



Cartography

Spatial Computing – University of Minnesota

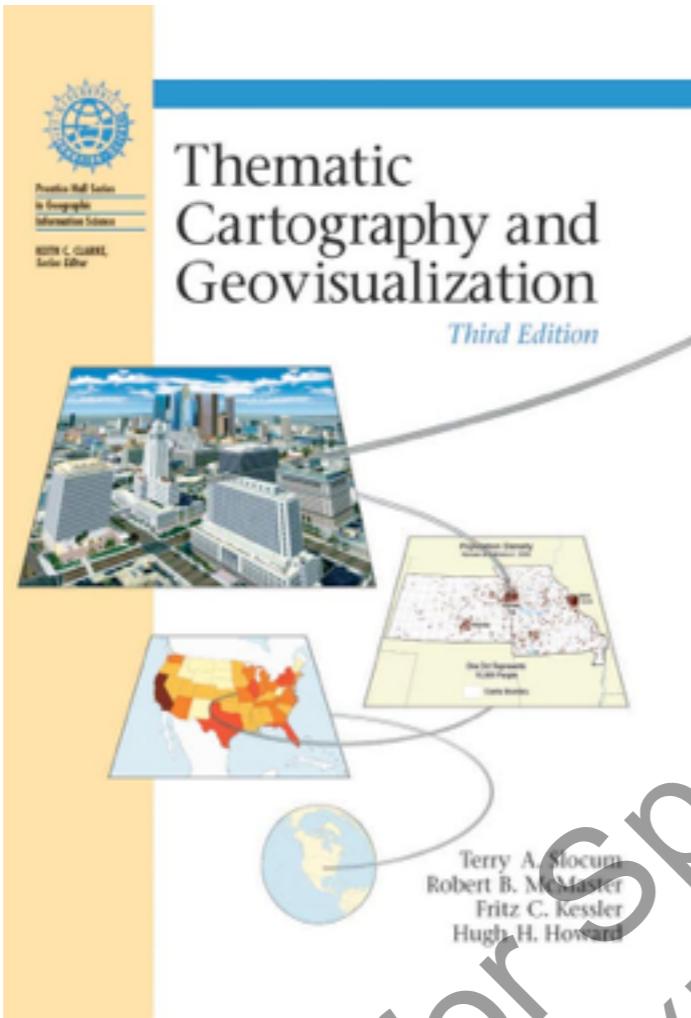


Cartography

Spatial Computing – University of Minnesota

Learning Objectives

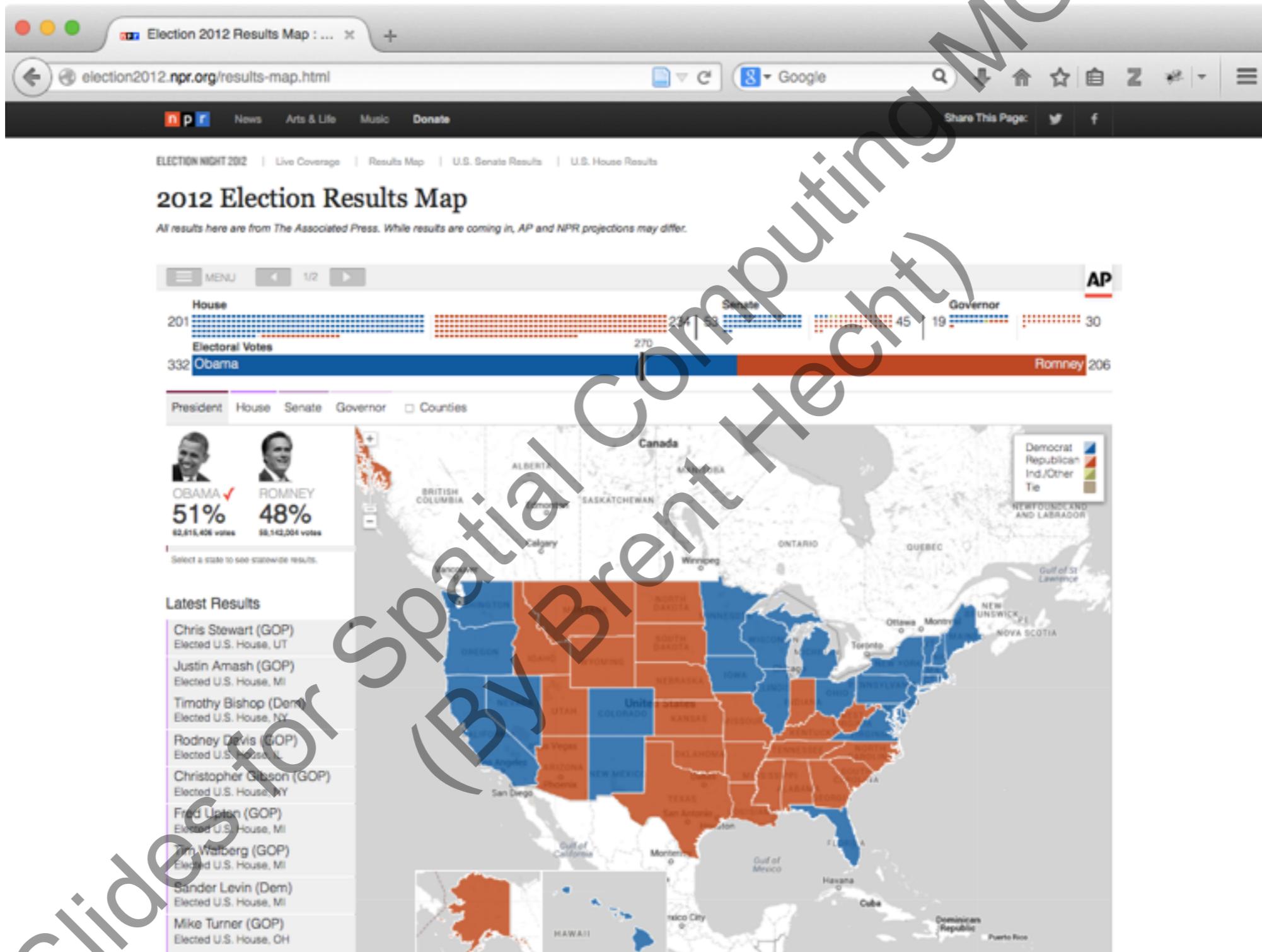
1. Understand the drastically **changed** (and changing) **professional context** of modern cartography.
2. Be able to distinguish between and understand the purpose of the two major types of maps: **reference** and **thematic**.
3. Know the **limitations** of popular online and mobile reference maps. (**Technical track:** Know how to get around them)
4. Be able to distinguish between types of **thematic maps** and choose the correct type for a given **geocommunication** need.
5. Have an understanding of some of the **computing-oriented innovation** going on in cartography (i.e. *spatialization*)



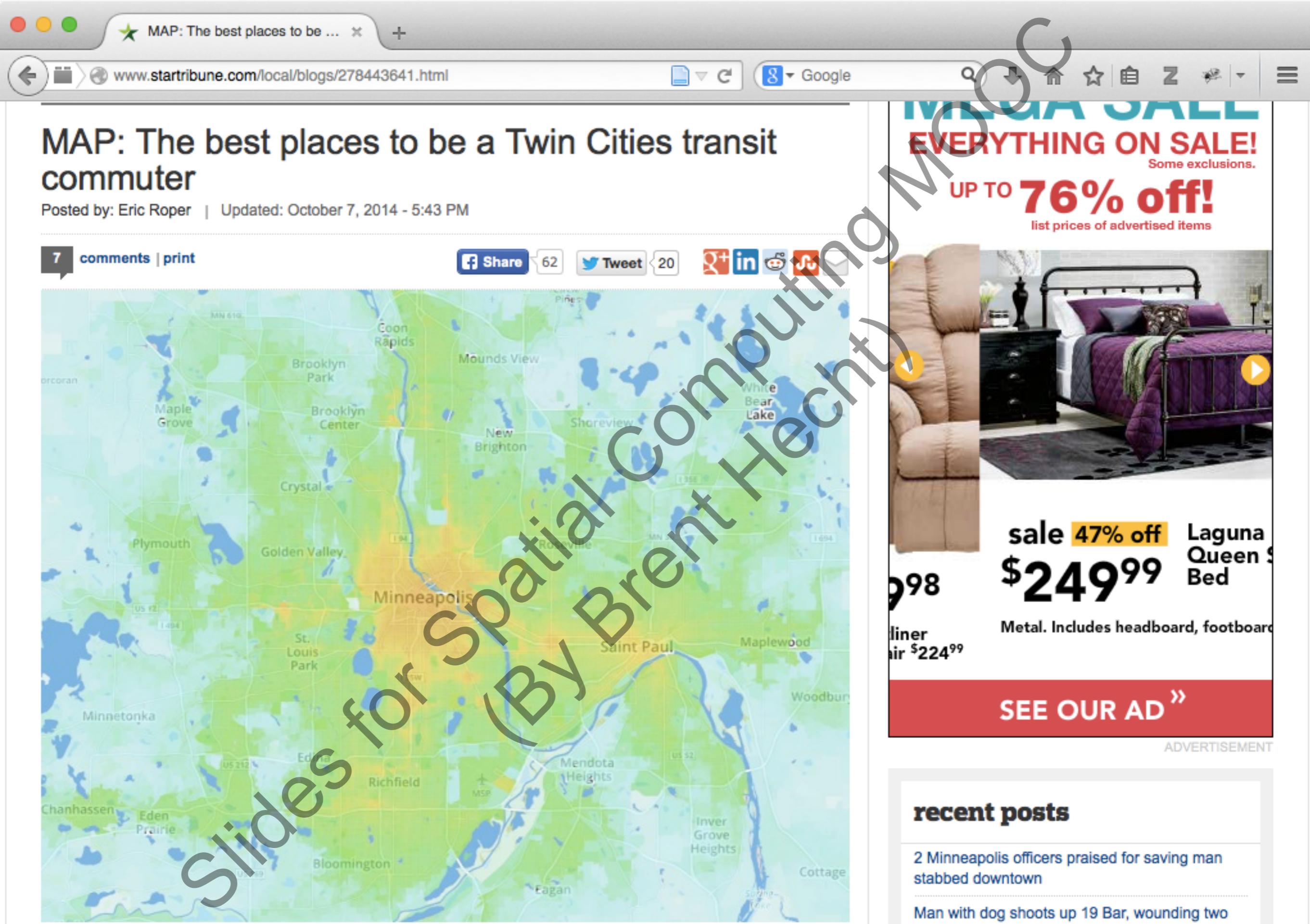
(Slocum et al. 2009)

Thematic maps are
“used to emphasize the
spatial distribution
of one or more
geographic attributes”.

Election maps:



<http://election2012.npr.org/results-map.html>



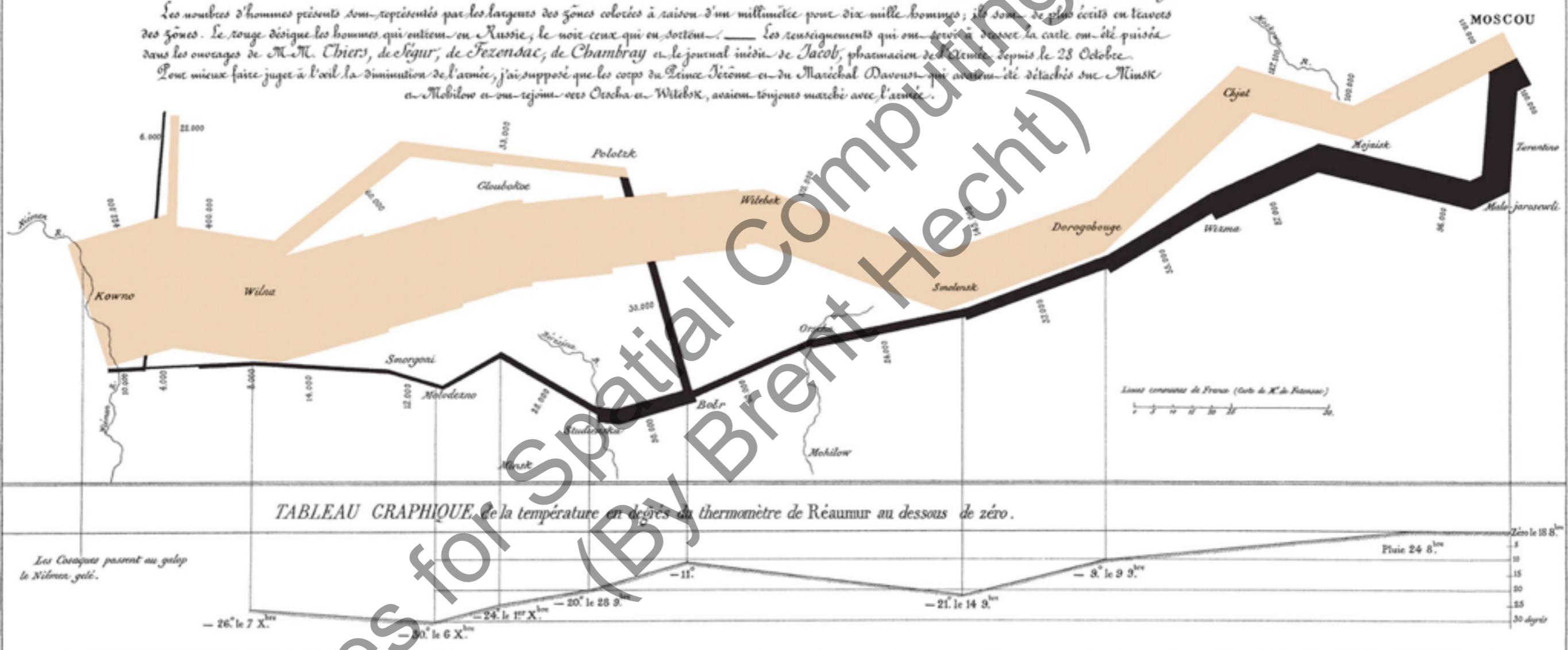
Above: Number of jobs accessible from different points within 30 minutes, between 7 a.m. and 9 a.m.
[Click here](#) to see the full map, with a legend.

*Carte Figurative des pertes successives en hommes de l'Armée Française dans la Campagne de Russie 1812-1813.
Dessiné par M. Minard, Inspecteur Général des Ponts et Chaussées en retraite*

Paris, le 20 Novembre 1869.

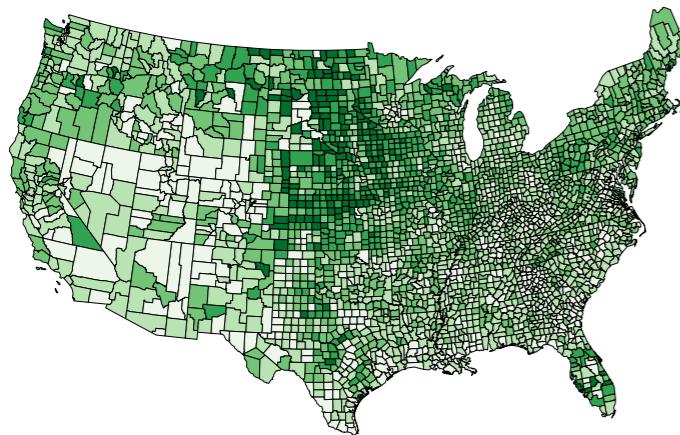
Les nombres d'hommes présentés sont représentés par les larges des zones colorées à raison d'un millimètre pour dix mille hommes ; ils sont de plus écrits en lettres des zones. Le rouge désigne les hommes qui entrent en Russie ; le noir ceux qui en sortent. — Les renseignements qui ont servi à dresser la carte ont été pris dans les ouvrages de M. Chiers, de Séjourné, de Fezenac, de Chambray et le journal médical de Jacob, pharmacien de l'armée depuis le 28 Octobre.

Pour mieux faire juger à l'œil la diminution de l'armée, j'ai supposé que les corps du Prince Jérôme et du Maréchal Davout, qui avaient été détachés de Minsk à Mohilow et qui rejoignirent Orléans et Witebsk, avaient toujours marché avec l'armée.

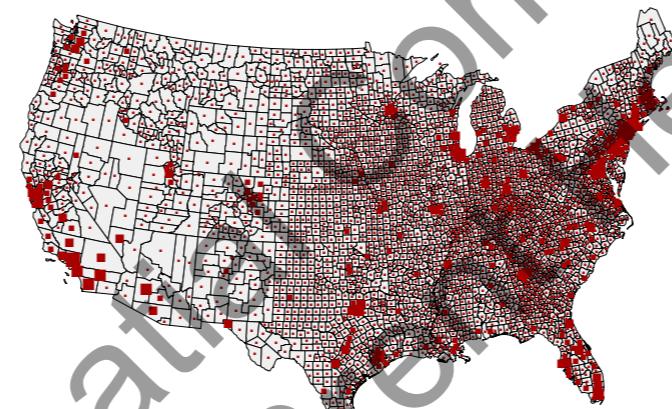


Slides for Spatial Computing (By Brent Hecht)

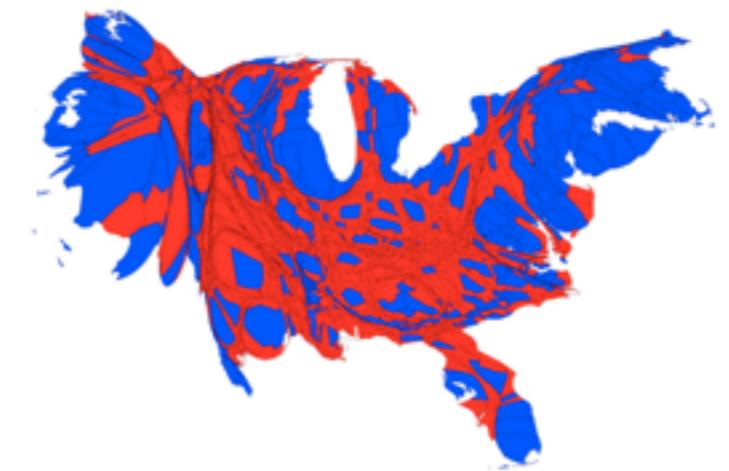
Types of thematic maps we're going to cover:



Choropleth



Graduated /
Proportional
Symbol

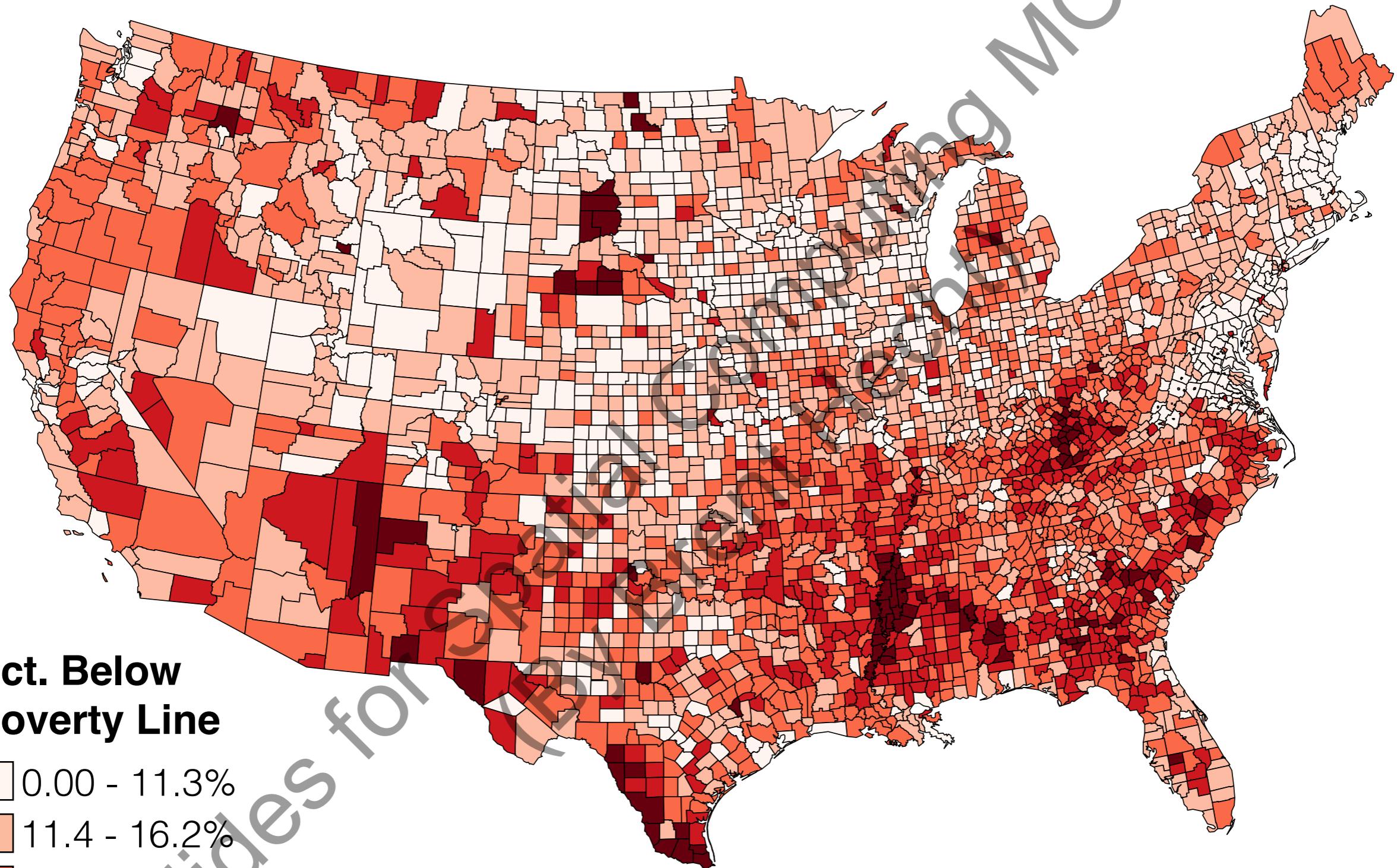


Cartograms

Slides for Spatial Computing MOOC
(BY-BY-Brecht)

Poverty in the United States

Percent of the Population Below the Poverty Line



Data sources: U.S. Census American Community Survey 2006-2010, ESRI
Classification: Natural Breaks

COLOR-related challenges when making **choropleth** maps:

1. Deciding on the set of colors you will use
2. Deciding how to assign colors to specific data values (data classification)

COLOR-related challenges when making **choropleth** maps:

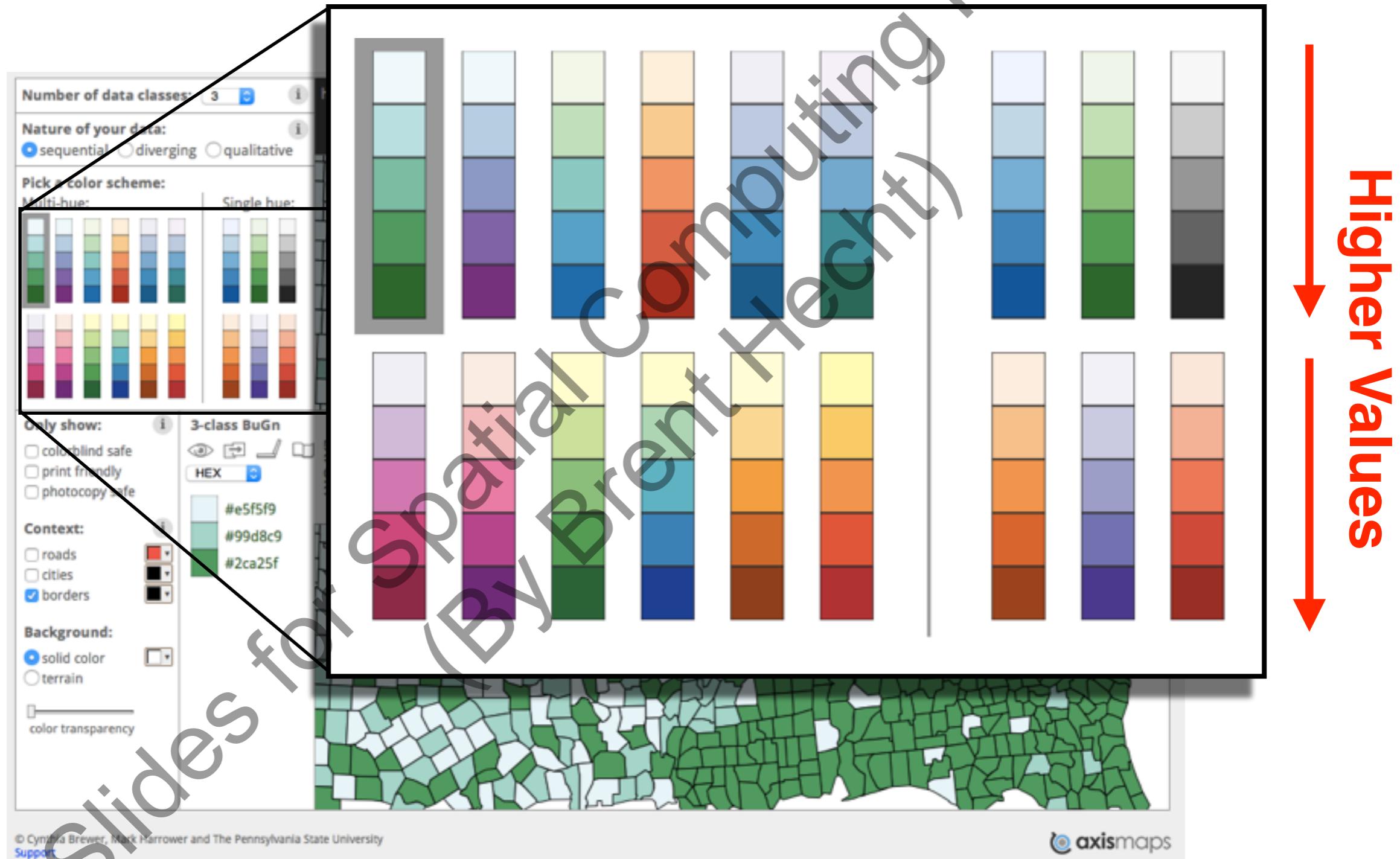
1. Deciding on the set of colors you will use

