Lecture 7:
Maps, 2 of 2: How to Map Data

March 17, 2025

Course Administration

1. Sign up for consultations!
   - This week, Wed. and Thurs., in lieu of class meeting April 17
   - If more slots needed, let me know
2. In-class workshop April 7: handout online, linked under lecture 6
   - April 6, 3 pm: post rough drafts of graphs
3. Last Monday and Wed. of class – April 28 and 30 – are in-person presentations
4. Anything else?

Next Week's Assignment

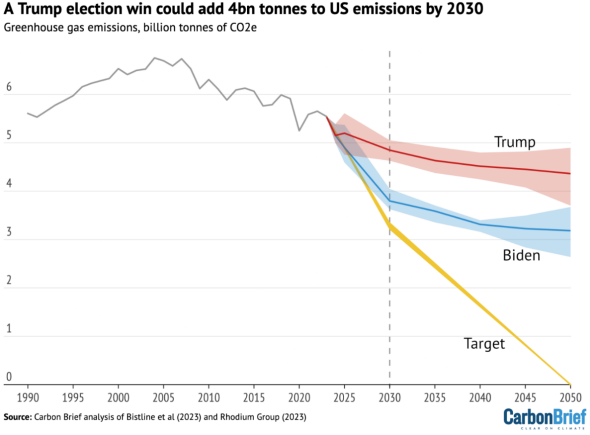
Find a choropleth or dot density or other data map.

Finder	Commenter
Caden S.	Cade D.
Maddie S.	Natalie W.

This Week's Good Bad and Ugly

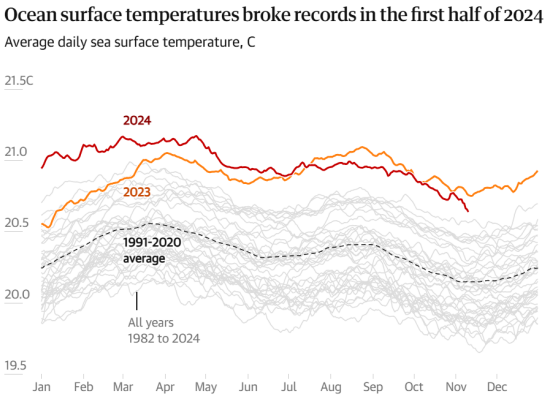
Finder	Commenter
Cade D.	Liz W.
Natalie W.	Caroline W.

Liz on Cades's Example: Greenhouse Gas Emissions



Analysis: Trump election win could add 4bn tonnes to US emissions by 2030, *Carbon Brief: Clear on Climate*, March 6, 2024.

Caroline on Natalie's Example: Changing Temperatures



Horton et al, "The climate crisis in charts: how 2024 has set unwanted new records," *The Guardian*, Nov. 20, 2024. [link]

Map Half of Lecture

A. Important choices for choropleth maps
B. Three types of maps
    1. Graduated symbols
    2. Dot density
    3. Choropleth
    4. Combination of count and intensity
C. Size versus intensity
D. Best practices
E. Goats

What You've Already Learned About Maps

- What a map is
  - projection
  - borders
- Use only if you want to convey a geographic relationship
- How to make maps in R: `sf`

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Today: more on how to show data in maps

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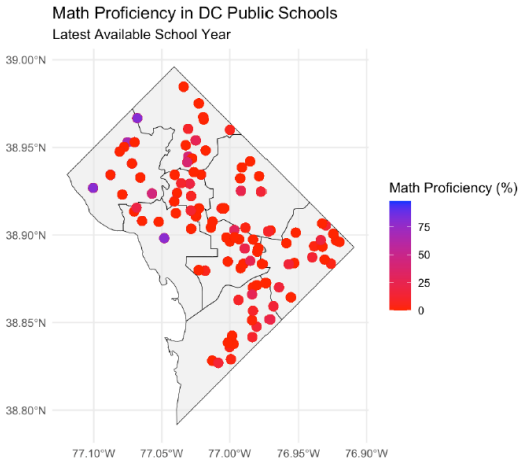

A. Five Big Choices

A. Five Big Choices in Presenting Data

1. "how many categories to use"
2. "how to make these categories reflect significant trends in the data"
3. "how to show progressive increases in intensity with an unambiguous series of graphically stable area symbols"
4. "how to describe the intensity variable clearly and concisely"
5. "how to link the symbols, classification, and intensity measurements with an informative, easily interpreted map key"

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Largely drawn from Mark Monmonier's *Mapping it Out: Expository Cartography for the Social Sciences*

A Pathway to Answers

Start with the point

- What question are you trying to answer?
- What point are you trying to make?
- Which parts of the distribution are important?

