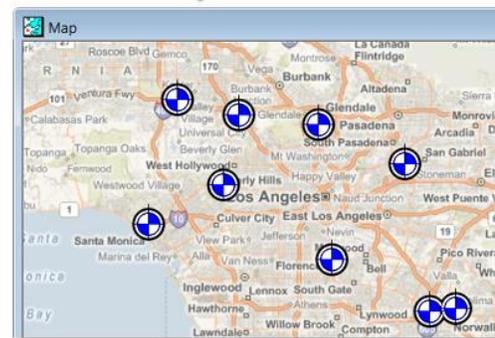# Cookbook 4 November 2013
Geocoding (Part 1)

Overview

1. Network Analyst Tutorial
2. What is Geocoding?
3. Geocoding *without* ArcGIS
4. Geocoding *with* ArcGIS: Fully Automatic!
5. A Geocoding Example and Application
6. Homework for Thursday

Geocoding Tutorial

The Geocoding Tutorial for ArcGIS 10.1 is available at
http://resources.arcgis.com/en/help/main/10.1/index.html#//002500000006000000

- The tutorial data are located on the Bates 022 PCs at C:\arcgis\ArcTutor – just copy and paste the \Geocoding folder to your own USB drive.
- The tutorial data are also provided with your ArcGIS for Desktop Student Trial software – that's the second DVD. See http://www.esri.com/landing-pages/software/arcgis/arcgis-desktop-student-trial

1) Network Analyst Tutorial

Nice demo!
http://blogs.esri.com/esri/gisedcom/2013/06/14/using-drive-time-buffers-to-teach-spatial-concepts/
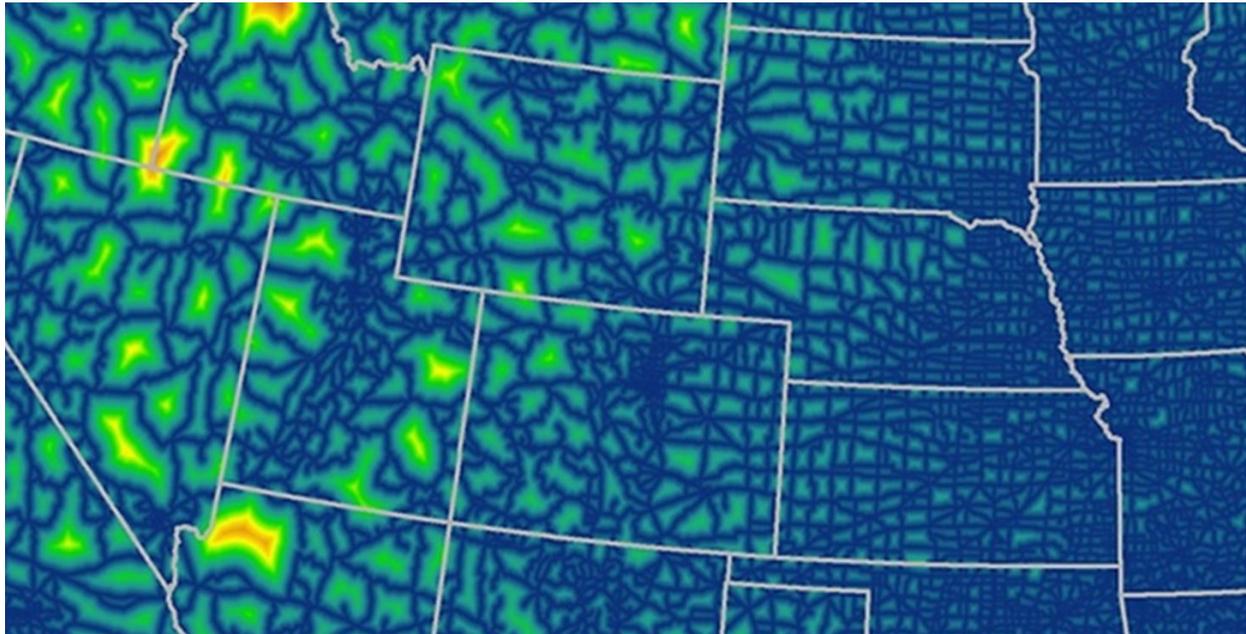
2) What is Geocoding?

