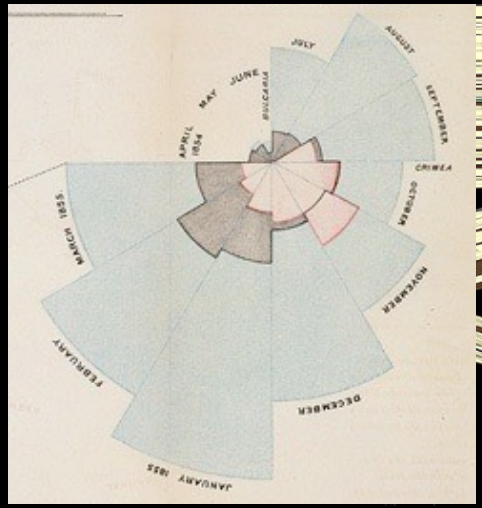
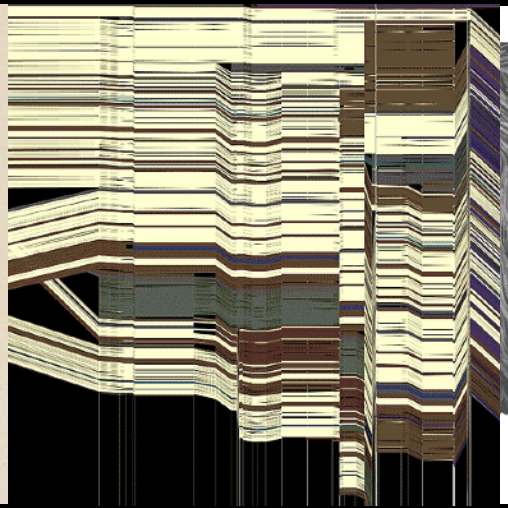
CSE P 590A - Data Visualization

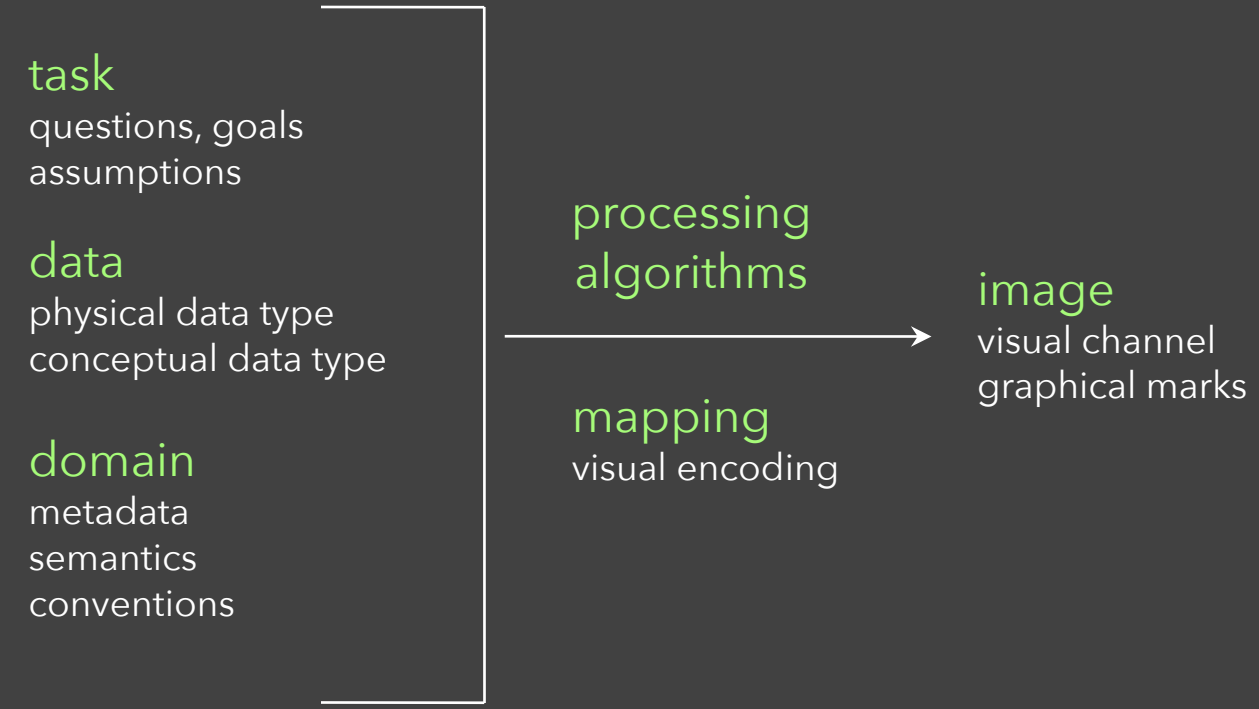
Visual Encoding





Jeffrey Heer University of Washington

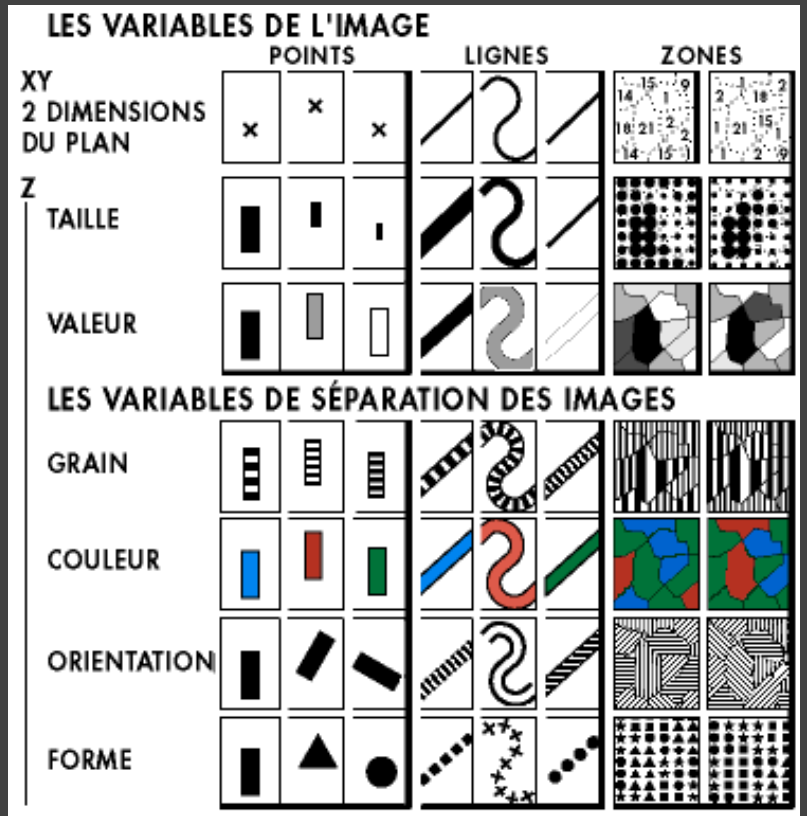
The Big Picture



Formalizing Design

Which Channel to Use?

Position (x 2)
Size
Value
Texture
Color
Orientation
Shape



Choosing Visual Encodings

Assume *k* visual encodings and *n* data attributes.
We would like to pick the “best” encoding among a combinatorial set of possibilities of size $(n+1)^k$

Principle of Consistency
The properties of the image (visual variables) should match the properties of the data.

Principle of Importance Ordering
Encode the most important information in the most effective way.

Bertin's Levels of Organization

Position	N	O	Q
Size	N	O	Q
Value	N	O	Q
Texture	N	O	
Color	N		
Orientation	N		
Shape	N		

Nominal

Ordinal

Quantitative

Note: **Q** ⊂ **O** ⊂ **N**

Information in Hue and Lightness

Lightness (“value”) is perceived as ordered

∴ Encode ordinal variables (O)

∴ Encode continuous variables (Q) [not as well]

Hue is normally perceived as unordered

∴ Encode nominal variables (N) using color

Design Criteria [Mackinlay 86]

Expressiveness

A set of facts is *expressible* in a visual language if the sentences (i.e. the visualizations) in the language express all the facts in the set of data, and only the facts in the data.

Effectiveness

A visualization is more *effective* than another visualization if the information conveyed by one visualization is more readily perceived than the information in the other visualization.

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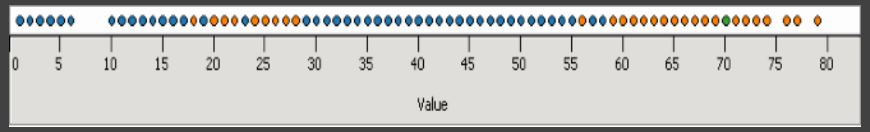
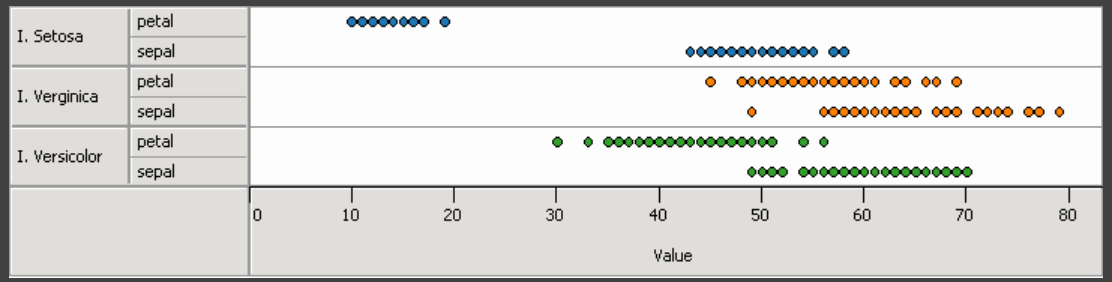
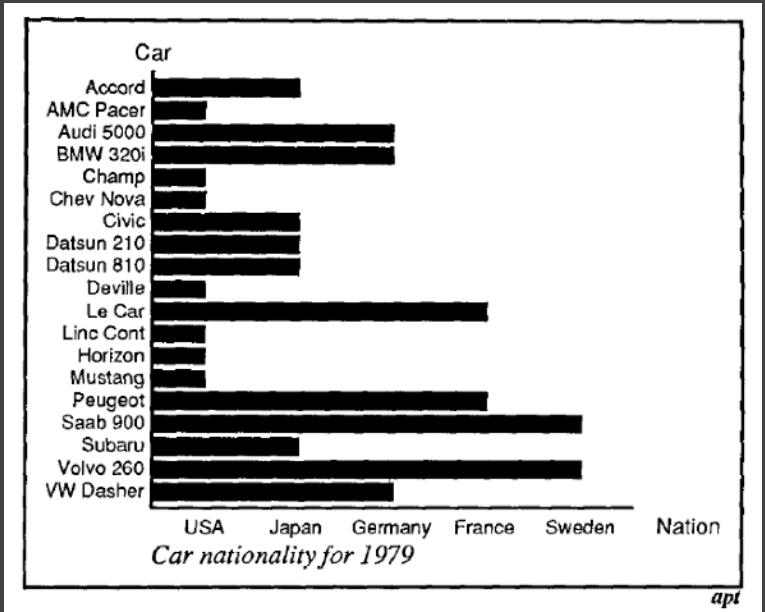
Can not express the facts

A multivariate relation may be *inexpressive* in a single horizontal dot plot because multiple records are mapped to the same position.





Expresses facts not in the data



A length is interpreted as a quantitative value.

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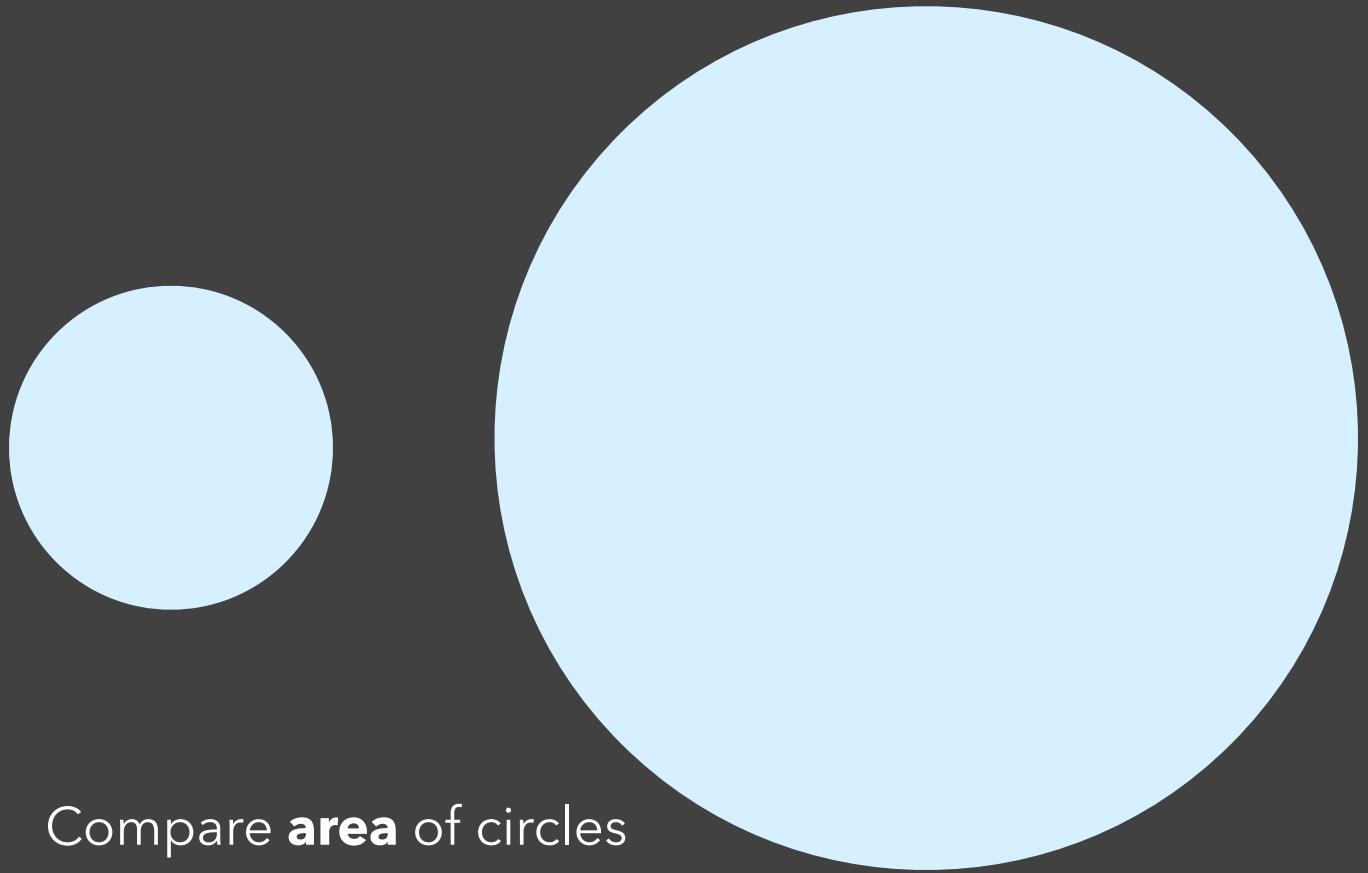
Design Criteria *Translated*

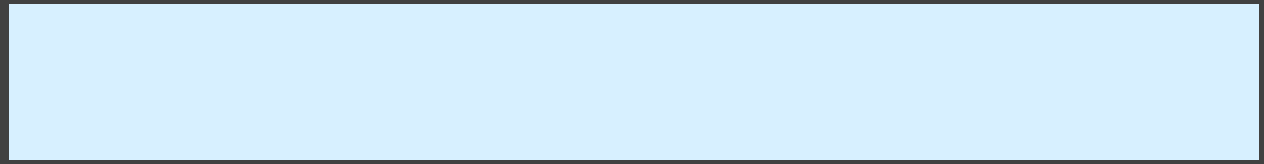
Tell the truth and nothing but the truth
(don't lie, and don't lie by omission)

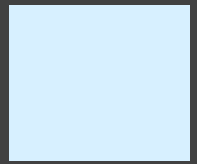
Use encodings that people decode better
(where better = faster and/or more accurate)

A Quick Experiment…

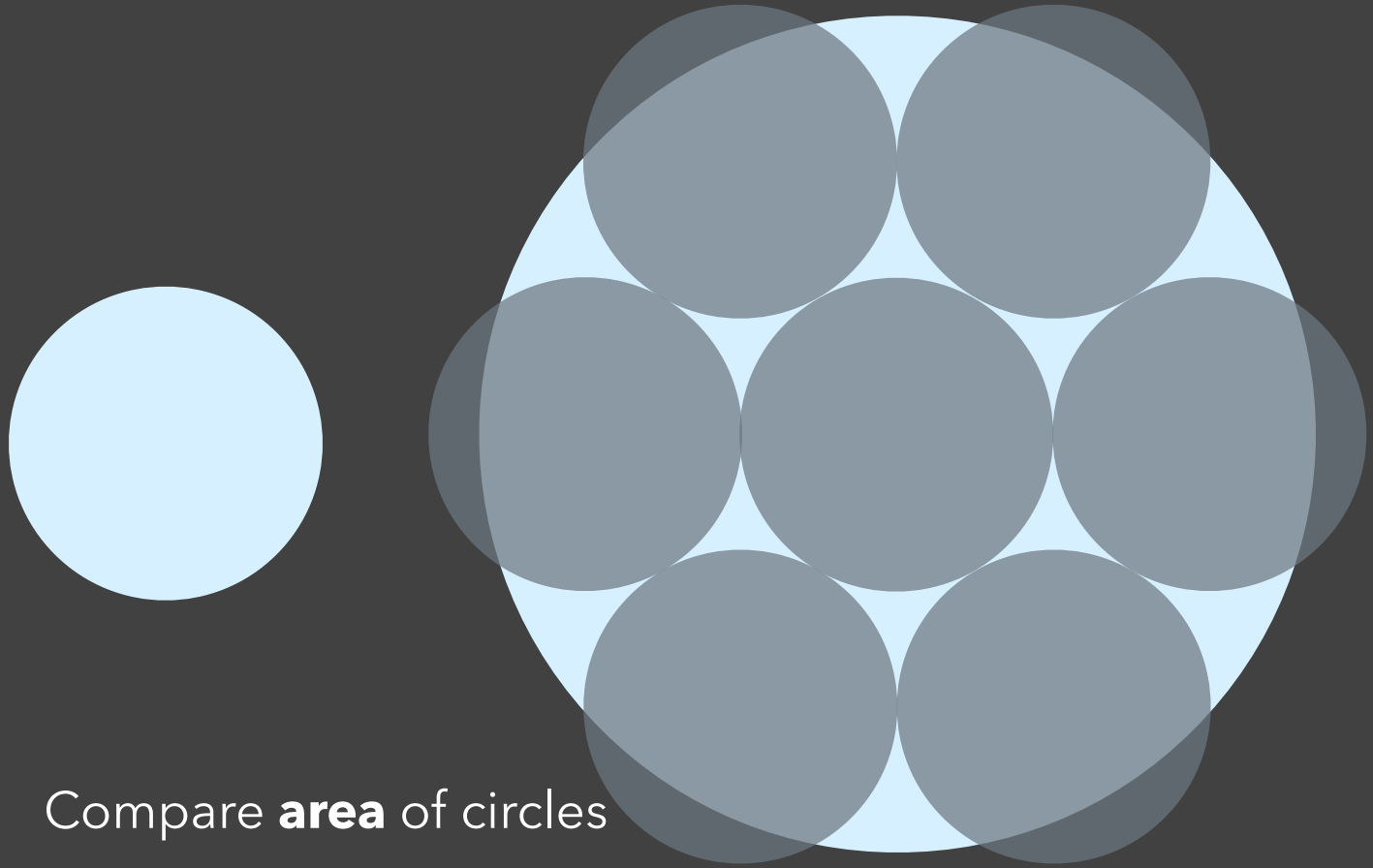


Compare **area** of circles





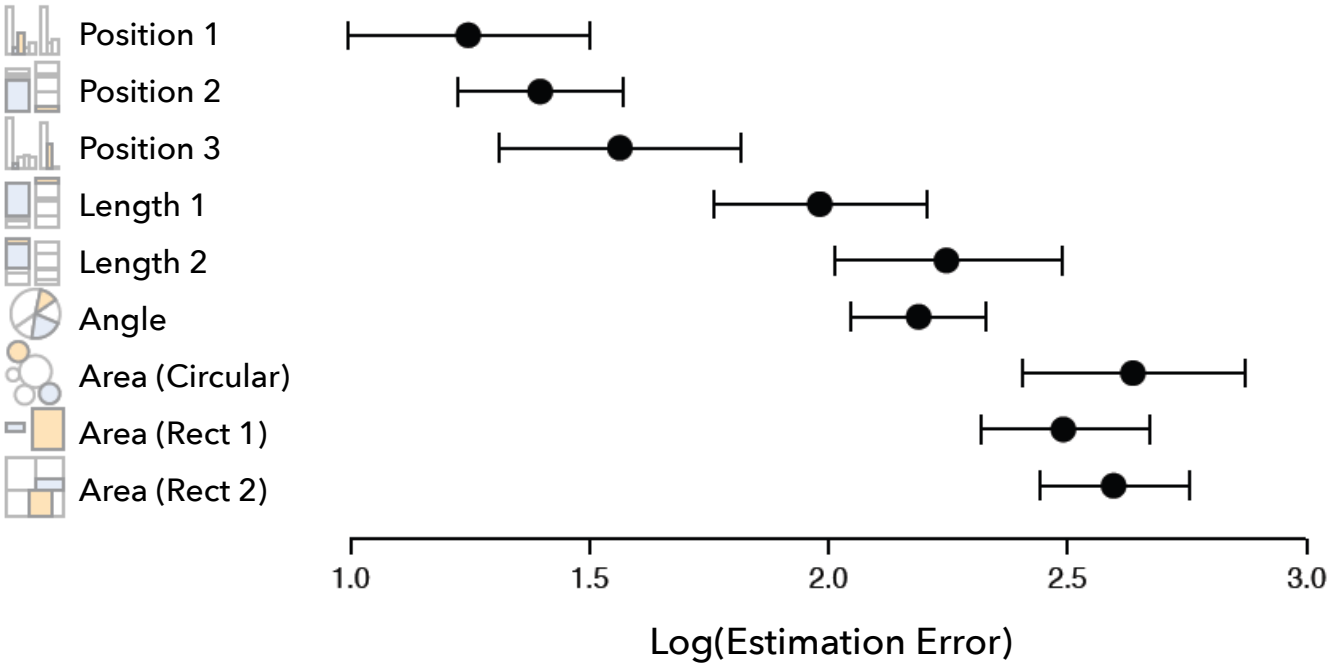
Compare **length** of bars



Compare **area** of circles

Compare **length** of bars

Accuracy of Visual Decoding



Ranking Visual Encodings

Most accurate

Comparing
Proportions

Least accurate

Position (common) scale
Position (non-aligned) scale

Length

Slope

Angle

Area

Volume

Color hue-saturation-density

Effectiveness Rankings [Mackinlay 86]

QUANTITATIVE	ORDINAL	NOMINAL
Position	Position	Position
Length	Density (Value)	Color Hue
Angle	Color Sat	Texture
Slope	Color Hue	Connection
Area (Size)	Texture	Containment
Volume	Connection	Density (Value)
Density (Value)	Containment	Color Sat
Color Sat	Length	Shape
Color Hue	Angle	Length
Texture	Slope	Angle
Connection	Area (Size)	Slope
Containment	Volume	Area
Shape	Shape	Volume

Conjectured *effectiveness* of encodings by data type

Effectiveness Rankings [Mackinlay 86]

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Position	**Position**	**Position**
Length	Density (Value)	Color Hue
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Volume	Connection	Density (Value)
Density (Value)	Containment	**Color Sat**
Color Sat	Length	Shape
Color Hue	Angle	Length
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Volume	Connection	Density (Value)
Density (Value)	Containment	Color Sat
Color Sat	Length	Shape
Color Hue	Angle	Length
Texture	Slope	Angle
Connection	Area (Size)	Slope
Containment	Volume	Area
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Conjectured *effectiveness* of encodings by data type

Mackinlay's Design Algorithm

APT - "A Presentation Tool", 1986

User formally specifies data model and type
Input: ordered list of data variables to show

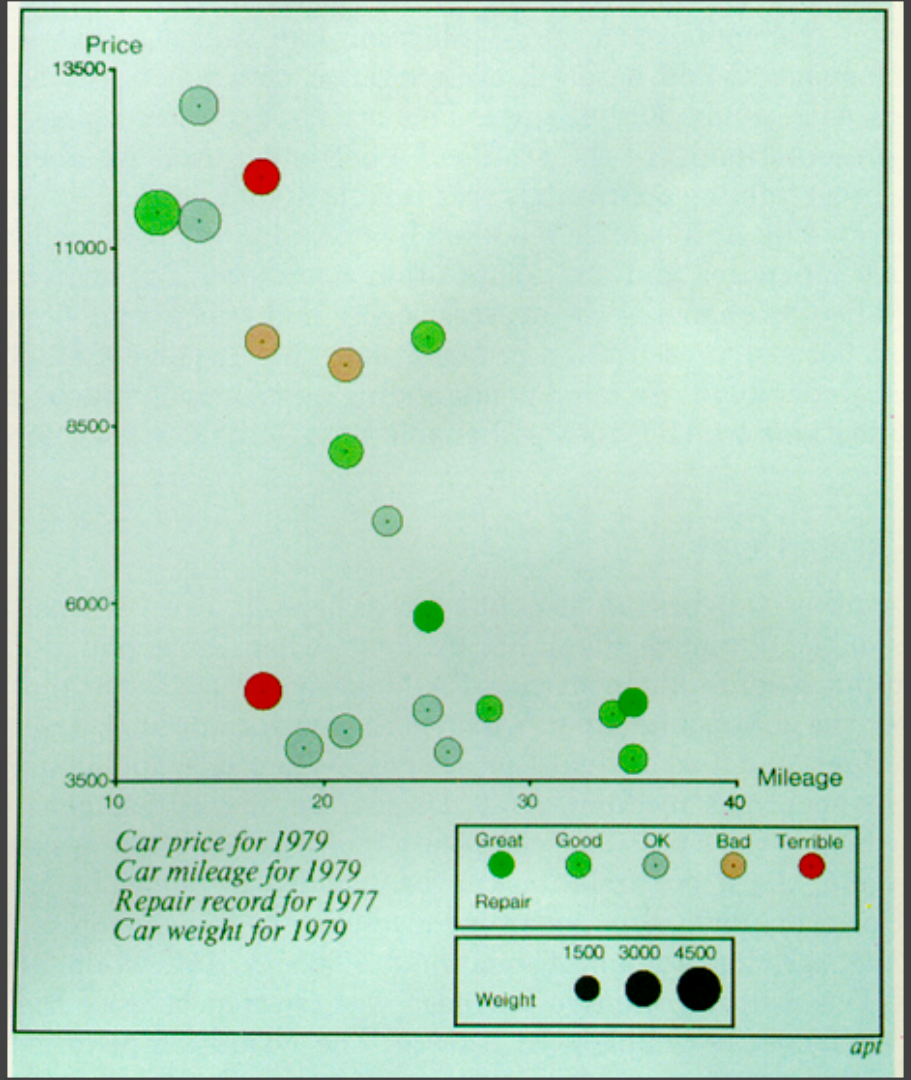
APT searches over design space
Test expressiveness of each visual encoding
Generate encodings that pass test
Rank by perceptual effectiveness criteria

Output the "most effective" visualization

APT

Automatically generate chart for car data

Input variables:
1. Price
2. Mileage
3. Repair
4. Weight



Limitations of APT

Does not cover many visualization techniques
Networks, hierarchies, maps, diagrams
Also: 3D structure, animation, illustration, …

Does not consider interaction

Does not consider semantics / conventions

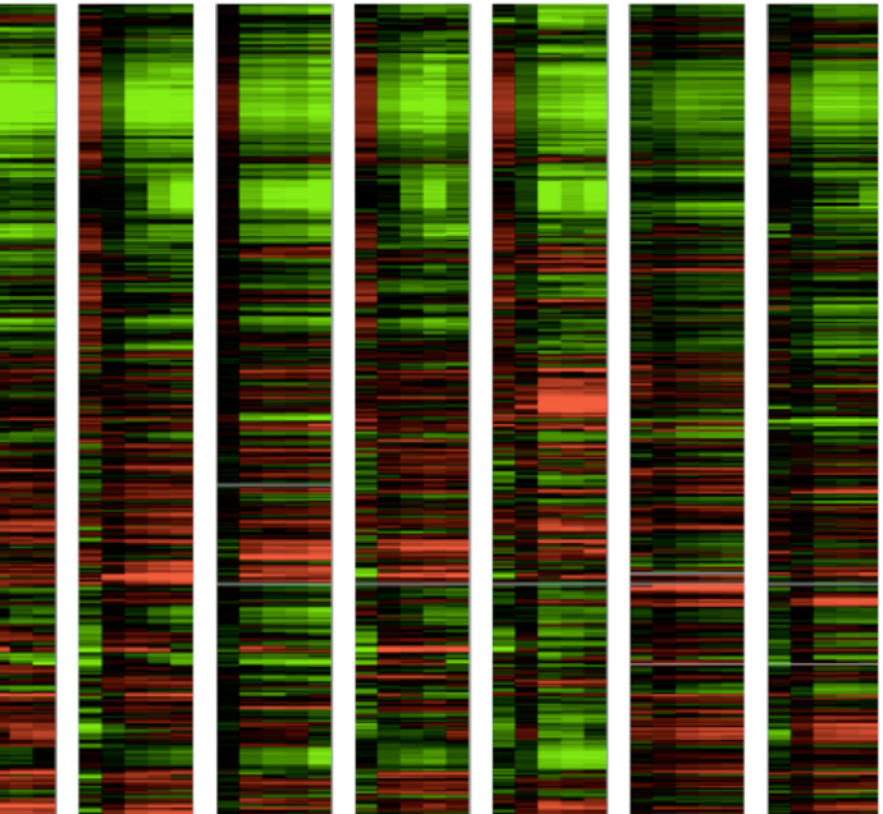
Assumes single visualization as output

Still an active area of research, e.g., the
Draco visualization design knowledge base

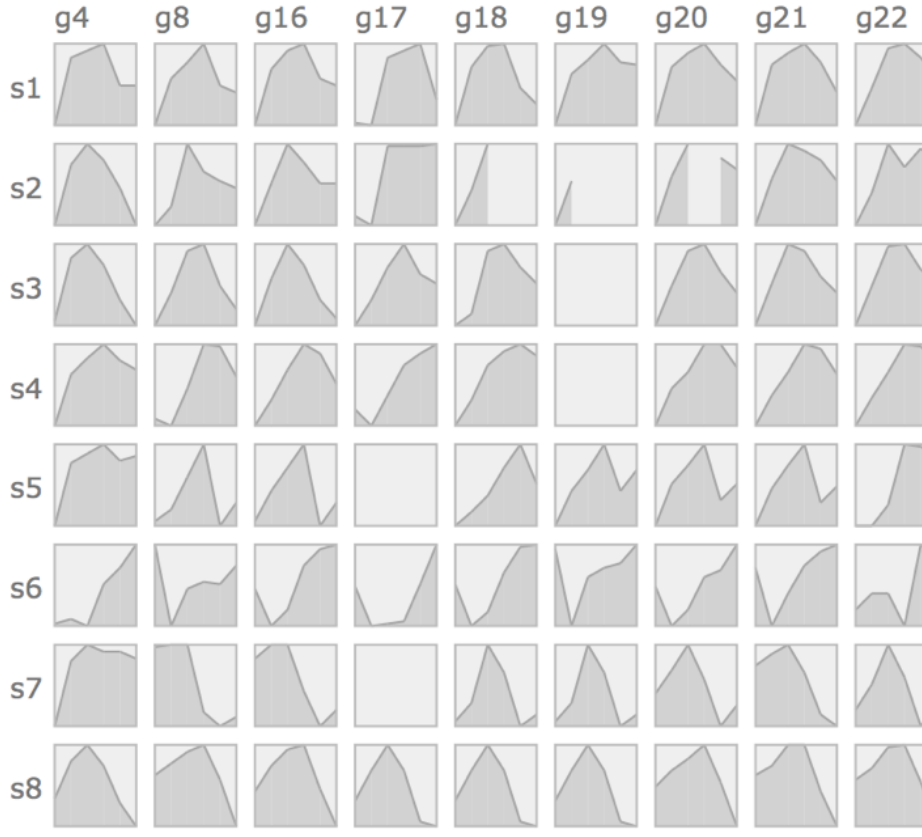
Design Examples

Gene Expression Time-Series [Meyer et al. 2011]

Color Encoding



Position Encoding



Effectiveness Rankings

QUANTITATIVE	ORDINAL	NOMINAL
Position	Position	Position
Length	Density (Value)	Color Hue
Angle	Color Sat	Texture
Slope	Color Hue	Connection
Area (Size)	Texture	Containment
Volume	Connection	Density (Value)
~~**Density (Value)**~~	Containment	Color Sat
Color Sat	Length	Shape
~~**Color Hue**~~	Angle	Length
Texture	Slope	Angle
Connection	Area (Size)	Slope
Containment	Volume	Area
Shape	Shape	Volume

Artery Visualization [Borkin et al. 2011]

