

## Using Hawth's Tools to Measure Geographic Distances

**Hawth's Tools** is an add-on created for ArcGIS that provides a set of spatial analysis tools not included in the ArcGIS software. It's very useful to have ArcGIS calculate distances between points; this tutorial will show you how to use the **Distances between Points** feature of **Hawth's Tools**.

Note: The distances calculated using **Hawth's Tools** are "as the crow flies," and do not represent actual mileage travelled when driving or using other forms of ground transportation.

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Krista White  
GIS Support Specialist  
x 3926  
[kwhite2@drew.edu](mailto:kwhite2@drew.edu)  
Office HS 337

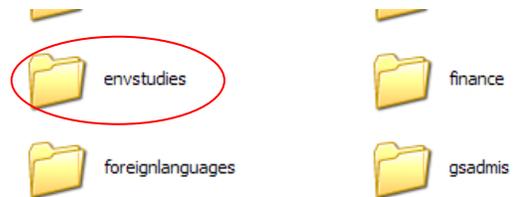
T, Th 8:00AM-12:00PM, 1:00PM-4:00PM  
F 8:00-11:30AM

Catherine A. Riihimaki  
Assistant Professor  
Environmental Studies and Sustainability  
x 3349  
[criihimaki@drew.edu](mailto:criihimaki@drew.edu)  
Office HS 100

## Copy Data Files to the Desktop

To complete this tutorial, you will need to copy the **Geocoding** folder from the **O:\envstudies\GIS Tutorials** folder to the desktop of your computer. If you have done this already, skip to the next section, **Start a New Map Document**.

1. Go to the **Start** menu
2. Click **My Computer**
3. Double click on the **O:** Drive
4. Folders are listed alphabetically by department.  
Double click on the **envstudies** folder.
5. Double click on the **GIS Tutorial** folder. Inside you will see the **Hawths Tools** folder.
6. Right click on the **Hawth's Tools** folder, and choose the **Copy** option.
7. Close the **GIS Tutorial** window.
8. Right click anywhere in the blank, blue space on the **Desktop** of your computer. Choose the **Paste** option. You should now see the **Hawths Tools** folder on your **Desktop**.



## Install Hawth's Analysis Tools

If you are working on a laptop or a computer in your office, you will need to download and install **Hawth's Analysis Tools** before beginning this tutorial. Download the files at

<http://www.spatial ecology.com/htools/download.php>

and follow the installation instructions in the **ReadMe** file. Once you've installed the software, restart your computer.

## Map Projections

**Hawth's Tools** requires a specific type of **Map Projection** in order for its **Distance** analysis tool to work. Map Projections are mathematical calculations that allow the spherical shape of the earth to be projected onto a flat surface using latitude and longitude values. Our Base Map, **tl\_2009\_us\_state\_Project.shp** and **StreetSegmentPublic.shp**, have a **Geographic Coordinate System** projection. **Hawth's Tools** only works with **Projected Coordinate Systems**. For the purposes of this tutorial, the **Coordinate Systems** of the base maps have been changed for you. Please contact Krista White if you need other base maps adjusted for your GIS projects.

NOTE: If you add more **Shapefiles** (files ending in **.shp**) or **Layer files** (files ending in **.lyr**) that you did not create using the provided files, you will need to perform the steps outlined in the *Map Projections in ArcGIS Tutorial* for each file you add so that the map projects the correct coordinate system for each new layer.

## Start a New Map Document

1. Open ArcMap.
2. Choose **A new empty map document**.
3. Click **OK**.



## Add a Base Map to Your Map Document

Base maps are the foundation of all ArcGIS map documents. In the Geocoding tutorial, you learned to add base map from the ArcGIS server. Hawth's Tools has some very specific requirements for map creation that are not met by the ArcGIS server maps. Other kinds of base maps are freely available from many sources. You can find many of these resources at the [Drew University Environmental Studies and Sustainability GIS Resources web page](#).

1. Click the **Add Data** button. 
2. In the **Look In:** menu of the **Add Data** dialog box, highlight **I:\YourUserName\Desktop\Hawths Tools\ New Projections\tl\_2009\_us\_state\_Project.shp**.
3. Click the **Add** button.

