

GARP 0544 Cookbook 22 April 2013

GIS Analysis (Part 1)

Overview

1. What is GIS Analysis?
2. Select By Attributes
3. Select By Location
4. About the MassGIS Project
5. Homework Assignment #8

It all comes back to Week 1:

Geospatial data are spatial data and attribute data linked together. This allows us to perform GIS analysis using the location of a feature and/or its characteristics.

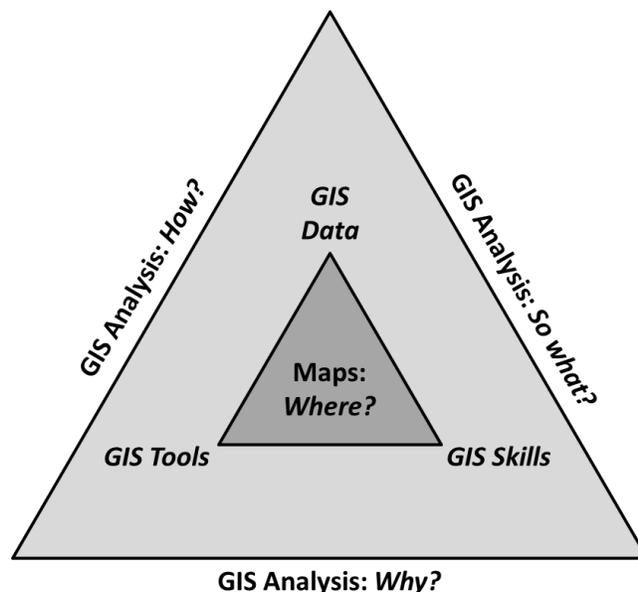
For example, we can select an important wetland using some biodiversity indicator and create a 1 mile buffer around the wetland for protection.

Then we can determine which building parcels are located inside this buffer.

Then we can talk to the homeowners about reducing pesticide runoff from their lawns into the wetland.

This basic sequence described above is referred to as Geospatial Analysis, Geoprocessing, GIS Analysis, Spatial Analysis, GIS Modeling, etc. Whatever the name, the basic idea is the same: Use the power of geospatial data for meaningful analysis.

Finally, we can present the results of our analysis as a GIS poster combining maps, tables, graphs, text, photographs, and more. Plus, we document our analysis as a report.



1) What is GIS Analysis?

Data processing and data analysis go together: you process your data as part of an analysis, but you often need to process your data before you can start your analysis!

Consider the following example:

You work for the City of Westfield Planning Department as a GIS Specialist and are tasked to delineate a new business park to stimulate the local economy based on the following three criteria:

1. The parcel has to be at least 10 acres in area.
2. The parcel has to be at least 100 feet from any wetland or water body.
3. The parcel has to be already industrial or commercial zoned to avoid a contentious rezoning process.

This is a classic site selection – a GIS analysis task which you need to break-down into a series of steps:

- Step 1** Project Organization
This is often overlooked...before you start anything you need to organize the project in your head! What do I need to do? How do I get the data? What is the outcome? Here you should create a flowchart of your entire project!
- Step 2** Data Acquisition
What data do I need? Do I have the data? Can I get the data from MassGIS? Do I have to digitize and create the data myself?
- Step 3** Data Exploration = test-drive your data to make sure that you really have the data you need to perform your analysis.
- Step 4** Data Manipulation, for example editing, sub-selecting the needed features using Select By Attributes, Select By Location, clipping, merging, combining, etc. Data often cannot be used 'as-is', but need some manipulation.
- Step 5** Data Analysis = translating the three written criteria above into a logical sequence of ArcGIS Tools. This is best done by creating a flow chart to visualize the analysis steps.
- Step 6** Map Creation (= making your analysis meaningful for other people).

This sounds easy, but here are a few common mistakes:

- People tend to forget about Step 1! Big mistake!
- People tend to jump to Step 2 and then immediately to Step 5...this usually does not work, since you first need to explore and manipulate the data.
- Data often need to be ‘massaged’ before they are usable in your specific application!
- People tend to forget creating a flow chart before starting their data analysis.
- People tend to be too focused initially with the end product...the final map. Nothing wrong with planning ahead, but Step 6 is impossible without Steps 1 to 5.
- People forget to adequately document their project.

2) Select By Attributes

One of the selection methods you can use to select features in a data layer is to select features using an attribute query. This is performed using the Select By Attributes tool.

