Lecture 5: Maps 1 of 2

Online Lecture

1. Maps in general
   - 1.1 What is a map?
   - 1.2 Why maps?
   - 1.3 When do maps deceive?
   - 1.4 Save for next map class: Choropleth maps and dot density maps
2. Digital maps
   - 2.1 What they are
   - 2.2 What they can do (in person)

What and Why of Maps

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- "almost always smaller" than reality
- in distilling reality, there are three key choices
  1. scale
  2. projection
  3. symbolization

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  - equivalence: size proportional to physical size
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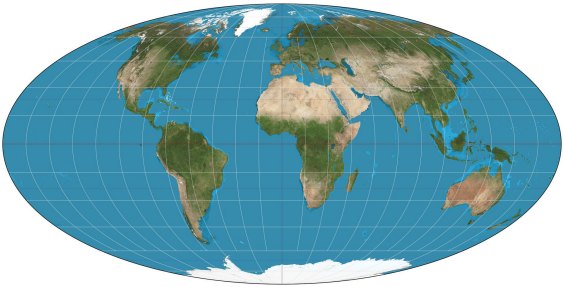
- But you cannot do both!
- When does this matter?
  - This matters for maps of the world
  - It is practically irrelevant for a map of DC
  - For small areas, we care about precision of distance
  - Frequently use a UTM (Universal Transverse Mercator) projection: units in meters

Rules of Thumb for Projections for Medium Areas

- Monmonier (p. 45) suggests for US either
  - Albers equal-area conic
  - Lambert conformal conic
- However, most maps you use should come with a projection defined

An Equal-Area Projection

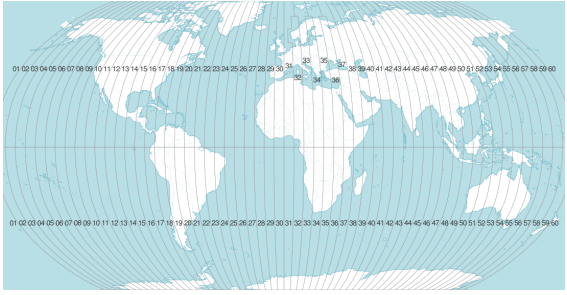


Thanks, Wikipedia.

The USA Four Ways

Thanks to Michael Corey.

UTM Zones



For small areas, use UTM projection if you need to calculate distances. Each number is a zone.
Thanks to Michael Corey.

2. Why Maps?

- Use a map when you want to show a **spatial** relationship
- Don't use a map if you want to compare geographic units

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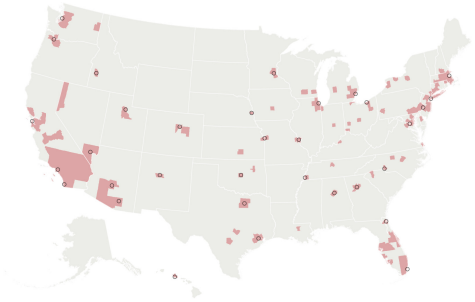
Don't use a map if you can do something simpler!

3. Why Avoid Maps?

- They add complexity
- Geographic unit size infrequently related to importance
  - but remember that size indicates value
  - problematic!
- Examples?

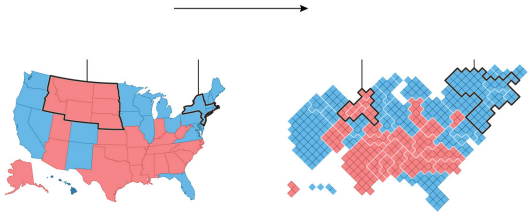
Red and Grey Areas Have About the Same Number of Votes Cast in 2012



With many thanks to the Washington Post

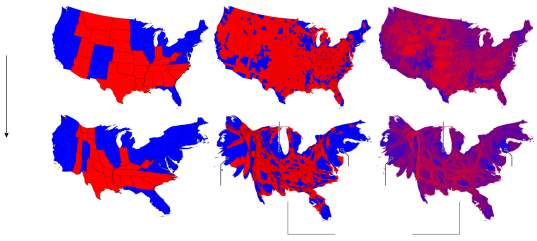
One Possible Solution

- A "cartogram" sizes locations by something: votes or people or electoral votes
- Five red midwestern states correspond to red block
- Mid-Atlantic corresponds to blue block

