GIS III: **GIS Analysis**
Module 1a: Network Analysis Tools

*** Files needed for exercise: MI_ACS*09_cty.shp; USBusiness09_MI.dbf; MI_ACS09_trt.shp; and streets.sdc* (provided by Street Map USA)

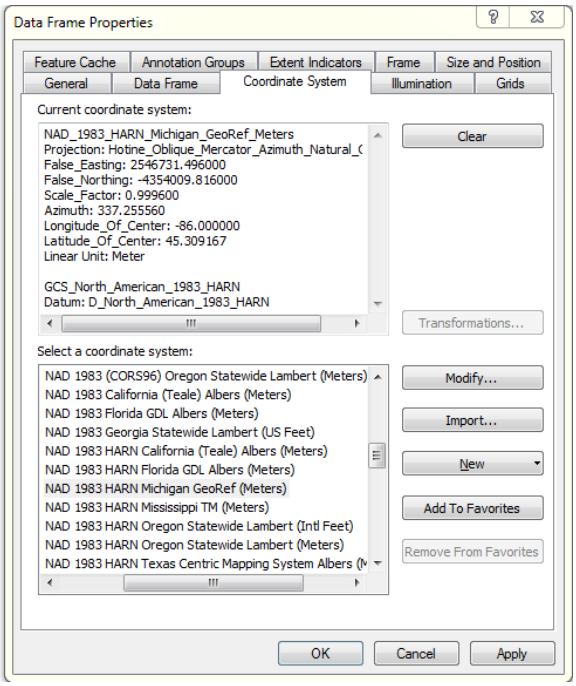
Goals: To learn how to use the Network Analyst tools to perform network-based analyses. Specifically, to use the Network Analyst Extension to add network locations, set your analysis properties and perform a basic service area analysis.

Skills: After completing this exercise, you should have a basic familiarity with Network Analyst Tools and have experience performing a service area analysis.

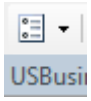
Service Area Problem: We are interested in finding out the percentage of Michigan's population that is within a 30 minute drive time from any Target store. To do this we will create service area polygons representing a 30 minute drive time through a nationwide network dataset (StreetMap USA) to a Target retail store. We will use Target locations for the state of Michigan from the InfoUSA dataset.

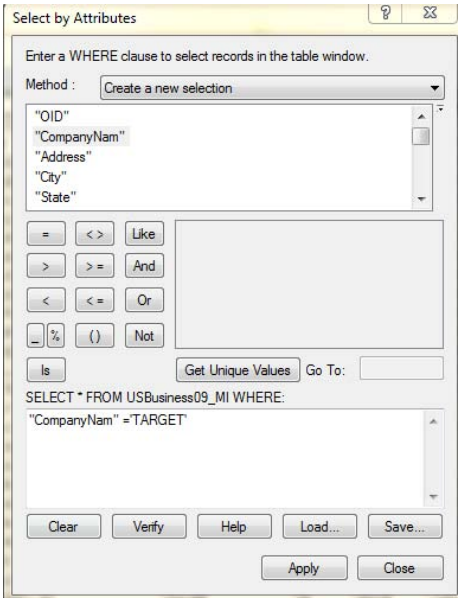
Prepare your node data:

1. Open ArcMap.
2. Right click on your data frame and set your coordinate system to Michigan's standard projected coordinate system: *Projected Coordinate Systems > State Systems > NAD 1983 Michigan GeoRef (Meters).*
   Note: All training state systems are listed in the StandardMapProjections.txt file located in the *Exercise01_data* folder.

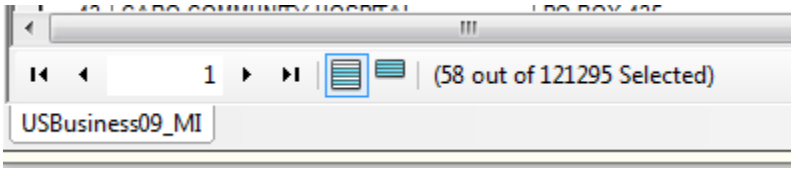


Click **OK**.