Geocoding = Address Mapping

Geography
- *Where? - Why? - How?* Things occur on Earth
- Geography is to Space what History is to Time.

Geographic Information
- Information that includes the location of the information in some kind of mathematical format (street address, latitude/longitude, x/y/z coordinates, etc.)

Geographical Information System
- Geographic information that is systematically organized (= as a database)

➔ *If we have geographical information, organized in a systematic manner, then we can use a computer for quantitative geographic analysis.*

Geospatial Data or Information
- Data that include the location of the data in some kind of systematic mathematical format.

*We use two different mathematical formats for locations:*

Street, City, State, Zip Code.
That's the system that we are all used to.
One problem: the address system is not uniform between different countries of the world, which makes it difficult when you deal with different countries.

Latitude and Longitude = the Geographic Grid.
The geographic grid is great because it works the same way no matter where you are on the planet!
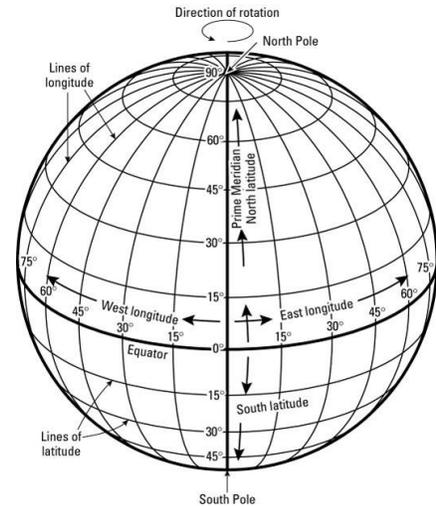
➔ *ArcGIS can use both systems and converts easily between them!*

Example: Carsten's House

Street Address	Geographic Coordinates	
110 Haywood Street	Latitude:	42.598631°N
Greenfield, MA 01301	Longitude:	-72.586614°W
USA		

Both formats are useful. If you want to send me a present with the U.S. Postal Service you would use my street address. If you want to find my house in a GIS you can use both formats!

Geocoding is the process of transforming a description of a location - such as a pair of coordinates, an address, or a name of a place - to a location on the earth's surface. You can geocode by entering one location description at a time or by providing many of them at once in a table. The resulting locations are output as geographic features with attributes, which can be used for mapping or spatial analysis.

With geocoded addresses, you can spatially display the address locations and begin to recognize patterns within the information. This can be done by simply looking at the information or by using some of the analysis tools available with ArcGIS.

Geocoding acts as a crucial part of customer data management. Nearly every organization maintains address information for each customer or client. This is usually in tabular format, containing the customer name, address, buying habits, and any other information you have collected. Geocoding allows you to take your customers' information and create a map of their locations.

To geocode, you need three things:

1. The addresses
2. The address locator
3. The reference data

What is an Address?

http://resources.arcgis.com/en/help/main/10.1/index.html#/What_is_an_address/00250000000n000000/

An address is simply a method used to describe a location. Addresses are represented in a wide range of formats. A common address format used in the United States consists of the following series of address elements: house number; prefix direction, prefix type, street name; street type, suffix direction; and zone information such as city, state, and ZIP Code.
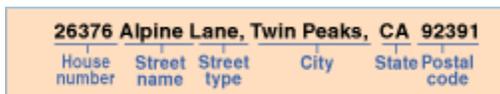
However, in many areas, addresses are presented in different formats. Besides the common street addresses, a place-name such as Lincoln Center, Mount McKinley, or a ZIP Code can be considered as an address for geocoding purposes. Sometimes, finding a location by only the ZIP Code is a common practice, as an area that covers the ZIP Code can be identified.

