Using GIS Training to Address Blood Pressure Medication Adherence Proximity Part II

*** Files needed for Part 2 of this exercise: *MN_county10_prj_carto.shp*, *MN_PW_tracts2010.shp*, *2014_npi_pharm_taxon.shp*, and *Streets* (network dataset provided by StreetMap USA)

Part 2 Goals: The goal of this exercise is to compare the results proximity based analyses seeing to get an understanding of evaluate geographic access at a statewide scale to a select set of resources: Pharmacies and Pharmacist within the state of MN. First you will calculate the Euclidean distance using the **generate near table tool**, next you will calculate Network based estimates using an **Origin Destination (OD) cost matrix**. With this measures you will estimate geographic access for each US Census Tract population aggregated its population weighted centroid.

Part 2 Skills: After completing this exercise, you should have a basic familiarity with both Euclidean and Network based proximity analyses and have an understanding of the implications of population aggregation.

Part 1 Problem: Understanding statewide geographical access to pharmacy resources: what is the average distance to the 5 closest pharmacies? This information can be useful in estimating the how far the state's population has to travel on average to reach a reasonable set of pharmacy options in space. You are interested in quantifying geographic access for the state's entire population to the 5 closest Pharmacy resources. To do this, you will create both a Euclidean near table, and an OD cost table.

Add the data for you area of interest:

1. Open a new blank map in ArcMap and add *MN_county10_prj_carto.shp, this will provide useful cartographic context and also since it has been correctly projected for the state of MN, set the coordinate system of your data frame.*
2. Add *MN_PW_tracts2010.shp*. This shapefile represents the population weighted US Census Tract census tract centroids for MN, it also has population data from the 2010 Decennial Census. You can get these data for any state here: https://www.census.gov/geo/reference/centersofpop.html
3. Next add 2014_npi_pharm_taxon.shp. This shapefile represents the select set of locations from the Centers for Medicare & Medicaid Services (CMS) National Plan and Provider Enumeration System (NPPES). The **types** included are Pharmacy Taxonomies:

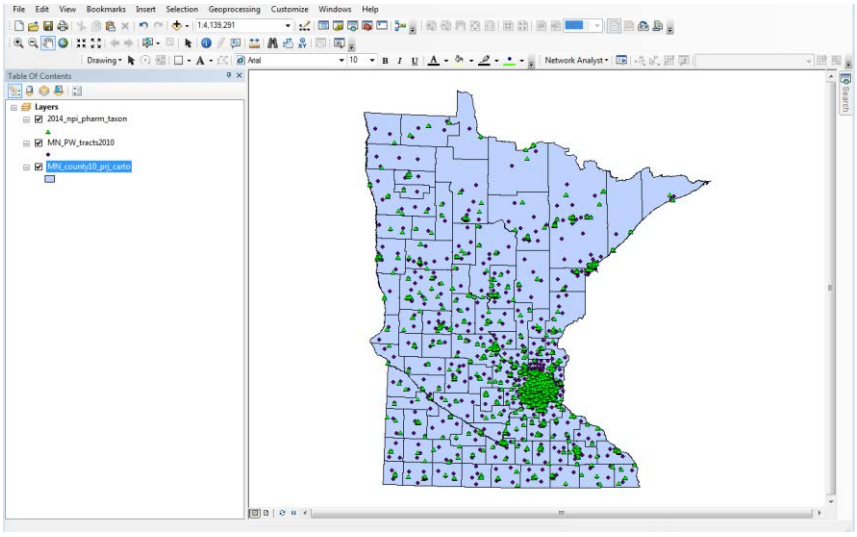
Pharmacy 3336%
- Pharmacy - 333600000X
- Clinic Pharmacy - 3336C0002X
- Community/Retail Pharmacy - 3336C0003X
- Compounding Pharmacy - 3336C0004X
- Home Infusion Therapy Pharmacy - 3336H0001X

Institutional Pharmacy - 3336I0012X
Long Term Care Pharmacy - 3336L0003X
Mail Order Pharmacy - 3336M0002X
Managed Care Organization Pharmacy - 3336M0003X
Nuclear Pharmacy - 3336N0007X
Specialty Pharmacy - 3336S0011X

Pharmacist 1835%
Pharmacist - 183500000X
Ambulatory Care - 1835P2201X
Critical Care - 1835C0205X
Geriatric - 1835G0303X
Nuclear - 1835N0905X
Nutrition Support - 1835N1003X
Oncology - 1835X0200X
Pediatrics - 1835P0200X
Pharmacist Clinician (PhC)/ Clinical Pharmacy Specialist - 1835P0018X
Pharmacotherapy - 1835P1200X
Psychiatric - 1835P1300X

Pharmacy Technician 1837%
Pharmacy Technician - 183700000X

4. All of the datasets you have added have been projected to the MN state standard projected coordinate system in any proximity based analysis your data must be projected correctly, confirm the projection of your datasets by examining their properties.
5. Make sure you points are on top of your polygons and symbolize your data so they are distinguishable.



