

GIS III: GIS Analysis

Module 1b: Network Analysis Tools

*** Files needed for exercise are *NYstate_stroke_assets.shp*; *NY_ACS09_trt.shp*; *NY_ACS09_trt_cent.shp*; and *streets.sdc* (provided by Street Map USA)

Goals: Our goal for this activity is to use Network Analyst to generate an origin-destination (O-D) matrix or table. The tables and graphics provided by this practical network analysis method provide a great deal of information.

Skills: After completing this activity you will know how to complete an O-D analysis using Network Analyst and develop some ideas for how to apply this useful tool in your own work. At the application level, this tool will allow you to calculate distances between points through a network with accumulation or cost variables (distance or time).

Origin-Destination Matrix Problem: New York State Stroke Assets – and neighborhood accessibility. We will create an O-D matrix to understand stroke resource (Upstate Stroke, Telestroke NYD, and NYC Stroke point shapefiles merged) accessibility for census tracts in New York State. We will measure the drive time from the center of each census tract to all the stroke resources within a defined time frame – for the purposes of this exercise, let's say within a 30 minute drive time. This time frame is likely very important and should be considered in a useful analysis.

Comparing tract level demographic data related to risk factors for stroke alongside accessibility to stroke treatment resources could prove useful for programming and planning efforts. Our O-D matrix could be used to evaluate network-based accessibility to stroke treatment resources by census tract. Which New York census tracts have the most convenient driving accessibility?

Prepare your data:

1. Open ArcMap
2. Add the New York State stroke assets, *NYstate_stroke_assets.shp*. This statewide dataset for the point locations of stroke resources will serve as destinations in your analysis.
3. Add the point representation of NY census tracts *NY_ACS09_trt_cent.shp*. These points will serve as origins in your analysis (we need a point representation to serve as the starting point for the Origin to Destination calculation).
4. Add NY census tracts to your project *NY_ACS09_trt.shp*. This statewide shapefile will provide some useful geographical context for your analysis.

Establish your Network:

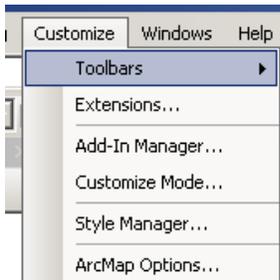
1. Turn on your NA extension by clicking **Customize > Extensions**.



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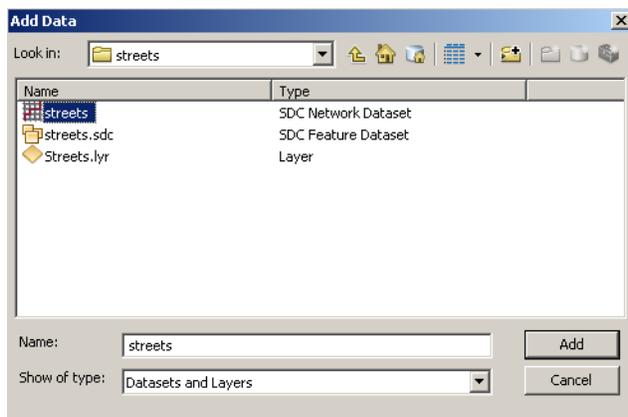
2. Activate your NA toolbar by clicking **Customize > Toolbars** and checking **Network Analyst**.



The toolbar looks like this:



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

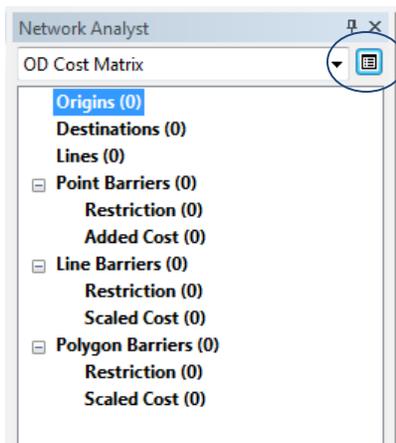


Note: This is a nationwide dataset included in your ESRI ArcGIS Data disks. Be forewarned- it is large. The .sdc format is un-editable, but using this means you will not need to create your own network dataset. You should see a detailed road network begin to fill in. You can turn these off by un-checking them in the TOC to speed things up a bit.