The **Data Frame** should now contain a map of the continental United States, Alaska, Hawaii, and U.S. Territories.



The **Table of Contents** – located on the left hand side of the screen – should now display the name of the maps shape file you just added: **tl\_2009\_us\_state\_Project**.

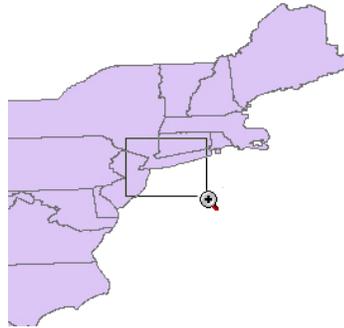
## Rename the Map Shape File Layer

1. Right click on the name **tl\_2009\_us\_state\_Project**. Choose **Properties...** from the bottom of the pull down menu. The **Layer Properties** dialog box will appear.
2. Click on the **General** tab.
3. Next to Name Layer Name: replace **tl\_2009\_us\_state\_Project** with **US State Boundaries**.
4. Click **OK**. The name of the shape file layer in the **Table of Contents** column should now be **US State Boundaries**.
5. If you would like New York streets and street names visible on your map, repeat the steps above to add the **StreetSegmentPublic\_Project.shp** file to your map. Rename it **New York Streets**.

## Create a Spatial Bookmark

**Zooming In** adjusts the map's scale so that you can see features like streets and read the labels. To make sure that you can come back to the map at this scale, you can create a **Spatial Bookmark**.

1. Click and drag with the Zoom In tool around the New York City area. Continue to use the Zoom In tool until you have the island of Manhattan (North) and I-478 (South) centered in window.

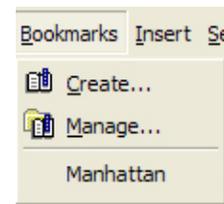


around the New York City area. Continue to use the Zoom In tool until you have the island of Manhattan (North) and I-478 (South) centered in window.

2. Click on the Bookmarks pull down menu at the top, left-

3. Choose Create.

4. In the **Spatial Bookmark** dialog box that appears, name your **Bookmark** "Manhattan."



at the top, left-

5. Use the **Bookmark** pull down menu – your "Manhattan" should be there.

**Spatial**

**Bookmark**

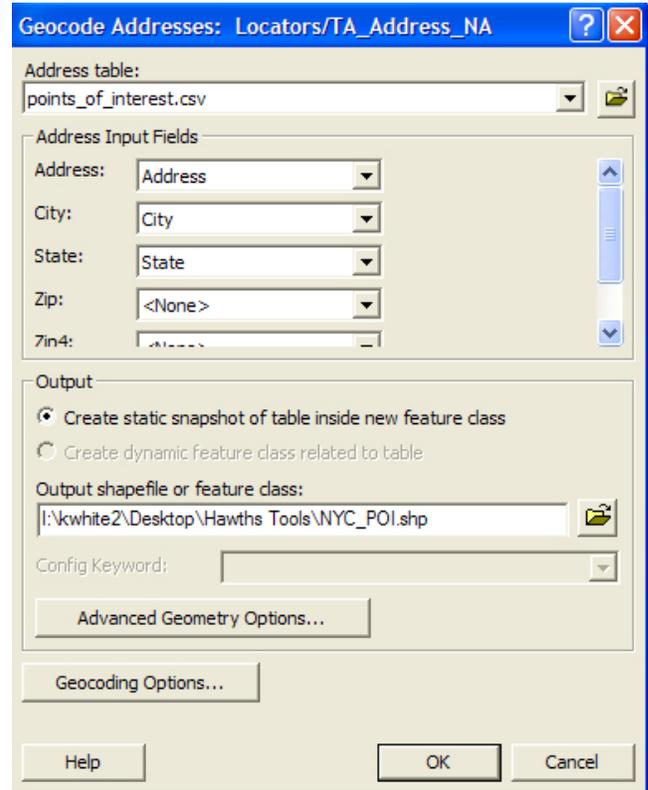
Now any time you want, you can use the **Bookmark** tool to zoom out to the scale you created with the **Manhattan** bookmark. To erase or re-organize **Bookmarks**, use the **Manage** function.

