Using Network Analyst

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What we will do today

• Create a network dataset from an existing shapefile
  – What is a network dataset?

• Try four features of Network Analyst
  – Routes, Nearest Facilities, and Service Area
Requirements

• Network Analyst extension, enabled
• Network Toolbar
• Network Window
  – Load Locations is done in this window
• Valid Network Dataset
  – Built from street network in ArcCatalog
• Shapefiles with origins and destinations
Get your data copied to your desktop

- Cambridge street centerline data from our repository, renamed street.shp

- Two point shapefiles, with the same projection as the Cambridge street shapefile and stored in the same location as the street shapefile
  - origin.shp
  - schools.shp
Add a distance column to the street shapefile

• Call it DISTANCE, make it type DOUBLE. Populate it using the CALCULATE GEOMETRY tool and use length.

• Alternatively, you can calculate the time traveled on a road segment, calculated on presumed speeds and the distance traveled.
Adding data to shapefiles

• We added a single point to your ORIGIN shapefile
  – 77 Mass Ave or your T stop, any location is fine
• Add multiple points to your DESTINATION shapefile (or use the schools.shp shapefile)

  (this is already done but feel free to edit points if you are already familiar with editing shapefiles)
Making a Network Dataset

• Open Arcmap then open the ArcCatalog window in Arcmap and navigate to the folder containing street.shp

• Right click on layer in ArcCatalog and select New Network Dataset
Sequence of forms for creating network dataset

• Model turns – yes, then click next
• Click on Connectivity button, click on OK on Connectivity form then Next on main form
• No, don’t model elevation. Click Next.
• Add a new attribute called DISTANCE, units = feet, then click next.
Sequence of forms for creating network dataset, continued

• Model directions – yes, then click yes
Summary:

Name: streets_ND
Type: Shapefile-Based Network Dataset

Sources:
Edge Sources:
streets

Turns:
<Global Turn>

Connectivity:
Group 1:
Edge Connectivity:
streets (End Point)

Elevation Model: None

Attributes:
Length:
Usage Type: Cost
Data Type: Double
Units Type: Feet
Use by Default: True
Source Attribute Evaluators:
streets (From-To): Field
Language: VBScript
Expression: [Shape]

Default Attribute Evaluators:
Default Edges: Constant = 0
Default Junctions: Constant = 0
Default Turns: Constant = 0

DISTANCE:
Usage Type: Cost
Data Type: Double
Units Type: Feet
Use by Default: False
Source Attribute Evaluators:
streets (From-To): Field
Finishing

• Build it – yes
• Add all feature that participate in dataset – yes

Now let’s use this ...
Four tools

- Routing to multiple stops
- Closest facility
- Service area
- Origin Destination (OD) Cost Matrix (not in exercise)

All available from the Network Analyst toolbar dropdown menu
Routing to multiple stops

• Routing finds the best route between two or more locations

• Best could be:
  – Shortest distance
  – Shortest time
  – Certain characteristics of the network

  – All of the above have to be coded into your network dataset
Routing to multiple stops

- Add the Network Window

- Right click on Stops and add Origin and Destinations (or schools), in that order, using LOAD LOCATIONS. You can use a single shapefile.

- Returns a shapefile showing path along network to each stop in order that it appears in the shapefile
Load Locations

Load From: origin

- Only show point layers
- Only load selected rows

Sgtr Field:

Location Analysis Properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Field</th>
<th>Default Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RouteName</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TimeWindowStart</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TimeWindowEnd</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CurbApproach</td>
<td></td>
<td>Either side of vehicle</td>
</tr>
<tr>
<td>Attr_Length</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Attr_DISTANCE</td>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>

Location Position

- Use Geometry
  - Search Tolerance: 5000 Meters
- Use Network Location Fields

Advanced...  About load locations
Solving ...

