

Geography 38/42:286

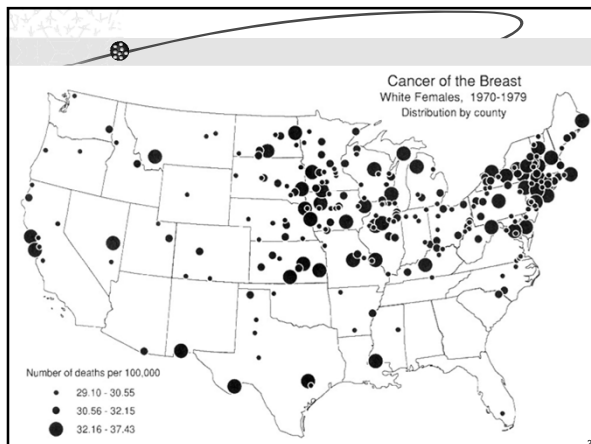
GIS 1

Topic 9: Proportional
Symbol Mapping

Chapter 9: Chang
Chapter 8: Dent

What is a Proportional Symbol Map?

- ✦ Depicts spatial variations in value or magnitude
- ✦ Using proportionally sized point symbols
- ✦ May also convey density of phenomena



Spatial Data Characteristics

- ✧ Discrete point data
- ✧ Data aggregated by discrete areal unit
- ✧ May be used to map sampled values of a continuously distributed phenomenon

Aspatial Data Characteristics

- ✧ Can use raw or derived data (according to Dent)
 - Derived values used to control range of data values
- ✧ Our own rule of thumb will be:
 - raw for:
 - discrete point features or areal units represented as pts.
 - when phenomena are related to area
 - derived for
 - discrete point features or areal units represented as pts.
 - when phenomena are related to population
 - or when data are aggregated by discrete areal unit

When Is It Used?

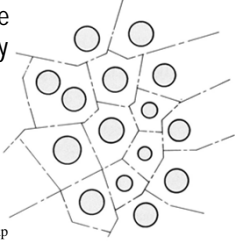
- ✧ Used in two circumstances:
 1. When objective is to show spatial variations in value/magnitude at point locations
 - **only choice**
 2. For mapping areally discrete data represented at a point
 - other alternatives

Not the best choice when?

1. Range of data values is limited
2. Data provided is normalized by area
3. Data are interval level and have an arbitrary 0 value

Data Range

NOTE: variations in attribute value must be adequately large so that there is significant differences in relative symbol size



Limited variation in symbol size = boring map

Advantages/Disadvantages

✦ Advantages:

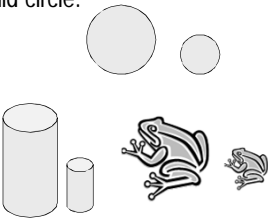
- ease of interpretation
- ability to portray distribution of multiple phenomena
- ability to portray multiple attributes of phenomena

✦ Disadvantages:

- inaccurate perception of symbol size

Considerations: Symbol Selection

- ✧ Any point symbol that can be scaled may be used
- ✧ Most common is a solid circle:
 - compact
 - easily scaled
 - visually stable
 - no orientation



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Considerations: Symbol Selection

- ✧ **IF** more than one distribution is represented:
 - Use same symbol style
 - Unless replicative and carefully scaled symbols
 - Vary colour hue, not saturation/value

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Considerations: Symbol Size

- ✧ Area is geometric property scaled
- ✧ Volume in the case of 3-D symbols
 - more compact
 - greater range can be presented
 - **BUT**, perception of relative value/magnitude is poor
 - only use to represent volumetric quantities

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Considerations: Symbol Size

- ✦ Map-readers consistently underestimate symbol size
- ✦ Error increases with size
- ✦ Solutions:
 - Legend Design
 - Range graded symbols
 - Apparent magnitude scaling

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Range Graded Symbols

- ✦ Data classed
- ✦ Standard symbol sets used
- ✦ No longer proportional

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Range Graded "Proportional" Symbols

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Apparent Magnitude Scaling

- ✧ Adjusts symbol size to account for misinterpretation
- ✧ Based on experimental values
 - not consistent but improved map interpretation