What is an Address Locator?

http://resources.arcgis.com/en/help/main/10.1/index.html#/Understanding_address_locator_styles/00250000000t000000/

Think of the address locator as a street guide or map book that you use to look up an address; it directs you to the page and pinpoints the location of the address. When you enter an address you want to find, the geocoding engine converts the input address into pieces, such as number, street name, and street type, based on the parsing rules defined in the address locator. These pieces are known as address elements. The geocoding engine may generate multiple interpretations of the same address, as some values in the input address can be considered in more than one element. For example, the word park can be both a street name and a street type. Each combination of the address elements will be searched in the address locator. The goal is to find all the possible matching candidates. Once possible candidates are identified, each individual variable in the candidate is compared with each corresponding address element. A score is generated indicating how well the address is matched. Finally, the address locator presents the best matches based on the score and the location of the address being matched.

ArcGIS loads some locators for you by default, including the MGRS (Military Grid Reference System) locator and the geocode services from ArcGIS Online. This allows you to begin geocoding right away without the need to create and configure an address locator yourself.

What is the Reference Data?

http://resources.arcgis.com/en/help/main/10.1/index.html#/Preparing_reference_data/00250000
000w000000/

Reference data refers to a geographic information system (GIS) feature class containing the address attributes you want to search. For example, when searching for house number addresses, the reference data must contain the house number ranges, street names, or address attributes of the specific parcels. In assessing whether the reference data that you have will work for your geocoding process, there are a few points to consider based on the extent and resolution of the data.

The reference data needs to cover the same area that you want to geocode. For example, if you are attempting to geocode cities across the entire continental United States, reference data that only presents features in the western states will not perform the task. Each address that you want to geocode must be present in your reference data. This leads to the second property of the reference data, the resolution.

2.1) Finding Addresses in ArcGIS Desktop

Finding an Address in the Find dialog box
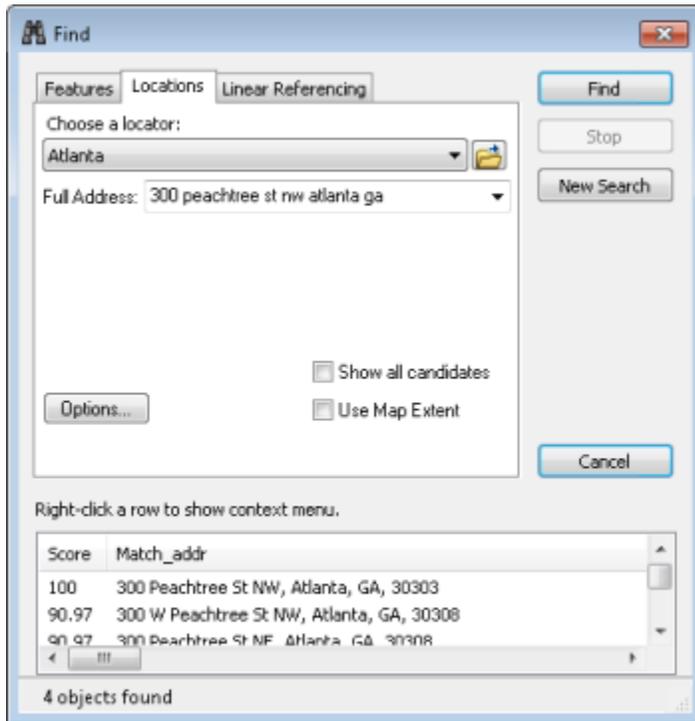
http://resources.arcgis.com/en/help/main/10.1/index.html#/in_Find_dialog_box/002500000024
000000/

Finding an Address using the Geocoding Toolbar

http://resources.arcgis.com/en/help/main/10.1/index.html#/using_the_Geocoding_toolbar/0025
00000023000000/