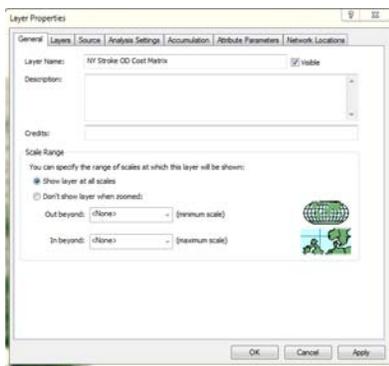
4. If your network analyst window is not visible, make it visible by left clicking on  in the toolbar.
5. In the Network Analyst toolbar, click **Network Analyst > New OD Cost Matrix**.
6. Adjust your service area properties and analysis settings. Left click on the **OD Cost Matrix Properties** icon in the Network Analyst window (in the upper right-hand side).

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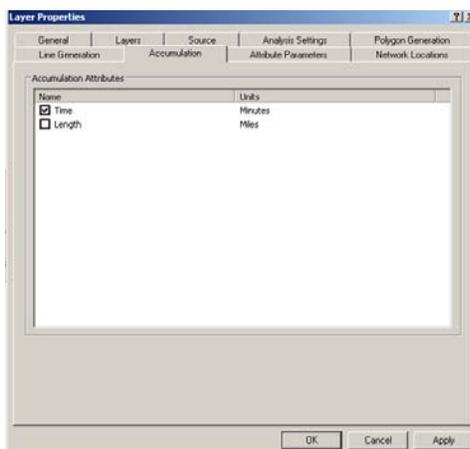
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- Under the **General** tab you can name this service area layer: *NY Stroke OD Cost Matrix*.



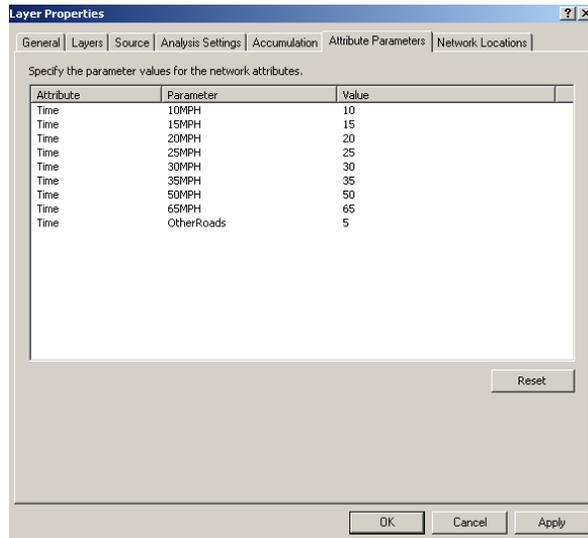
- Under the **Accumulation** tab, check **Time**. This will set your impedance measurement or cost for moving through the network based on time.



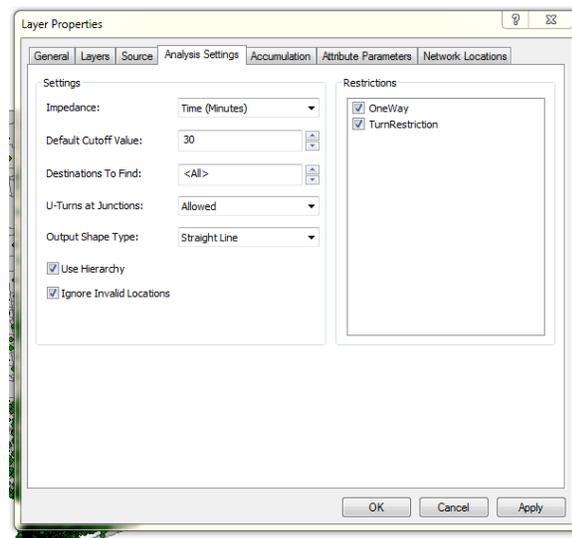
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- Take a look at your **Attribute Parameters** tab. You can see that the time attribute is informed by speed limit parameters for your network.



