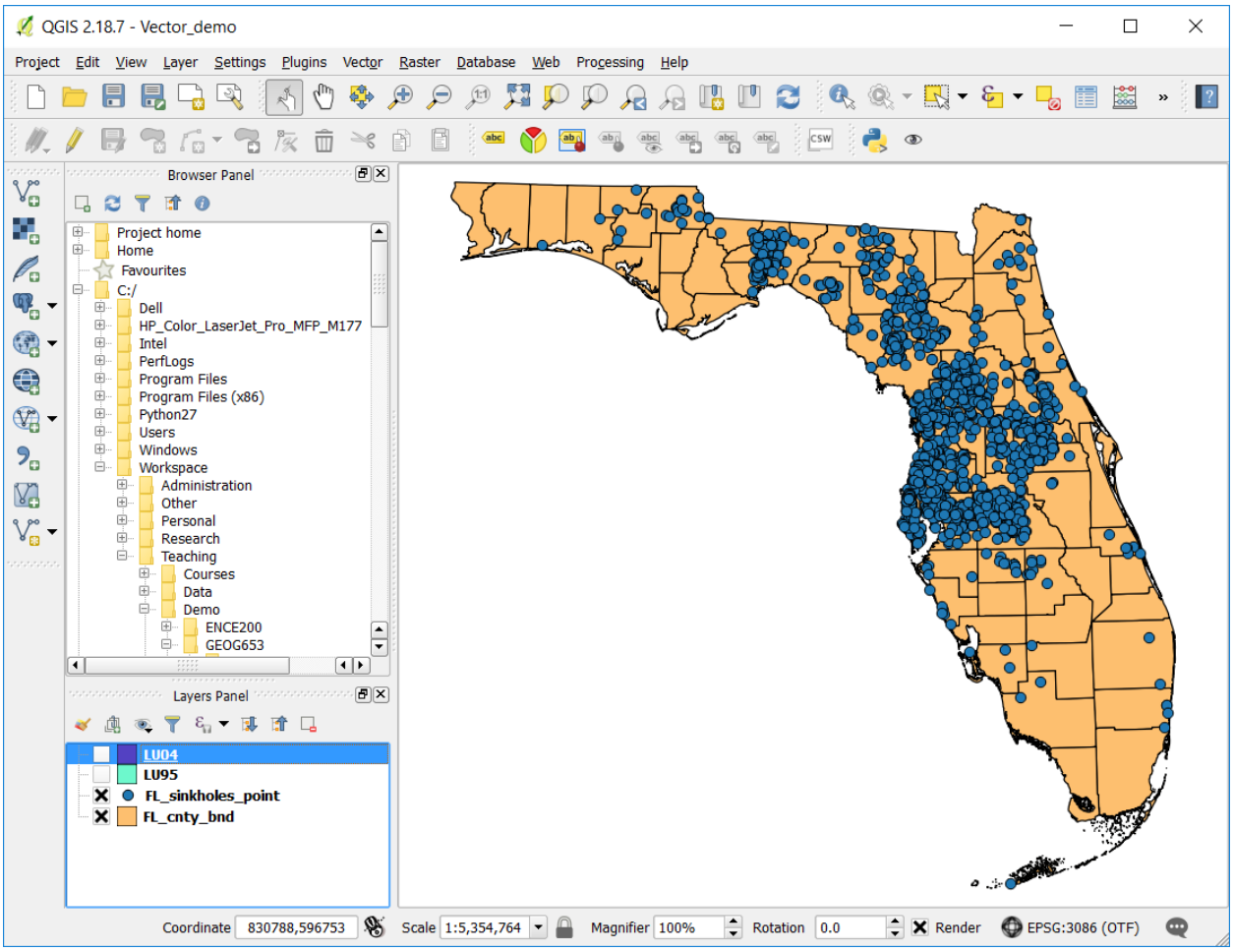
Part II – Working with QGIS

QGIS is probably the most popular and widely used open source GIS software. Even though it is not as powerful or complete as ArcGIS, QGIS has some unique features and functions/tools that you should be aware of. In this exercise, you are going to learn the basics of QGIS including: QGIS interface, adding data, manipulating/processing data, working with tables, analyzing data, and making maps.

Firstly, you need to download and install QGIS: http://www.qgis.org Make sure you choose V3.10 which has been tested to be stable.

Working with Vector Data

Now, you can add the data from the data folder – QGIS/Vector.



You are required to complete these tasks:

1. Create a new layer to show the centroids of the counties.

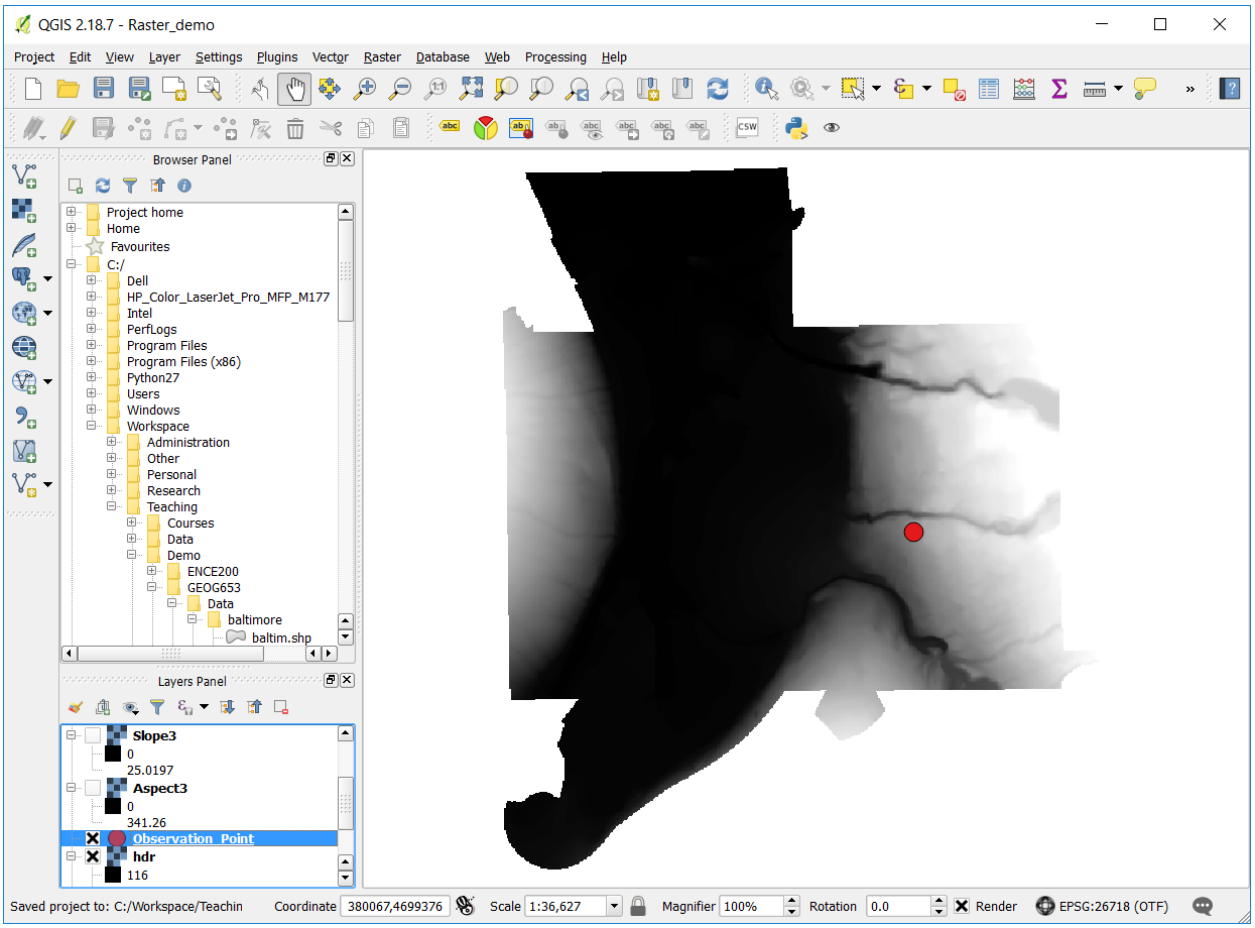
- [3] Make a screen shot of the output layer and then include it in the lab report.

2. Do an analysis to find out the number of sinkholes in each county.
   - [4] Make a screen shot of the table and then include it in the lab report.
3. Do a Union geoprocessing operation on the LULC data (LU95 and LU04).
   - [5] Make a screen shot of the Union output table and then include it in the lab report.

If you have difficulty to complete these tasks, you may refer to the video archive of the lab session this week.

Working with Raster Data

Now, you can start a new QGIS window. Add the data from the folder – QGIS/Raster.



Click on "Plugins" on the menu bar and then select "Manage and Install Plugins…". From the list, find and install Visibility Analysis plugin.

You are required to complete these tasks:

1. Create a Slope surface based on the DEM

- [6] Make a screen shot of the output surface and then include it in the lab report.