QUANTITATIVE
attributes

QUALITATIVE
attributes

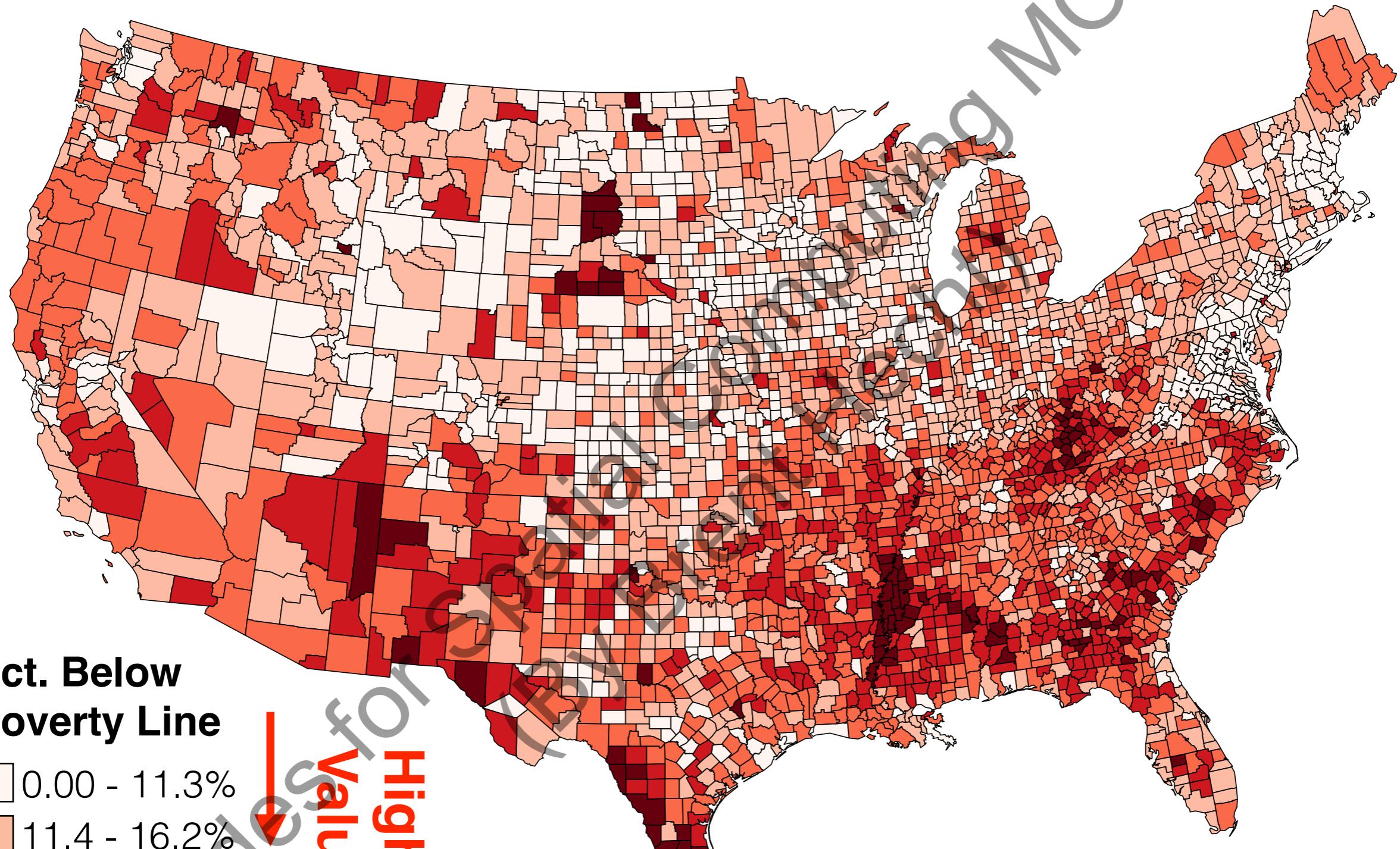
Slides for Spatial Computing MCOC
(By Brent Hecht)

With **quantitative** attributes, you want color schemes like:



Poverty in the United States

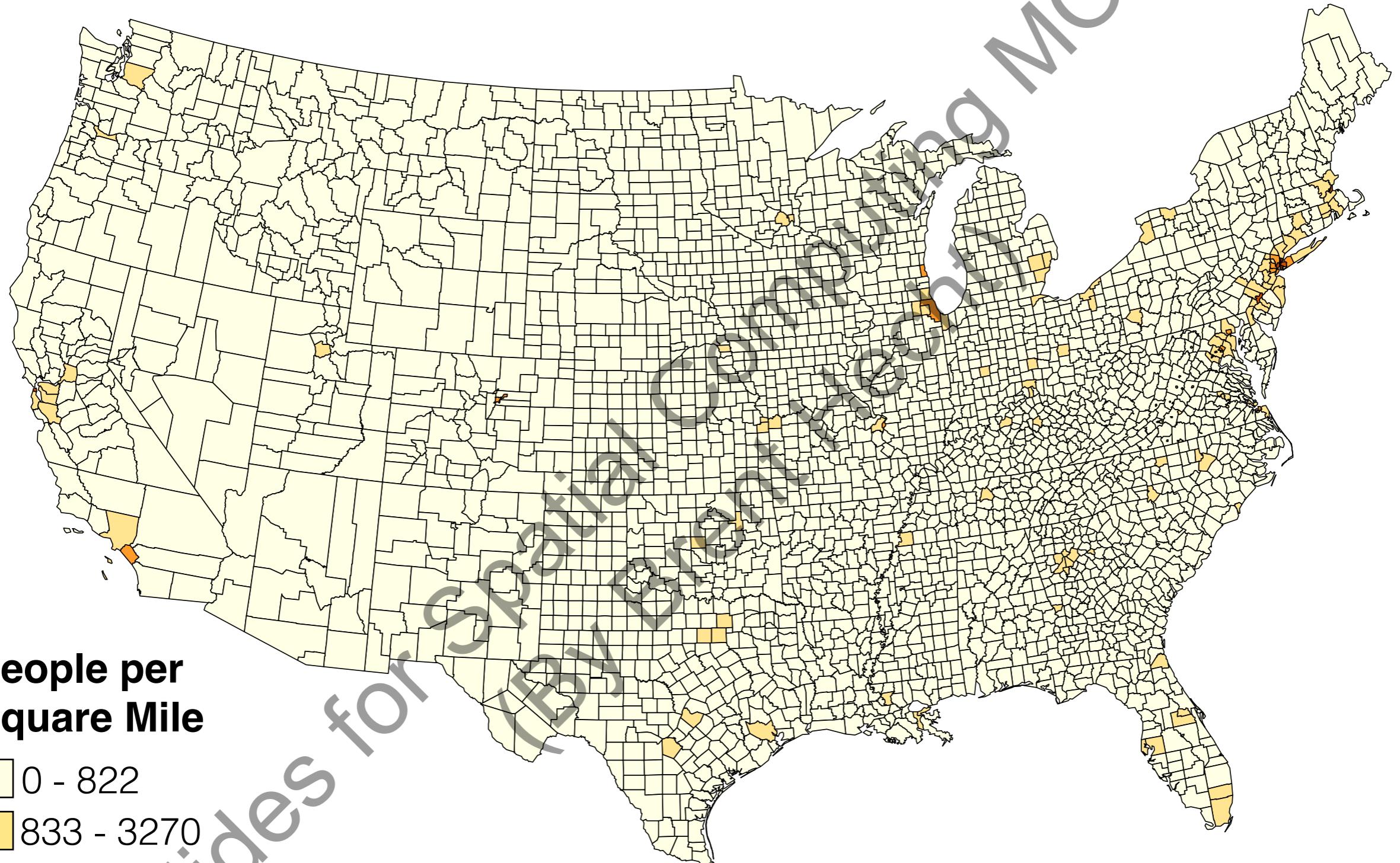
Percent of the Population Below the Poverty Line



Data sources: U.S. Census American Community Survey 2006-2010, ESRI
Classification: Natural Breaks

Population Density in the U.S.

People per Square Mile by County



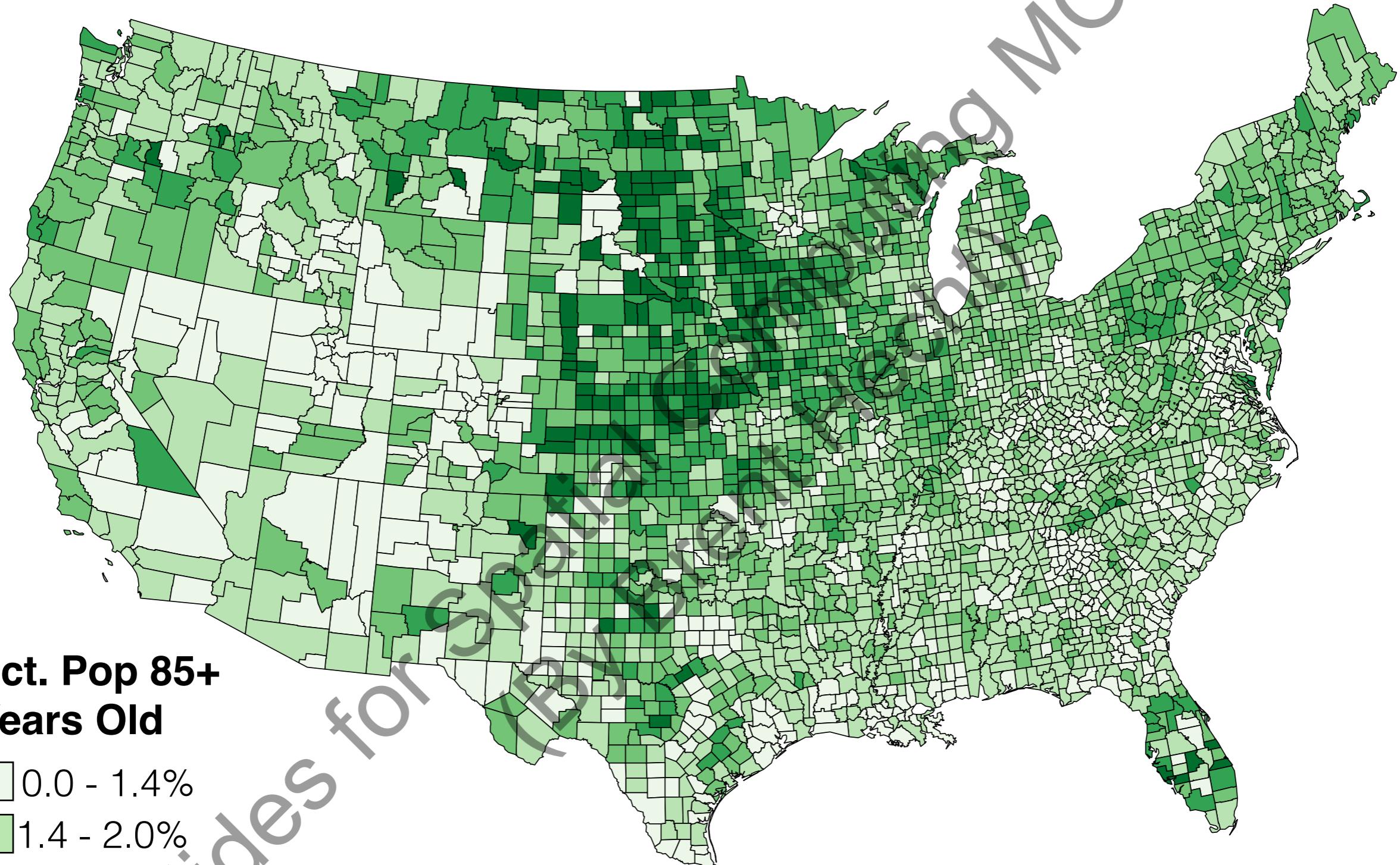
**People per
Square Mile**

- 0 - 822
- 833 - 3270
- 3721 - 9675
- 9676 - 20418
- 20419 - 69568

Data sources: U.S. Census, ESRI
Classification: Natural Breaks

85+ Population in the United States

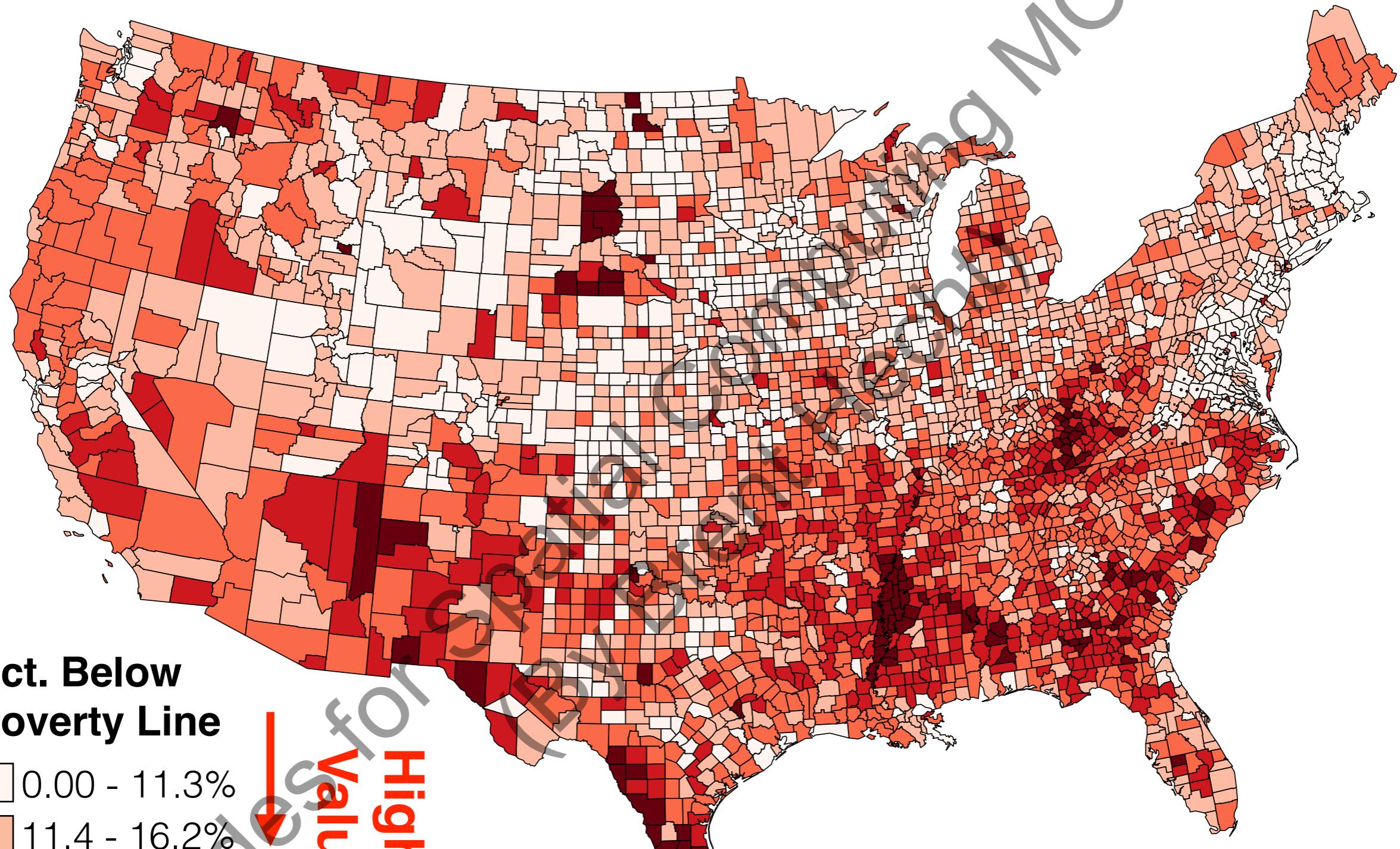
Pct of the Population that is 85 Years Old or Older



Data sources: U.S. Census, ESRI
Classification: Natural Breaks

Poverty in the United States

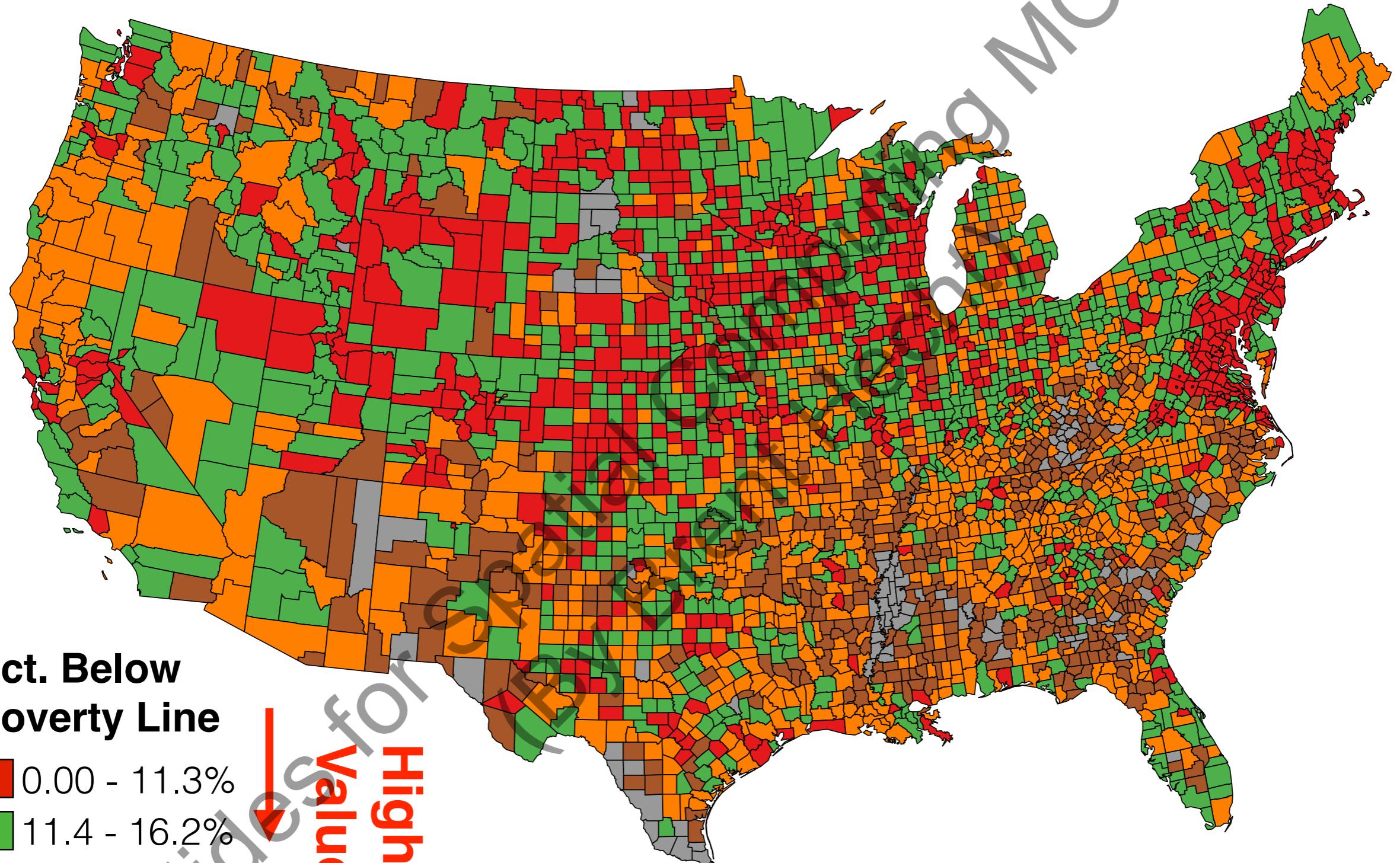
Percent of the Population Below the Poverty Line



Data sources: U.S. Census American Community Survey 2006-2010, ESRI
Classification: Natural Breaks

Poverty in the United States

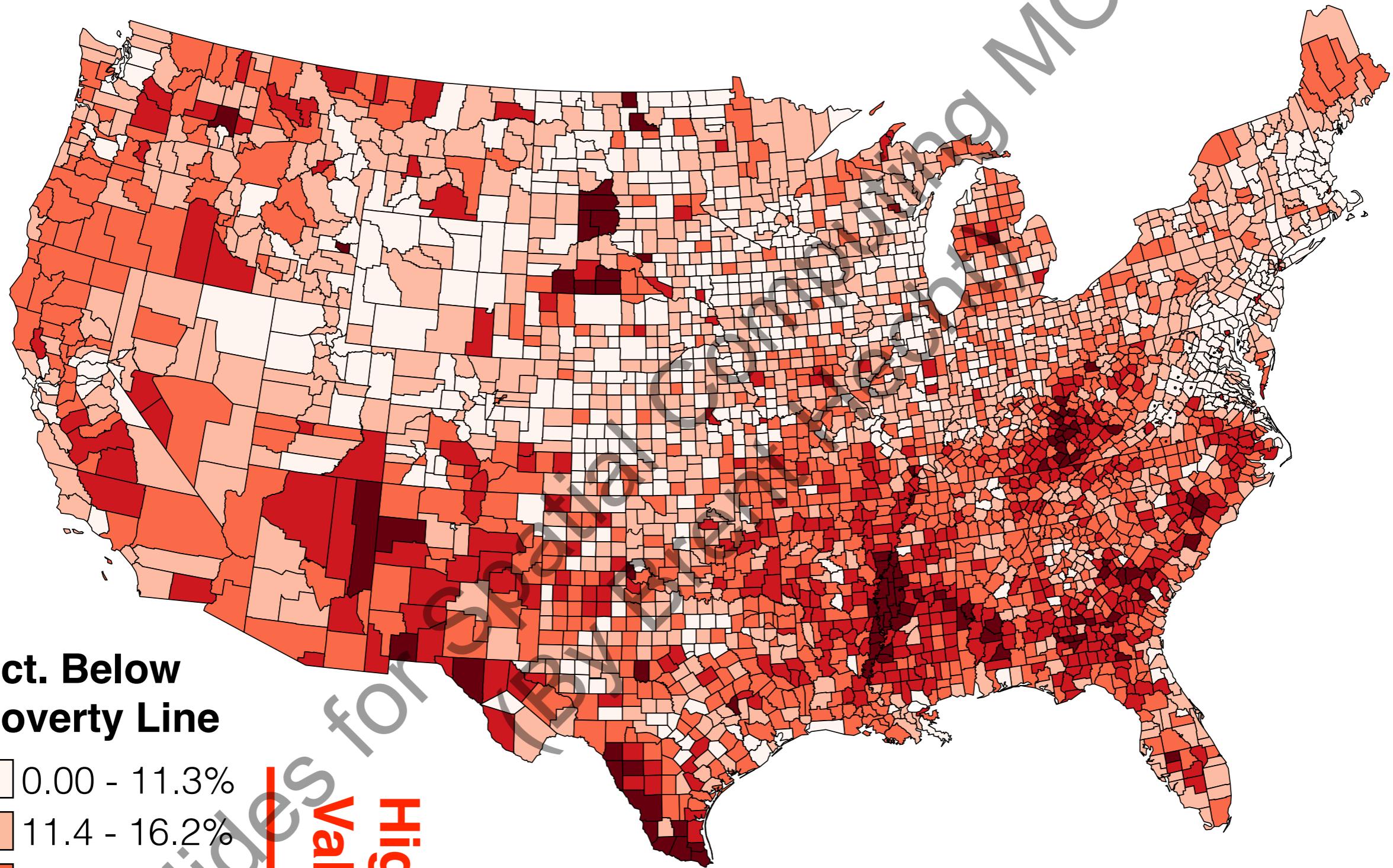
Percent of the Population Below the Poverty Line