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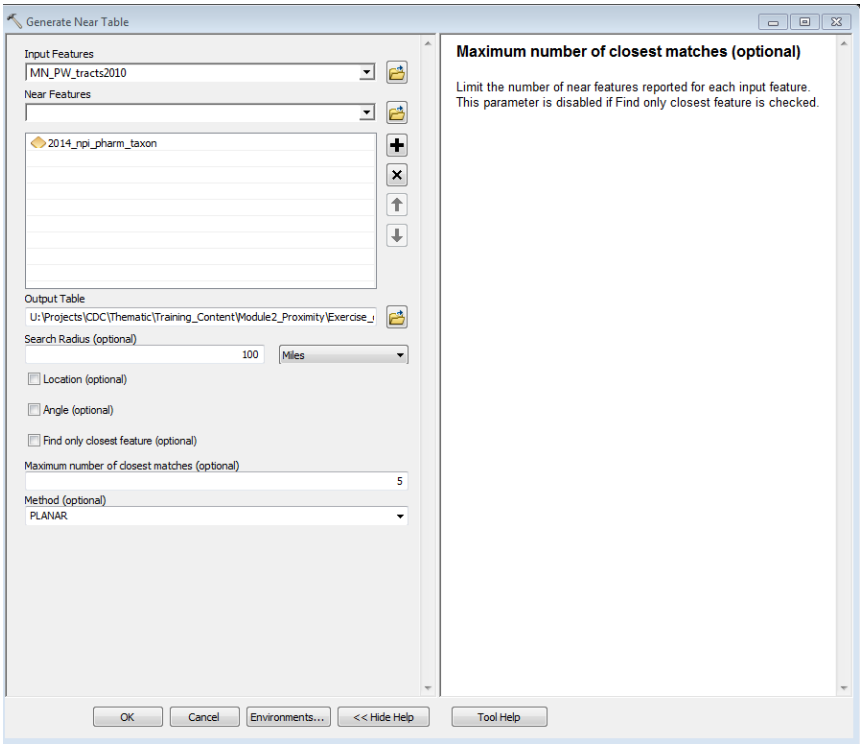
Generate a near table

1. Activate the Generate Near Table tool- you can find this tool using the Search window, or under the Proximity Analysis Toolset in ArcToolBox

2. Parameters for the tool:
    a. Your input features will be: *MN_PW_tracts2010*
    b. *Your Near features will be: 2014_npi_pharm_taxon*
    c. Save you output table as: *tract2pharmNPI_5near*
    d. Extend your search radius to 100 miles. Do you know why we made this choice?
    e. You will choose ALL for the dissolve type- do you know why?
    f. Uncheck find only closest feature- we want to find the 5 closest features within a 100 mile threshold.
    g. Input 5 for the maximum number of matches- this will insure the tool will find no more than five (the closest) within the defined search radius.
    h. Stick with the defaults for the remainder of the tool inputs.



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3. Take a look at your results by opening your 2014_npi_pharm_taxon table

tract2pharmNPI_5near

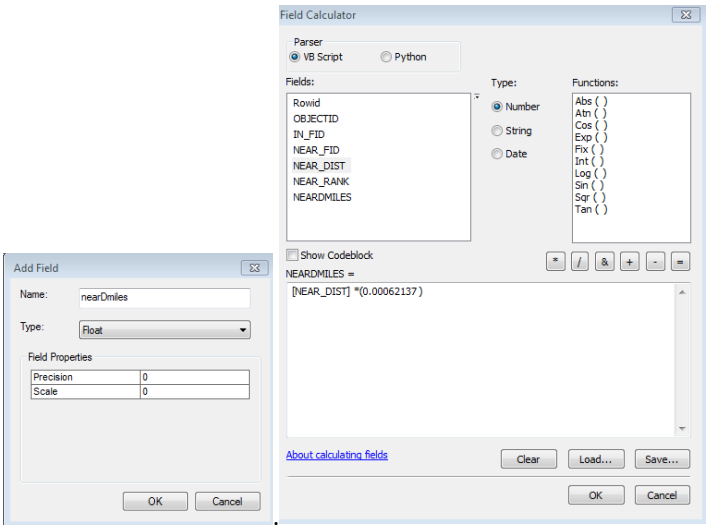
Rowid	OBJECTID	IN_FID	NEAR_FID	NEAR_DIST	NEAR_RANK
1	0	0	3349	12412.034735	1
2	0	0	3577	12412.034735	1
3	0	0	3903	13059.777659	2
4	0	0	2254	30201.294422	3
5	0	0	2255	30201.294422	3
6	0	1	3341	35516.331365	1
7	0	1	1686	35970.536853	2
8	0	1	1902	35970.536853	2
9	0	1	666	36284.142588	3
10	0	1	667	36284.142588	3
11	0	2	3451	1041.743418	1
12	0	2	3452	1041.743418	1
13	0	2	3656	1041.743418	1
14	0	2	3657	1041.743418	1
15	0	2	3165	1111.381454	2
16	0	3	3903	7018.799006	1
17	0	3	3349	7829.037896	2
18	0	3	3577	7829.037896	2
19	0	3	2254	36585.051792	3
20	0	3	2255	36585.051792	3
21	0	4	4005	21186.672859	1
22	0	4	3166	29419.724676	2
23	0	4	3659	29419.724676	2
24	0	4	3660	29419.724676	2
25	0	4	2254	29844.822043	3
26	0	5	3166	9225.56192	1
27	0	5	3659	9225.56192	1
28	0	5	3660	9225.56192	1
29	0	5	2254	10471.434084	2
30	0	5	2255	10471.434084	2
31	0	6	1994	1577.08424	1
32	0	6	1995	1577.08424	1
33	0	6	3492	1577.08424	1
34	0	6	189	13787.451165	2