You can simply load an address locator into ArcMap, then use it to find addresses. ArcGIS loads some address locators for you by default, including the MGRS (Military Grid Reference System) locator and the World Geocode Service from ArcGIS Online. This allows you to begin geocoding right away without the need to create and configure an address locator yourself.
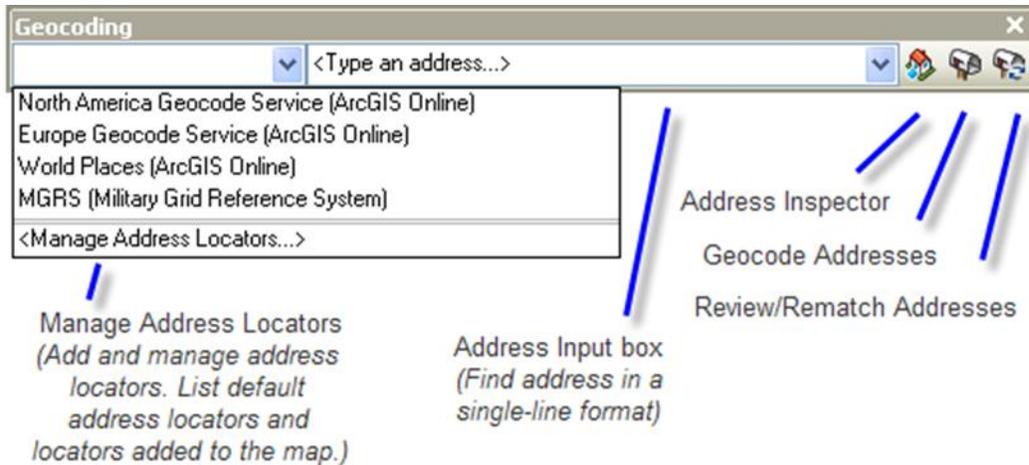
3) Geocoding *without* ArcGIS

There are many options available to geocode without ArcGIS.

Google Earth, Google Maps
That's perhaps the easiest and most widely-used geocoding option – just google your address.

http://geocoder.us/
An easy way to get latitude and longitude for an address.

http://www.travelgis.com/geocode/
Global single-line geocoding.

Free Geocoding from Texas A & M
https://geoservices.tamu.edu/Services/Geocode/Default.aspx

This is a great and free geocoding service for single addresses and tables against Census data. Also provides a free desktop client and links to other geocoders.

ZeeMaps
http://www.zeemaps.com/

ZeeMaps is great for mapping lists or tables. You can import address lists in industry-standard .csv [comma separated value] format. ZeeMaps geocodes the address and places the locations on a Google map. Each map marker contains information you've pre-formatted and identified in your .csv file and can include website links, photos, and YouTube videos. After you've added all the information you want, you'll have a map that can be easily published onto a webpage or blog.

Useful Resources to get you started with ZeeMaps

- YouTube: http://youtu.be/qOHXu89IYvs
- YouTube: http://youtu.be/WAmAdiood4c
- YouTube: http://www.youtube.com/watch?v=DDqdUHSaMb0
- YouTube: http://www.youtube.com/watch?v=0Zd__UKE78I
- YouTube: http://youtu.be/l0ohIbsOkFY
- Tutorial: http://multimedia.journalism.berkeley.edu/tutorials/zeemaps/
- Tutorial: http://www.newsu.org/fa/courses/spreadsheets-maps-together-zeemaps

Google Fusion Tables
http://www.google.com/fusiontables/Home/

Google Fusion Tables allows you to upload you own geographic data as spreadsheet tables and to visualize your data online as graphs or maps. You can share these graphs or maps on a website, blog, via Email, or via social media. Furthermore, Google Fusion Tables allows you and other people to collaborate on the data collection and data editing in real-time.

Help Resources
- http://support.google.com/fusiontables/?hl=en

Great Tutorials
- http://support.google.com/fusiontables/bin/answer.py?hl=en&answer=184641
- http://earth.google.com/outreach/tutorial_fusion_publish.html
- http://earth.google.com/outreach/tutorial_fusion_sample.html
- http://blog.apps.chicagotribune.com/2010/03/04/quickly-visualize-and-map-a-data-set-using-google-fusion-tables/

YouTube Resources
- http://www.youtube.com/watch?v=p0xnk9zFQpY
- http://www.youtube.com/watch?v=aC67HbtRne8&feature=related
- YouTube search: Google Fusion Tables Tutorial

4) Geocoding *with* ArcGIS: Fully Automatic!

http://resources.arcgis.com/en/help/main/10.1/index.html#/What_is_geocoding/002500000001000000/

