



TEXAS McCombs

MASTER OF SCIENCE IN BUSINESS ANALYTICS

Data visualization: Examples of bad graphics (hall of shame) and how to do better



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Outline

The data viz hall of shame

How to do better



The data viz hall of shame



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Plotting pitfalls

- Axis trickery
- Violations of basic math
- Nearly content-free figures
- Gratuitous chartjunk
- Poorly chosen 3D graphics
- Bad design choices

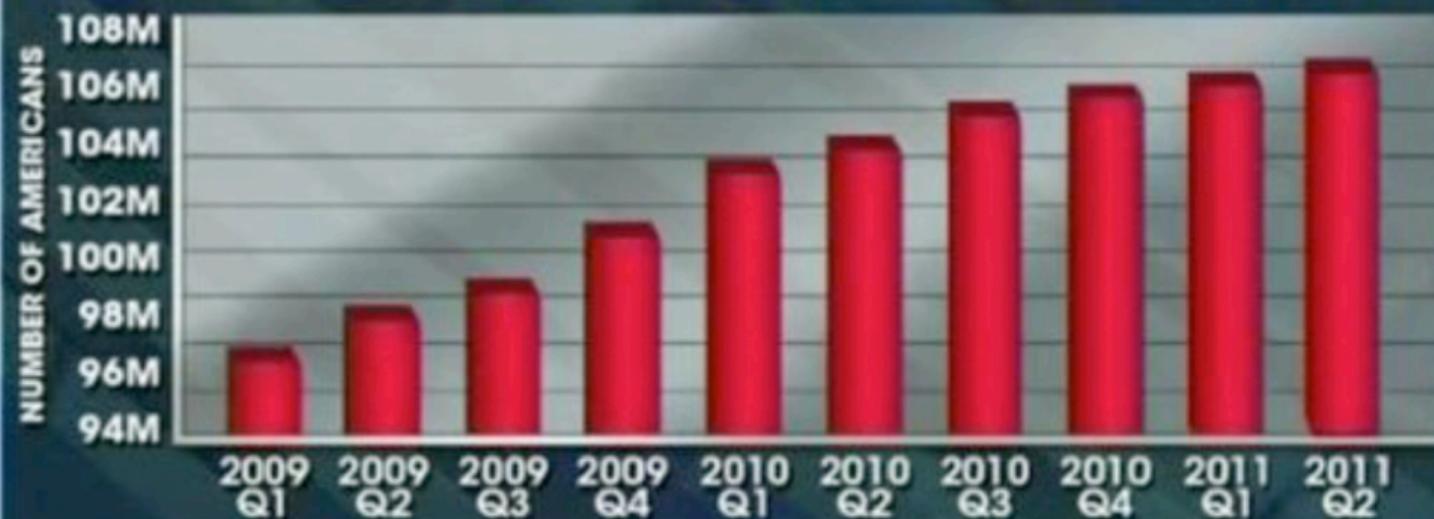


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FEDERAL WELFARE RECEIVED IN U.S.



FOX
NEWS .COM

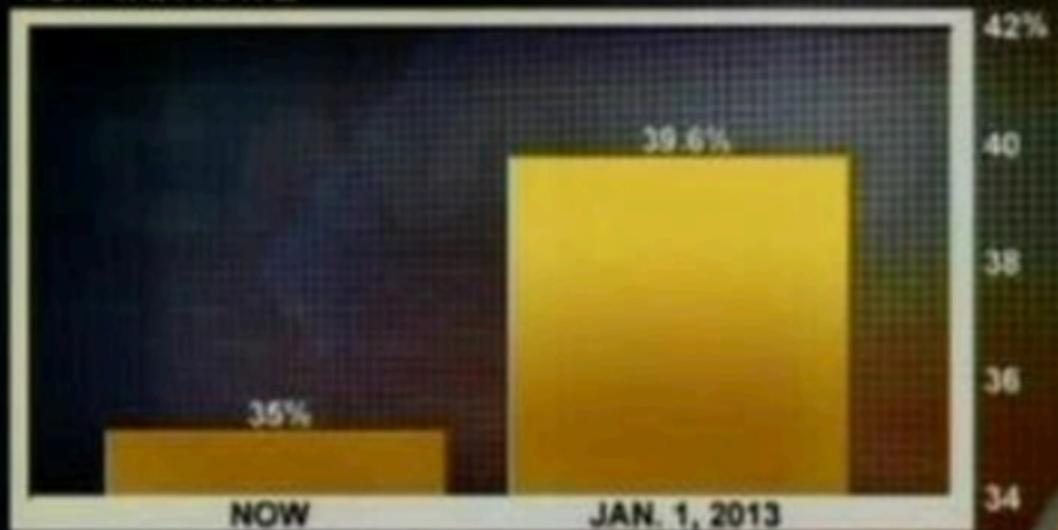
SOURCE: U.S. CENSUS SURVEY



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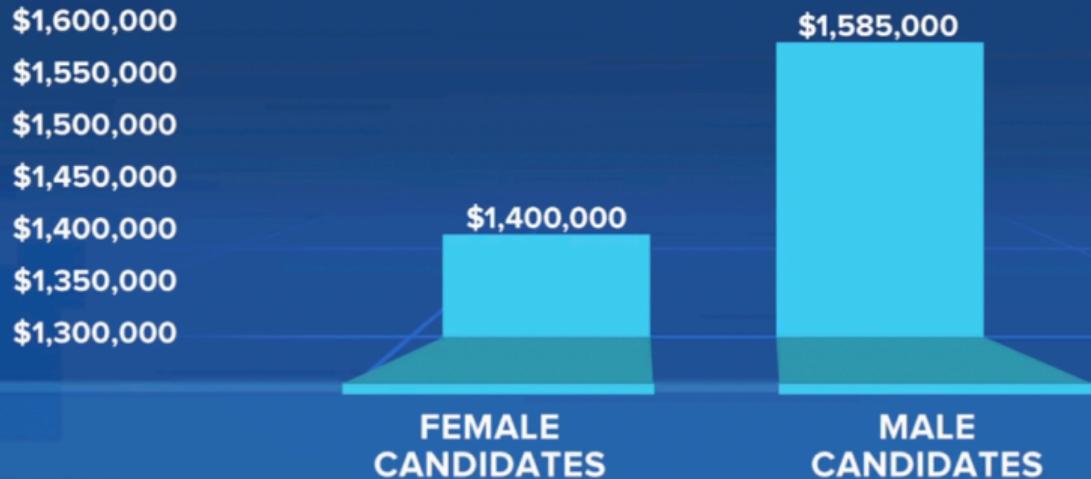
IF BUSH TAX CUTS EXPIRE