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And think about the data

- What question can your data answer?
- What level of aggregation does your point require?

B. Three Types of Maps

Three Types of Maps

1. Graduated symbols
2. Dot density
3. Choropleth

B.1. Graduated Symbols

- Use symbol of graduated size to convey size or number
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- Or at point location
- Used to convey absolute magnitudes – examples?

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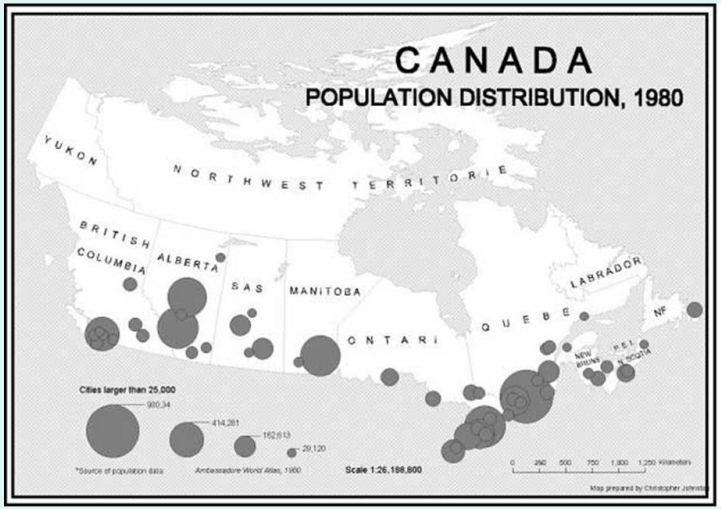
- Or at point location
- Used to convey absolute magnitudes – examples?
  - area
  - number of people
  - total home value

Graduated Symbol Example



Strengths and Weaknesses of Graduated Symbol Maps

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  - One of few methods for conveying absolute magnitude geographically
- Weaknesses
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  - 2-D size frequently not interpreted quantitatively appropriately

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Best for situations where you want to convey absolute, not relative, magnitude

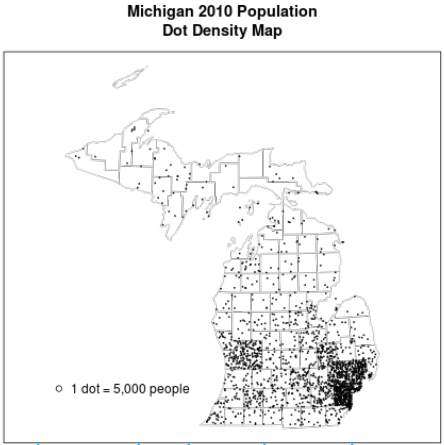
Best Practices for Graduated Symbol Maps

- Use them to convey magnitude
- Make symbols large enough to distinguish
- Be careful of overlap

B.2. Dot Density Maps

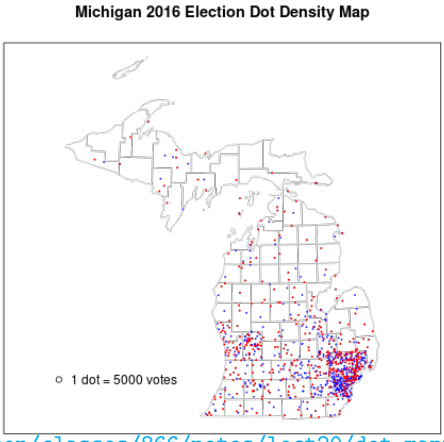
- Use dots within administrative unit polygons to represent magnitudes
- Similar to graduated symbol map, but can convey magnitude of more than one group
- Each dot can represent one unit, or can represent multiples, such as 10 people

Dot Density Example



From https://msu.edu/~ashton/classes/866/notes/lect20/dot_mapping.html

And With Two Variables



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Strengths and Weaknesses

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- Strengths
  - In my opinion, frequently better at conveying magnitude that graduated symbols
  - Can describe magnitude of more than one type
- Weaknesses
  - Conveys a geographic specificity to data that do not exist
  - May generate confusion with specific points

Dot Density Best Practices

- Use only when geographical granularity of data approximate granularity of depiction
- Use color as in our upcoming discussion of choropleth maps