This is the easiest approach: you have a Microsoft Excel table with addresses and you are using an ArcGIS online address locator and reference data.
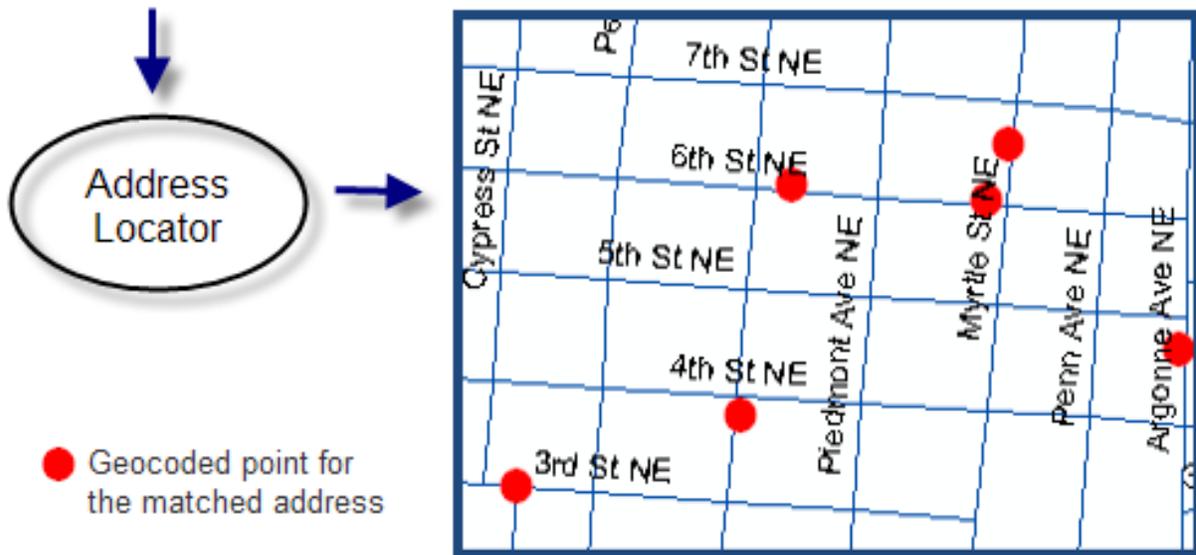
When you geocode a table of addresses, you use a locator to create point features that represent the locations of the addresses. The output is simply a point feature class.

Geocoding is (usually) not the end of a GIS analysis, but rather an intermediate step in a GIS analysis!

5) A Geocoding Example and Application

Mapping and Analysis Question

Create a map showing the locations of the five Home Depot stores closest to my house and calculate the straight-line distances to each of the five stores.

First you need a simple MS Excel table with the five addresses and the following fields:

- Name of store
- Street
- City
- State
- Zip Code
- Countrry

| Name	Address	City	State	Zip	Country
HD Greenfield	264 Mohawk Trail	Greenfield	MA	01301	USA
HD Hadley	350 Russell Street	Hadley	MA	01035	USA
HD Westfield	514 East Main Street	Westfield	MA	01085	USA
HD Keene	22 Ashbrook Road	Keene	NH	03431	USA
HD Chicopee	655 Memorial Drive	Chicopee	MA	01020	USA

Enter the data and save the table as a MS Excel 1997-2003 workbook – somehow the older version seems to work better than the newer versions.

Now, in ArcGIS:

1. Add any street base layer from ArcGIS Online and zoom-in to Massachusetts. This step is strictly-speaking not necessary, but gives you a nice base layer reference for your geocoded points.

    Adding this base layer from ArcGIS Online means that your data frame will be in the WGS_1984_Web_Mercator_Auxiliary_Sphere projected coordinate system.

2. Select File, Add Data, Geocoding, Geocode Addresses…or open the Geocoding Toolbar and click the Geocode Addresses button.