3. Add MI counties: MI_ACS*09_cty.shp*. This county shapefile will provide some useful geographical context for your analysis.
4. Add the InfoUSA table *USBusiness09_MI.dbf.* These data represent all the MI businesses present in the 2009 InfoUSA dataset. (If you are interested, similar data for your state can be accessed here: https://cehi.nicholas.duke.edu/share/projects/gis-state-surveillance-phase-iii/gis-state-surveillance-phase-iii-implementation-teams/shared-documents/infousa/)
5. Next you will make a selection from this table in order to limit records that represent a Target Retail Store business.
    a. Right click on the table in your table of contents (TOC) and select **open** to open the table for viewing.
    b. Click on the drop down arrow on the table options icon  to select by attributes.
    c. **Create a new selection** WHERE: "CompanyNam" ='TARGET' and click apply.

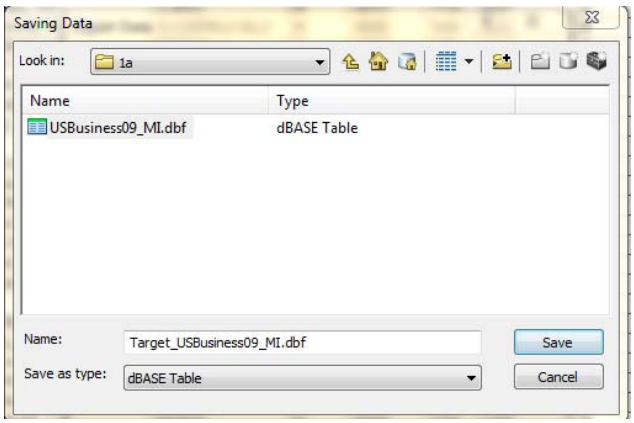


You should note that 58 out of 121295 records have been selected in the lower right hand side of your table.



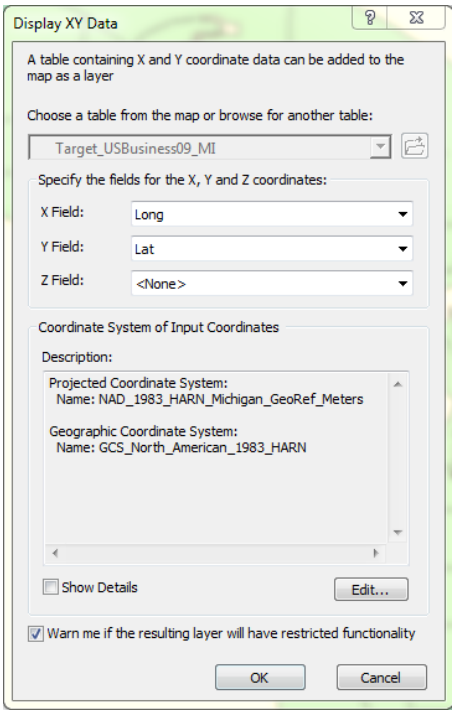
These represent the records that meet the requirements of your query- Target Stores

6. While the table is still open click on the table options icon again and select **export;** this will export the 58 selected records to create a new table.
7. Save the table as *Target_USBusiness09_MI.dbf* in the exercise 1a folder; make sure you select dBASE Table in the **Save as type**: dropdown.

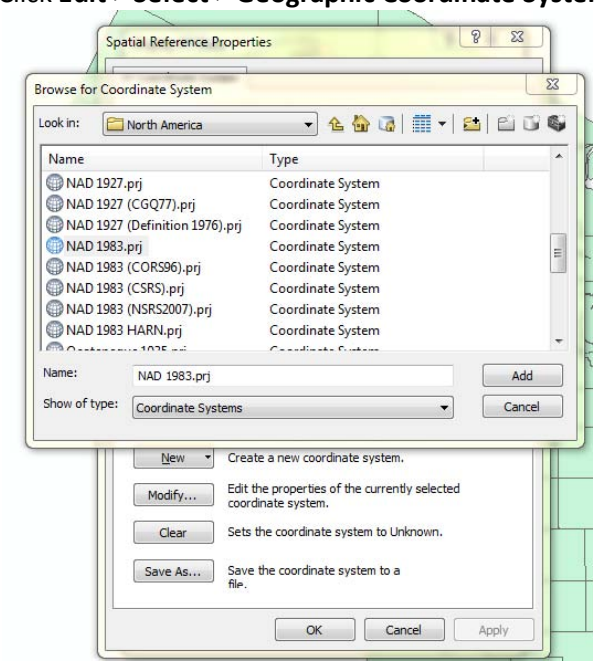


When you are asked if you would like to add the new table to the current map, click **yes**.

