



Thematic Mapping: Mapping Spatial Data

Resource Note #6
2001 Census Consortium
February 2006



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 is intended to be informal and informative.

Introduction

- ✧ This is the 6th Resource Note (Note 1 – Census Geography, Note 2 – Census Data, Note 3 – PCensus Database, Note 4 – Geocoding, Note 5 – Cartographic Principles)
- ✧ Resource Note # 5 is on cartographic and map design principles that help us to create effective and accurate maps. This Resource Note focuses on the “what’s” and “how’s” of thematic mapping
- ✧ It covers the various types of thematic maps and their suitability to map spatial data
- ✧ The different types of classification schemes are discussed with examples
- ✧ Appropriate ArcMap procedures and some of their limitations are discussed

Thematic Maps

There are two type of maps

- ✦ General Purpose Map (also known as Reference Map)
 - shows a collection of features such as roads, rivers, city boundaries, human settlement...example: a tourist map or a topographic map
- ✦ Thematic Map
 - focuses on a single feature or a special purpose, presents a single theme about a topic (e.g.. a map showing the population density of a city)

Types of Thematic Maps

- ✦ Qualitative Thematic Map
 - shows nominal or categorical data (e.g. race/ethnicity)
- ✦ Quantitative Thematic Map
 - shows numerical data on ordinal/interval/ratio scale (e.g. percentage of low income family within a community)

Components of a Thematic Map

✧ Geographic Layer

- provides the necessary spatial (locational) information to which the thematic overlay can be related

✧ Thematic Layer

- captures the attribute/data to be mapped

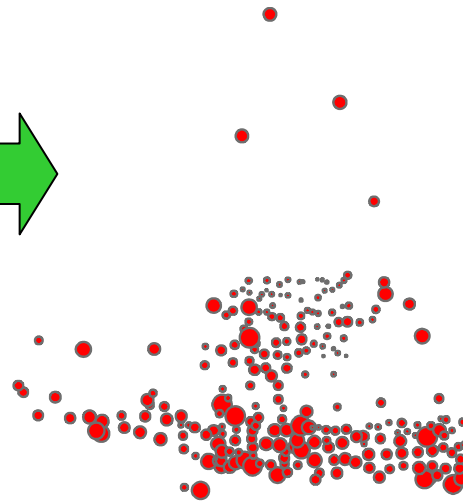
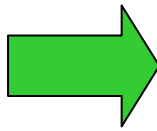
✧ Importance of map scale

- The choice of a map scale will determine the details of information that can be portrayed.

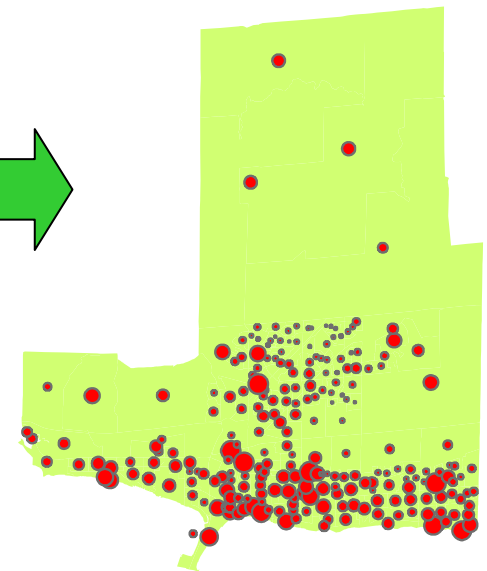
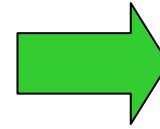
Geographic/Thematic Layers



Geographic Layer



Thematic Layer



Thematic Map



Types of Thematic Map

- ✧ Choropleth Map
- ✧ Graduated Symbol Map
- ✧ Proportional Symbol Map
- ✧ Dot Density Map
- ✧ Chart Map
- ✧ Isoline Map (not discussed here)



Choropleth Map

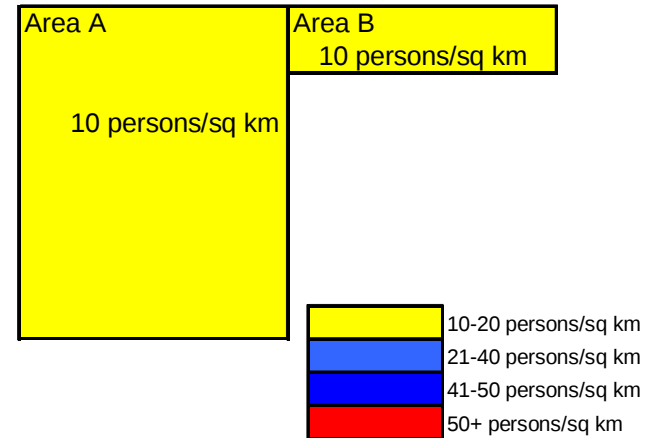
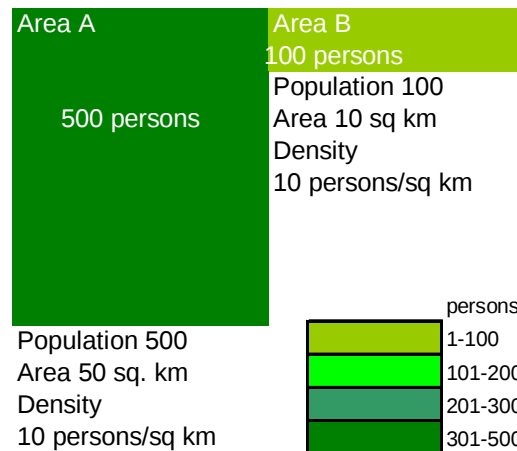
- ✦ “Choros” means place, “pleth” means value – area or shaded mapping
- ✦ Most frequently used mapping technique
- ✦ To show ratios, proportions or densities by areal unit such as Dissemination Areas or Census Tracts
- ✦ Data are grouped into classes and each class is assigned a unique shade or colour
- ✦ Each areal unit is then symbolized according to class membership



Choropleth Map (2)

- ✦ Also most common and problematical misuse of the technique to map **raw** values of variable that are affected by the physical size of the area
- ✦ Use ratios involving area (density) or ratios independent of area (percentage of population) to overcome the problem
- ✦ If raw numbers have to be shown, the graduated symbol map may be an alternative
- ✦ Not suitable for mapping continuous data

Choropleth Map (3)



- ✳ Areas A and B have the same population density
- ✳ The size of Area A and the data total alter the impression of the distribution
- ✳ Mapping data totals masks the even densities of the two areas

Classification

✧ Why classify the data?