3. Choose the Address Locator USA Geocoding Service.
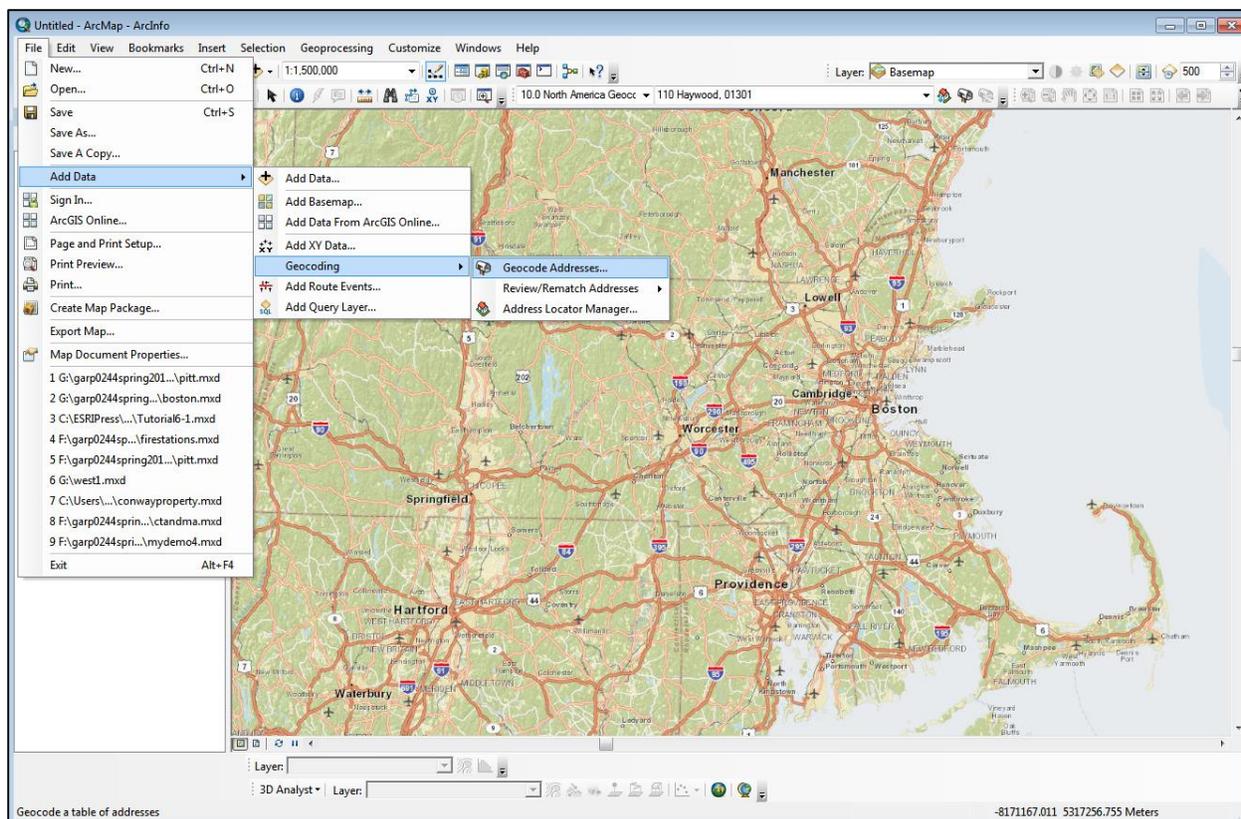
4. In the Geocode Addresses dialog box select your address table, define the correct Address Input Fields based on your address table and save the output as a shapefile or feature class. **DO NOT HIT OK YET!**

    First, click on Advanced Geometry Options…and select Use the map's spatial reference. Now WGS_1984_Web_Mercator_Auxiliary_Sphere is displayed in the field. Now click OK and OK again.

As the geocoding executes you get a dialog box with the progress and the number of matched, tied, and unmatched addresses. Hit Close and your resultant points are added to your map. Now you have the 5 Home Depots mapped as 5 points on your map!

5. Open the attribute table to verify the geocoding results.

See http://resources.arcgis.com/en/help/main/10.1/index.html#/About_geocoding_a_table_of_addresses/002500000025000000/ for information on the added attribute fields.

