Mitchell Ch. 1, 2, 3, 4 Notes

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GEOG 191

Ch 1: Introducing GIS Analysis

GIS analysis allows one to look at geographic patterns within data and relationships between features. The process someone should go through when performing an analysis in GIS includes:

- framing a question: create a question that will get you the info you need
- understanding your data: what type of data are you working with?
- choosing a method: decide what method to use based on the original question
- process the data
- look at the results

Utilizing all of those techniques when approaching GIS, it will help to understand if the data is valid or if a different method should be used for a different output.

Types of Features:

- Discrete features: the actual location can be pinpointed
- Continuous phenomena: can be found or measured anywhere (ex: precipitation or temperature)
- Features summarized by area: the counts or density of individual features within area boundaries (ex: # of businesses in each zip code, the total length of streams in a watershed)

The two ways of representing geographic features:

1) Vector: each feature is a row in a table, feature shapes defined by x,y locations in space. Features can be discrete locations, events, lines, or areas.
    - Lines like streams, roads, or pipelines are seen as a series of coordinate pairs.
    - Areas with borders are represented as a closed polygon
2) Raster: features are represented as a matrix of cells in continuous space. A layer represents an attribute and analysis usually occurs after combining layers. The cell size should match the original map scale.
   Discrete features and data summarized by area= vector
   Continuous categories= vector or raster
   Continuous numeric values= raster

Map projections and coordinate systems: map projections translate locations on the globe onto a flat surface, distorting shapes and features, measurements of area, distance, and direction.

Understanding Geographic Attributes:

Types of attribute values:

- Categories: groups of similar things to help you organize and understand your data

- Ranks: put features in order from high to low and are used when direct measures are difficult or the quantity represents a combination of factors
- Counts and amounts: show you total numbers. A count is the number of features on a map and an amount is any measurable quantity associated with a feature (ex:# of employees at a business).
- Ratios: the relationship between two quantities and are created by dividing one quantity by another for each feature (ex: # of people in each tract / # of households = average # of people per household)
- Continuous and noncontinuous values: counts, amounts, and ratios

Working with data tables:

- Selecting: features to work w/ a subset or to assign a new attribute value to just those features (ex: assigning a specific rank to different categories)
- Calculating: calculate attribute values to assign new values to features in the data table
- Summarizing: summarize the values for specific attributes to get statistics.

Ch 2: Mapping Where Things Are

Why map where things are? Mapping where things are can show you patterns help you better understand the area being mapped as well as what needs to be done to meet criteria (ex: areas with higher vs lower crimes). By looking at the features on the map, patterns could be seen (ex: plant distribution related to rainfall, terrain, etc).

Deciding what to map:

In order to find geographic patterns in data, the features can be mapped in layers using varying symbols and displayed based on what information needs to be extracted.

- What information do you need from the analysis?
  Where features are vs where they are not
- How will you use the map?
  Appropriate for the audience/issue being addressed (determines how detailed it should look)

Preparing your data:

- Assigning geographic coordinates: each feature needs a location in geographic coordinates
- Assigning category values: each feature must have a code that identifies it's type (ex: crime type as assault, burglury, theft, etc.).

Making Your Map:

- Mapping a single type: draw all features using the same symbol

What GIS does: GIS stores the location of each feature as either a pair of coordinates or a set of coordinate pairs that define its shape

- Using a subset of features: all features in a data layer/subset based on category value can be used on a map
- Mapping by category: drawing features using a different symbol for each category value (ex: roads being categorized as freeway, highway, primary arterial, or secondary arterial).
- Displaying features by type: use different categories to reveal different patterns
- How many categories: on a single map → no more than 7
    - Features being mapped: less categories if an area has many small scattered features
    - Map scale: if area is large relative to the features, more than 7 make patterns difficult to see
- Grouping categories: more than seven, try grouping them to make patterns easier to see (ex: 18 categories grouped down to five general categories).
- Choosing symbols: use varying colors and shapes when needed
- Map reference features: display recognizable landmarks (highways, towns, cities, rivers)

Analyzing Geographic Patterns:

A pattern will emerge if the map presents the information from the data clearly. Hidden patterns could be seen using statistics to find the relationships between features.