TOP TAX RATE



DEMOCRATIC WOMEN RAISE LESS MONEY THAN DEMOCRATIC MEN

AVERAGE RAISED BY HOUSE PRIMARY WINNERS



SOURCE: CENTER FOR RESPONSIVE POLITICS

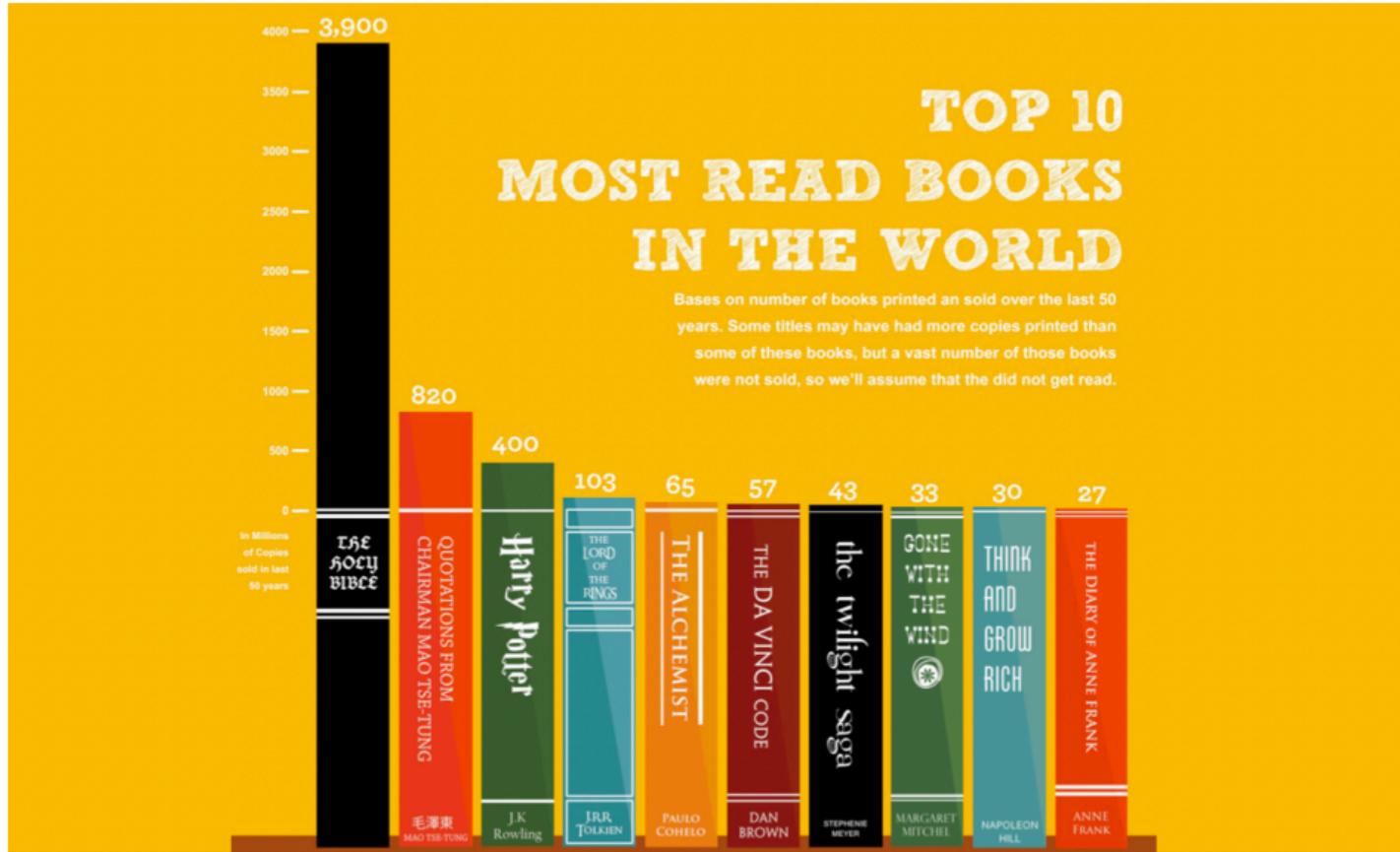
ELBER THE BEAT WITH ARI MELBER

THE BEAT WITH ARI MELBER

MSNBC

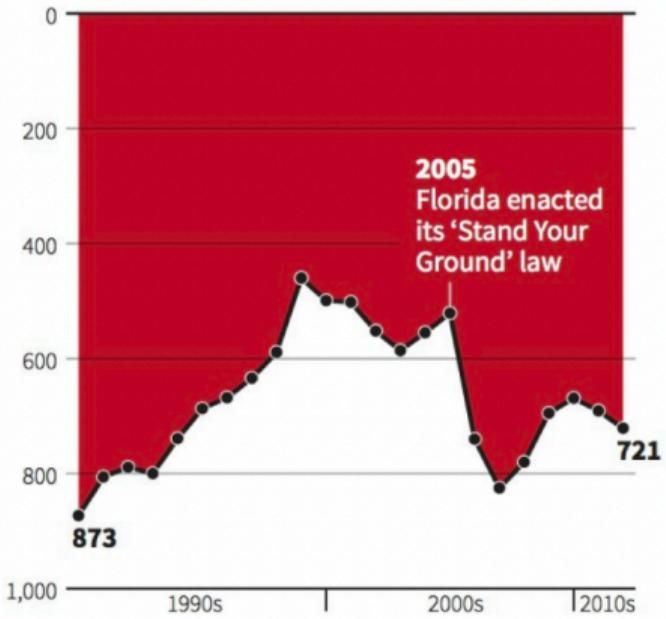


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Gun deaths in Florida

Number of murders committed using firearms



Source: Florida Department of Law Enforcement

C. Chan 16/02/2014

REUTERS



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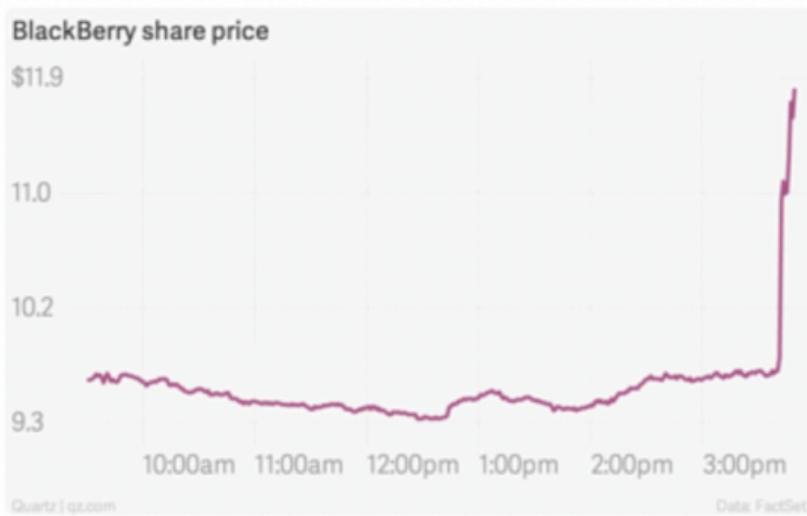
Are there situations where it might be ok to start the y-axis at a point other than 0?