B.3. Choropleth Maps

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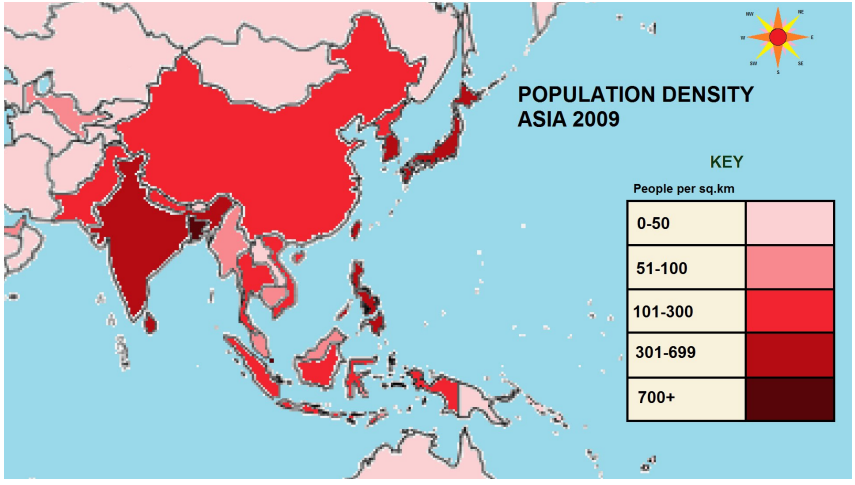
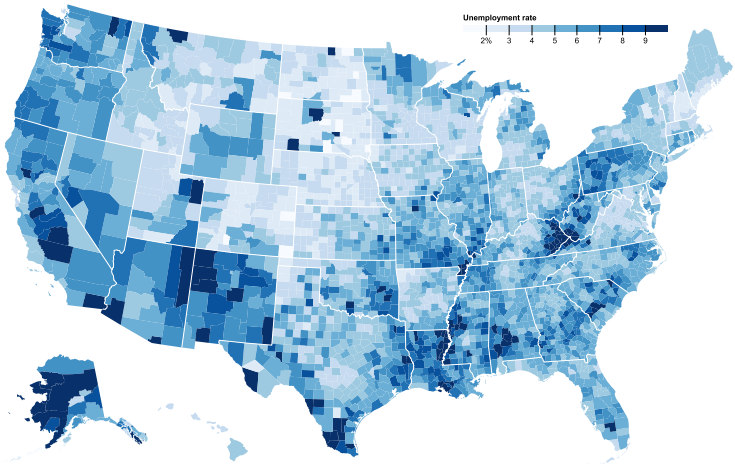
- Examples?
  - ACA adoption or not
  - type of procurement legislation

Choropleth with Intensity



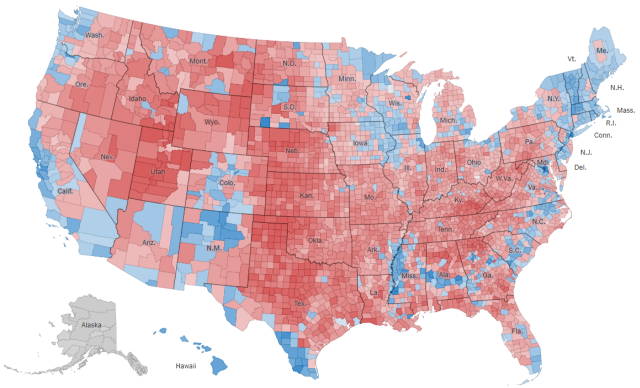
From https://www.youtube.com/watch?v=PkmAiINPdrI

Choropleth with Intensity



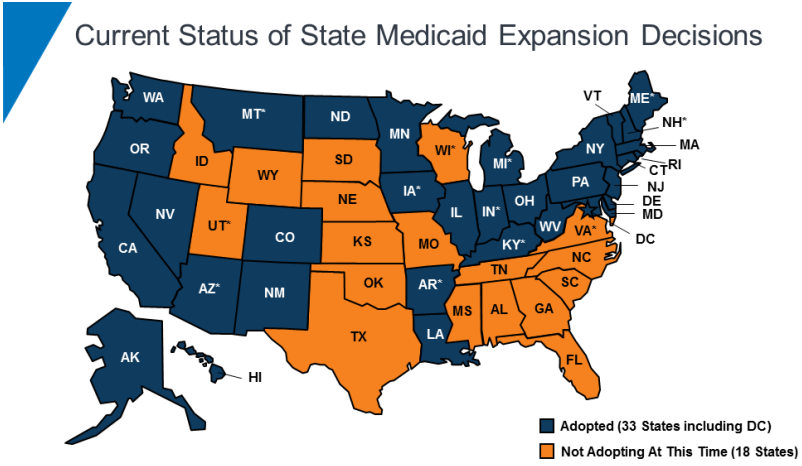
From https://bl.ocks.org/mbostock/4060606

