

INTRODUCTION TO GIS ANALYSIS

Week 1

GIS551

What is GIS Analysis?

- A process for looking at :
 - geographic patterns in the data
 - relationships between features
- Methods may range from:
 - simple (e.g., making a map)
 - complex (e.g., modeling climate change)

GIS Analysis Methodology

1. Frame the question
2. Understand your data
3. Choose a method of analysis
4. Process the data
5. Look at the results

1. Frame the question

- Figure out what information is needed.
- How will the info be used?
- Who will use it?
- Analysis results may be used for:
 - understanding how things behave
 - for discussion by policy makers
 - scientific review
 - legal proceedings

2. Understand your data

- The method to be used is dependent on:
 - type of data available
 - features available for analysis
- Need to know what data you have got (i.e., features & attributes) and what you need to get or create
- Creating new data – new values in data tables OR obtaining new layers

3. Choose a method

- Always 2 or 3 ways of getting the info needed
- Generally, 1 method is quicker and gives approximate info
- Others may need more detailed data & increased processing time, but give you precise results
- User decides which method to use, based on the question and how the results of this analysis will be used

4. Process the data

- Once a method has been selected, the necessary steps must be performed in a GIS
- Requires an understanding of the concepts underlying a GIS – for better interpretation of the results
- Some context for selecting the parameters , which are required for the analysis

5. Look at the results

- Can be a map, values in a tables, or a chart (essentially creating new information)
- Decide what info to include in your map
- How to group the values to best present this info
- Chart vs table vs map – select one that helps others to see the info easily

5. Look at the results

- Helps the analyst decide whether info is valid or useful
 - to rerun the spatial analysis with different parameters or using a different method
- GIS makes it easy to make the changes to generate new output
- Compare results of different analyses to see which method presents the info most accurately

Understanding geographic features

- Type of geographic features – affects all the steps of the analysis process
- Types of Features:
 - Discrete features (e.g., roads, parcels, buildings, etc.)
 - Continuous phenomena (e.g., precipitation, topography, soils, etc.)
 - Features summarized by area (e.g., businesses or residences within a postal code, population within a city, etc.)

Understanding geographic features

- Two ways of representing geographic features:
 - Vector model
 - Raster model
- Vector model:
 - Each feature is a row in a table
 - Feature shapes defined by x,y locations in space
 - Features can be discrete locations , or events, lines or areas
 - Areas – defined by borders (closed polygons)
 - Analysis involves working with attributes in the layer's data table

Understanding geographic features

- Raster model:
 - Features are represented as a matrix of cells (i.e., grid) in continuous space
 - Most analysis involves combining layers with new cell values
 - Cell size affects the results of analysis (i.e., how the map looks)
 - Cell size should be based on the original map scale & the minimum mapping unit
 - Large cell sizes can cause info to be lost
 - Small cell sizes cause large file sizes (i.e., more storage space) – longer processing times

Map Projections & Coordinate Systems

- All data layers must be in the same map projection & coordinate system
- If not, you cannot superimpose them, or combine them to see relationships
 - what features are inside an area
 - e.g., Businesses within Toronto
 - what features are near another feature
 - e.g., hotels near Pearson Intl. Airport
- Projections distort shapes, areas, distances & directions of features

Understanding geographic attributes

- Each geographic feature has one or more attributes that identify it:
 - describe it
 - represent some magnitude associated with the feature
- Types of Attribute values:
 - Categories
 - Ranks
 - Counts
 - Amounts
 - Ratios

Understanding geographic attributes

- Categories
 - Are groups of similar things
e.g. Roads
 - Highways
 - Regional Roads
 - Local Roads
 - Represented using numeric codes or text
- Ranks
 - Puts features in order (high to low)
 - Used when direct measurements are difficult or if the quantity represents a combination of factors
e.g., quantifying a scenic value of a river
 - Ranks are relative – only know where a feature falls in the order, but not how much higher or lower the value is than another value

Understanding geographic attributes

- Ranks
 - One can assign ranks based on another feature, attribute, usually a type or category
 - e.g., all soils of a certain type have the same suitability for slope failure
- Counts & Amounts
 - Show you total numbers
 - Count: Actual number of features on a map
 - e.g., # of “Subway” stations in Toronto
 - Amount: Any measurable quantity associated with a feature
 - e.g., # of passengers passing a “Subway” station daily

Understanding geographic attributes

- Ratios
 - Show a relationship between 2 quantities
 - created by dividing one qty. by another (for each feature)
 - e.g., # of people in Toronto/ # of households in Toronto = # of people/household in Toronto
 - Evens out differences between large & small areas OR areas having many features with those having few features
 - Accurately shows the distribution of features
- Two special “ratios”:
 - Proportions
 - Densities

Understanding geographic attributes

- Proportions
 - Show what part of a total each value is
 - e.g., $\frac{\text{\# of seniors in Toronto}}{\text{\# Total population of Toronto}} \times 100 = \text{\% of seniors in Toronto}$
 - Often presented as percentages (%)
- Densities
 - Show the distribution of features or values per unit area
 - e.g., $\frac{\text{Population of Canada}}{\text{its land area (km}^2\text{)}} = \text{people/km}^2$

Understanding geographic attributes

- Categories & Ranks
 - Not continuous values (set # of values in data layer & more than 1 feature may have the same value)
- Counts, Amounts & Ratios
 - Continuous values (each feature has a unique value anywhere in the range, between highest & lowest values)