Monitoring Cities: Urban Waste

Outline
The provided dataset consists of waste tonnages collected by the Department of Sanitation for the year 2014. These tonnages are divided into each of the 59 Community Districts as well as divided into three waste streams: Refuse, Paper, MGP (metal/glass/plastic). Furthermore, the dataset also includes the total population and average annual income of the Community District.

The provided dataset was derived from the following sources:
- NYC Open Data: DSNY Monthly Tonnage Data
  - https://data.cityofnewyork.us/City-Government/DSNY-Monthly-Tonnage-Data/ebb7-mvp5
- NYC Population 2010 (ACS)
  - http://www.nyc.gov/html/dcp/html/census/demo_tables_2010.shtml
- NYC Income (PUMA)
  - http://www.nyc.gov/html/dcp/html/census/popacs.shtml
- NYC Community District Shapefiles
  - http://www.nyc.gov/html/dcp/html/bytes/districts_download_metadata.shtml

Homework
Using this data, calculate each Community Districts diversion rate. The diversion rate is the total amount of recycling extracted from the total waste stream:

$$\text{Diversion Rate} = \text{Total Recycling} / \text{Total Waste}$$

After calculating the Diversion Rate for each Community District, normalize the Diversion Rate by population:

$$\text{Per Capita Diversion Rate} = \text{Diversion Rate} / \text{Total Population}$$

Once you calculated these values, visualize them using the NYC Community District spatial data. What differences do you notice between the diversion rates across the city? How does this change when taking population into account? Does visualizing the data help to highlight those differences?

Calculations
The calculations can be done in Excel or directly in ArchGIS/QGIS. In QGIS:

1) Open QGIS and navigate to the menubar and select **Layer > Add Layer > Add Vector Layer.** Browse to the **nycd.shp** file and select **Open.** (*Notice the downloaded geometry has five files which are necessary. This includes a .dbf, .prj, .shpxml and .shx file.*) After opening the file you should see the NYC geometry.

2) Next, in the menubar select **Layer > Add Layer > Add Delimited Text Layer.** The dataset does not have any geographic information, so under 'Geographic definition' select the radial button labeled **'No Geometry'**. Then click 'OK'

3) You should now have two layer files in the layers window. One file is the geometry data and one file is the waste data. In order to perform any operation we will need to join these two datasets. To do this, right click the NYC geometry layer (nycd.shp) and select 'Properties'. Then navigate to the **'Joins'** section.

4) Click the green plus button to add a new join. In the popup window, select the waste dataset as the 'Join Layer'. You will then need to select the columns on which QGIS will try to merge. This should be 'BoroCD' column for both the 'Join field' and 'Target field'. Select 'OK'. Select 'OK' in the 'Properties' window.

5) The data should now be joined together and you can begin calculating the diversion rate. Right click again on the NYC geometry layer and select 'Open Attributes Table'.

Toggle editing mode by click the pencil icon [pencil icon]. In editing mode, click the [icon] icon to add a new column. Name the column and give it a 'Decimal' type as well as increase the width and precision to 6. Click 'OK'.

6) The new column will be generated from a calculation of other columns. To do so, from the dropdown menu, select the column you wish to update with an expression (ie.. the

new column). Then select the [ε] equation button. In the 'Expression Dialog' popup window, use the 'Fields and Values' search to build your equation. It should look something like this:

("paper_column" + "mgp_column") / ("paper_column" + "mgp_column" + "refuse_column")

7) Once you've completed the equation, click 'OK' in the expression dialog window. Then click 'Update All' in the 'Attribute Table'. Once the column is updated, click the

[pencil icon] icon and select 'Save'

Styling the Map

1) Once the new column has been created, right click once again on the NYC geometry layer in the layers window. Select 'Properties' and navigate to the 'Style' section.

2) The first dropdown box defaults to 'Single Symbol'. We want to change this to 'Graduated'. In the next drop down menu, select our new column (ie the diversion column). Click 'Classify', then 'Apply'. You should see the map change.

3) The styles section provide other features such as the division mode (equal, quantile etc…), the number of class divisions as well as different coloring options. Play with these features to create the map which best shows demonstrates the data.

4) Generate several maps based on the data. You can export these maps as images with legends and text.