Choropleth with Divergent Scale



From https://www.nytimes.com/2016/10/19/upshot/what-this-2012-map-can-tell-us-about-the-2016-election.html

Categorical Map



NOTES: Current status for each state is based on KFF tracking and analysis of state activity. *AR, AZ, IA, IN, KY, MI, MT, and NH have approved Section 1115 expansion waivers. VA is considering adopting expansion in their FY 2019 state budget and UT passed a law directing the state to seek CMS approval to partially expand Medicaid to 100% FPL using the ACA enhanced match; see the link below for more detail. CMS approved the Kentucky HEALTH expansion waiver on January 12, 2018; implementation will begin in April 2018. ME adopted the Medicaid expansion through a ballot initiative in November 2017; the ballot measure requires submission of a state plan amendment (SPA) within 90 days and implementation of expansion within 180 days of the measure's effective date; however, the governor failed to meet the SPA submission deadline (April 3). WI covers adults up to 100% FPL in Medicaid, but did not adopt the ACA expansion.

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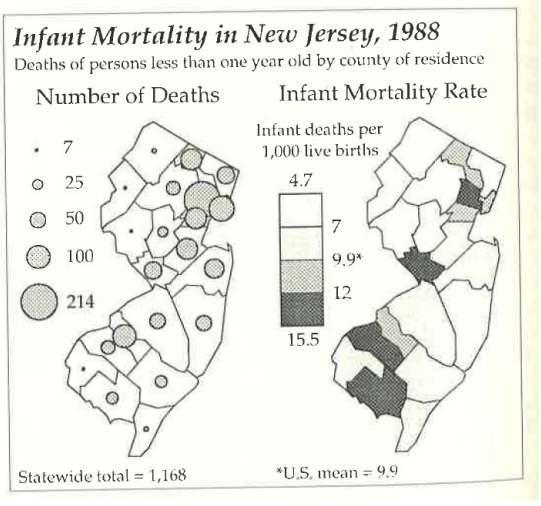
Best for situations where you want to convey relative, not absolute, magnitude; and for categorical definitions where space matters

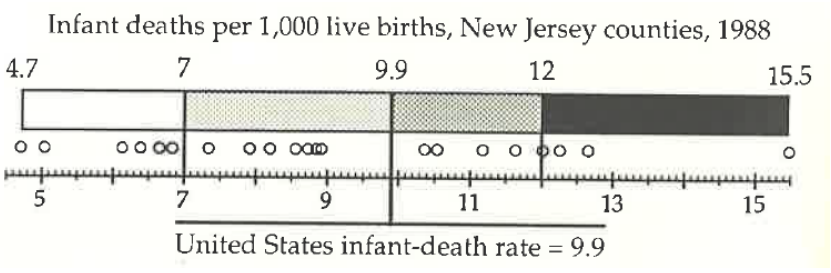
B.4. Combination of Count and Intensity Information



Monomnier, Figure 6.5

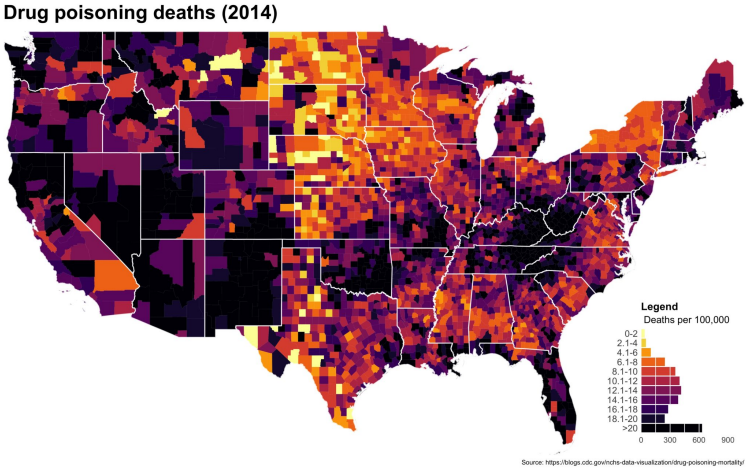
Better Yet, the Histogram Legend

What does this add that the choropleth cannot convey?