- organizes the data to be mapped
- reduces the complexity of the image
- enhances communication

✧ How?

- individual objects (data) are placed in groups that have identical or similar features (e.g. grouping individuals over 65 years old into one category – seniors)

✧ Identity lost

- when an object is placed into a group, its original identity and details are lost

Classification

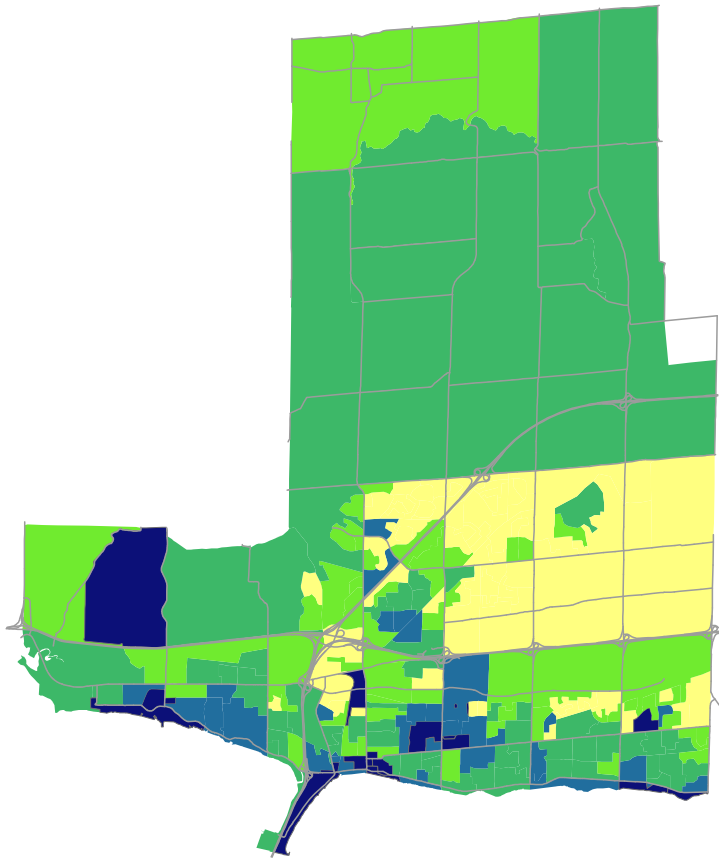
- ✦ It is important to note that the classification that we choose can have a **major impact** on the visual appearance of the spatial distribution created by the map
- ✦ We want a classification that **reveals** whatever spatial variation exists and **minimizes potential misinterpretation** of the map

Classification (2)

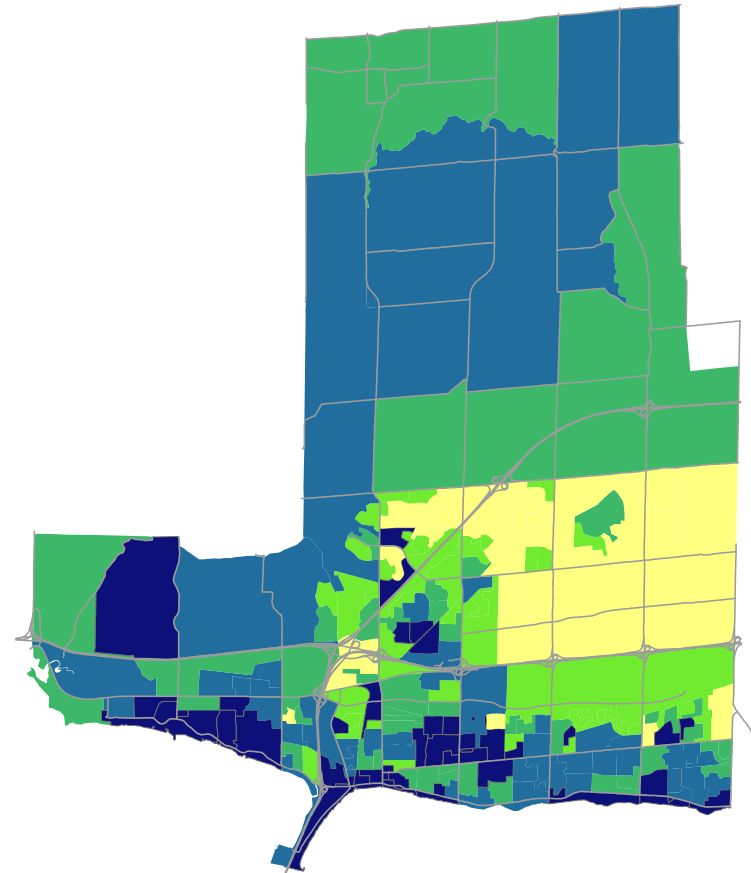
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Same data – different classifications