1 (0 out of 6670 Selected)

tract2pharmNPI_5near

There are 6670 records in this table= 1334 tract centroids X 5 closest pharmacy resources.

4. You may notice that the distance units are clearly not miles- they have been calculated in the de facto linear unit for MN's projected coordinate system: meters. To make this table easier to interpret and compare create a new numeric field – float type and calculate a new value by multiplying the NEAR_DIST field by 0.00062137 to convert to miles



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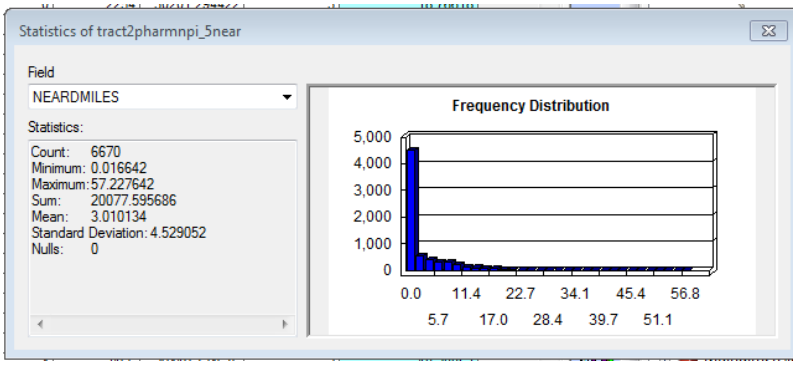
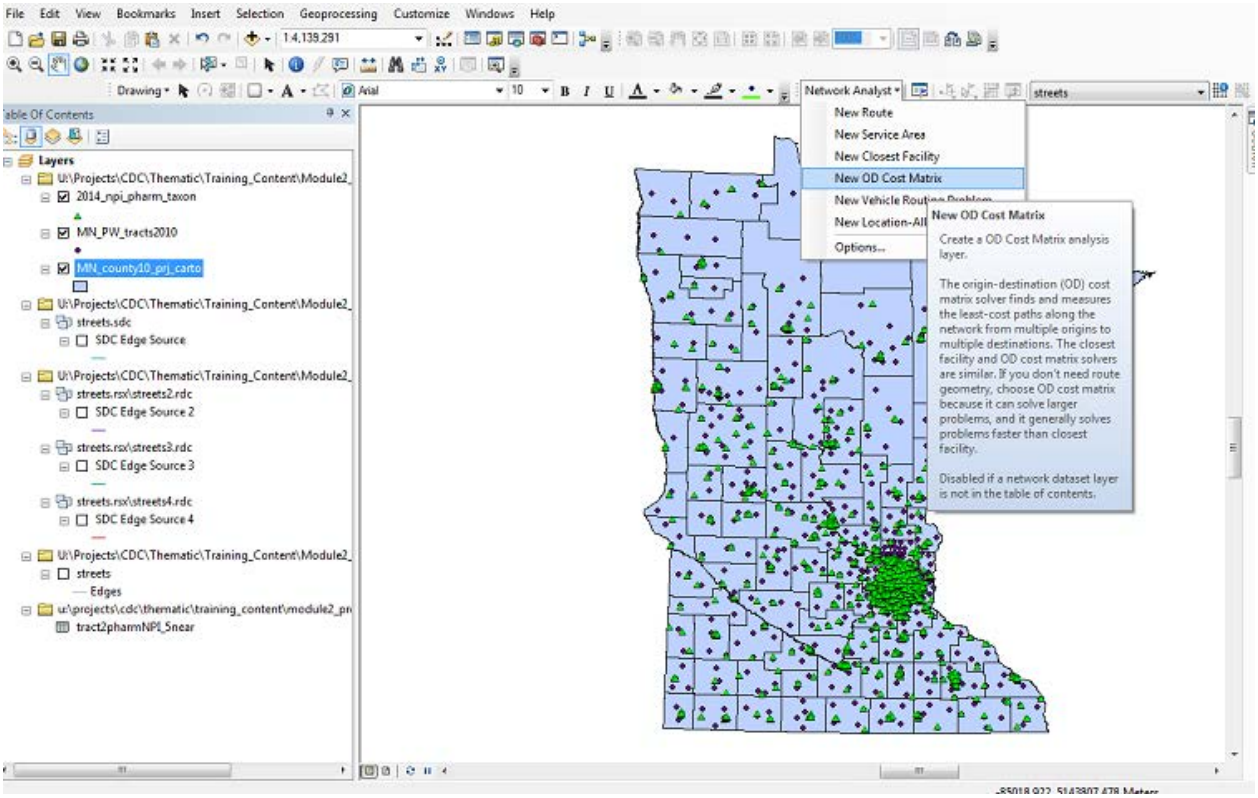
What is the average Euclidean distance to the 5 closest Pharmacy resources?