Basic Procedure

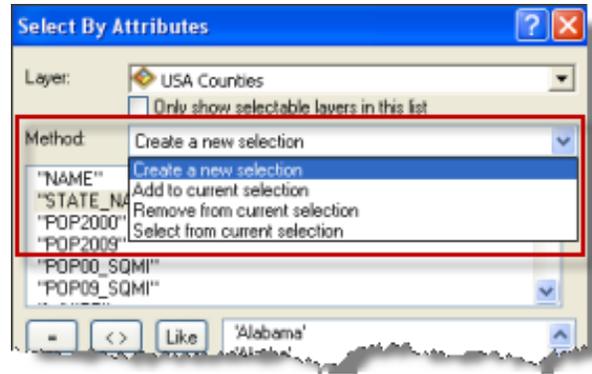
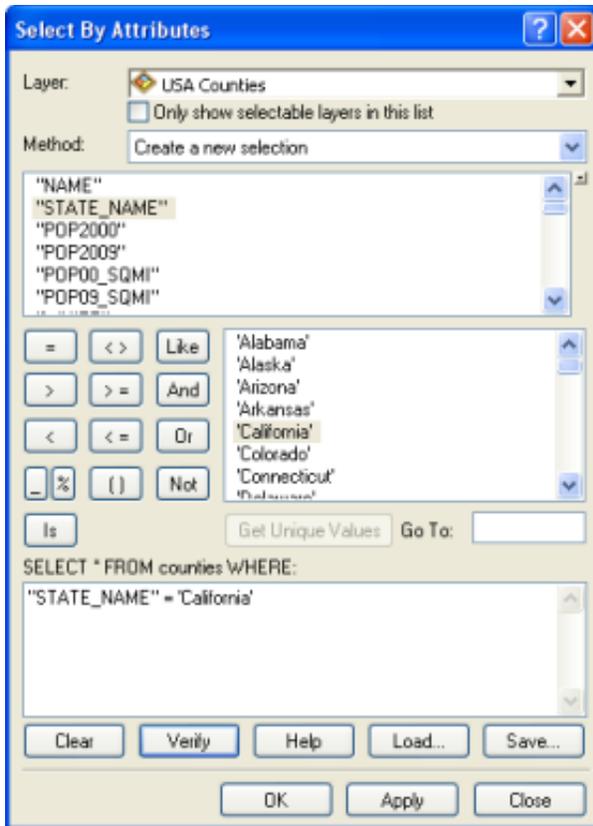
1. Click Selection > Select By Attributes to open the Select By Attributes dialog box.
2. Choose the layer to perform the selection against.
3. Specify the selection method.
4. Enter a query expression using buttons and the keyboard.
5. Validate your query expression by clicking Verify.
6. Click OK or Apply to execute your selection expression and work with the selection results.

A Few Comments

- This tool is very similar to the Definition Query tool – except it only selects the desired features as opposed to querying and “hiding” them. In other words: a definition query allows you to query the features you want to show on your map. Select By Attributes allows you to select the features you want (for whatever reason) and save these selected features as a new data file.
- GIS Tutorial 8-1, 9-1, 9-2
- ArcGIS 10.1 Help
<http://resources.arcgis.com/en/help/main/10.1/index.html#//00s500000021000000>

This tool is simple and effective – a good way to sub-select certain features from a larger data set or to aggregate your data

➔ *You will use this tool extensively in the MassGIS Project!*

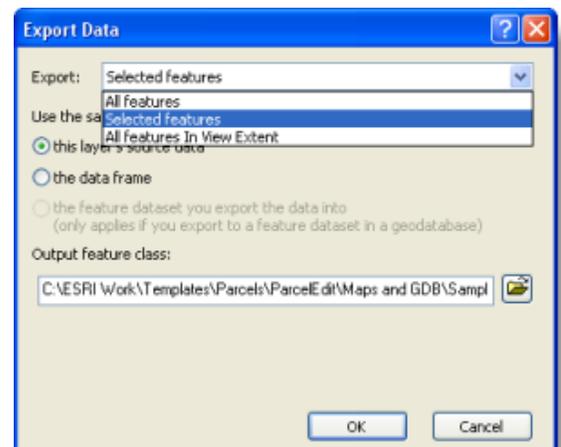


2.1) Exporting selected features as a dataset

You can export selected features as a new dataset for a specific layer by right-clicking the layer name in the table of contents and clicking Data > Export Data. This displays the Export Data dialog box.

You can choose to export the complete data source or only the selected features.

This often makes sense – for example you have the complete zoning map for your city, but you are only interested in parcel with a specific zoning code:



Select By Attributes on the zoning code and export the selected features as a new feature class.