## Geocode Points of Interest to your Map

If you already took the Geocoding tutorial, this will seem familiar. Rather than using the shape file geocoding results from that tutorial, we will geocode the addresses from the **points\_of\_interest.csv** file again, because we need to change the **map projection** during the geocoding process to match the projection of the **US State Boundaries** map.

### Choose Addresses to Geocode

1. Go to the **Tools** pull down menu→**Geocoding**→**Geocode Addresses** command.
2. When the **Choose an Address Locator to use...** dialog box appears, highlight **Locators/TA\_Address\_NA**.
3. Click **OK**. The **Geocode Addresses** dialog box will appear.
4. Click on the **Browse** button  next to the **Address table:** field.
5. Navigate to **I:\YourUserName\Desktop\HawthsTools**
6. Highlight the **points\_of\_interest.csv** file and click **Add**.
7. Under **Output**, the **Output shapefile or feature class** should be set to **I:\YourUserName\Desktop\Hawths Tools\NYC\_POI.shp**. The settings in the **Geocode Addresses** dialog box should look like the picture on the right.



### Set the Map Projection of Geocoding Result

8. In **Output**, click on the **Advanced Geometry Options...**. The **Advanced Geometry Options** dialog box will appear.
9. Under **Spatial Reference**, choose **Use a different spatial reference**. Click the **Edit** button. The **Spatial Reference Properties** dialog box will appear.
10. Click the **Select** button, and navigate to **Projected Coordinate Systems\State Plane\NAD HARN (Feet, Intl and US)**.
11. Scroll down and choose **NAD 1983 HARN StatePlane New York Long Island FIPS 3104 Feet.prj**. Click the **Add** button.
12. Click **OK** three times – once for each open dialog box.
13. When it says geocoding is 100% complete, click **Close**.

### Save Geocoding Results as a New Layer File

In order to use your geocoded results in calculations and measuring distances in **Hawth's Tools**, you will need to save the results as a separate layer file.

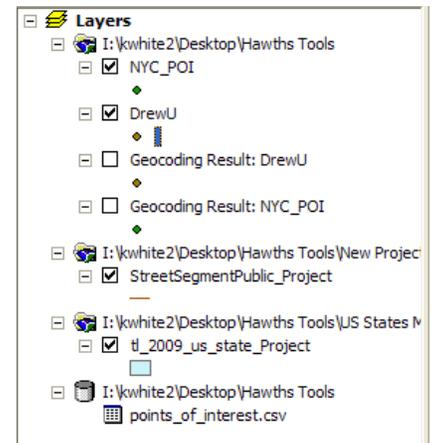
14. In the **Table of Contents**, right click on the shapefile layer name, **NYC\_POI**.
15. In the pull down menu, choose the **Save As Layer File** option.
16. Save your map by navigating to **I: →YourUserName→Desktop →HawthsTools**. In the **File name:** field, name your file **NYC\_POI.lyr**.
17. Click **OK**.

### Geocode Drew University's Address

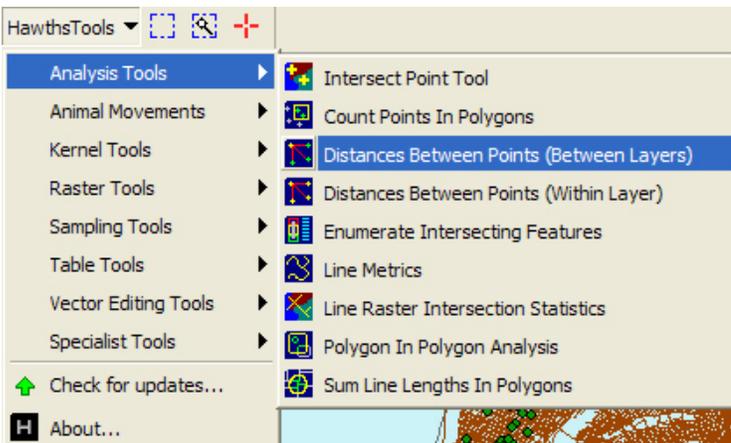
Repeat the Geocoding steps above using the following changes:

1. In Step 6, use the **DrewAddress.csv** file
2. In Step 7, the **Output shapefile or feature class** should be set to **I:\YourUserName\Desktop\Hawths Tools\DrewU.shp**
3. In Step 14, substitute the **DrewU** shapefile layer.
4. In Step 16, name your file **DrewU.lyr**.