8. Right click on your table and select **Display X|Y data**. Do not click OK yet!

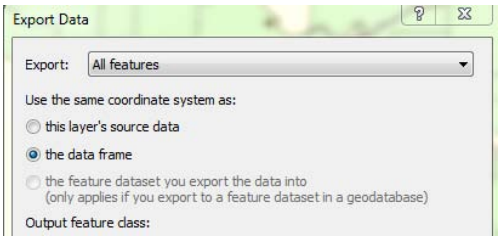


9. Note that the raw data from the InfoUSA data is geographically defined using latitude and longitude coordinates (decimal degrees). You will need to let the software know to use a Geographic Coordinate System, NAD 1983, for proper georeferencing when displaying X|Y data.
10. Click **Edit > Select > Geographic Coordinate Systems > North America > NAD1983** and click **Add**.



Finally, click **OK**. You have now let the software know that these are Geographic Coordinates.

11. Your 58 target stores should now be displayed on top of your Michigan counties.
12. Right Click on your 'event' class and export to a new shapefile.
13. Using the same coordinate system as the data frame, name the shapefile: *MI_Target_retail.shp.*



Add the the new shapefile *MI_Target_retail.shp* to your project.

Network Analysis:

1. Turn on NA extension - **Customize > Extensions.**

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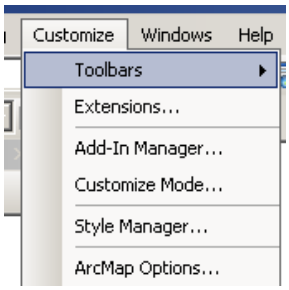
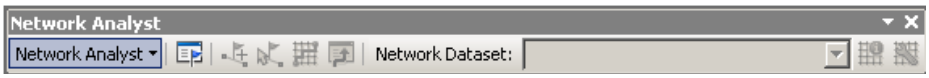
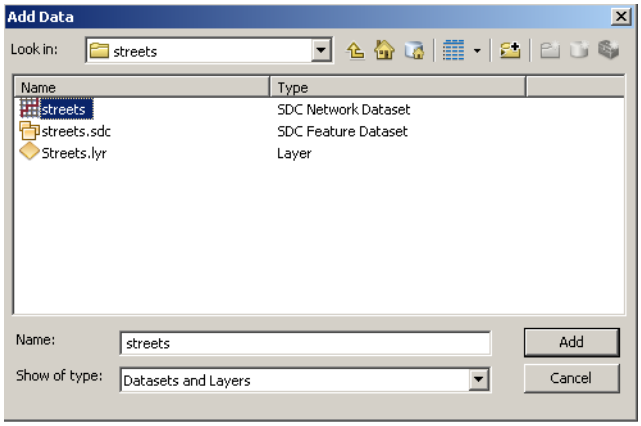
2. Activate your NA toolbar **- Customize > Toolbars > Network Analyst.**



Looks like this:



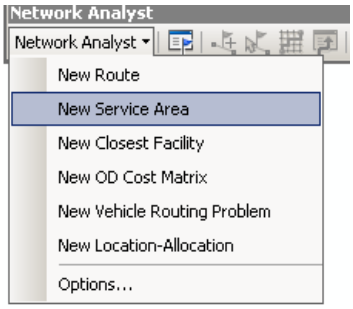
3. Add your StreetmapUSA network dataset *streets.* Choose **yes** to add all feature classes that participate in the network dataset.



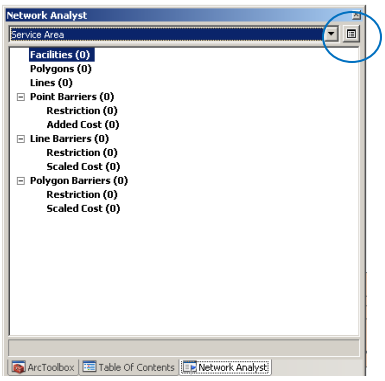
Note: This is a nationwide dataset included in your ESRI ArcGIS Data disks. Be forewarned- it is large. The .sdc format is un-editable, but it means you will not need to create your own network dataset. You

should see a detailed road network begin to fill in. You can turn these off by un-checking them in the TOC to speed things up a bit.