• Click on the SOLVE icon, which should be active

• This will find routes, and directions, from origin to all destinations and returns to origin
Solution
Why directions depend on a good network

<table>
<thead>
<tr>
<th>Route: Location 1 - Location 5</th>
<th>8.2 mi</th>
<th>Map</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Start at Location 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2: Go northwest on Massachusetts Ave toward Vassar St</td>
<td>1.8 mi</td>
<td>Map</td>
</tr>
<tr>
<td>3: Bear left on Garden St</td>
<td>0.8 mi</td>
<td>Map</td>
</tr>
<tr>
<td>4: Bear right on Sherman St</td>
<td>0.7 mi</td>
<td>Map</td>
</tr>
<tr>
<td>5: Turn left on Rindge Ave</td>
<td>0.4 mi</td>
<td>Map</td>
</tr>
<tr>
<td>6: Turn right on Alewife Brook Pkwy</td>
<td>0.2 mi</td>
<td>Map</td>
</tr>
<tr>
<td>7: Turn left on Alewife T Station Access Rd</td>
<td>&lt; 0.1 mi</td>
<td>Map</td>
</tr>
<tr>
<td>8: Arrive at Location 2, on the left</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9: Depart Location 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10: Go back east on Alewife T Station Access Rd</td>
<td>&lt; 0.1 mi</td>
<td>Map</td>
</tr>
<tr>
<td>11: Turn right on Alewife Brook Pkwy</td>
<td>0.2 mi</td>
<td>Map</td>
</tr>
<tr>
<td>12: Turn left on Rindge Ave</td>
<td>0.8 mi</td>
<td>Map</td>
</tr>
<tr>
<td>13: Turn right on Massachusetts Ave</td>
<td>0.4 mi</td>
<td>Map</td>
</tr>
<tr>
<td>14: Arrive at Location 3, on the right</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15: Depart Location 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16: Go southeast on Massachusetts Ave</td>
<td>&lt; 0.1 mi</td>
<td>Map</td>
</tr>
<tr>
<td>17: Continue on Somerville Ave</td>
<td>0.2 mi</td>
<td>Map</td>
</tr>
<tr>
<td>18: Turn right on Beacon St</td>
<td>1.1 mi</td>
<td>Map</td>
</tr>
<tr>
<td>19: Continue on Hampshire St</td>
<td>0.8 mi</td>
<td>Map</td>
</tr>
<tr>
<td>20: Arrive at Location 4, on the right</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21: Depart Location 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22: Go back northwest on Hampshire St</td>
<td>&lt; 0.1 mi</td>
<td>Map</td>
</tr>
<tr>
<td>23: Make sharp left on Portland St</td>
<td>0.3 mi</td>
<td>Map</td>
</tr>
<tr>
<td>24: Bear right on Albany St</td>
<td>0.1 mi</td>
<td>Map</td>
</tr>
<tr>
<td>25: Make sharp left on Massachusetts Ave</td>
<td>0.2 mi</td>
<td>Map</td>
</tr>
<tr>
<td>26: Finish at Location 5, on the right</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Driving distance: 8.2 mi</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Closest Facility

- Finds least cost route between one or more facilities (origins) and one or more incidents (destinations)
- Returns driving directions and creates a shapefile with routes
Closest Facility

• Facilities are found in what we called the ORIGIN shapefile. Incidents are found in our DESTINATION shapefile.
• Once set, solve for the closest facilities
• Will solve for more than one facility (origin) and incident (destination)
• Output is shapefile and shows paths along network
Solution
Service Area (or buffer by travel distance)

• A network service area is a region that encompasses all accessible streets (that is, streets that are within a specified impedance – distance or time).

• Returns a polygon shapefile representing the areas surrounding facilities (origins)
Service Area (or buffer by travel distance)

• Load shapefiles with one or more points into Facilities

• Set the distance in the Service Area properties
Solution
OD Cost Matrix

• Find the least cost paths along networks from multiple origins to multiple destinations

• Similar to Closest Facility but faster
  – No directions
  – No shapefile with correct route
  – Length of routes are accurate

• Set Origins and Destinations before running
Solution