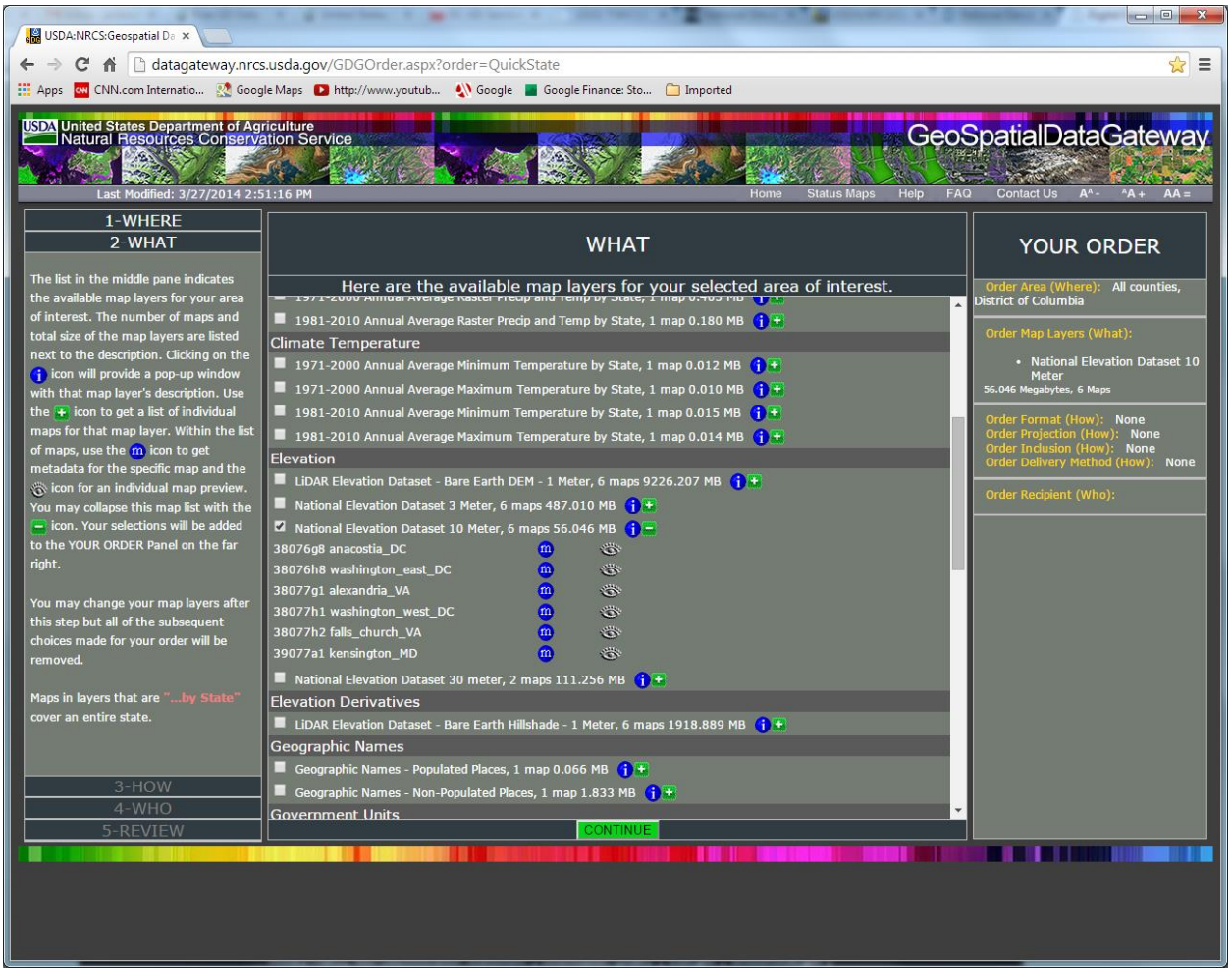
2. Create an Aspect surface based on the DEM
   - [7] Make a screen shot of the output surface and then include it in the lab report.
3. Create a viewshed surface based on the DEM and the observation point.
   - [8] Make a screen shot of the output surface and then include it in the lab report.

In Exercise #5, you have already practiced creating a DEM of Washington D.C. with ArcGIS.

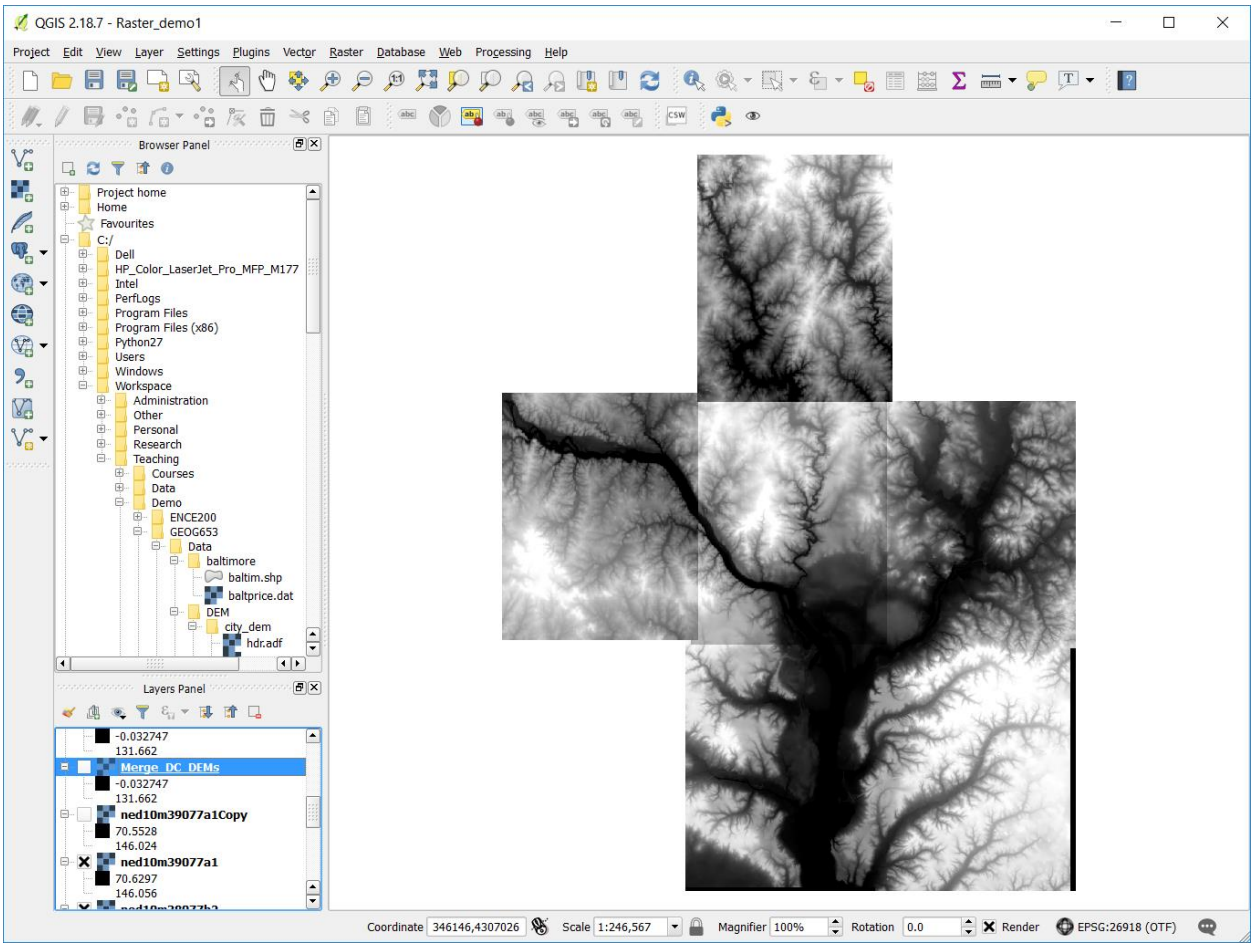
Now, you can try to create the same data using QGIS.