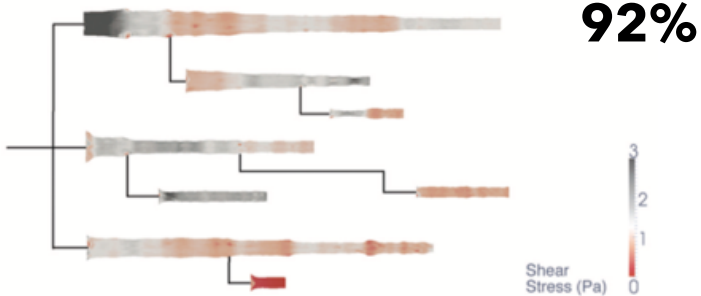
Rainbow Palette

Diverging Palette

2D

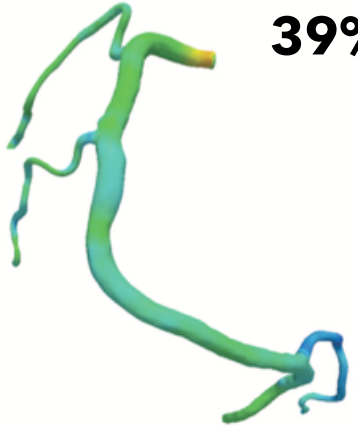
62%

92%

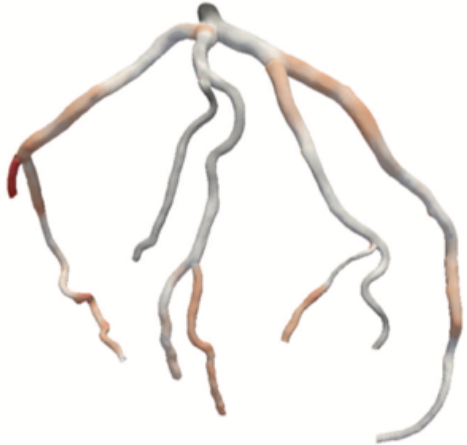


3D

39%



71%



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Area (Size)	Texture	Containment
Volume	**Connection**	Density (Value)
Density (Value)	Containment	Color Sat
Color Sat	Length	Shape
~~**Color Hue**~~	Angle	Length
Texture	Slope	Angle
Connection	Area (Size)	Slope
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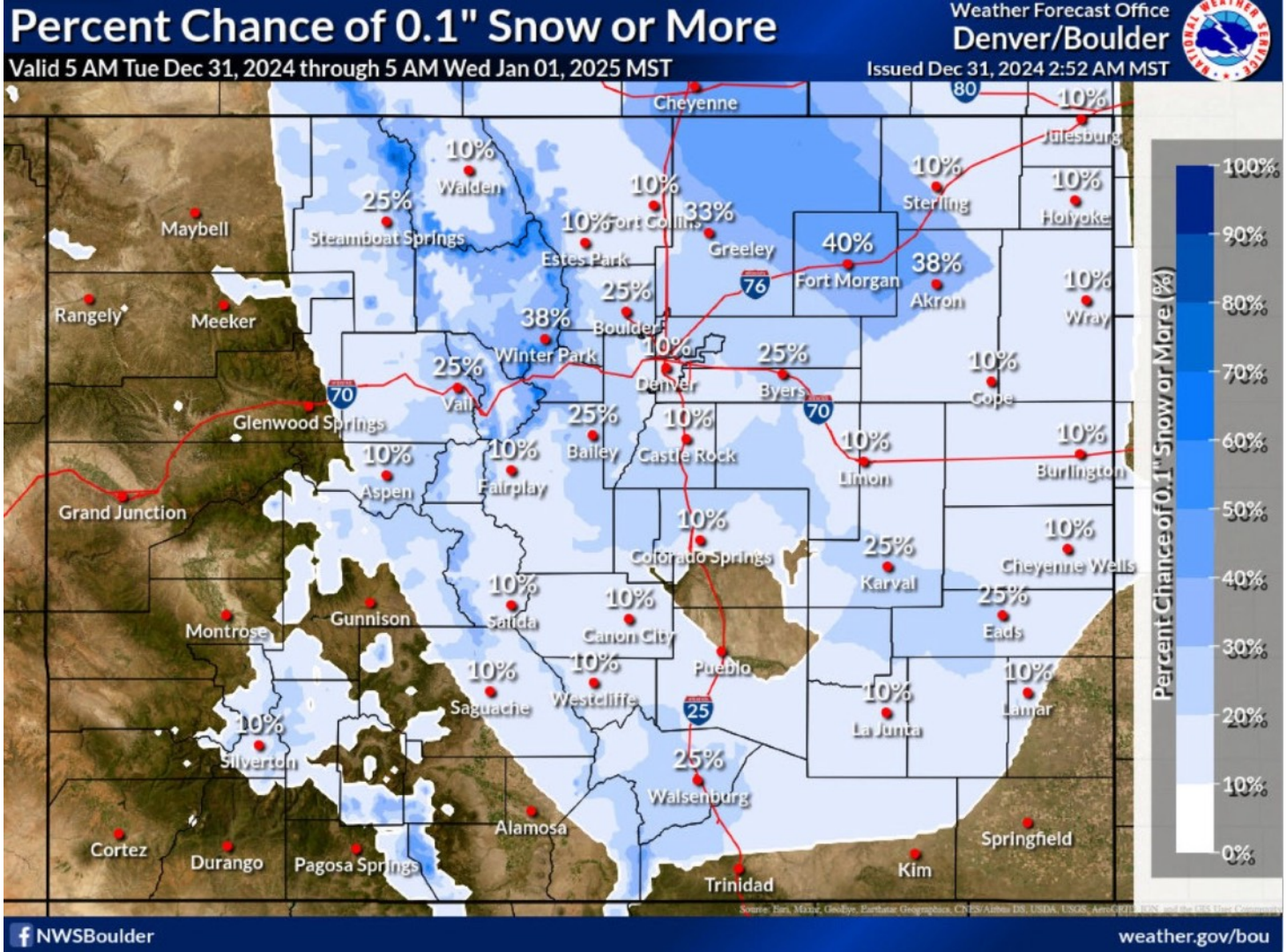
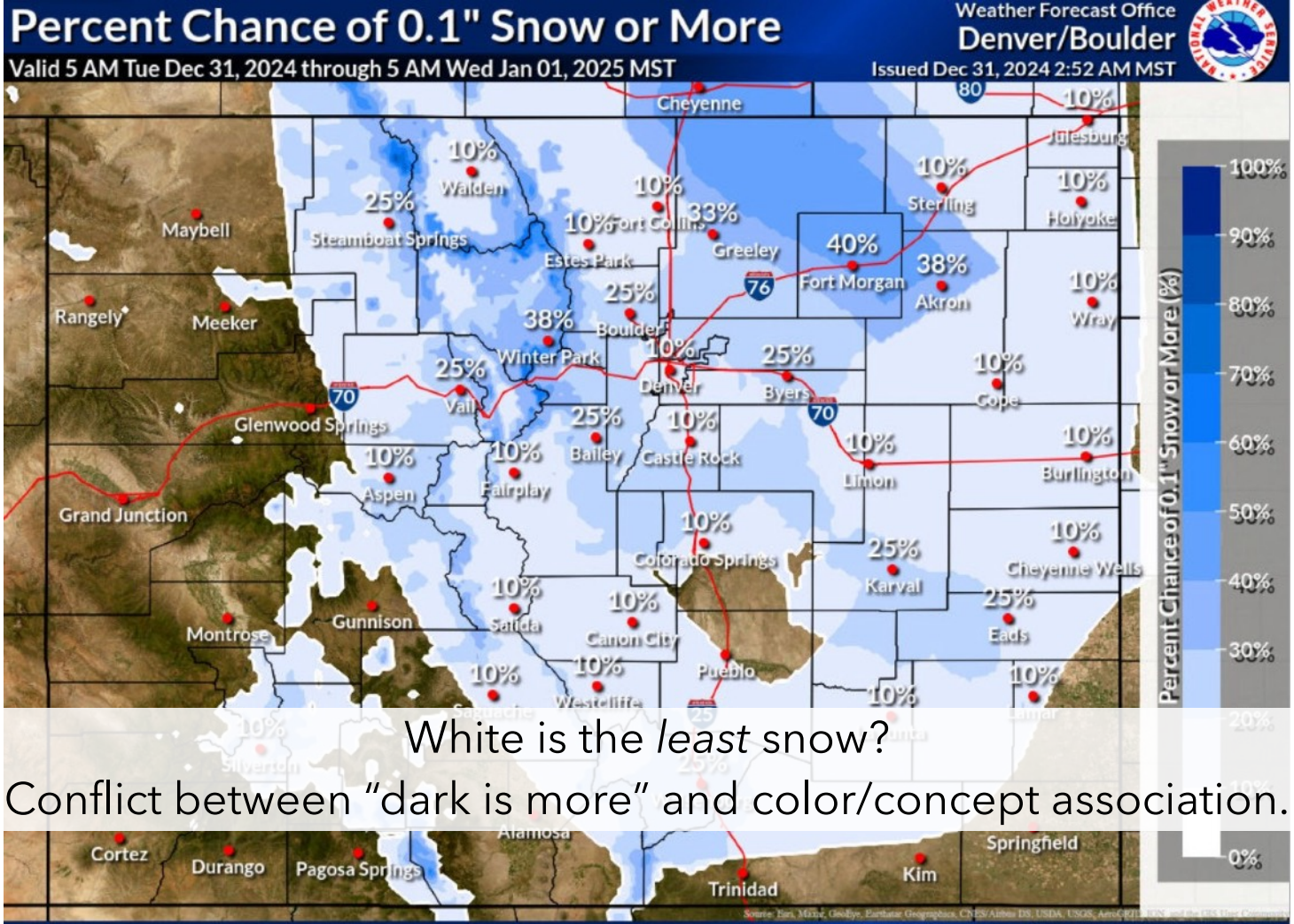

Percent Chance of 0.1" Snow or More
Valid 5 AM Tue Dec 31, 2024 through 5 AM Wed Jan 01, 2025 MST
Weather Forecast Office
Denver/Boulder
Issued Dec 31, 2024 2:52 AM MST
Cheyenne
Julesburg
Sterling
Holyoke
Akron
Wray
Fort Morgan
Greeley
Fort Collins
Estes Park
Steamboat Springs
Walden
Maybell
Rangely
Meeker
Glenwood Springs
Grand Junction
Aspen
Vail
Winter Park
Boulder
Denver
Byers
Cope
Bailey
Castle Rock
Limon
Burlington
Fairplay
Colorado Springs
Karval
Cheyenne Wells
Eads
Lamar
La Junta
Walsenburg
Trinidad
Kim
Springfield
Alamosa
Pagosa Springs
Durango
Cortez
Silverton
Montrose
Gunnison
Saguache
Westcliffe
Salida
Canon City
Pueblo
10%
25%
33%
40%
38%
Percent Chance of 0.1" Snow or More (%)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
NWSBoulder
weather.gov/bou

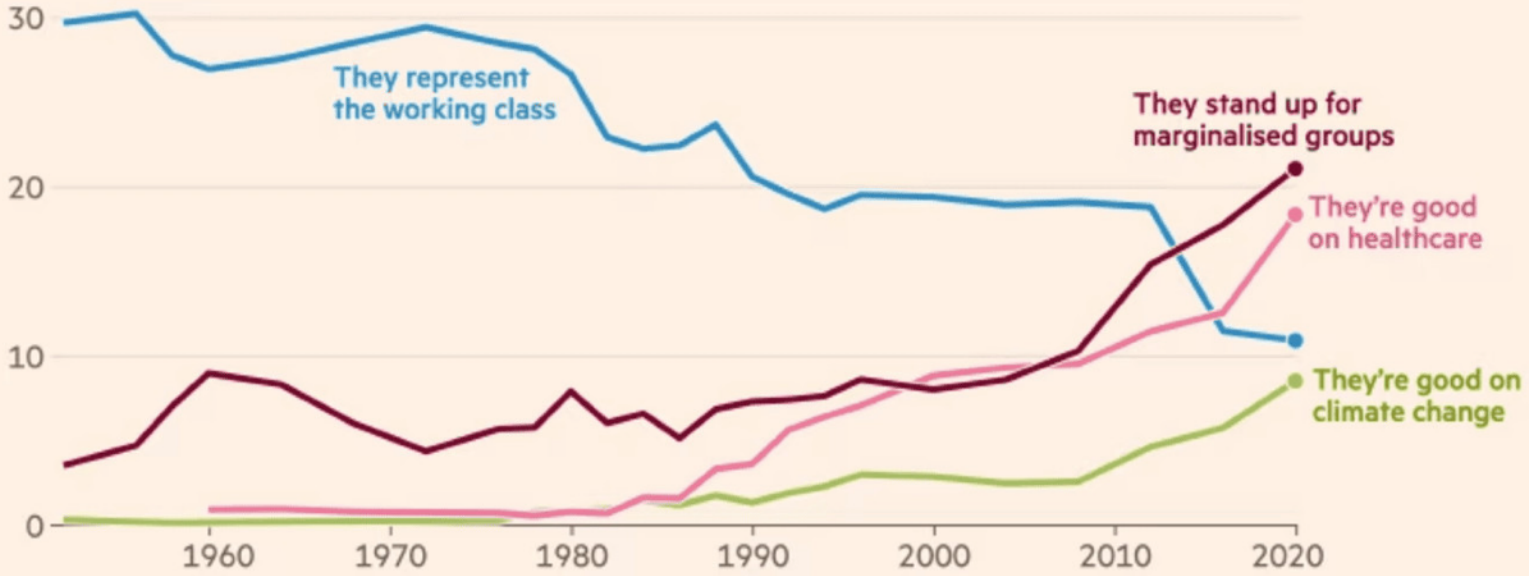


White is the *least* snow?

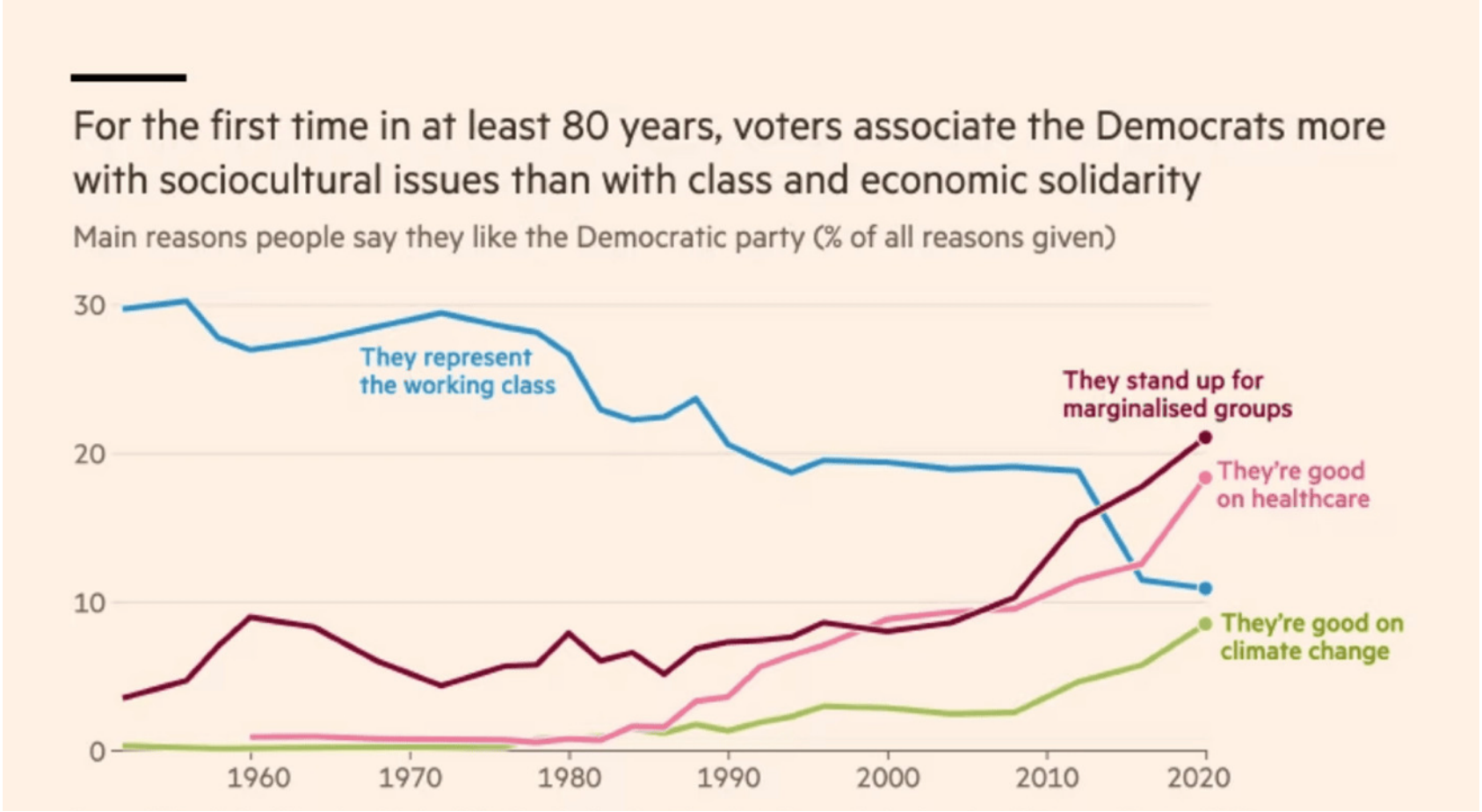
Conflict between “dark is more” and color/concept association.

For the first time in at least 80 years, voters associate the Democrats more with sociocultural issues than with class and economic solidarity

Main reasons people say they like the Democratic party (% of all reasons given)

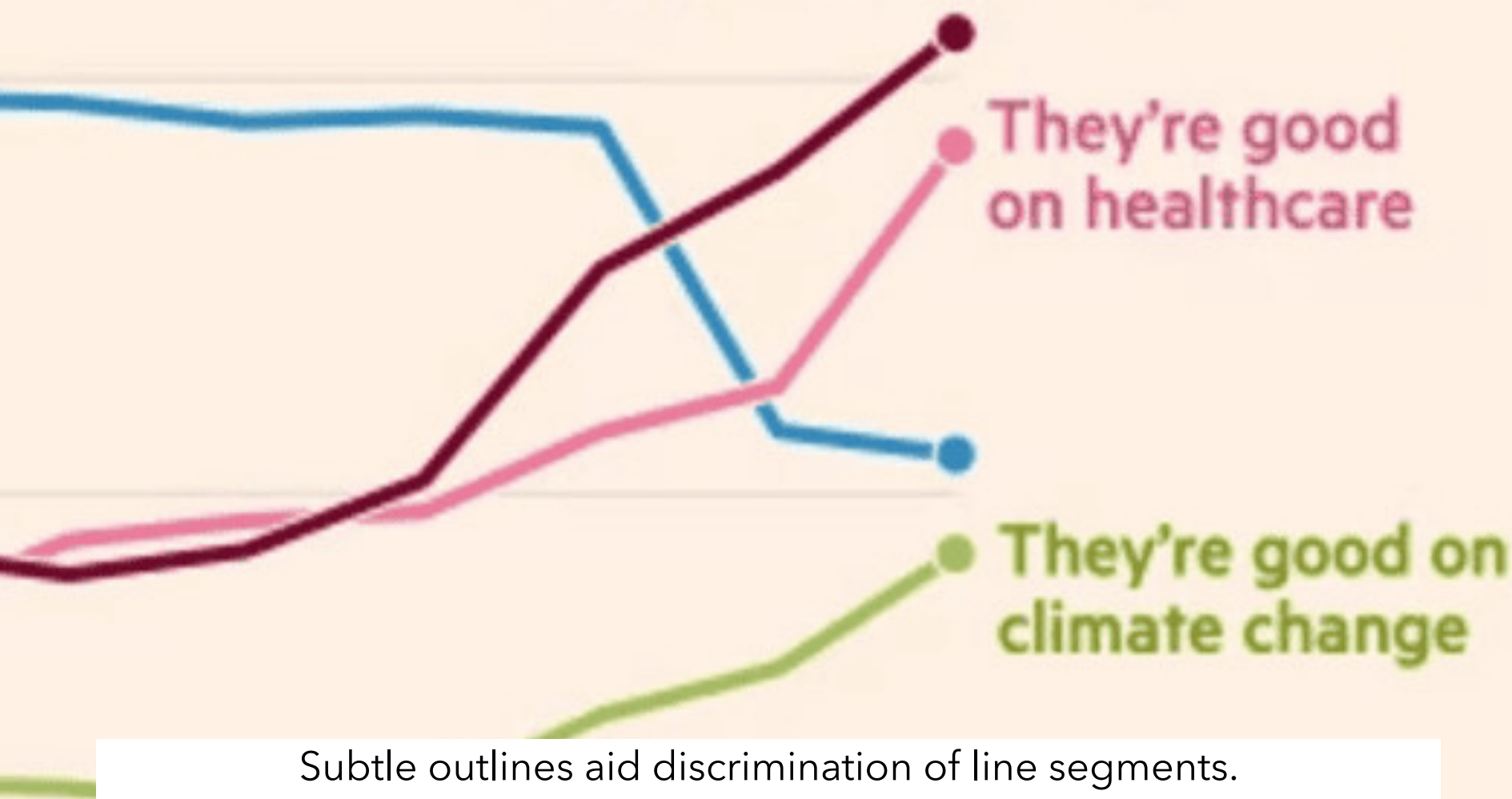


Source: FT analysis of American National Election Studies, based on Party Images in the American Electorate (Brewer, 2008)
FT graphic: John Burn-Murdoch / @jburnmurdoch



Direct labels, rather than legend. (But y-axis units?)

Title and subtitle convey context and steer interpretation.



Subtle outlines aid discrimination of line segments.

A Design Space of Visual Encodings

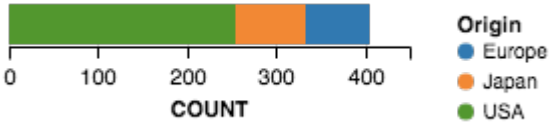
Mapping Data to Visual Variables

Assign **data fields** (e.g., with *N, O, Q* types) to **visual channels** (*x, y, color, shape, size, …*) for a chosen **graphical mark** type (*point, bar, line, …*).

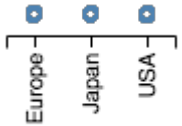
Additional concerns include choosing appropriate **encoding parameters** (*log scale, sorting, …*) and **data transformations** (*bin, group, aggregate, …*).

These options define a large combinatorial space, containing both useful and questionable charts!

1D: Nominal



Raw



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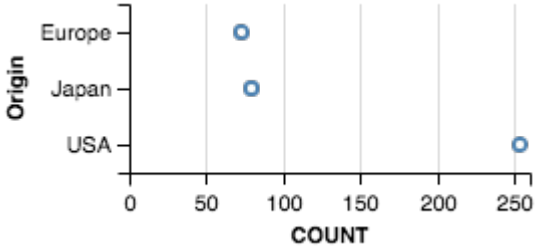
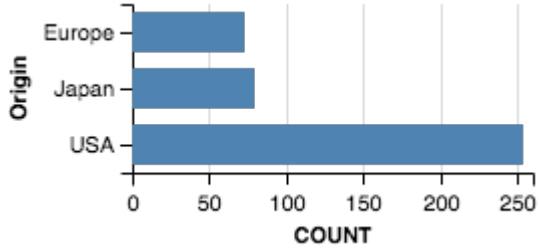
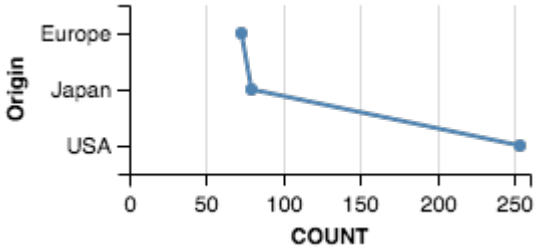
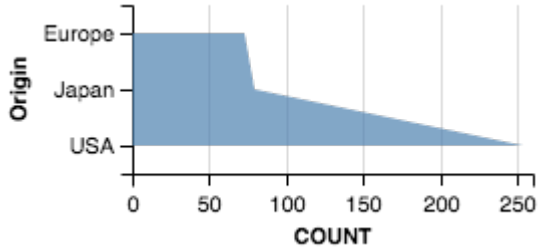
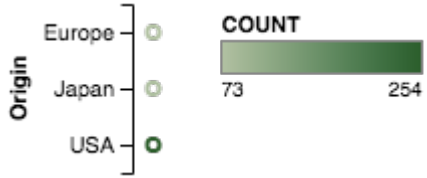
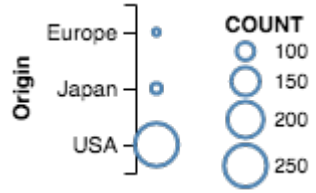




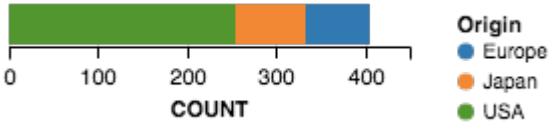






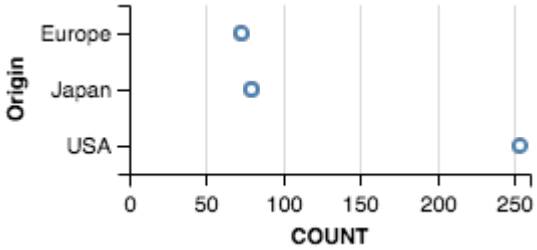


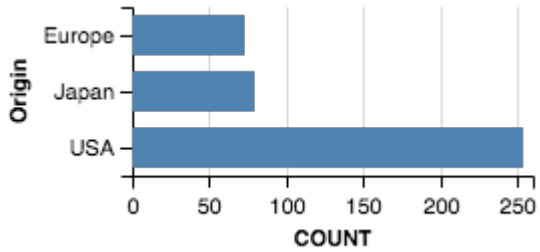
Expressive?

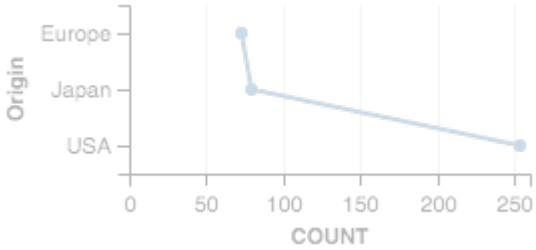


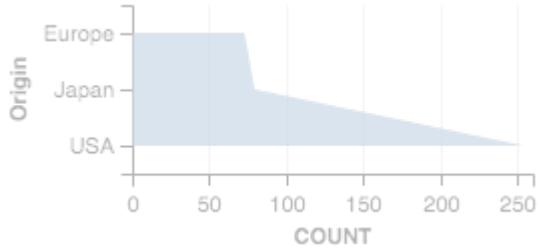
Raw

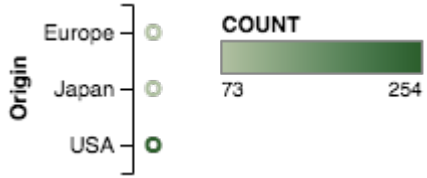
Aggregate (Count)

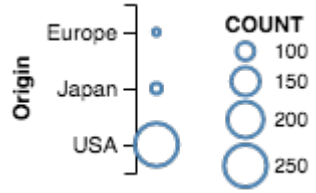






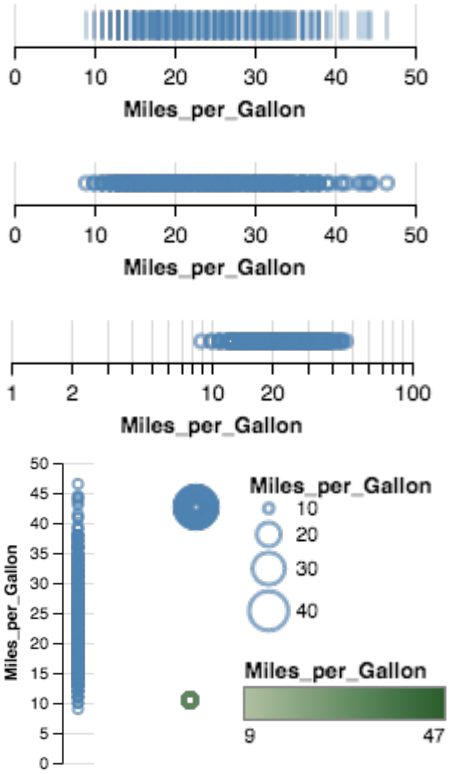






1D: Quantitative

Raw



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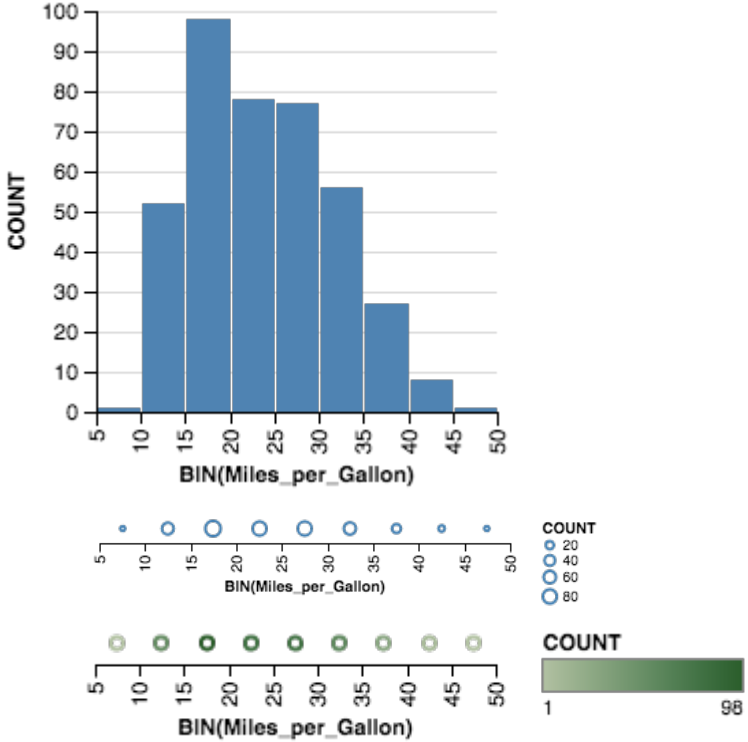
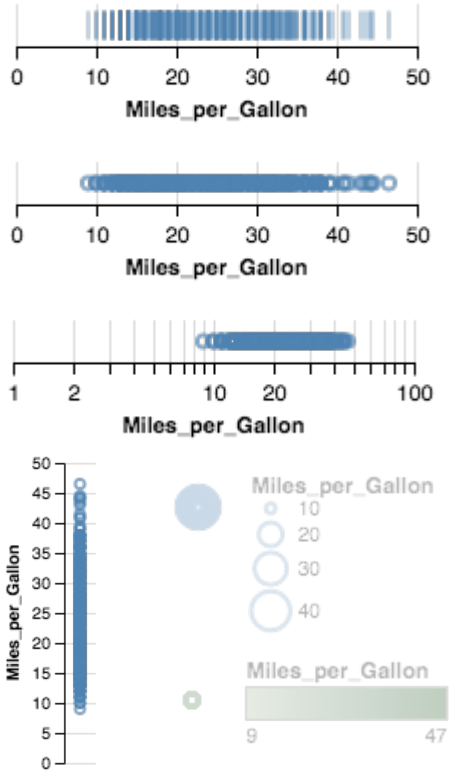
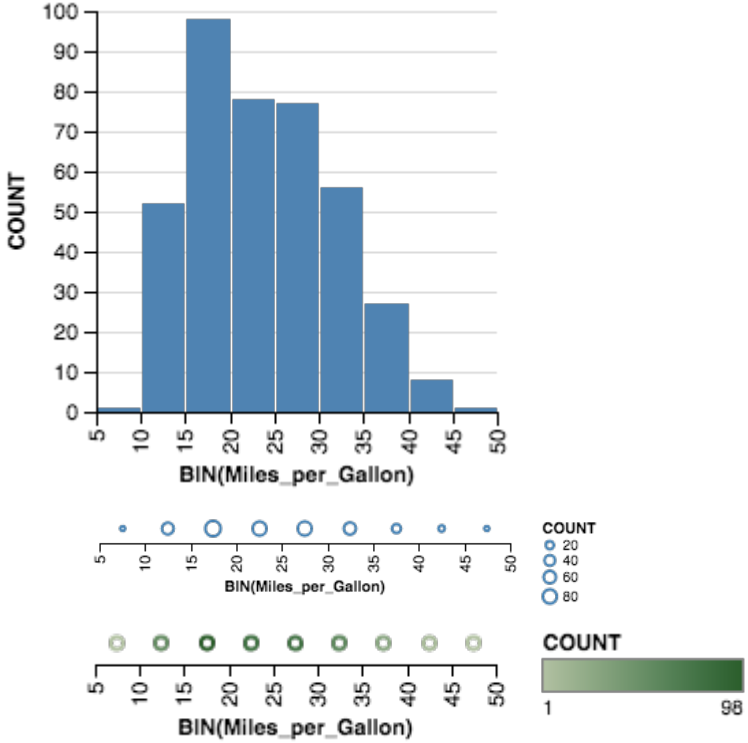


Expressive?

Raw

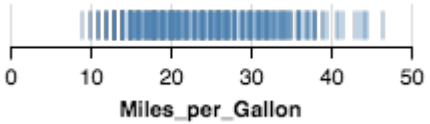


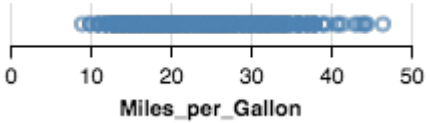
Aggregate (Count)

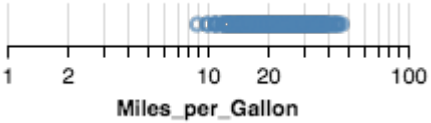


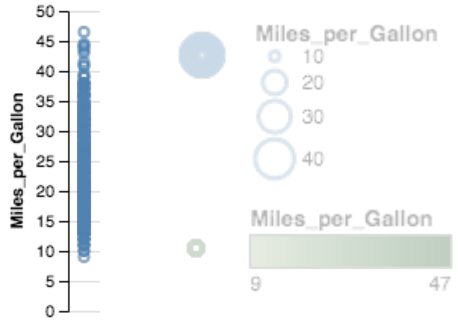
Effective?