2.2) Select By Attributes: Applications

Select By Attributes is a great tool for data processing: you can select a set of features from within a larger file and save those selections as a new and smaller file.

- You need to know and understand the attributes included in the attribute table.
- Read and understand the MassGIS data layer description!
- You will use the Select By Attributes tool extensively in the MassGIS project!

Examples

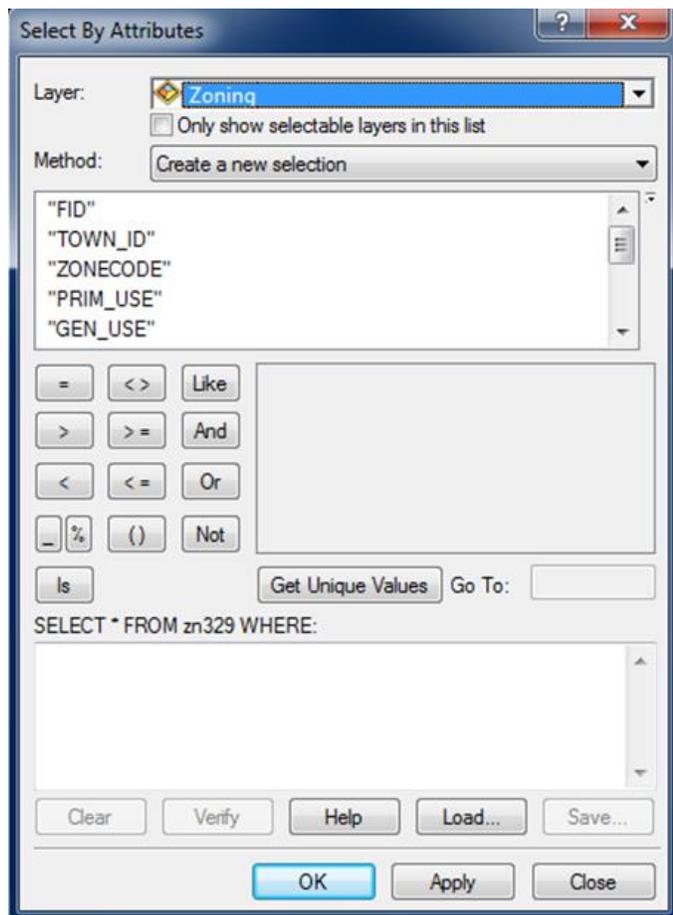
1. You downloaded the state-wide fire stations data layer at, but for your analysis you only need the fire stations in Westfield and Springfield.
2. You downloaded the Colleges and Universities data layer, but for your analysis you only need the private colleges and universities.
3. You downloaded the zoning data layer for your city/town, but your analysis you only need the parcels zoned industrial.

➔ As long as the attribute is in the attribute table...you can use Select by Attributes!

Hands-on Example

Create a zoning map for city of Palmer that only shows parcels zoned either Light Industrial or General Industrial.

Design your map professionally!



3) Select By Location

The Select By Location tool lets you select features based on their location relative to features in another layer.

For instance, if you want to know how many homes were affected by a recent flood, you could select all the homes that fall within the flood boundary.