Perform an OD cost matrix analysis to calculate the same information using a network based approach.

If your network analyst window is not visible, make it visible by left clicking on  in the toolbar.

1. In the Network Analyst toolbar, click **Network Analyst > New OD Cost Matrix**.



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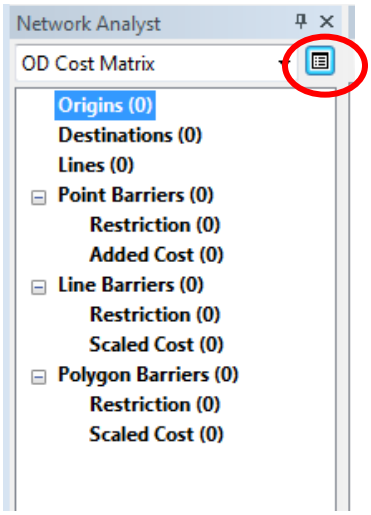
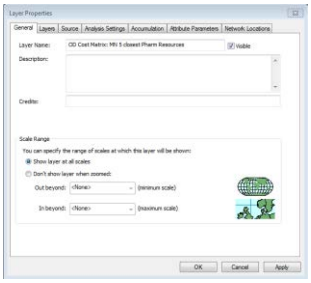
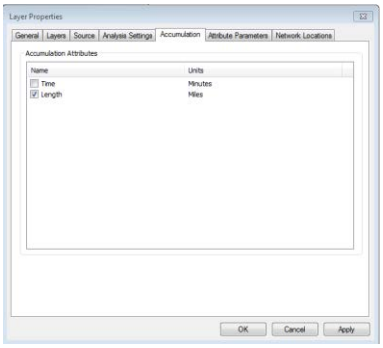
2. To adjust your service area properties and analysis settings, click on the **Service Area Properties** icon in the Network Analyst window (on the upper right-hand side).



3. Under the **General** tab, name this OC Cost Matrix layer: OD Cost Matrix: MN 5 closest Pharm Resources. Click **Apply** rather than OK.

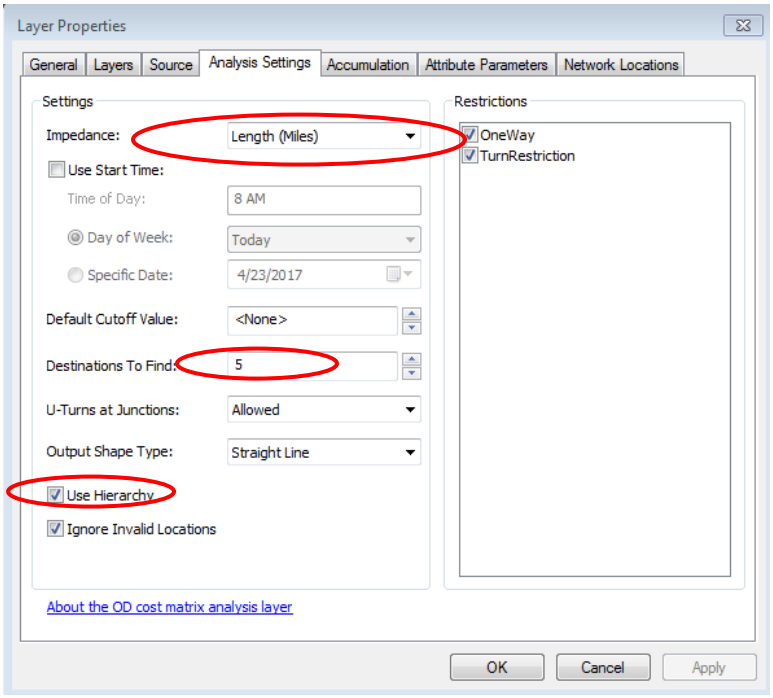


4. Under the **Accumulation** tab, check **Length**. This will calculate both time and length of moving through the network for your analysis. Click **Apply** rather than OK.