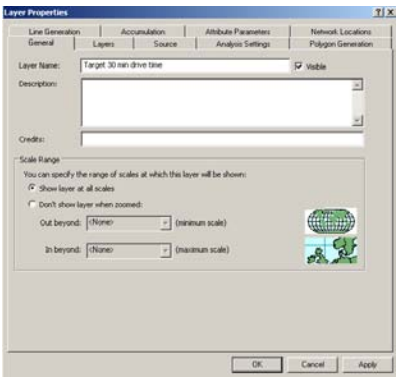
4. If your network analyst window is not visible, make it visible by left clicking on in the toolbar.
5. In the Network Analyst toolbar, click **Network Analyst > New Service Area**.



6. Adjust your service area properties and analysis settings. Left click on the **Service Area Properties** icon in the Network Analyst window (in the upper right-hand side).



7. Under the **General** tag, name this service area layer: *Target 30 min drive time;* click **Apply** rather than **OK**.



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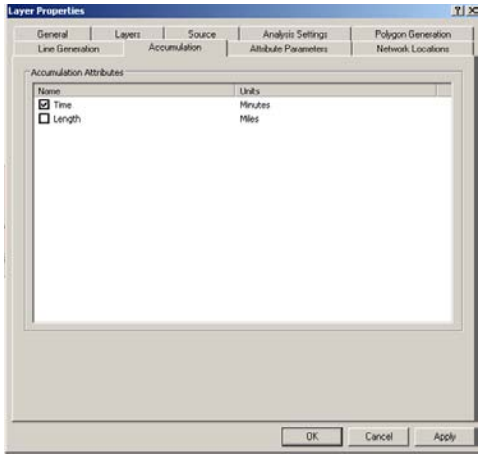
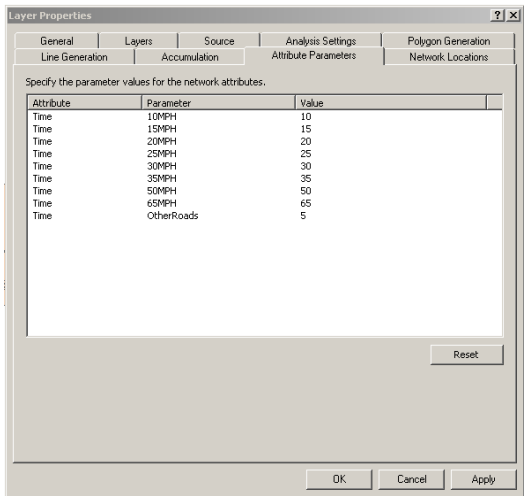
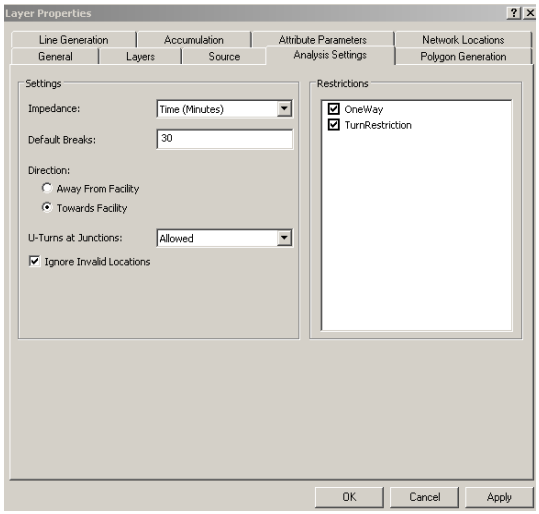
1. Under the **Accumulation** tab, check **Time**. This will set your impedance measurement or cost for moving through the network based on time. Click **Apply** rather than **OK**.