Quartz
@qz

Acquisition rumors light a fire under BlackBerry's stock.
qz.com/note/326942/

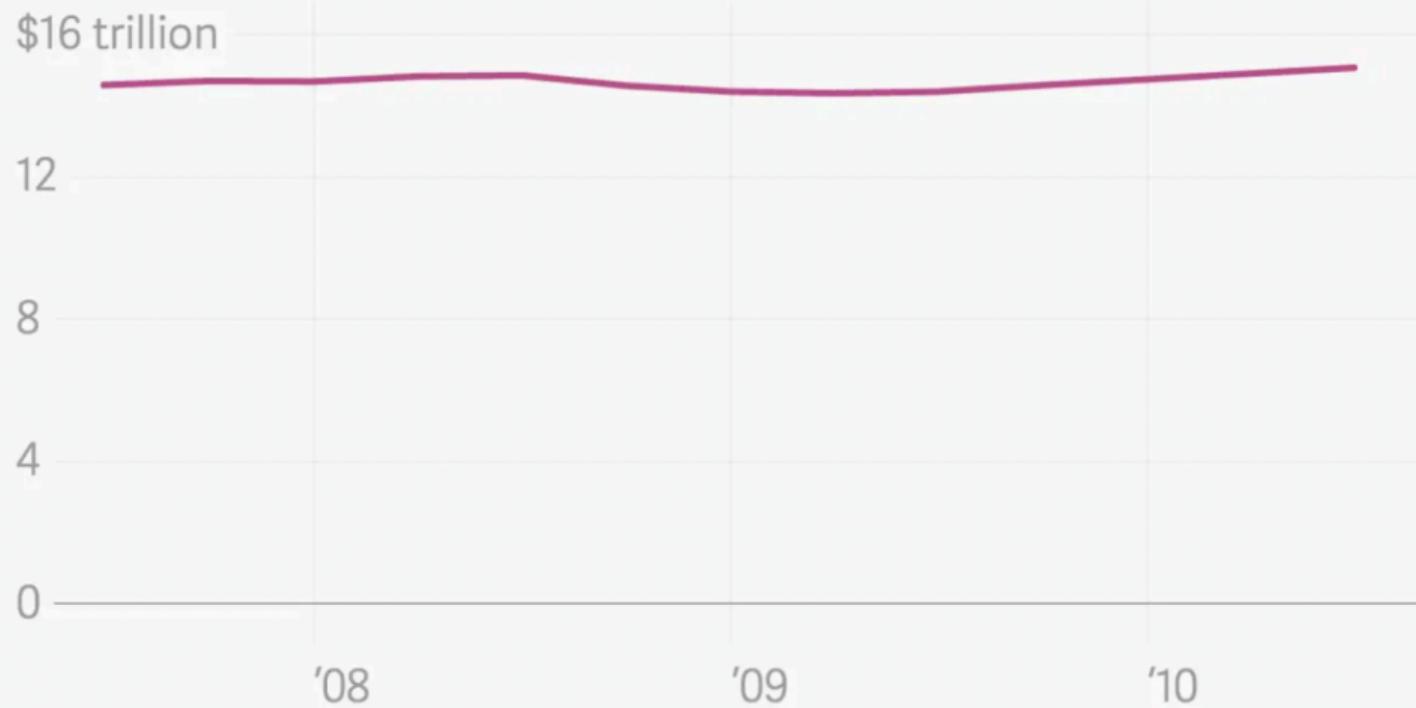


♥ 6 4:44 PM - Jan 14, 2015



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US GDP



US GDP

\$15.00 trillion

14.75

14.50

14.25

14.00

'08

'09

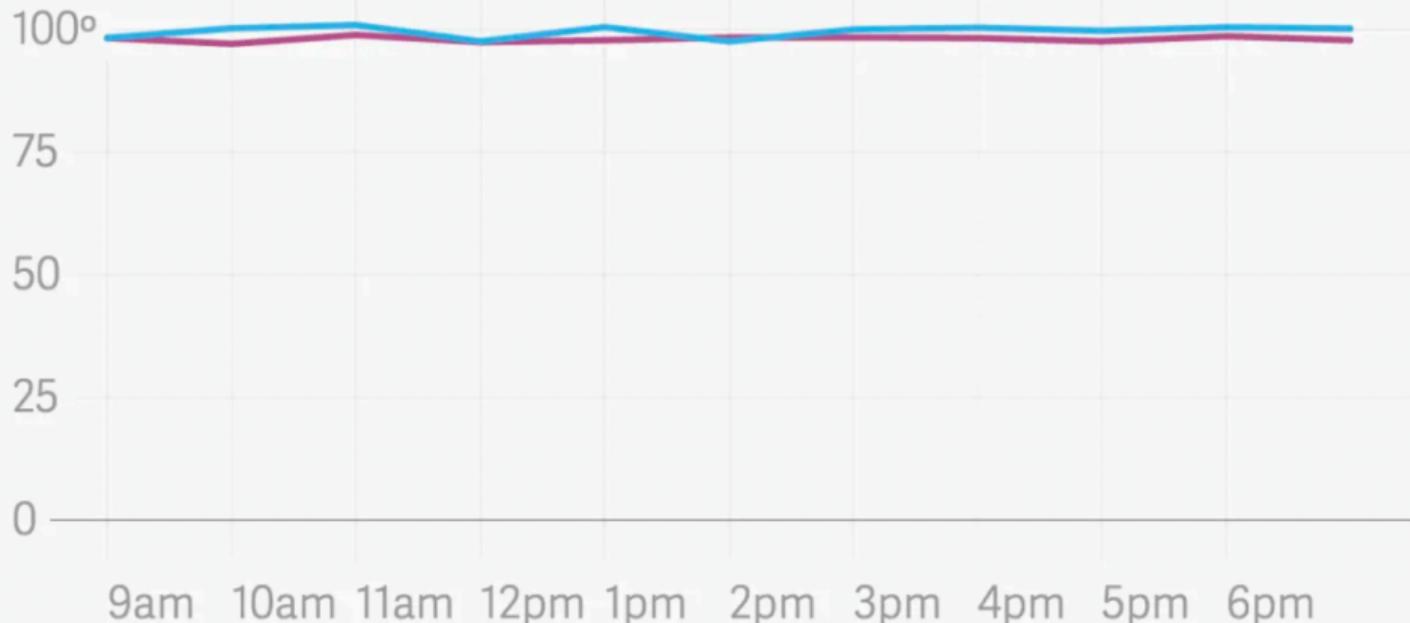
'10



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Oral temperature

Sara Bob



Oral temperature

Sara Bob

100.5°

99.5

98.5

97.5

96.5

95.5

9am 10am 11am 12pm 1pm 2pm 3pm 4pm 5pm 6pm



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Truncating the y-axis is sometimes ok

- When you're trying to emphasize change, rather than relative magnitude.
- When you're plotting data over time.
- When zero is not a sensible baseline for comparison.