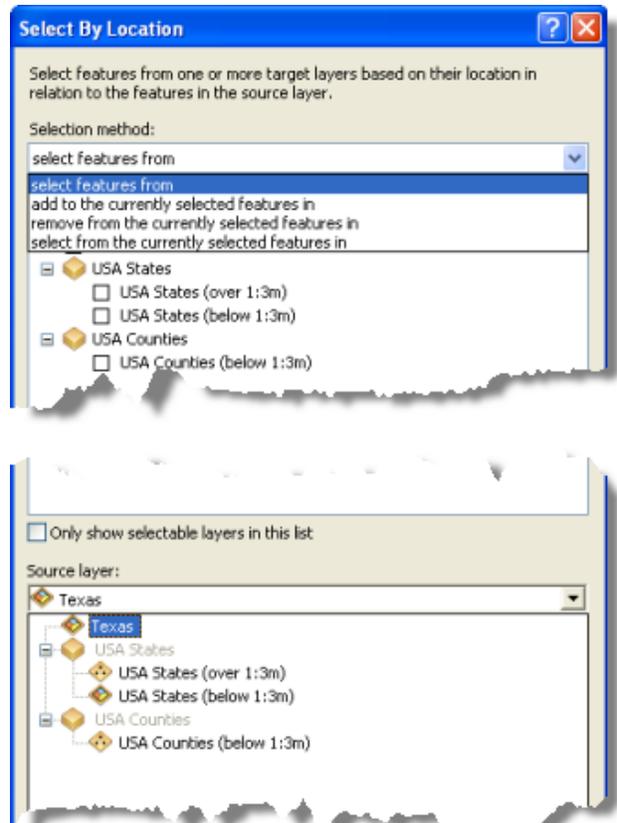
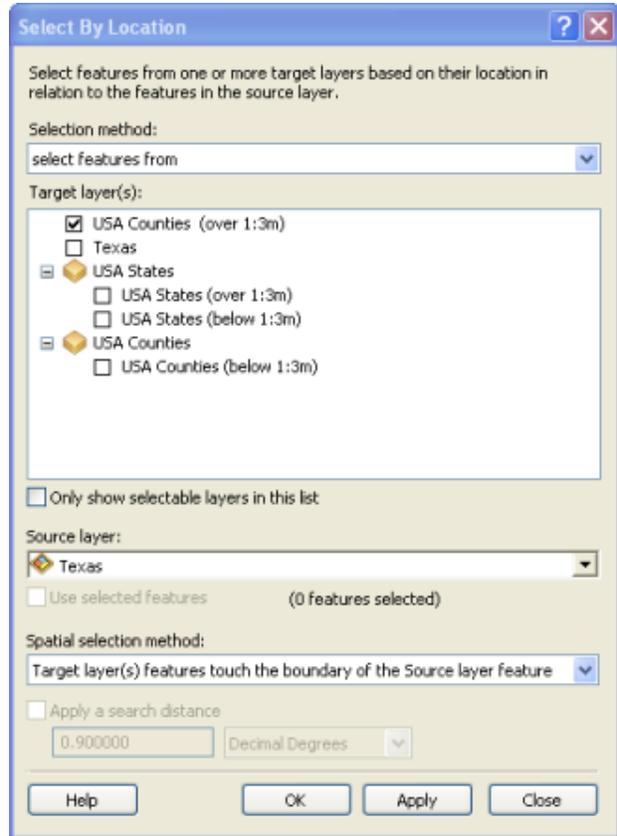
You can use a variety of selection methods to select the point, line, or polygon features in one layer that are near or overlap the features in the same or another layer.

➔ ***Here you are select features from one data layer based on their location relative to features in another data layer.***

1. Click Selection > Select By Location to open the Select by Location dialog box.
1. Choose your Selection method. Click the drop-down arrow to see your choices.
2. Choose the target layer(s) from which features will be selected.

Again – the target layer(s) is/are the layer(s) from which the features will be selected = the target of the selection.

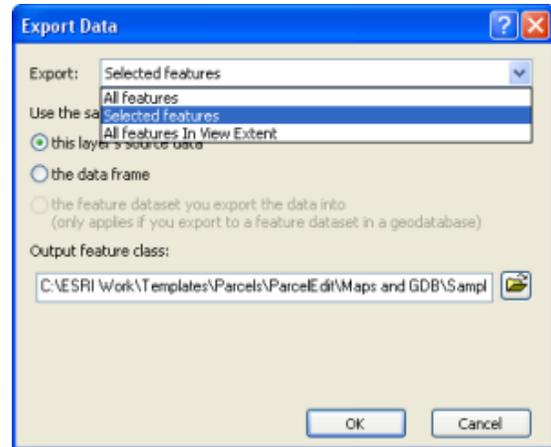
3. Specify the source layer that will be used to select features from the target layer.
4. Choose the spatial selection method that will be used for selection.
5. Export you selection as a new data set.