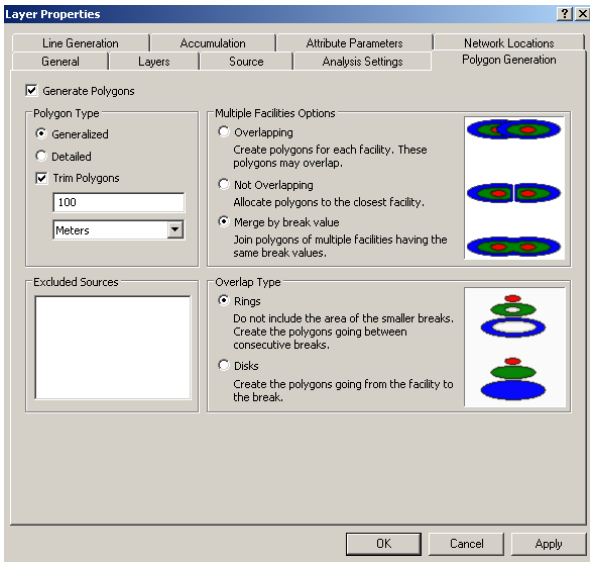
2. Take a look at your **Attribute Parameters** tab. You can see that the time attribute is informed by speed limit parameters for your network. Click **Apply** rather than **OK**.



3. Under the **Analysis Settings** tab you should see that your impedance or cost will be measured in time (minutes). Set your default break as **30 minutes**. Set your direction as **Towards Facility**. Go with defaults for the remaining options on this tab. Click **Apply** rather than **OK**.



4. Under the **Polygon Generation** tab, keep all the defaults with the exception of **Multiple Facilities Options.** Select **Merge by break value** and click **Apply** rather than **OK**.



5. Under the **Network Locations** tab we will set the tolerance for loading or locating the Target store locations on the network dataset. Set the **Search tolerance** for finding the Target stores on the network to **500 meters**. This will set the tolerance for loading locations onto the network (i.e. locations up to 500 meters from a road will be *located* on the network).

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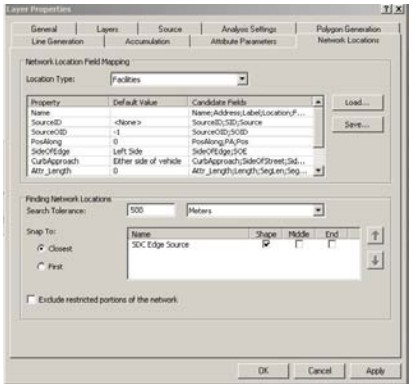
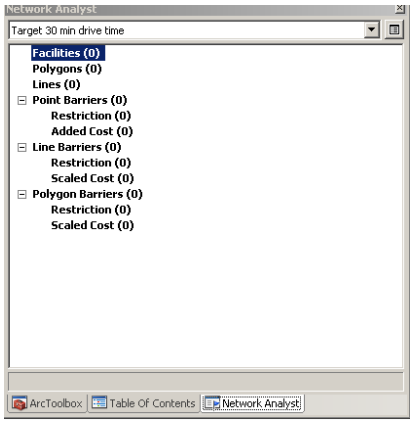
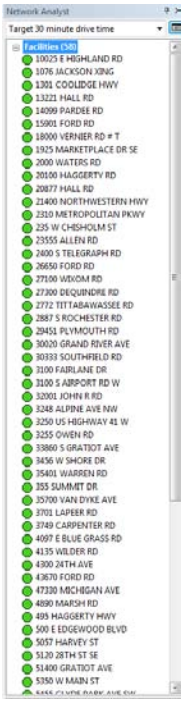


6. Click **Apply** then **OK.**
7. Right click on **Facilities** in the Network Analyst window and select **Load locations**. The target stores are the **Facilities** that you will be creating service areas for.



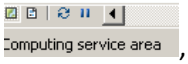
8. Make sure that your shapefile *MI_Target_retail.shp* is the data to be loaded and select **Address** as your **sort field**. You can sort by any of the attributes in the table but it is a good idea to use a unique identifier. The Search Tolerance you input in the **Network Locations** tab should be reflected here.

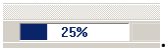
9. Click **OK**. You should see 58 facilities located in your Network Analyst window.



