EHS207: Intro to GIS and Public Health
Lab Assignment 3 – Multi-criteria Decision Analysis

In this lab exercise you will use your GIS and spatial analysis skills to select areas for an asthma intervention program and create a personal geodatabase in ArcGIS.

Part 1: Multi-criteria Analysis and Overlay

You have been hired by a public health interest group to help them delineate areas for an intervention into community areas for those at greatest risk of suffering from exacerbated asthma symptoms. They are concerned with 5 major risk factors: access to smoking, proximity to expressways, socioeconomic status and ambient air pollution. The survey and field work has already been conducted to catalog the number of subjects with asthma and the number of stores that sell tobacco. You will find this information in a database file called tobacco_asthma.dbf. These data are referenced to the ID field (GEOID) of the census block group shapefile called blockgroup_studyarea.shp; this layer delineates your study area. *Note that the files are not in the same spatial reference systems.*

You will have to determine areas that satisfy all of the following conditions:

1. Areas must be within 1000 meters of an expressway from the road network (streets_studyarea.shp). Expressways are categorized by having a route class value (CLASS_RTE) of 0, 1, or 2. *(What I did: Import shapefiles starting with the "blockgroup." Set the projection to NAD 1927. Then create multiple ring buffer for expressways within 1000m distance)*

2. The median household income at the block group level must be less than or equal to $30,000. *(What I did: click blockgroups layer > selection menu > select by attributes > income <= 30000 > ok> right click blockgroups layer > create layer from selected features)*

3. To maximize the public health group's efforts, you will ensure that there is a threshold density of asthmatics in the block group area greater than or equal to 300 asthmatics per square kilometer. *(Made sure all projections are NAD1927 in projected coordinate systems > continental > NAD 1927 to match with NAD1927 geographic coordinate systems of each shapefile. Join the blockgroups to tobacco_asthma table > by GEOID field > add field called "asth_d" using FLOAT type > right click for calculate geometry tool > property: area, selected use coordinate system of data frame, units sq km. Next step use field calculator for a new field "AsthD300K" > divide asthma by asthma*

density. Last step, select by attributes in the table, select where previous field >=300 > create new layer from selected features.)

4. Air pollution can be a trigger for asthma symptoms; as such, you want to select areas that are greater than the average exposure gradient in the study area. After determining the average exposure level in the study area, you will have to process the grid further. Because individuals rarely stay in one place, we are concerned with their potential activity space. The public health group decided that 500 meters was a reasonable activity space for general activity such as walking to the convenience store, going to the mailbox, etc. You will have to compute the average exposure within 500 meters of any location and then select those areas that have average exposures greater that the overall average gradient in the study area. Hint: you will have to perform a neighborhood calculation on the pollution surface NO2_LA.

You can use the raster file that I created for you Download the raster file that I created for you to proceed. This raster file is the area that have greater air pollution than the average exposure gradient in the study area. You can then convert this raster file to a Polygon Shapefile, and then proceed with your analysis. (*What I did: Use conversion tool in toolbox > from raster > from raster to polygon > value = count)*

What tools you need to use in order to do this step (part 4)? Where you find these tools and why? Why the final raster file I provide to you is in integer format instead of float format? Please write a step-by-step method. (At least 4 major tools will be used.)

To calculate average exposure within 500 meters of any location I used the ***Focal statistics tool*** *with these criteria: Input raster: Data, Neighborhood: circle, radius: 500, units: map > ok. Why:* This tool allows calculation of a statistics of values in neighborhoods around it. I called this the output raster. *I then used* ***Cell statistics tool*** *to calculate the mean (average) of the data raster (overall average gradient). Input raster was the overall one (not the 500 meters). Mean was 22.31. Why:* This tool was used to calculate the mean statistic in order to find out what the overall average gradient in the entire study area was. *After this, I used the* ***Raster calculator tool*** *with the following steps: Output raster >= 22.31 to find those that meet criteria (typed in "OutputRaster" > 22.31). I got an output value with 0 and 1 and changed the color to 0 white and 1 black. Why:* I did this in order to find the output raster (average exposures within 500 meters) that had average exposures greater than the overall average exposure in the area. *The focal statistics, cell statistics, raster calculator were all found under spatial analyst. In the last step I used the conversion tool in toolbox called* ***Raster to Polygon*** *using the following inputs: from raster > from raster to polygon > value = "count" in order to convert the raster to a polygon.* The raster file provided is in integer format because it is a requirement from ArcGIS in order to be able to convert the raster to a polygon (https://desktop.arcgis.com/en/arcmap/latest/tools/conversion-toolbox/raster-to-polygon.htm).

5. Because smoking can be a trigger for asthma and we don't have smoking rates, we will use the number of stores that sell tobacco as a proxy metric. You will additionally select areas that have more than 25 stores per square kilometer. (*What I did: Kept joined tables between block groups and tobacco asthma table from step 3 > add field called tob_dens using FLOAT type > right click for calculate geometry tool > property: area, selected use coordinate system of data frame, units sq km. Next step use field calculator for a new field called TOB_25k using short interger> divide tobacco by tobacco density field. Last step, select by attributes in the table, select where* ***previous field >25*** *then create new layer from selected features.)*

Your final answer will be a map showing those areas that satisfy all of the above five criteria.

Create a map with only the solution. Use the "New Text" tool to write your name in the lower right hand corner of the map before exporting it to a .pdf file. Attach a copy of the map to your assignment. (*What I did: Use the intersect tool for this, make sure files are in geodatabase first. Then dissolve multicriteria layer to eliminate lines between the block group. Dissolve by FID and sum FID from previous layers.)*

Part 2: Personal Geodatabase

You are going to create a personal geodatabase that includes the **final** shapefiles you used to satisfy criteria 1 through 5 and your final solution. Note: if it took you multiple steps with intermediary shapefiles to create a feature to satisfy any given criteria, please don't include the intermediary files. Do not include any raster data in the geodatabase.

Ensure that you assign spatial referencing correctly using the original files and respective spatial referencing. You will name the geodatabase according to the convention *yourfirstnameinitial_lastname_geodatabase.gdb.* You will archive the geodatabase using the .zip format and upload to BruinLearn.

TO SUBMIT

-map(s) of your MCDA. (at least one composite.) -TO BruinLearn
-brief write-up of your methods and discussion/observations -TO BruinLearn -personal file
Methods are listed in blue italics: "*(What I did…)"*
Discussion: There were two expressways along the edges where all the 5 criteria were met. The inside block groups did not meet the criteria for the most part. I also noticed that when I tried to join tables I had previously joined, it messed up my data.
-geodatabase with final layers from MCDA -TO BruinLearn