Raw

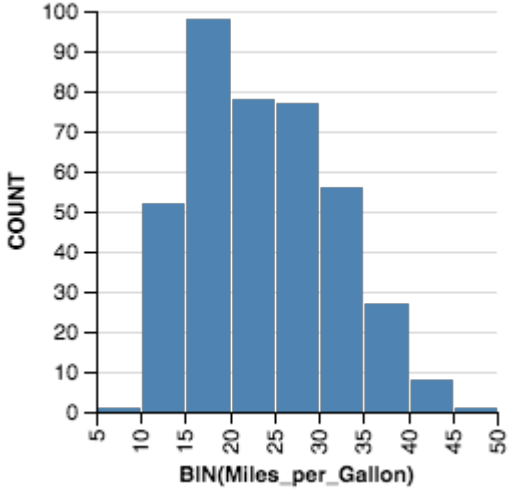


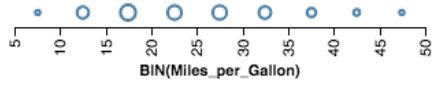


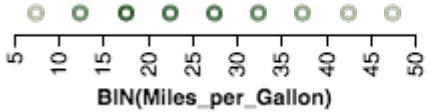




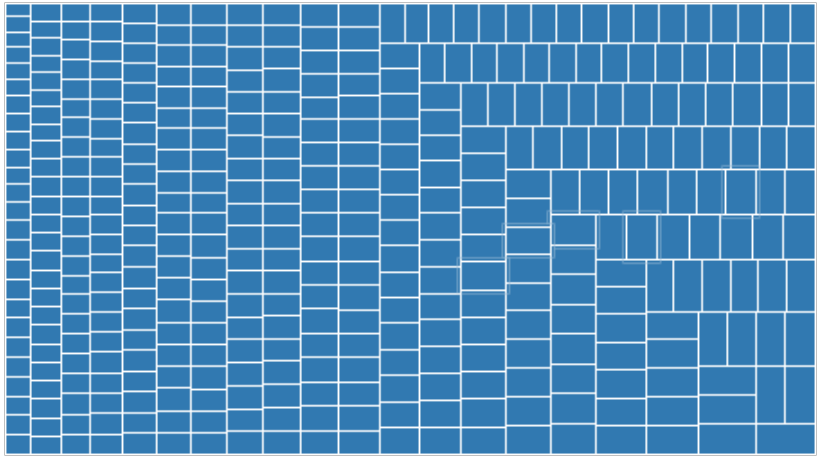
Aggregate (Count)



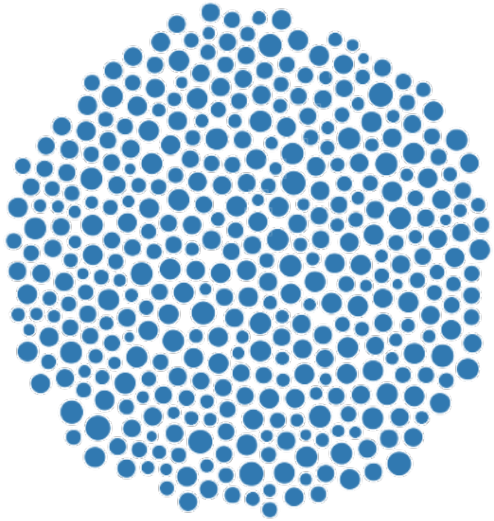




Raw (with Layout Algorithm)

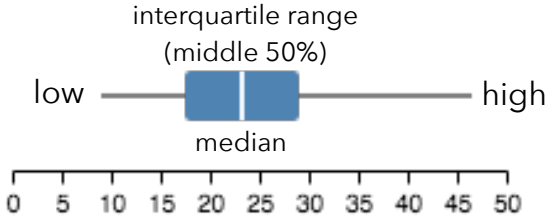


Treemap

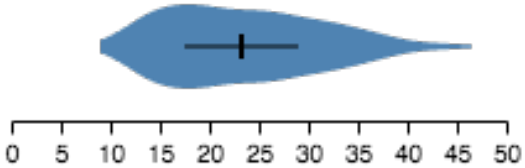


Bubble Chart

Aggregate (Distributions)

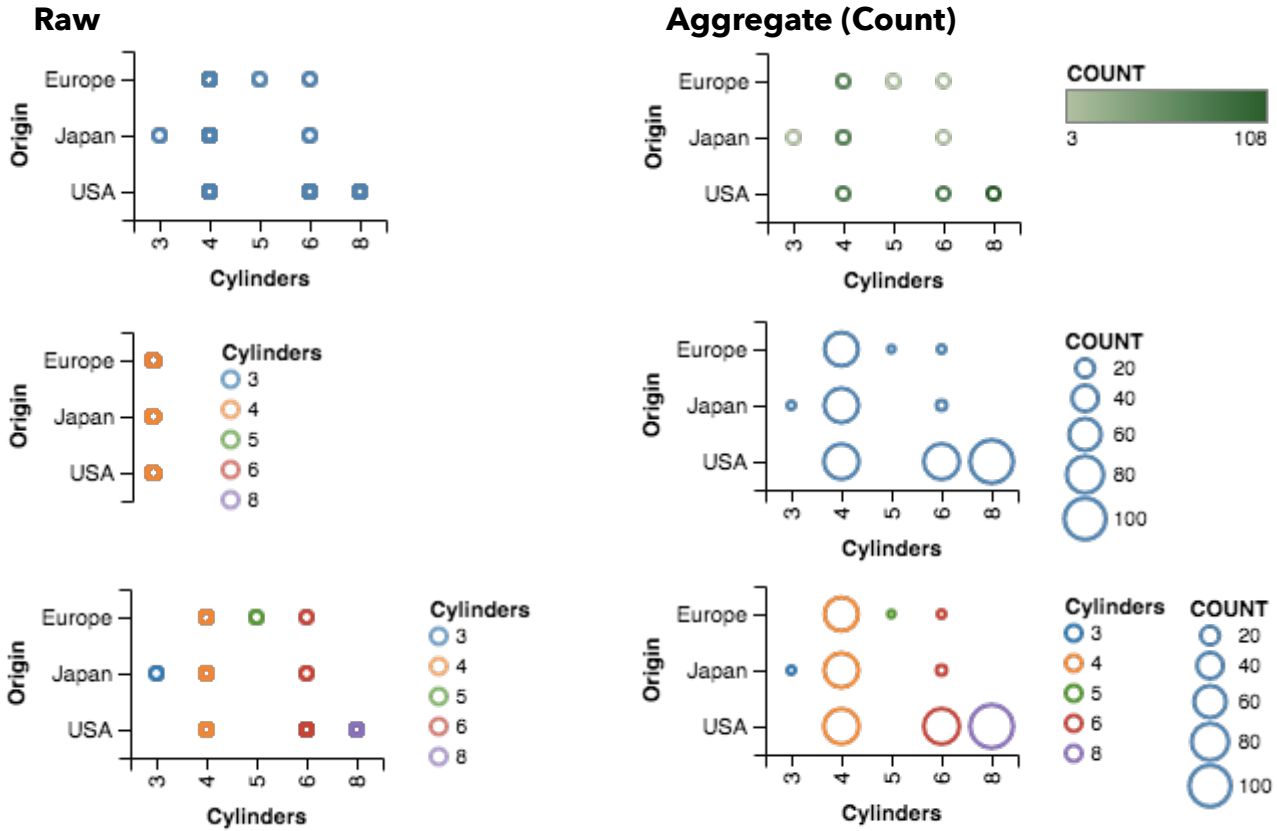


Box Plot

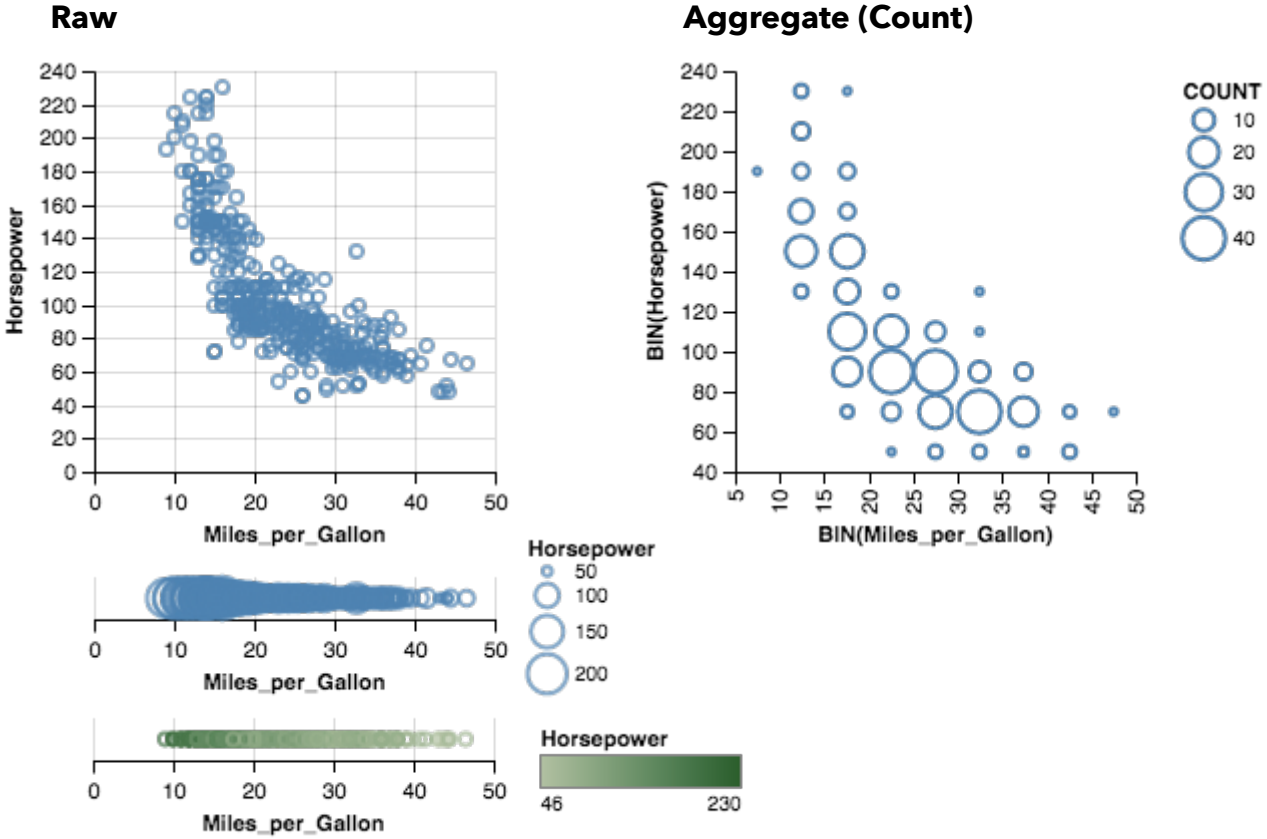


Violin Plot

2D: Nominal x Nominal

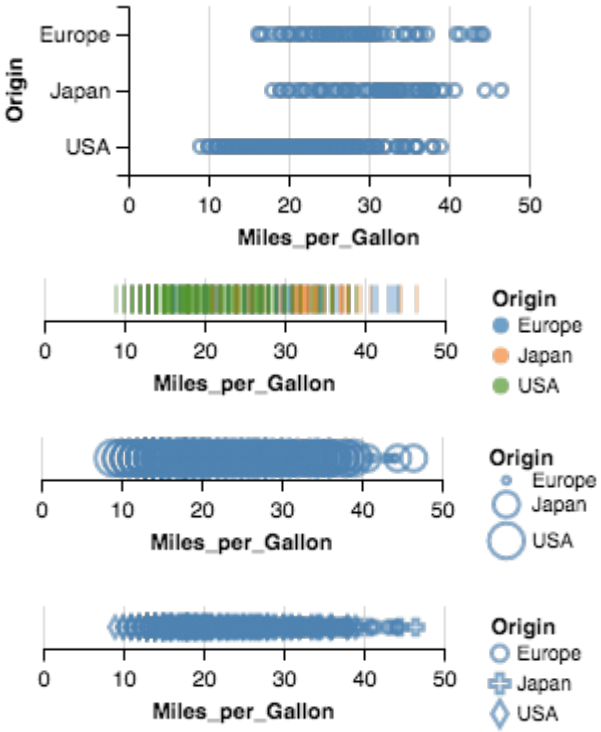


2D: Quantitative x Quantitative

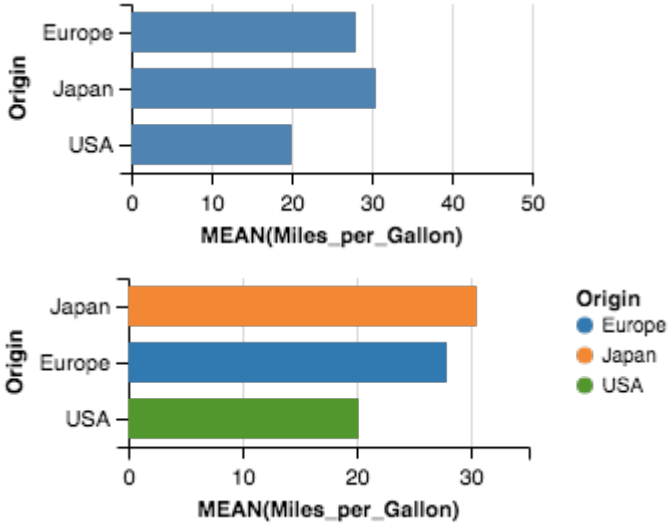


2D: Nominal x Quantitative

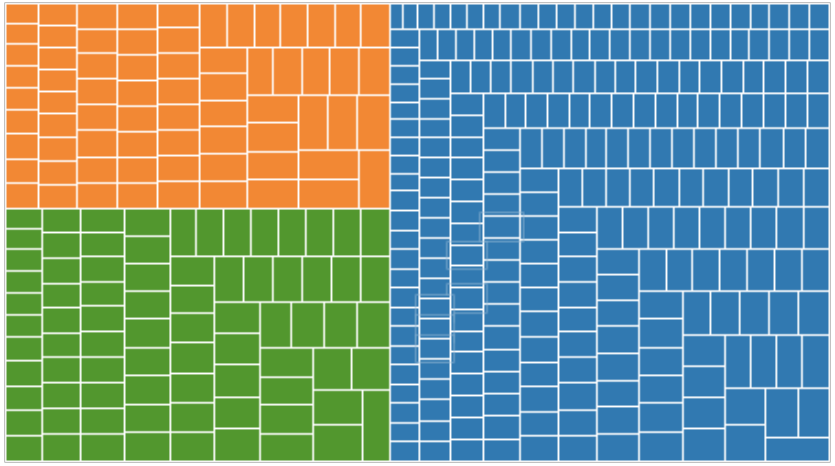
Raw



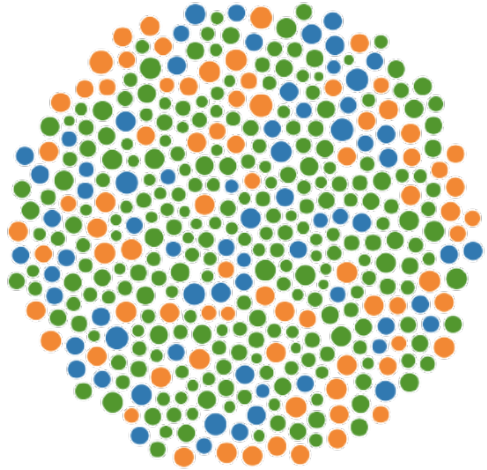
Aggregate (Mean)



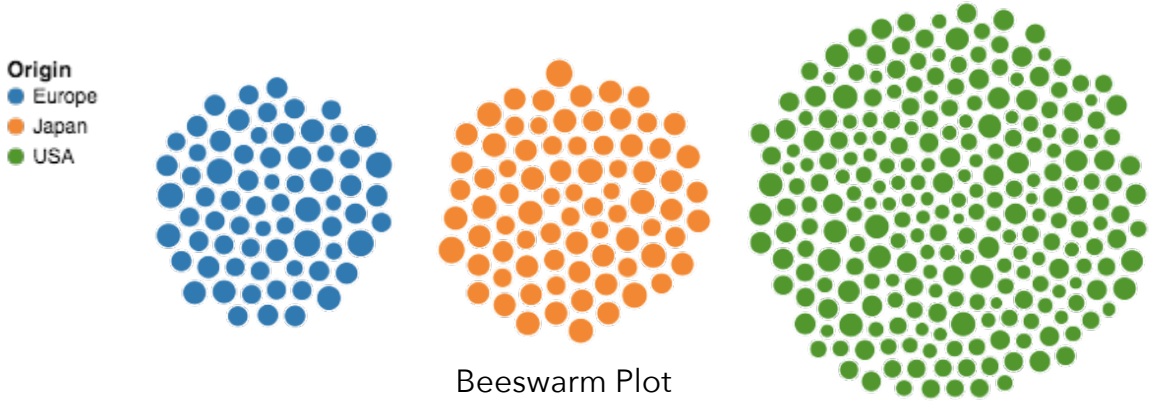
Raw (with Layout Algorithm)



Treemap



Bubble Chart



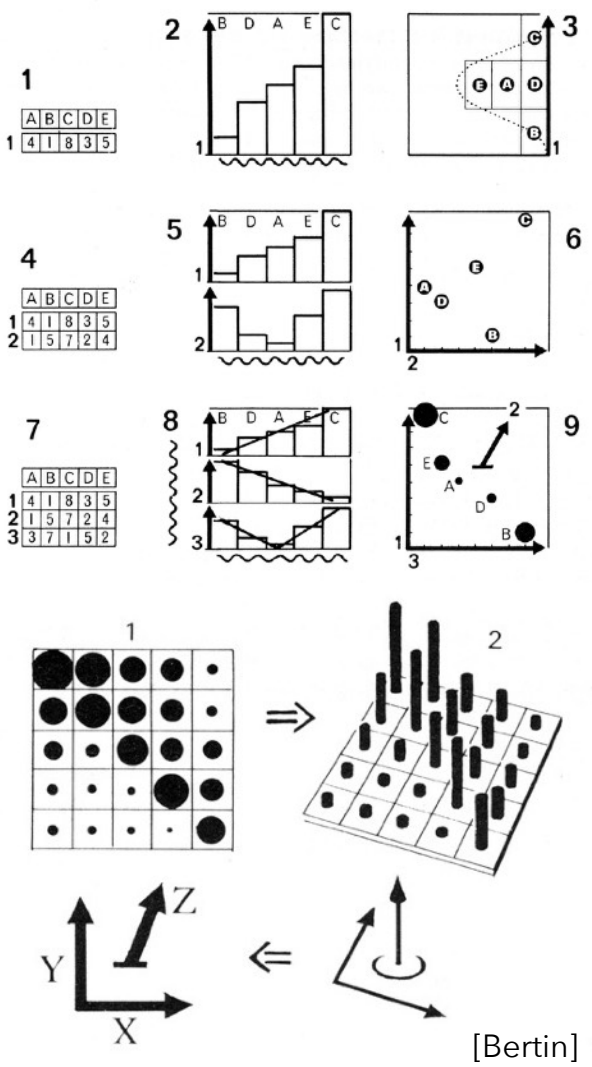
Beeswarm Plot

3D and Higher

Two variables [x, y]
Can map to 2D points.
Scatterplots, maps, …

Third variable [z]
Often use one of size, color, opacity, shape, *etc*. Or, one can further partition space.

What about 3D rendering?



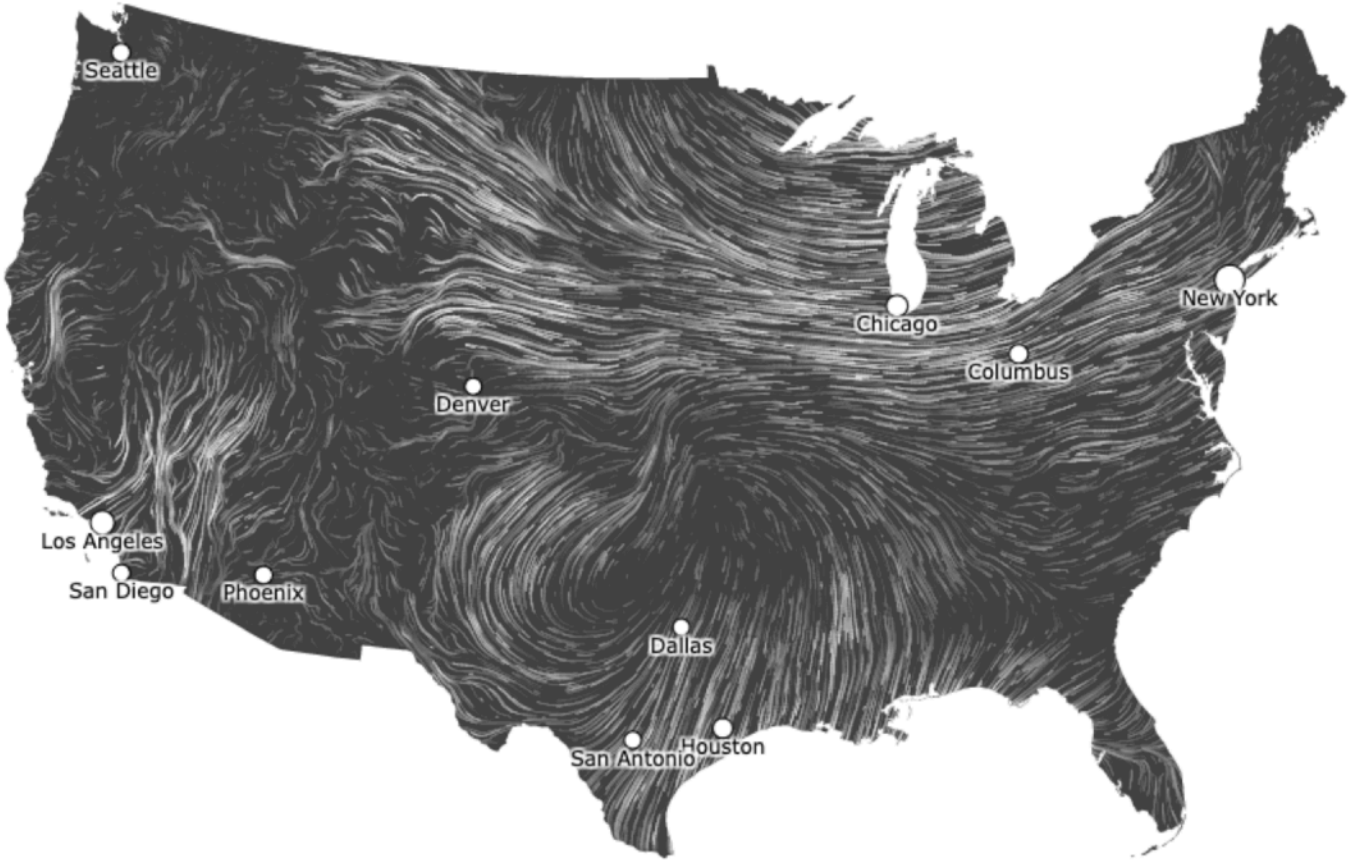
[Bertin]

wind map

[Viegas & Wattenberg]

January 13, 2025
12:21 pm EST
(time of forecast download)

top speed: **25.2 mph**
average: **8.1 mph**



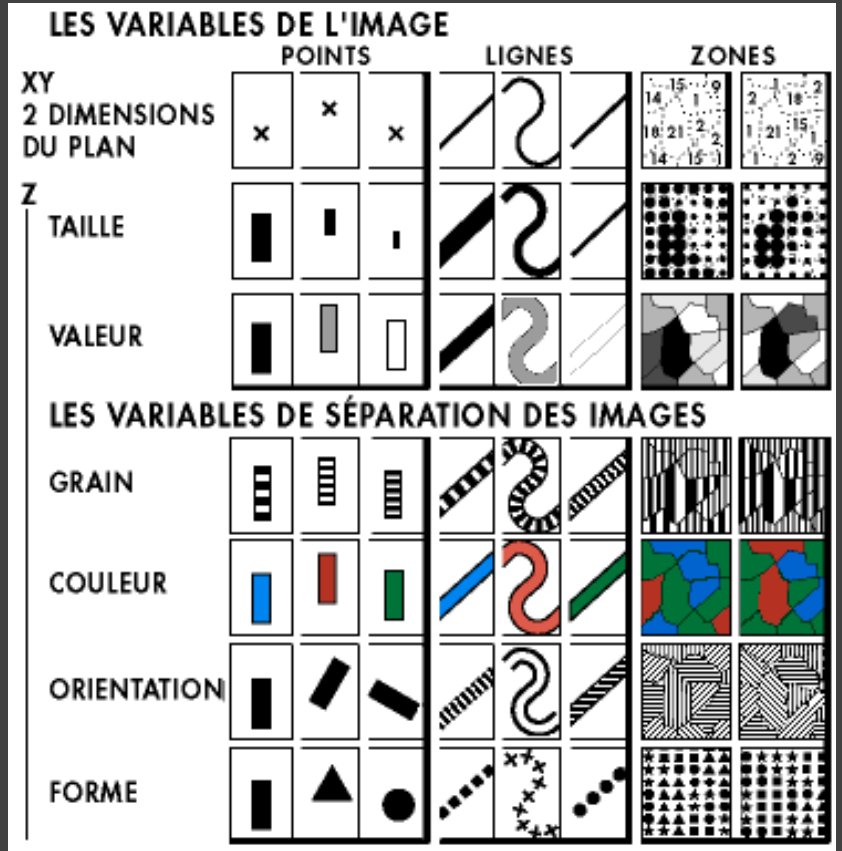
1 mph
3 mph
5 mph
10 mph
15 mph
30 mph

Multidimensional Data

Visual Encoding Variables

Position (X)
Position (Y)
Area
Value
Texture
Color
Orientation
Shape

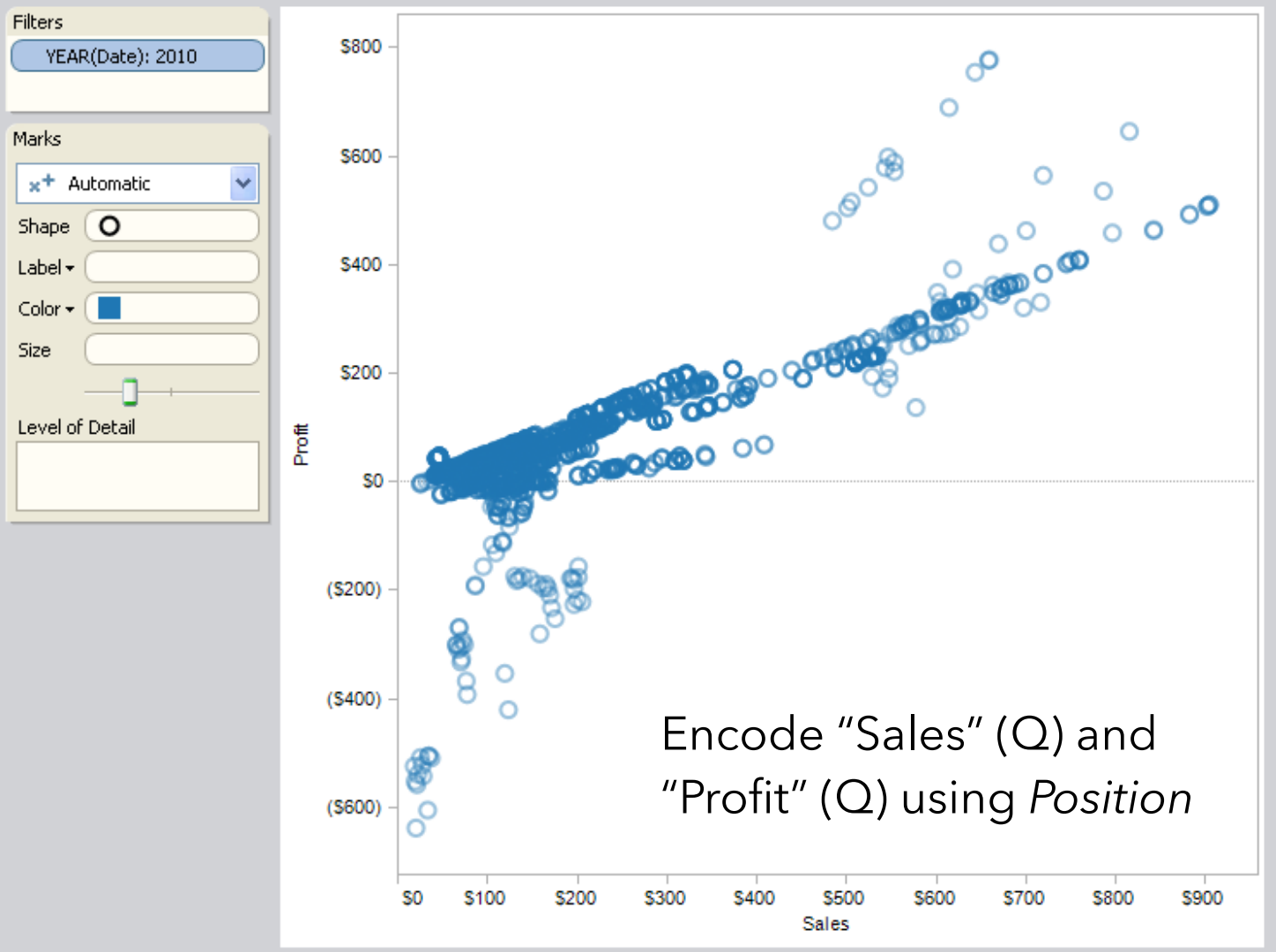
~8 dimensions?

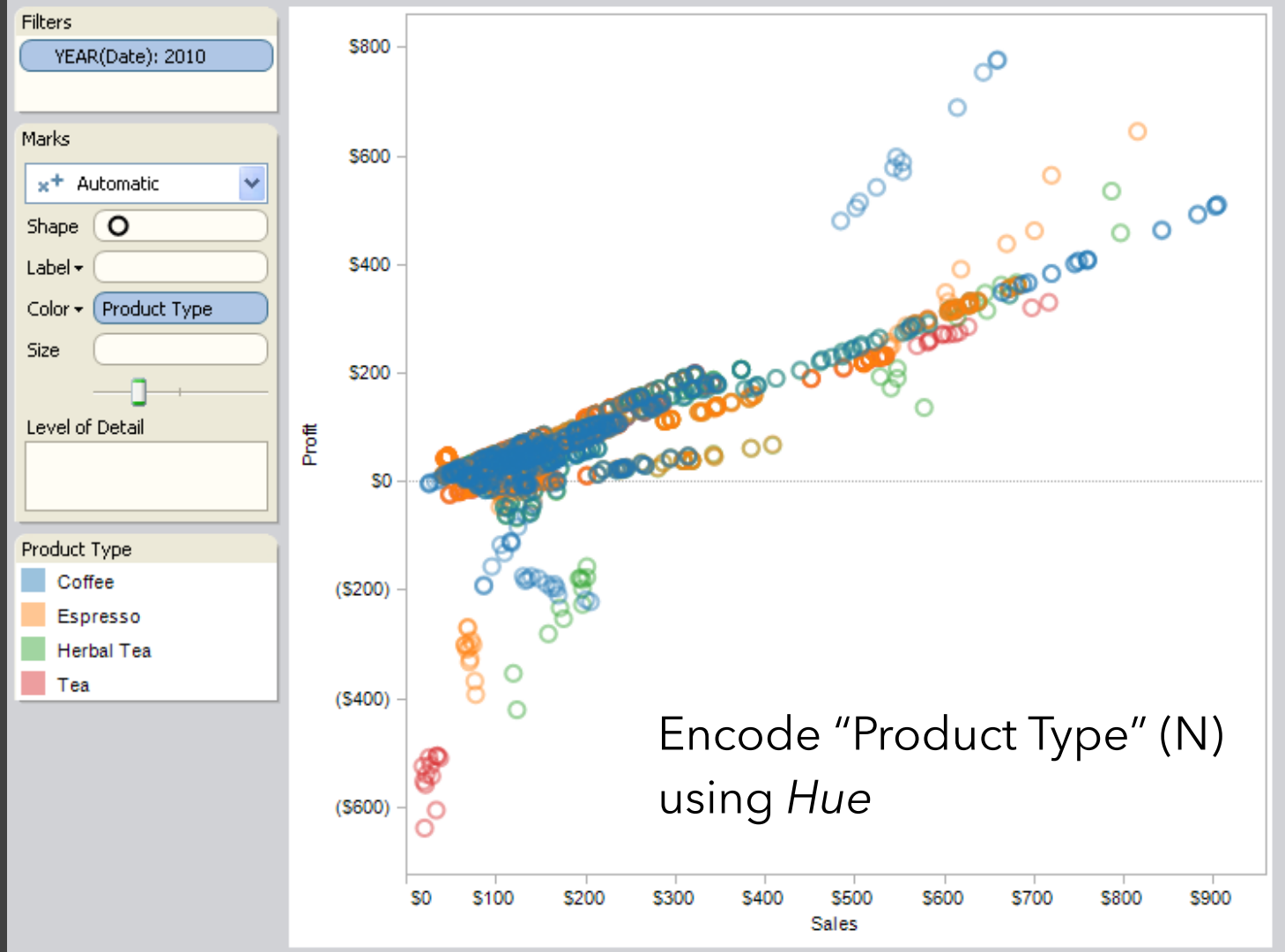


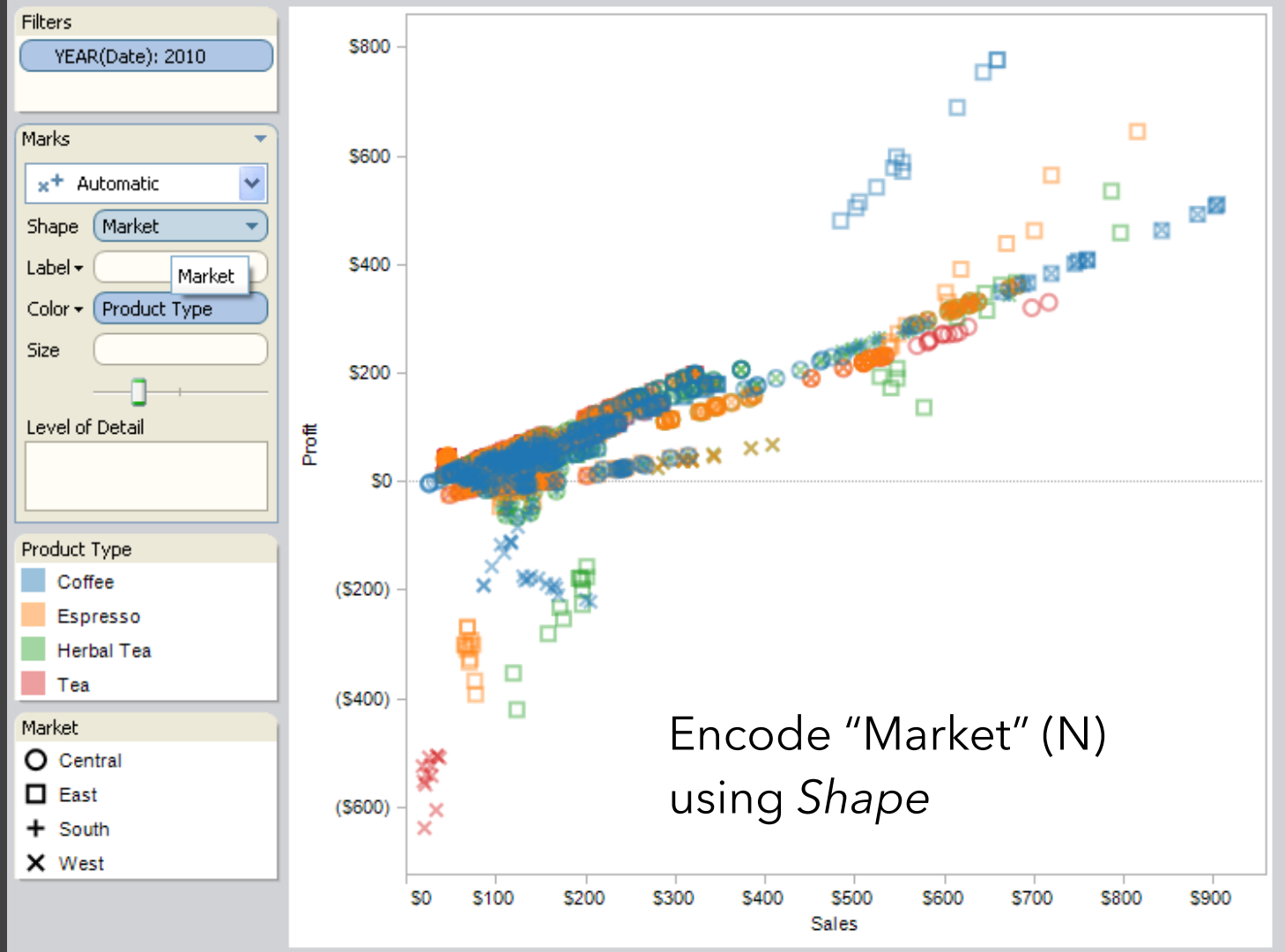
Example: Coffee Sales

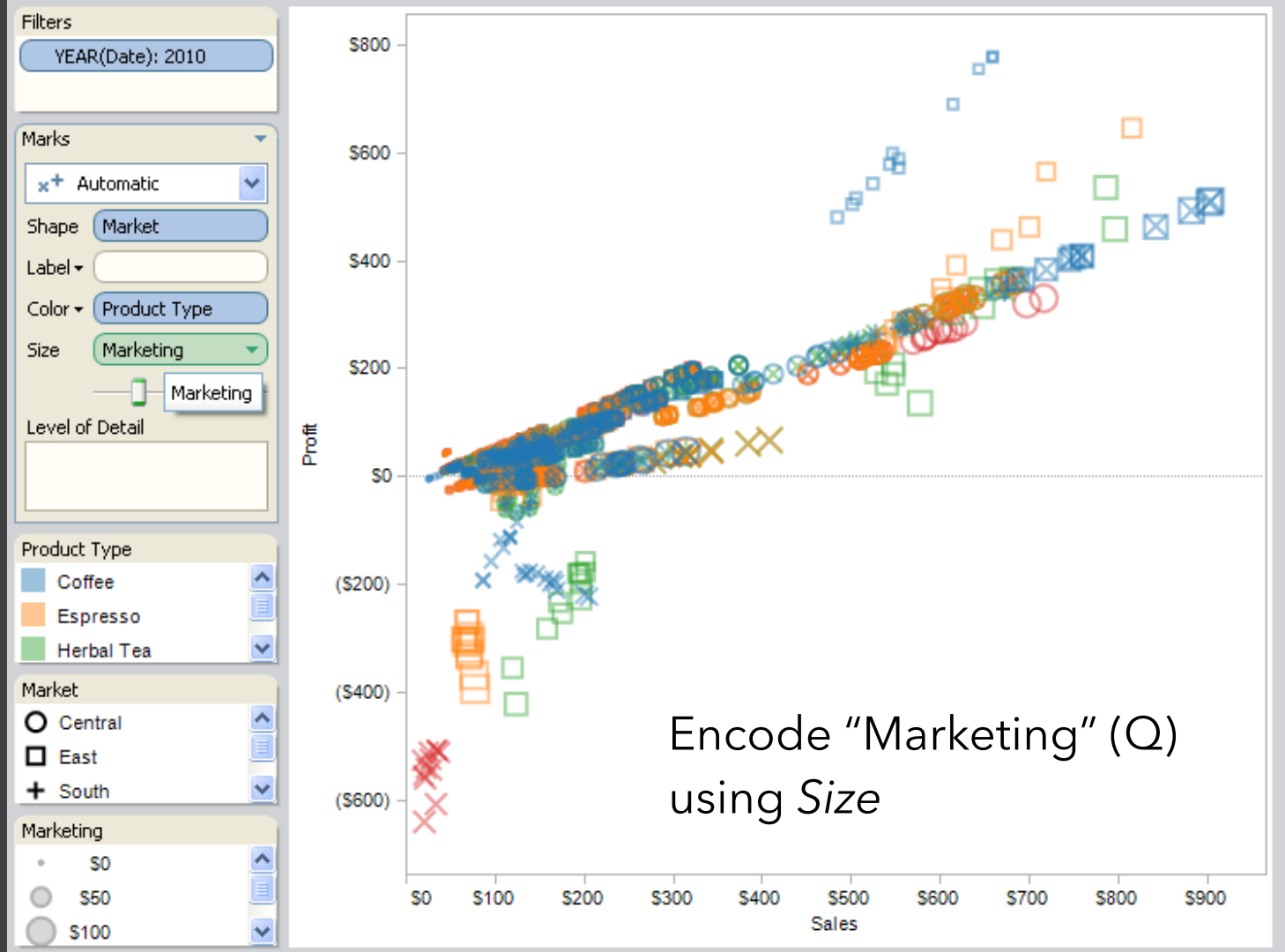
Sales figures for a fictional coffee chain