The following questions #9-12 are optional and for your practice only.

First, you can download the original DEM tiles from here - http://datagateway.nrcs.usda.gov/GDGOrder.aspx?order=QuickState



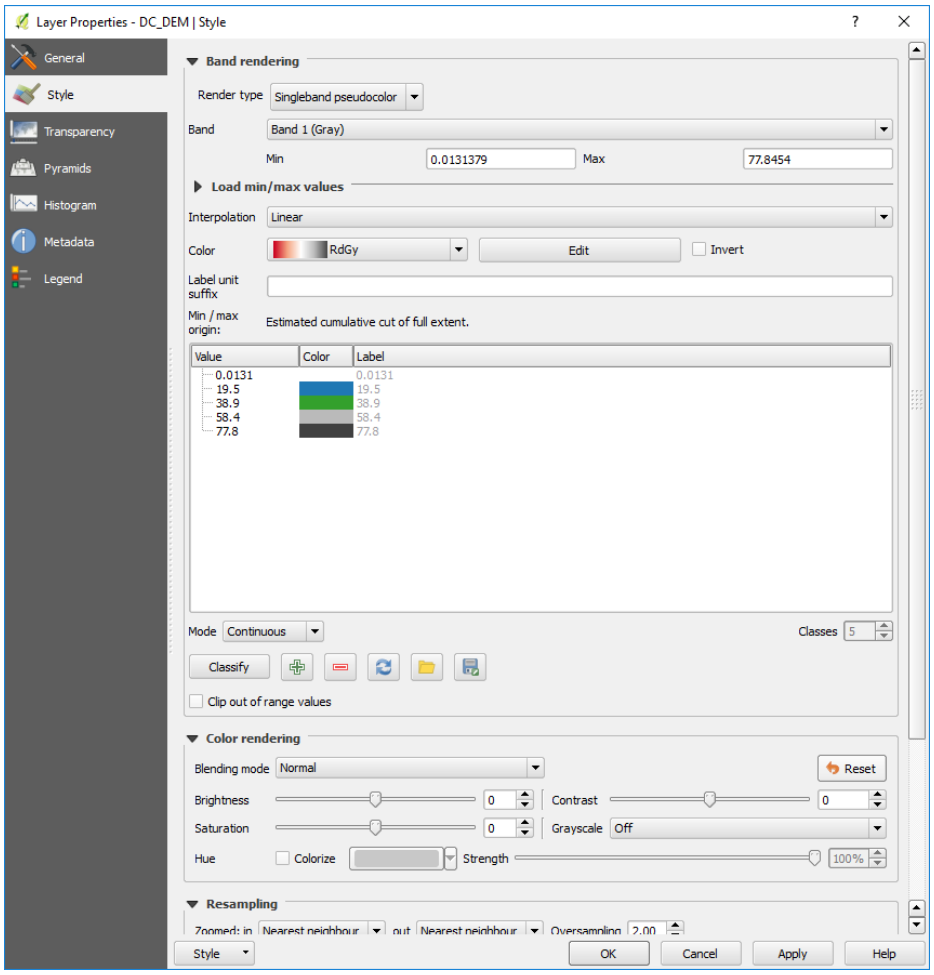
After downloading the DEM tiles, you can add them into QGIS as shown below.



Now, you will need to merge (i.e. mosaic) the tiles into a single DEM and then extract only the portion that is within DC boundary.

The requirements for this exercise:

- Combine the DEM tiles to cover the entire DC region. In QGIS, you can find the tool from the menu bar – **Raster > Miscellaneous > Merge**.
    - [9] Make a screen shot of the output and then include it in the lab report.
- Extract the DEM based on the administrative boundary in Raster folder - tl_2016_11_cousub.shp (https://catalog.data.gov/dataset/tiger-line-shapefile-2016-state-district-of-columbia-current-county-subdivision-state-based) (Note: Remember to check and track the coordinate system of the data that you are using.)
- Also change the symbology so that the new DEM is displayed in color and those cells with "no-data" are invisible. (see my demo example below) You can choose your favorite color ramp. Based on my experiences, it is recommended that you modify the colors assigned from classification. For example, you may want to choose the color "White" for the class with the smallest values which
    - [10] Make a screen shot of the output and then include it in the lab report.