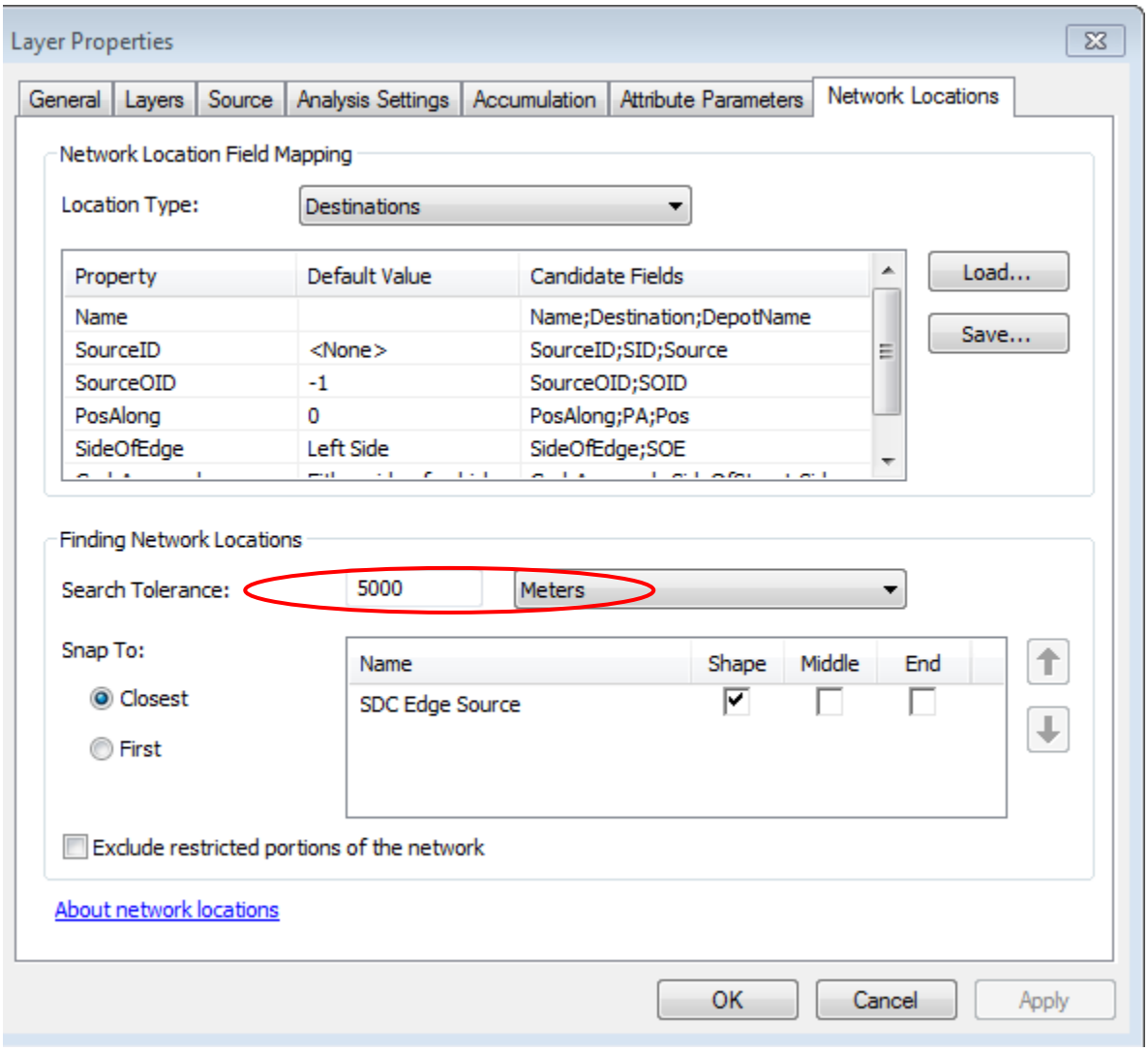


5. Under the **Analysis Settings** tab you should see that your impedance or cost will be measured in length (miles). In this analysis you will **Use Hierarchy so make sure it is checked NOTE**: **Hierarchical analysis** is a heuristic method for solving drive time by favoring travel on larger roads (e.g. highways) over small roads (e.g. local streets). Network Analyst can compute service areas more quickly when using a hierarchical analysis, but it is less exhaustive than a non-hierarchical analysis. The About network analysis with hierarchy help page has more information.)
6. Input 5 destinations to find- this will ensure that you only find the 5 closest resources for each population center.

   Click **Apply** rather than OK

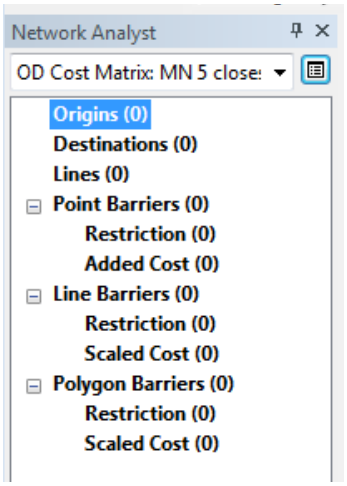


7. **Remember you have two sets of points to load onto the network: origins and destinations- use the dropdown to toggle back and forth between them.** Under the **Network Locations** tab, stick with the default for the tolerance for locating both your origins (population weighted centroids) and your destinations (5 closest pharmacy resources) onto the network dataset.