Natural Breaks (Jenks)
Classes: 5



Quantile (Equal number of features)
Classes: 5



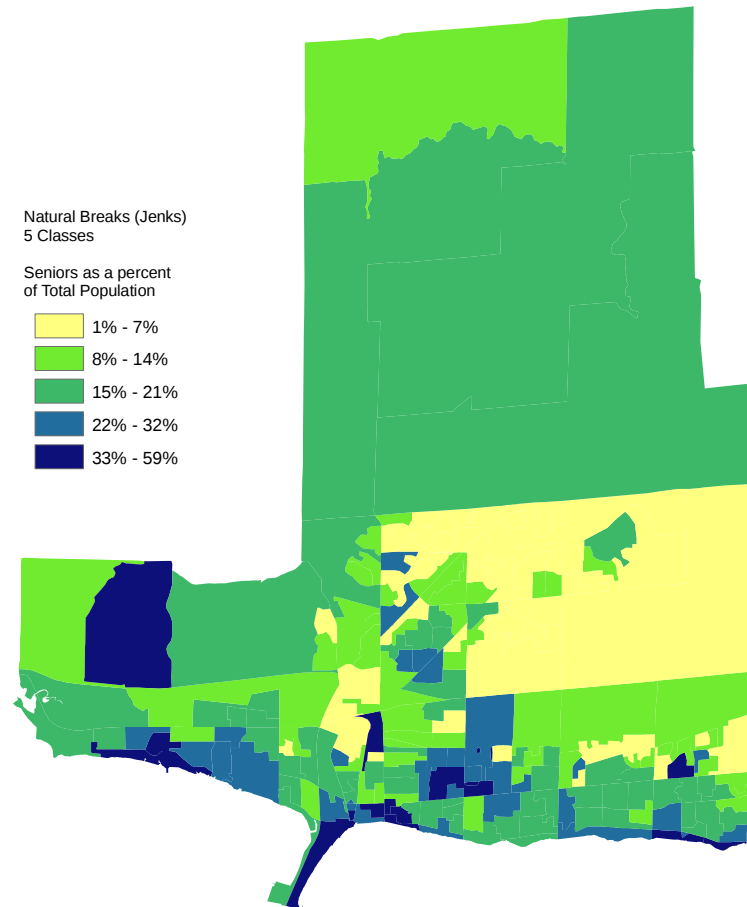
Classification

✧ ArcMap provides five classification schemes:

- Natural Breaks (Jenks)
- Quantile
- Defined Interval
- Equal Interval
- Standard Deviation

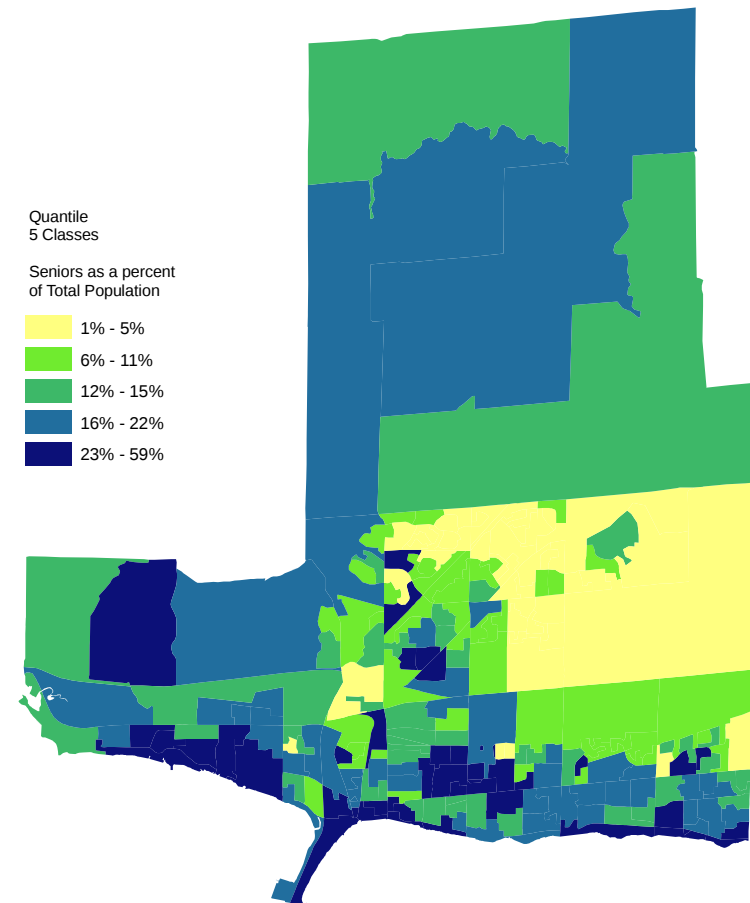
Natural Breaks (Jenks)

- ✦ ArcMap identifies break point by picking the class breaks that best group similar values and maximize the differences between classes
- ✦ Data distribution is taken into consideration
- ✦ Effective for single maps but may make map comparisons difficult



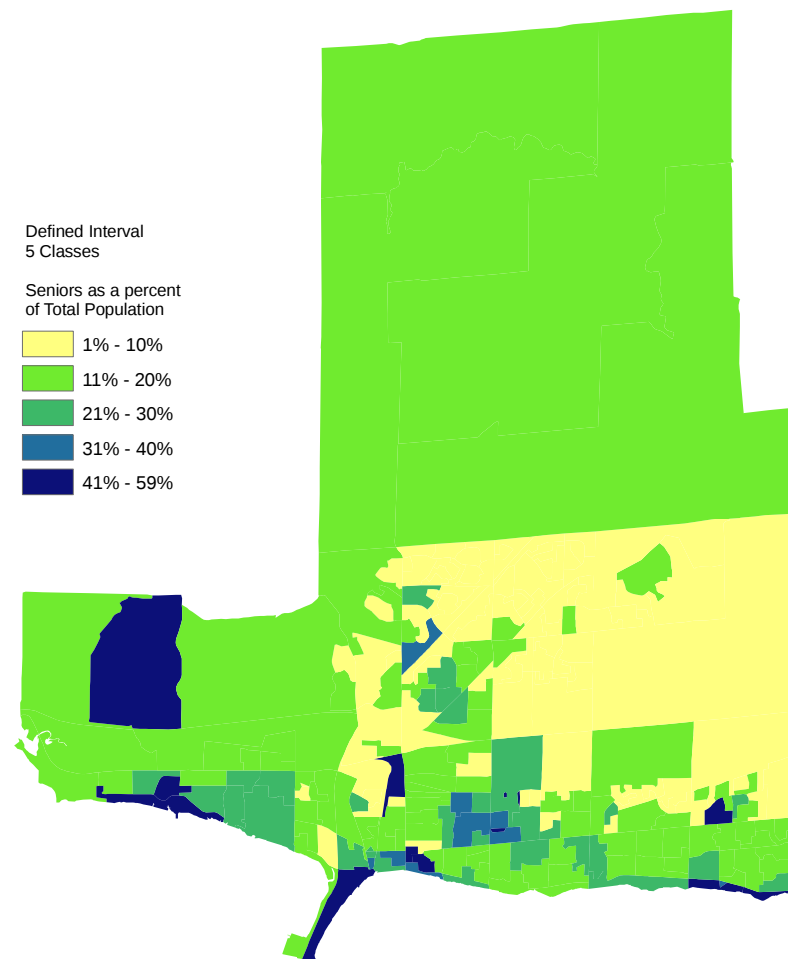
Quantile

- ✦ each class contains an equal number of features, well suited to linearly distributed data but misleading for other type of data.
- ✦ can group a broad range of values into a single class
- ✦ allow comparison based on the rank ordering of classes



