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
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Institutional Pharmacy - 333600012X
Long Term Care Pharmacy - 33360003X
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 your 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.
3. Take a look at your results by opening your 2014_npi_pharm_taxon table

<table>
<thead>
<tr>
<th>Round</th>
<th>OBJECTID</th>
<th>IL_PID</th>
<th>NEAR_DIST</th>
<th>NEAR_RADIUS</th>
</tr>
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<td>0</td>
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<td>1794</td>
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</tbody>
</table>

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

Field Calculator

- Name: nearDist
- Type: Float
- Formula: NEAR_DIST * 0.00062137

Add Field

- Name: nearStiles
- Type: Float
- Formula: NEAR_STILES * 0.00062137

Add Calculated Fields

- NearStiles
- NEAR_STILES * 0.00062137

Show Calculated Field

NEAR_STILES * 0.00062137

Save Field

NearStiles

OK Cancel
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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.
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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**
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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.
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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.
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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:

![Network Analyst Messages dialog box](image)

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:

![GIS map showing analysis results](image)

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

6. What are your distance/length units 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?