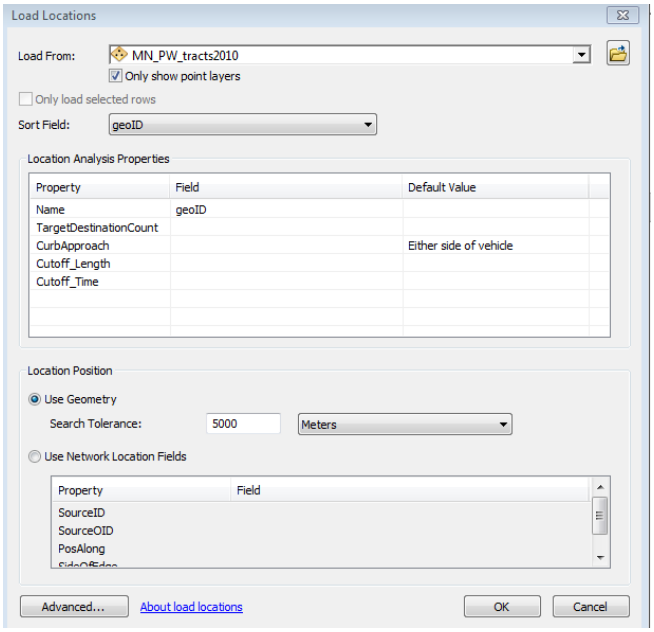


Note: You may need to adjust this since how well the locations load depends on the condition of the network dataset and the quality of your geocoded data. Stick with the defaults for the rest of the settings. Click **Apply,** then **OK.**

8. Load your origins: Right click on **Origins** in the Network Analyst window and select **Load Locations**. The census track population weighted centroids are your origins.

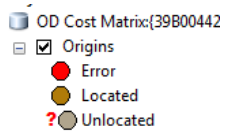


9. Make sure that your shapefile *MN_PW_tracts2010.shp* is the data to be loaded and select **GEOID** as your **Sort Field**. You can sort by any of the attributes in the table, but it is a good idea to use a unique identifier. For the **Name** Property select **GEOID** field; this will identify each tract by its name



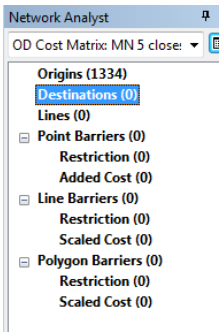
10. Click **OK**. You should see 1334 tracts were located in your Network Analyst window. All of your tracts have been loaded and located on the network dataset indicated by a brown colored circle (yours will likely be a different color).

If any of your locations were not located or have errors you will see a red circle, or a circle with a question mark in your TOC.

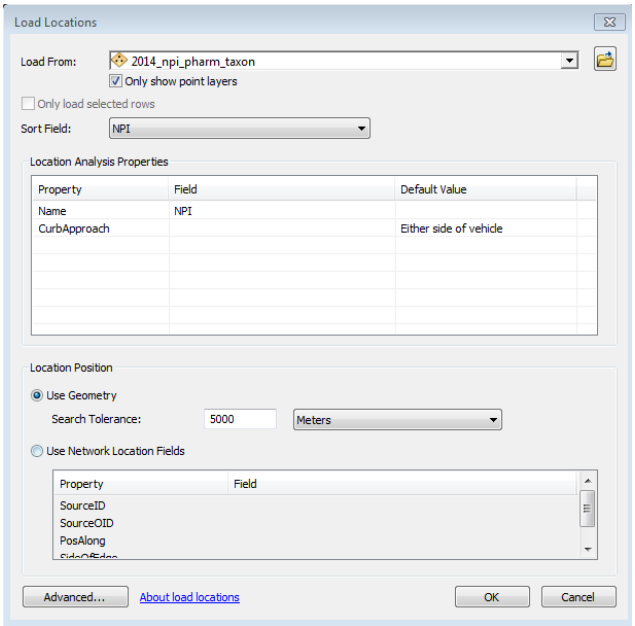


11. Load your destinations: Right click on **Destinations** in the Network Analyst window and select **Load Locations**.

    The pharmacy resources are your destinations.

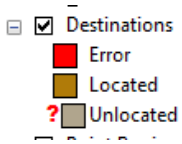


12. Make sure that your shapefile *2014_npi_pharm_taxon.shp* is the data to be loaded and select **NPI** as your **Sort Field**. You can sort by any of the attributes in the table, but it is a good idea to use a unique identifier. For the **Name** Property select **NPI** field; this will identify each resource by its name.



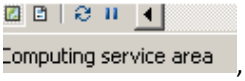
13. Click **OK**. You should see 4,055 resources were located in your Network Analyst window. All of your resources have been loaded and located on the network dataset indicated by a brown colored square (yours will likely be a different color).