Sales	Q-Ratio
Profit	Q-Ratio
Marketing	Q-Ratio
Product Type	N {Coffee, Espresso, Herbal Tea, Tea}
Market	N {Central, East, South, West}

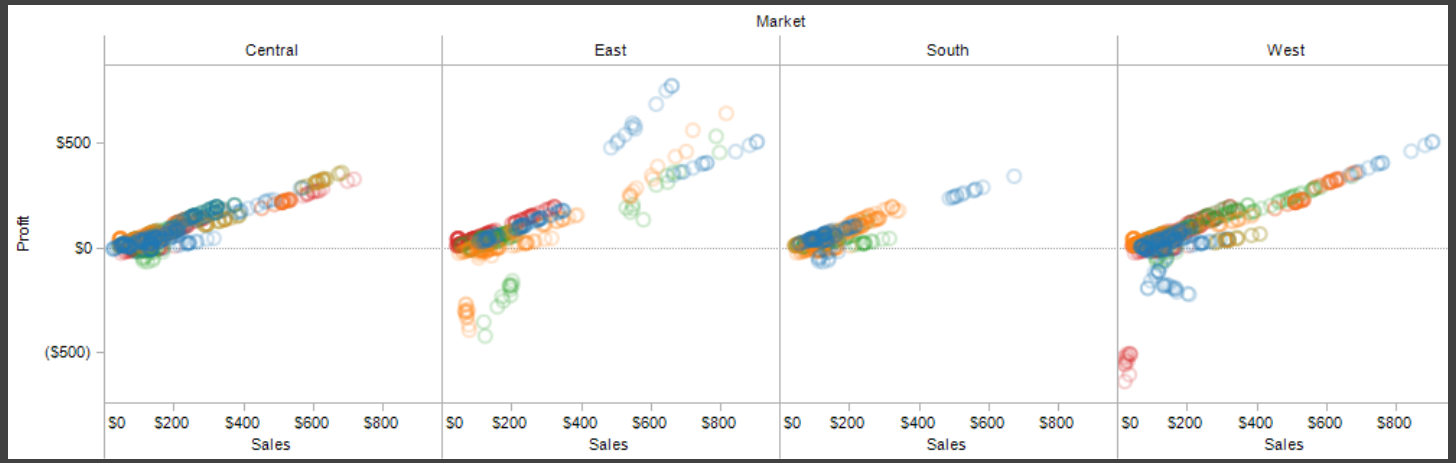

Filters
YEAR(Date): 2010
Marks
Automatic
Shape
Label
Color
Size
Level of Detail
$800
$600
$400
$200
$0
($200)
($400)
($600)
Profit
$0
$100
$200
$300
$400
$500
$600
$700
$800
$900
Sales
Encode “Sales” (Q) and
“Profit” (Q) using *Position*


Filters
YEAR(Date): 2010
Marks
Automatic
Shape
Label
Color
Product Type
Size
Level of Detail
Product Type
Coffee
Espresso
Herbal Tea
Tea
$800
$600
$400
$200
$0
($200)
($400)
($600)
Profit
$0
$100
$200
$300
$400
$500
$600
$700
$800
$900
Sales
Encode “Product Type” (N)
using *Hue*


Filters
YEAR(Date): 2010
Marks
Automatic
Shape
Market
Label
Market
Color
Product Type
Size
Level of Detail
Product Type
Coffee
Espresso
Herbal Tea
Tea
Market
Central
East
South
West
$800
$600
$400
$200
$0
($200)
($400)
($600)
Profit
$0
$100
$200
$300
$400
$500
$600
$700
$800
$900
Sales
Encode "Market" (N)
using *Shape*


Filters
YEAR(Date): 2010
Marks
Automatic
Shape
Market
Label
Color
Product Type
Size
Marketing
Marketing
Level of Detail
Product Type
Coffee
Espresso
Herbal Tea
Market
Central
East
South
Marketing
$0
$50
$100
$800
$600
$400
$200
$0
($200)
($400)
($600)
Profit
$0
$100
$200
$300
$400
$500
$600
$700
$800
$900
Sales
Encode “Marketing” (Q)
using *Size*

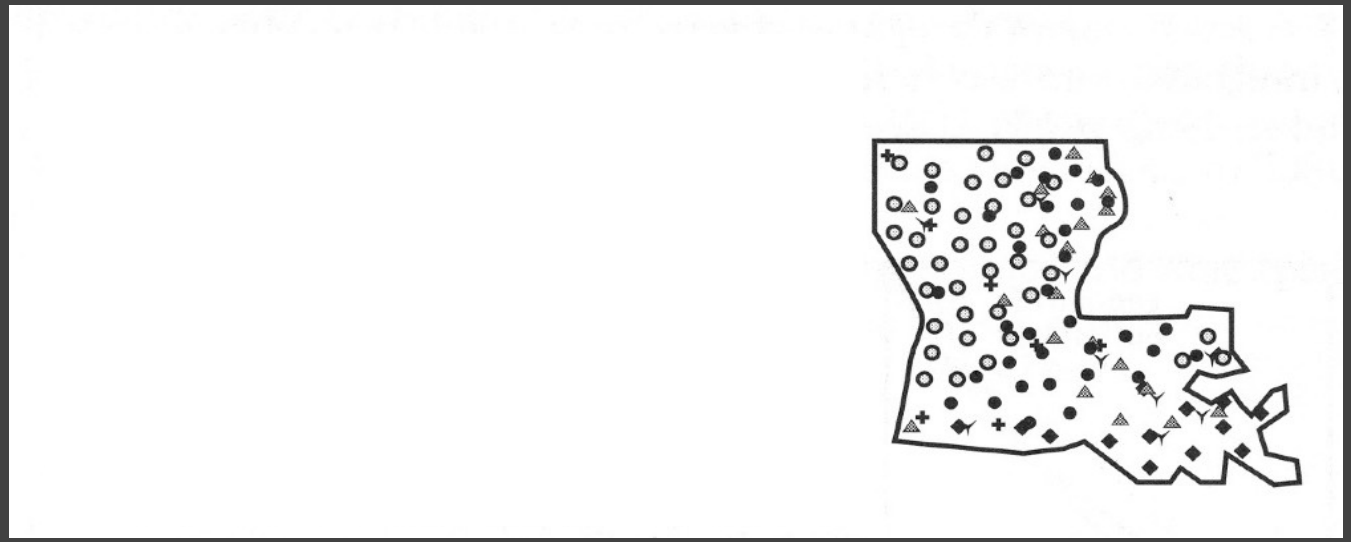
Trellis Plots



A *trellis plot* subdivides space to enable comparison across multiple plots.

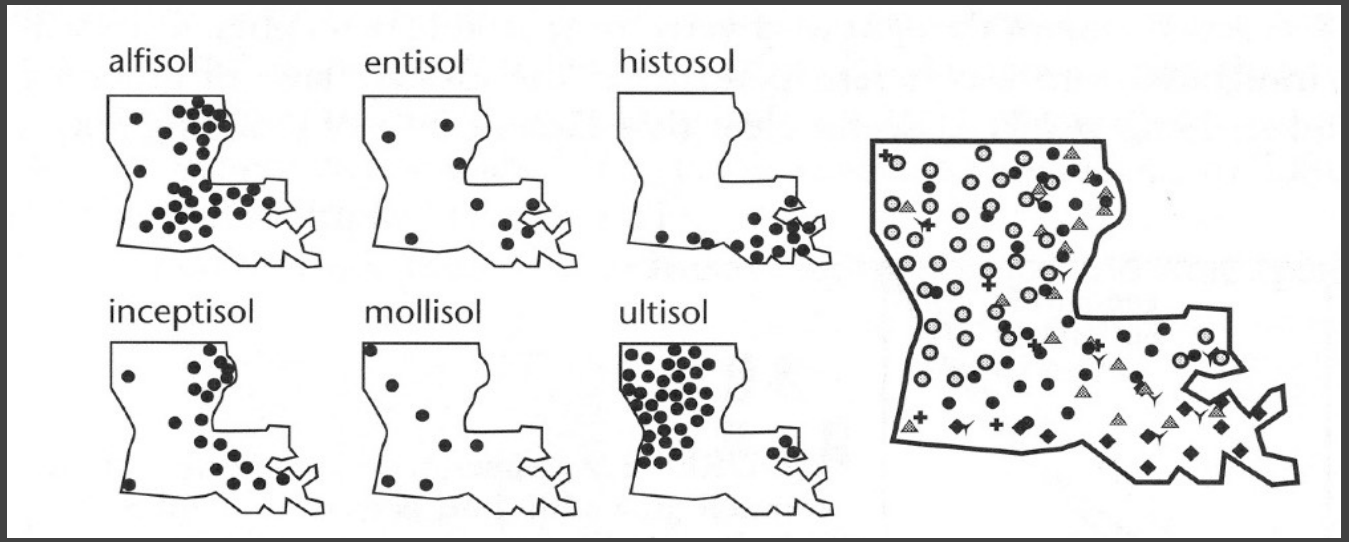
Typically nominal or ordinal variables are used as dimensions for subdivision.

Small Multiples



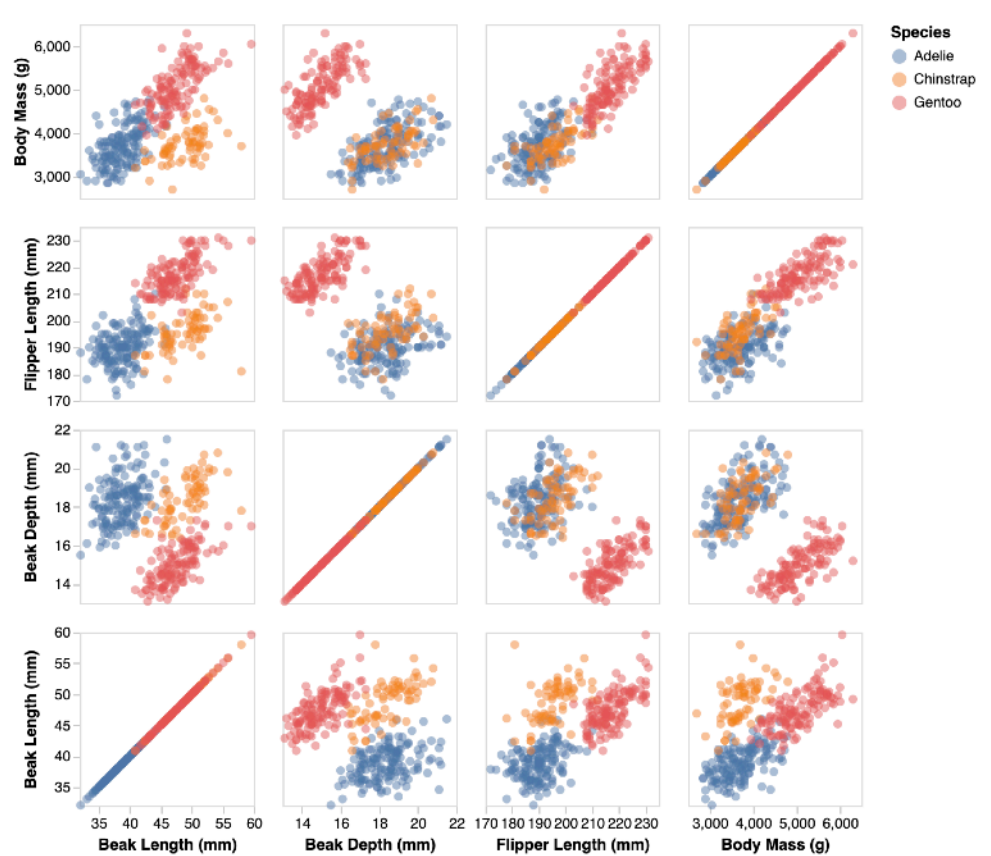
[MacEachren ’95, Figure 2.11, p. 38]

Small Multiples



[MacEachren ’95, Figure 2.11, p. 38]

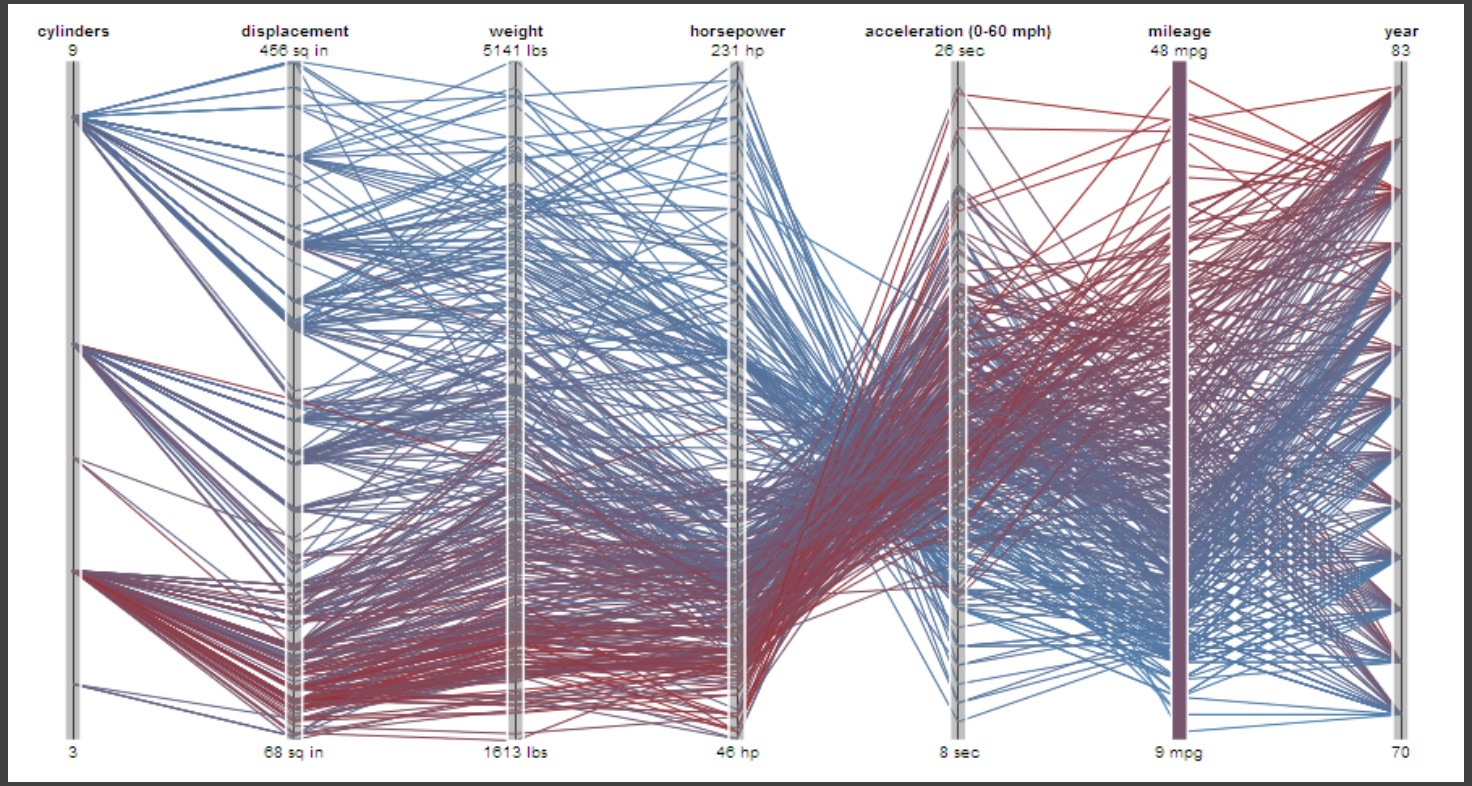
Scatterplot Matrix (SPLOM)



Scatter plots for pairwise comparison of each data dimension.

Parallel Coordinates

Parallel Coordinates [Inselberg]



Parallel Coordinates [Inselberg]

Visualize up to ~two dozen dimensions at once

1. Draw parallel axes for each variable
2. For each tuple, connect points on each axis

Between adjacent axes: line crossings imply neg. correlation, shared slopes imply pos. correlation.

Full plot can be cluttered. **Interactive selection** can be used to assess multivariate relationships.

Highly sensitive to axis **scale** and **ordering**.

Expertise required to use effectively!

Scales & Axes

Scale Transforms

$$f\colon D \rightarrow R$$

A **scale** is a function that maps a domain D of data values to a range R of visual values.

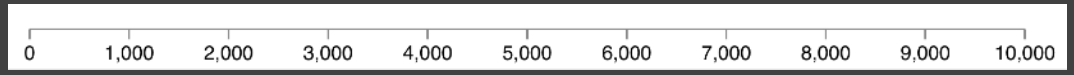
Example ranges: x-position, color, size, angle

Scales are the workhorses of visual encoding!

We can modify domains, ranges, transforms (log, etc.), padding, and more…

Positional Scales $R = pixels$

Continuous / Quantitative



linear

log

sqrt

Discrete / Ordinal

point

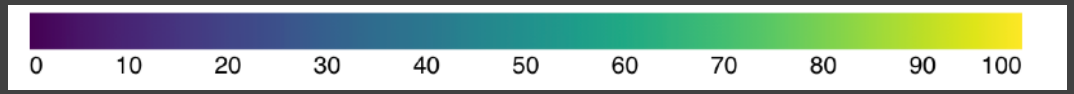
band

Color Scales $R = colors$

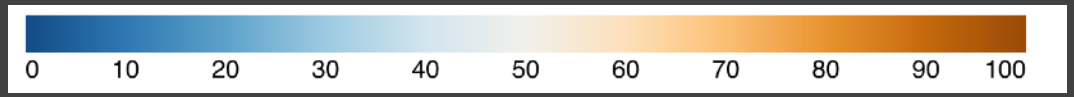
Discrete / Categorical

ordinal

Continuous / Quantitative

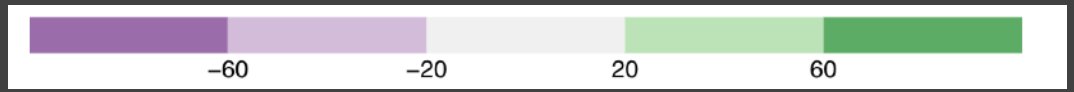


sequential



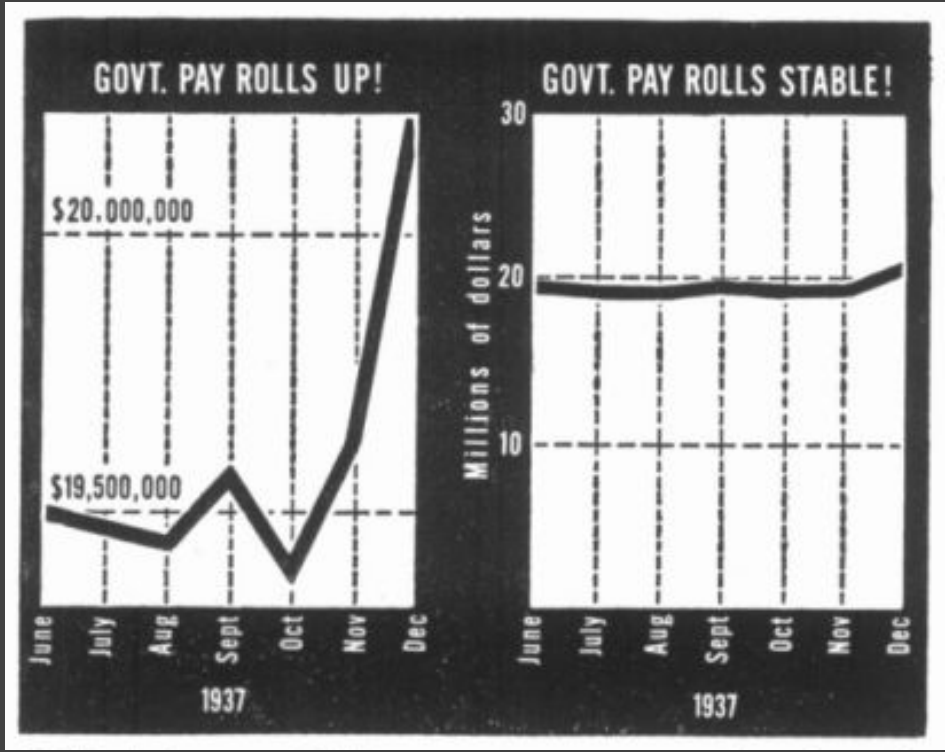
diverging

Discretized / Binned Quantitative



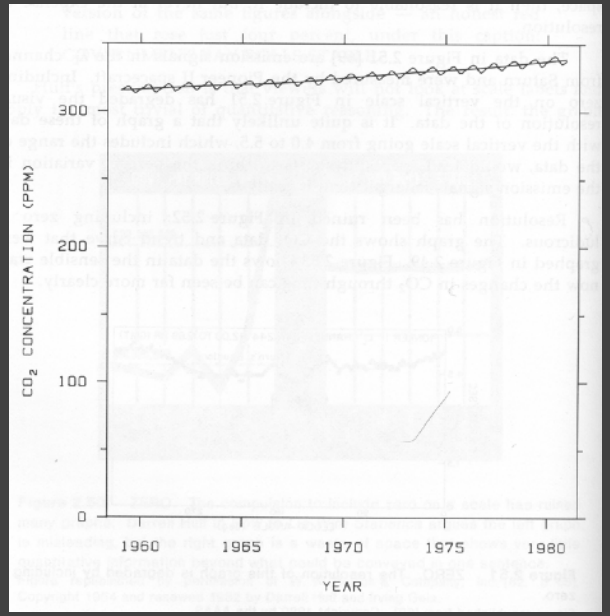
quantize

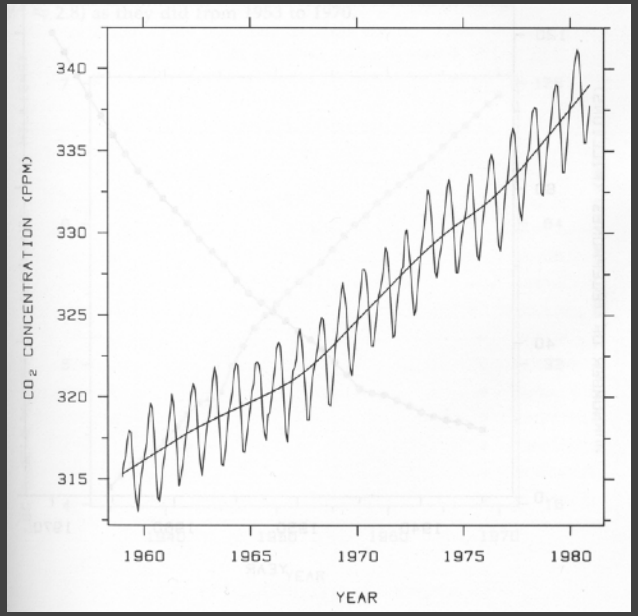
Include Zero in Axis Scale?



Government payrolls in 1937 [How To Lie With Statistics. Huff]

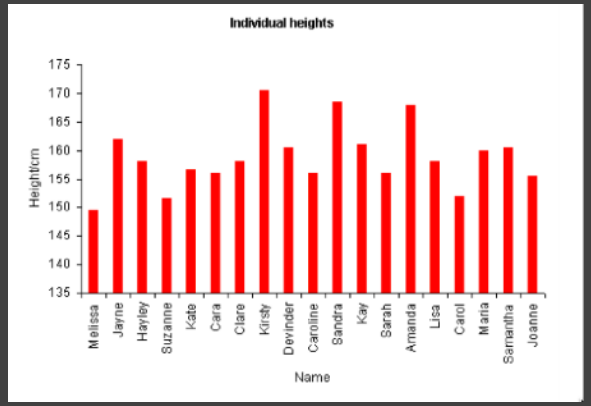
Include Zero in Axis Scale?





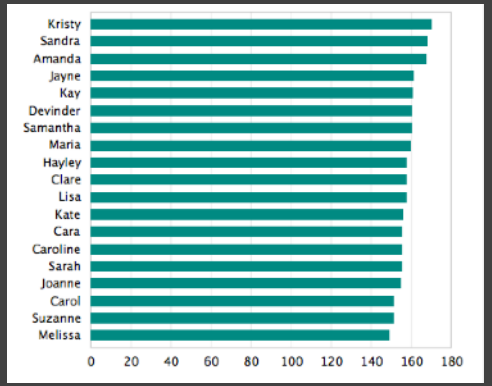
Yearly CO_2 concentrations [Cleveland 85]

Include Zero in Axis Scale?

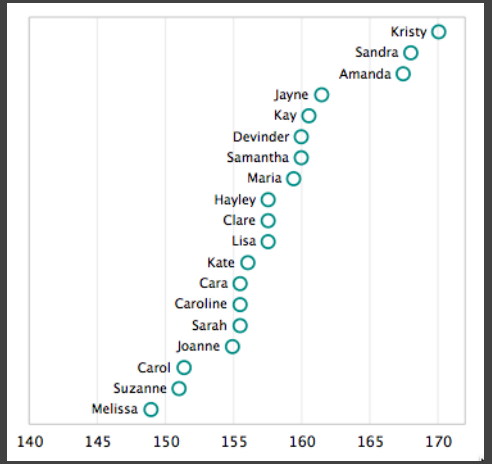


Violates Expressiveness Principle!

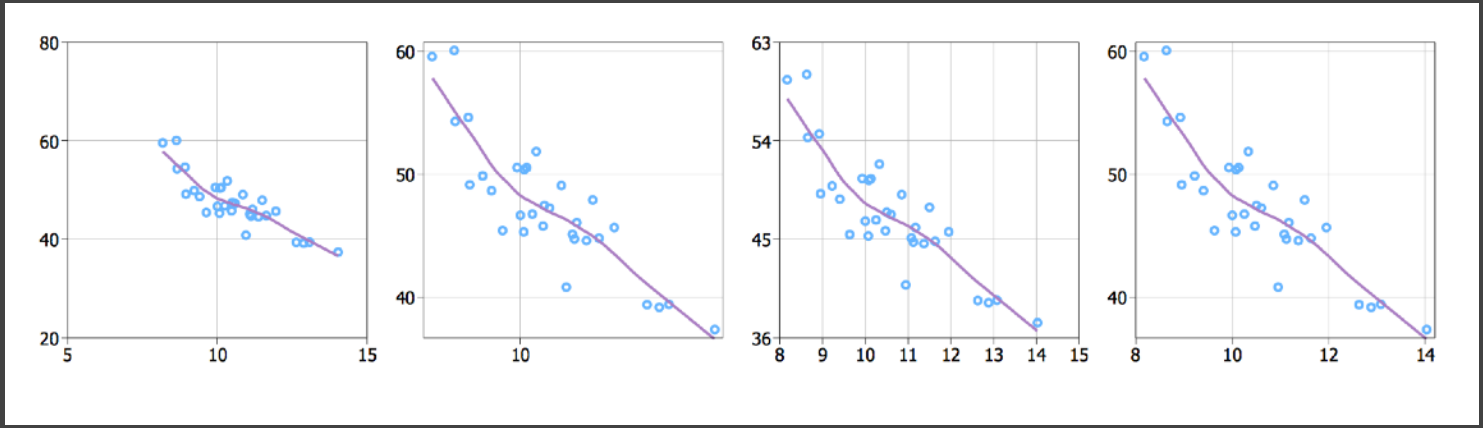
Compare Proportions (Q-Ratio)



Compare Relative Position (Q-Interval)

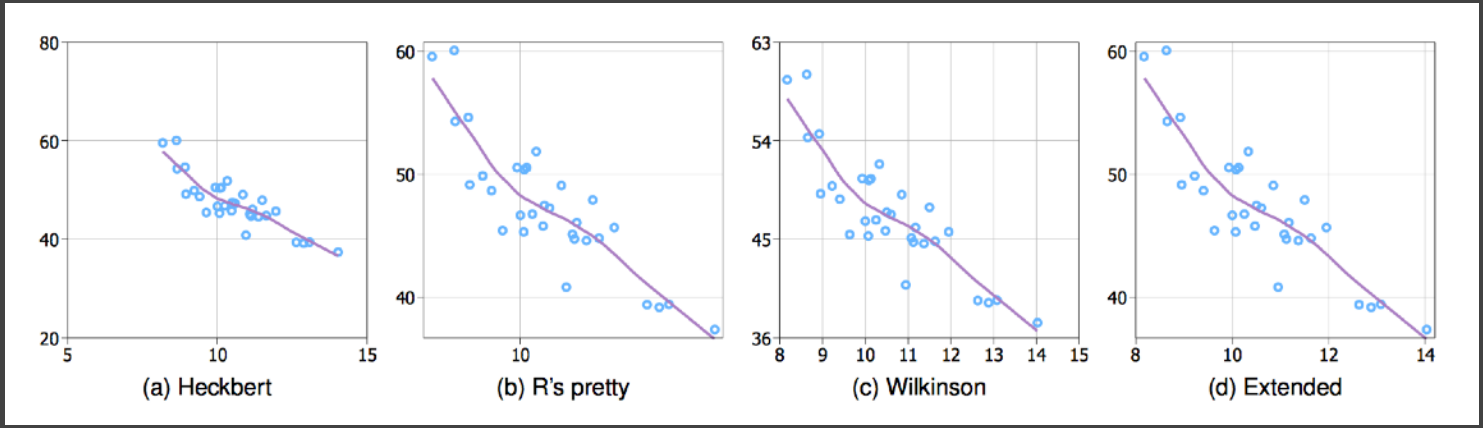


Axis Tick Mark Selection



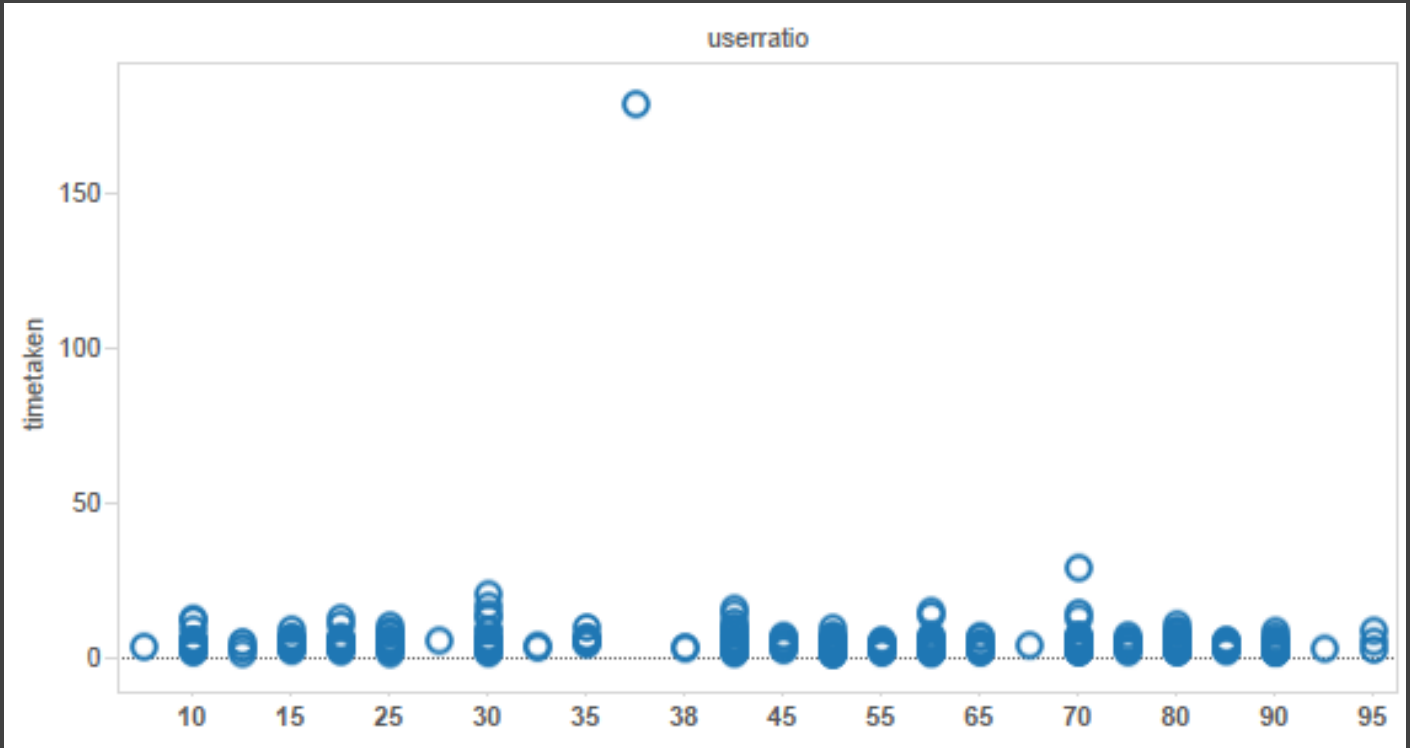
What are some properties of “good” tick marks?