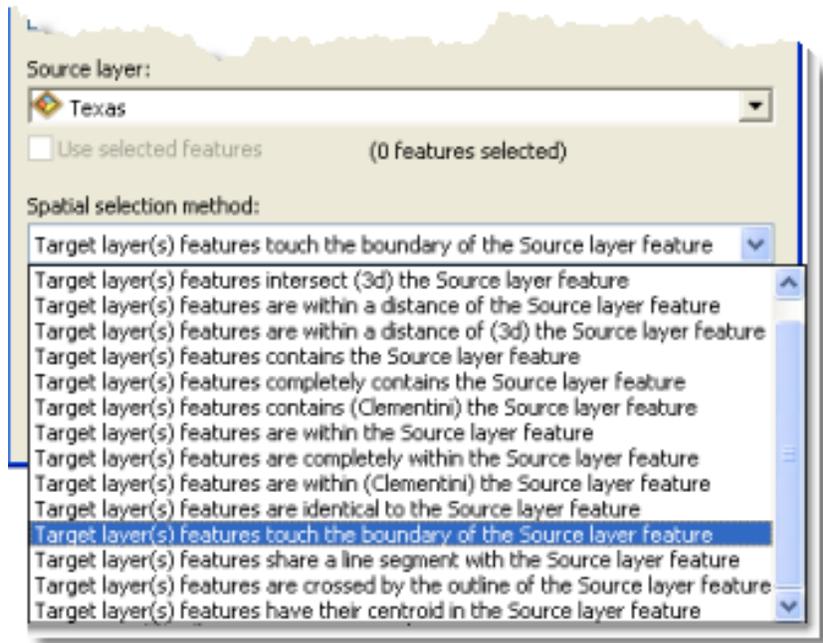
Exporting selected records as a dataset

You can export selected features as a new dataset for a specific layer by right-clicking the layer name in the table of contents and clicking Data > Export Data.

This displays the Export Data dialog box. You can choose to export the complete data source or only the selected features.



Spatial Selection Method



The spatial queries or spatial selection methods are all explained and illustrated with examples in ArcGIS Help 10.1.

More Information

- GIS Tutorial 8-2, 9-1
- Select By Location
<http://resources.arcgis.com/en/help/main/10.1/index.html#//00s50000002q000000>

3.1) Select By Location: Applications

Select By Location is a great tool for data processing: you can select a set of features from one data set depending on how they are located with respect to the features in another data set.

ArcGIS provides many spatial relationship rules – some even include a buffer distance!

- Select all fire stations within 10 miles of the MassPike.
- Select all prisons located within 2 miles of a high school.
- Select all cities and towns in the Westfield River watershed.

Hands-on Example #1

1. Open the Massachusetts fire stations map you created on 25 March 2012 and saved into your \week10 folder.

Otherwise: create the map by adding the Massachusetts fire stations and Massachusetts towns layer from your \data folder.

2. Download the major drainage basins data layer from MassGIS and add it to your map.
3. Use Select By Locations to select the fire stations located in Westfield and Springfield and export your selection as a new data layer.
4. Use Select By Locations to select the cities and towns located in the Westfield River watershed and export your selection as a new data layer.
5. Use Select By Locations to select the fire stations located in the Westfield River watershed and within 5 miles of it and export your selection as a new data layer.
6. Remove all data layers except for the Westfield River watershed and its cities/towns and fire stations.
7. Insert a useful legend and save your map into your \week12 folder.

Hands-on Example #2

How many underground storage tanks are located...

- In Amherst?
- Within the Westfield River watershed?
- Within 2 miles of the Westfield River?

Tip: use the 1:100,000 Hydrography to make things easier!

4) About the MassGIS Project

The basic project sequence is simple:

1. Pick a city or town in Massachusetts (other than Westfield!)
2. Analyze the land use changes between 1971 and 1999.
3. Present your analysis results as a professional GIS poster that combines maps, graphs, a table, and text.
4. Document your analysis in a professional project report.

The details are explained in the project description.

You know your basic map layout:

- 24 inches wide, 18 inches tall.
- 4 data frames, ~7 by 7 inches
- 1 data frame, ~ 6 by 4 inches
- Keep a ~0.5 to 1 inch margin, including your neat lines!
- Align data frames with guidelines.
- You need room for text, graphs, a table, data credits, affiliation, etc.

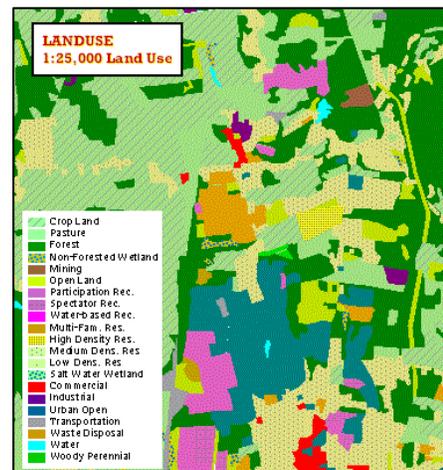
Set-up your map and save it (using relative pathnames).

4.1) Land Use Data – Display!

You have two data frames for the land use data: One data frame shows the land use in 1971, the other shows the land use in 1999 – both using the 21-category classification system. In essence, you are creating a simple choropleth map where the land use polygons are colored based on the LU21_1971 and LU21_1999 field in the attribute table. That would be a choropleth map!