Bottom line: use your judgment; don't mislead people; watch out for “little y lies.”



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- **Violations of basic math**
- Nearly content-free figures
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RASMUSSEN REPORTS POLL

Did scientists falsify research to support their own theories on Global Warming?

59%

SOMEWHAT LIKELY

35%

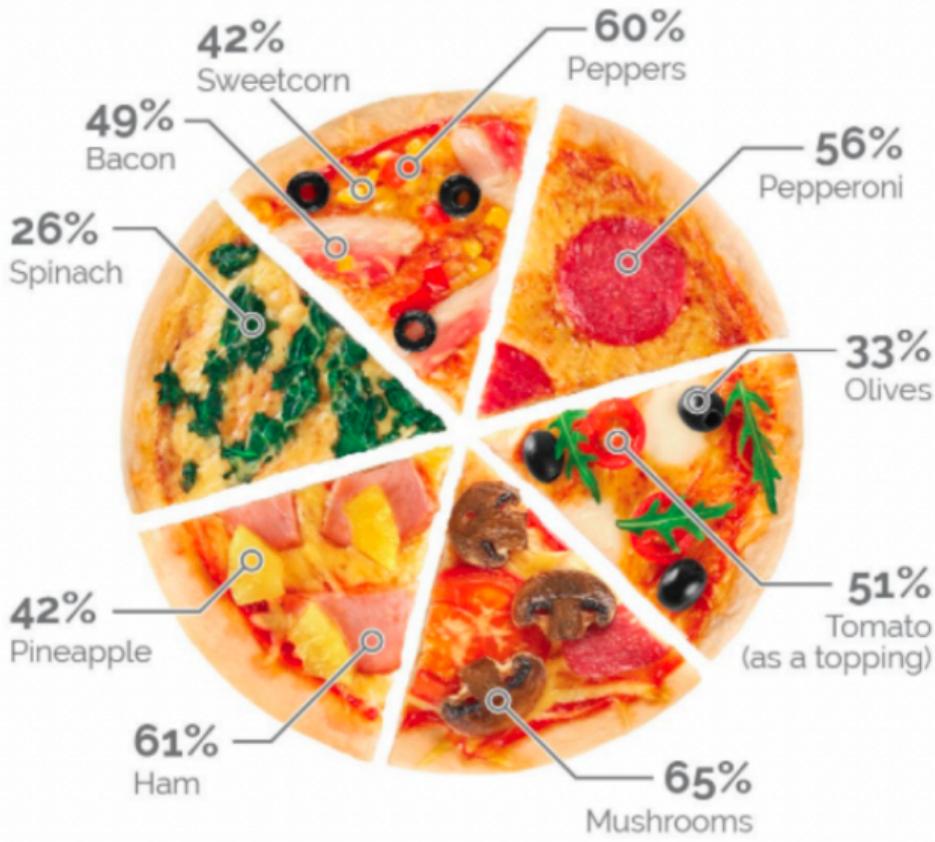
VERY LIKELY

26%

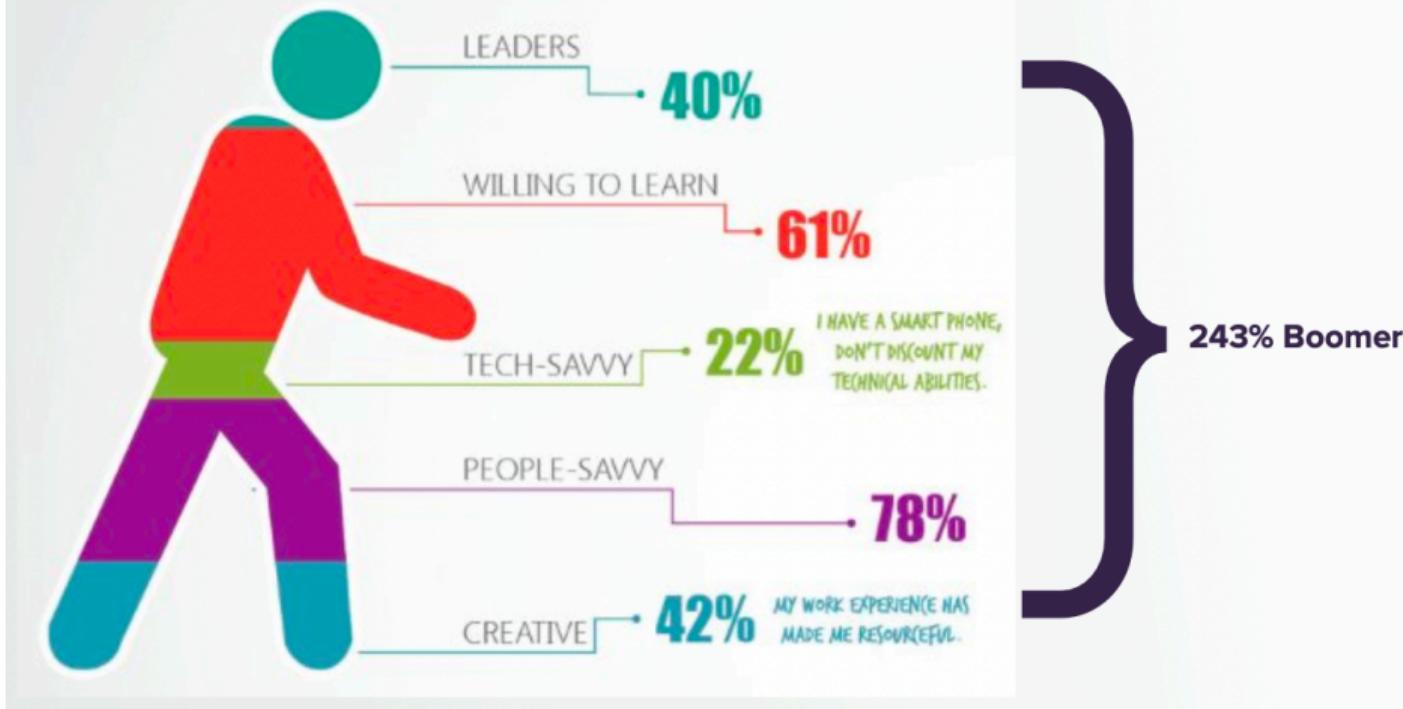
NOT VERY LIKELY



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HOW BABY BOOMERS DESCRIBE THEMSELVES



UNEMPLOYMENT RATE UNDER PRESIDENT OBAMA



FOX
NEWS

2011

SOURCE: BUREAU OF LABOR STATISTICS



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WHAT IS YOUR FAVORITE SEASON? @FCNMIKE