Monomnier, Figure 6.10

Another Histogram Legend



From https://mathewkiang.com/2017/01/16/using-histogram-legend-choropleths/

C. Size vs Intensity

Monmonier on Count vs. Intensity Data

- Monmonier says never use a choropleth map for count data
  - Why?

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  - Because size should be the "principle visual variable" for such maps
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Monmonier on Count vs. Intensity Data

- Monmonier says never use a choropleth map for count data
  - Why?
  - Because size should be the "principle visual variable" for such maps
- M. says use a choropleth for intensity
- Agree with overall sentiment, but not sure it holds in all cases

D. Best Practices

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1. Categories
2. Colors
3. Histogram legend
4. Worst practices

D.1. Categories

- 4 is great
- Don't use more than 5 or 6
- Use an intensity ramp only when
  - you care very little about the exact values
  - you care little about comparison between values

D.1. How to select categories?

Potential category types

- Equal interval
- Quantile
- Natural breaks

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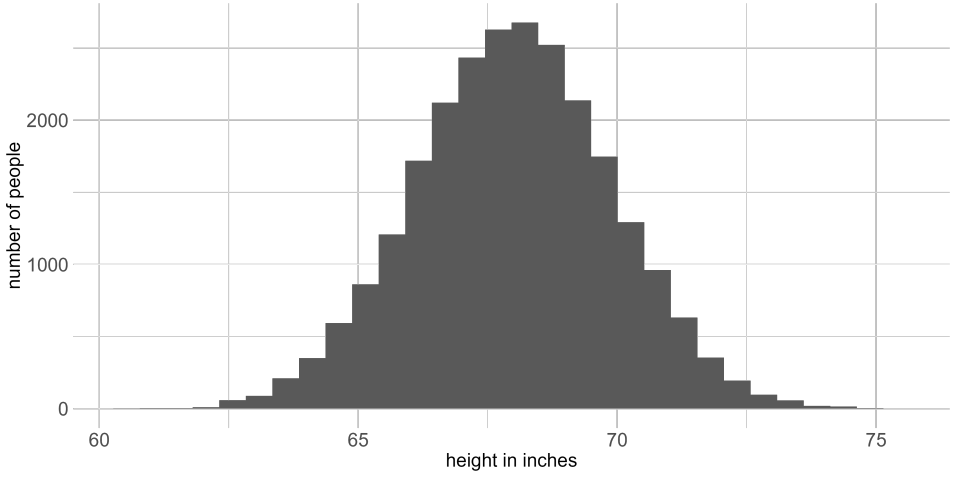
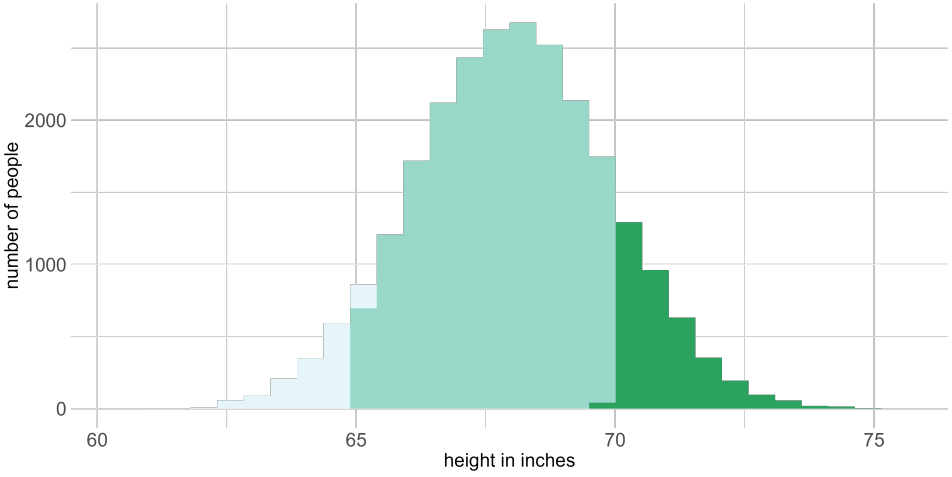
Use data to show example