1. First, confirm how many land use classes you have...the classification system we are using includes 21 classes, but your town may not have a certain land use classes, for example land use class 14: salt wetland.
2. Symbology – Quantities – Graduated Colors. Use LU21_1971 and LU21_1999 as Value and select the correct number of classes for your city.

Then: adjust the colors to make them meaningful.
You can also use the symbolization files provided by MassGIS:



Goto <http://www.mass.gov/anf/research-and-tech/it-serv-and-support/application-serv/office-of-geographic-information-massgis/datalayers/ftplus.html> and download: lus_sym.exe. Save this file into the same folder as your land use data layer, unzip, and you will see four files:

- ArcGIS 9.0 layer files (21-categories, 37-categories)
- ArcView 3.x legend files (21-categories, 37-categories)

Now select Symbology – Quantities – Graduated Colors – Click Import...and follow the instructions to apply these symbolizations.

See <http://resources.arcgis.com/en/help/main/10.1/index.html#//00s50000002p000000> for additional information.

4.2) Land Use Changes – Visually!

Now you can compare your two land use data frames – first visually. You may need to look carefully, depending on what city or town you are working on, but you should be able to visually notice some changes.

- In general, polygons shown as forest, open land, farm land, etc. typically have decreased.
- In general, polygons shown as residential, commercial, and industrial land use typically have increased.
- You will probably see the greatest increases for low-density residential land use.

Comparing the data frames visually is fun – and you are able to see where exactly what type of land use change occurred where in your city or town. The next step is to quantify these land use changes!

4.3) Land Use Change – Quantitative!

Basic Sequence

- 1) Select By Attributes: To select the land use class(es) of interest.
- 2) Show Selected: To only show you selected features in the attribute table.
- 3) Statistics: To determine the summary statistics for you selected features.
- 4) MS Excel: Record your data in a MS Excel spreadsheet.

That's all you need to compare land use in 1971 and 1999. But: be careful and take your time – these steps are easy, but it is also easy to make a mistake! The data analysis is described in the project description. Here are a few simple ways to make sure that you have not made a mistake:

- Visually check your Select By Attributes on the computer screen to confirm that the correct polygons were selected in the correct data frame.
- Once you have calculated the areas for your 10 broader land use classes: add them up and compare with the total area of your city/town – they have to be the same!
- The same applies to the percentages – they have to add up to 100!

- The same applies to the percentage changes – they have to add up to zero (unless your city/town has changed in size between 1971 and 1999).

Now, every version of MS Excel is a bit different and there was definitely a big change from MS Excel 1997-2003 (the ‘old’ version) to the current versions (MS Excel 2007 or MS Excel 2010).

That makes it somewhat difficult to provide universal instructions!

However, please realize that only the menus and layout = the Graphic User Interface (or GUI) have changed, not the basic functionality of the software.

A quick Google Search will yield 1,000s of tutorials on how to create pie charts in MS Excel – here are a few examples:

- <http://www.youtube.com/watch?v=48zCCcrE8UU>
- <http://www.youtube.com/watch?v=pzSBKrV8C4c>
- <http://www.homeandlearn.co.uk/Me/mes4p6.html>
- <http://www.homeandlearn.co.uk/ME/mes4p7.html>
- http://spreadsheets.about.com/od/excelcharts/ss/pie_chart.htm

5) Homework Assignment #8

This assignment consists of two parts: two sections of the GIS Tutorial and a GIS analysis.

Part 1: Sections 9-1 and 9-2 from the GIS Tutorial

- Tutorial 9-1 is a buffer analysis using an example of crimes around bars. Please print the map you have on your screen after completing Step 7 on Page 299. You can also export the map as a PDF or JPG file.
- Tutorial 9-2 is a suitability analysis – in this case locating an additional police station. Please print the map you have on your screen after completing the Your Turn Box on Page 306. You can also export the map as a PDF or JPG file.

Part 2: GIS Analysis

Simple question: which towns and fire stations are within 3 miles of the MassPike and I91? Present your GIS analysis as a professional map.

- Use the Major Routes data layer that I will email you.
- Create your map in 8.5 by 11 inches landscape format.
- Remember: your map has to be able to ‘stand-alone’ = be understandable without a corresponding written report!

Where are at least two different ways to do this – try both!

Deliverables

- Very simple: a title page and three maps, that’s it.
- Due Date: next class meeting.

➔ *Contact me for help or clarification of this assignment or my expectations as needed.*