53%



17%

17%

13%

FALL

SUMMER

WINTER

SPRING



#KATIESCOMMUTERS

DEADLY CRASH

DEADLY HOME INVASION

75°

6:51

FIRSTCOAST
NEWS

22



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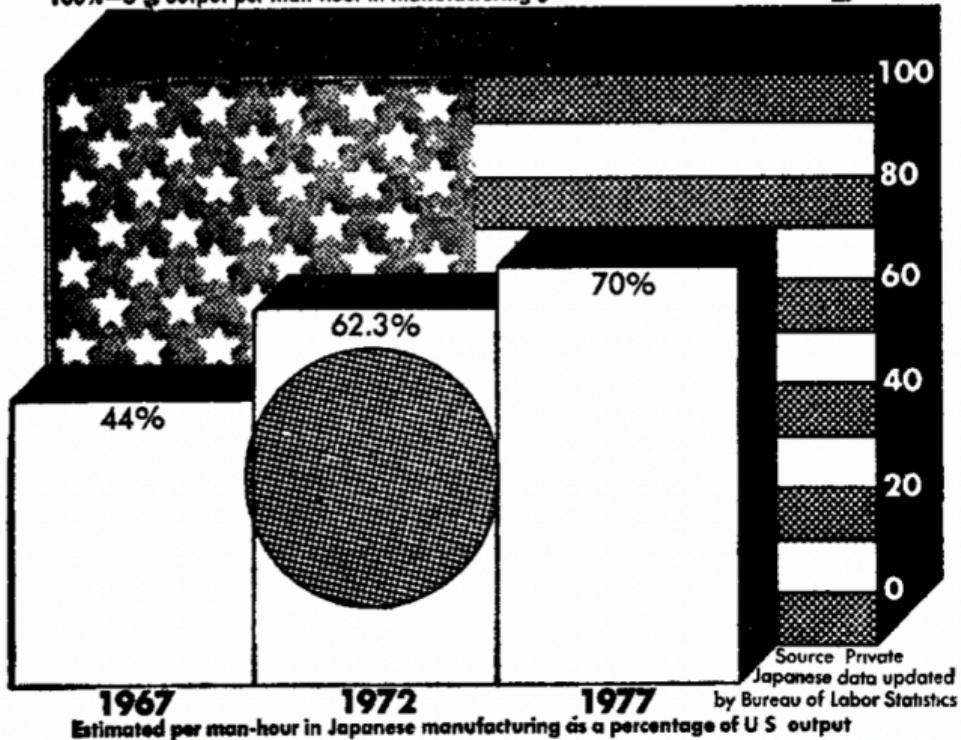
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Labor Productivity: U.S. vs Japan