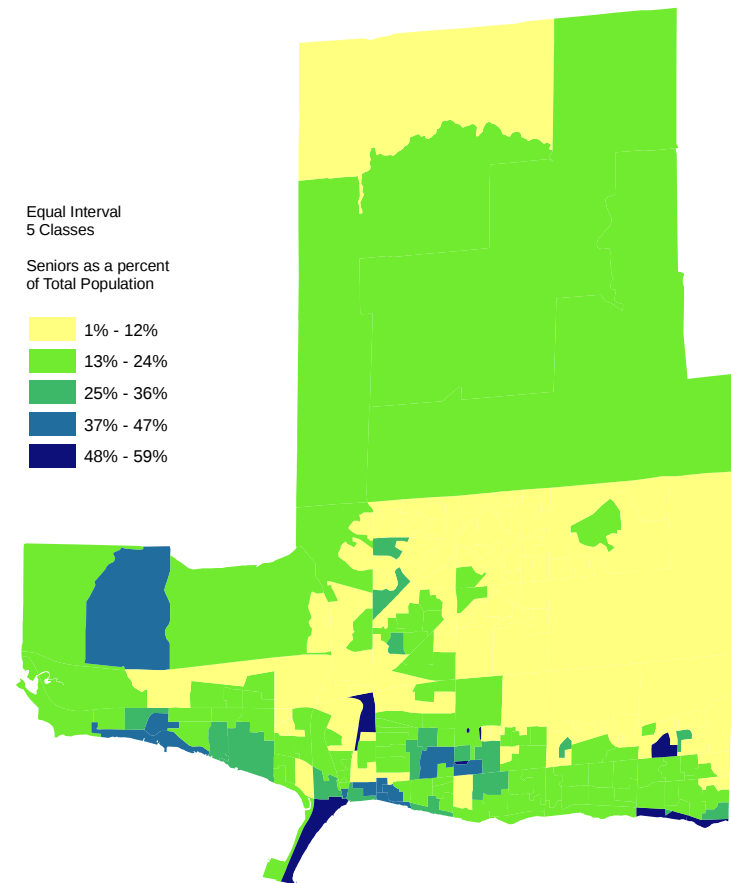
Defined Interval

✦ one specifies the interval values, ArcMap automatically determines the number of classes based on the interval.



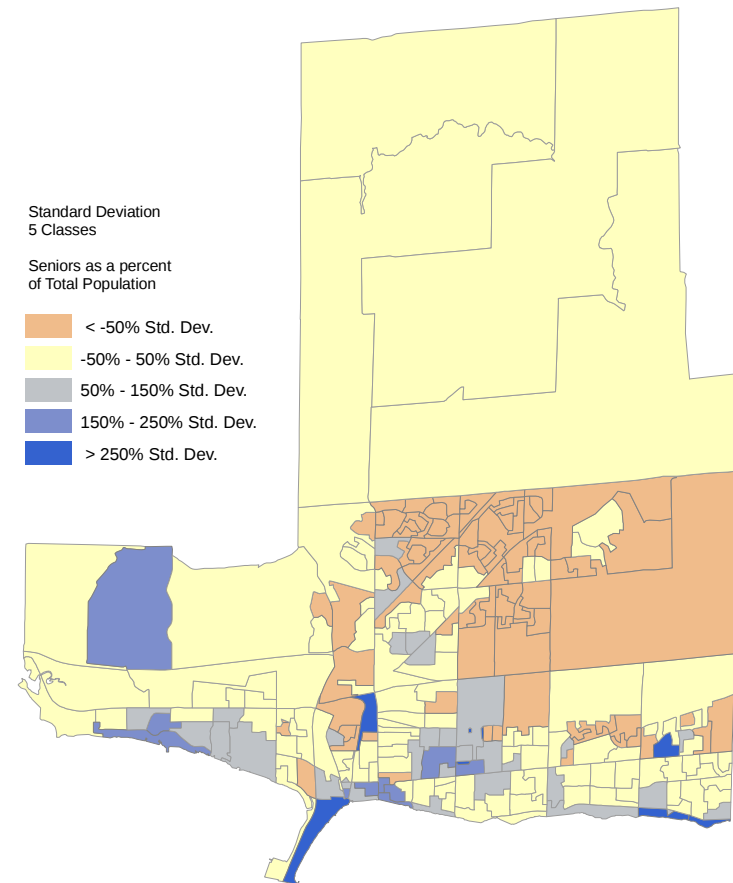
Equal Interval

- ✦ Equal Interval : divides the range of values into equal-sized subranges, allowing one to specify the number of intervals while ArcMap determines where the breaks should be
- ✦ effective when data values are uniformly distributed over the range of values



Standard Deviation

✦ shows how much a feature's attribute value varies from the mean, ArcMap calculates the mean values and the standard deviation from the mean.



Classification

✧ Which classification to choose?