- Under the **Analysis Settings** tab you should see that your impedance or cost will be measured in time (minutes). Change the default cutoff value to 30 minutes; remember that we only want to know those stroke assets that are within a 30 minute drive time. Go with defaults for the remaining options on this tab.



- Under the **Network Locations** tab you can set the tolerance for loading or locating the **origins** (census tracts) and **destinations** (stroke assets) on the network dataset. Toggle back and forth by selecting either origins or destinations in location type. We will stick with the 5000 meter search tolerance for both.

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Layer Properties [?] [X]

General | Layers | Source | Analysis Settings | Accumulation | Attribute Parameters | Network Locations

Network Location Field Mapping

Location Type: **Origins**

Property	Default Value	Candidate Fields	Load...
Name		Name; Origin; DepotName	
TargetDestinationCo...		MaxDestinations; Cutoff; Destinat...	
SourceID	<None>	SourceID; SID; Source	Save...
SourceOID	-1	SourceOID; SOID	
PosAlong	0	PosAlong; PA; Pos	
SideOfEdge	Left Side	SideOfEdge; SOE	
CurbApproach	Either side of vehicle	CurbApproach; SideOfStreet; Sid...	

Finding Network Locations

Search Tolerance: 5000 Meters

Snap To:

Closest

Name	Shape	Middle	End
SDC Edge Source	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

First

Exclude restricted portions of the network

OK Cancel Apply

Layer Properties [?] [X]

General | Layers | Source | Analysis Settings | Accumulation | Attribute Parameters | Network Locations

Network Location Field Mapping

Location Type: **Destinations**

Property	Default Value	Candidate Fields	Load...
Name		Name; Destination; DepotName	
SourceID	<None>	SourceID; SID; Source	Save...
SourceOID	-1	SourceOID; SOID	
PosAlong	0	PosAlong; PA; Pos	
SideOfEdge	Left Side	SideOfEdge; SOE	
CurbApproach	Either side of vehicle	CurbApproach; SideOfStreet; Sid...	

Finding Network Locations

Search Tolerance: 5000 Meters

Snap To:

Closest

Name	Shape	Middle	End
SDC Edge Source	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

First

Exclude restricted portions of the network

OK Cancel Apply

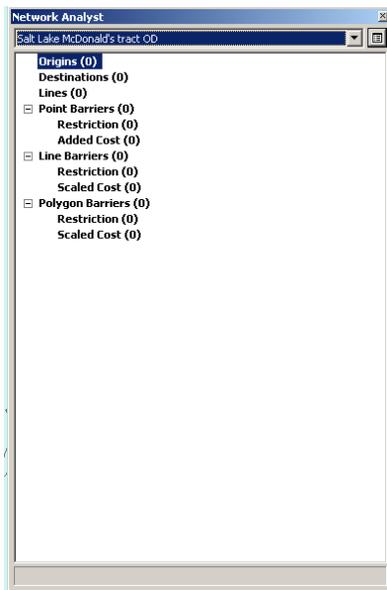
12. Once you have taken a look you can click **Apply** and **OK**.