Axis Tick Mark Selection

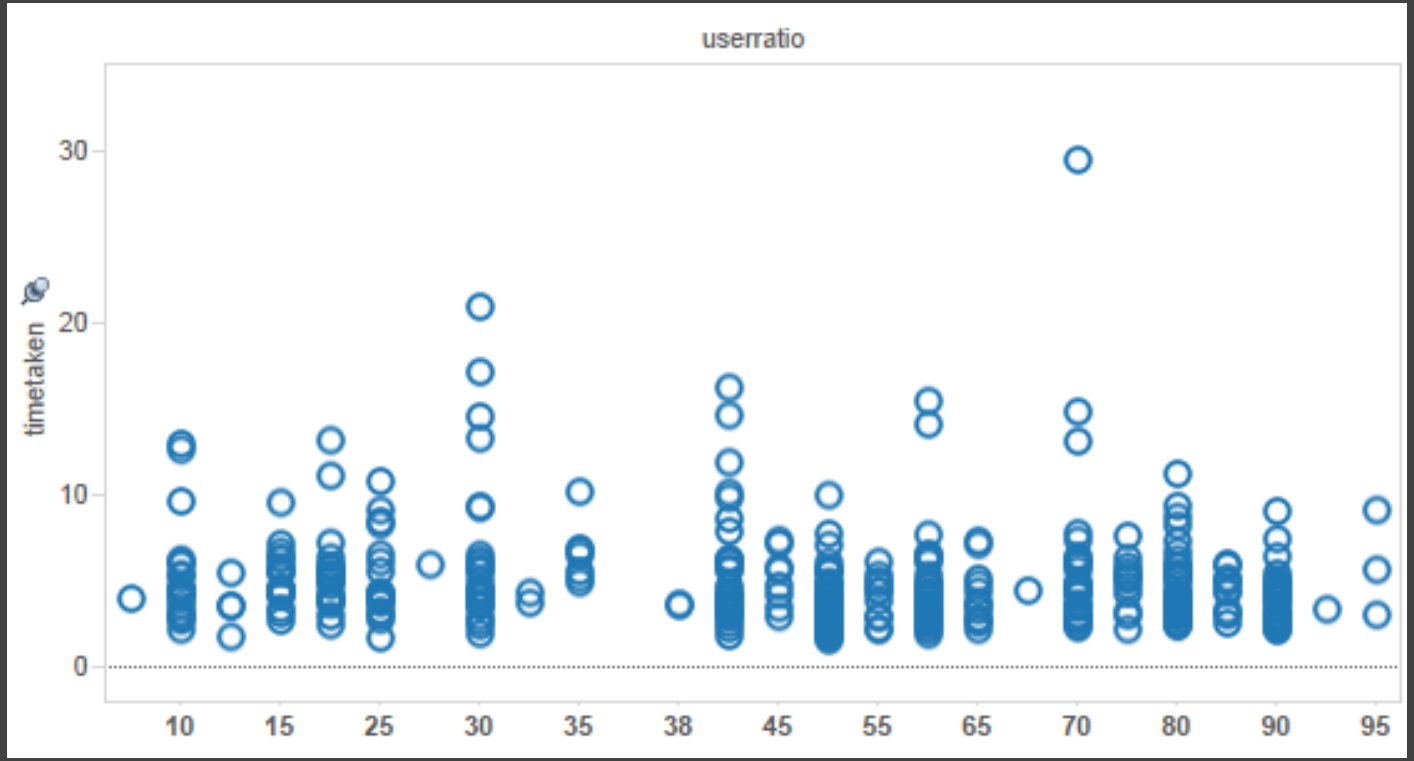


Simplicity - numbers are multiples of 10, 5, 2
Coverage - ticks near the ends of the data
Density - not too many, nor too few
Legibility - whitespace, horizontal text, size

How to Scale the Axis?

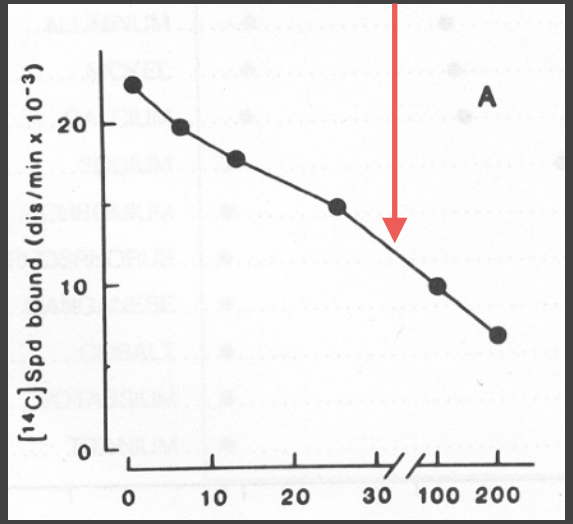


One Option: Clip Outliers

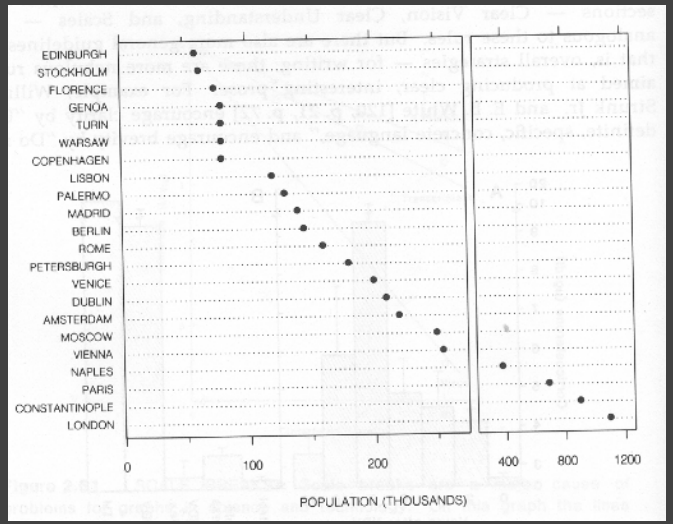


Clearly Mark Scale Breaks

Violates Expressiveness Principle!

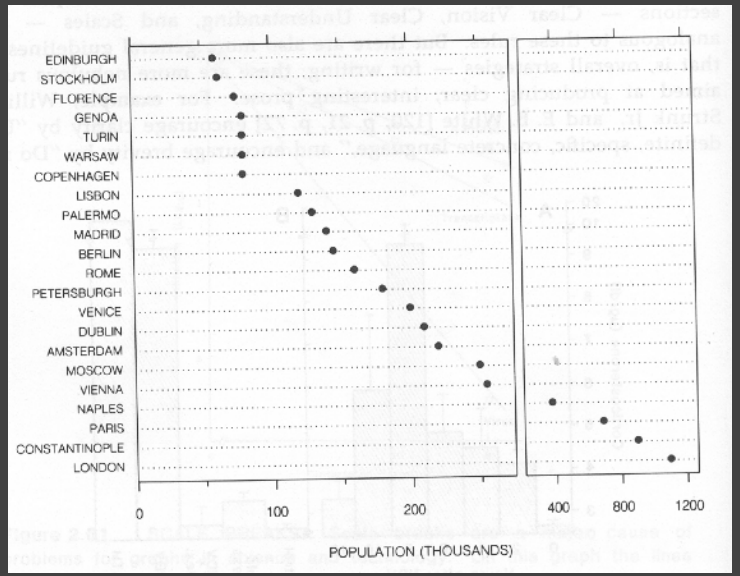


Poor scale break [Cleveland 85]

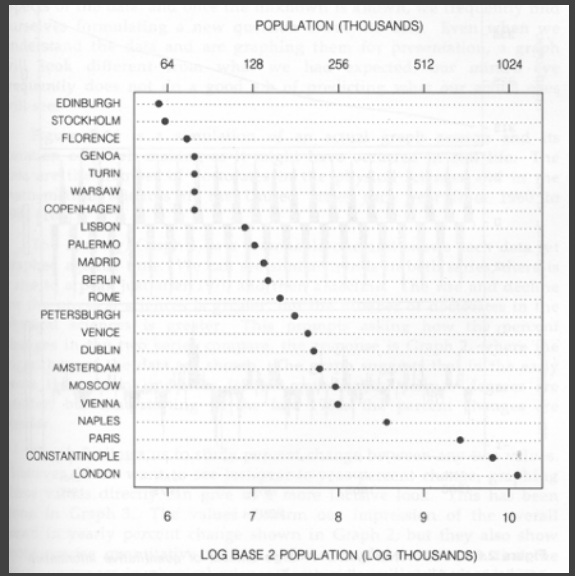


Well-marked scale break [Cleveland 85]

Scale Break vs. Log Scale



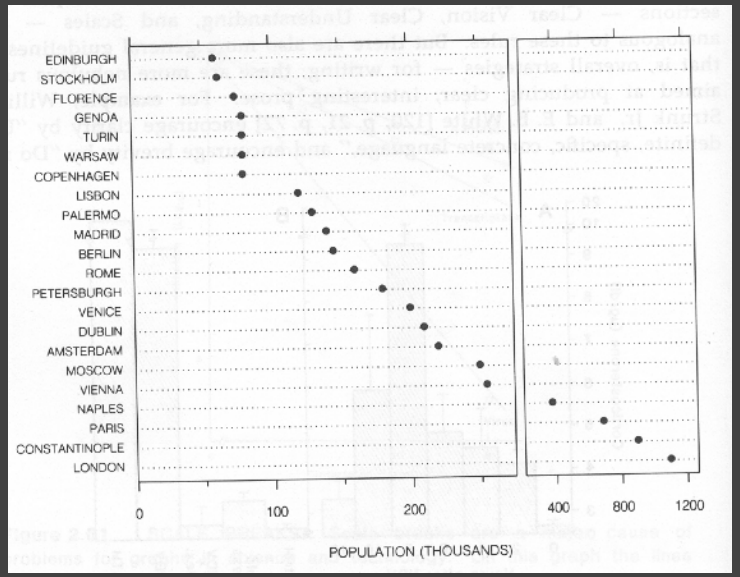
Scale Break

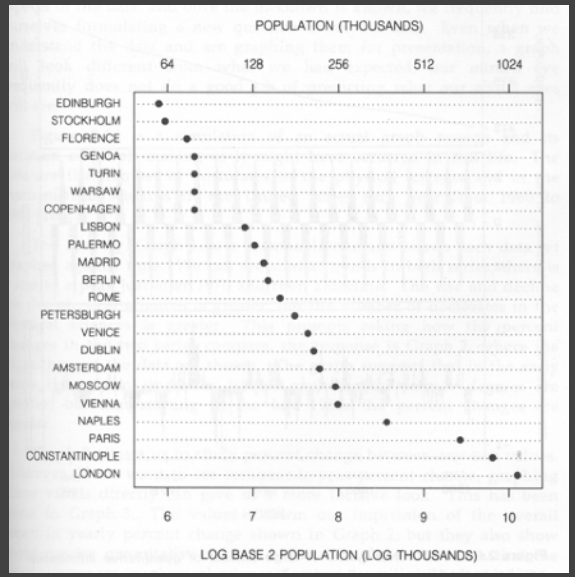


Log Scale

[Cleveland 85]

Scale Break vs. Log Scale





Both increase visual resolution

Scale break: difficult to compare (*cognitive* – not *perceptual* – work)

Log scale: direct comparison of all data

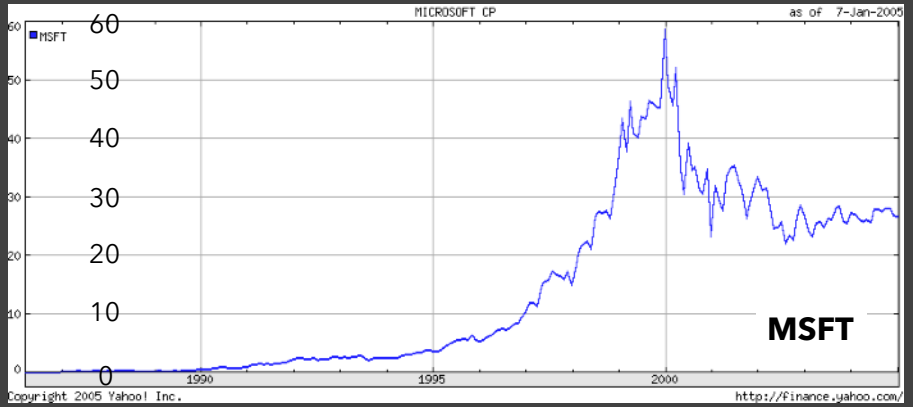
Logarithms turn *multiplication* into *addition*.

$$\log(x\,y) = \log(x) + \log(y)$$

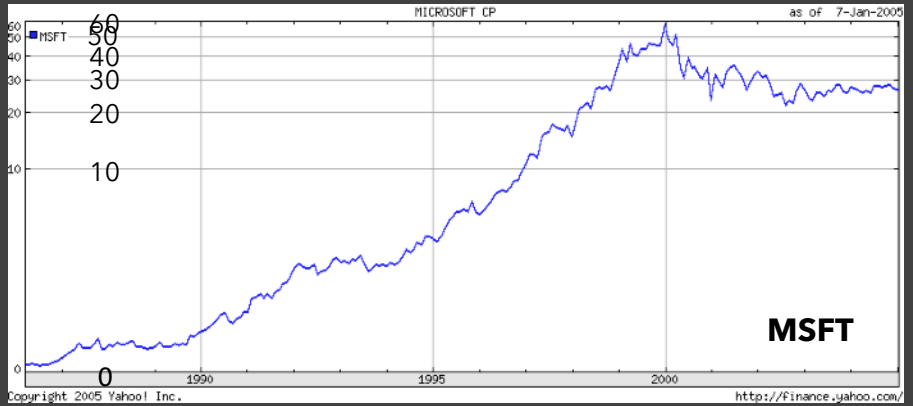
Equal steps on a log scale correspond to equal changes to a multiplicative scale factor.

Linear Scale vs. Log Scale

Linear Scale



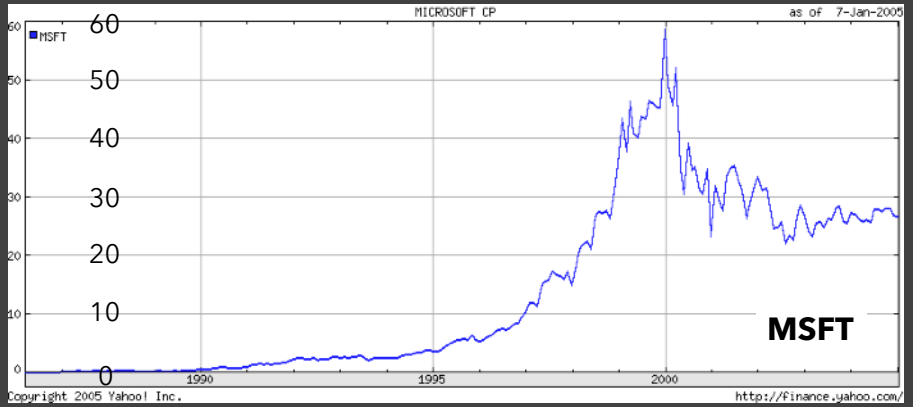
Log Scale



Linear Scale vs. Log Scale

Linear Scale

Absolute change

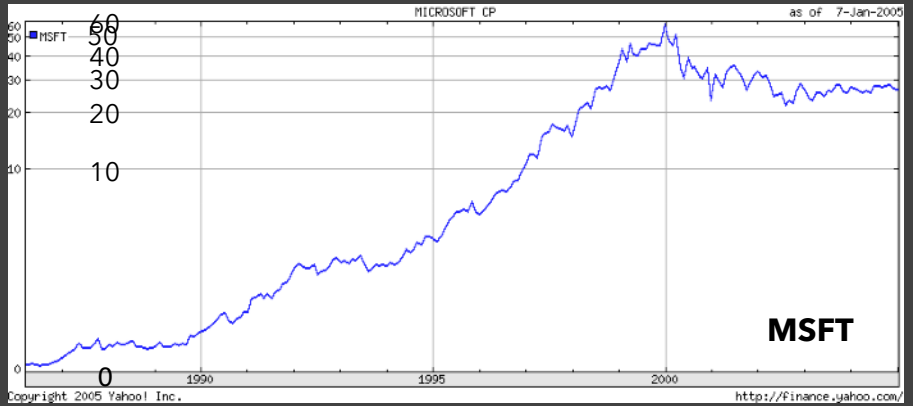


Log Scale

Small fluctuations

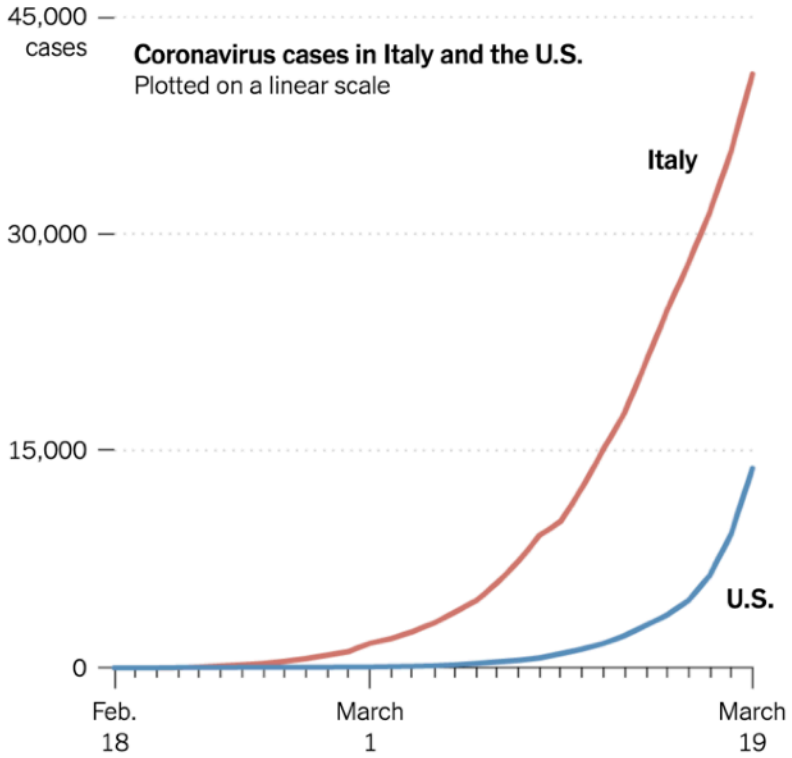
Percent change

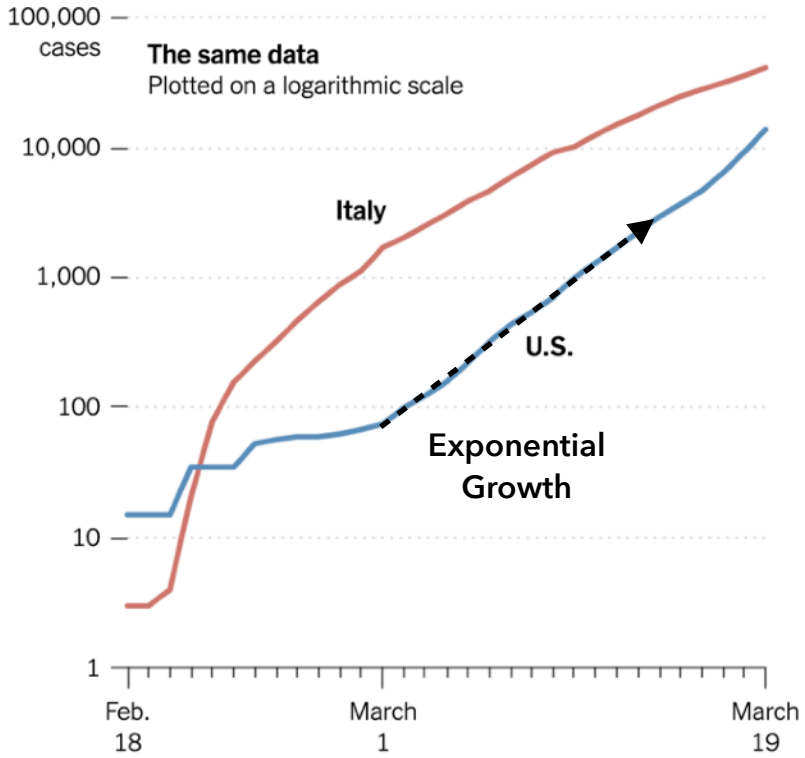
d(10,30) > d(30,60)



Bending the Curve

Logarithmic scales can emphasize the rate of change in a way that linear scales do not. Italy seems to be slowing the coronavirus infection rate, while the number of cases in the United States continues to double every few days.





By The New York Times | Data from Worldometer

When To Apply a Log Scale?

Address data skew (e.g., long tails, outliers)

Enables comparison within and across multiple orders of magnitude.

Focus on multiplicative factors (not additive)

Recall that the logarithm transforms ✕ to +!

Percentage change, not linear difference.

Constraint: **positive, non-zero values**

Constraint: **audience familiarity?**

Visual Encoding Design

Use **expressive** and **effective** encodings
Reduce the problem space
Avoid **over-encoding**
Use **space** and **small multiples** intelligently
Use **interaction** to generate *relevant* views

Rarely does a single visualization answer all questions. Instead, the ability to generate appropriate visualizations quickly is critical!

About the design process…

Visualization draws upon both science and art!

Principles like expressiveness & effectiveness are not hard-and-fast rules, but can assist us to guide the process and articulate alternatives.

They can lead us to think more deeply about our design rationale and prompt us to reflect.

It helps to know "the rules" in order to wisely bend (*or break*) them at the right times!

Break Time!

W1 Assignment Review

Deceptive Visualization

Slides by Michael Correll

Deceptive Visualizations

Incorrect Visualizations

Illegible Visualizations

Bullshit Visualizations

Unconventional Visualizations

Deceptive Visualizations

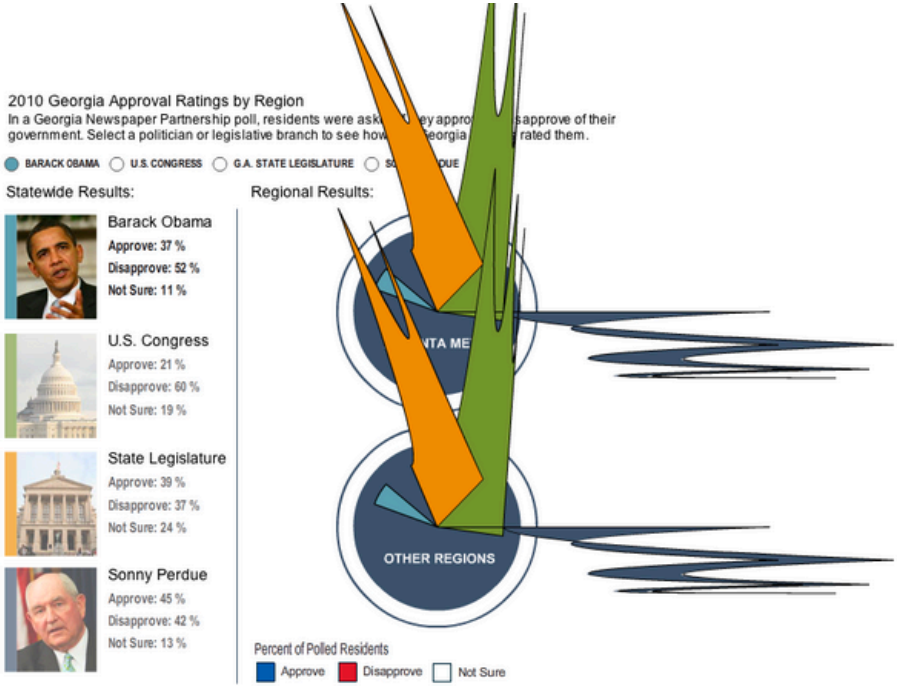
Incorrect Visualizations

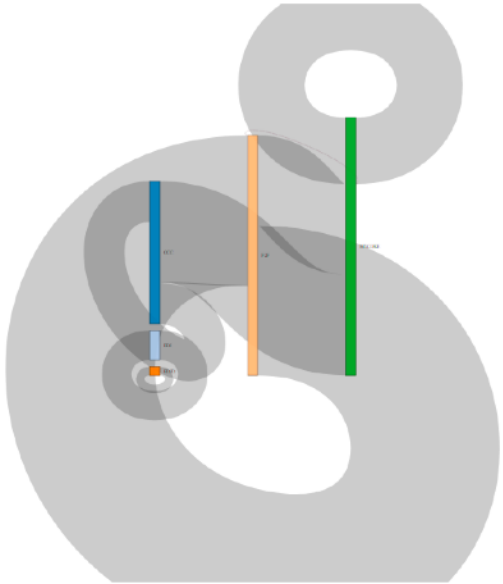
Illegible Visualizations

Bullshit Visualizations

Unconventional Visualizations

Incorrect Visualization



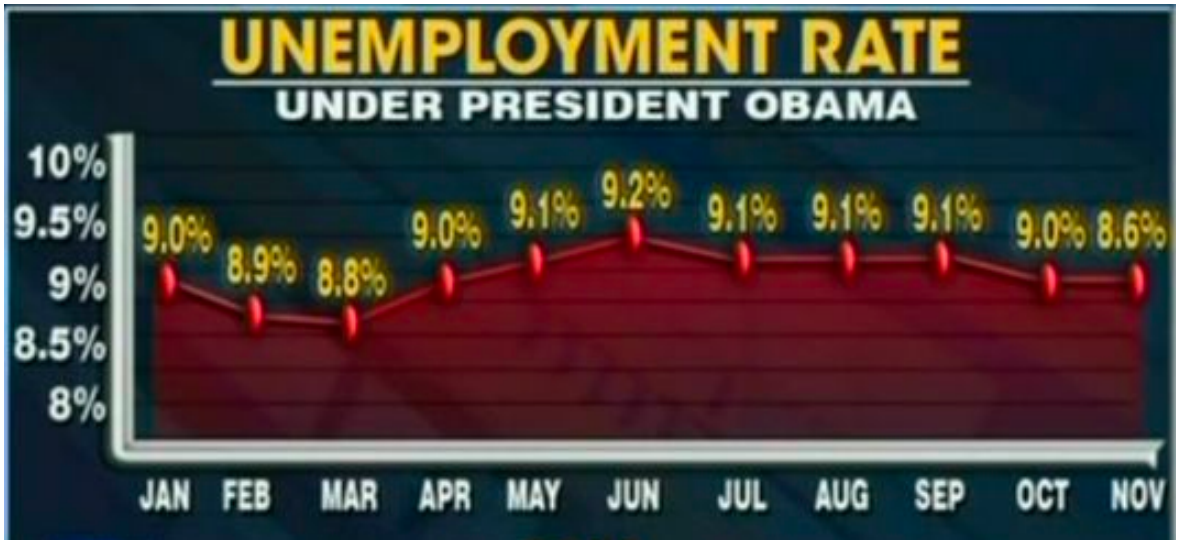


https://accidental-art.tumblr.com/

RIGHT NOW | CHICAGO 71° | DETROIT 66° | HOUSTON 77°

EALTH EVALUATION IN MIRIAM CAREY'S HOME AFTER DC (CNN.com


RIGHT NOW
TEMPERATURES
FOX 10
AccuWeather
Wickenburg
2385
Cave Creek
2960
Surprise
1350
Deer Valley
65
Fountain Hills
1665
Glendale
66
Scottsdale
64
Buckeye
66
Goodyear
64
Sky Harbor
64
Mesa
63
Apache Junction
64
Ahwatukee
1270
Chandler
63
Gateway
63
Queen Creek
Maricopa
63
Florence
1625
FOX 10
12:20
64°