- No single method is most appropriate
- Know and understand your data
- Best approach is to study the trends and patterns revealed by different classification techniques
- Too many classes make map more difficult to interpret (ideally 4 to 6 classes)
- To compare maps, choose quantile or classes based means and standard deviations



Graduated Symbol Map

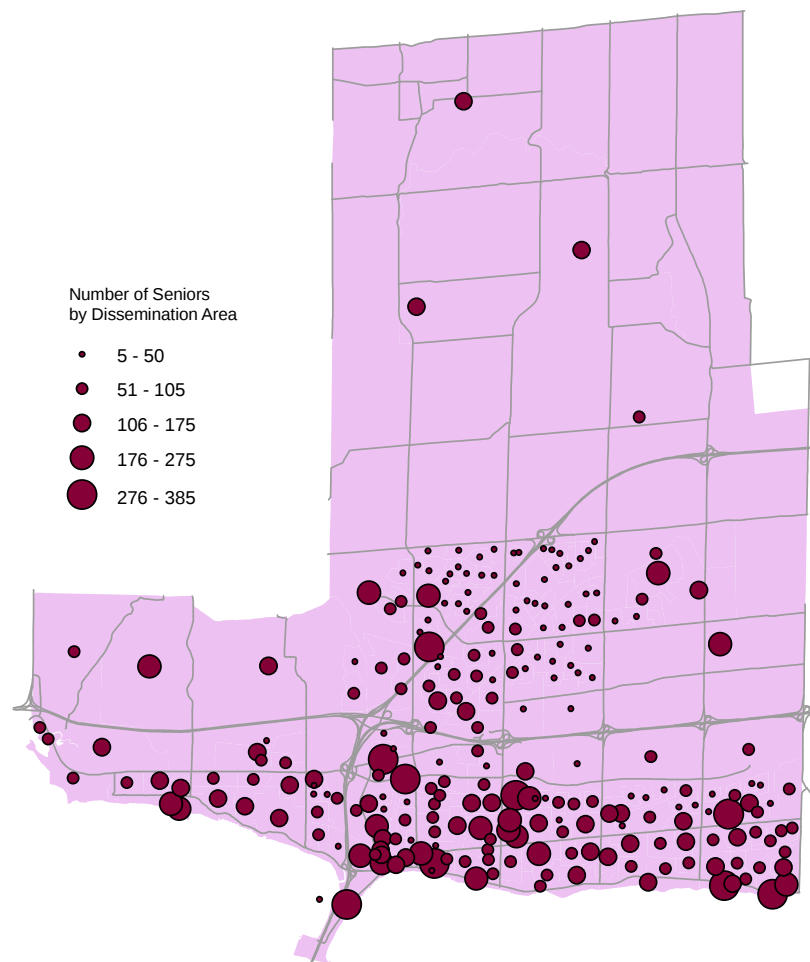
- ✦ Very similar in nature to choropleth map
- ✦ Use symbol in varying sizes to portray the magnitude of the attribute
 - Advantage: independent of areal size
 - Disadvantage:
 - Difficult to fit large symbol within small area
 - Map readers tend to underestimate the quantities represented by larger symbols
 - ArcMap provides an option to compensate for the “underestimation”
 - Turn on Flannery Compensation, a technique that adjusts larger symbol sizes upward to account for the fact that map readers tend to underestimate the larger sizes of circular symbols.



Graduated Symbol Map (2)

- ✦ Choose the range of symbol sizes carefully.
 - The largest symbols need to be small enough that neighbouring symbols don't completely cover one another.
 - The size range to be great enough that the symbol for each class is distinct.

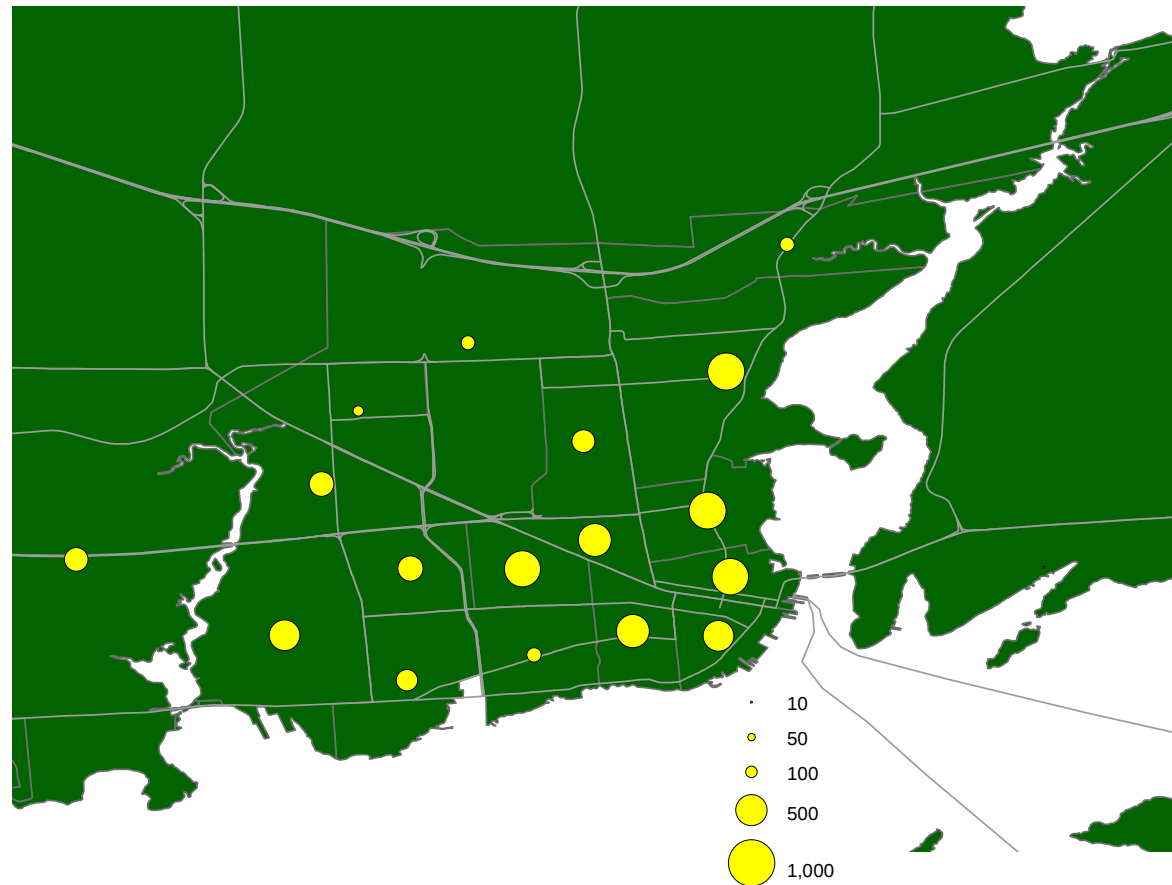
Graduated Symbol Map (3)