Data sources: U.S. Census American Community Survey 2006-2010, ESRI
Classification: Natural Breaks

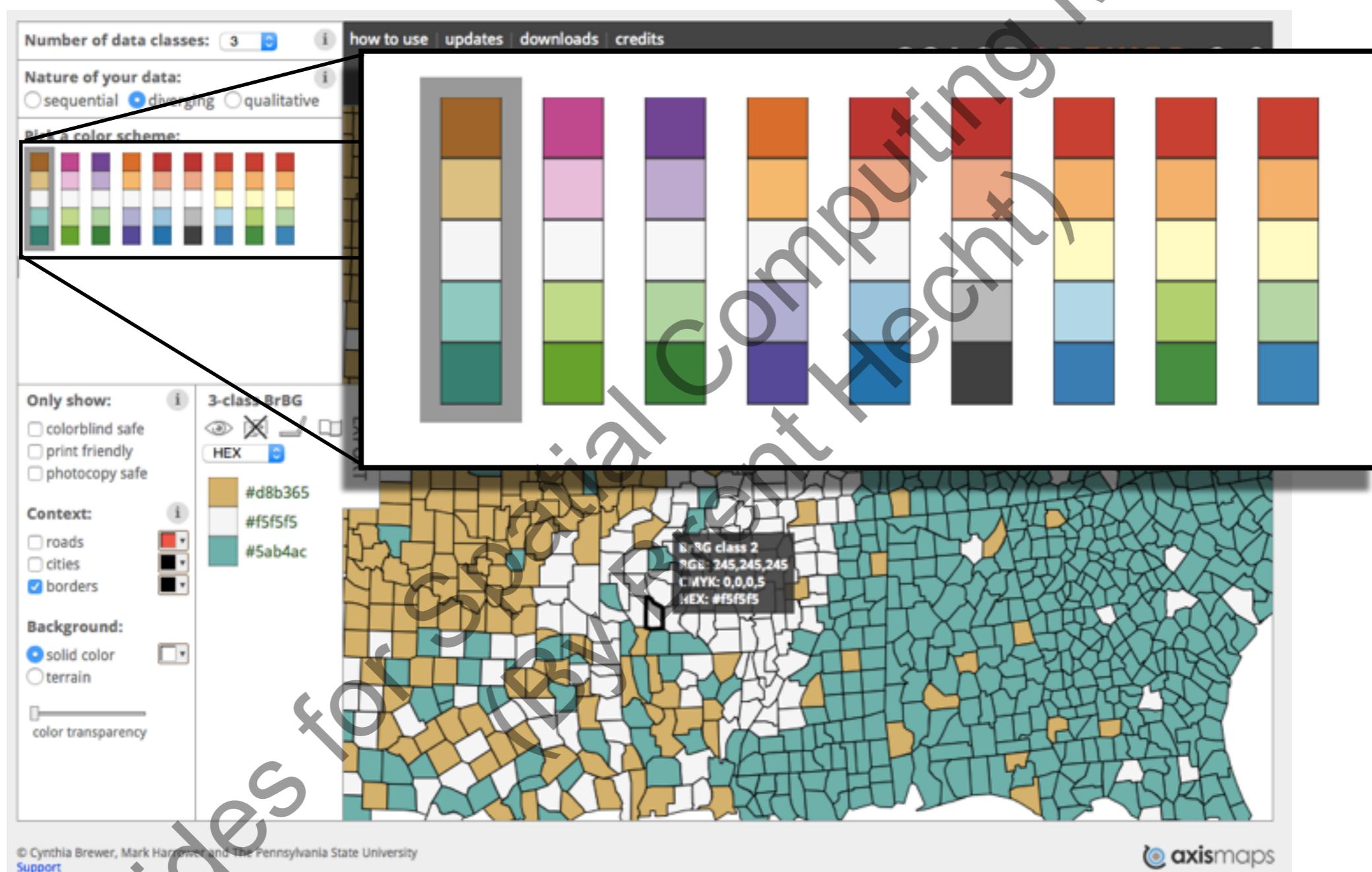
Poverty in the United States

Percent of the Population Below the Poverty Line



Data sources: U.S. Census American Community Survey 2006-2010, ESRI
Classification: Natural Breaks

Divergent color schemes:



Higher Values

colorbrewer.org



President Map

[Map](#) | [Big Board](#) | [Scenarios](#) | [Exit Polls](#)

FACEBOOK TWITTER

UPDATED NOV. 29

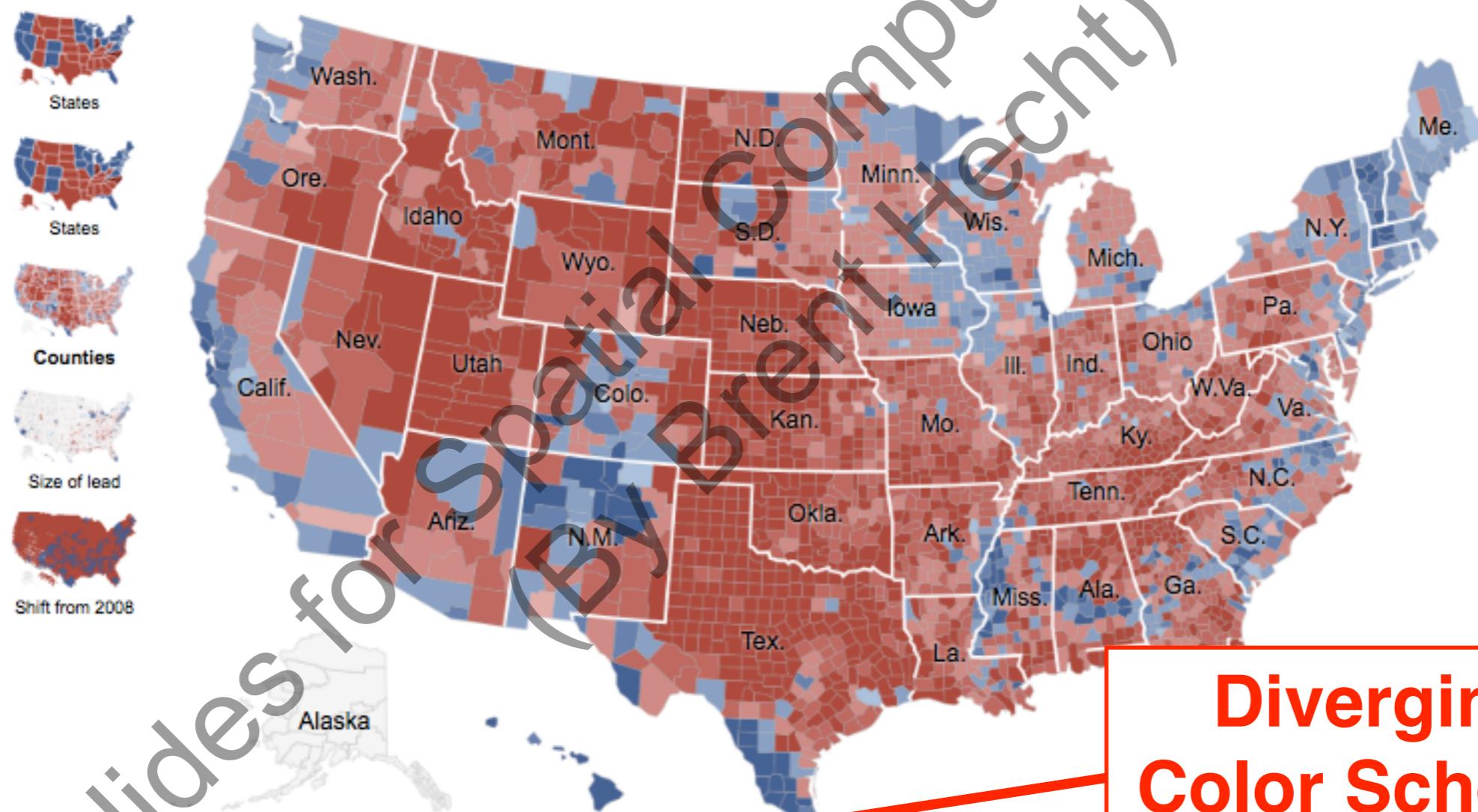
332 Obama

62,611,250 votes

0
undecided

Romney 206

59,134,475 votes



Diverging
Color Scheme

Slides for Spatial Computing MOOC

COLOR-related challenges when making **choropleth** maps:

1. Deciding on the set of colors you will use



QUANTITATIVE
attributes

QUALITATIVE
attributes

Slides for Spatial Computing
(By Brent Hecht)

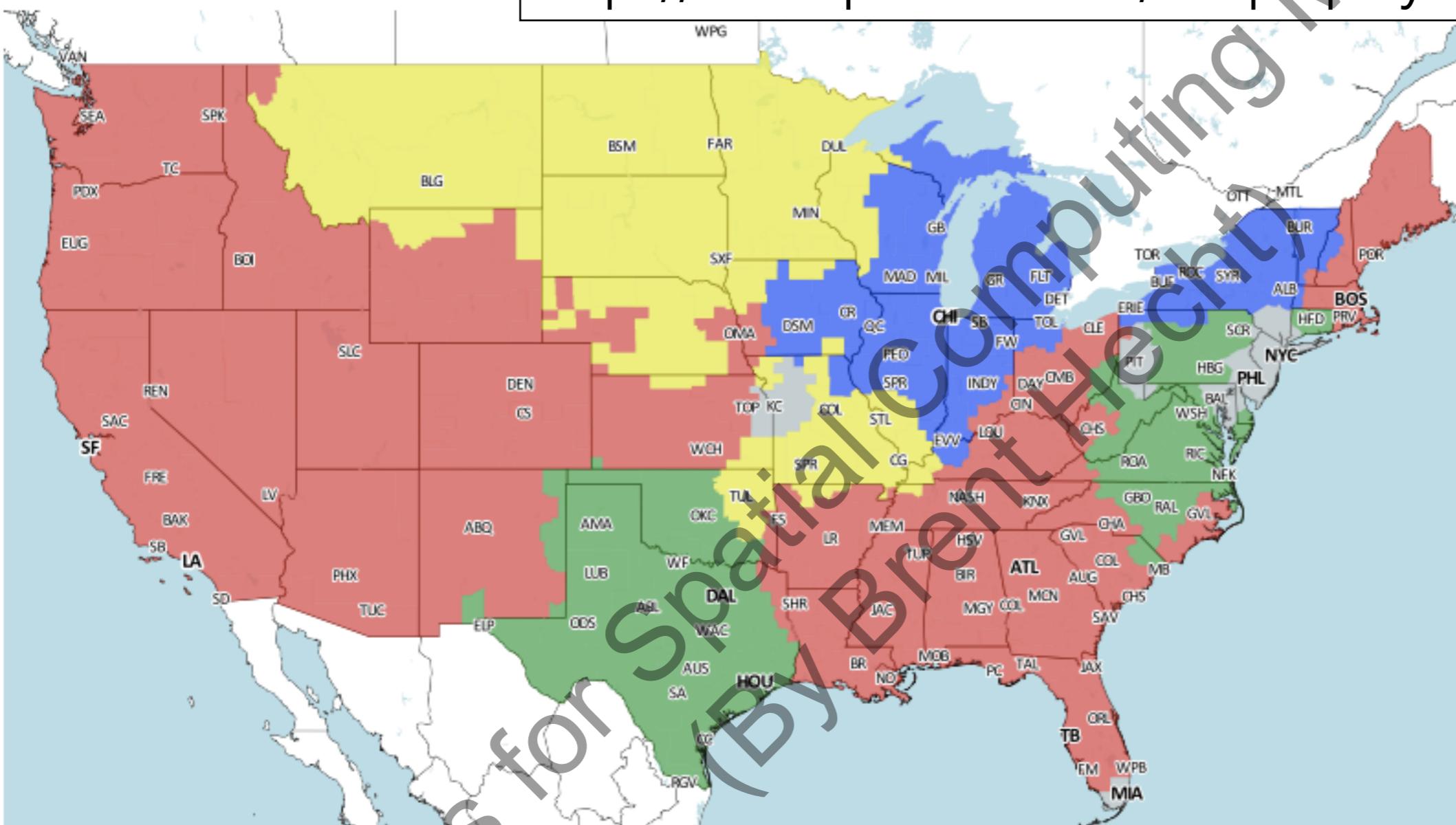
Examples of **qualitative** spatial attributes:

1. Land cover type (e.g urban, forest, water)
2. The primary religion in an area
3. The primary language spoken in area
4. The region of an area like East Coast, West Coast, Midwest, etc.

FOX EARLY

<http://506sports.com/nfl.php?yr=2014&wk=1>you might
have been
nervous.

ETS TOEFL



New Orleans @ Atlanta -- Kevin Burkhardt, John Lynch [Anchorage AK; HI]

Buffalo @ Chicago -- Kenny Albert, Daryl Johnston, Tony Siragusa

Washington @ Houston -- Thom Brennaman, David Diehl

Minnesota @ St. Louis -- Dick Stockton, Kirk Morrison [Fairbanks AK]

NO GAME due to NFL rules

UPDATES:

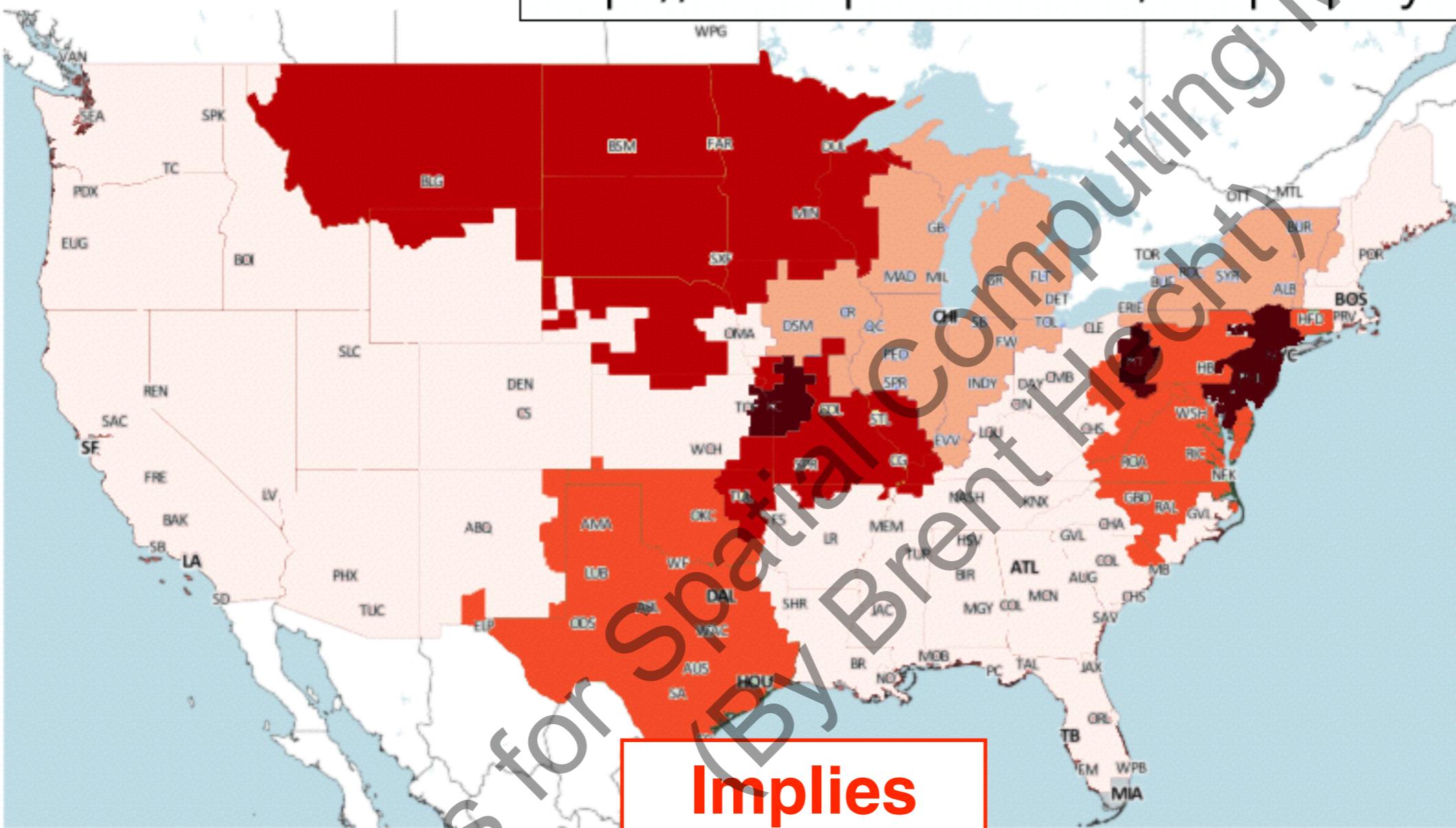
Boston MA: BUF-CHI to NO-ATL

FOX EARLY

<http://506sports.com/nfl.php?yr=2014&wk=1>

you might
have been
nervous.

ETS TOEFL



Implies
increasing
values

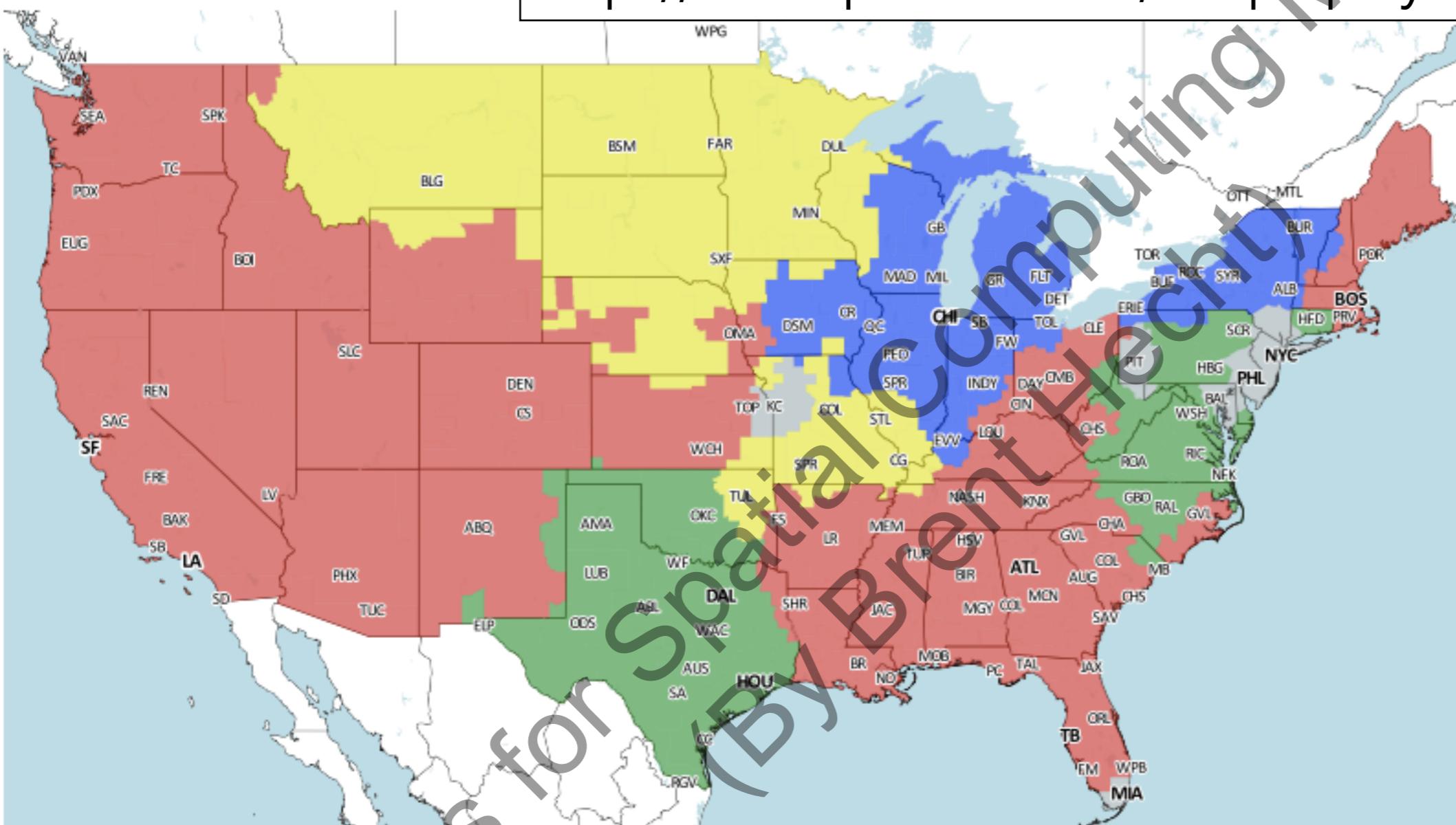
UPDATES:

Boston MA: BUF-CHI to NO-ATL

FOX EARLY

<http://506sports.com/nfl.php?yr=2014&wk=1>you might
have been
nervous.