Load data into your Network Dataset:

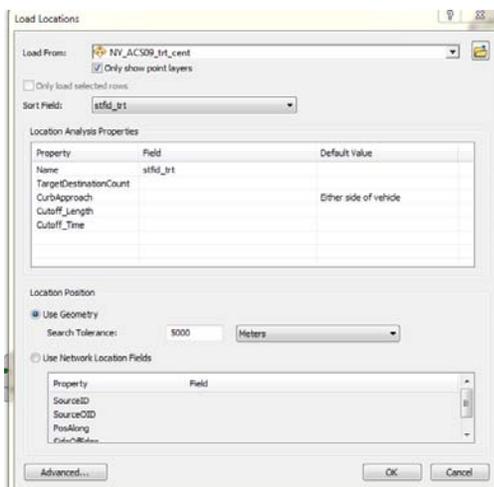
1. Right click on **Origins** in the Network Analyst window and select **Load Locations**.
2. Choose the shapefile *NY_ACS09_trt_cent.shp* as the data to be loaded. This means our starting point for measuring drive time will be the centroid for each census tract.

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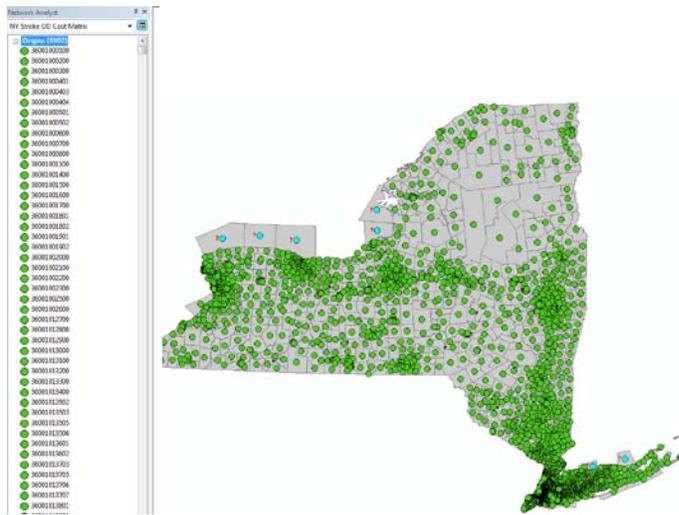


3. Select *stfid_trt* as your **sort field** from the **sort field** dropdown. You can sort by any of the attributes in the table but it is a good idea to use a unique ID.
4. You can also specify a **Name Property Field** here, which is handy when looking at the results. Select *stfid_trt*. Again, a unique field is probably best. Finally, the default **search tolerance** we saw under the **Network Locations** tab should be reflected here.
5. Click **OK**. 7 of the 4907 tract centroid points should load. This may take a while...
6. The 7 tracts centroids that did not load? These appear to be tracts that have their center in bodies of water; they exceeded the loading distance threshold.



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7. Load destinations into the Network Dataset. Right click on **Destinations** in the Network Analyst window and select **Load Locations**.



8. Choose the shapefile *NYstate_stroke_assets.shp* as the data to be loaded.
9. Select *Facility* as your **Sort Field** from the dropdown.
10. Specify *Facility* as **Name** property **Field** here.
11. Stick with the default Search tolerance again.
12. Click **OK**. All 152 NY state stroke asset points should load.

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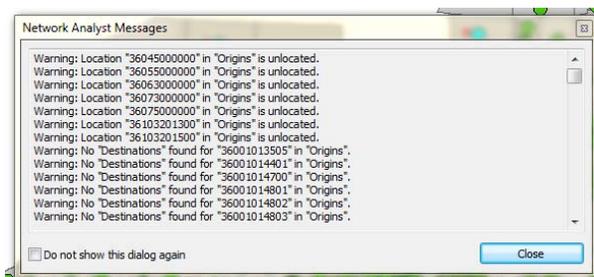
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Solve the O-D Cost Matrix problem

Remember: We want to create an O-D matrix that shows the drive times from the center of New York state census tract to stroke assets within a 30 minute drive time through the road network.