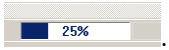
    If any of your locations were not located or have errors you will see a red square, or a square with a question mark in your TOC.



Solving the Service Area Problem

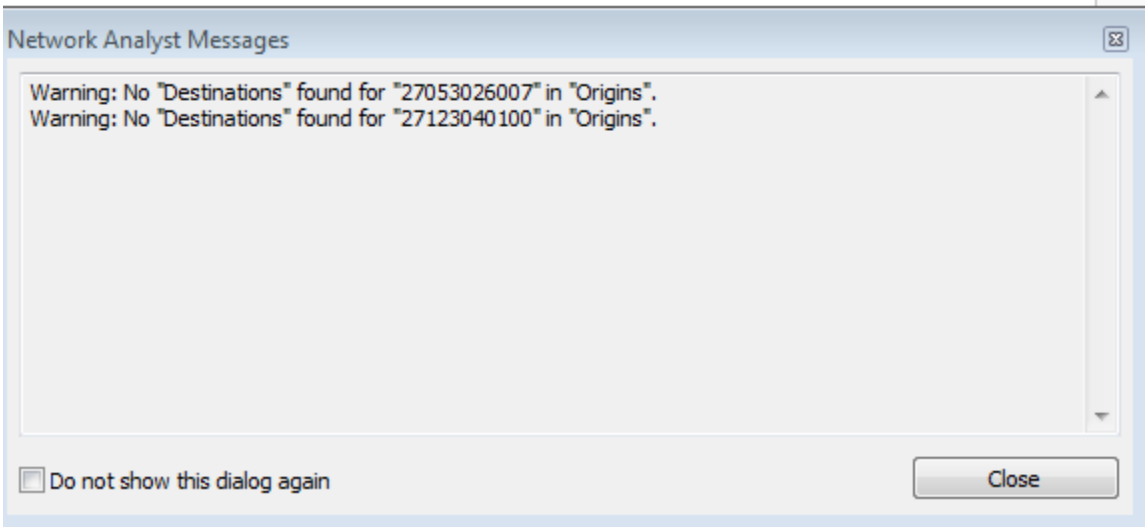
1. You have set up your analysis and loaded the origins and destinations - now you can solve. Remember, you want to create a network-based distance from each tract population weighted centroid to its 5 closest pharmacy resources. . Click on the Solve icon  to run the analysis. This may take a bit of time (remember that this is 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: 

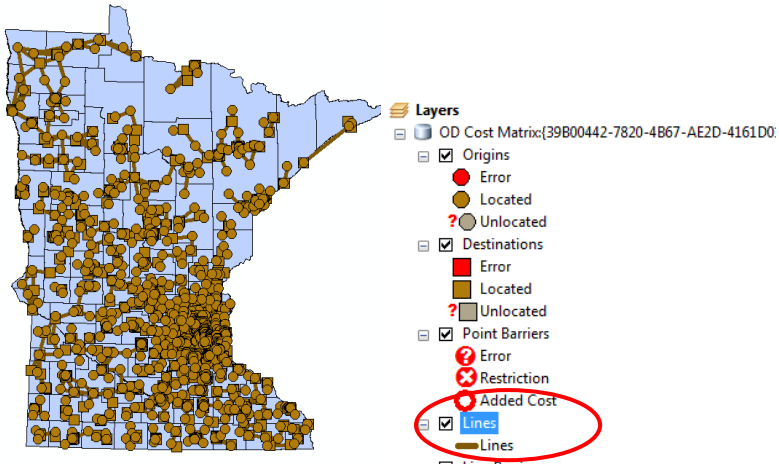
. Now is also a good time to stretch out, and ask any questions you may have.

3. You will get this message once the solve is complete:



This means that for two of your tracts- no destinations were found. This is likely due to errors in the network dataset.

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



5. In your table of contents you will see the results of your analysis. Right click on the Lines from your analysis and open the table.