UNEMPLOYMENT RATE
UNDER PRESIDENT OBAMA
10%
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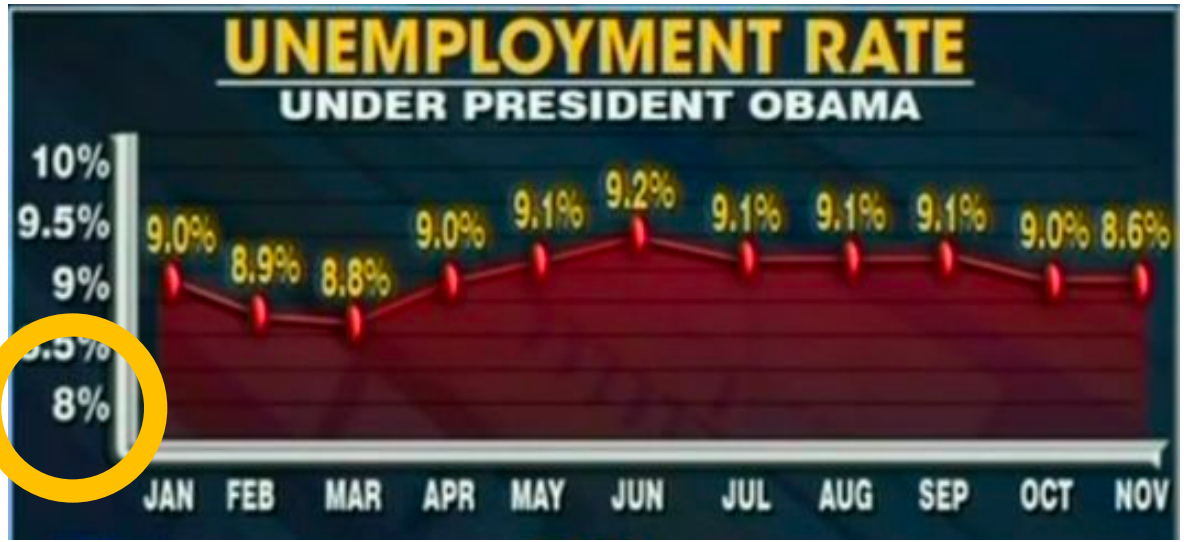
UNEMPLOYMENT RATE
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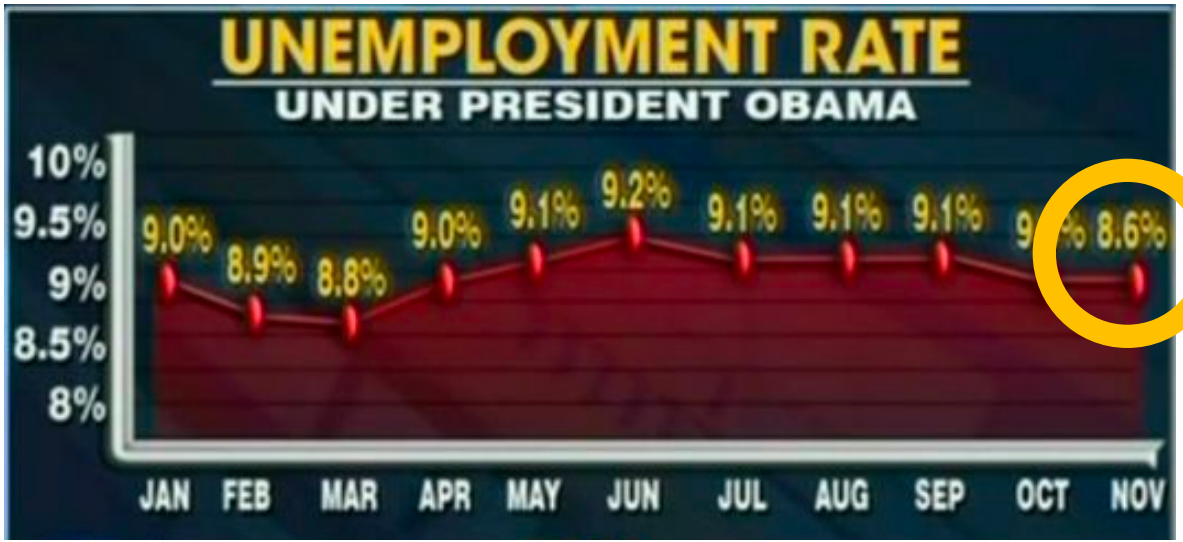
UNEMPLOYMENT RATE
UNDER PRESIDENT OBAMA
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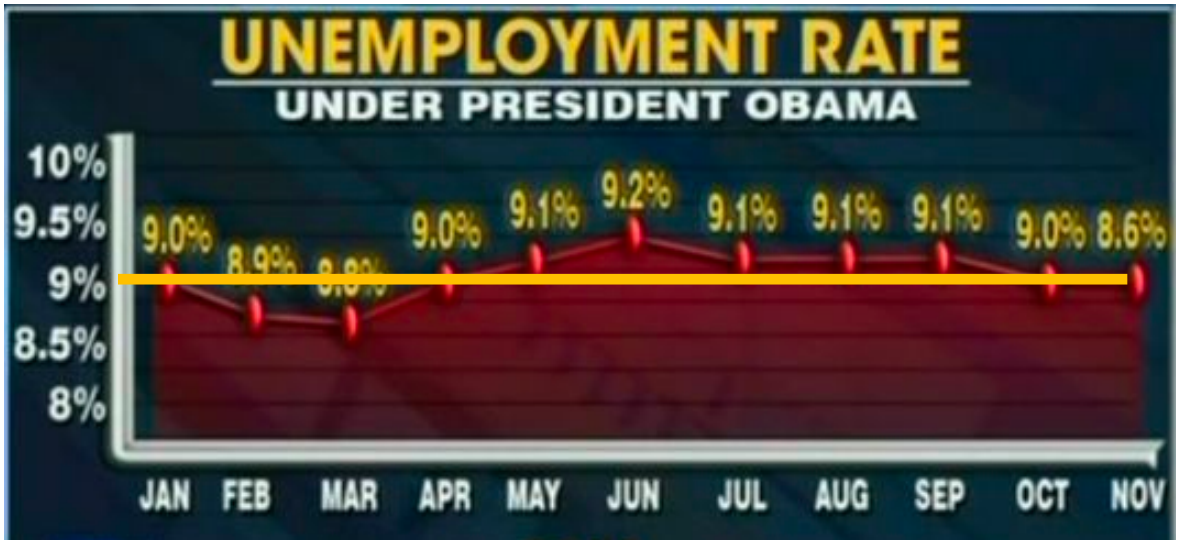
UNEMPLOYMENT RATE
UNDER PRESIDENT OBAMA
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UNEMPLOYMENT RATE
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UNEMPLOYMENT RATE
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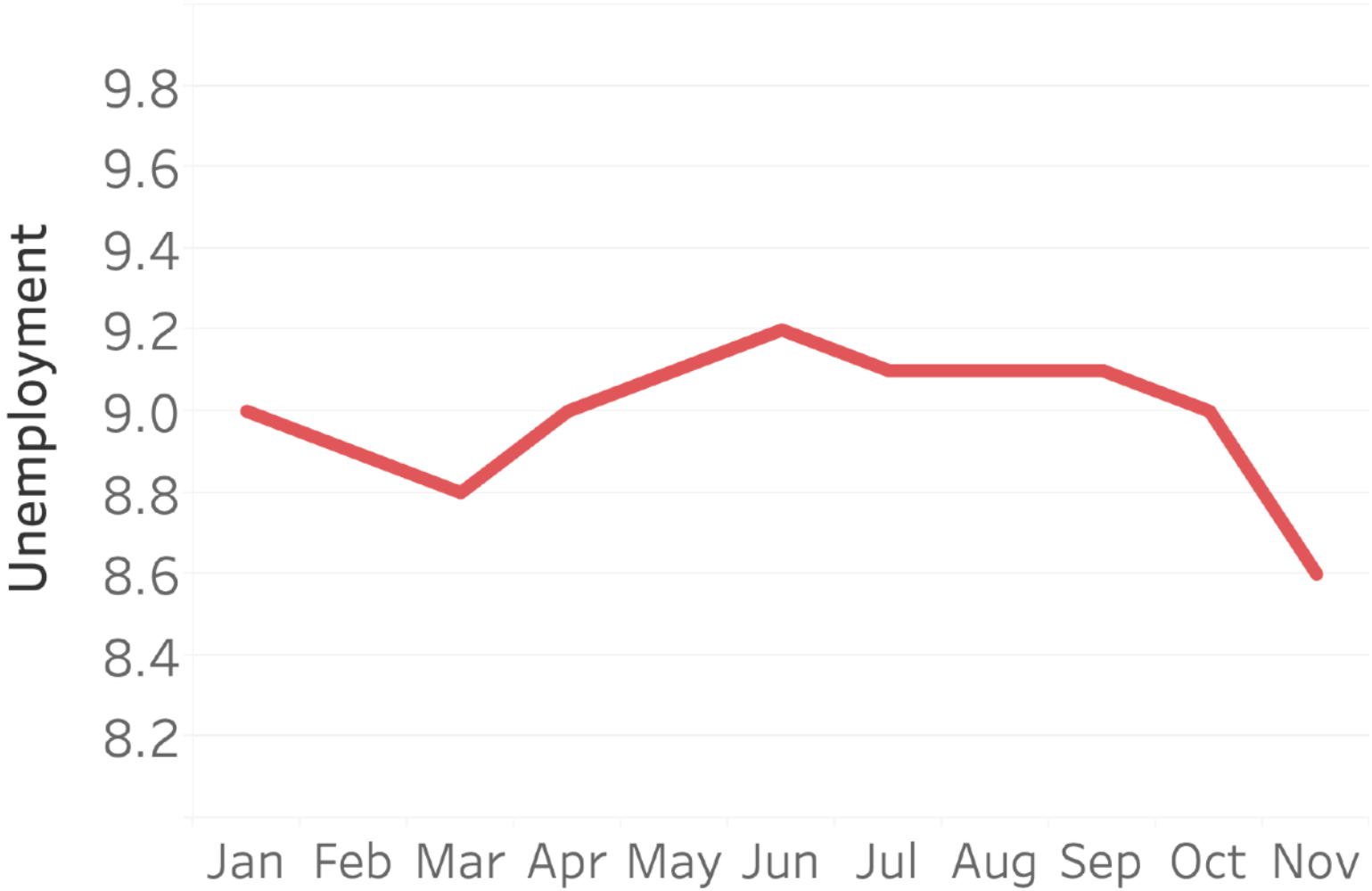
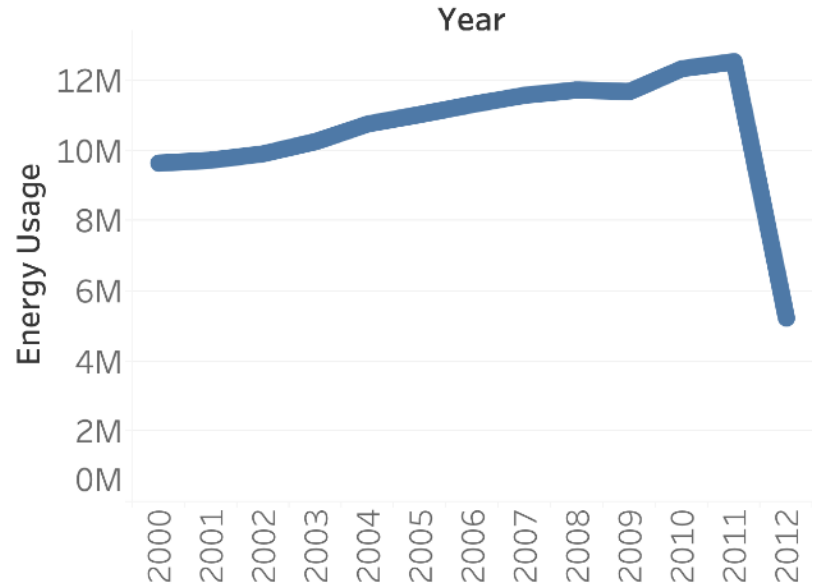
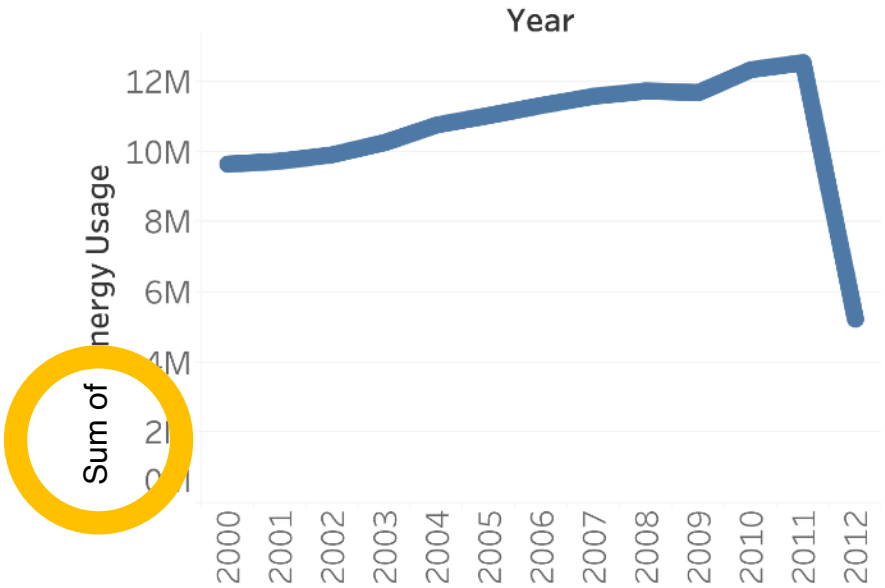

Unemployment
9.8
9.6
9.4
9.2
9.0
8.8
8.6
8.4
8.2
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov

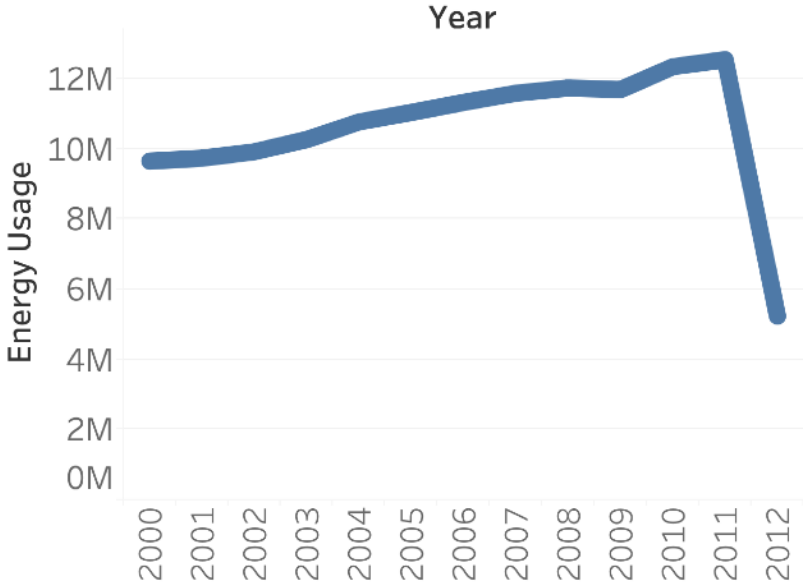
Energy Usage Down?

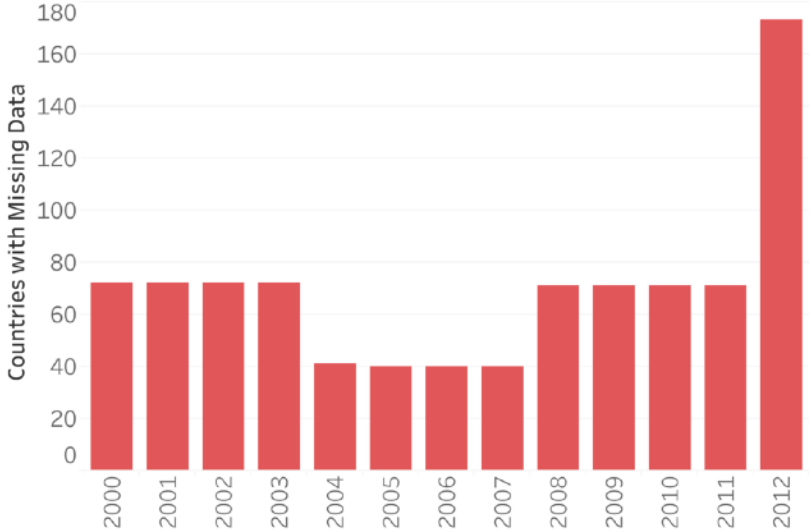


Energy Usage Down?

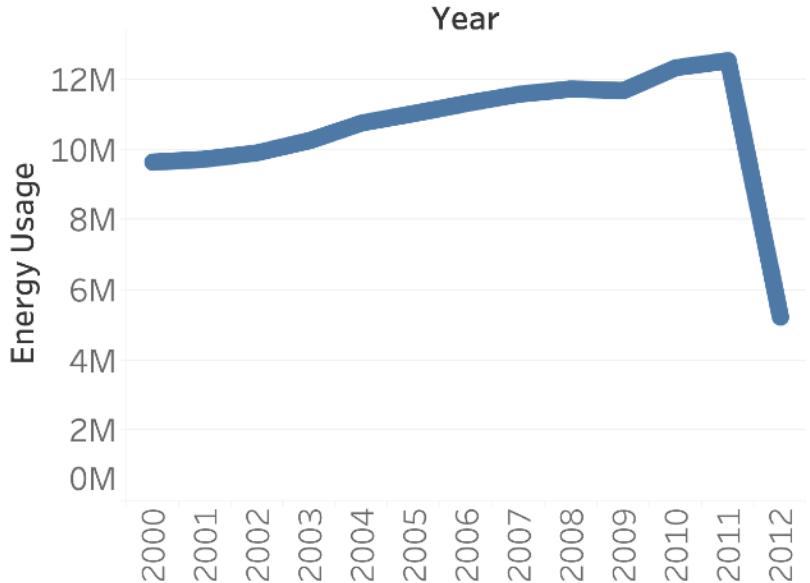


Energy Usage Down?

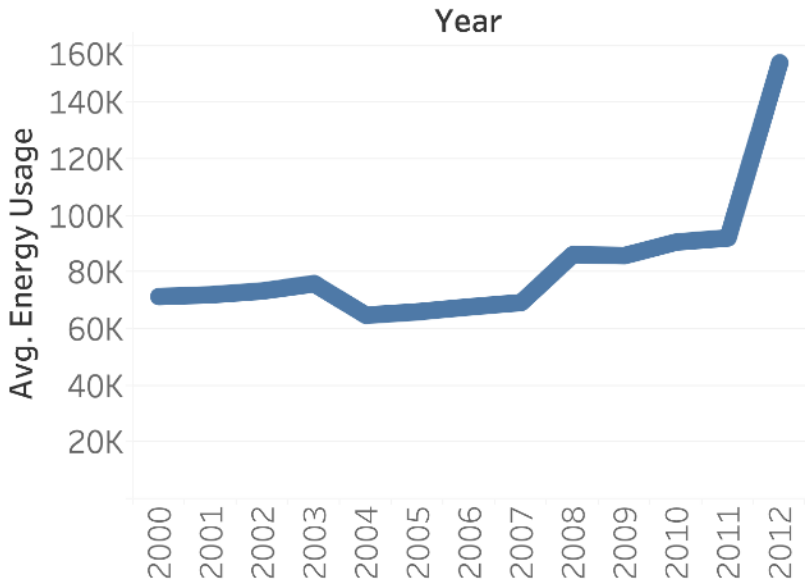




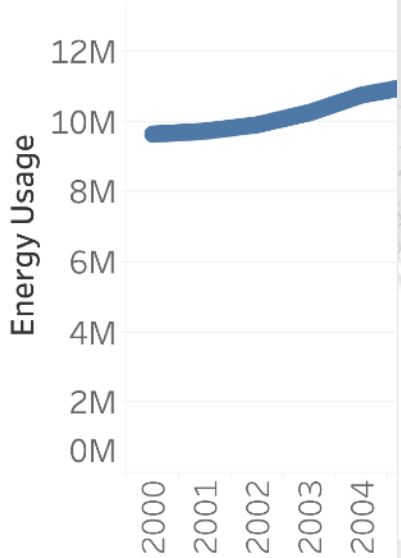
Energy Usage Down?



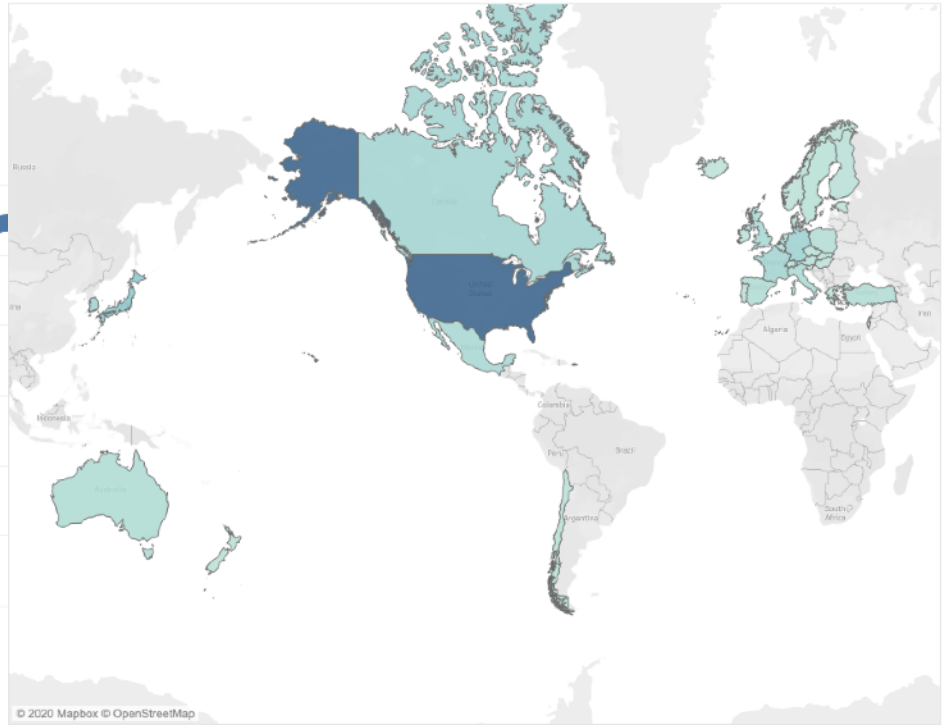
Energy Usage Up?



Energy Usage Down?



2012 Non-Nulls Are OECD Countries



Incorrect Visualizations

People assume that visualizations properly encode their data

…if we violate that assumption, we can do anything we want.

Deceptive Visualizations

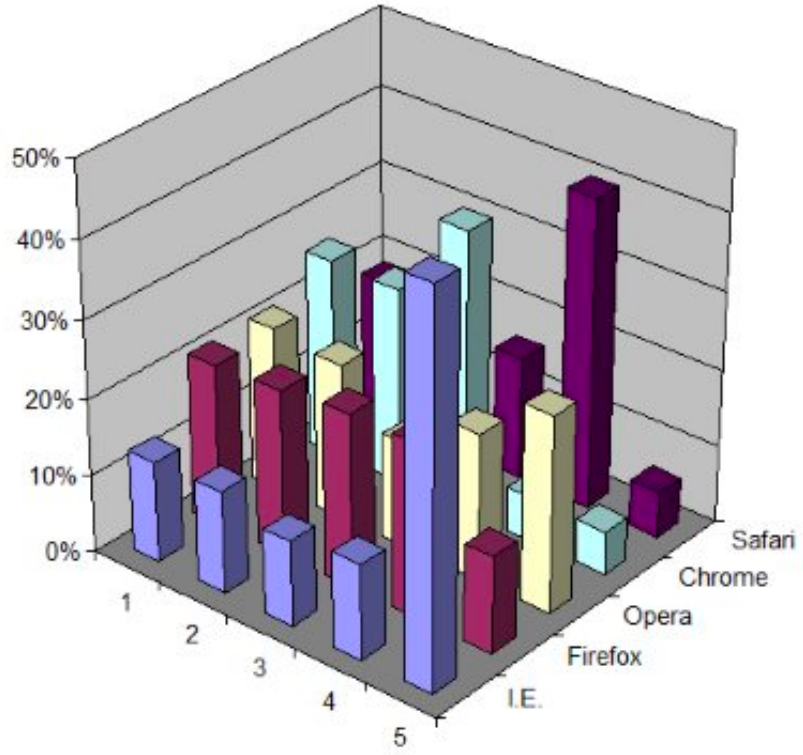
Incorrect Visualizations

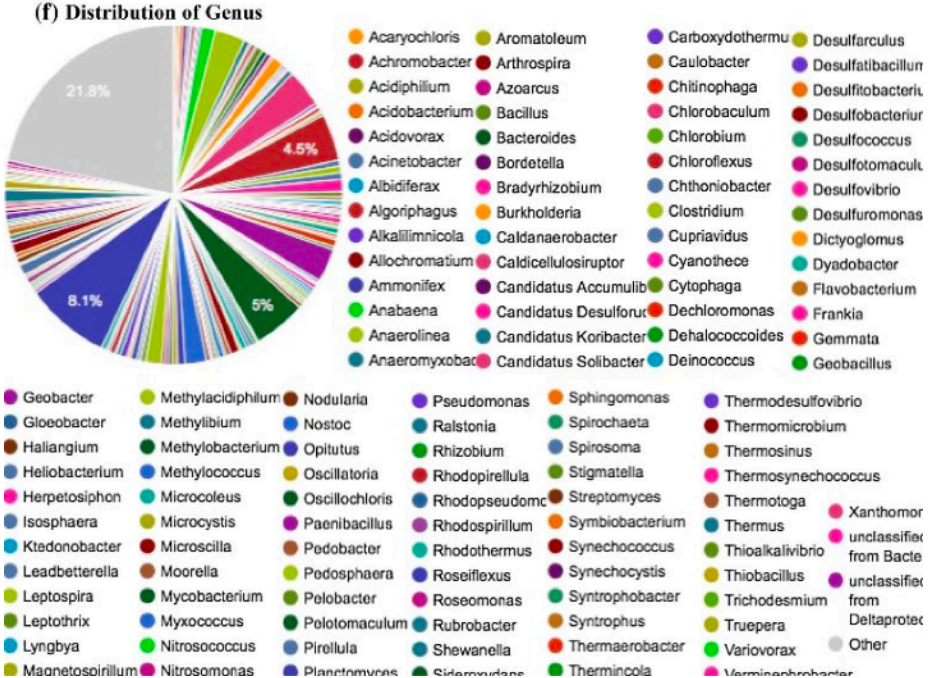
Illegible Visualizations

Bullshit Visualizations

Unconventional Visualizations

Illegible Visualization





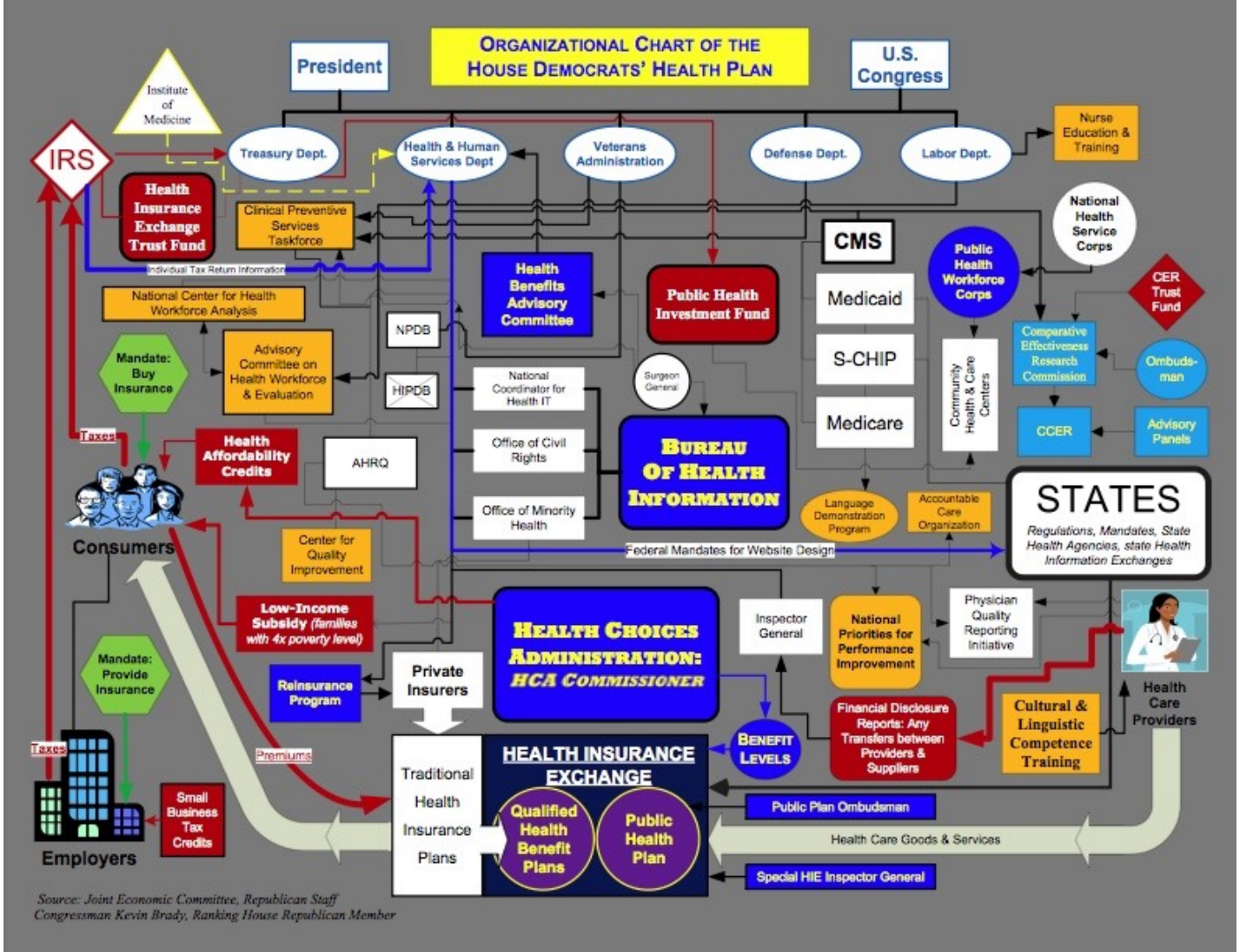
Interactive Weekly Unemployment Insurance Claims

Initial_Claims_byCounty | Historical

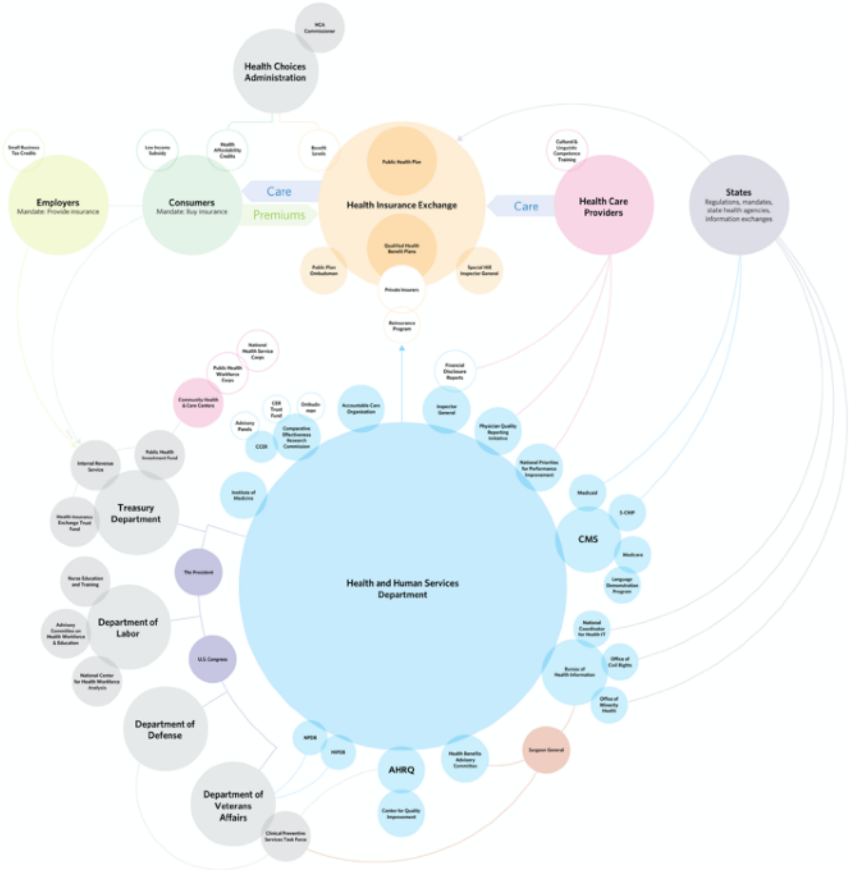
County
Total

2020-12-26	5,506
2021-01-02	10,986
2021-01-09	14,084
2021-01-16	11,983
2021-01-23	11,615
2021-01-30	12,664
2021-02-06	13,464
2021-02-13	12,087
2021-02-20	11,395
2021-02-27	11,624
2021-03-06	13,592
2021-03-13	16,506
2021-03-20	13,994
2021-03-27	18,710
2021-04-10	10,909
2021-04-17	8,983
2021-04-24	8,704
2021-05-01	10,325
2021-05-08	10,841
2021-05-15	9,377
2021-05-22	8,698
2021-06-05	7,290
2021-06-12	6,847
2021-06-19	7,108
2021-06-26	5,816
2021-07-03	7,295
2021-07-10	5,435
2021-07-17	4,254
2021-07-24	3,977
2021-07-31	6,793
2021-08-07	6,196
2021-08-14	5,469
2021-08-21	5,407
2021-08-28	5,431
2021-09-04	5,095

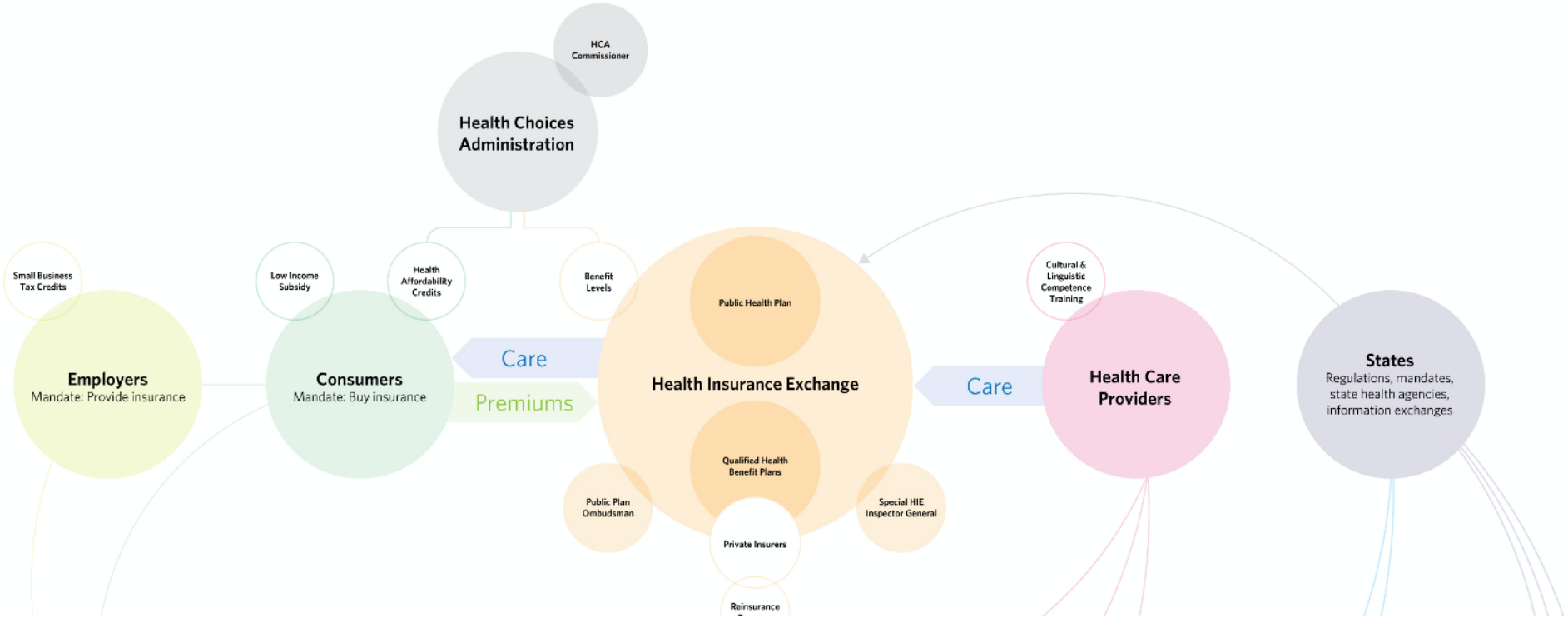
Historical Initial Claims by Week


ORGANIZATIONAL CHART OF THE HOUSE DEMOCRATS' HEALTH PLAN
President
U.S. Congress
Institute of Medicine
IRS
Treasury Dept.
Health & Human Services Dept
Veterans Administration
Defense Dept.
Labor Dept.
Nurse Education & Training
Health Insurance Exchange Trust Fund
Clinical Preventive Services Taskforce
National Health Service Corps
CMS
Public Health Workforce Corps
CER Trust Fund
Individual Tax Return Information
National Center for Health Workforce Analysis
Health Benefits Advisory Committee
Public Health Investment Fund
Medicaid
S-CHIP
Medicare
Community Health & Care Centers
Comparative Effectiveness Research Commission
Ombuds-man
CCER
Advisory Panels
NPDB
HIPDB
Advisory Committee on Health Workforce & Evaluation
Mandate: Buy Insurance
National Coordinator for Health IT
Surgeon General
Office of Civil Rights
Office of Minority Health
BUREAU OF HEALTH INFORMATION
Taxes
Health Affordability Credits
AHRQ
Consumers
Language Demonstration Program
Accountable Care Organization
STATES
Regulations, Mandates, State Health Agencies, state Health Information Exchanges
Federal Mandates for Website Design
Center for Quality Improvement
Low-Income Subsidy (families with 4x poverty level)
HEALTH CHOICES ADMINISTRATION: HCA COMMISSIONER
Inspector General
National Priorities for Performance Improvement
Physician Quality Reporting Initiative
Mandate: Provide Insurance
Reinsurance Program
Private Insurers
Financial Disclosure Reports: Any Transfers between Providers & Suppliers
Cultural & Linguistic Competence Training
Health Care Providers
Taxes
Premiums
Traditional Health Insurance Plans
HEALTH INSURANCE EXCHANGE
Qualified Health Benefit Plans
Public Health Plan
BENEFIT LEVELS
Public Plan Ombudsman
Health Care Goods & Services
Special HIE Inspector General
Small Business Tax Credits
Employers
Source: Joint Economic Committee, Republican Staff
Congressman Kevin Brady, Ranking House Republican Member

Organizational Chart of the House Democrats' Health Plan



"Do not fuck with graphic designers" – Robert Palmer



“Do not fuck with graphic designers” – Robert Palmer

Illegible Visualizations

People will get lost in the details or overwhelmed by complexity

…if we make things intentionally complex people then people may just assume we know what we're talking about or will be too dazed to check too closely.