Now you must add the **DrewU.lyr** and **NYC\_POI.lyr** files to your map. These are the files that **Hawth's Tools** will use to calculate distances. The new **Layer files** will appear as duplicates of **Geocoding Result: NYC\_POI** and **Geocoding Result: DrewU**. **ArcMap** always lists the latest **Layer files** added at the top of the **Table of Contents**, so you will know that the top 2 versions of **Geocoding Result: NYC\_POI** and **Geocoding Result: DrewU** are the ones that you just added. Rename these layers **NYC\_POI** and **DrewU**. When finished, your **Table of Contents** should look like the picture at right.



## Use Hawth's Tools to Calculate Distances



1. Open the View pull down menu. Hawth's Tools should appear as one of the options in the list. Choose Hawth's Tools; a Tool Box should appear in the ArcMap Desktop.

2. Click the down arrow next to the **Hawth's Tools** title and choose **Analysis Tools** → **Distances Between Points (Between Layers)**. The **Distance Between Points** dialog box will appear.

3. Under Input, the Source Point layer should be set to NYC\_POI.

4. Under Unique Source ID field, choose the option FID from the pull down menu.
5. The Target Point layer should be set to DrewU, and the Unique target ID field for DrewU should also be set to FID.
6. Under Analysis Option, you want to Create a linear distance matrix file.
7. Under Output, use the Browse button to navigate to : →**YourUserName**→**Desktop** →**HawthsTools**. Name the file **NYC\_POItoDrew**. This will appear in your **HawthsTools** tutorial folder as **NYC\_POItoDrew.csv**.

Before the distances you just calculated can be visualized on the map, you will need to add the data you just created to the map document and join it to the NYC\_POI layer.

## Visualize Distance Data

### Add the distance data to your map.

1. Right click on the **NYC\_POI** layer. Choose **Joins and Relates** → **Join...**. The **Join Data** dialog box will appear.
2. Select the following settings: Join attributes from a table  
Choose the field in this layer that the join will be based on: **FID**

Remember that this is the field we used as the **Unique Identifier** for the **Hawth's Tools** analysis.

Choose the table to join to this layer: **NYC\_POItoDrew**.  
Choose the field in the table to base the join on: **SOURCEUID**.

The values in the **SOURCEUID** field are identical to the values in the **FID** field in **NYC\_POI**. This common element provides the reference point to add the **Distance Data** to the **NYC\_POI** layer.

Join Options: **Keep all records**

3. Click **OK**

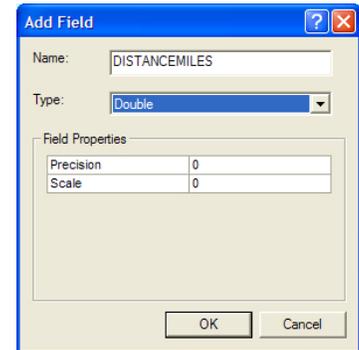
### Add a Calculated Field to Convert Feet to Miles

Distances in **Hawth's Tools** are calculated in Feet, since our Map Projection uses that measurement. In order to represent the distance in miles, you will need to add a new field to the **NYC\_POI Attribute Table** and calculate the distance in miles. If you are using another **Coordinate System**, you may need to use a different conversion.

#### Add a New Field to the Attributes Table

1. Right click on the **NYC\_POI** layer. Choose **Open Attribute Table**. The **Attributes of NYC\_POI** dialog box will appear.

Use the scroll bar at the bottom of the dialog box to scroll all the way to the far right side of the table. You will see a data column labeled Distance. These are the distances you calculated using Hawth's Tools.