100% = U S output per man-hour in manufacturing

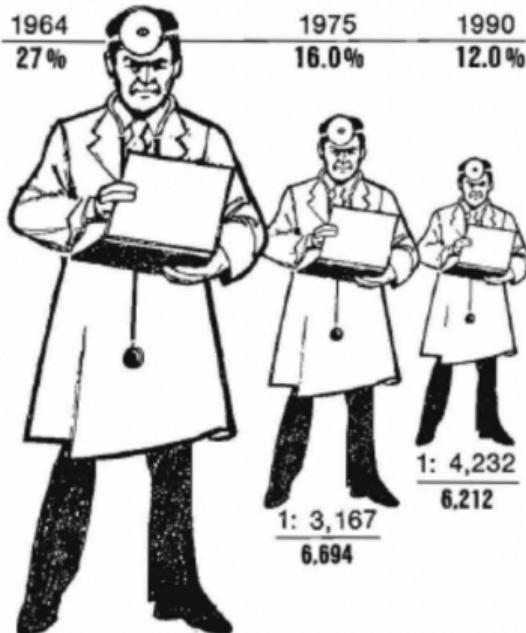


THE SHRINKING FAMILY DOCTOR

In California

Percentage of Doctors Devoted Solely to Family Practice

1964	1975	1990
27%	16.0%	12.0%



TRUMP TWEETS MENTIONING MUELLER BY NAME



LIVE

MSNBC

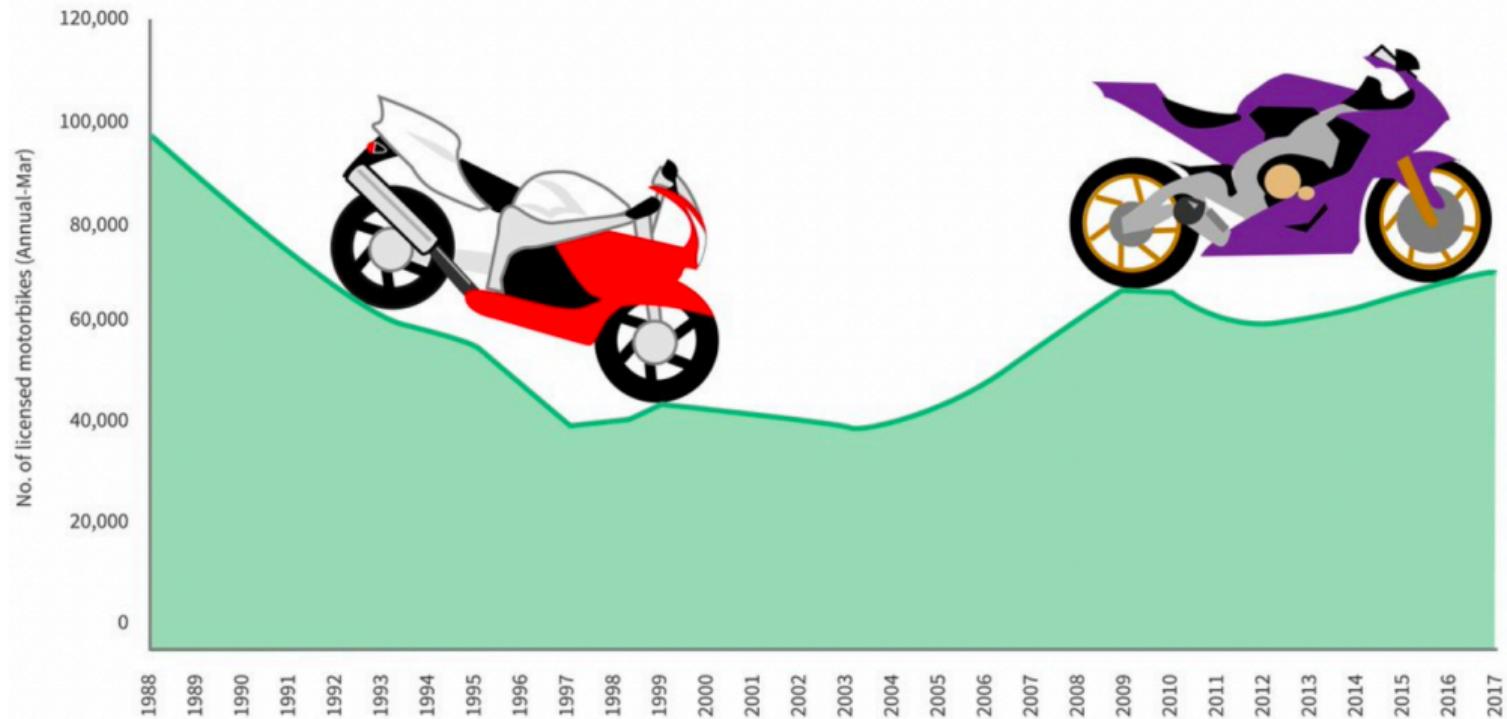


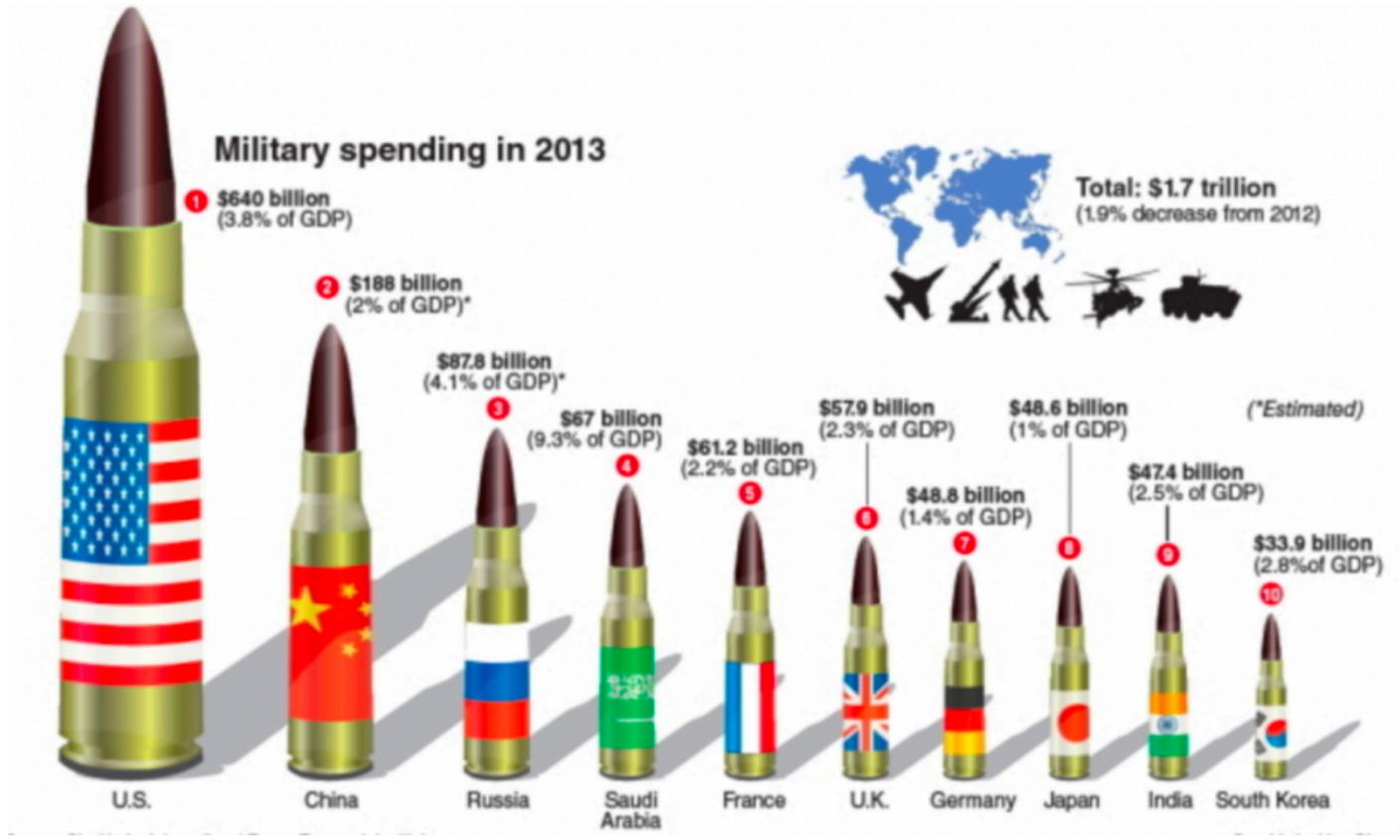
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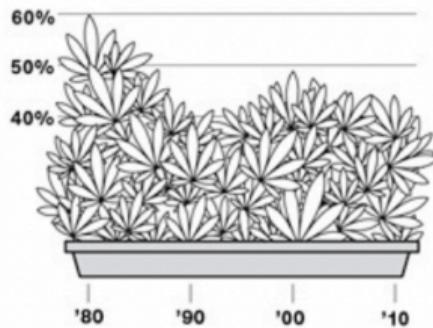
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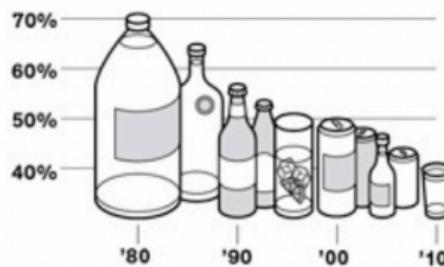




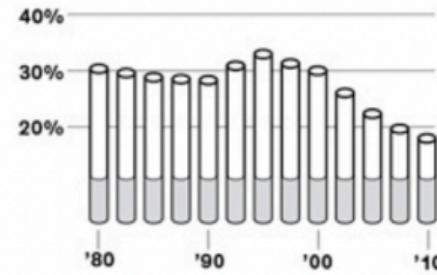




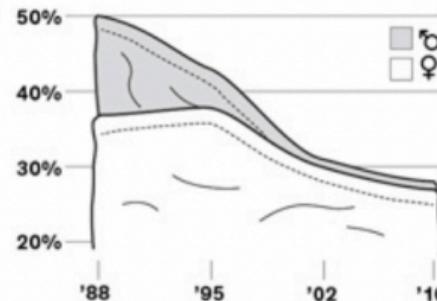
▲ Percentage of high-school seniors
who have ever tried pot.



○ Alcohol use by high-school
seniors over time.



■ Smoking habits of high-school
seniors over time.



♂ Percentage of 15-to-17-year-olds
who have had sex.