Deceptive Visualizations

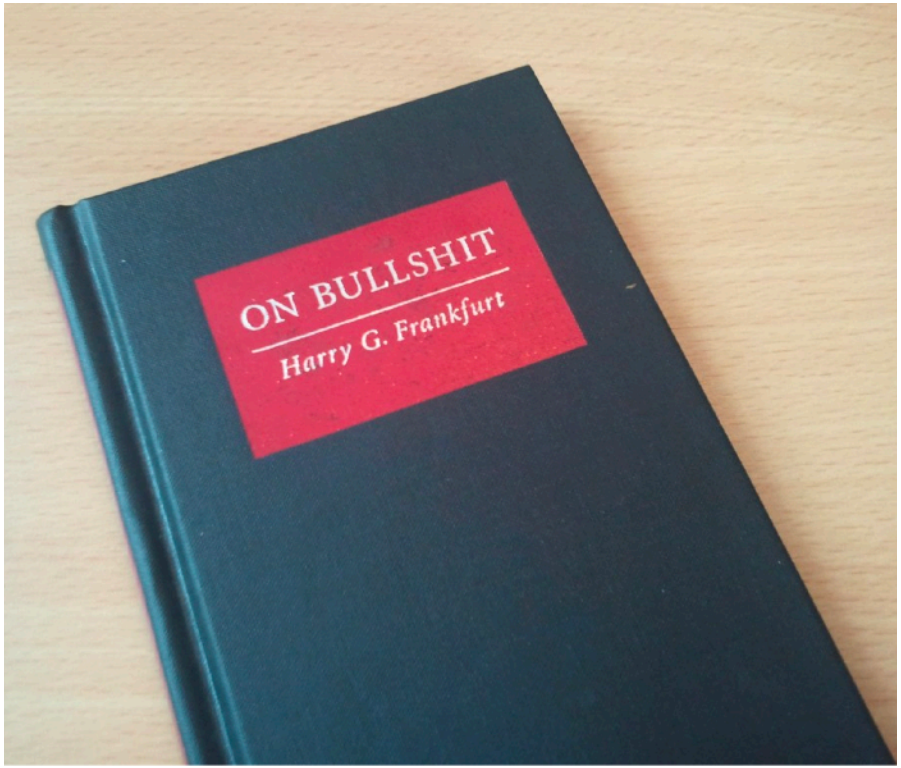
Incorrect Visualizations

Illegible Visualizations

Bullshit Visualizations

Unconventional Visualizations

Bullshit Visualization



Lie:

"No, officer, I wasn't speeding"

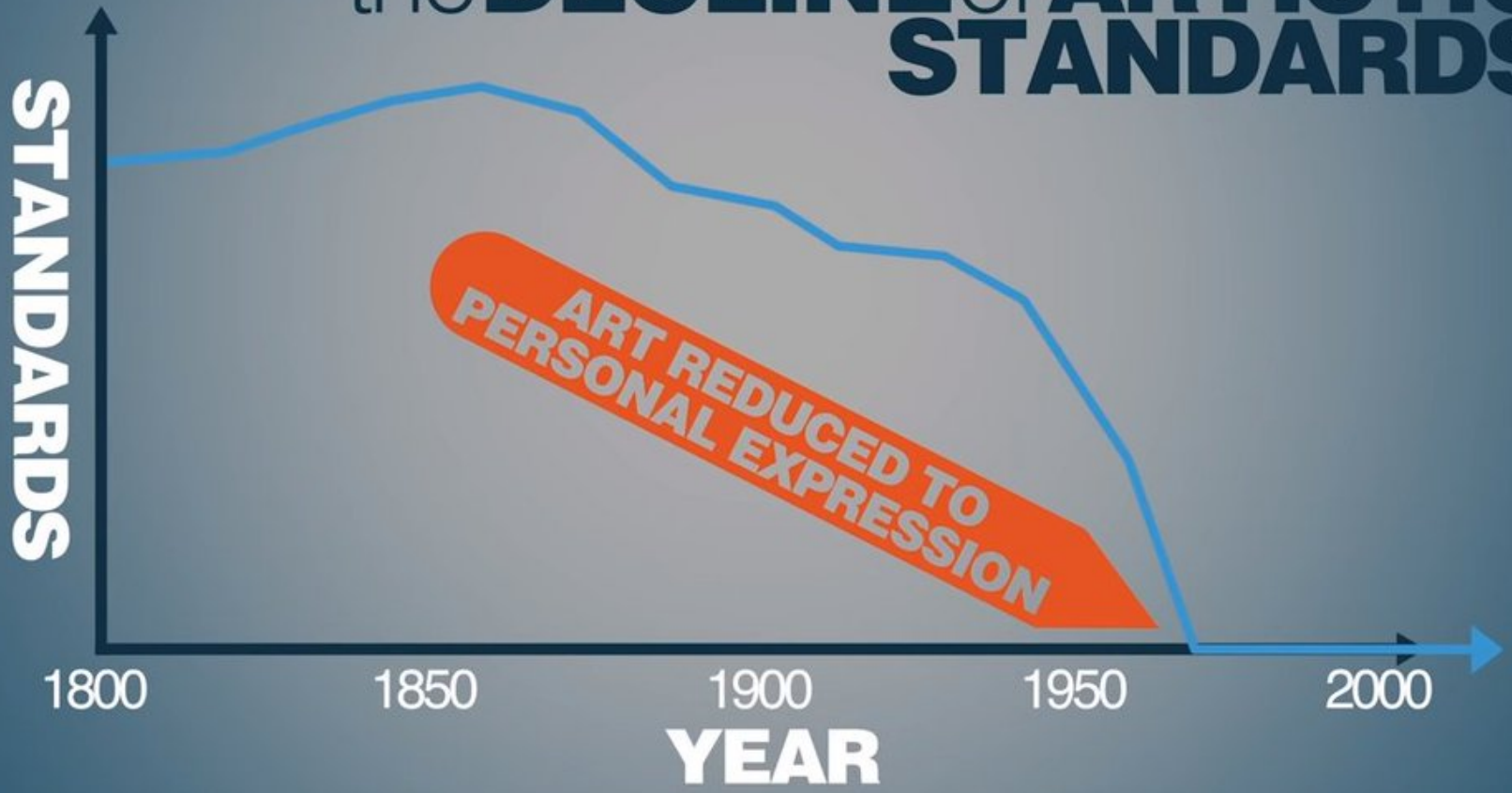
(you know the truth, but intentionally say something you know is untrue)

Bullshit:

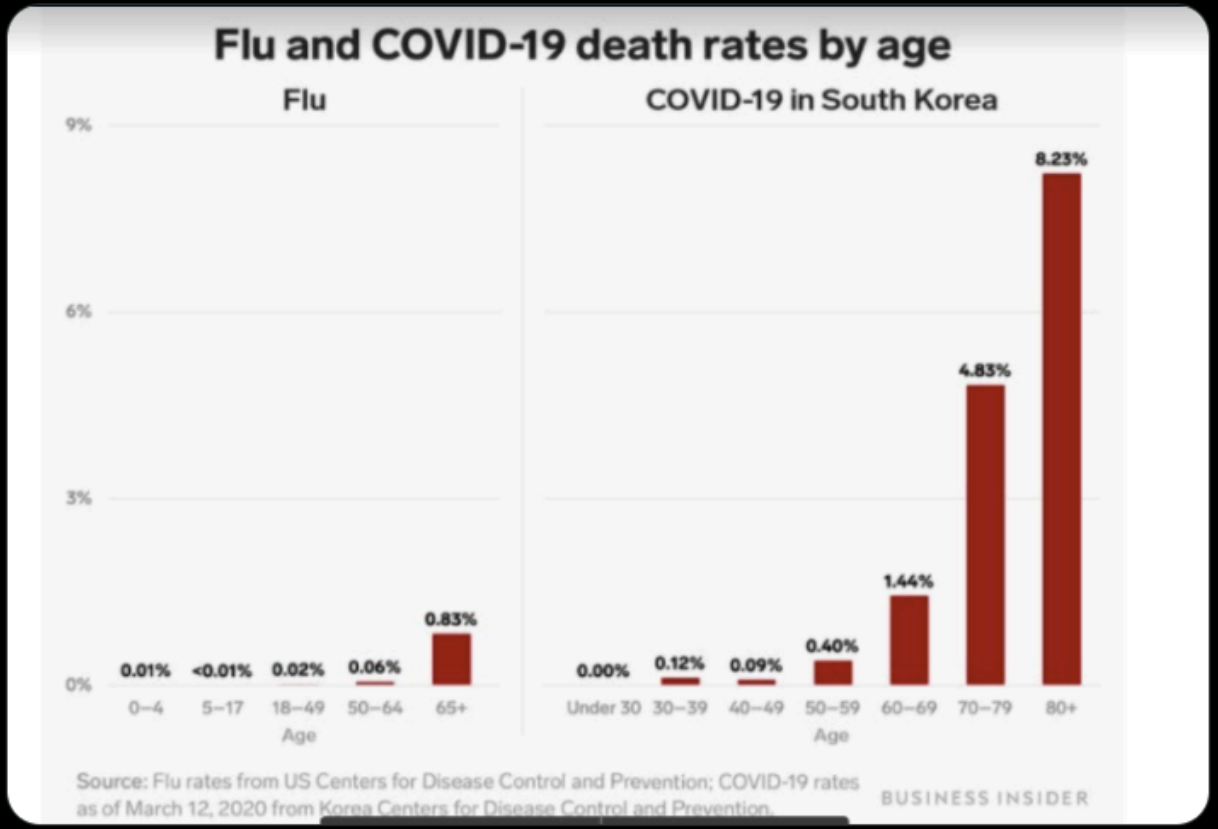
"The party was lame anyways, it's good I wasn't invited"

(you don't know or don't care about the truth, but intentionally say something you hope is persuasive)

the DECLINE of ARTISTIC STANDARDS



For people under 60, coronavirus is LESS dangerous than the seasonal flu:



Bullshit Visualizations

You can just make stuff up with no connection to reality

…show stuff that looks like data but isn’t

…assume a conclusion and pretend it’s true

…or give people data they can’t do anything with

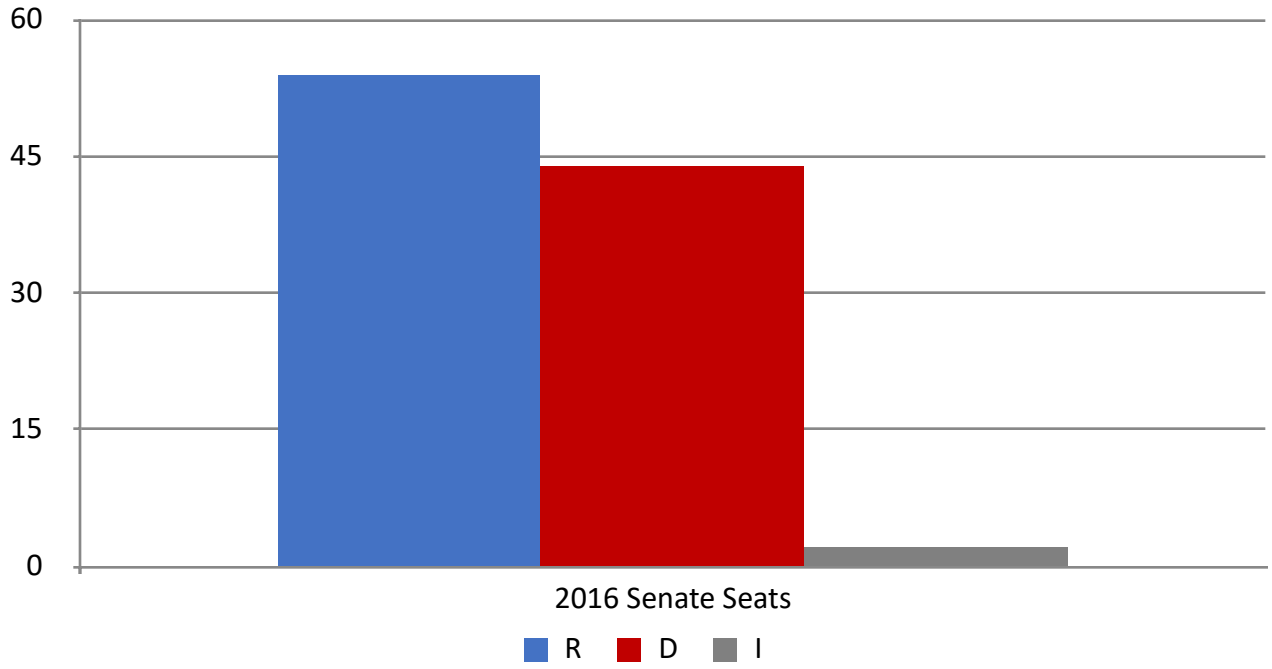
Deceptive Visualizations

Incorrect Visualizations

Illegible Visualizations

Bullshit Visualizations

Unconventional Visualizations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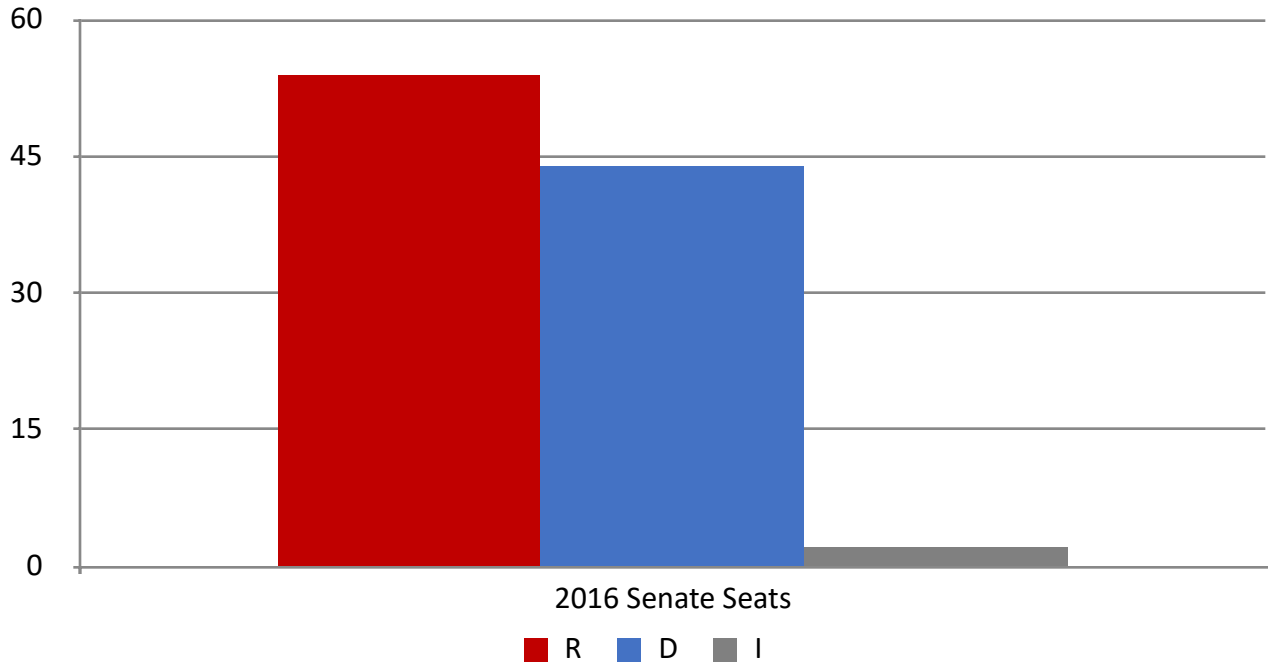
30
15
0
2016 Senate Seats
R
D
I


60
45
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0
2016 Senate Seats
R
D
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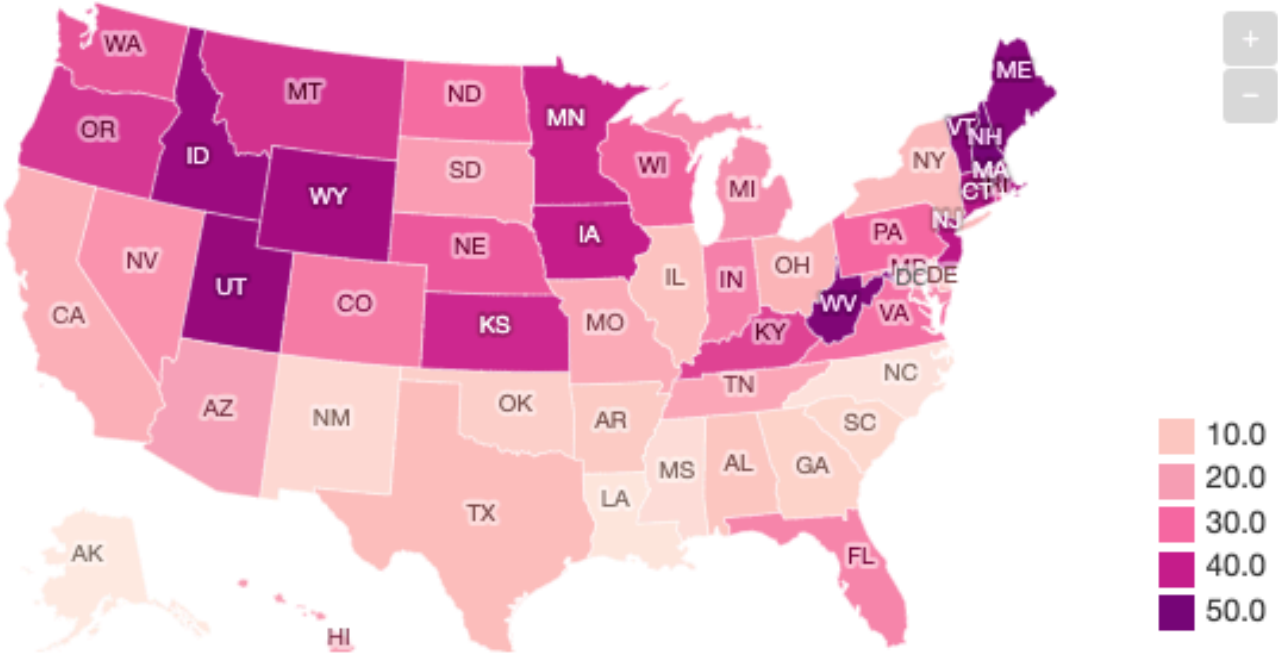
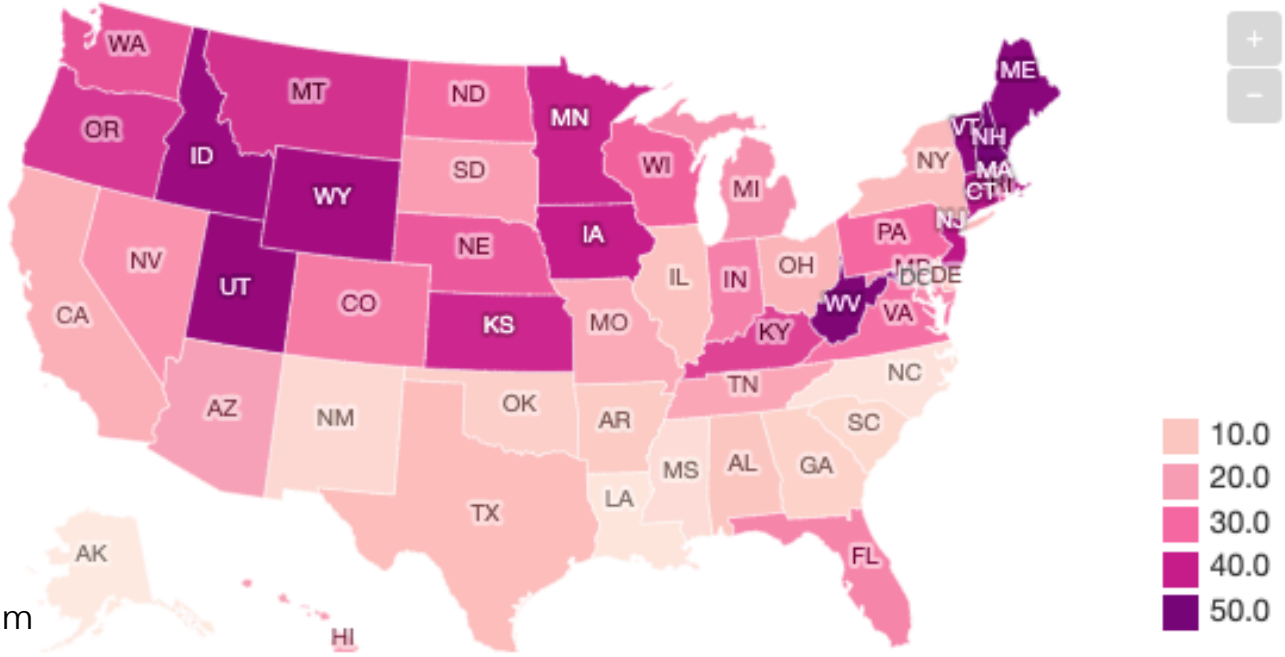
Which states have the most STIs?



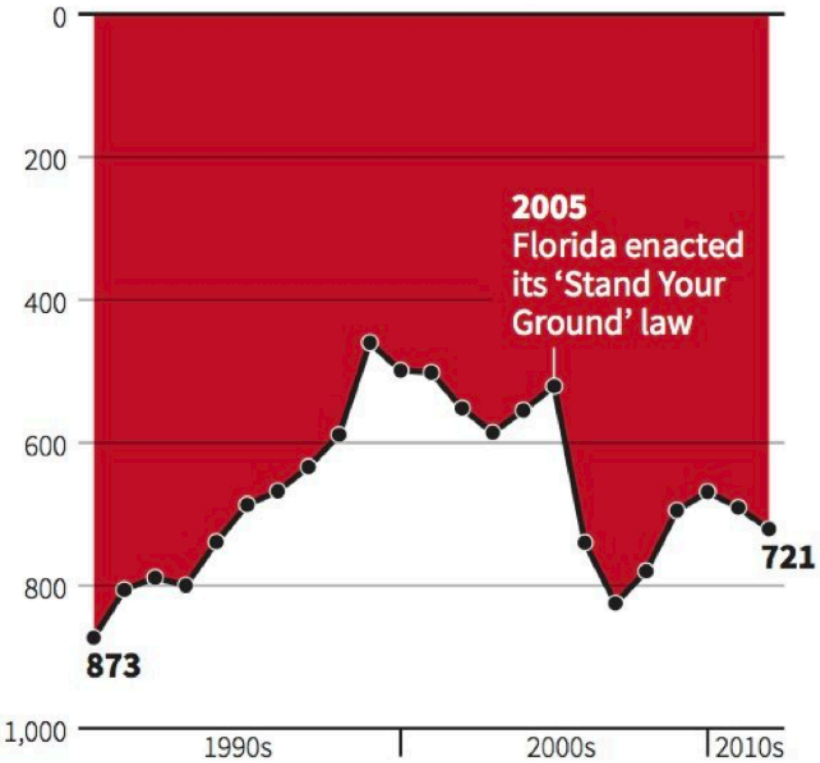
Which states have the most STIs?



"Each state has been rated from one to 50: the higher the score, the smaller the proportion of STIs. So on the map - the darker the color, the smaller the rate of STIs."

Gun deaths in Florida

Number of murders committed using firearms



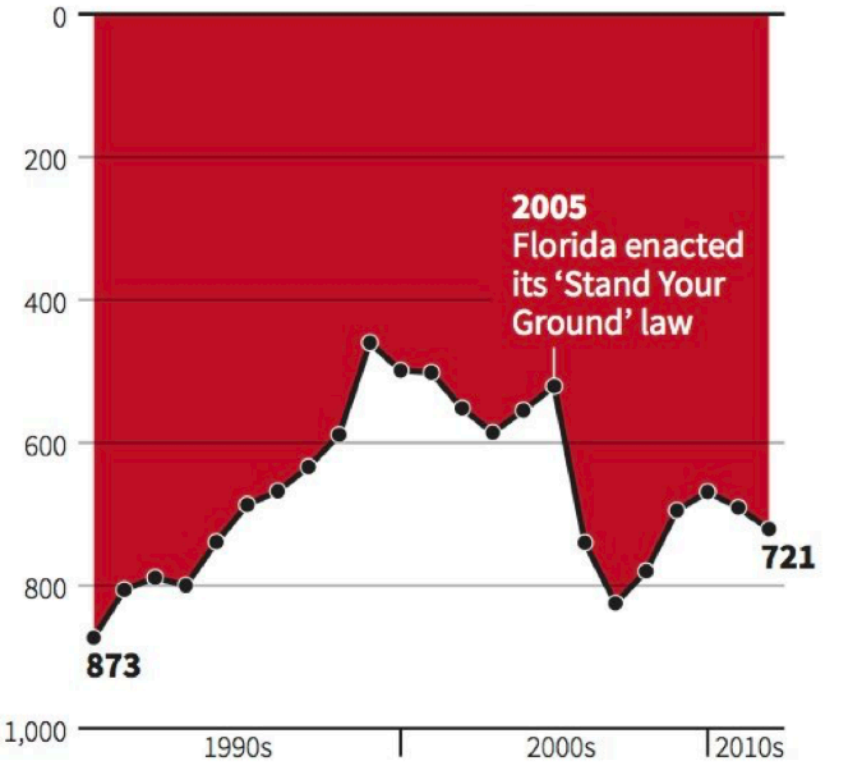
Source: Florida Department of Law Enforcement

C. Chan 16/02/2014

REUTERS

Gun deaths in Florida

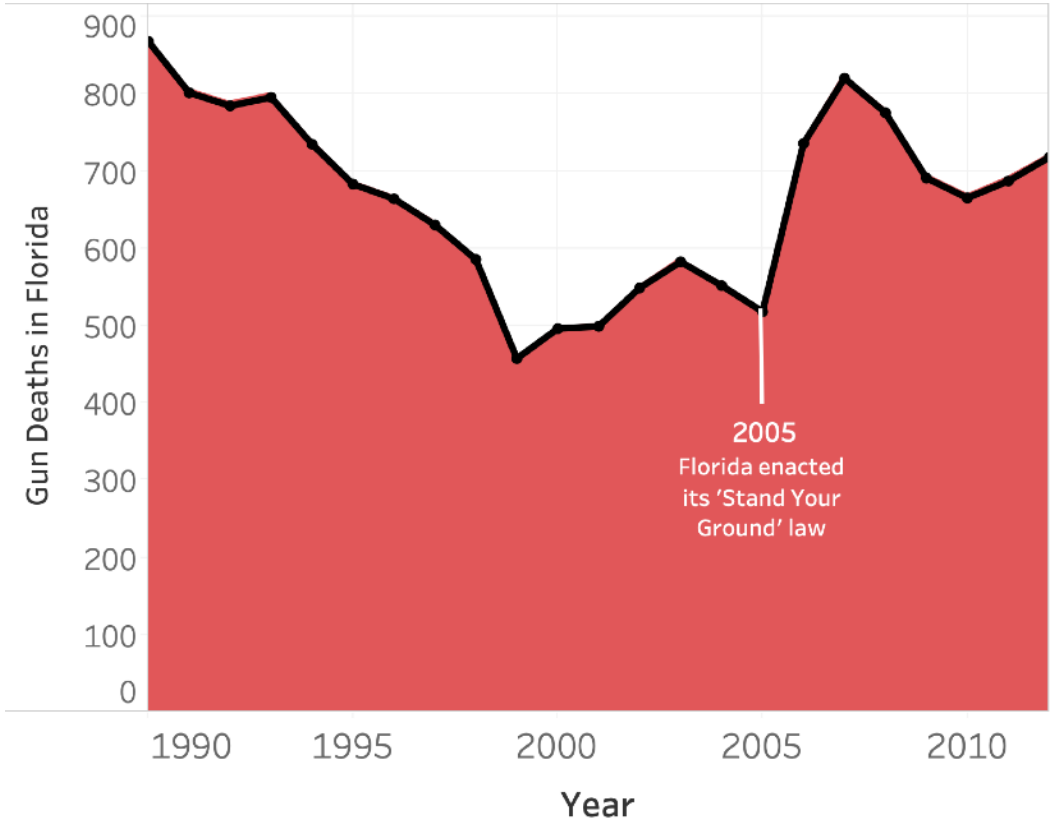
Number of murders committed using firearms



Source: Florida Department of Law Enforcement

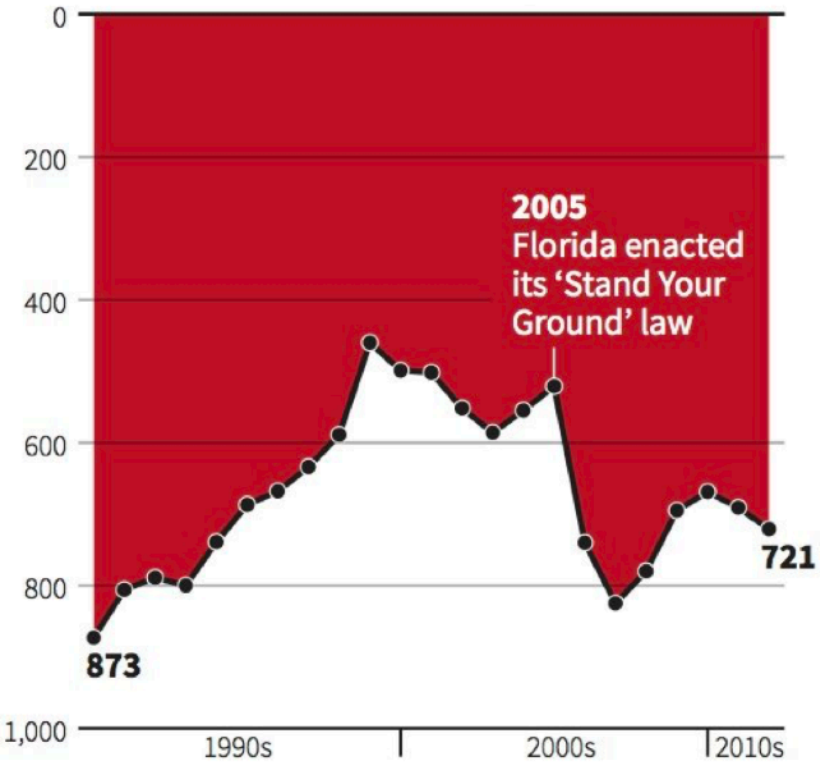
C. Chan 16/02/2014

REUTERS



Gun deaths in Florida

Number of murders committed using firearms

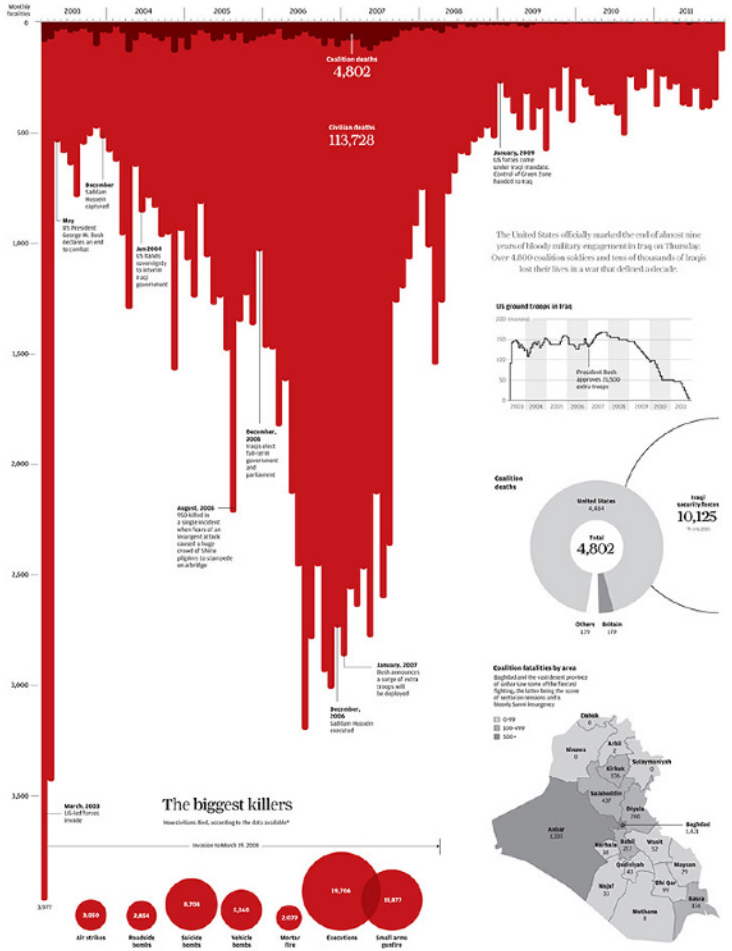


Source: Florida Department of Law Enforcement

C. Chan 16/02/2014

REUTERS

Iraq's bloody toll



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ITHACA TIMES

Planning Board approves Widewaters development

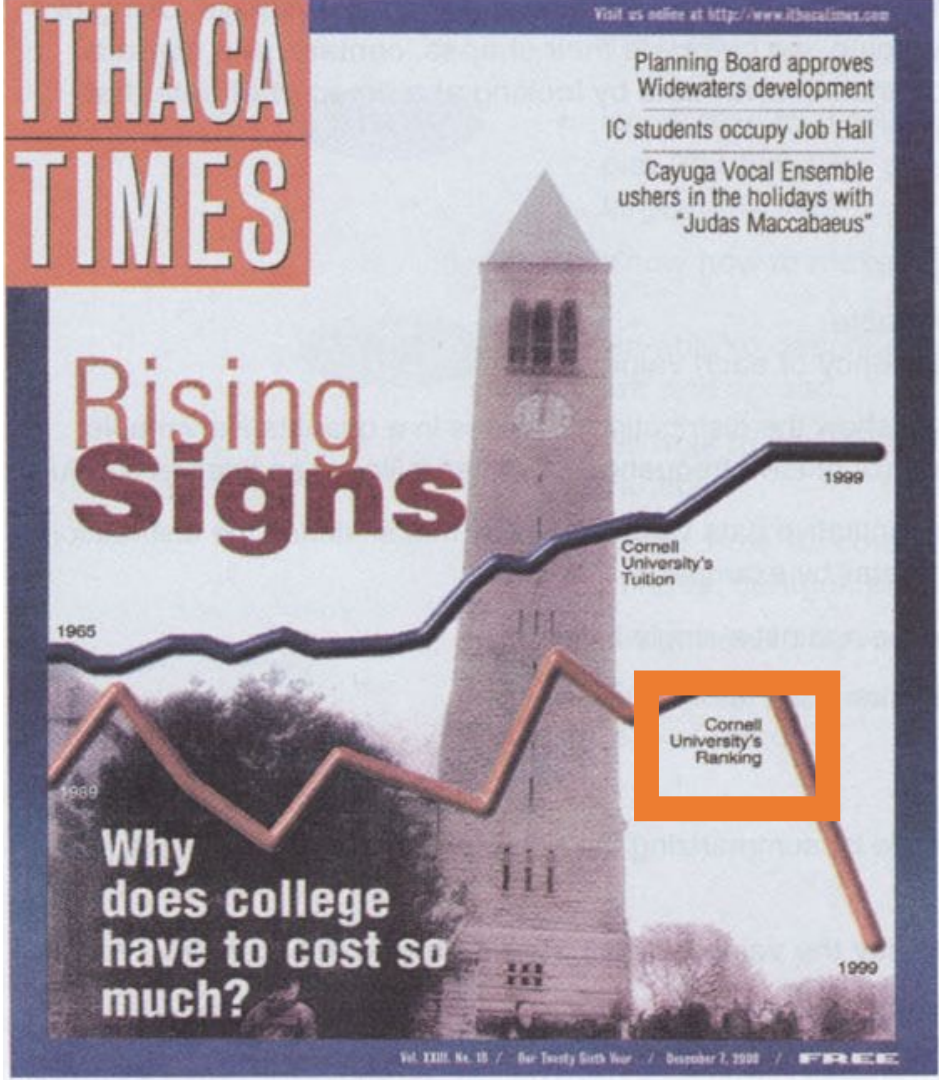
IC students occupy Job Hall

Cayuga Vocal Ensemble ushers in the holidays with "Judas Maccabaeus"

Rising Signs

Why does college have to cost so much?