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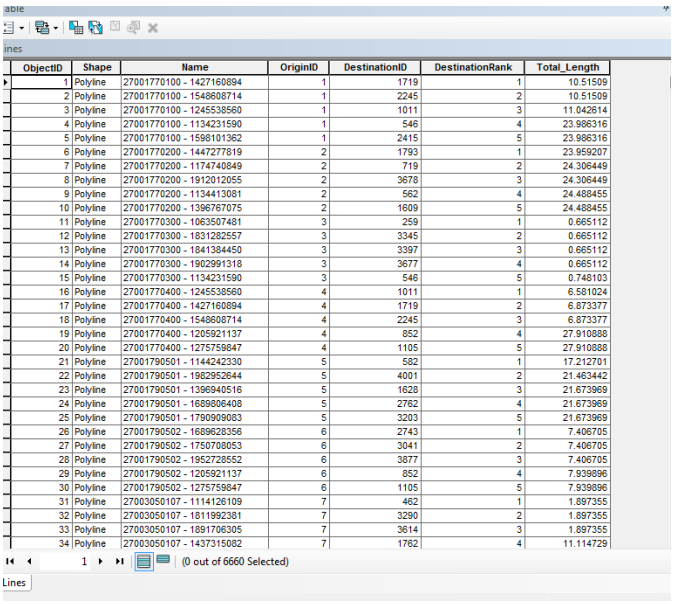
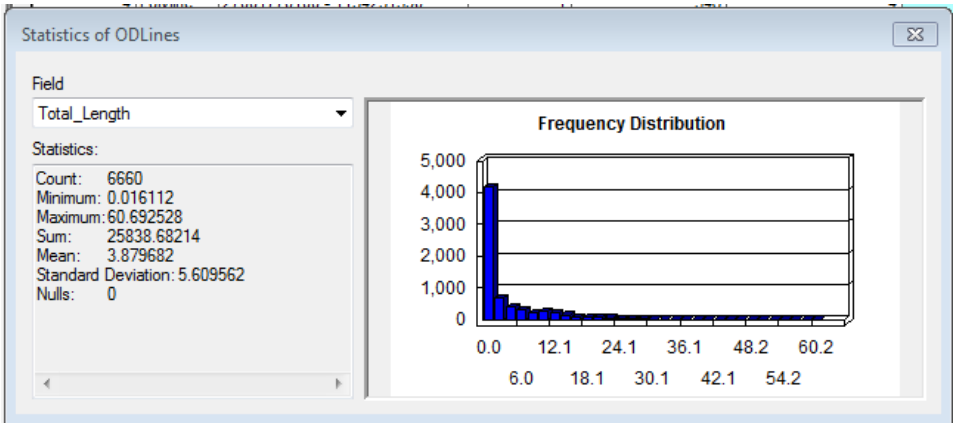


ObjectID	Shape	Name	OriginID	DestinationID	DestinationRank	Total_Length
1	Polyline	27001770100 - 1427160894	1	1719	1	10.51509
2	Polyline	27001770100 - 1548608714	1	2245	2	10.51509
3	Polyline	27001770100 - 1245538560	1	1011	3	11.042614
4	Polyline	27001770100 - 1134231590	1	546	4	23.986316
5	Polyline	27001770100 - 1598101362	1	2415	5	23.986316
6	Polyline	27001770200 - 1447277819	2	1793	1	23.959207
7	Polyline	27001770200 - 1174740849	2	719	2	24.306449
8	Polyline	27001770200 - 1912012055	2	3678	3	24.306449
9	Polyline	27001770200 - 1134413081	2	562	4	24.488455
10	Polyline	27001770200 - 1396767075	2	1609	5	24.488455
11	Polyline	27001770300 - 1063507481	3	259	1	0.665112
12	Polyline	27001770300 - 1831282557	3	3345	2	0.665112
13	Polyline	27001770300 - 1841384450	3	3397	3	0.665112
14	Polyline	27001770300 - 1902991318	3	3677	4	0.665112
15	Polyline	27001770300 - 1134231590	3	546	5	0.748103
16	Polyline	27001770400 - 1245538560	4	1011	1	6.581024
17	Polyline	27001770400 - 1427160894	4	1719	2	6.873377
18	Polyline	27001770400 - 1548608714	4	2245	3	6.873377
19	Polyline	27001770400 - 1205921137	4	852	4	27.910888
20	Polyline	27001770400 - 1275759847	4	1105	5	27.910888
21	Polyline	27001790501 - 1144242330	5	582	1	17.212701
22	Polyline	27001790501 - 1982952644	5	4001	2	21.463442
23	Polyline	27001790501 - 1396940516	5	1628	3	21.673969
24	Polyline	27001790501 - 1689806408	5	2762	4	21.673969
25	Polyline	27001790501 - 1790909083	5	3203	5	21.673969
26	Polyline	27001790502 - 1689628356	6	2743	1	7.406705
27	Polyline	27001790502 - 1750708053	6	3041	2	7.406705
28	Polyline	27001790502 - 1952728552	6	3877	3	7.406705
29	Polyline	27001790502 - 1205921137	6	852	4	7.939896
30	Polyline	27001790502 - 1275759847	6	1105	5	7.939896
31	Polyline	27003050107 - 1114126109	7	462	1	1.897355
32	Polyline	27003050107 - 1811992381	7	3290	2	1.897355
33	Polyline	27003050107 - 1891706305	7	3614	3	1.897355
34	Polyline	27003050107 - 1437315082	7	1762	4	11.114729

(0 out of 6660 Selected)

There are 6,660 records in your table – 10 fewer than your Euclidean table- do you know why?

6. What are your distance/length unites measured in?
7. What is the average distance for each tract to reach the 5 closest pharmacy resources?



Solution

It looks like the Euclidean distances are less: avg 3 miles to the closest 5 resources while the network based distances are higher for the same count: almost 4 miles on average. Why do you think this is the case?