ETS TOEFL



New Orleans @ Atlanta -- Kevin Burkhardt, John Lynch [Anchorage AK; HI]

Buffalo @ Chicago -- Kenny Albert, Daryl Johnston, Tony Siragusa

Washington @ Houston -- Thom Brennaman, David Diehl

Minnesota @ St. Louis -- Dick Stockton, Kirk Morrison [Fairbanks AK]

NO GAME due to NFL rules

UPDATES:

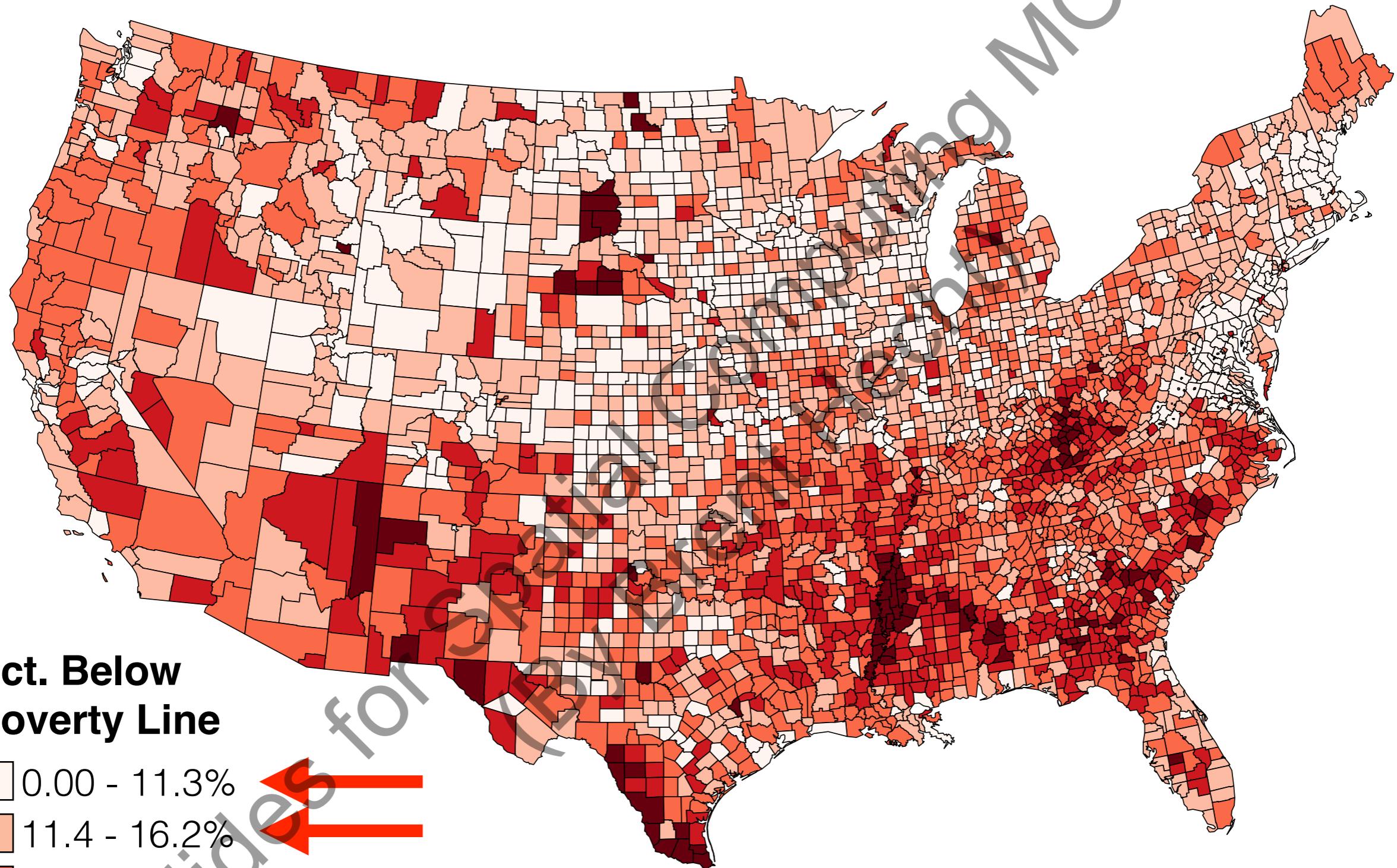
Boston MA: BUF-CHI to NO-ATL

COLOR-related challenges when making **choropleth** maps:

- 1. Deciding on the set of colors you will use
- 2. Deciding how to assign colors to specific data values (data classification)

Poverty in the United States

Percent of the Population Below the Poverty Line



Data sources: U.S. Census American Community Survey 2006-2010, ESRI
Classification: Natural Breaks

Choropleth Maps

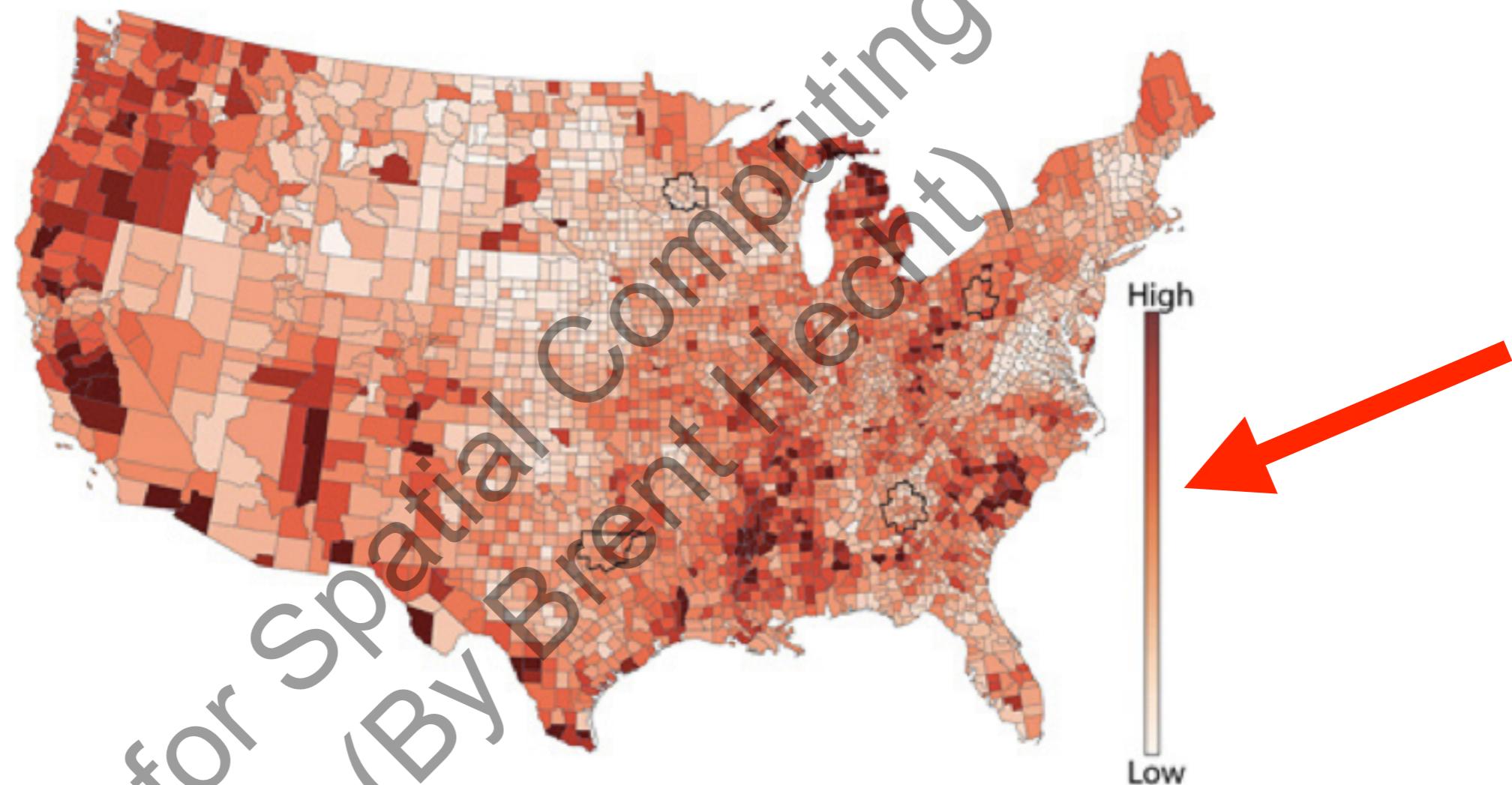
Unclassed Maps

Classed Maps

Slides for Spatial Computing
(By Brent Hecht)

Example Unclassed Choropleth Map

In the map below, notice how you can easily see a large geographic pattern of unemployment rates, but it is very hard to compare or rank counties: try to accurately arrange the counties in California from lowest to highest...it's nearly impossible.

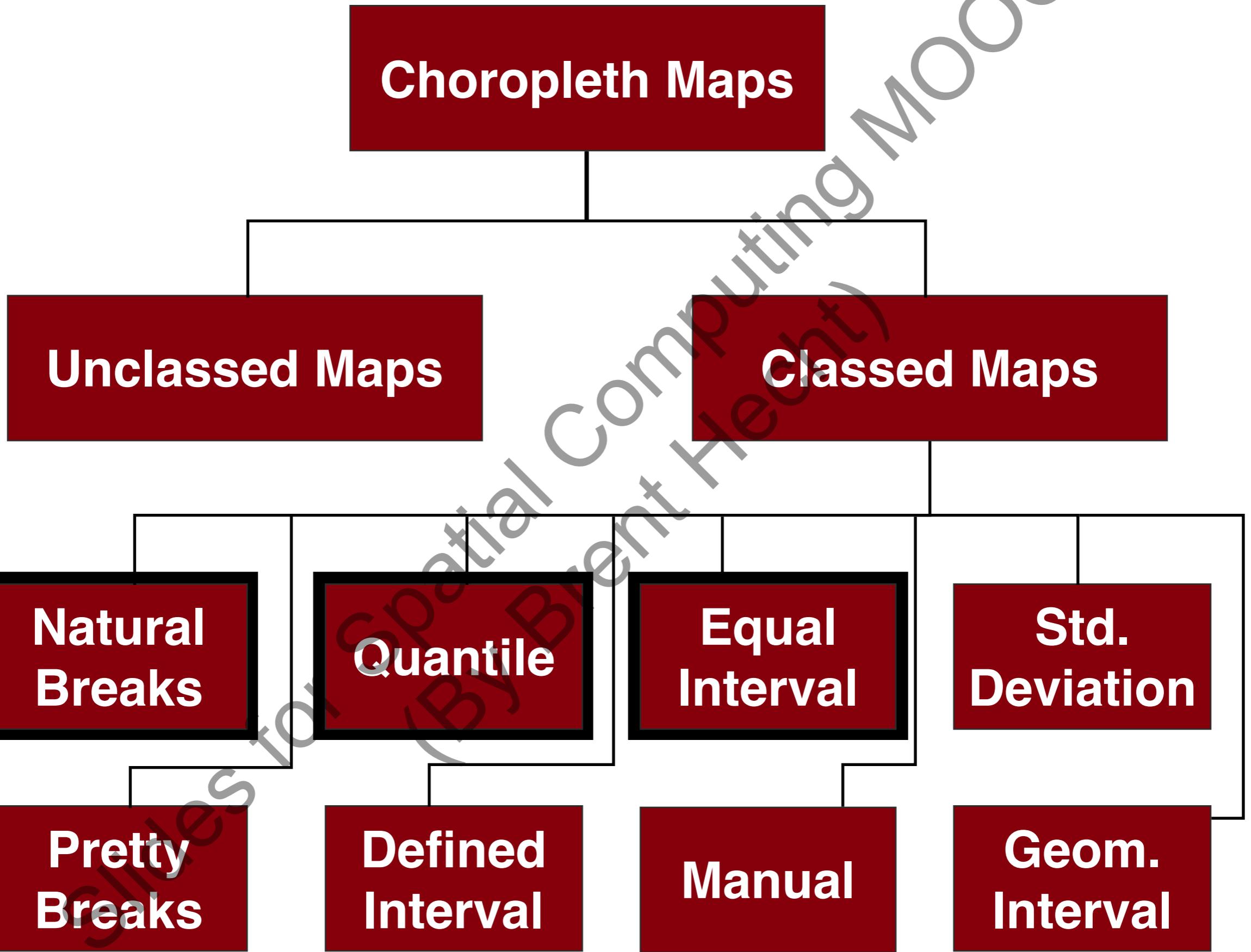


Limitations

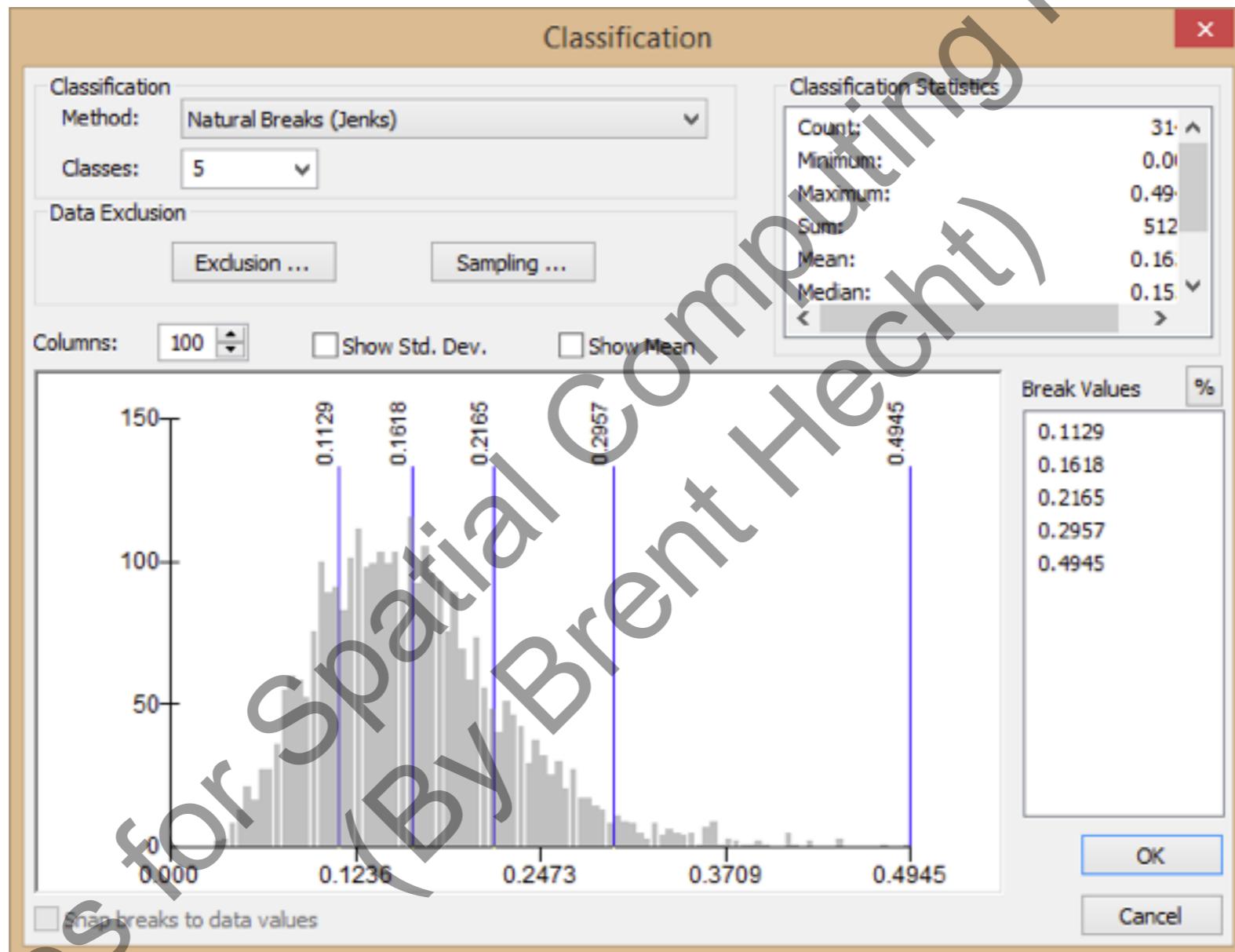
There are at least three major drawbacks with unclassed choropleth maps. First, while the idea of letting our data speak for itself is appealing we often find it has too much to say. Cartographers have long relied on classification to suppress random noise or insignificant variations to highlight large, major differences. For example, a very simple 2-class map of unemployment (using only 2 colors) would quickly show whether a place is above or below the national average. More detail

<http://indiemapper.com/app/learnmore.php?l=choropleth>

are easily confused with each other. This makes it very hard to estimate values or get specific numbers from the map (e.g.,

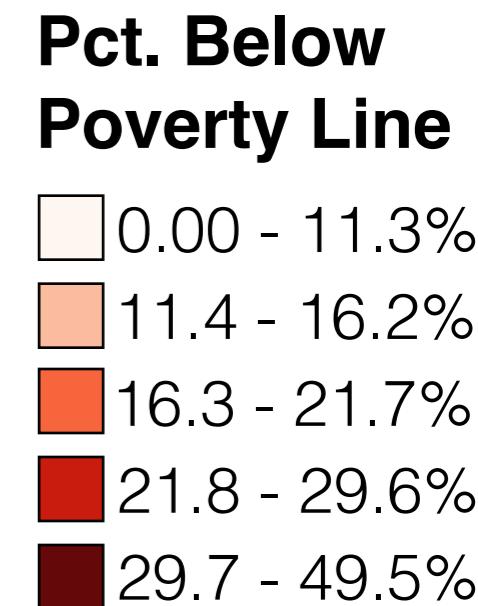
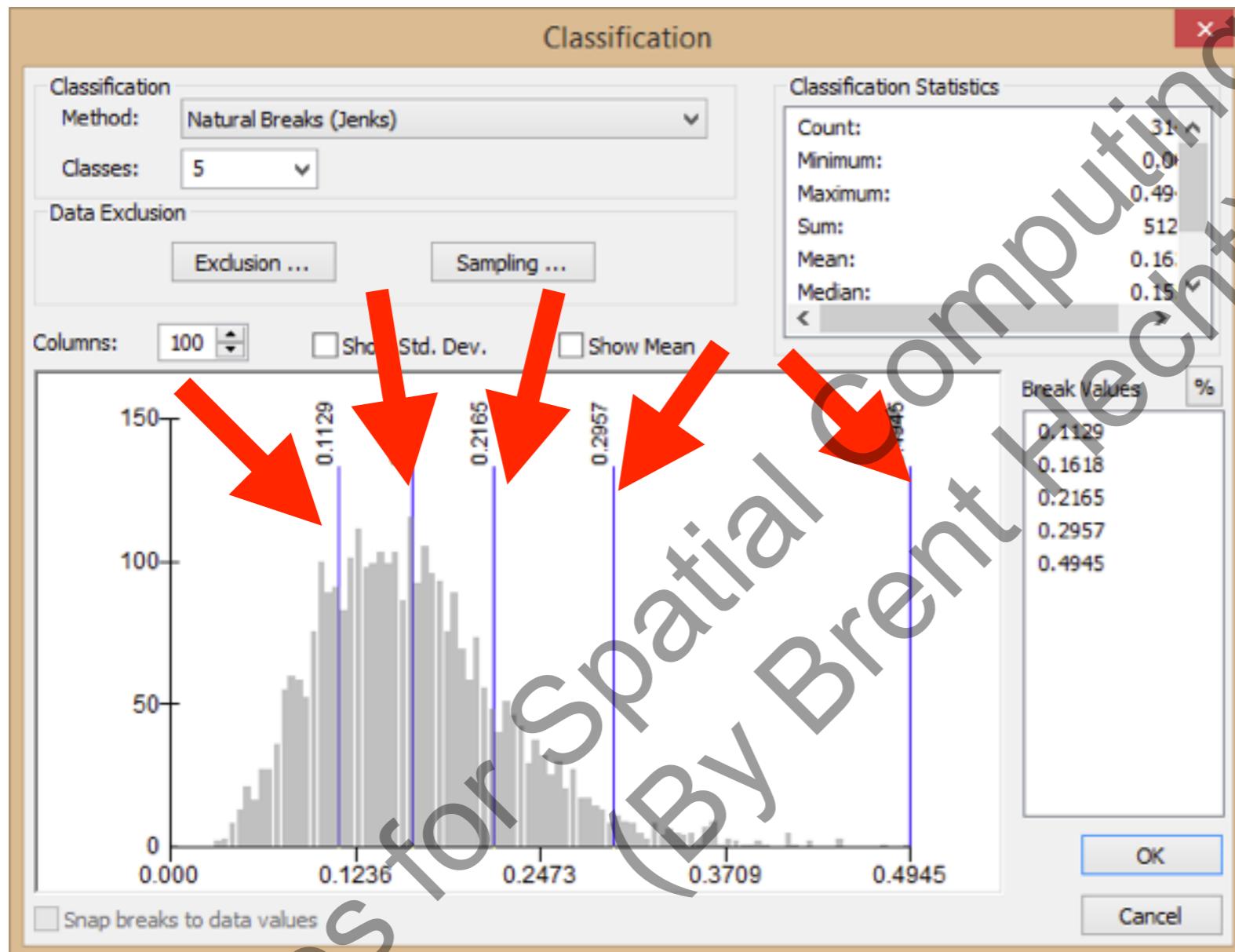


Natural Breaks Classification



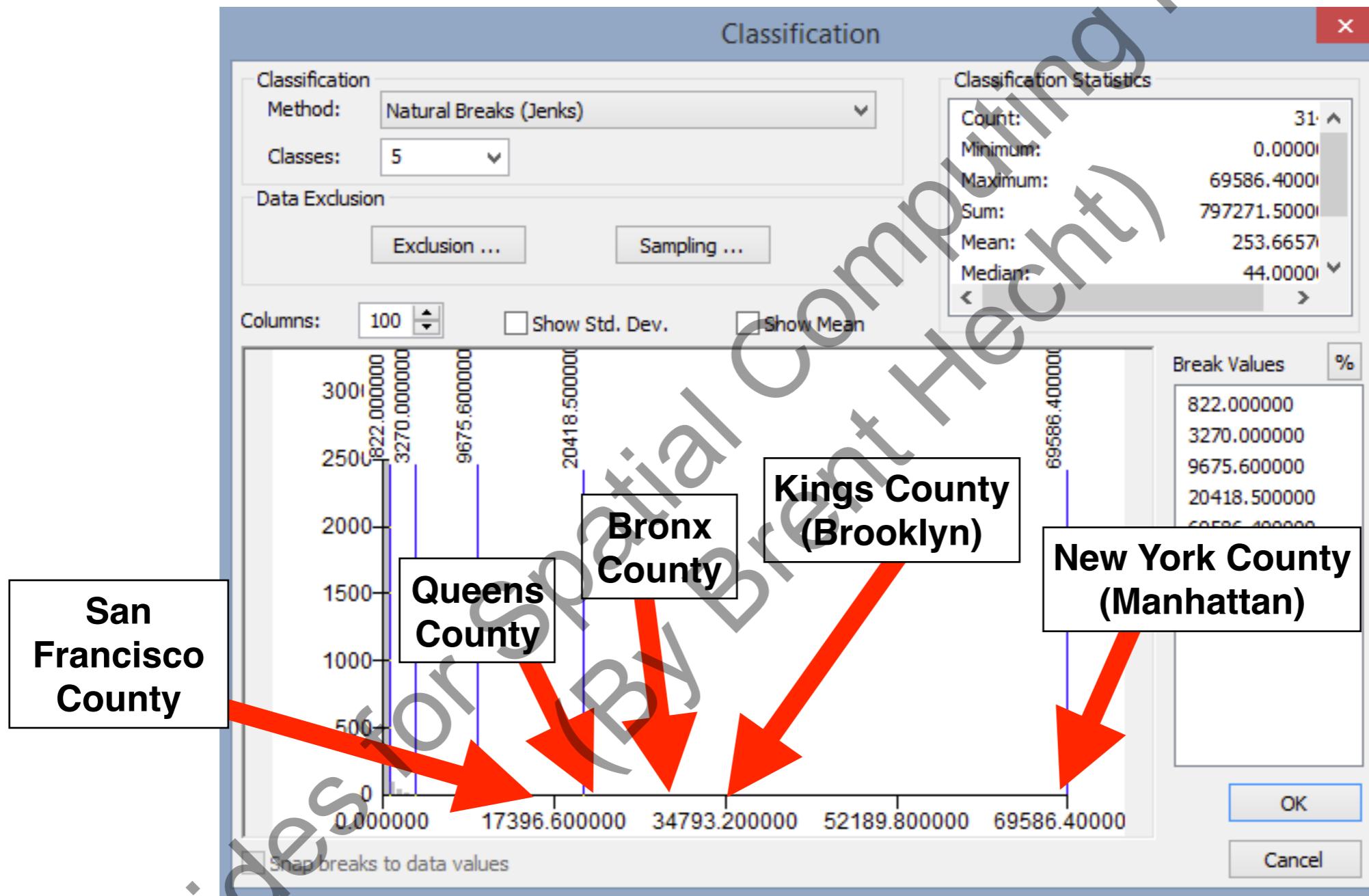
Pct. Below Poverty Line Attribute Value Distribution

Natural Breaks Classification



Pct. Below Poverty Line Attribute Value Distribution

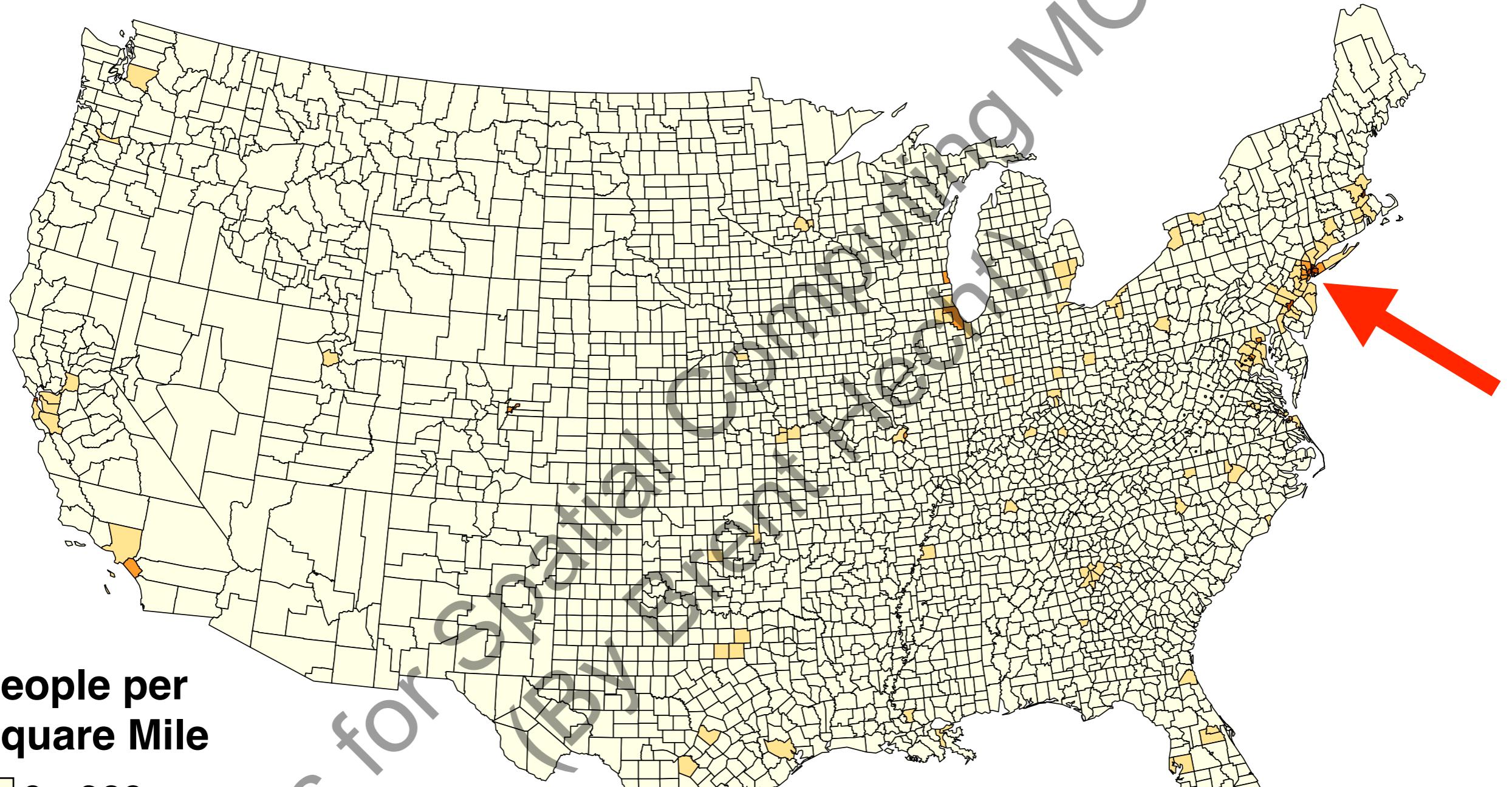
Natural Breaks Classification



Population Density (People per Square Mile)

Population Density in the U.S.