Proportional Symbol Map

- ✦ Similar to Graduated Symbol map
- ✦ Proportional symbols represent data values more precisely than Graduated symbols
- ✦ The size of a proportional symbol reflects the actual data value
- ✦ ArcMap will determine the size of the symbol once the number of symbols has been specified
- ✦ As with Graduated Symbol Map, high value symbols can become too large to obscure other symbols

Proportional Symbol Map (2)

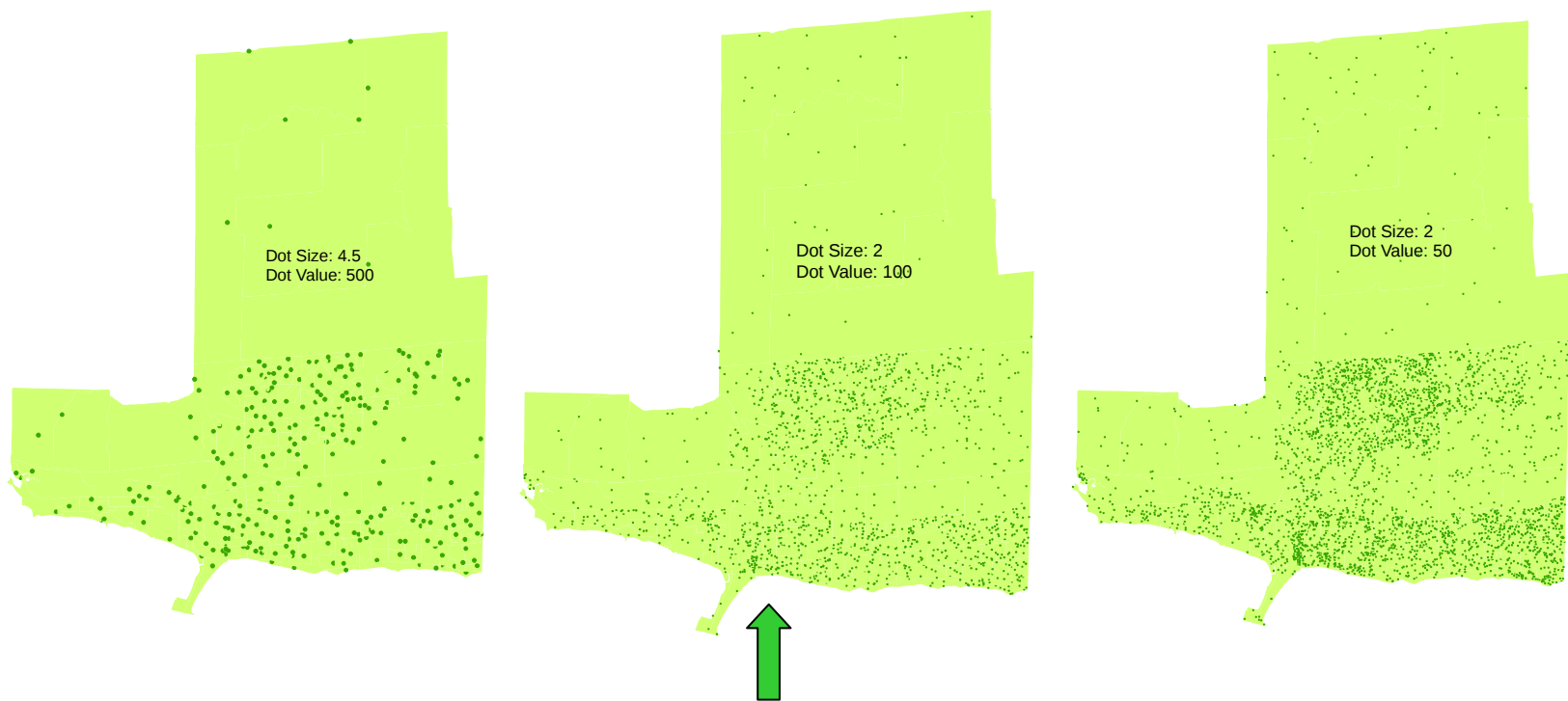




Dot Density Map

- ✧ Uses dots to represent a spatial distribution of individuals or events (e.g. population density or crop production)
- ✧ Three factors have to be considered:
 - Size of the dot
 - Value of each dot
 - Spacing of the dots
- ✧ In ArcMap, one can only specify the size and value of each dot not the spacing among them
- ✧ One might have to try different sizes and values in order to decide which map best to see a pattern
- ✧ ArcMap provides two options for placing dots within an area. Non-fixed Placement, the default option, indicates that the dots will be placed randomly each time the map is refreshed, while Fixed Placement freezes the placement of dots, even if the map is refreshed.

Dot Density Map (2)



Suggested by ArcMap

Dot Density Map (3)

✧ Advantages:

- concept easily understood by user
- effective way to illustrate spatial density
- can accommodate more than one set of dots (e.g. compare density of two population sub groups)

✧ Disadvantages:

- do not show exact quantities
- may give false impression of actual location of objects