Layer Properties - DC_DEM | Style
General
Style
Transparency
Pyramids
Histogram
Metadata
Legend
Band rendering
Render type
Singleband pseudocolor
Band
Band 1 (Gray)
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0.0131379
Max
77.8454
Load min/max values
Interpolation
Linear
Color
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Edit
Invert
Label unit suffix
Min / max origin:
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Value
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Label
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Mode
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Classify
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OK
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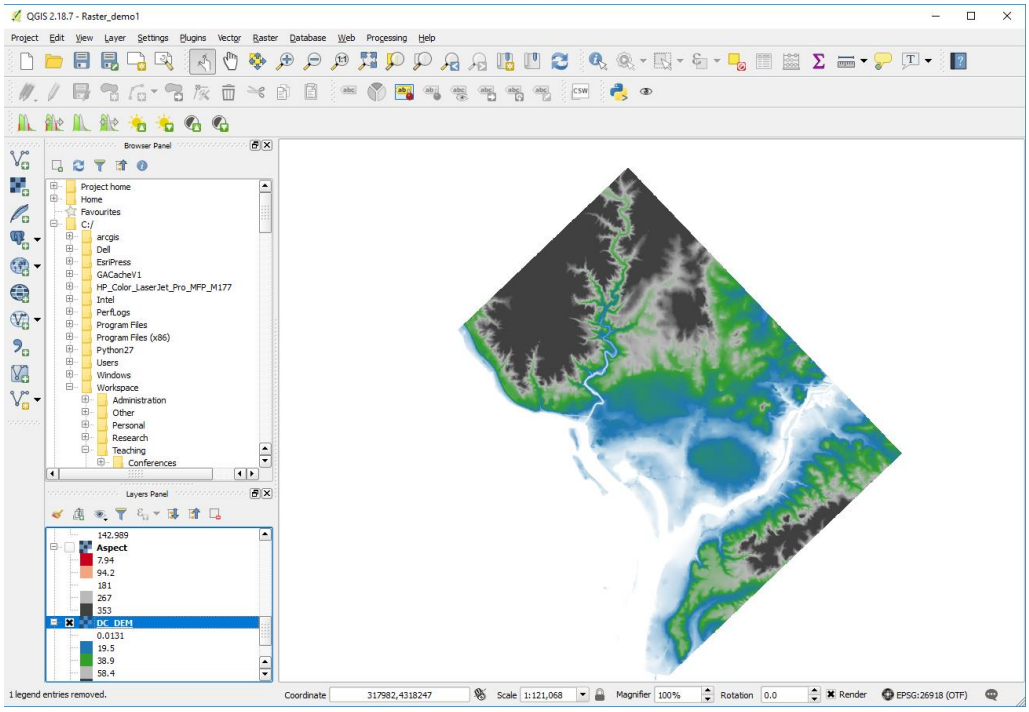
QGIS 2.18.7 - Raster_demo1
Project
Edit
View
Layer
Settings
Plugins
Vector
Raster
Database
Web
Processing
Help
Browser Panel
Project home
Home
Favourites
C:/
arcgis
Dell
EsriPress
GACacheV1
HP_Color_LaserJet_Pro_MFP_M177
Intel
PerfLogs
Program Files
Program Files (x86)
Python27
Users
Windows
Workspace
Administration
Other
Personal
Research
Teaching
Conferences
Layers Panel
142.989
Aspect
7.94
94.2
181
267
353
DC_DEM
0.0131
19.5
38.9
58.4
1 legend entries removed.
Coordinate
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Scale
1:121,068
Magnifier
100%
Rotation
0.0
Render
EPSG:26918 (OTF)

Once you have DEM ready, you can start to use it to do some analyses.

Your first task is to create a slope

[11] Make a screen shot of the output and then include it in the lab report.

Then, you will create an Aspect surface.

[12] Make a screen shot of the output and then include it in the lab report.

You can further explore raster analysis in QGIS. You may want to try out the Viewshed analysis, for example. You can refer to the video archive of the lecture if needed.

Part III – Working with GeoDa

GeoDa is a free and open-source software program that conducts spatial data analysis, geovisualization, spatial autocorrelation and spatial modeling. It is also used as an introduction to spatial data analysis.

GeoDa is a rather simple GIS software with limited features and functions comparing to ArcGIS software or QGIS. For example, it only works with shapefiles and tables. And it can deal with only point and polygon features. However, it has some unique tools and is specialized in spatial statistical analysis.

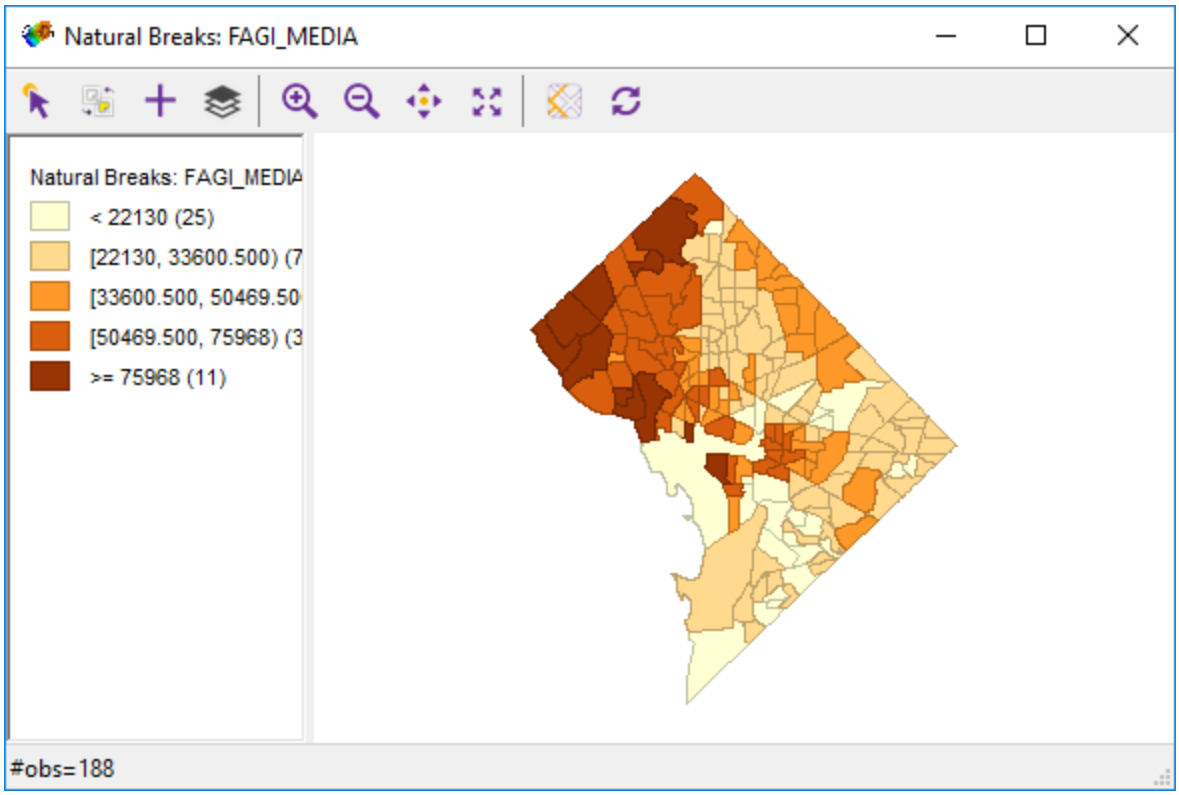
To learn more about GeoDa, you can refer to these resources:

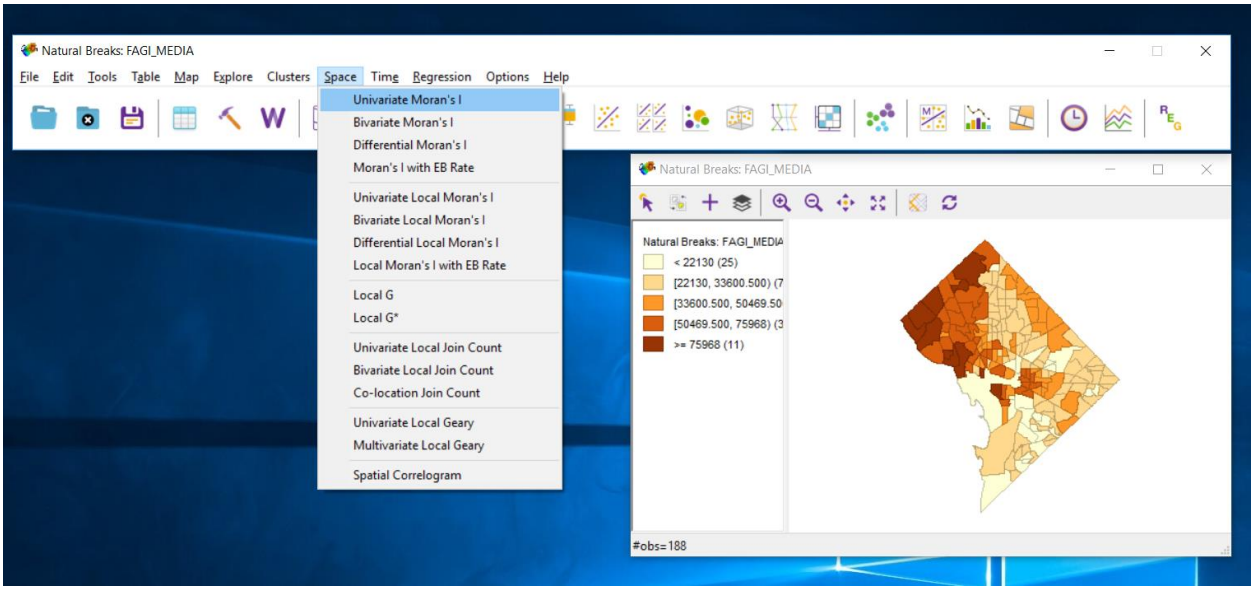
- OpenGeoDa
  - http://geodacenter.github.io/index.html
- Version 1.16 (10/26/2020)
  - Runs on a variety of platforms
  - http://geodacenter.github.io/download.html
- GeoDa tutorial
  - http://geodacenter.github.io/documentation.html
  - https://spatial.uchicago.edu/sample-data

In this exercise, you will use the Census Tract data from the folder “DC_Data”.

The first task is to use Moran’s I to investigate the median federal aggregated income (FAI) values by census tracts to find out whether these values are clustered or not.

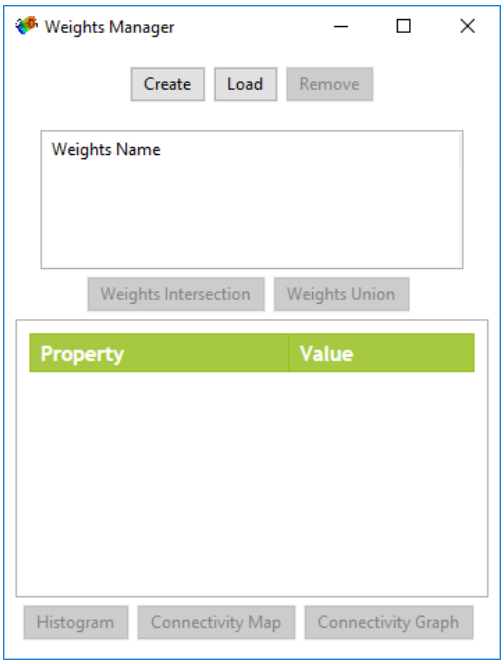
You can display the data based on these values. The patterns on the map (see the image below) can be misleading because they will look very different when you use different classification methods or different number of classes. Therefore, it is important to test the clustering with more robust methods or tools such as Moran’s I.