People per Square Mile by County



**People per
Square Mile**

- 0 - 822
- 833 - 3270
- 3721 - 9675
- 9676 - 20418
- 20419 - 69568

Data sources: U.S. Census, ESRI
Classification: Natural Breaks

Choropleth Maps

Unclassed Maps

Classed Maps

Natural
Breaks

Quantile

Equal
Interval

Std.
Deviation

Pretty
Breaks

Defined
Interval

Manual

Geom.
Interval



QuantileExample

QuantileExample

State Name Attribute Value

	State Name	Attribute Value
1	Wyoming	0.628684744
2	Wisconsin	0.2816115406
3	West Virginia	0.2724013457
4	Washington	0.4908310038
5	Virginia	0.9769108994
6	Vermont	0.6578557848
7	Utah	0.3490212685
8	Texas	0.6763919496
9	Tennessee	0.9685244795
10	South Dakota	0.2681739626
11	South Carolina	0.7328552068
12	Rhode Island	0.522504366
13	Pennsylvania	0.3542625622
14	Oregon	0.3522289195
15	Oklahoma	0.6720866978
16	Ohio	0.3768142592
17	North Dakota	0.0045091594
18	North Carolina	0.3309581964
19	New York	0.1054128092
20	New Mexico	0.6218491374
21	New Jersey	0.5054483407
22	New Hampshire	0.0565240593
23	Nevada	0.3271966181
24	Nebraska	0.0646708442
25	Montana	0.6962972083
26	Missouri	0.0163905404
27	Mississippi	0.7700615935

Columns (2/1)

State Name Attribute Value

Rows

All rows Selected Excluded Hidden Labelled

50 1 0 0 0

Slides for Spatial Computation BY Brent Heaton MOOC

Screenshot from JMP 11

QuantileExample

QuantileExample

State Name Attribute Value

	State Name	Attribute Value
1	Arizona	0.9852453978
2	Virginia	0.9769108994
3	Tennessee	0.9685244795
4	Alabama	0.9587183748
5	Arkansas	0.8629727496
6	Mississippi	0.7700615935
7	Minnesota	0.7410474042
8	Alaska	0.7367502658
9	South Carolina	0.7328552068
10	Iowa	0.7053067777
11	Montana	0.6962972083
12	Texas	0.6763919496
13	Delaware	0.6737801768
14	Oklahoma	0.6720866978
15	Vermont	0.6578557848
16	Louisiana	0.6430006351
17	Wyoming	0.628684744
18	New Mexico	0.6218491374
19	Georgia	0.5332210232
20	Rhode Island	0.522504366
21	New Jersey	0.5054483407
22	Washington	0.4908310038
23	Florida	0.4869914695
24	Kentucky	0.4696961681
25	Kansas	0.4348825025
26	Colorado	0.398861222
27	Connecticut	0.3847875695

Columns (2/1)

State Name Attribute Value

Rows

All rows Selected Excluded Hidden Labelled

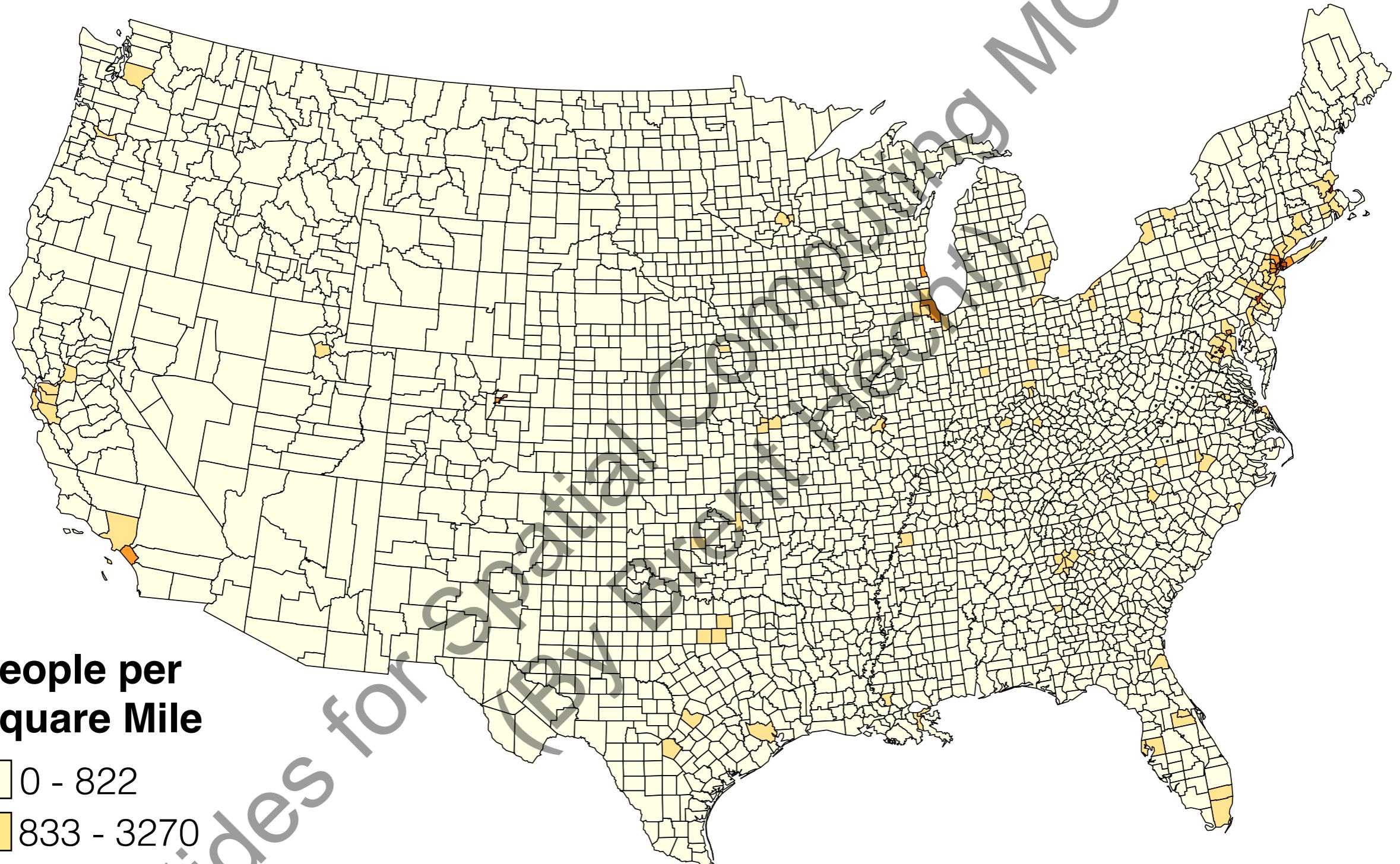
50 0 0 0 0

Slides for Spatial Computation MOOC

Screenshot from JMP 11

Population Density in the U.S.

People per Square Mile by County



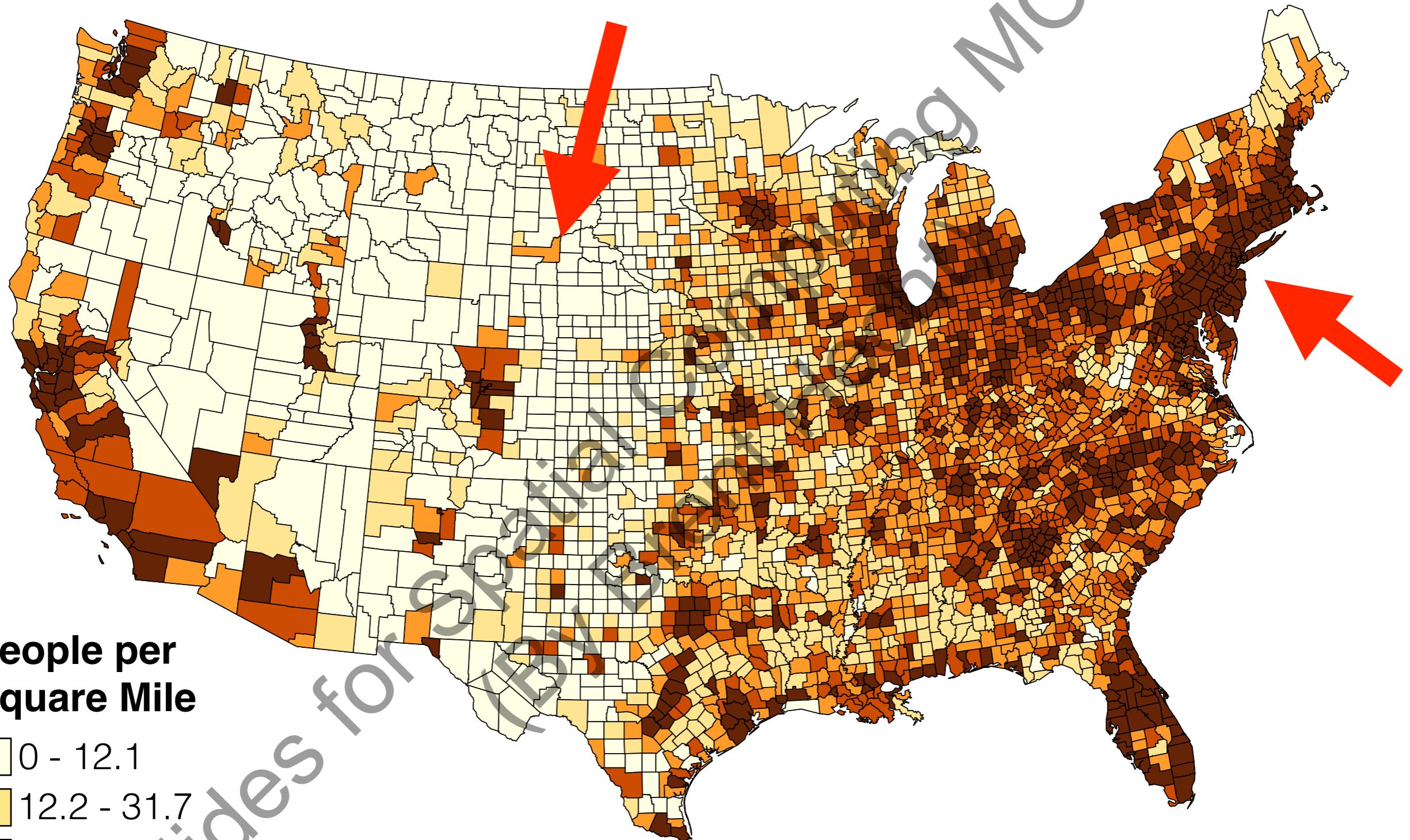
**People per
Square Mile**

- 0 - 822
- 833 - 3270
- 3721 - 9675
- 9676 - 20418
- 20419 - 69568

Data sources: U.S. Census, ESRI
Classification: Natural Breaks

Population Density in the U.S.

People per Square Mile by County

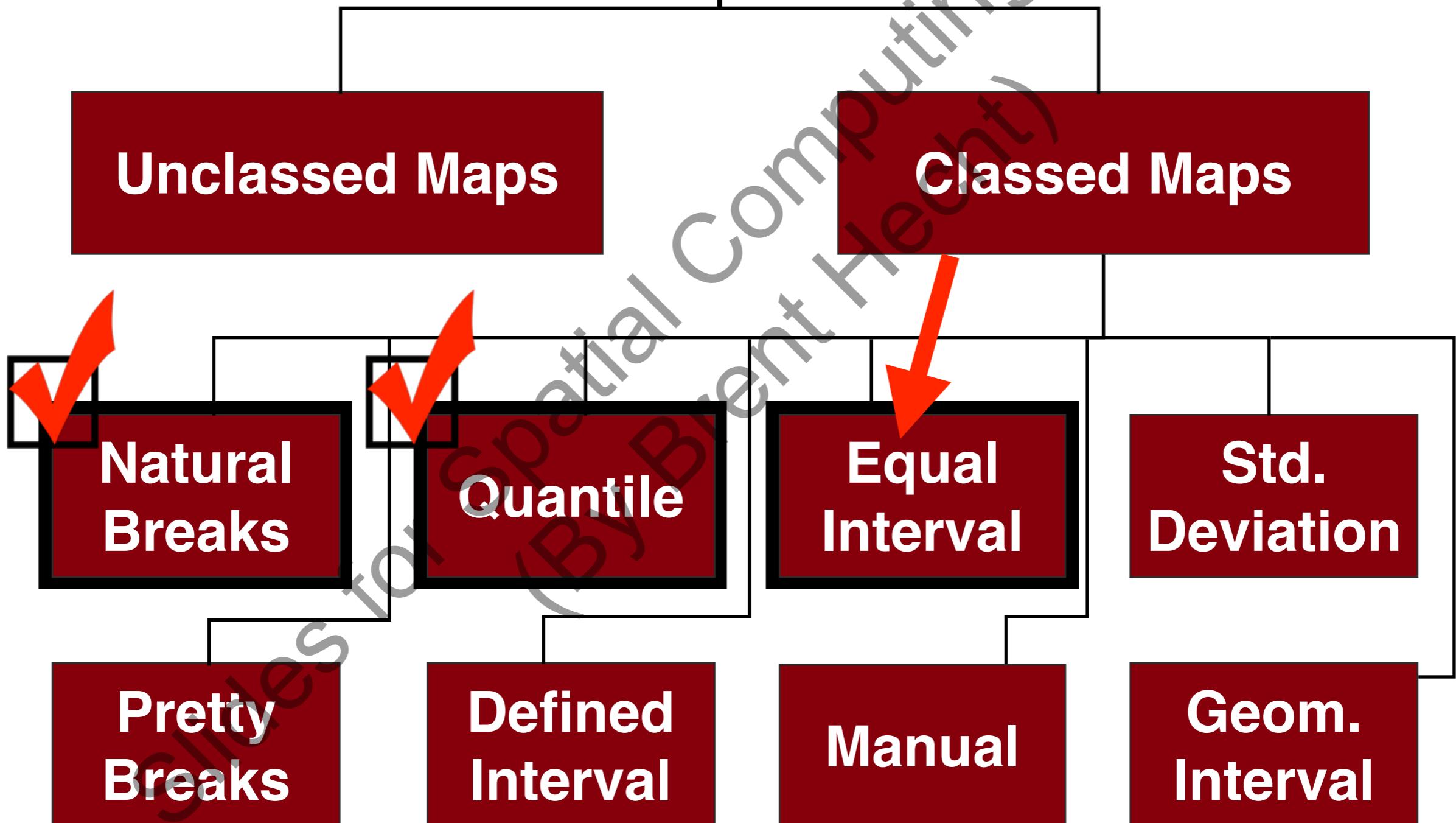


**People per
Square Mile**

- 0 - 12.1
- 12.2 - 31.7
- 31.8 - 61.2
- 61.3 - 154.2
- 154.3 - 69586.4

Data sources: U.S. Census, ESRI
Classification: Natural Breaks

Choropleth Maps



Highest
Attribute
Value
(e.g.
Manhattan's
population
density)

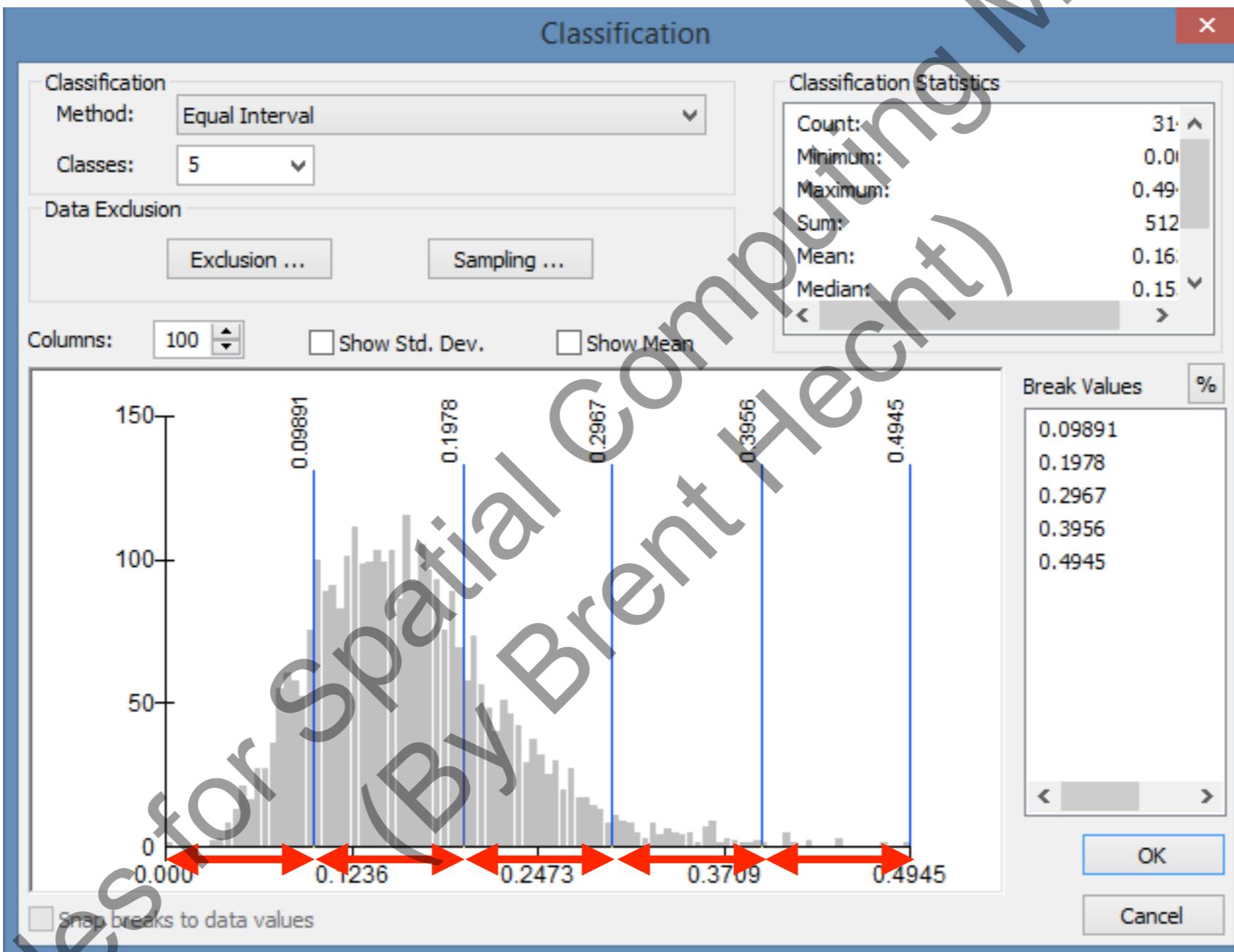
Lowest
Attribute
Value
(e.g. Loving
County, TX
population
density)

= **Class**
= **Width**

Number of classes
(we've been using '5')

Slides for Spatial Computing MOOC

by Brent Hecht



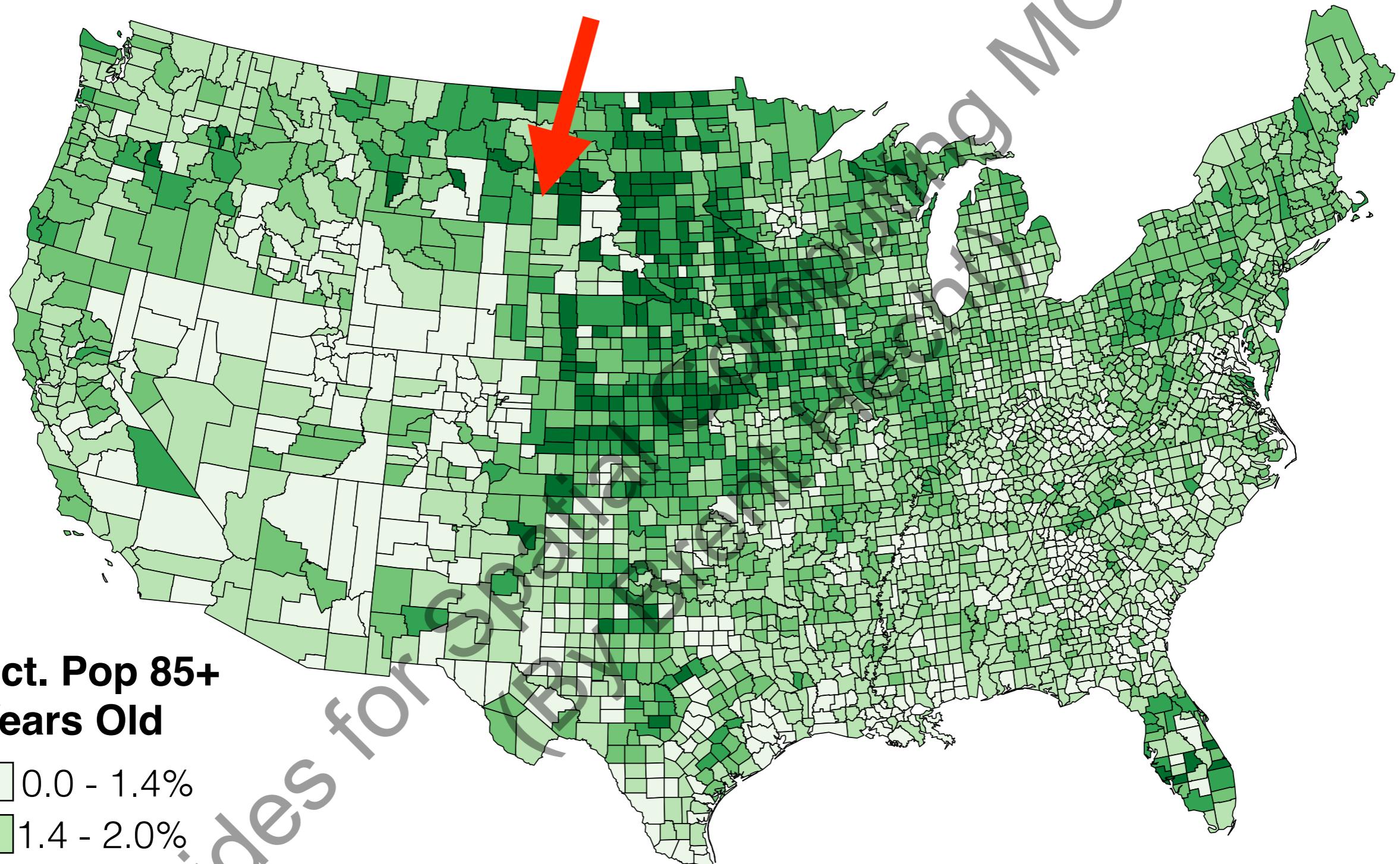
A photograph of a store window display filled with various wooden nutcracker figurines and dolls. The figures are painted in bright colors like red, green, and yellow. Some are dressed in traditional military-style uniforms with tall hats and gold buttons. Others are dressed as simple folk characters or have more whimsical designs. In the foreground, there are two large, stylized wooden dolls with long, puffy bodies and small heads. A white rectangular box with a black border is overlaid on the upper left portion of the image, containing the text.