Ch 3: Mapping the Most and Least

Being able to map the most and the least allows you to compare places based on quantities in order to see what places meet your criteria or see the relationships between places. Adds additional information beyond just mapping locations.

What do you need to map?:

Mapping the patterns of features with similar values → see where the most and least are

What type of features are you mapping?

- Discrete features: individual locations, linear features, or areas
- Continuous phenomena: areas/surface of continuous values
- Data summarized by area: shading each area based on its value

Understanding quantities:

To map the most and least, assign symbols to different features w/ an attribute that has a quantity.

- Counts and amounts: show total numbers
    - count= actual number of features on the map
    - amount= total of each value associated with that feature
- Ratios: the relationship between two quantities; done by dividing one quantity by another
    - Averages
    - Proportions
    - Densities
- Ranks: features in order from high to low

Creating classes:

Depending on what type of quantities you have, values can be assigned individually or grouped into classes. (Usually counts, amounts, and ratios)

- Mapping individual values: accurate representation of data, requires more effort, lets you search for patterns in raw data
- Using classes: classes group features with similar values and give them the same symbol
- Creating classes manually: should be done if looking for specific criteria
- Standard classification schemes: use if you want to group similar values to look for patterns
    - Natural breaks (Jenks): values within a class are similar and values between classes are different
    - Quantile: each class has an equal number of features
    - Equal Interval: each class has and equal range of values
    - Standard deviation: each class is defined by its distance from the mean value of all features
- Choosing a classification theme:
    - unevenly distributed → natural breaks
    - Evenly distributed → equal interval or standard deviation; quantile if you want to emphasize differences between features
- Outliers: put each in their own class, group into a class, group with the next closest, draw them with a special symbol

Making a map:

Keep the map simple and easily readable.

Options for creating maps to show quantities:

- Graduated symbols: locations, lines, areas ; counts/amounts, ratios, ranks
- Graduated colors: areas, continuous phenomenon ; ratios, ranks
- Charts: locations, areas ; counts/amounts, ratios
- Contours: continuous phenomena; amounts, ratios
- 3D perspective views: continuous phenomena, locations, areas ; counts/amounts, ratios

Looking for patterns:

Analyzing the values, like where they are on the map or the highest and lowest, can give you further insight into the relationships between places.

Ch 4: Mapping Density

Mapping the density of features allows you to see patterns where things are concentrated. (*A common theme discussed in the chapters before)*

Why Map Density: Density shows you where the highest concentration of features is, useful for finding patterns.

Deciding What to Map: Shade defined areas based on a density value/surface. Keep in mind the data being used and what is the desired outcome. Density of features can be mapped, like locations of businesses, or feature values, like the number of employees as each business.

Two Ways of Mapping Density:

1) Defined Area: map density graphically with a dot map or by calculating the the density value for each area
2) Density Surface: created in the GIS as a raster layer

Mapping Density for Defined Areas:

Show density for each area graphically using a dot map and can calculate density for each area and shade based on its value. Dot maps give the reader an understanding of the density in a place. Playing around with the dot size can help vidualize patterns.

Creating a Density Surface:

Density surfaces created as raster layers. GIS can calculate the density value for each cell in the layer. The parameters that specify what the patterns will look like includes:

- Cell size: smaller cell size = smoother surface, larger cell size=coarser surface ; book shows how to convert density units to cell units
- Search radius: a larger search radius results in a more generalized pattern
- Calculation method:
    - Simple calculation: counts only features within the search radius of cells
    - Weighted calculation: every cell is assigned a value
- Units: use the appropriate units for the situation (ex: square meters for plants, square miles for businesses)

A density surface can be displayed using graduated colors or contours.
Common classification schemes: natural breaks, quantile, equal interval, standard deviation.
Contour lines can be used to connect points of equal density on the surface.