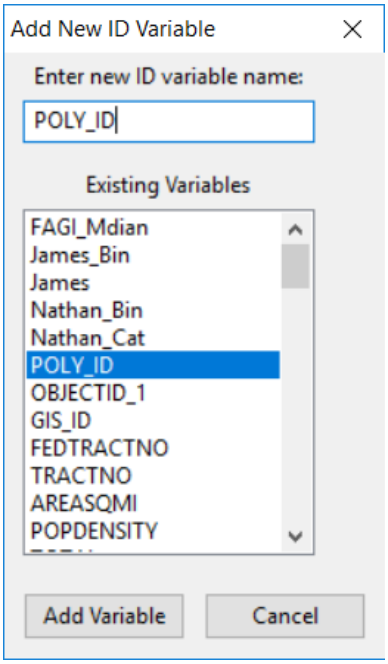


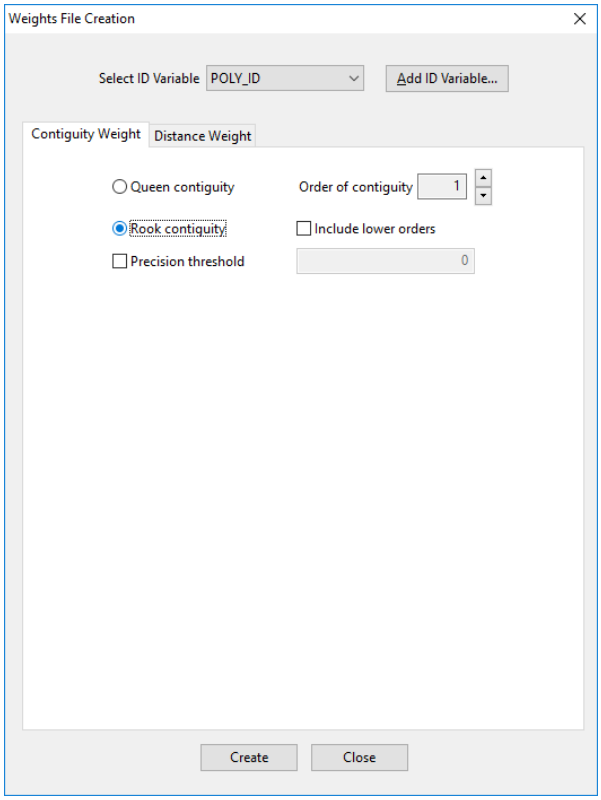


First, you will need to create a "weights file" which basically defines the spatial weight matrix. You will need to click Tools and then select Weight Manager.

As of the specific steps, you can use the following screenshots as hints.







Once you run the Univariate Moran's I tool, take a screenshot of the output diagram.

[13] Include the screenshot in the lab report and also discuss the result to decide if the values are clustered or not.

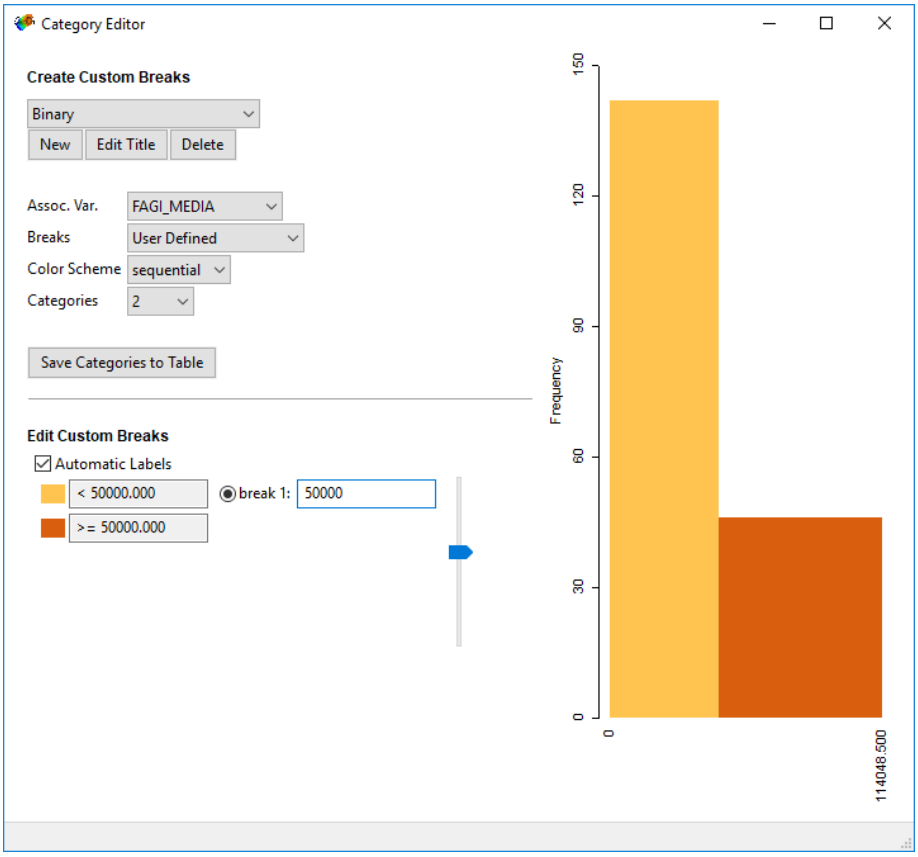
Join Count Analysis is a method to investigate spatial autocorrelation. It is specifically used for contiguous areas that have category attributes (i.e. nominal data), for example, election zones of "Yes" or "No".

Unfortunately, there is no corresponding tool in the toolbox of ArcGIS software. However, it is provided in GeoDa.