Plotting pitfalls

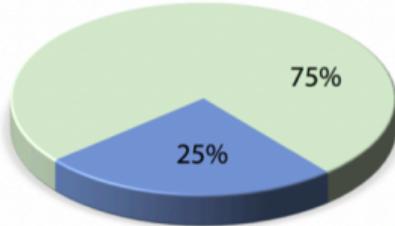
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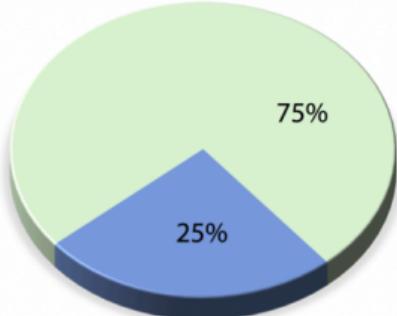
a



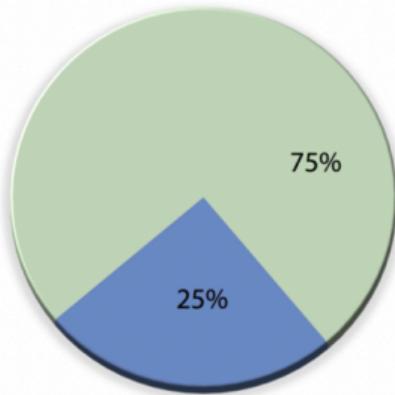
b



c

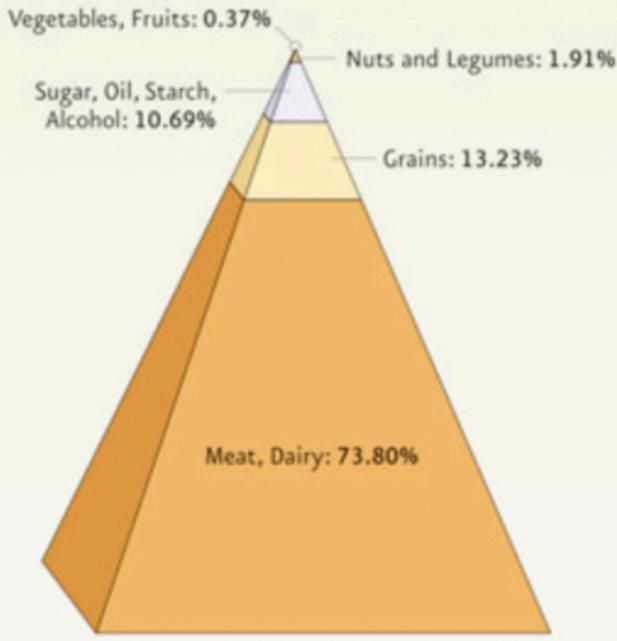


d

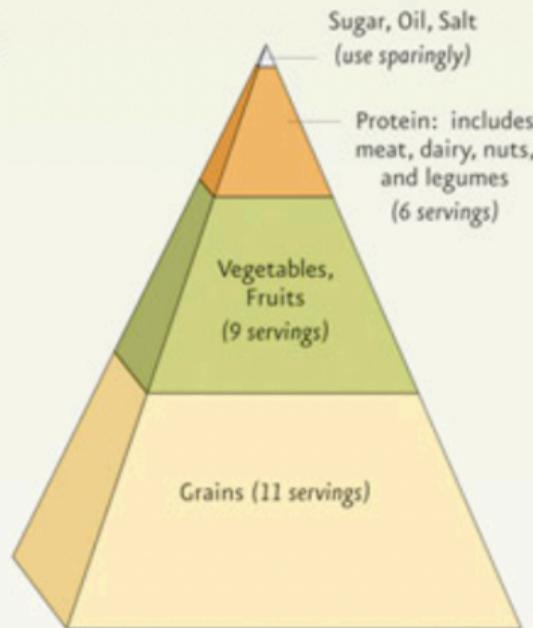


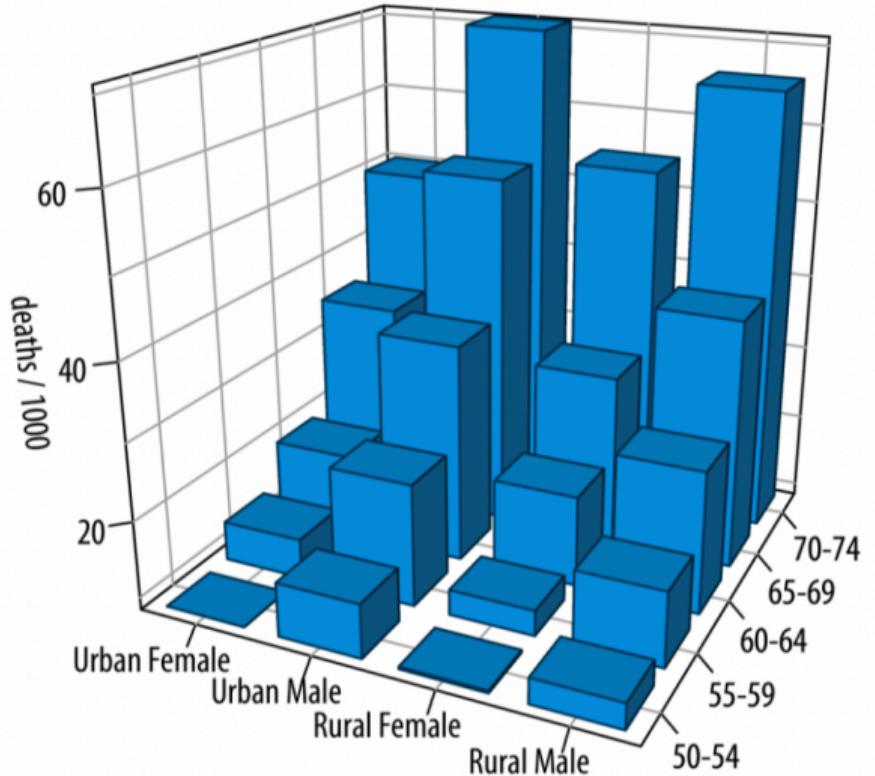
Why Does a Salad Cost More Than a Big Mac?

Federal Subsidies for Food Production, 1995-2005[®]