Vol. XXIII, No. 18 / Our Twenty Sixth Year / December 7, 2000 / FREE


ITHACA TIMES
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Planning Board approves Widewaters development
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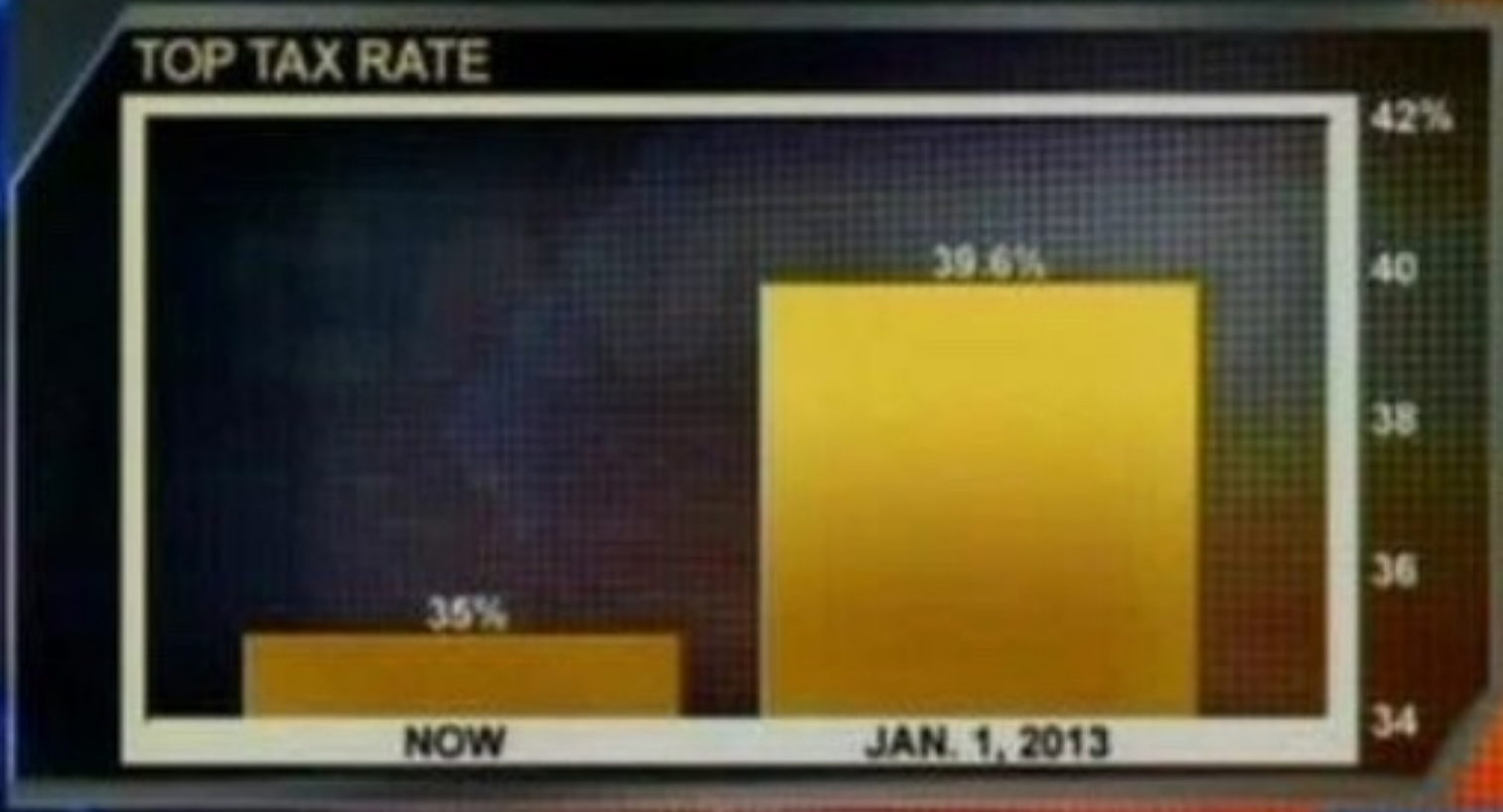
Rising Signs
1999
Cornell University's Tuition
1965
Cornell University's Ranking
1969
1999
Why does college have to cost so much?
Vol. XXIII, No. 18 / Our Twenty Sixth Year / December 7, 2000 / FREE

IF BUSH TAX CUTS EXPIRE

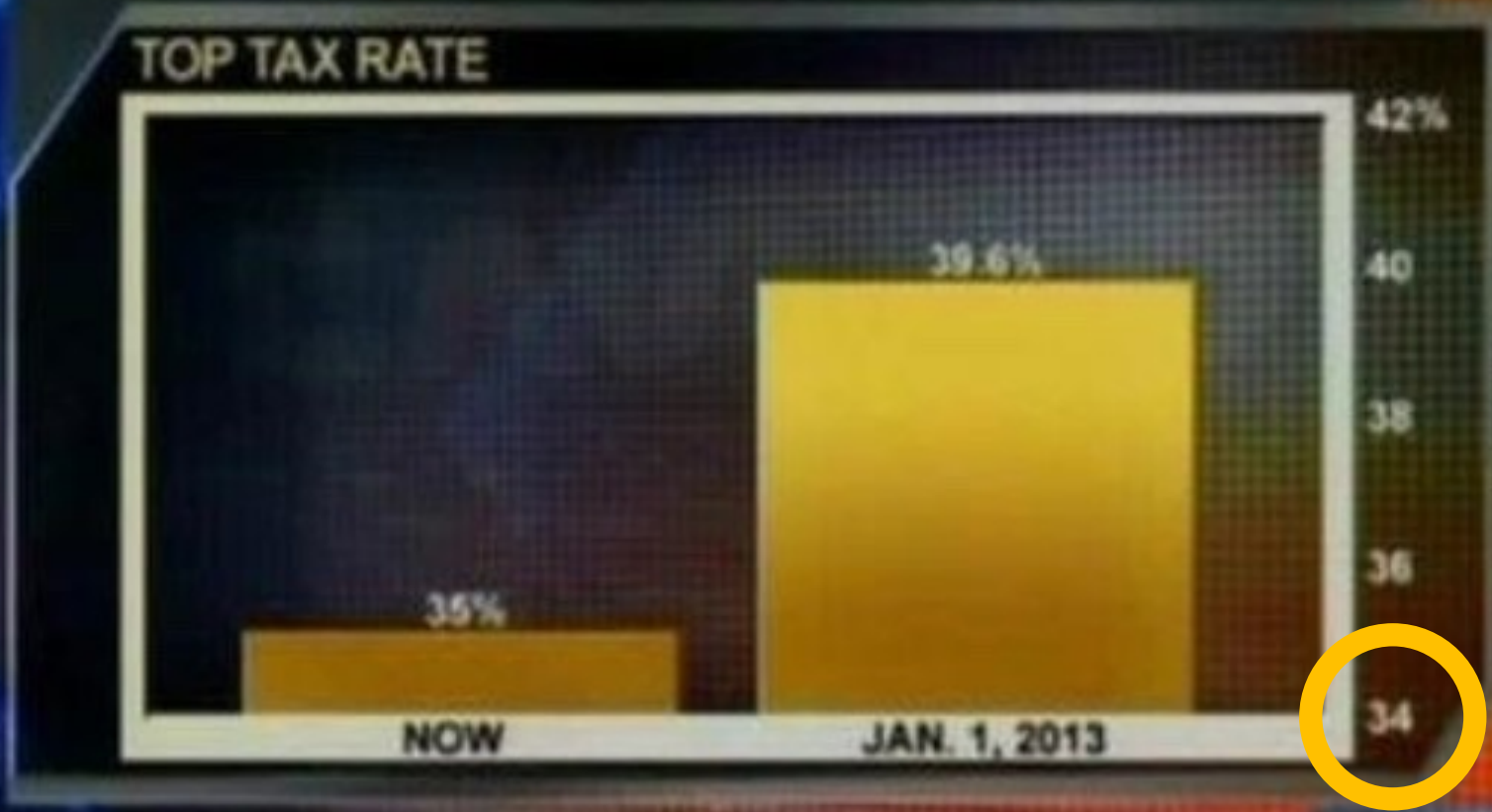


8:01p ET

FOX

TOP STORIES | TECHNOLOGY | CONSUMER

IF BUSH TAX CUTS EXPIRE



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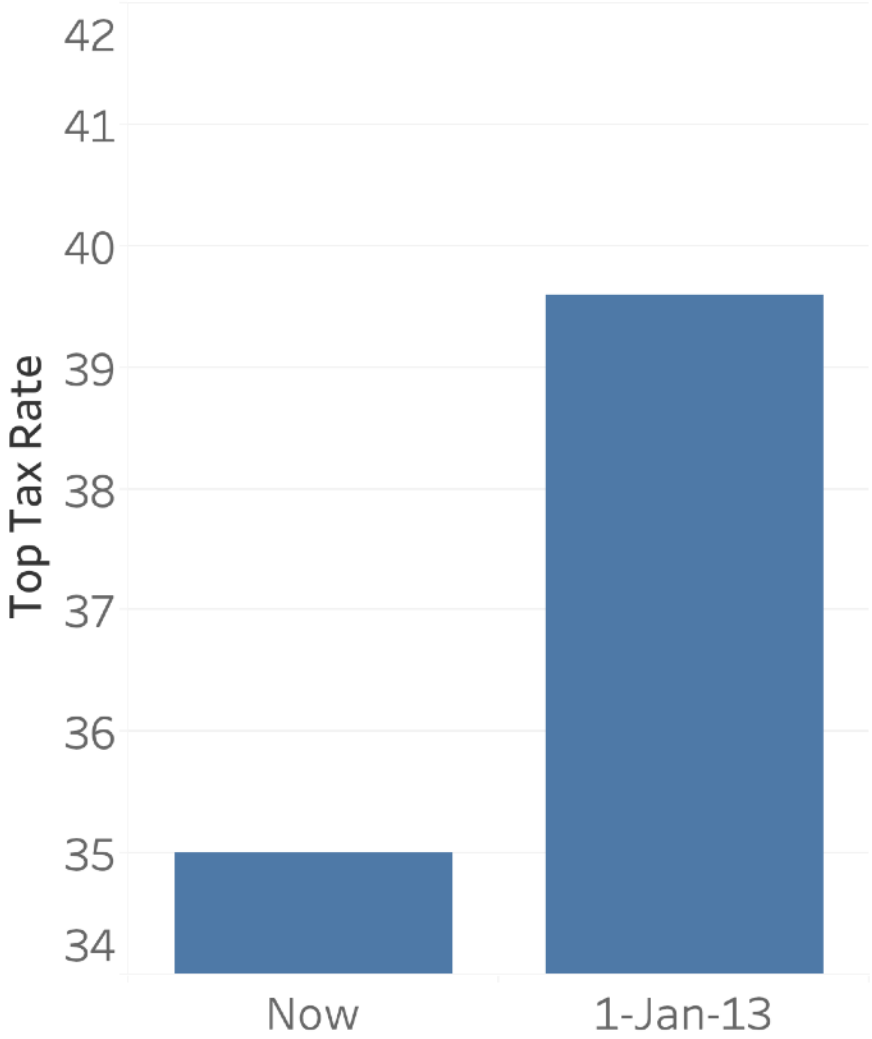
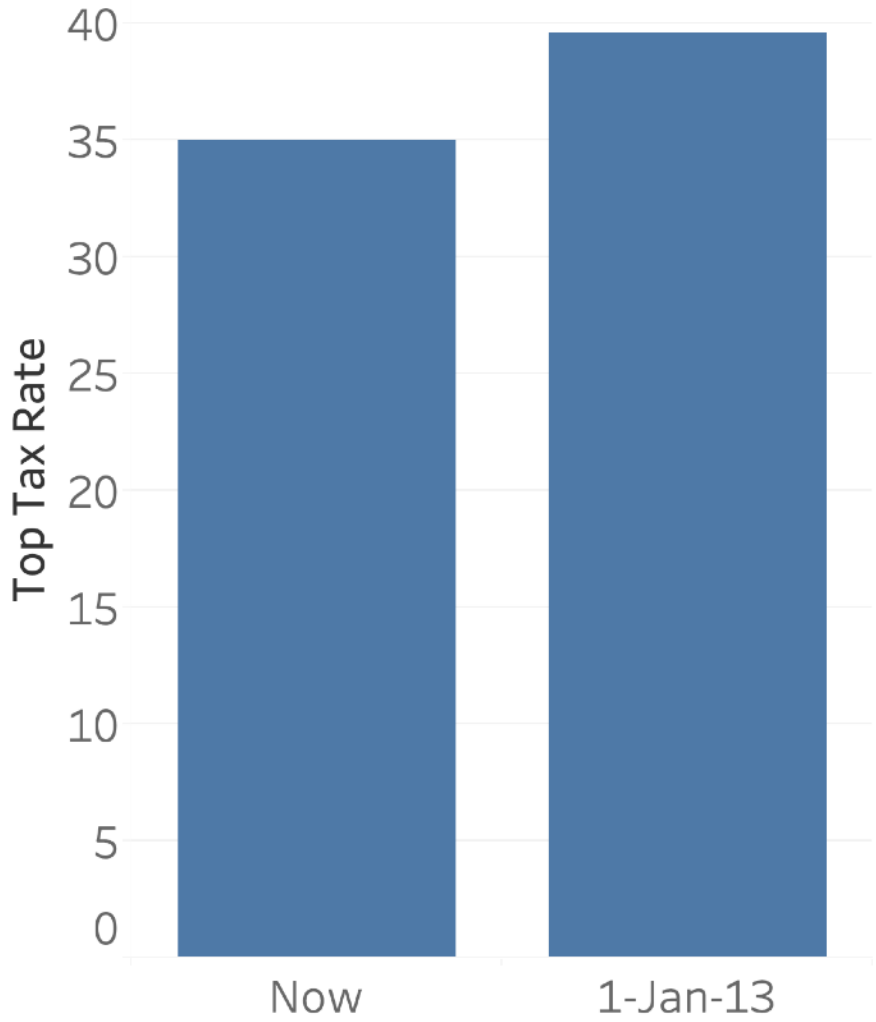
TOP STORIES | TECHNOLOGY | CONSUMER


Top Tax Rate
42
41
40
39
38
37
36
35
34
Now
1-Jan-13


Top Tax Rate
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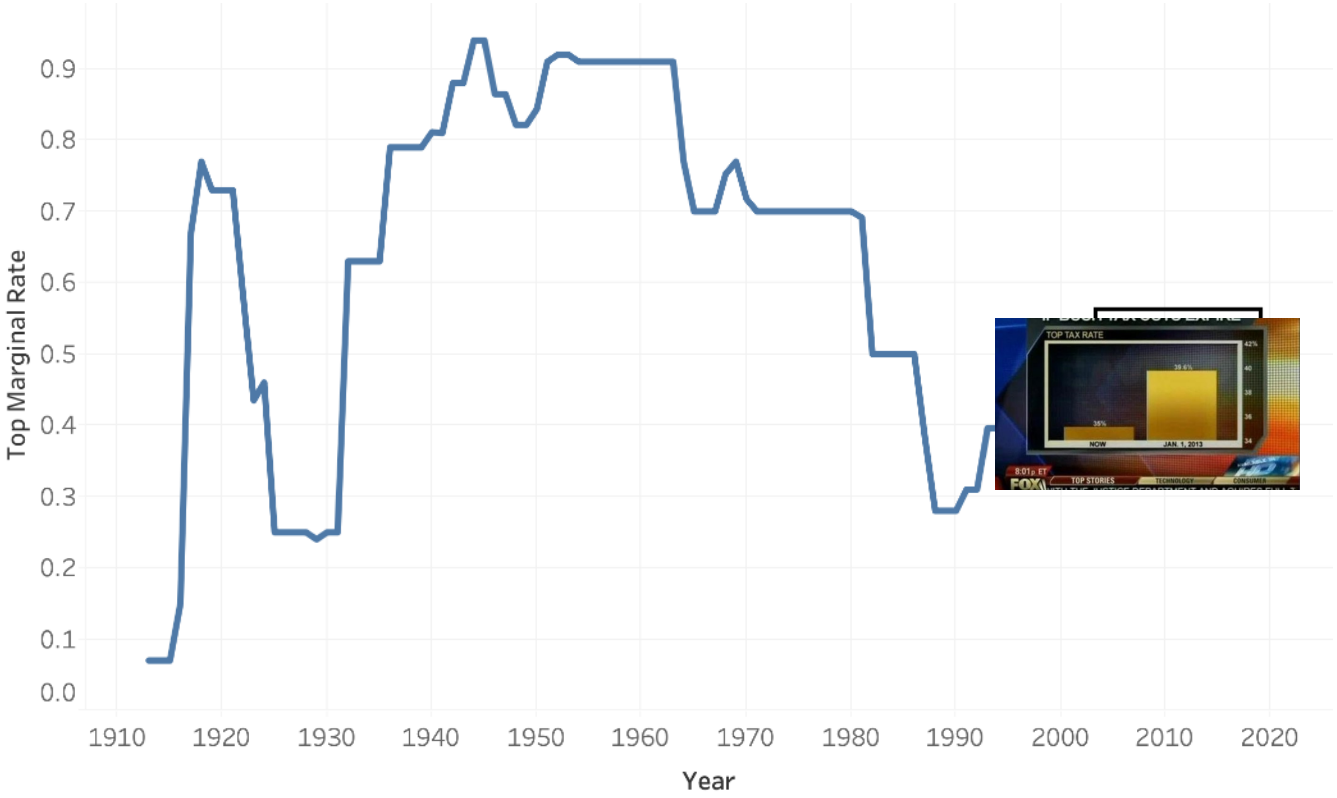
20
15
10
5
0
Now
1-Jan-13


Top Marginal Rate
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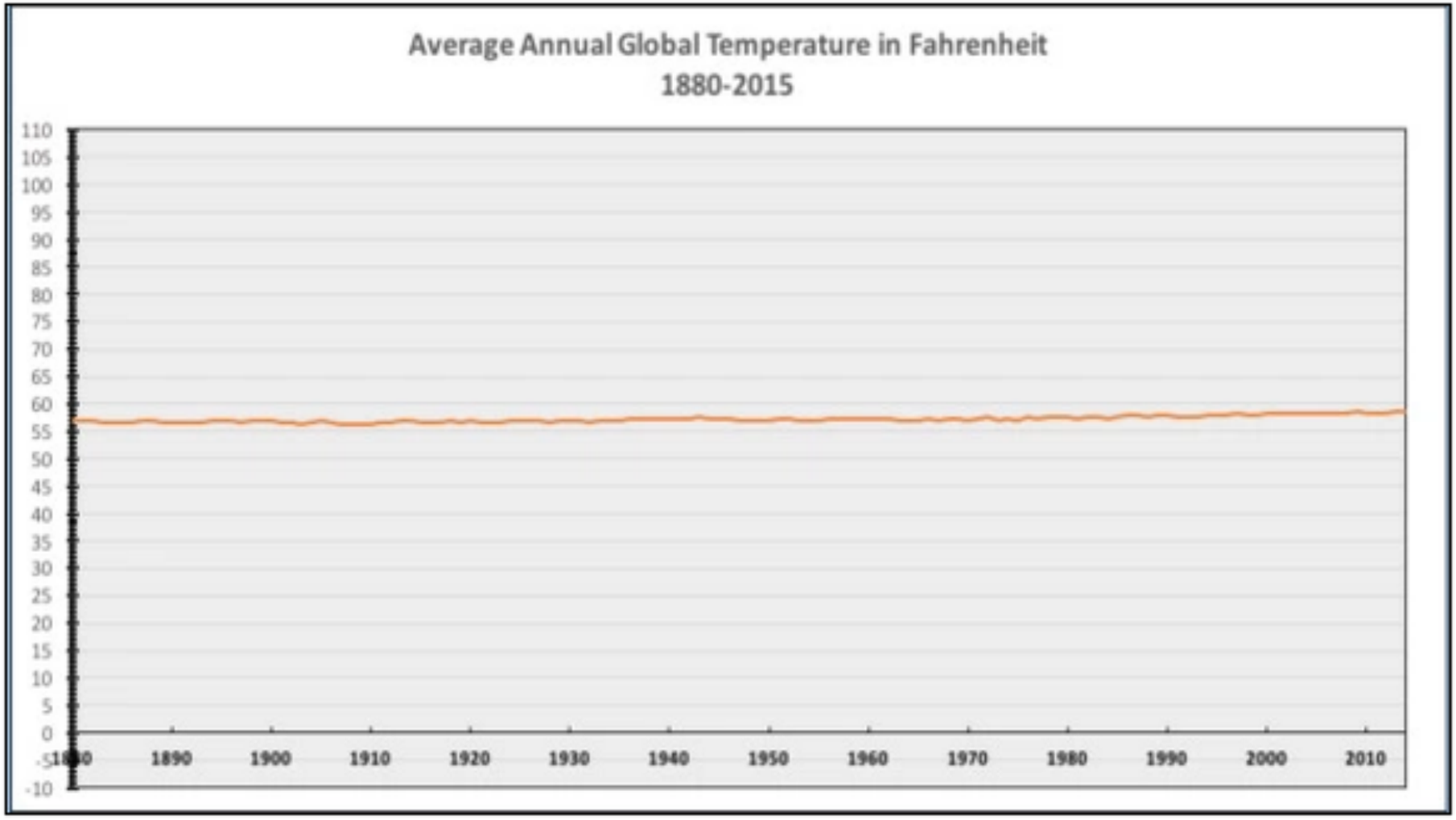
Year
TOP TAX RATE
NOW
JAN. 1, 2013
TOP STORIES


Average Annual Global Temperature in Fahrenheit
1880-2015
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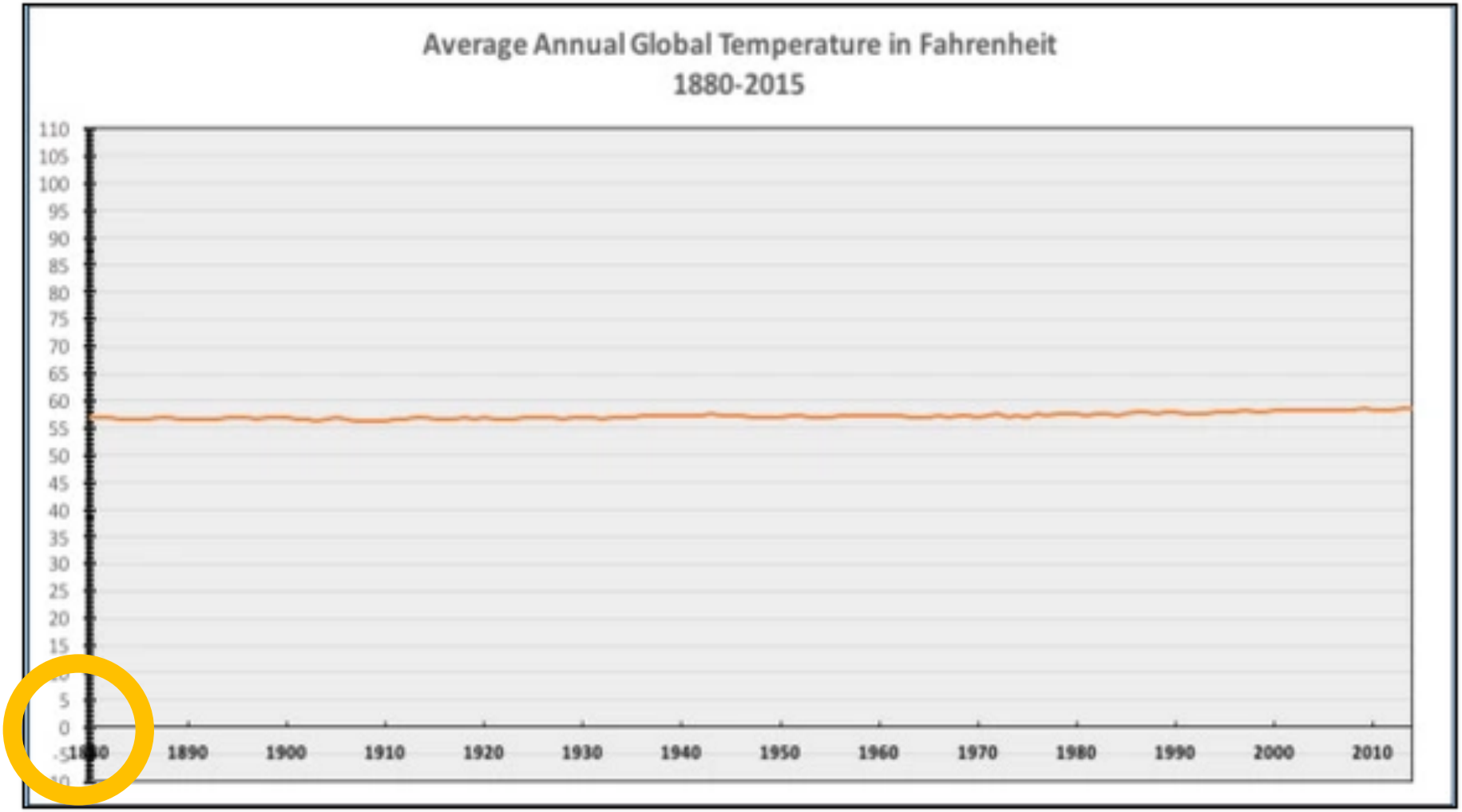
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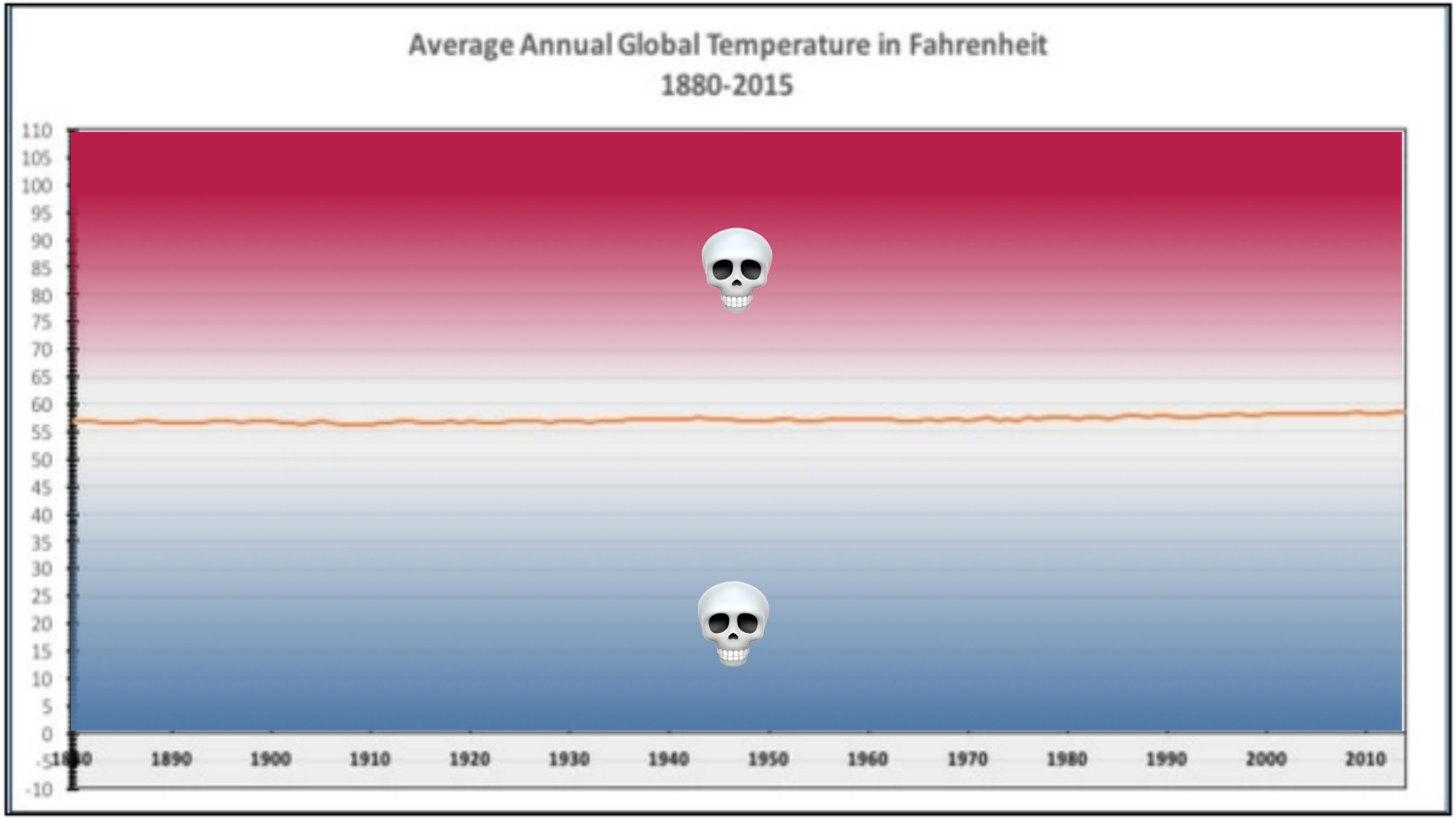
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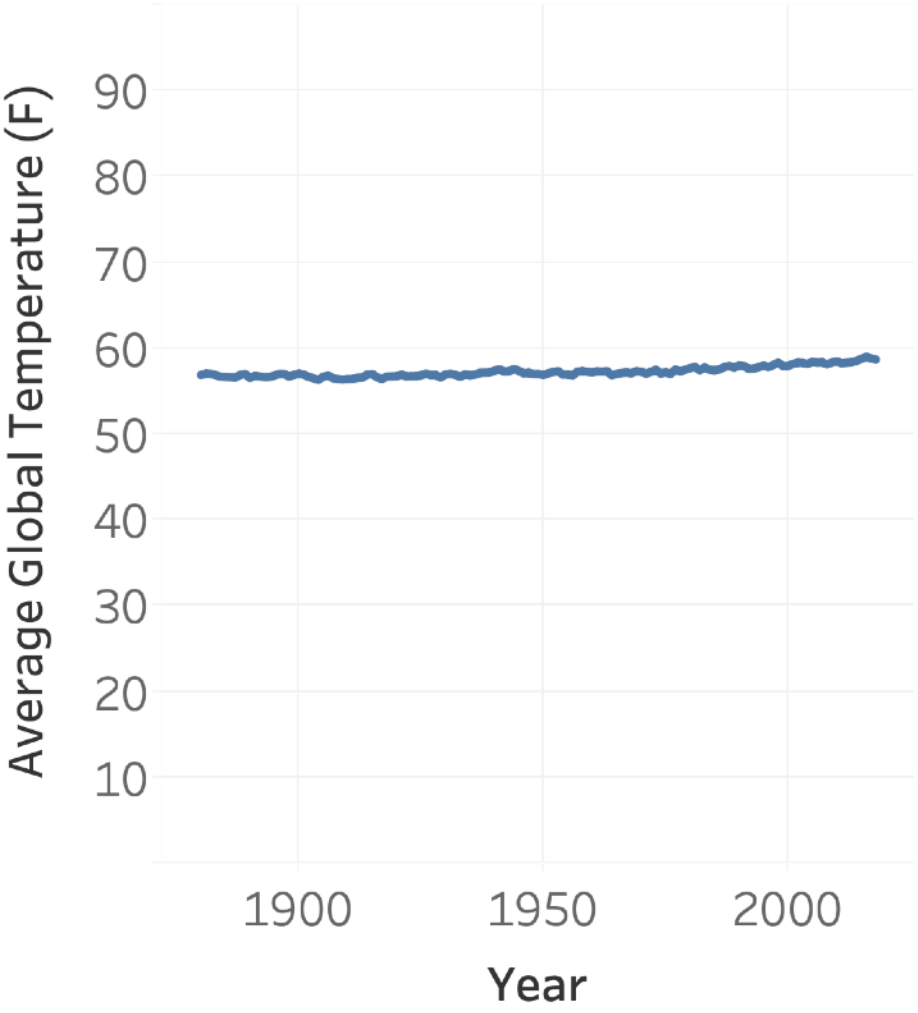
NRO



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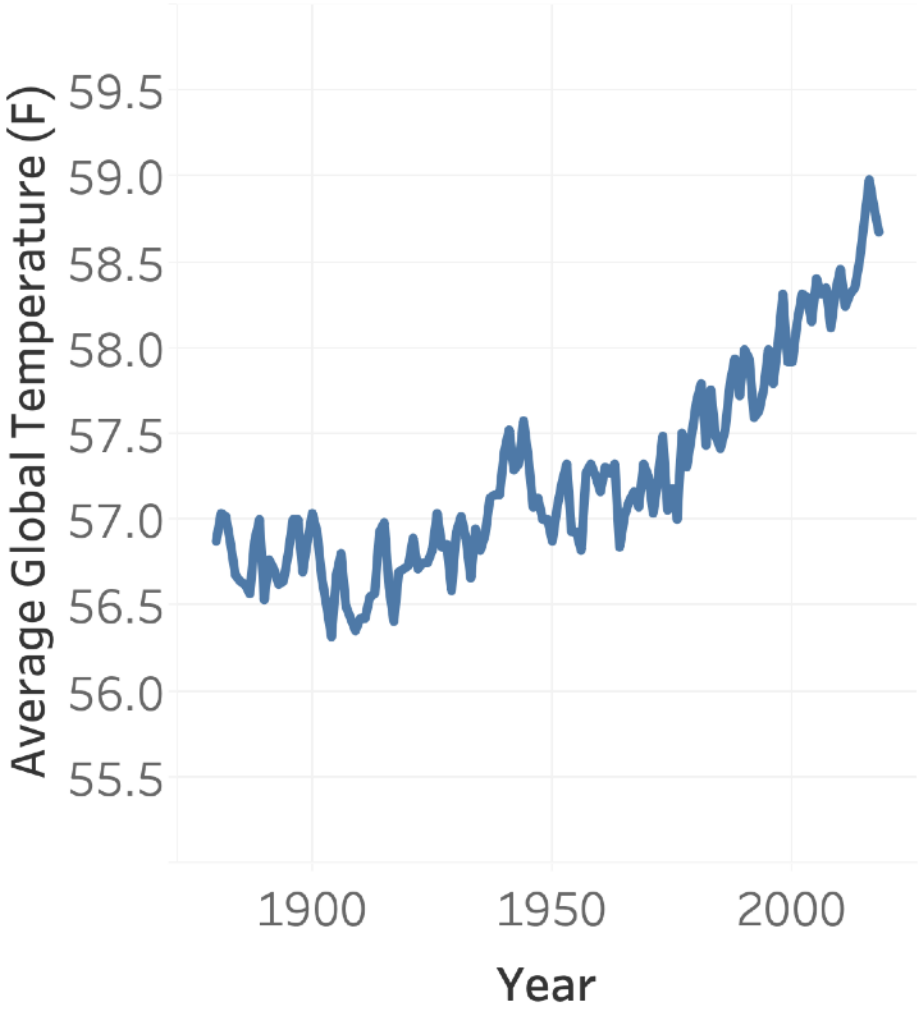

Unconventional Visualizations

People have tacit conventions on how they interpret charts (around colors, axes, slopes)

…if you violate those conventions, you can catch people off guard.

Deceptive Visualization Wrap-Up

Ways to mislead:

Breaking assumptions, expectations, conventions, drowning people in details… or just making stuff up.

Context matters:

Not every chart that breaks a design “rule” is misleading

Not every chart that follows the design “rules” is truthful

W2: Exercise & Assignment

W2: Deceptive Visualization

Design **two** static visualizations for a dataset:

1. An *earnest* visualization that faithfully conveys the data
2. A *deceptive* visualization that tries to mislead viewers

Your two visualizations may address different questions.

Try to design a deceptive visualization that appears to be earnest: *can you trick your classmates and course staff?*

You are free to choose your own dataset, but we have also provided some preselected datasets for you.

Submit two images and a brief write-up on Gradescope.

Due by **Tue 1/21 12:00 noon**.

W2 Exercise

This week you will get more practice rapidly creating visualizations, and think through how these visualizations may (mis)communicate.

Given a dataset of demographics and earnings, create both earnest and deceptive charts.

Hone your deception skills in advance of the W2 assignment!

We're here to help! If you complete the exercise with time to spare, start the W2 assignment.