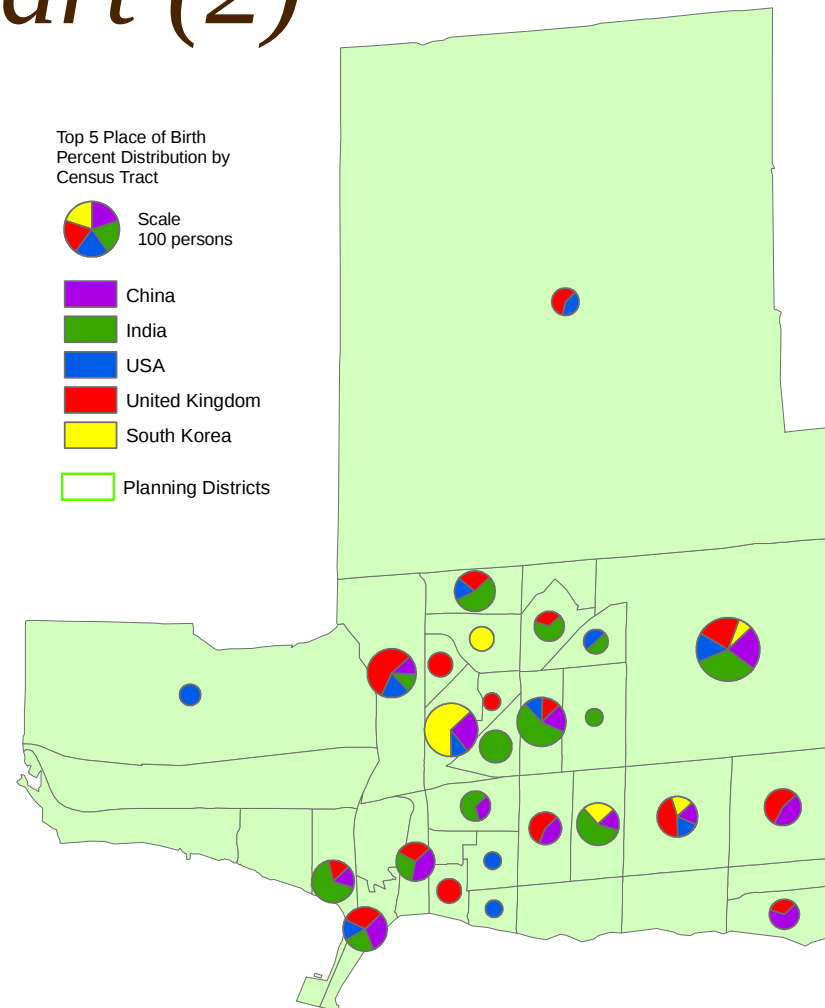
Chart Map

- ✦ Presents more information on the attribute than the Graduated Symbol Map
- ✦ Includes Pie, Bar/Column, Stacked Bar/Column
- ✦ Not influenced by areal size

Pie Chart

- ✦ Most suitable to show the relationship of individual parts of the whole (e.g. percentage of the population by age for each census tract)
- ✦ Size of pie can vary according to size of the sample
- ✦ ArcMap provides three options:
 - Fixed size
 - Vary size using the sum of the field values
 - Vary size using a field or a field normalized by another field

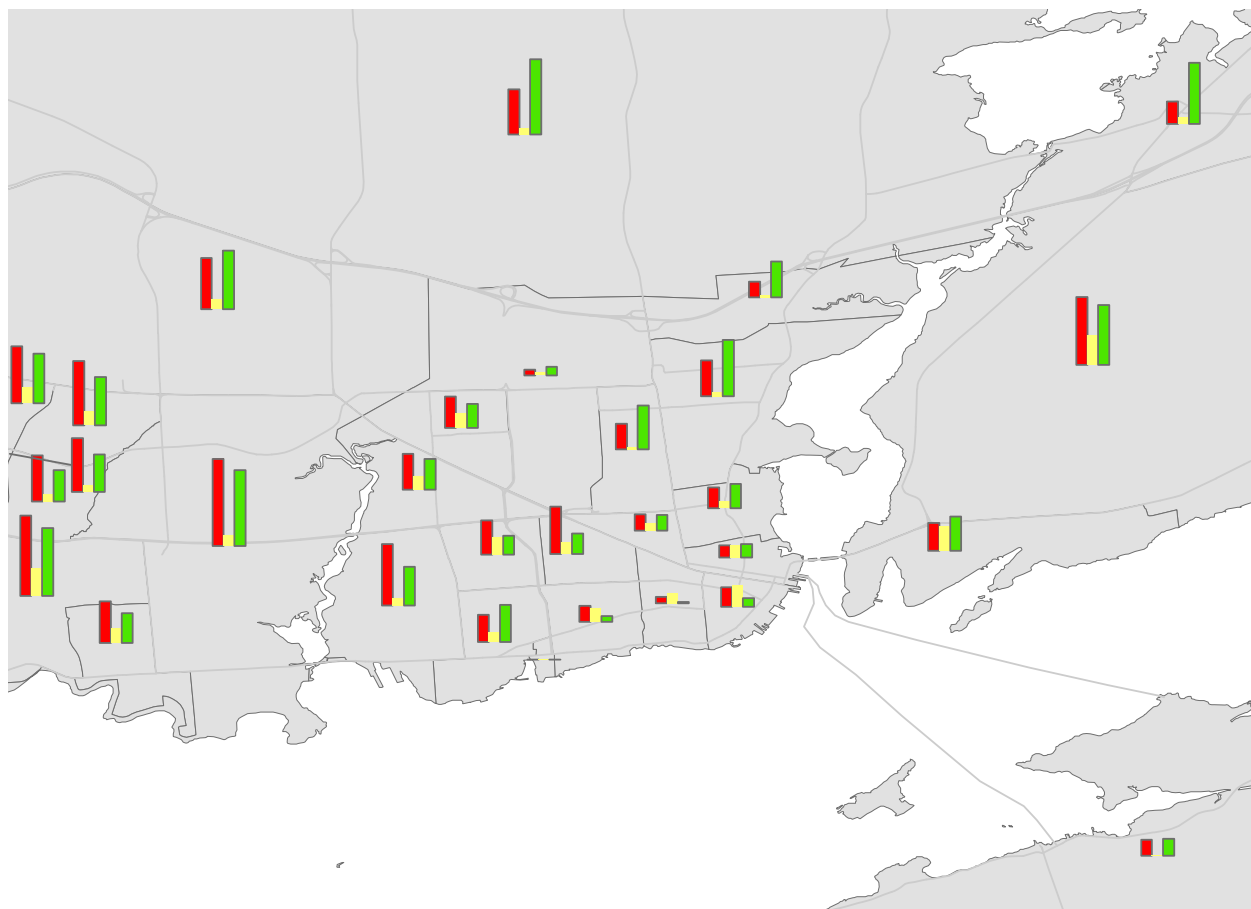
Pie Chart (2)