No, really! This is
what the data says!

Lying with maps!

85+ Population in the United States

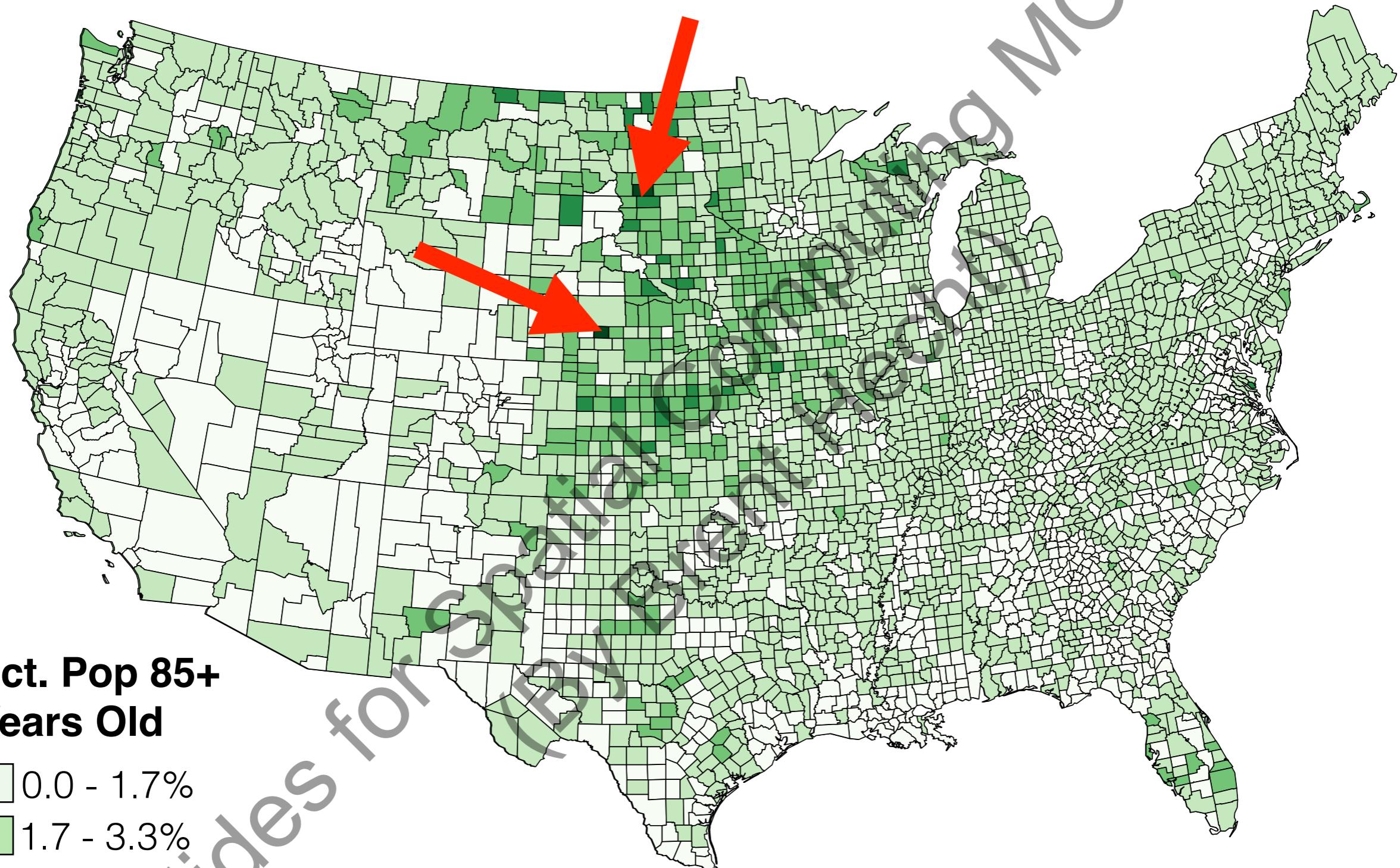
Pct of the Population that is 85 Years Old or Older



Data sources: U.S. Census, ESRI
Classification: Natural Breaks

85+ Population in the United States

Pct of the Population that is 85 Years Old or Older



Data sources: U.S. Census, ESRI
Classification: EQUAL INTERVAL

COLOR-related challenges when making **choropleth** maps:

1. Deciding on the set of colors you will use
2. Deciding how to assign colors to specific data values (data classification)

ColorBrewer: Color Advice for M... +

colorbrewer2.org Google

Number of data classes: 5 how to use | updates | downloads | credits

Nature of your data: sequential diverging qualitative

Pick a color scheme:

Only show: colorblind safe print friendly photocopy safe

Context: roads cities borders

Background: solid color terrain

color transparency

5-class Accent

EXPORT

Color	Hex
#7fc97f	#7fc97f
#beaed4	#beaed4
#fdc086	#fdc086
#ffff99	#ffff99
#386cb0	#386cb0

<http://www.colorbrewer.org>

<http://www.wired.com/2014/10/cindy-brewer-map-design/>

MapLab



HERE BE DRAGONS

The Cartographer Who's Transforming Map Design

BY GREG MILLER 10.20.14 | 6:30 AM | PERMALINK

[Share 1.3k](#) [Tweet 1,132](#) [g+1 236](#) [in Share 204](#) [Pin it 1](#)



ColorBrewer: Color Advice for M... +

colorbrewer2.org Google

Number of data classes: 5 how to use | updates | downloads | credits

Nature of your data: sequential diverging qualitative

Pick a color scheme:

Only show: colorblind safe print friendly photocopy safe

Context: roads cities borders

Background: solid color terrain

color transparency

5-class Accent

EXPORT

HEX

	#7fc97f	#beaed4	#fdc086	#ffff99	#386cb0
green	#7fc97f	#beaed4	#fdc086	#ffff99	#386cb0
purple					
orange					
yellow					
blue					

<http://www.colorbrewer.org>

ColorBrewer: Color Advice for M... +

colorbrewer2.org Google

Number of data classes: 5 i how to use | updates | downloads | credits

Nature of your data: i

sequential diverging qualitative

Pick a color scheme: Multi-hue Single hue:

Only show: i

- colorblind safe
- print friendly
- photocopy safe

Context: i

- roads
- cities
- borders

Background: i

- solid color
- terrain

color transparency

5-class YIOrBr

EXPORT

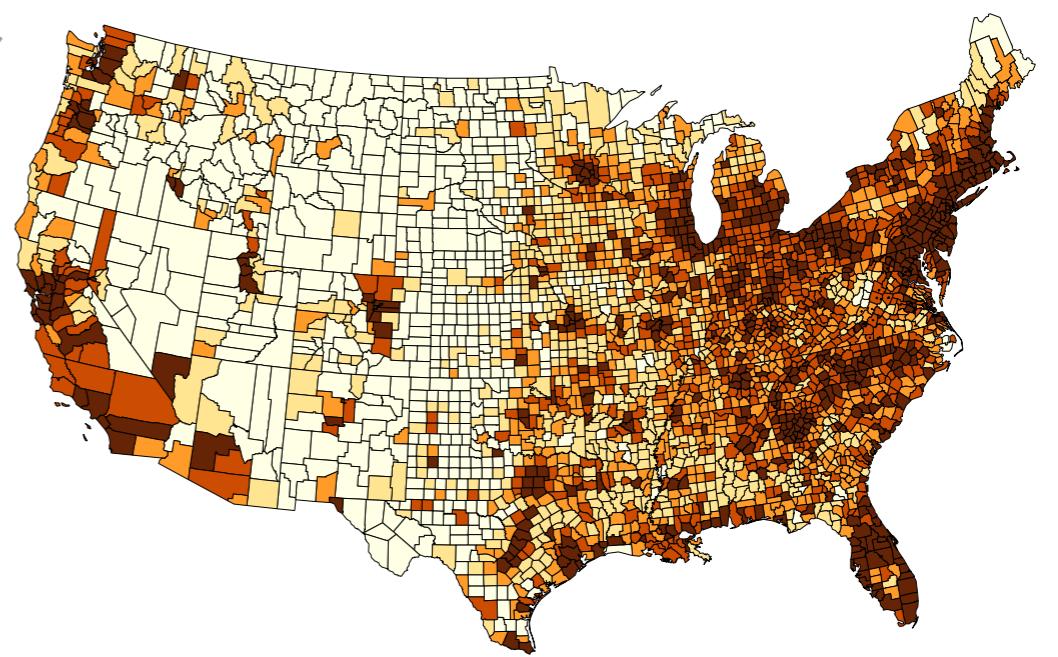
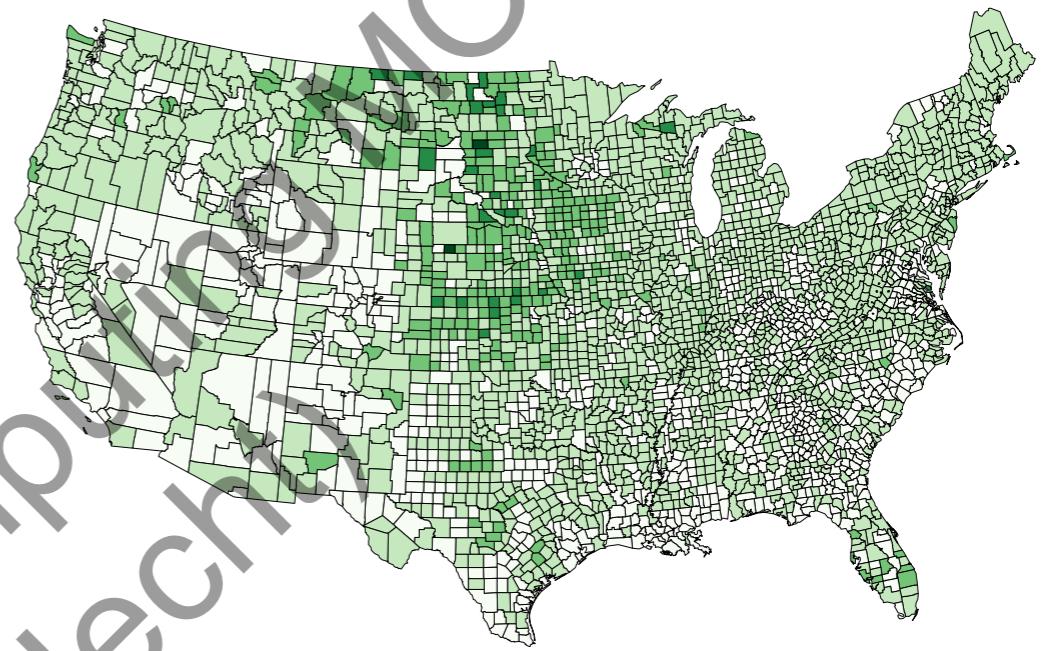
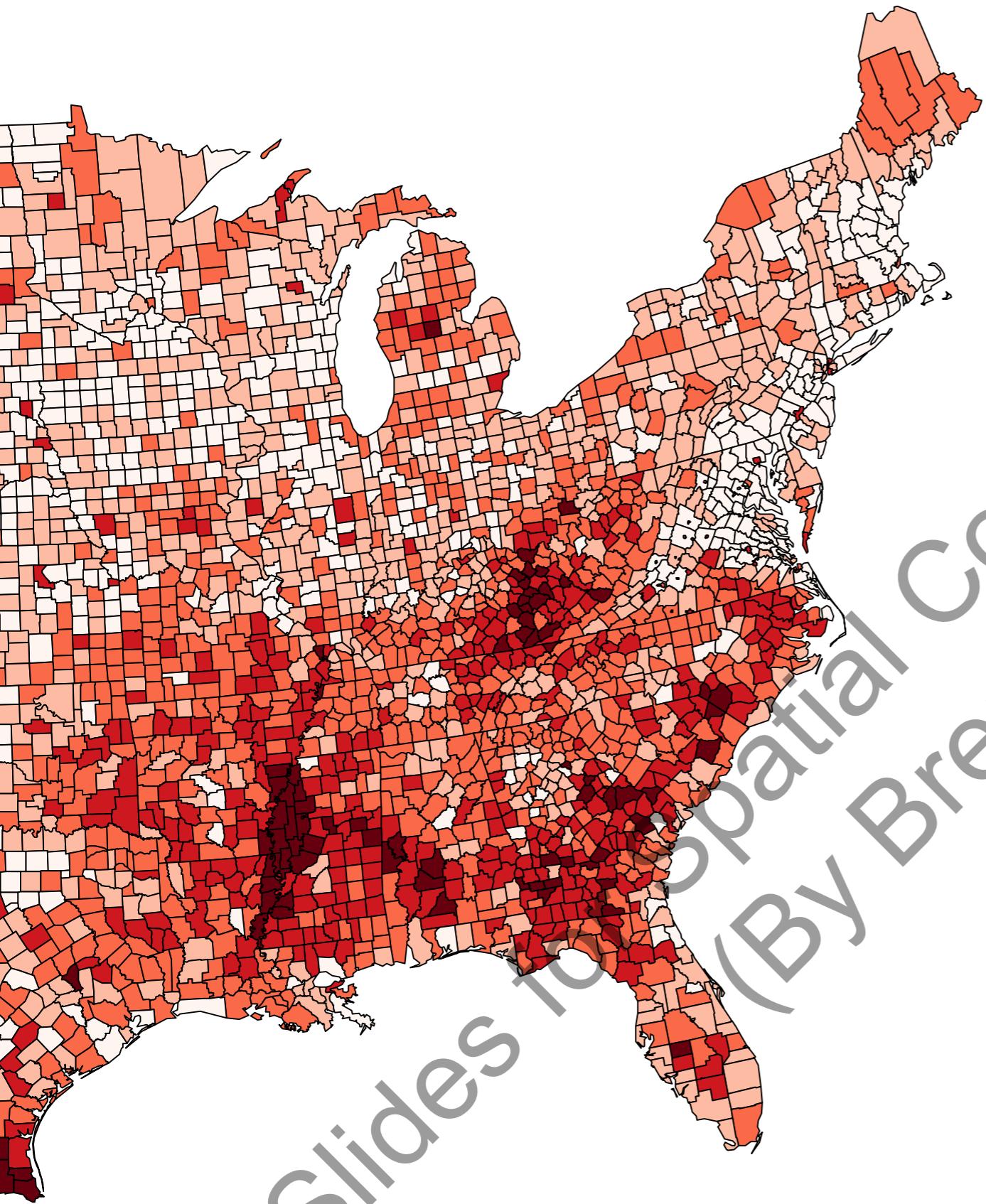
- HEX

#ffffd4
#fed98e
#fe9929
#d95f0e
#993404

Slides for MOOC

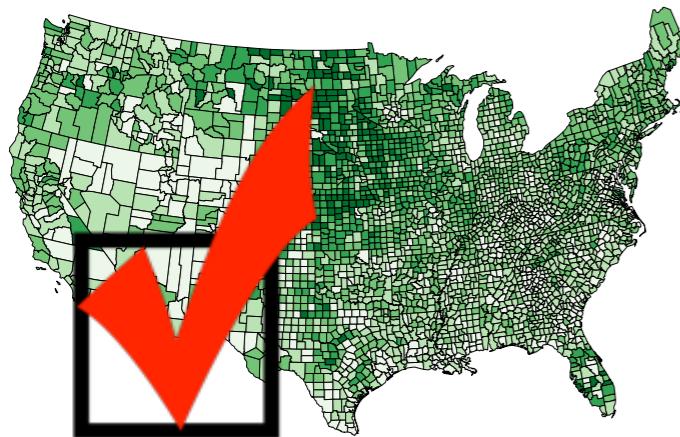
© Cynthia Brewer, Mark Harrower and The Pennsylvania State University

axismaps

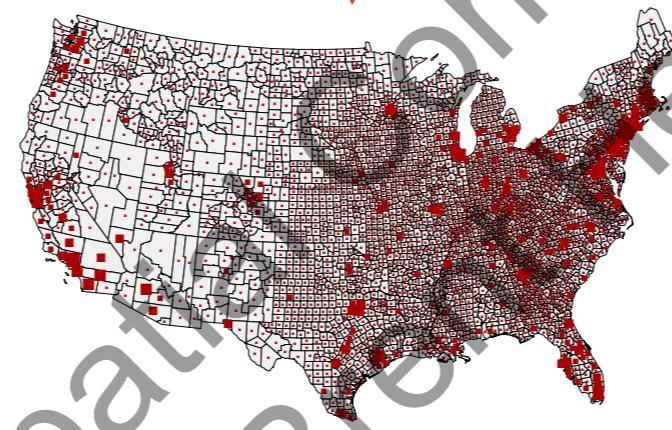


Slides for Spatial Computation MOOC
By Brent Hecht

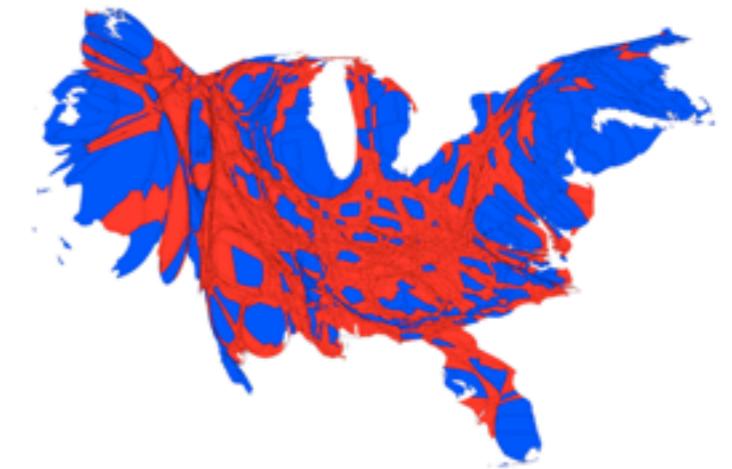
Types of thematic maps we're going to cover:



Choropleth



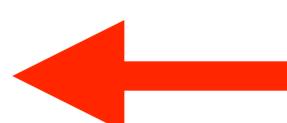
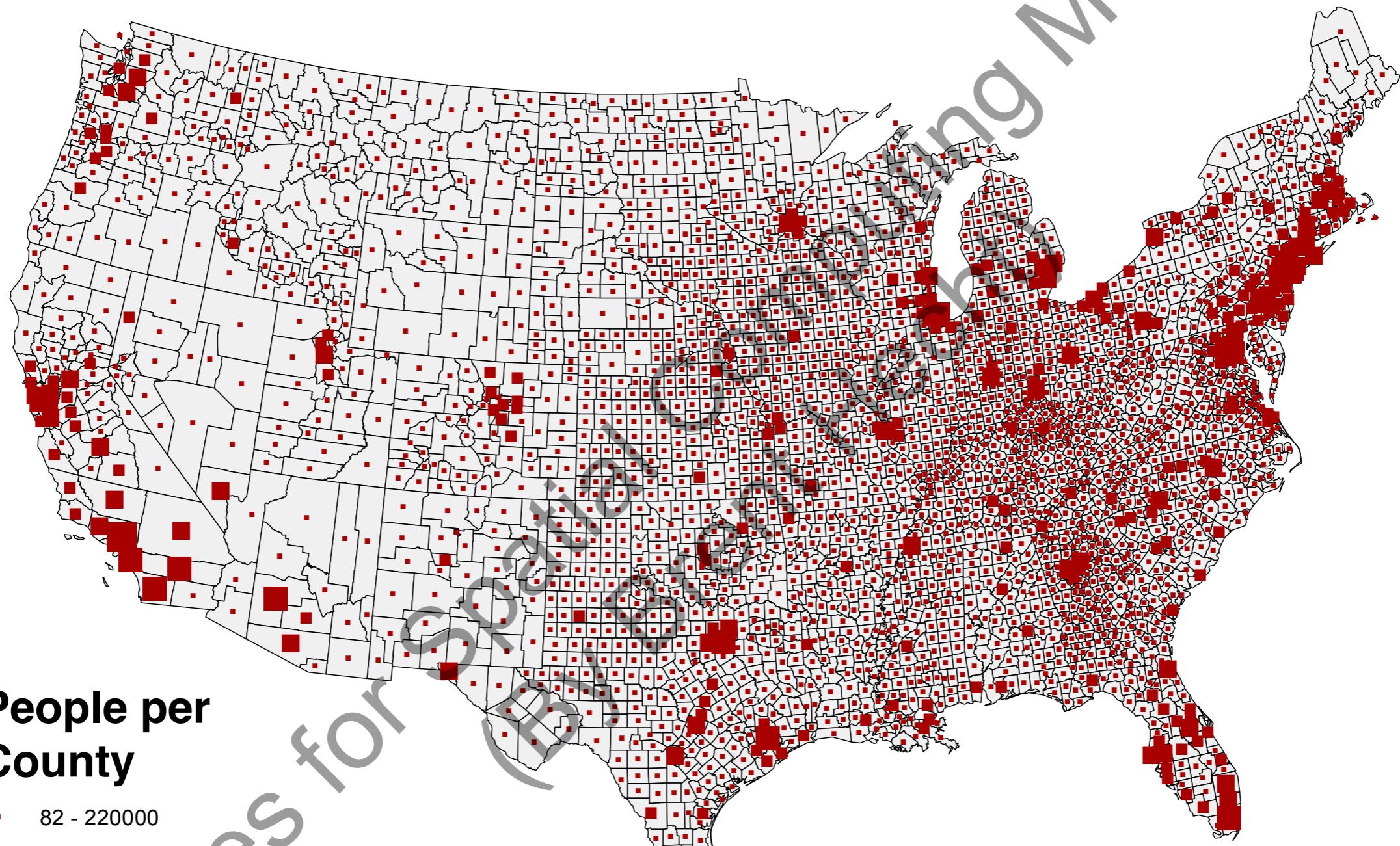
Graduated /
Proportional
Symbol