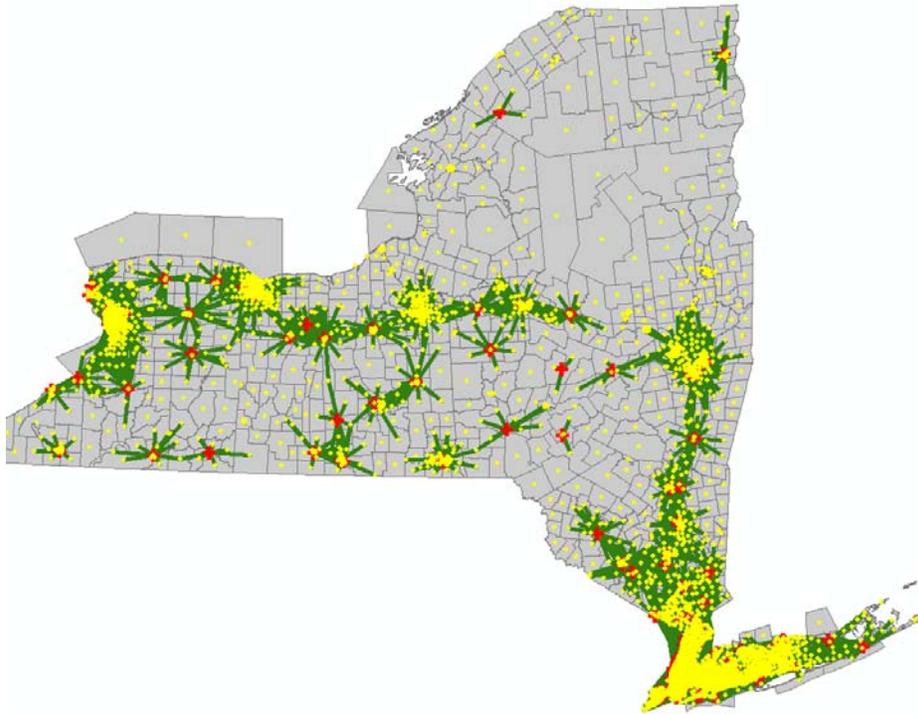
1. Click on the solve icon .
2. You may see something like this:



What do you think this means? First- the seven records at the top indicate the 7 tracts that were not located as origins- there can be no solution for these records unless you change your search tolerance; would you want to? The next 6 items represent the 6 *tract centers where no destinations were found*; in my experience this is usually due to network errors- this is a reality with a nationwide network dataset.

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

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- In your table of contents you will see the results of your analysis; we are interested in the table associated with the lines that connect your origins and destinations. Right click on the lines feature in the TOC and open the table.

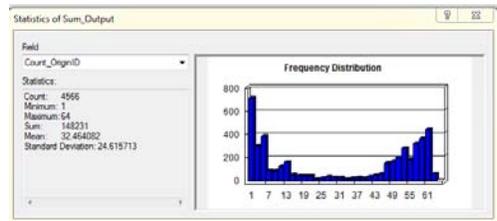
Layers

- NY_ACS09_trt_cen
- NVstate_stroke_assets
- NY Stroke OD Cost Matrix
 - Origins
 - Error
 - Located
 - Unlocated
 - Destinations
 - Error
 - Located
 - Unlocated
 - Point Barriers
 - Error
 - Restriction
 - Added Cost
- Lines
 - Lines
 - Line Barriers

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- To quickly get an idea of the tracts that have the most routes to reach a stroke asset in 30 minutes or less, right click on the **OriginID** field and summarize it; name the sum table and add the result to your TOC.
- Right click on **Count_OriginID** and select **statistics** to get some descriptive statistics on the counts by origin.



- It looks like OriginID 3666 has the most stroke assets within a 30 minute or less drive time-64. Can you find it?



- These lines represent a simplification of the routes between the tract with the most stroke assets within the specified time and the assets they reach. Even though the lines are displayed as the crow flies, they are in fact measured (distance-wise) through the network.



Discussion:

- Do you buy this?
- Can you locate the tracts that do not have 30 drive time access to NY state stroke assets?
- What are some likely assumptions/caveats to this type of analysis?
- How could you use a similar O-D analysis in your work?
- What would you do differently?