In this part of exercise, you will classify the median federal aggregated income (FAI) values into two categories. Then, you will use Join Count Analysis to find out whether these categorical values are clustered or not. Specifically, you will use the tool - Univariate Local Join Count to investigate whether there is clustering or not.

The first step is to create a category variable to be added in the attribute table. Suppose we want to classify the FAI values into two categories: less than $50,000; at least $50,000.

Click o Edit and then Category.

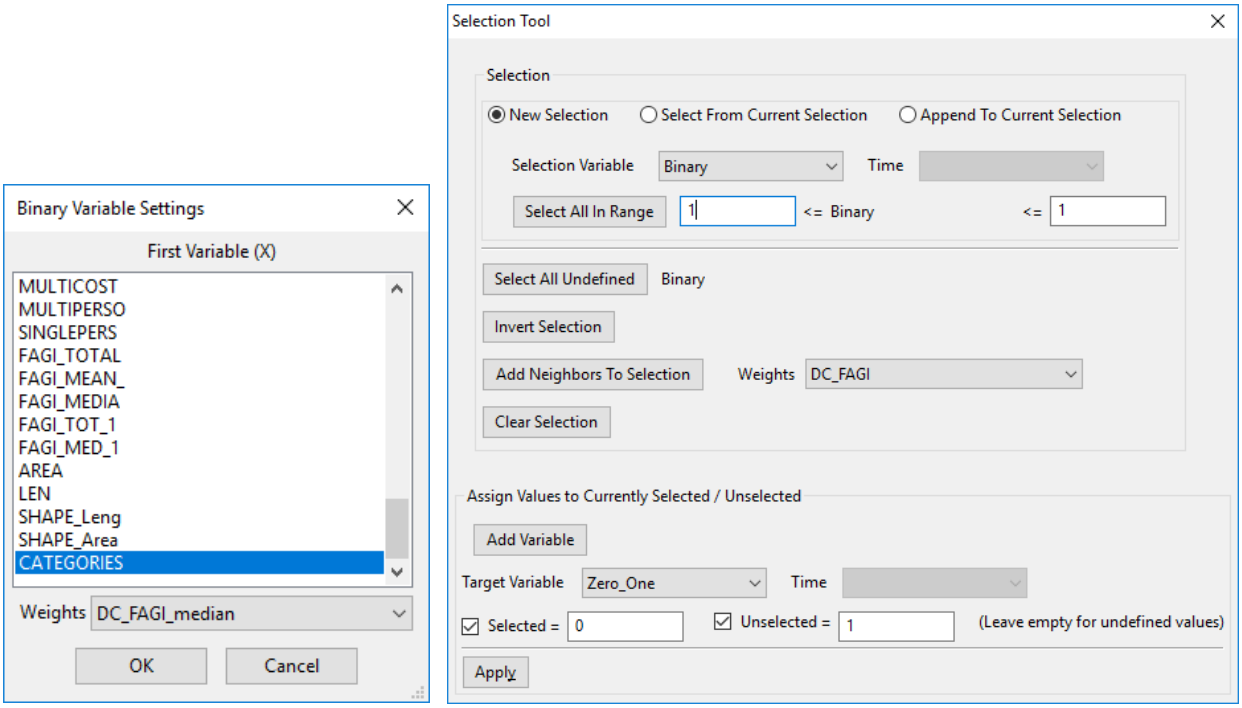


This new category variable can be directly used for Join Count Analysis because the values need to be 0 and 1. However, a category with values (1 and 2) are not considered binary. Therefore, you will need to find a way to convert these categorical numbers into 0 and 1.

Note: Make sure to click the button - "Select All in Range".

You will need to create a new variable in the attribute table and then calculate its values based on the category variable.

Click on Table and then choose Selection Tool.



You will need to have a weight file to run the Univariate Local Join Count tool. In this case, you will use the same weights file you created in previous task.

As of the specific steps, you can use the following screenshots as hints. You can also refer to the video archives of the lecture from last week.

Once you run the Univariate Local Join Count tool, take a screenshot of the output diagram.

[14] Include the screenshot in the lab report and also discuss the result to decide if the values are clustered or not.

Part IV – Using ModelBuilder

In this exercise, you are going to use ModelBuilder to carry out a simple project on modeling with vector data.

Let's say that you are the CEO of a real estate development company and you want to find the best places in ***Hillsborough County*** where you may want to develop new houses (not a particularly good time right now, but, anyway…)

The new places must meet the following criteria:

- **Must be within 6 km from those principle arterial roads** (*i.e. RURAL: Principal Arterial – Interstate; RAL: Principal Arterial – Other; URBAN: Principal Arterial – Interstate; URBAN: Principal Arterial – Other; and URBAN: Principal Arterial - Other Freeways and Expressways*)
- **Must be 1 km away from those principle arterial roads**
- **Must not be in "Area III" type of soil composition area which tend to have the highest occurrence rate of sinkholes**
- **Must be outside of the buffer zones of those existing sinkholes**
    - The buffer distance varies and is dependent on the size of each sinkhole.
    - The buffer distance is defined as: **½*(sinkhole_length + sinkhole_width)*10**
    - You need to find the sinkhole dimension fields from the metadata.

After you finished the project, make a screen shot of ArcMap which should show only the final output layer and Hillsborough County boundary layer.

Also briefly describe how you carried out the project. It is the best to use ModelBuilder to create a model which will be self-explanatory.

You can also try to set some of the variables as parameters, for example, the inputs, buffer distance, etc. This will be more efficient when trying to investigate "what-if" questions.

[15] Include the screen shot of the output and also the description in your report.

----- THE END -----