- "synthetic" height data
- from Hong Kong
- based on real data
- documentation lacking

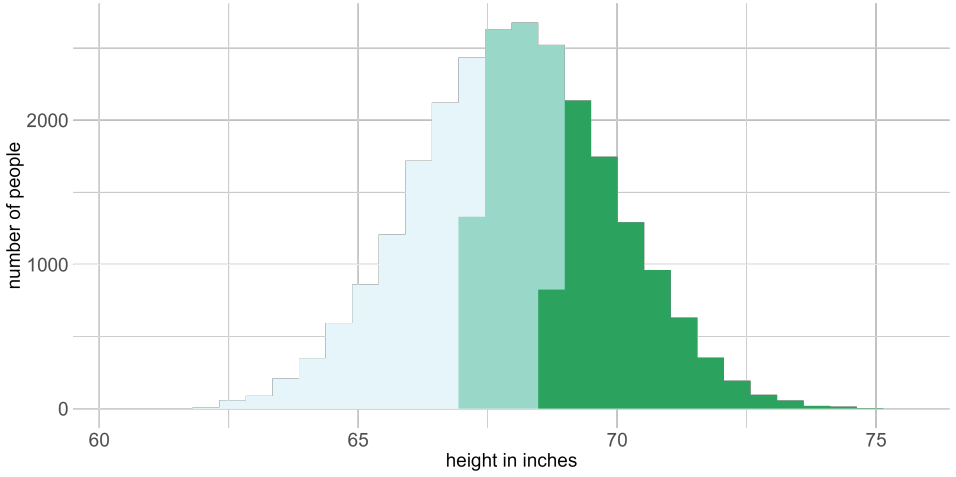
Histogram for Height



Is this Equal Interval or Terciles?



And Terciles



D.2 Colors

- Make the most intense color the largest value
- Avoid pattern fills if at all possible
- Make your legend a dot plot or histogram with the same colors
- Put anything else on map in a light color

Three Types of Color Fills

Categorical

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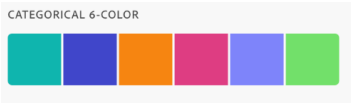

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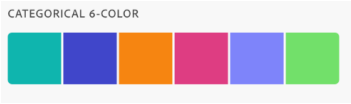

Sequential

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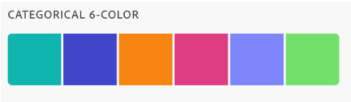

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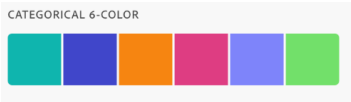

Sequential

Diverging

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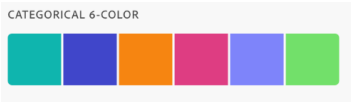
Categorical



Sequential

Diverging

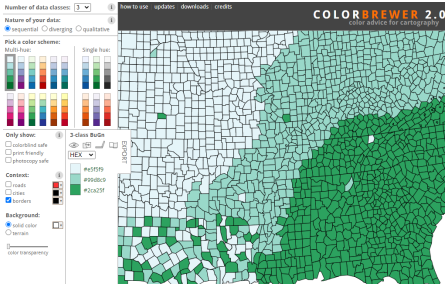
More Color Rules, From Adobe

1. Use categorical colors for categories, not ordered items
2. Use sequential colors for ordered items, not categories
3. Use diverging colors for ordered items where the middle matters
4. Don't use more than 6 categorical colors
5. Use darker colors for larger numbers

See full page on data visualization colors here

Use ColorBrewer

- Named after Cynthia Brewer
- http://colorbrewer2.org/
- You say
  - number of classes
  - sequential or divergent or qualitative
  - multi-or single hue
  - your preferred color
  - color-blind friendly?
  - screen or printer?
  - and more...
- and it gives you a color scheme!



D.3. Histogram Legend

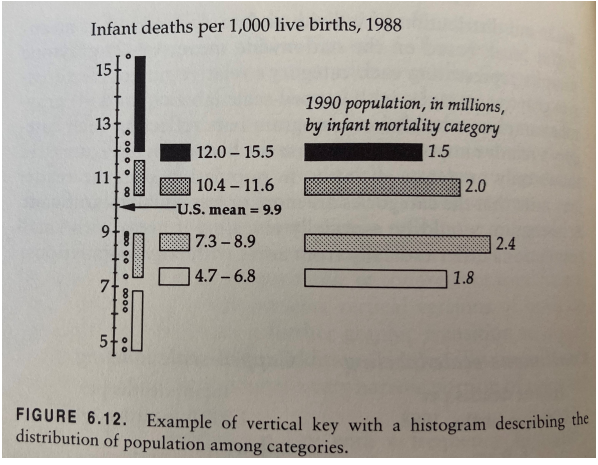


FIGURE 6.12. Example of vertical key with a histogram describing the distribution of population among categories.

