## Choropleth Mapping revisited

Resource Note #17 Community Social Profile Project May 2009



## Preface

- \* The Resource Note is intended to increase our understanding of and broaden our knowledge base on key subject areas that are fundamental in building our capacity in numeric and geographic analysis.
- ✗ It is not an in-depth or comprehensive discussion of the subject matter.
- It highlights certain relevant and important areas that deserve our attention and consideration.
- It can also serve as a "how-to" guide with instructions to perform certain task
- **★** It is intended to be informal and informative.

### Introduction

#### \* This is the 17<sup>th</sup> Resource Note, previous notes include:

1	Census Geography	11	Community Social Profile Template (part 1)
2	Census Data	12	Some quick ways to access census data
3	PCensus Database	13	Community Social Profile Template (part 2)
4	Geocoding	14	Mapping Migration and Commuting data
5	Cartographic Principles	15	Census of Agriculture
6	Thematic Mapping	16	ArcMap 101
7	2006 Census		
8	Population Pyramid		
9	PCensus DBX v8.5		
10	GIS Data and File Management		

### Introduction

- \* The topic on the use of choropleth map was discussed in Resource Note # 6 – <u>Thematic Mapping: Mapping Spatial</u> <u>Data, February, 2006</u>
- \* This resource note revisits the subject in more details and shows the potential of misinterpretation and erroneous conclusion of the spatial distribution from the improper use of the choropleth mapping method
- It also looks at different 'normalization' processes in ArcMap and discusses their applications
- \* Additional resources are provided to supplement the colour scheme (colour ramp) available from ArcMap to symbolize data classes in choropleth mapping

# Choropleth Map

\* "Choros" means place, "pleth" means value

area or shaded mapping

\* Most frequently used mapping technique
\* Data are grouped into classes and each class is assigned a unique shade or colour
\* Each areal unit is then symbolized according to class membership

*Example – choropleth map* 

Proportion of low income seniors by census tract, City of Ottawa, 2005



Source: Statistics Canada, 2006 Census

### Misuse of choropleth mapping method

- The most common mistake in choropleth mapping is to compare areas based on count statistics (e.g. number of persons, families, low income seniors)
- \* By using the choropleth mapping method, the reader is comparing the size of the areas visually instead of the actual count statistics
- \* Areal units (e.g. DAs or CTs) are usually arbitrary in size
- \* There is no relationship between the count data to be mapped and the size of the areal unit (i.e. a small area can have a high population count, conversely, a large area can have few people living in it)
- \* The resulting spatial distribution of the data can lead to misinterpretation and erroneous conclusion

### Choropleth map showing count data



Potential interpretation and conclusion

\* Based on the spatial distribution pattern of the senior population shown in the choropleth map, the reader may conclude that there are more seniors living in the suburbs than those in the inner city – there are more census tracts fall into high values classes

#### Dot density map showing actual number of seniors



**Community Social Profile Project Resource Note 17** 



# Effect of areal unit size

- \* The following example is used to demonstrate the effect of the size of the areal units, four areas of similar size are selected.
- With the exception of Area 4, each contains a number of census tracts
- \* Visually, the choropleth map shows higher number of seniors in Areas 2, 3 and 4 than Area 1 which is located in the inner city based on the class values and colour scheme

#### Visually, Area 1 has less seniors than the other three areas



### Effect of areal unit size

- ★ In fact, Area 1 has the highest number of seniors, nearly double that of Area 3, many times higher than Area 4 and 10% higher than Area 2
- \* The reader cannot see this because the total number of seniors in Area 1 is distributed in many census tracts that are smaller in size compared to those in the suburbs



May 2009

\* On the other hand, there is only one census tract in Area 4 and has 11% of the Area 1's senior population

### Area 1 has the highest number of seniors



## Normalizing the data

\* The effect of areal unit size can be removed by 'normalizing' the data

\* The count data can be "normalized" in two ways:

- Use ratios involving area (density = population/area)
- Use ratios independent of area (percentage of population)

### Normalization process

#### In ArcMap, the normalization of a data variable can be done in the Symbology Layer Properties window

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Features	
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<ul> <li>Proportional symbols</li> <li>Dot density</li> </ul>	Color Ramp:
Charts	Symbol Bange
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	313.300/230 - 1337.00070 321 - 1,538
11 1 1 497	1537.86671 - 2750.40432 1,539 - 2,750
	2/00.40433 - 5133.58521 2,751 - 5,134
WILL CAL	Show class ranges using feature values     Advanced
	OK Cancel Apply

### Normalization process

- However, it is important to note that ArcMap provides a variable named 'Percent of total' in the normalization drop down window
- The 'Percent of total' is the total of that variable for the whole area and should not be confused with the total of the areal unit (e.g. DAs or CTs)
  - For example, for the City of Toronto, 'Percent of total' is the total number of seniors in Toronto (about 353,000)
- If the 'Percent of total' is used, the effect of areal unit size still remains because the individual value is divided or normalized by a constant (see following map)
- \* The number of seniors in an area (DA or CT) should be normalized by other variables such as the total population or the number of square kilometres (or other areal measure unit) of the same area (DA or CT)

Percent of total



### Density mapping

- \* By dividing the number of seniors by the area of the areal unit (census tract), the effect of the size of the area is therefore removed
- \* The resulting map shows a different spatial distribution pattern
- \* There are more areas (census tracts) with higher number of seniors per square kilometre in the inner city than in the suburb – in fact, some of the areas with high values (in the choropleth map) have very low density of seniors

21

### Mapping population density



Mapping ratios



## Mapping count data

\* There are ways to map count data without the effect of areal unit size

- <u>Graduated symbol</u> use varying size symbols to portray the magnitude of the variable
- <u>Proportional symbol</u> the size of the proportional symbol reflects the actual data value
- <u>Dot density</u> use dots to represent a spatial distribution of individuals or events
- <u>Bar chart</u> use horizontal/vertical bar to portray the magnitude of the variable



# Colour Scheme (ramp)

ArcMap provides a collection of colour scheme (ramp) for various symbology

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May 2009

 In addition, the ColorBrewer (<u>http://ColorBrewer.org</u>) is a web tool for selecting colour scheme for thematic maps, most useful for choropleth maps.

It provides a step-by-step approach with a "learn more" feature for a full understanding of how to use the diagnostic map display

\* The colour specs will appear for use in ArcMap colour ramp – colour selector

### Colour Selector



#### Colour Use Guidelines for Mapping and Visualization



Source: ColorBrewer.org

May 2009

### Colour Use Guidelines for Mapping and Visualization – Examples



Source: ColorBrewer.org

May 2009

### Colortool

## (http://gis.cancer.gov/tools/colortool/)

The Colortool website makes it easier to use ColorBrewer's colour scheme in ArcMap

\* You can download the tool and create a button on your ArcMap toolbar (View>Toolbars>NCI tools)

It also contains information about the readability on different formats (photocopier, screen, print, projectors, etc)

## Colortool



# Any questions or comments?

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Thank You

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