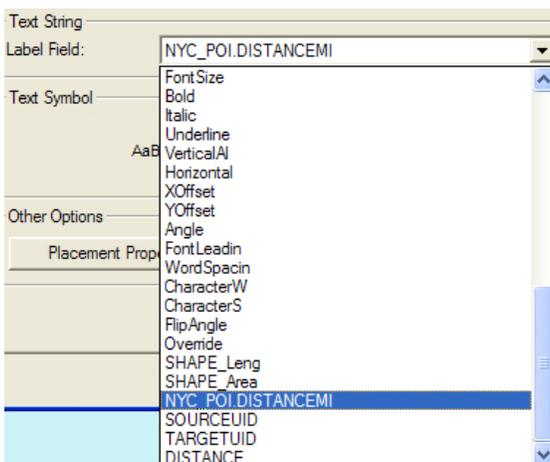
2. Click on the Options button at the bottom of the dialog box. Choose Add Field. The Add Field dialog box will appear. Name the new field **DISTANCEMI**. In the **Type** pull down menu, choose **Double**.
3. Click OK. The new field you created will show up as a column just before the **SOURCEUID** column. It will be named **NYC\_POI.DISTANCEMI**.

#### Create a Field Calculation to Convert Feet into Miles

4. Right click on the title of the NYC\_POI.DISTANCEMI column. Choose Field Calculator from the pull down menu. A warning box will appear. Click Yes.
5. The Field Calculator dialog box will appear. Click the cursor in the large, free-text box at the bottom of the dialog box under NYC\_POI.DISTANCEMI=.
6. Type in the following formula:  $[DISTANCE] / 5280$ . Make sure that there is a single space between each of the elements of the formula.
7. Close the **Attributes of NYC\_POI** dialog box.

#### Turn on Labels

1. Right-click on the name **NYC\_POI** layer. Choose **Properties** at the bottom of the drop-down list. The **Layer Properties** dialog box will appear.



2. Click on the **Labels** tab.
3. Check the box at the top, left-hand corner next to **Label** features in this layer.
4. In the **Text String** area, click on the drop-down menu for the **Label Field** field.
5. Scroll down the list until you find the attribute **NYC\_POI.DISTANCEMI**. Choose **NYC\_POI.DISTANCEMI**.

6. In the **Text Symbol** area, click **Bold**, and make the font size **9 point**.
7. Click **Apply**, and then **OK**.
8. Right-click the **NYC\_POI** label in the **Table of Contents**.
9. Choose **Label Features**.

The distance in miles from Drew of all the points of interest you geocoded now appear on the map.

### Re-symbolize Your Points of Interest

You can adjust the color and shape of the points of interest.

1. Right-click on the small dot below the **NYC\_POI** label in the **Table of Contents**. The **Symbol Selector** dialog box will appear.
2. Choose the type of **Symbol**, the **Color**, and the **Size** for your icons.

### Save Your Map File with Relative Path Names

Now is a good time to save your map file. It's always a good idea to save your files with Relative Path Names. This allows ArcMap to be flexible in finding data sources when you move a map or its data from one location to another – for instance, if you decide to save your files on your F:\ drive or a departmental G:\ drive.

1. Go to the File pull down menu. Choose Document Properties.
2. In the **Document Properties** dialog box, click on the button located in the bottom, right hand corner of the box that says **Data Source Options**. The **Data Source Options** dialog box will appear.
3. Click the radio button next to the option, “**Store relative path names to data sources.**”
4. You may also check the box next to the option, “**Make relative paths the default for new map documents I create.**” This will save your preference for making map documents in the future.
5. Click **OK** in each open dialog box.
6. Return to the **File** pull down menu. **Save** your document, rewriting it as **Desktop\Hawths Tools\HawthsToolsTutorial.mxd**.

### Export Map Data to a Spreadsheet or Database File

If you want to be able to open the distance information stored in the **Attributes Table**, you can export the contents of a table to a **Database file** (file ending in **.dbf**) that can be opened in Microsoft Excel or Microsoft Access.

1. Right click on the **NYC\_POI** layer. Choose **Open Attribute Table**.
2. Click on the Options button at the bottom, of the **Attributes of NYC\_POI** dialog box. Choose **Export....**

3. Navigate to **I:\YourUserName\Desktop\Hawths Tools**.
4. Name the file **DistanceExport**.
5. You can now open the data as an **Excel** spreadsheet by using **Excel's Import** feature and saving the file as an **Excel** workbook.