Cartograms

Population in the United States

Number of People per County



Data sources: U.S. Census, ESRI
Classification: Natural Breaks

Proportional Symbol Maps

Choropleth Maps

Graduated Symbol Maps

Unclassed Maps

Classed Maps

Natural Breaks

Quantile

Equal Interval

Std. Deviation

Pretty Breaks

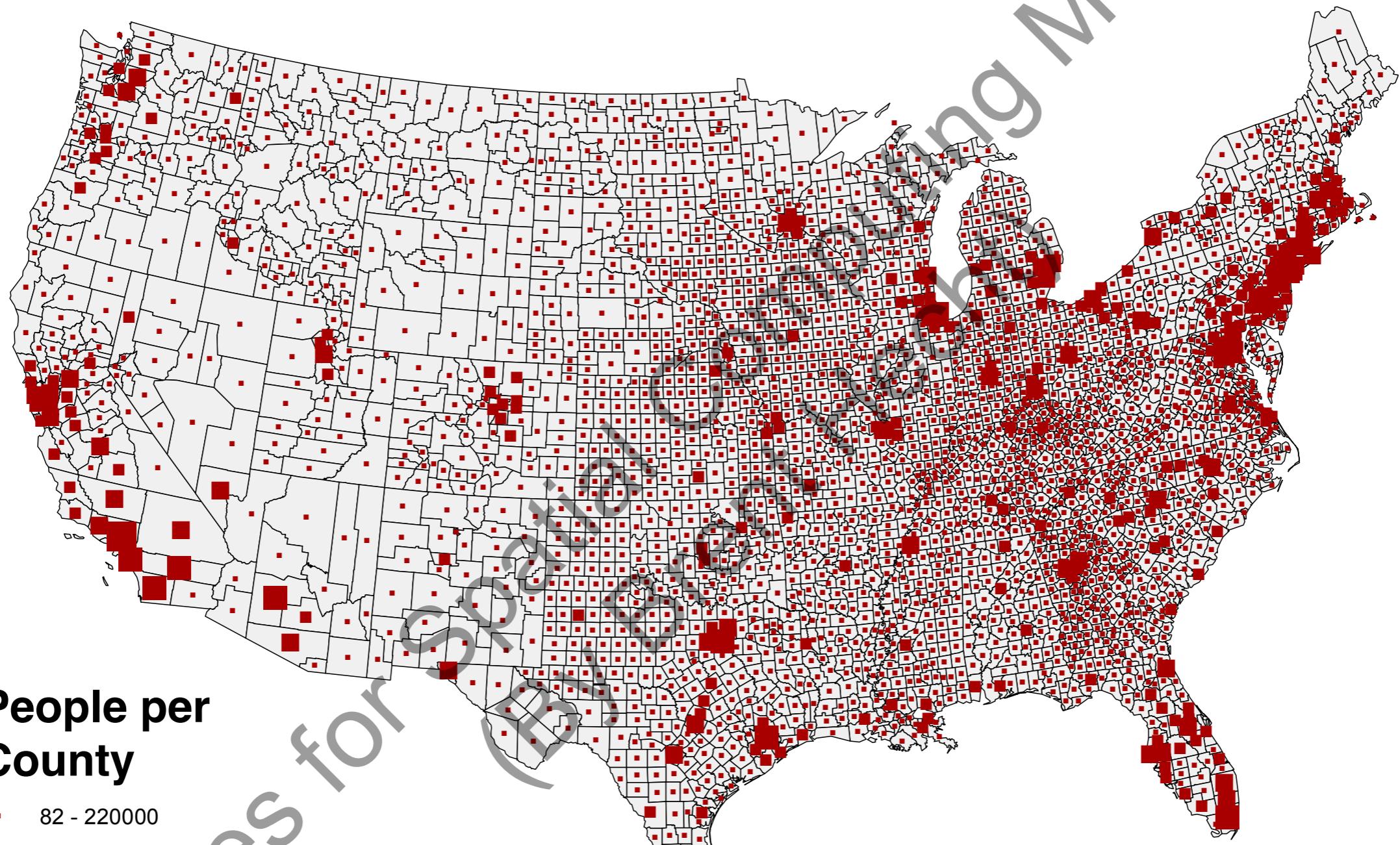
Defined Interval

Manual

Geom. Interval

Population in the United States

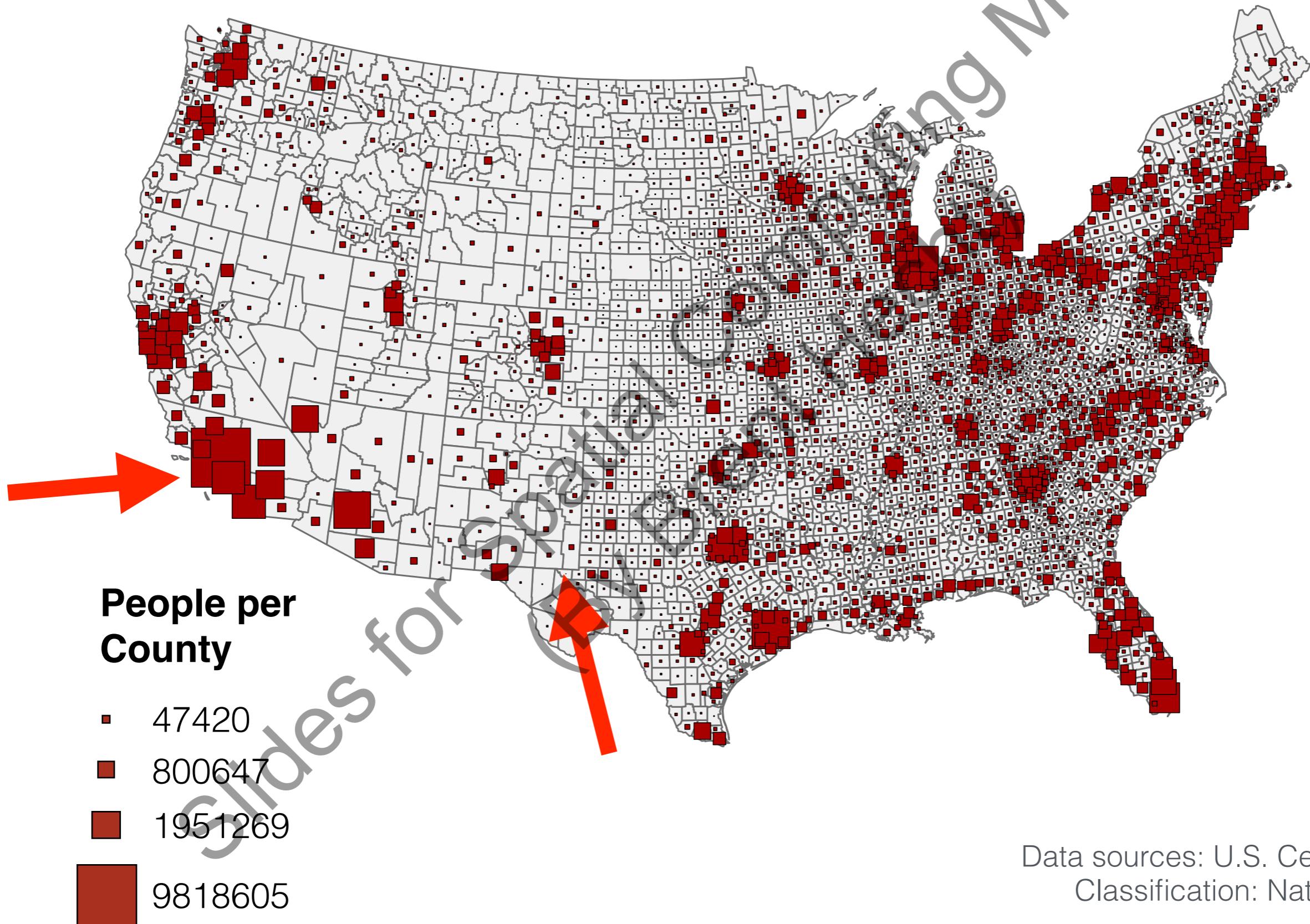
Number of People per County



Data sources: U.S. Census, ESRI
Classification: Natural Breaks

Population in the United States

Number of People per County



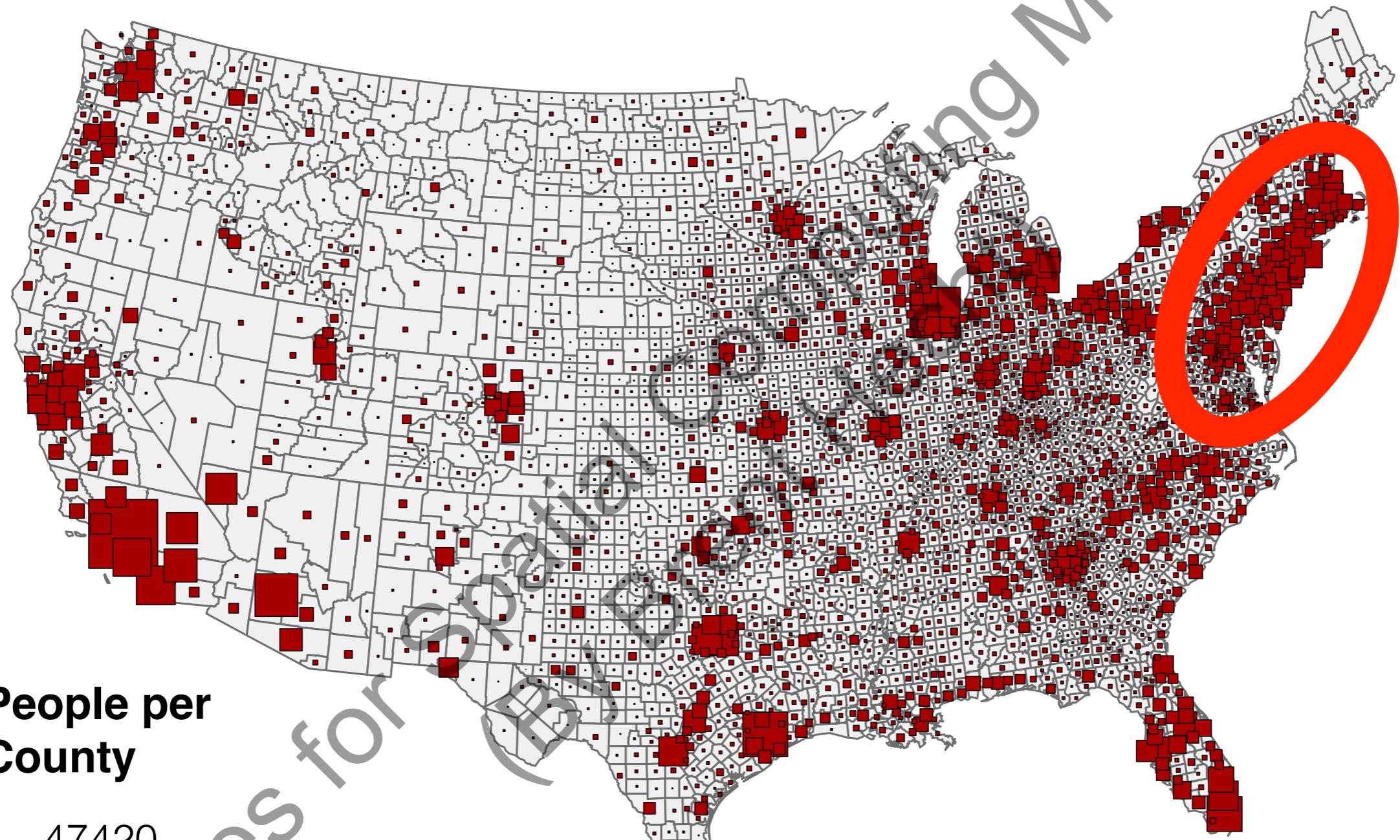
Pros and **cons** of graduated/proportional maps relative to **choropleth** maps:

Pro: Differences in size may be better than differences in color for some purposes

Con: Symbols overlap

Population in the United States

Number of People per County



People per County

- 47420
- 800647
- 1951269
- 9818605

Data sources: U.S. Census, ESRI
Classification: Natural Breaks

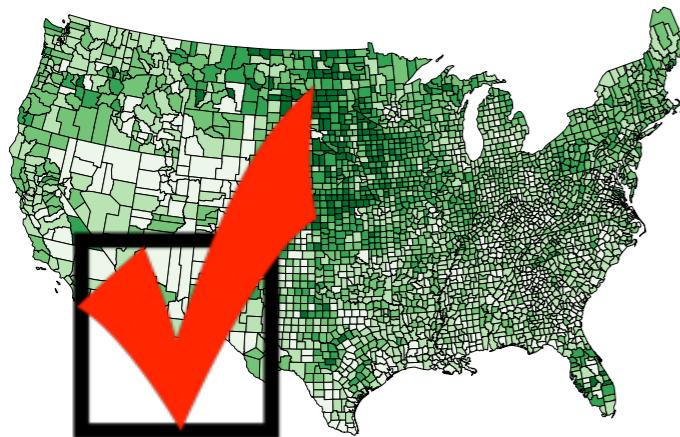
Pros and **cons** of graduated/proportional maps relative to **choropleth** maps:

Pro: Differences in size may be better than differences in color for some purposes

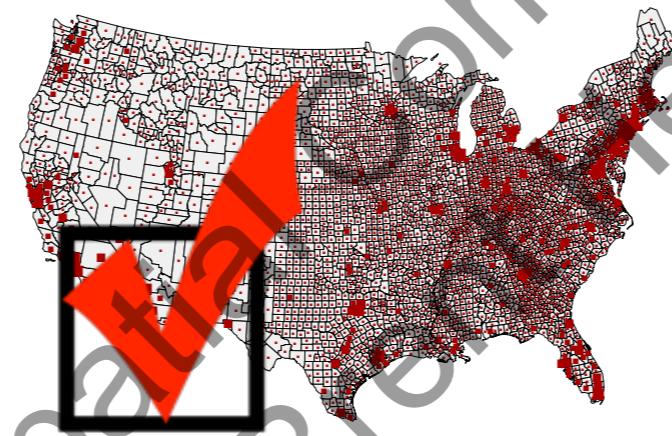
Con: Symbols overlap

Con: Confusing to use size for percentages, densities, etc.

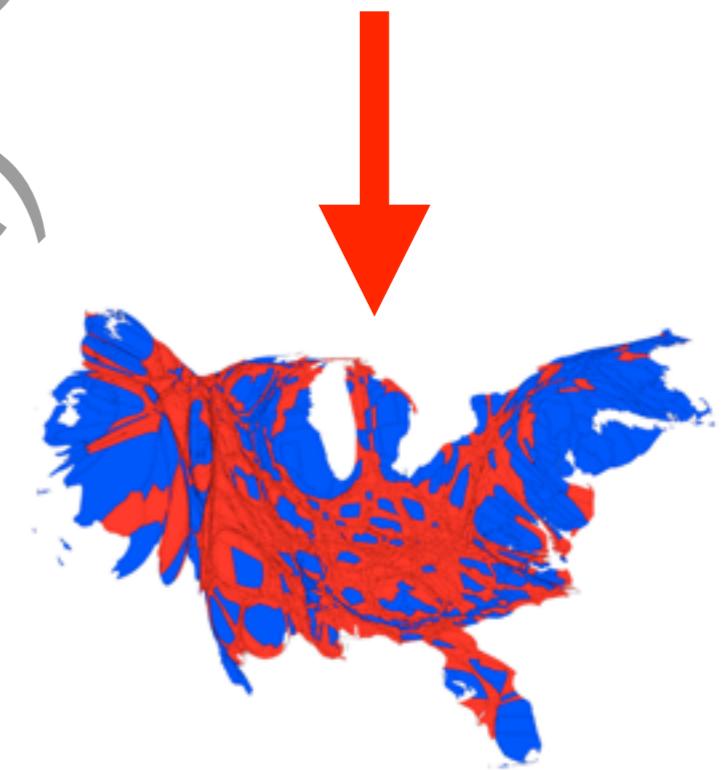
Types of thematic maps we're going to cover:



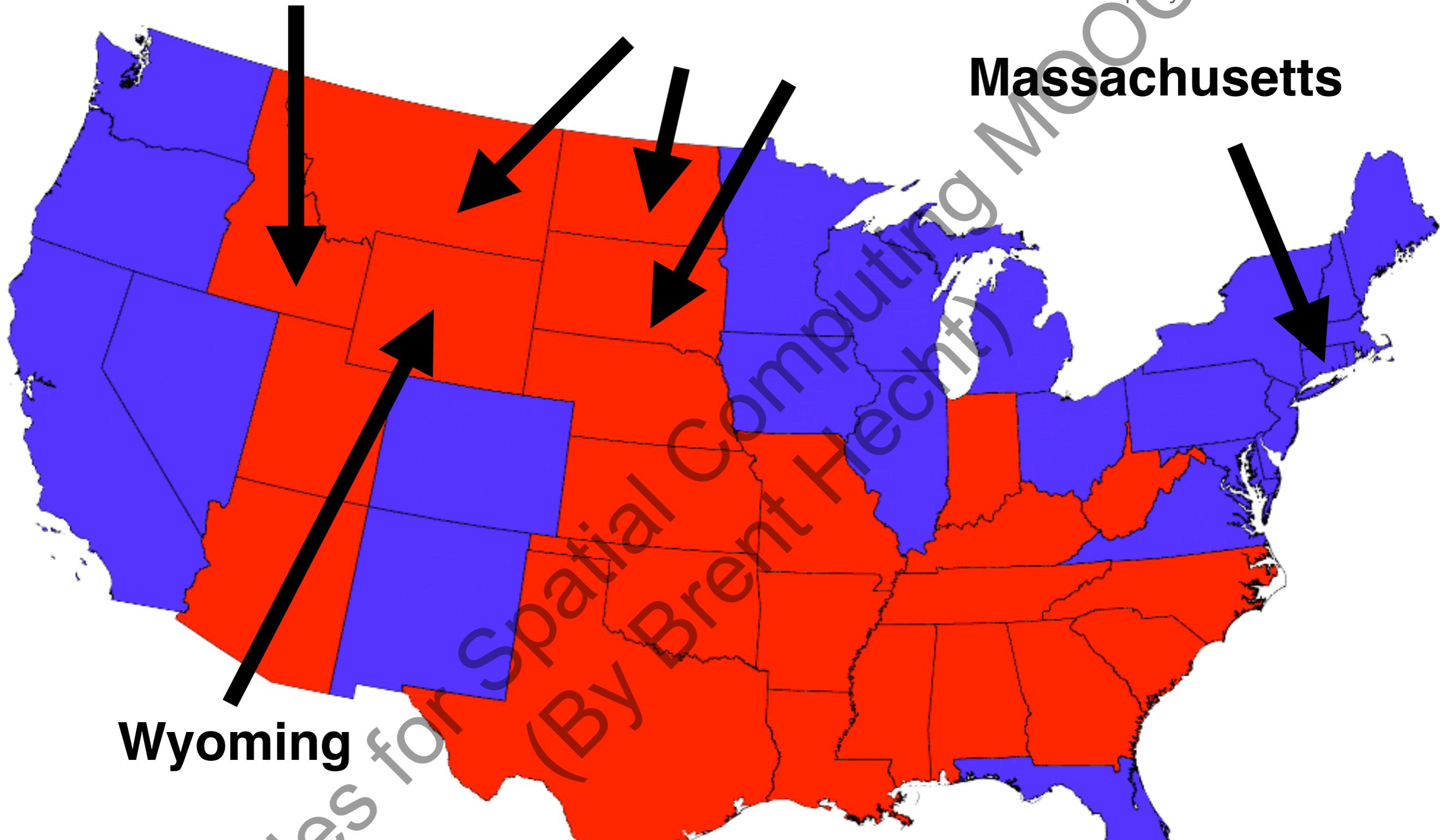
Choropleth



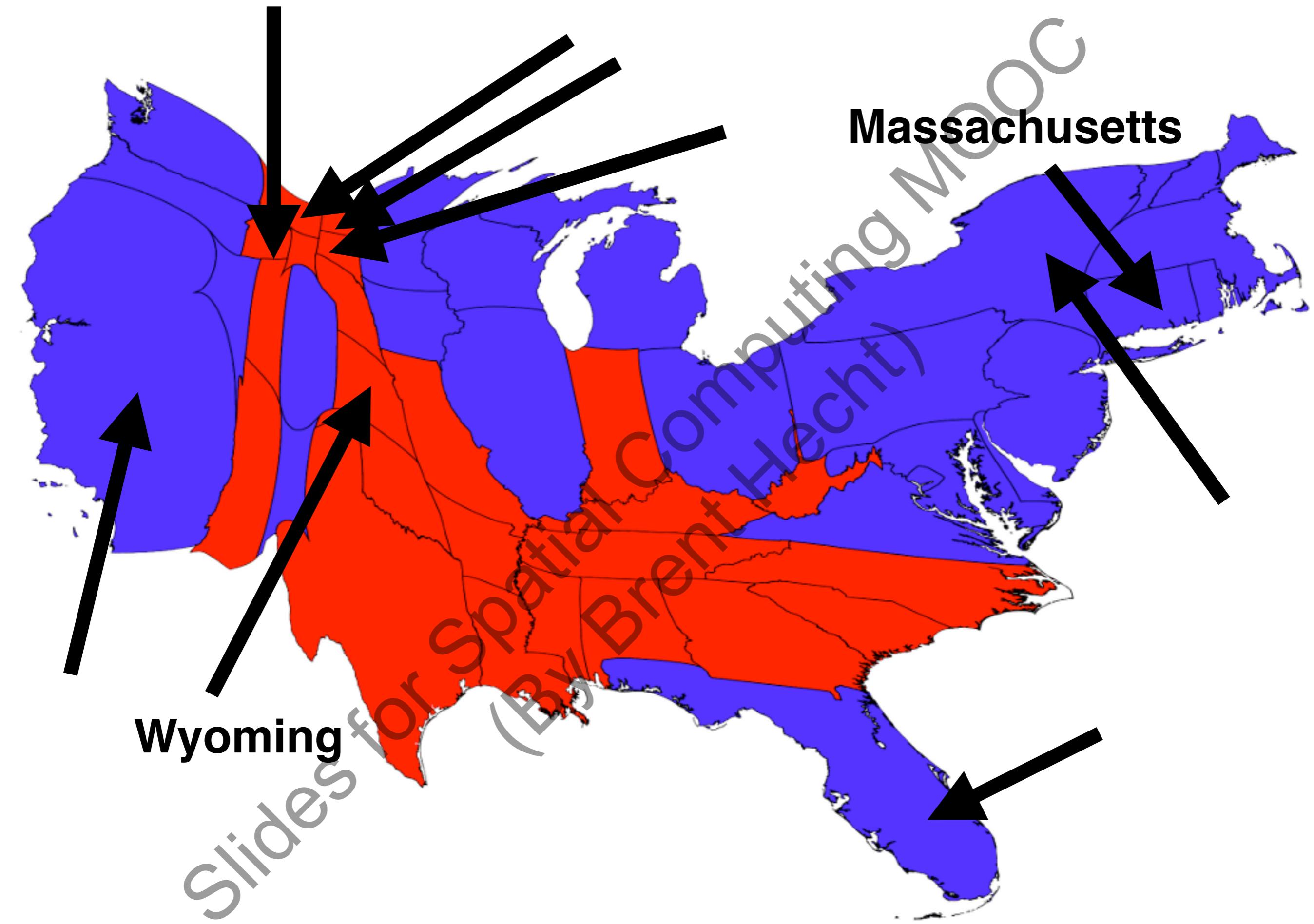
Graduated /
Proportional
Symbol



Cartograms

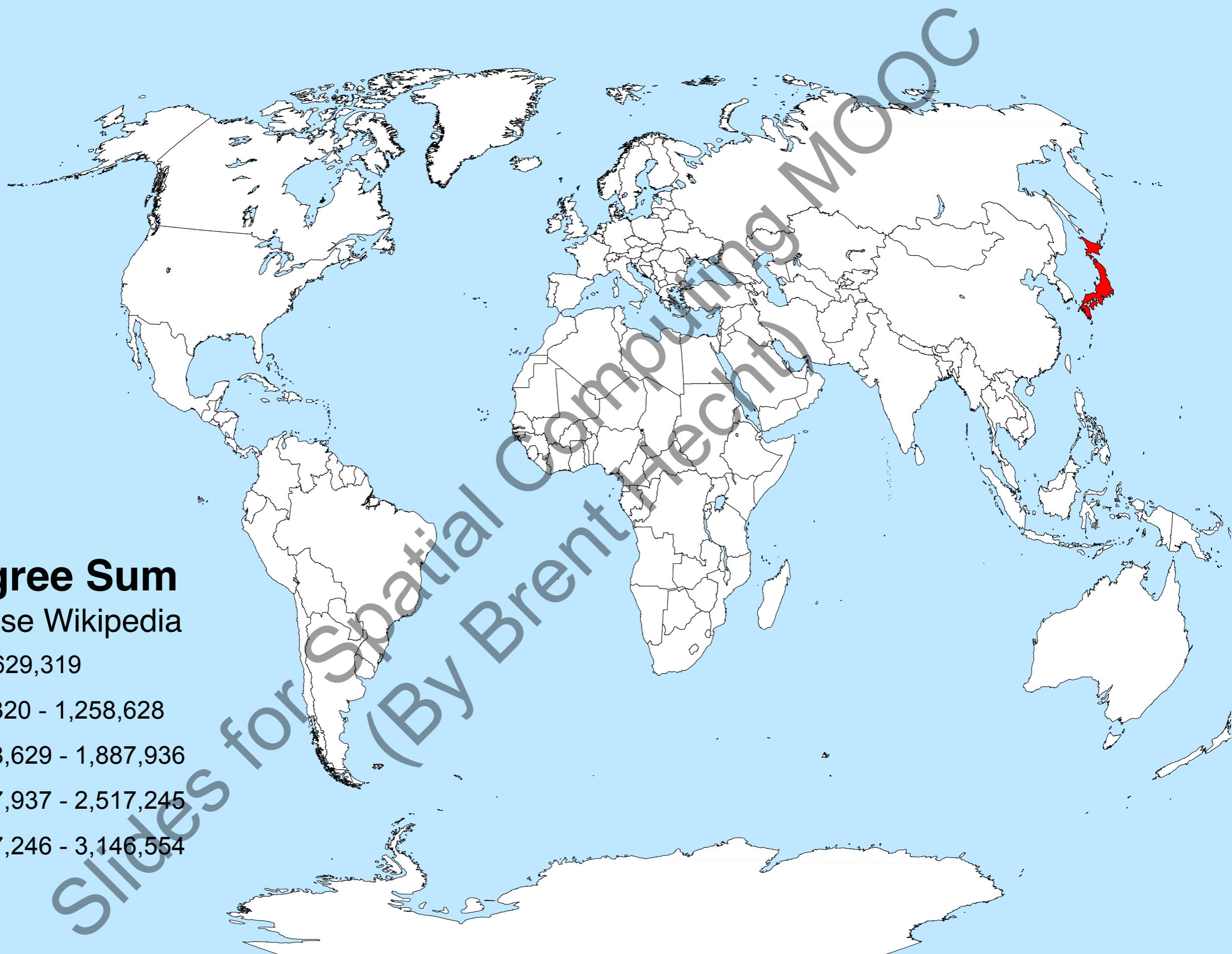
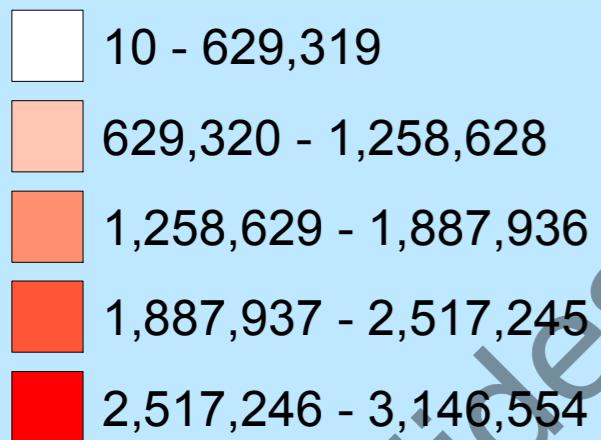