Circles drawn by
absolute scaling

Circles drawn by
apparent
scaling
(Flanery)

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Determining Symbol Size

1. Select minimum symbol size; still visible
2. Verify maximum symbol size is not too large

To be proportional
 $Area_1 / Area_2 = Value_1 / Value_2$

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Determining Absolute Symbol Size

For a circle, area = πR^2 so,
 $\pi R_1^2 / \pi R_2^2 = Value_1 / Value_2$ or,
 $R_1^2 / R_2^2 = (Value_1) / (Value_2)$ or,
 $R_1 / R_2 = [(Value_1) / (Value_2)]^{1/2}$ or,
 $R_1 = R_2 [(Value_1) / (Value_2)]^{1/2}$

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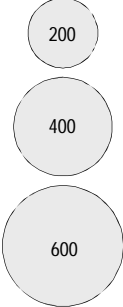
Determining Symbol Size

3. Given minimum symbol size and value calculate all other symbols by:

- E.g. radius of smallest circle = 1.5 cm
- Value smallest circle = 200
- Value other circle = 400

$R_u = R_s [(Value_u)/(Value_s)]^{1/2}$
 $R_u = 1.5 \text{ cm} \times [(400)/(200)]^{1/2}$
 $R_u = 2.12 \text{ cm}$

Note: Apparent scaling would use an exponent value of 0.5716:
so $R_u = 2.23 \text{ cm}$




200
400
600

Determining Symbol Size

✦ For a square symbol:

$S_u = S_s [(Value_u)/(Value_s)]^{1/2}$

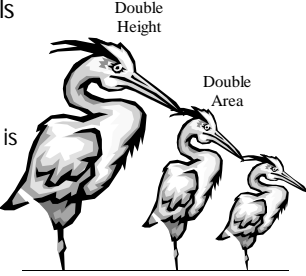


200 400 600

Determining Symbol Size

✦ For replicative symbols

- area should also be scaled proportional
- Not height
- Proper legend design is important



Double Height
Double Area

Considerations: Multivariate Symbols

- ✦ Symbols may be:
 - segmented (pie charts)
 - colour coded
 - and inset (small circles inside of larger circles)
- ✦ in an attempt to portray multiple attributes

Size of circle proportional to total output for each year

Part A Part B Part C

Considerations: Symbol Overload

- ✦ Complex symbols detract from perception of spatial variations in value
- ✦ As a rule, no more than two variables represented with one symbol
 - usually a total amount
 - broken down by category

Size of circle proportional to total output for each year

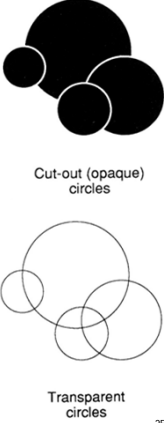
Part A Part B Part C

Considerations: Symbol Placement

- ✦ Symbols representing AUs should be:
 - located at geographic centre
 - exceptions to avoid overlap/confusion
- ✦ Symbols representing discrete point features:
 - located at absolute position
 - not normally adjusted for placement

Symbols Design

- ✦ Cut-outs more aesthetically pleasing; but less accurate
- ✦ Transparent circles more accurate; but difficult to identify and differentiate
- ✦ Symbols should be foreground objects
- ✦ Minimal base map info

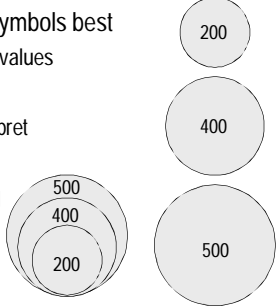


Cut-out (opaque) circles

Transparent circles

Considerations: Legend Design

- ✦ Three representative symbols best
 - min, max, and median values
- ✦ Nested or stacked
 - Stacked easier to interpret
 - Nested more compact
- ✦ Note EAs not reporting
 - or true 0 values



200

400

500

200

400

500

Consideration: Map Projection

- ✦ Discrete point features or points representing discrete areal units
 - No particular projection may be required
 - Unless density of phenomena is portrayed
 - then _____ projection should be used
- ✦ Discrete areal units
 - Then _____ projection should be used

NEXT Up:
Other Thematic Mapping Techniques
