Network Analysis Tools

GIS III: GIS Analysis

Children's Environmental Health Initiative
Learning Objectives

• Introduce basic components of a network

• Understand general network analysis concepts

• Offer a few examples of current application

• Introduce network analysis in ArcGIS
What is a Network?

- Interconnected set of points (nodes) and lines (edges)

- Examples
  - Information networks
  - Social networks
  - Stream networks
  - Transportation networks

- Connectivity allows for analysis/problem solving
Networks and GIS

- A set of interconnected line entities whose attributes share some common theme primarily related to flow

- Network lines define relationships between nodes

- Flow types:
  - Data
  - Objects
  - Materials
Networks and GIS

- **Rules** dictate how objects can move through the network

- **Types**
  - Direction – one way streets
  - Barriers
  - Time of day
  - Node restrictions – stroke centers
  - Sequence – stop 1 then stop 2
• Cost:
  What is the impact of an object flowing through the network?

• Types
  - Time
  - Distance

Based on connectivity, flow, and rules
• Set of nodes connected by lines

• Represent some type of flow

• Incorporate flow rules

• Rules determine cost
Network Analyst

- Network analysis is a set of analysis techniques used with networks

- Network Analyst is the ESRI extension that performs network analysis in ArcMap

- Network Analyst uses network datasets

- Types of analysis:
  - Route
  - Service areas
  - Closest facility
  - Origin-destination cost matrix
  - Vehicle routing
  - Location allocation
• Route:
  - Can be simple – finding driving directions between two points
  - More complex – best route between 10 different stops
• “Best” can mean different things:
  - Shortest distance
  - Quickest
  - Most scenic
  - No highways
Service areas:

- Calculate an area based on time or distance from an input
- Good for estimating populations
- Different than a simple buffer
Closest facility:
- Calculate the nearest X number of facilities to an incident or point of interest
- Closest can be based on network distance or time
- Set up a cutoff
  - Find all the hospitals within 5 minutes of an accident
  - Find all the clinics within 2 miles of a home address
Origin-destination cost matrix:

- Creates a cost matrix from multiple origins to multiple destinations
- Good for calculating distance or time between multiple start and end points
Useful Examples

Geographic and Sociodemographic Disparities in Drive Times to Joint Commission–Certified Primary Stroke Centers in North Carolina, South Carolina, and Georgia

Prev Chronic Dis 2011;8(4):A79

Jenna A. Khan, MPH; Michele Casper, PhD; Andrew W. Asimos, MD; Lydia Clarkson, MPH; Dianne Enright, GISP; Laura J. Fehrs, MD; Mary George, MD, MSPH; Khosrow Heidari, MA, MS; Sara L. Huston, PhD; Laurie H. Mettam, MEd; G. Ishmael Williams, Jr, MA; Linda Schieb, MSPH; Sophia Greer, MPH

Driving times and distances to hospitals with percutaneous intervention in the United States: Implications for prehospital triage of patients coronary with st-elevation myocardial infarction

Circulation 2006;113;1189-1195

Brahmajee K. Nallamothu, Eric R. Bates, Yongfei Wang, Elizabeth H. Bradley, and Harlan M. Krumholz

Access to primary percutaneous coronary intervention for ST-segment elevation myocardial infarction in Canada: a geographic analysis

Open Medicine 2010;1(1):e21

Alka B. Patel, Jack V. Tu, Nigel M. Waters, Dennis T. Ko, Mark, J.Eisenberg, Thao Huynh, Stéphane Rinfret, Merril Knudtson, and William A. Ghali
Getting Started with NA

- Network locations
- Network Analyst workflow
- Useful analyses
  - Routes
  - Service areas
  - Closest facility
  - Origin destination cost matrices
Review and New Terms

• A network is made up of edges and nodes
  - Edges are the “lines” of the network
  - Nodes are physical locations

• Edges for all cases discussed in this module will be roads

• Types of locations (nodes)
  - Stops
  - Barriers
  - Facilities
  - Incidents
  - Origins
  - Destinations
Network locations

- Adding your own network locations to a network
  - Create Network Location tool
  - Load Locations tool
  - Find tool
Network locations

- Finding network locations
  - Search tolerance
  - Snapping environment
Network Analyst workflow

1. Create network analysis layer
2. Add network locations
3. Set analysis properties
4. Perform analysis and display results