6. Repeat Steps 1 to 5 and geocode the MS Excel table with my home address.

This finishes the first part of the mapping / analysis – we have successfully geocoded my house and the 5 Home Stores closest to my house.
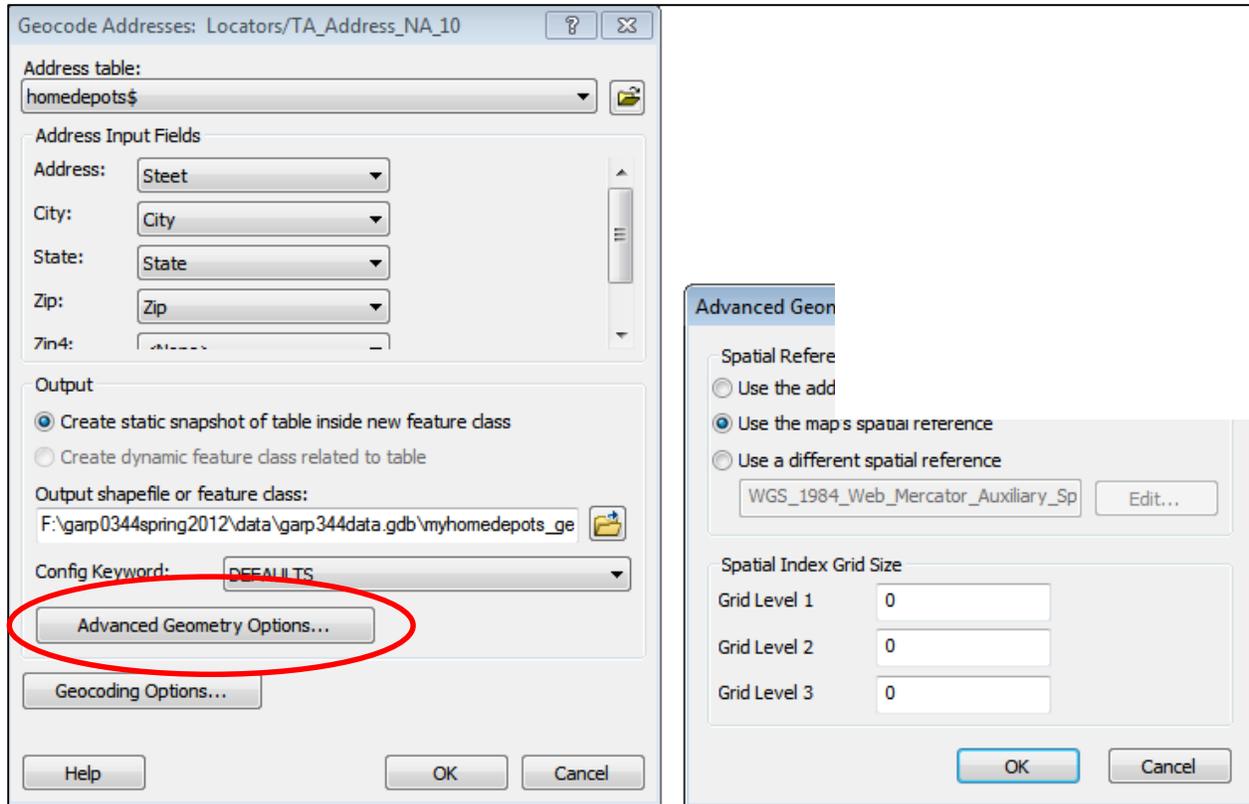
Now we need to calculate the straight-line distances from my house to each of the 5 Home Depot stores using the Point Distance tool. Using the tool is easy – however – pay attention to the following:

ALL data layers and the data frame involved in this calculation – and in ANY spatial analysis using ArcGIS – have to be in the SAME projected coordinate system.

For more information and how to easily convert coordinate systems see http://ocw.tufts.edu/data/54/616862.pdf or the Proximity Analysis tutorial at http://www.westfield.ma.edu/cbraun/teaching/advanced-gis/

7. Open the Point Distance Tool

8. Set as Input Features: My House; Set as Near Features: the 5 Home Depots; save the table into a file geodatabase and click OK.

Open the table and confirm the distances (in meters!) using the Ruler tool!

9. Add a new floating point (FLOAT) field to the table.

10. Select the new field, right-click, select Field Calculator and divide DISTANCE by 1,609.344 to get the distance in miles.

Confirm your conversion using the Ruler Tool!

6) Homework for Wednesday

Mapping and Analysis Question

Create a map showing the locations of the five [whatever you want] *closest to your house and calculate the straight-line distances to each of the five* [whatever you want].

Present your analysis as a map!

We need the map and address data on Wednesday!