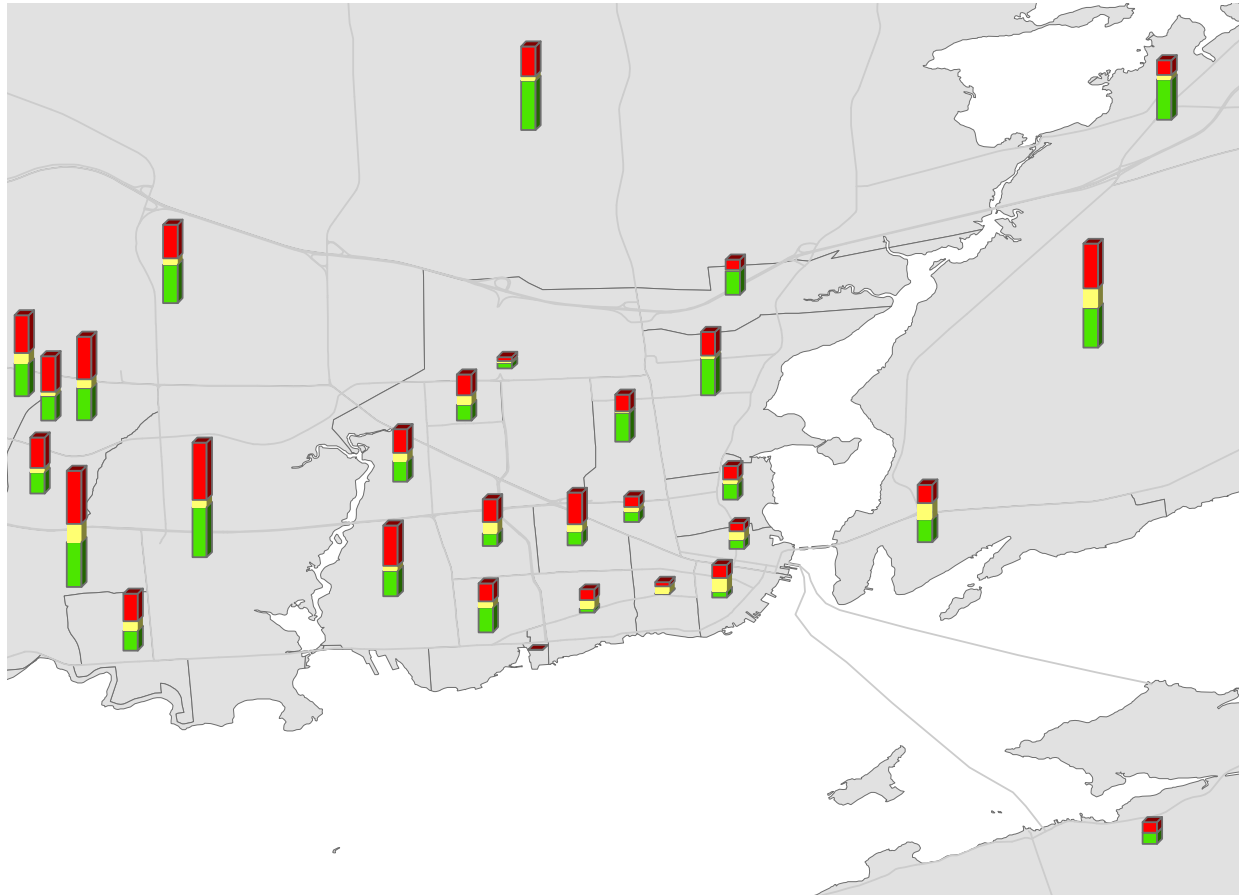
Bar/Column Chart

- ✦ Suitable to show relative amounts, rather than a proportion of a total
- ✦ Also suitable to show relative amount of an attribute over time (e.g. population change)
- ✦ Stacked bar/column to show relative amount as well as the relationship of parts to the whole

Bar/Column Chart (2)

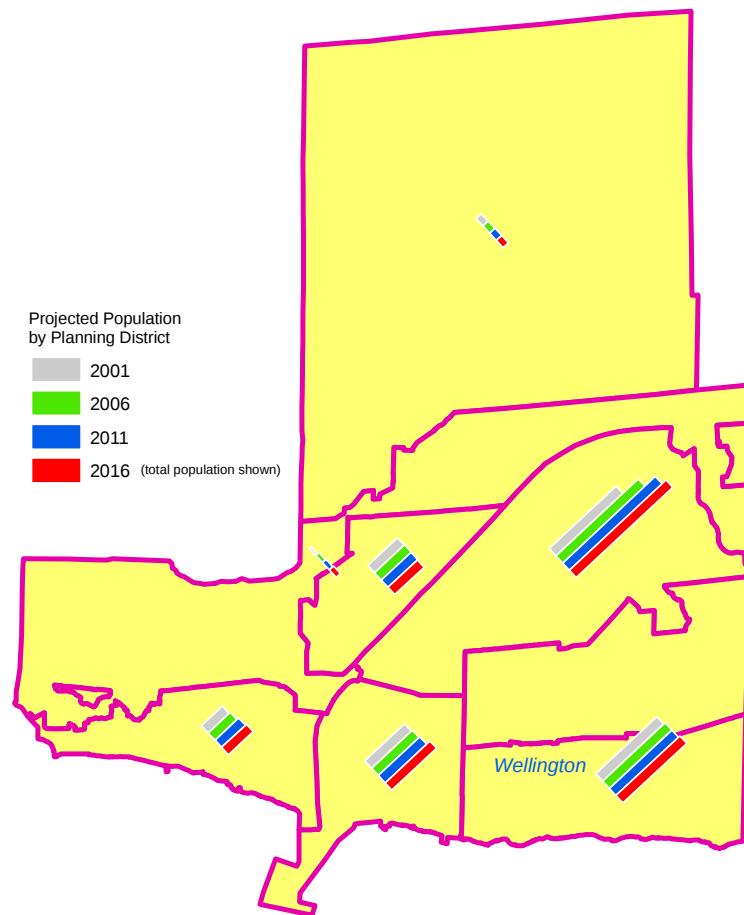


Stacked Bar/Column Chart



Bar/Column Chart

✦ Note: ArcMap does not allow charts (pie, bar/ column) to rotate together with the geographic layer



What Have We Learned?

- ✦ Various ways to map spatial data
- ✦ Different types of thematic maps
- ✦ The proper way to use choropleth map
- ✦ Importance of Classification schemes and their associated advantages and disadvantages
- ✦ How to choose the right classification
- ✦ Some of the possibilities and limitations of related ArcMap procedures

Any questions or comments?

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Thank you