Solve the 30 min drive time service area problem:

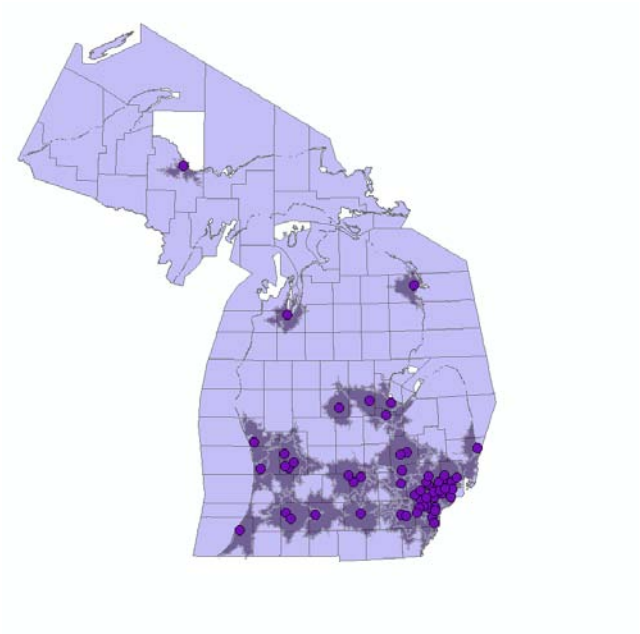
Remember- we want to create a network-based area that represents a 30 minute drive time to any Target store within MI.

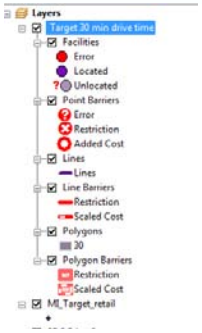
1. Right click on the solve icon . This may take a bit of time (remember that we are using a very large network dataset).
2. While you wait, take a look around. Take a look at the lower left-hand side of your screen. If you see this: 

, it's a good sign. Some indication of progress on the lower right-hand side of your screen is also a good thing: 

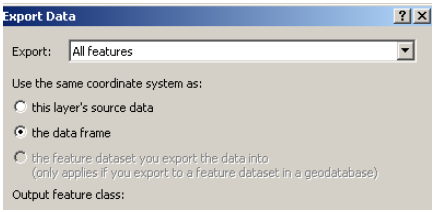
. Now is also a good time to stretch out and ask any questions you may have.

3. When the solving is complete you should see something that looks like this:





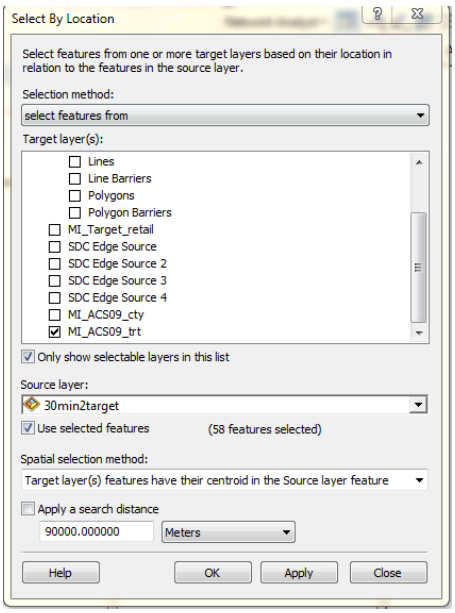
4. In your table of contents you will see the results of your analysis. Export the polygons for your analysis to a new shapefile by right clicking on them and choosing **Export Data**. This time, use the projection system of **the data frame**. Name the file *30min2target.shp.*



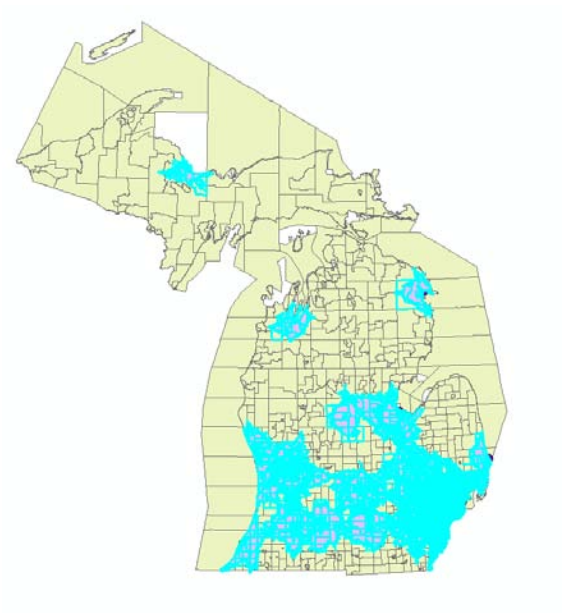
Add *30min2target.shp* to your dataframe