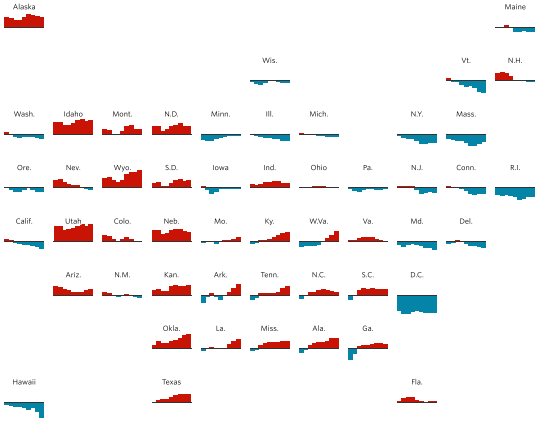


Another Possible Solution

- Thanks to U of Michigan physicist Newman
- Columns are state winner, county winner, county shaded by popular vote share
- Top is real map, bottom is cartogram
- Leftmost sized by electoral votes, others by votes cast



And a Quasi Map



Thanks to the Wall Street Journal, here.

Digital Maps

1. Digital Maps Have

- Units defined by coordinates in space
- Data for each unit

Examples of a map unit of observation, please!

Digital Maps

- A map is a representation of space
- A digital map is a file that tells a computer how to do this
- There are many formats, but we'll focus on shapefiles
- Shapefiles are a ArcInfo format, but can be read in R

Three Major Types of Shapes for Maps

1. points
2. lines
3. polygons

Points in Space

- location 1: (x, y)
- location 2: (x, y)
- location 3: (x, y)

What would you represent with points?

A Points Dataframe Example

LibID	X	Y	Name	Books
Ana	38.866	-76.980	Anacostia	500
CV	38.889	-76.932	Capitol View	501
Gtn	38.913	-77.068	Georgetown	499

Lines in Space

- location 1: $(x_1, y_1), (x_2, y_2)$
- location 2: $(x_1, y_1), (x_2, y_2)$
- location 3: $(x_1, y_1), (x_2, y_2)$

What would you represent with lines?

A Lines Dataframe Example

Int	X1	Y1	X2	Y2	Name	Condition
495	45	-62	26	-62	I495W	good
695	23	-50	25	-50	I695S	poor
10	15	-23	18	-24	I10	excellent

Polygons in Space

- location 1: $(x_1, y_1), (x_2, y_2), (x_3, y_3), (x_4, y_4), (x_1, y_1)$
- location 2: $(x_1, y_1), (x_2, y_2), (x_3, y_3), (x_4, y_4), (x_5, y_5), (x_1, y_1)$
- location 3: $(x_1, y_1), (x_2, y_2), (x_3, y_3), (x_1, y_1)$

Note that last point is the same as the first point.[1]
What would you represent with polygons?

[1] Polygons can have holes; we can talk about this.

A Polygon Dataframe Example

Triangle	X1	Y1	X2	Y2	X3	Y3	X4	Y4
a	1	1	1	2	2	1	1	1
b	1	1	1	3	3	1	1	1

But Where Do the Points Go?

- A map file needs some instructions on what the points mean
- We are not drawing on a globe, so we need some way of taking true coordinates and making them flat: projection
- Map makers define coordinate systems so that everyone agrees on what $(x_1, y_1), (x_2, y_2)$ means
- Coordinate systems have a defined unit of measurement: meters, feet, decimal degrees
- There are two major types of systems
  1. geographic/global/spherical system: in latitude/longitude
  2. projected coordinate system: in terms of meters/feet/miles

Implications for Mapping

- You can't put maps with two different coordinate systems on top of each other
- Easier to calculate distances and areas with projected coordinate systems
- You can go from one projection to another, but **use the right command**
- Digital maps usually come with a projection defined