Why is this even better than the previous?

D.4. Worst Practices

- Rainbow colors for classification
- Ones that are frequently bad ideas
  - Map total amounts
  - Map by geographic unit "geographic features that are continuous in nature"

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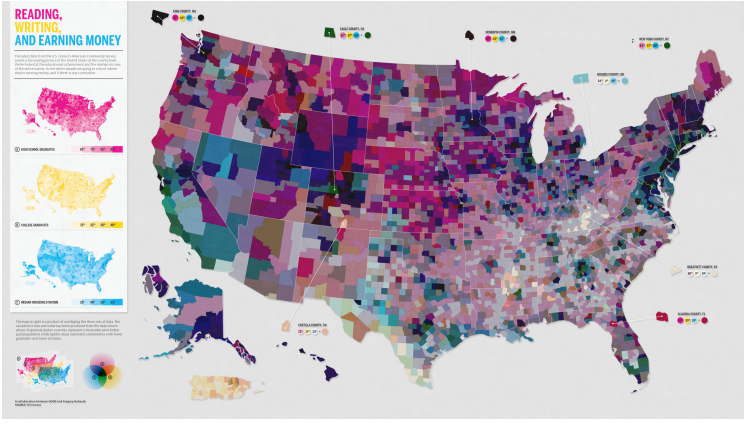
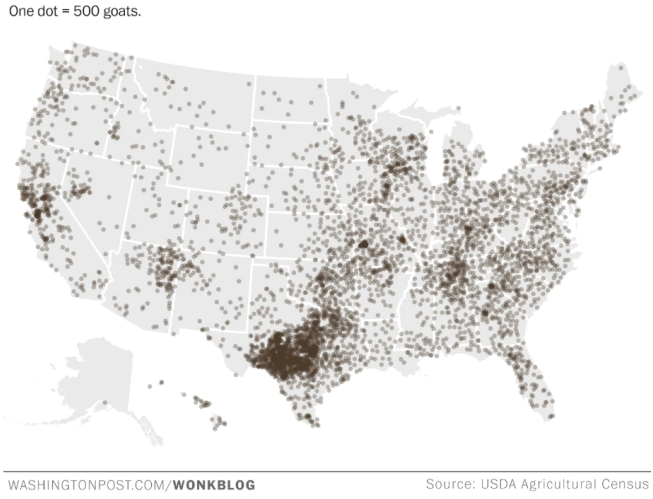
Beautiful Confusing Map



From https://gis.stackexchange.com/questions/3087/what-makes-a-map-be-classed-as-badly-designed

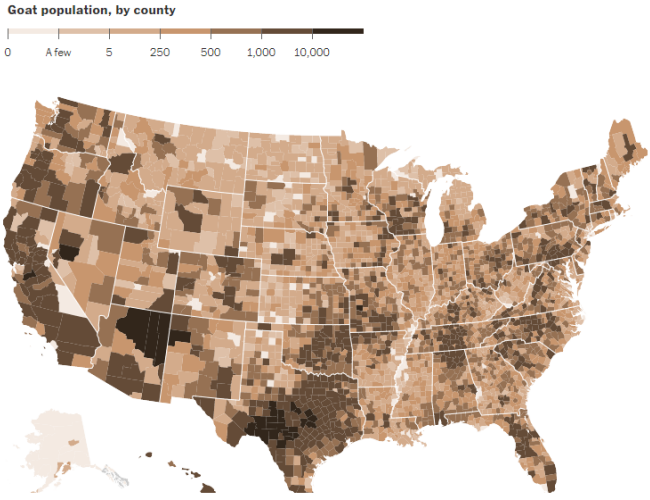
D. Think About Goats

"This is Literally Every Goat in the United States"



Except it is not! See WP article

Goats by County



See WP article

These Maps in R

Next Lecture

- Next week: No class – consultations later this week
- Next next week: Line charts
- Read
  - Few, parts of Chapter 10, pages 217-200, Chapter 13
  - Chang, Chapters 4 and 7