5. Add the Michigan Census tracts: *MI_ACS09_trt.shp.*

6. Click **Selection > Select by Location**. Spatially select all **census tracts** (**target layer**) that **have their centroid** (center of gravity) in the **30 minute drive time** polygon (**source layer**). We will make an assumption that all tracts with their centroid within the 30 minute drive time polygon have populations that are within the 30 minute window to a Target store. Click **Apply**; then **OK**.

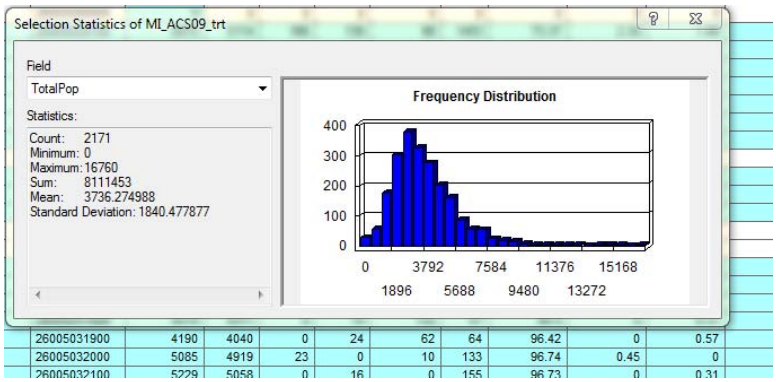


The results should looks something like this:

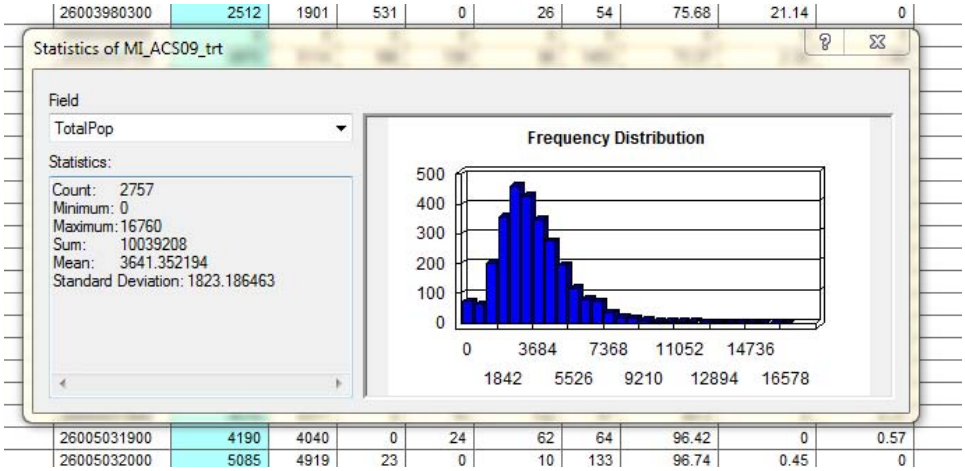


7. Open the table for *MI_ACS09_trt.shp*; you should see that 2171 of the 2757 MI tracts have been selected. Right click on the *TotalPop* attribute field and select **statistics** for these selected

tracts**.** Take a look at the sum of the tract values for your selection. There are 8,111,453 people within a 30 minute drive time of a Target.



8. Now **Clear selection** and take a look at the sum of the tract values for all of MI. The total Michigan population estimate in 2009 was 10,039,208.



Solution: It looks like ~ 81% of MI's population is within a 30 minute drive time to a Target.

Discussion:

1. Do you buy this?
2. What are some likely assumptions/caveats to this type of analysis?
3. Do you think Target used location-based intelligence when locating its stores across the state?
4. How could you use a similar service area analysis in your work? What would you do differently?