<http://www-personal.umich.edu/~mejn/election/2012/statemap1024.png>



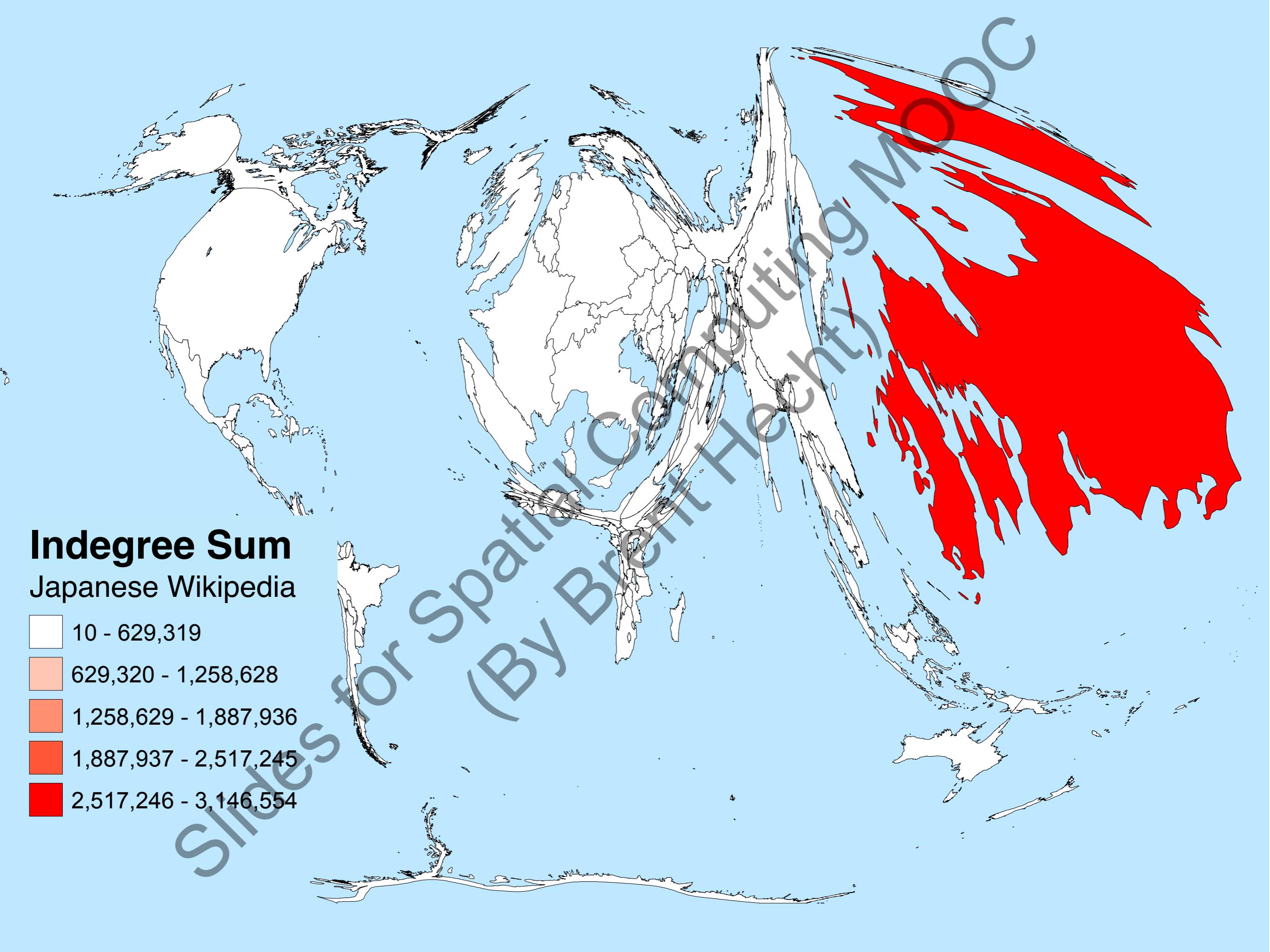
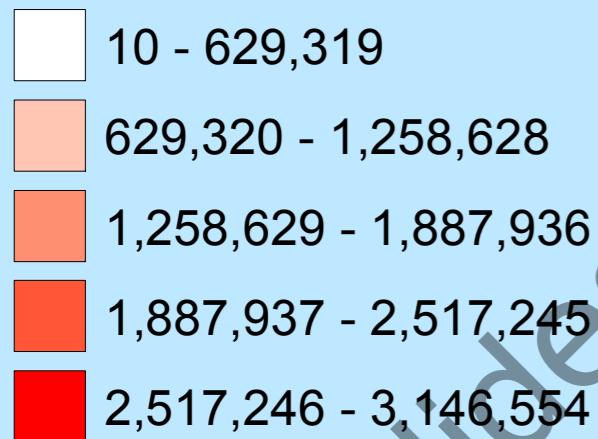
Indegree Sum

Japanese Wikipedia



Indegree Sum

Japanese Wikipedia



**THE ELECTORAL MAP. DRAWS A PATH TO VICTORY**[◀ Prev](#)[Next ▶](#)[Map](#)

1

2

3

4

5

6

7

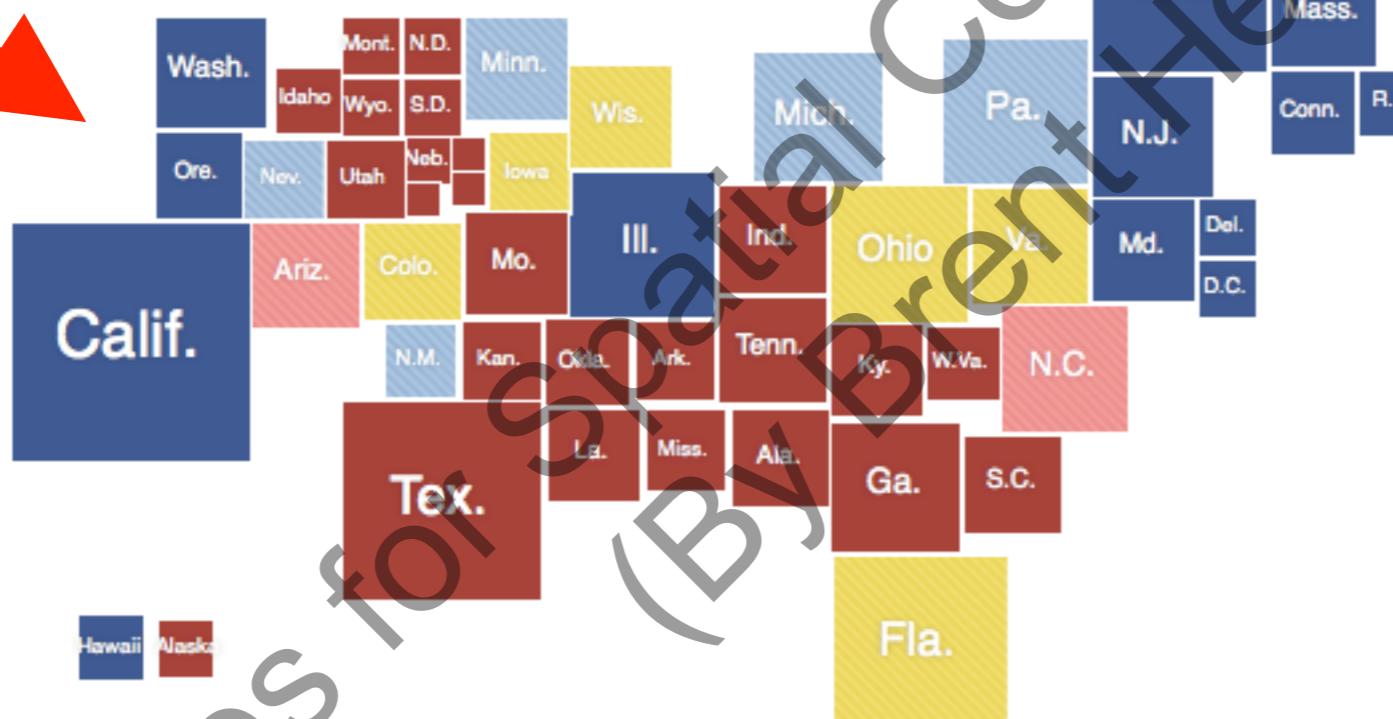
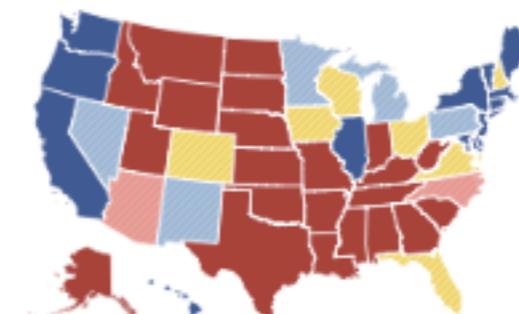
8

[Make Your Own Scenarios](#)*A New York Times assessment of how states may vote, based on polling, previous election results and the political geography in each state.***Obama****243**

ELECTORAL VOTES

Needs 27
to win**206****Romney**

ELECTORAL VOTES

Needs 270
to win**States sized by number of electoral votes****Geographic View****Leaning Democratic (6)****Maine**

Maine has largely slipped from the ranks of top battleground states, with Democrats winning here in the last five presidential elections. The

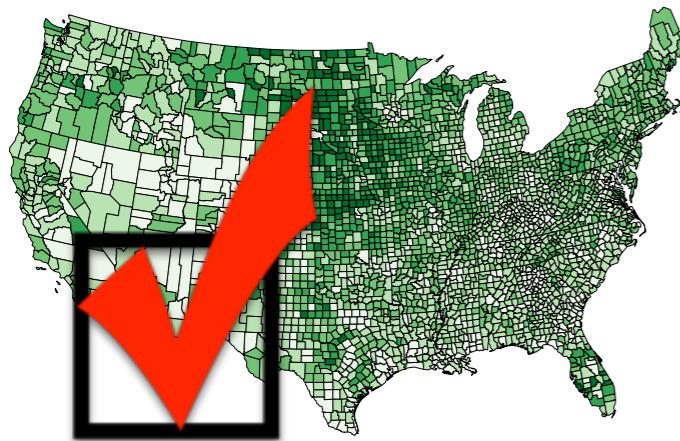
Tossup (7)**Colorado**

President Obama's victory in Colorado was among his most prized accomplishments in 2008, after the state had voted reliably

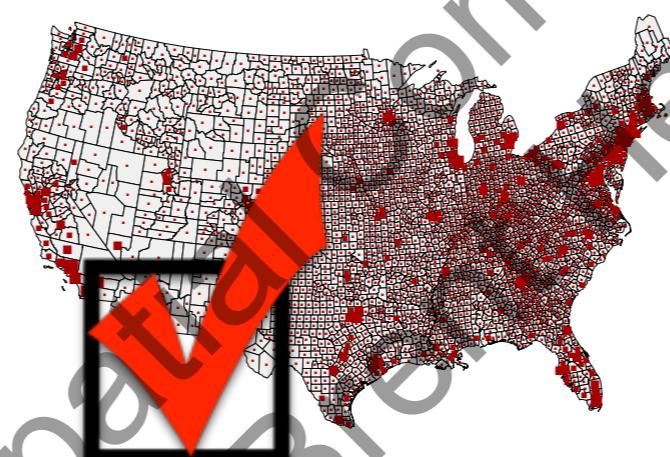
Leaning Republican (2)**Arizona**

The politics of Arizona are gradually shifting with its demographics. For now, Republicans believe their party has an advantage in presidential

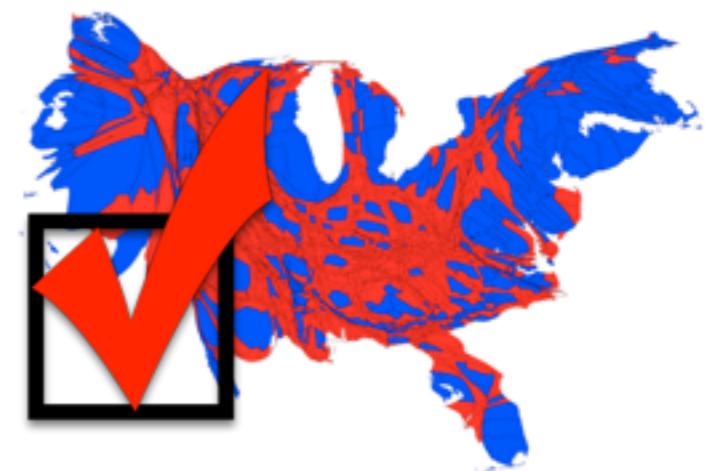
Types of thematic maps we're going to cover:



Choropleth



Graduated /
Proportional
Symbol



Cartograms

Dot Maps

2010 Census Block Data

1 Dot = 1 Person

- White
- Black
- Asian
- Hispanic
- Other Race / Native American / Multi-racial

<http://demographics.coopercenter.org/DotMap/>

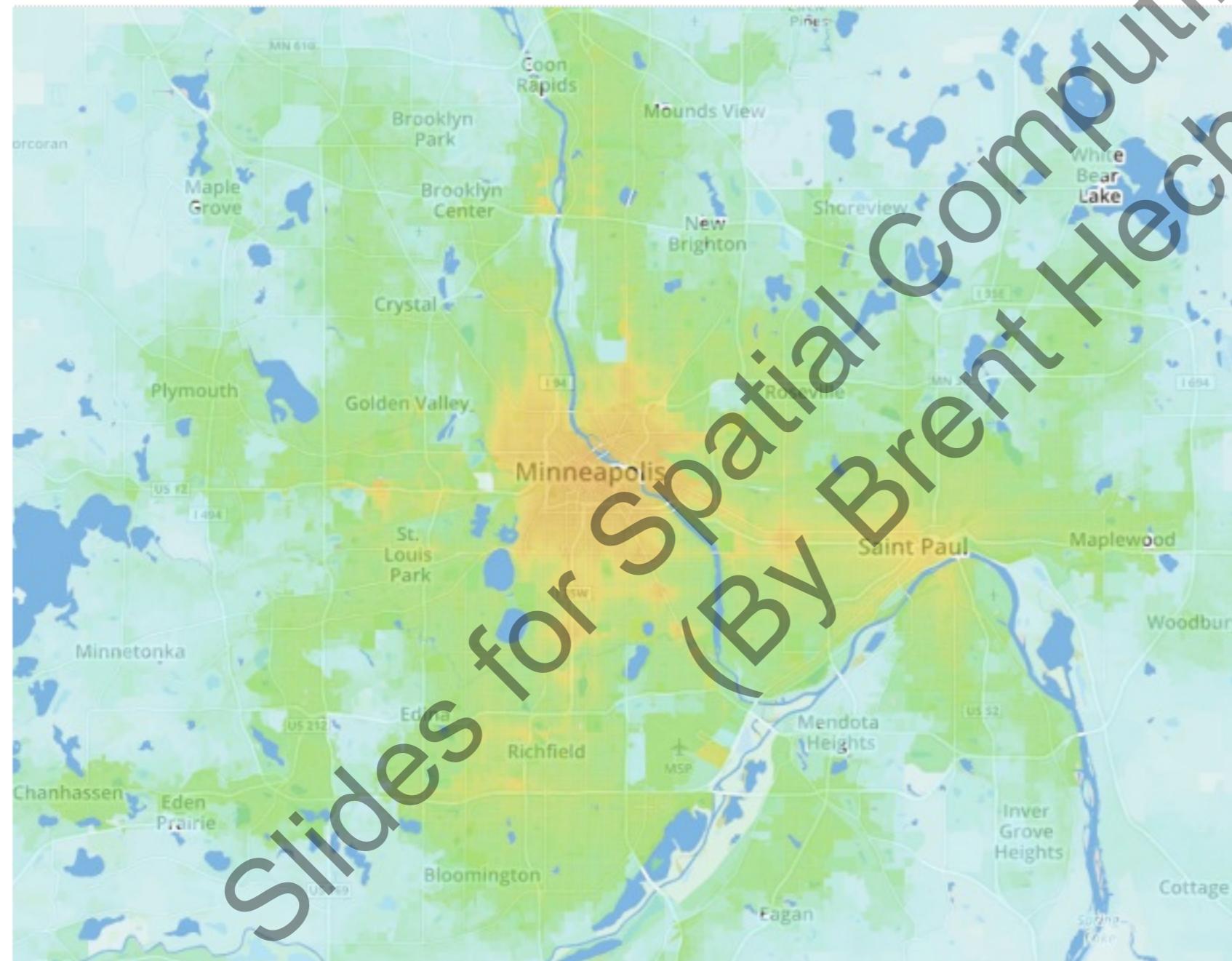
What am I looking at...?

MAP: The best places to commute

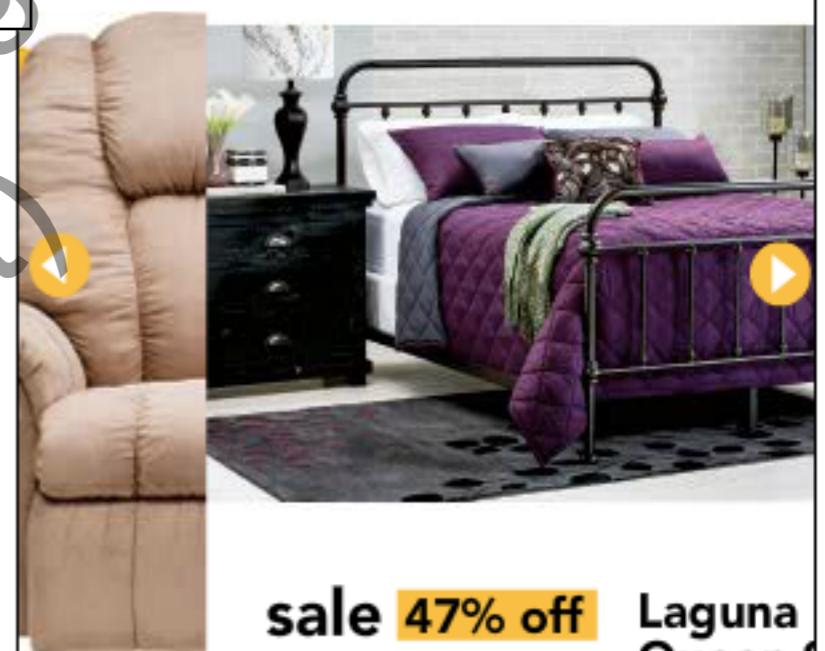
Posted by: Eric Roper | Updated: October 7, 2014 - 5

Heat Maps

[Share](#) 62 [Tweet](#) 20 [+in](#) 10 [Email](#)



EVERYTHING ON SALE!
Some exclusions.
UP TO 76% off!
list prices of advertised items



sale 47% off
~~\$298~~ \$249.99
Metal. Includes headboard, footboard
liner \$224.99

[SEE OUR AD »](#)

ADVERTISEMENT

recent posts

2 Minneapolis officers praised for saving man stabbed downtown

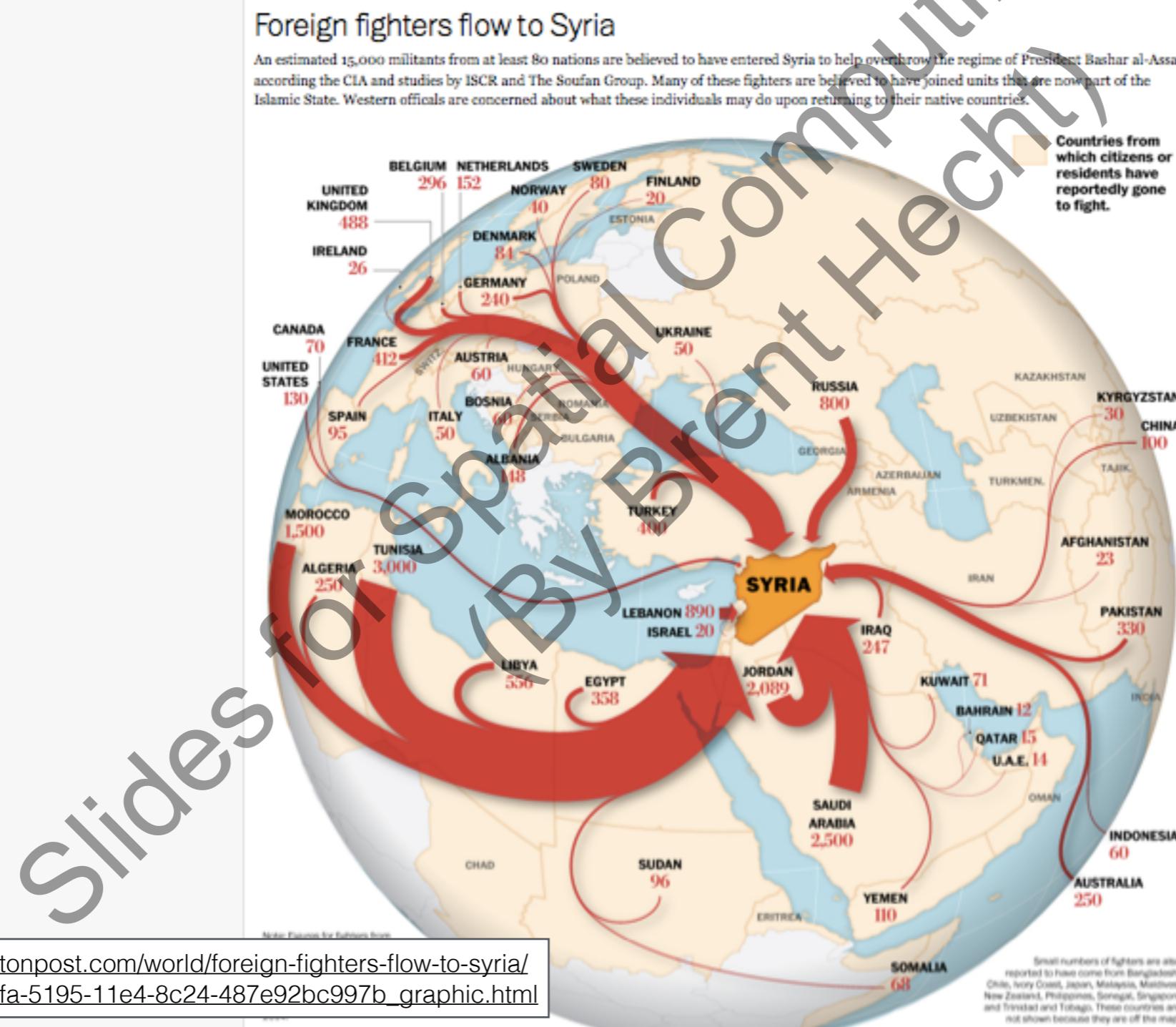
Man with dog shoots up 19 Bar, wounding two before fleeing

Minneapolis seeks high-rise for Nicollet Hotel



Foreign fighters flow to Syria

An estimated 15,000 militants from at least 80 nations are believed to have entered Syria to help overthrow the regime of President Bashar al-Assad according to the CIA and studies by ISCR and The Soufan Group. Many of these fighters are believed to have joined units that are now part of the Islamic State. Western officials are concerned about what these individuals may do upon returning to their native countries.



Cartography

Spatial Computing – University of Minnesota

Attributions

By Vladimir Menkov (Own work) [GFDL (<http://www.gnu.org/copyleft/fdl.html>), CC-BY-SA-3.0 (<http://creativecommons.org/licenses/by-sa/3.0/>) or CC-BY-SA-2.5-2.0-1.0 (<http://creativecommons.org/licenses/by-sa/2.5-2.0-1.0>)], via Wikimedia Commons