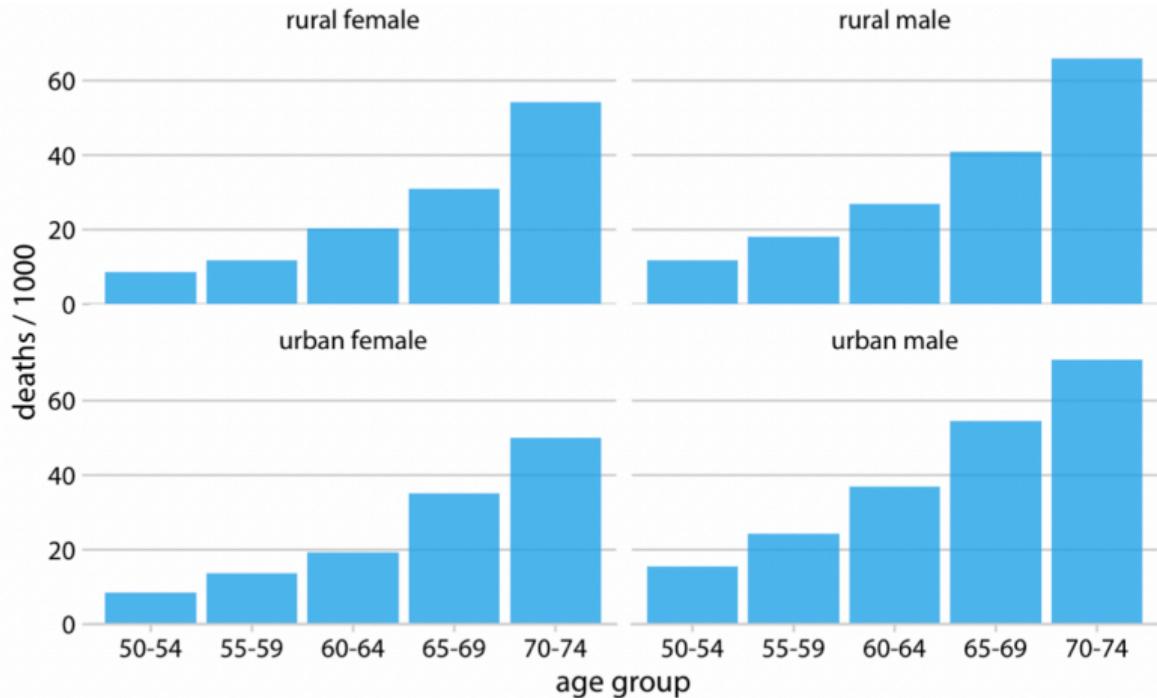


Federal Nutrition Recommendations





same data as previous slide, but now using technique called **faceting**

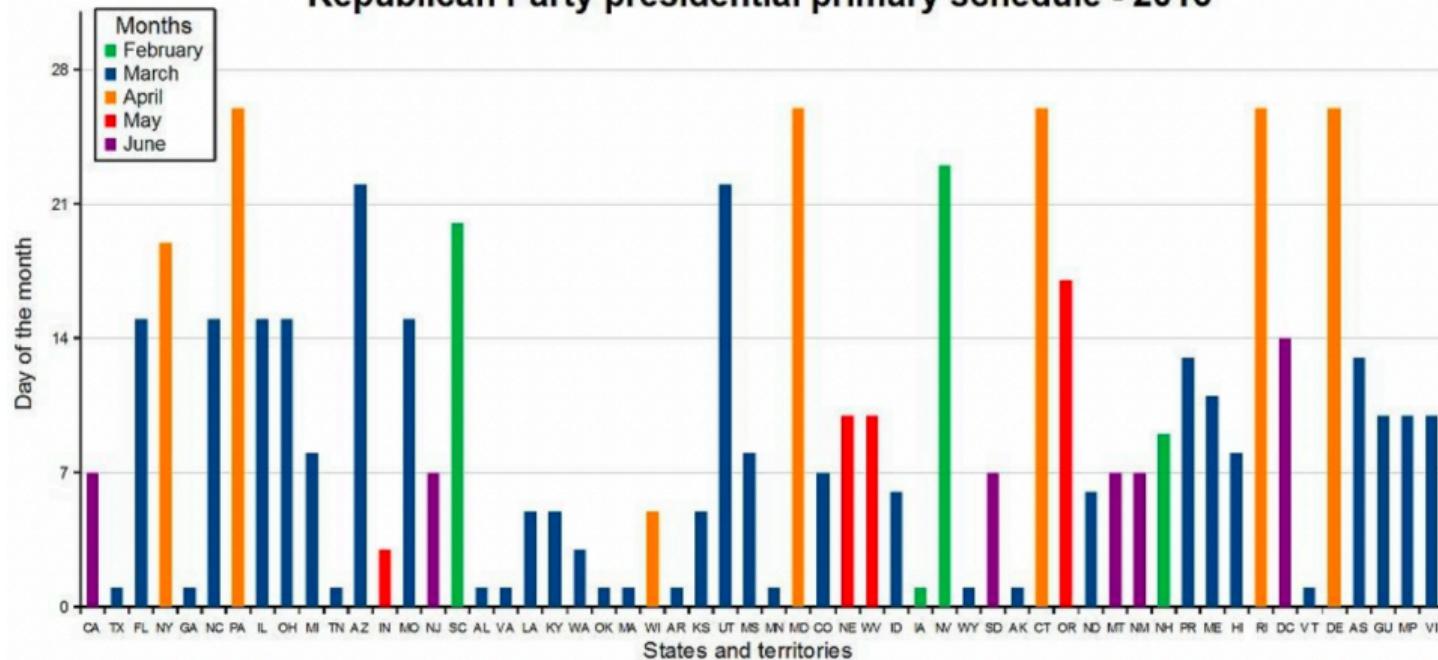


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Republican Party presidential primary schedule - 2016



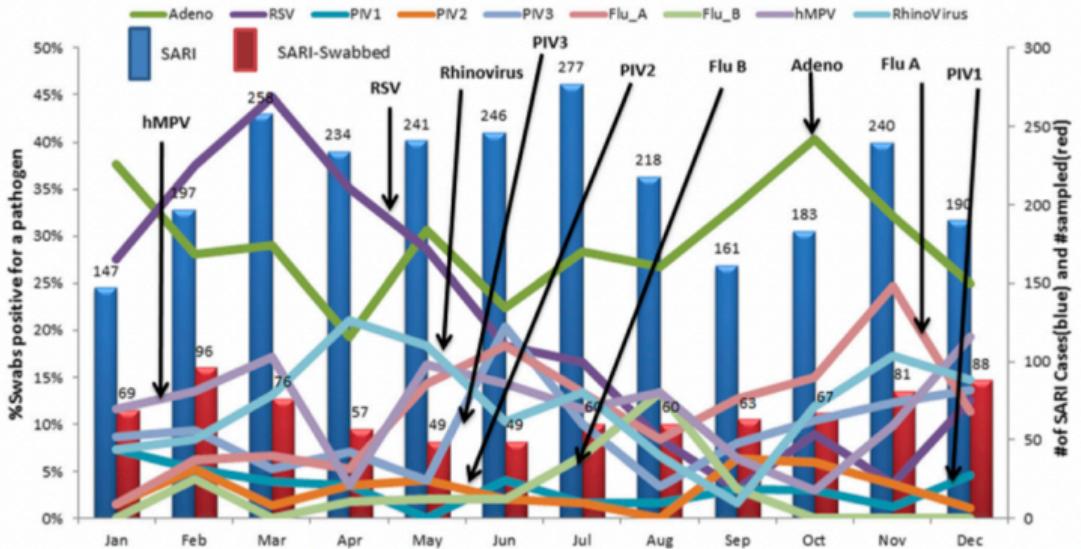
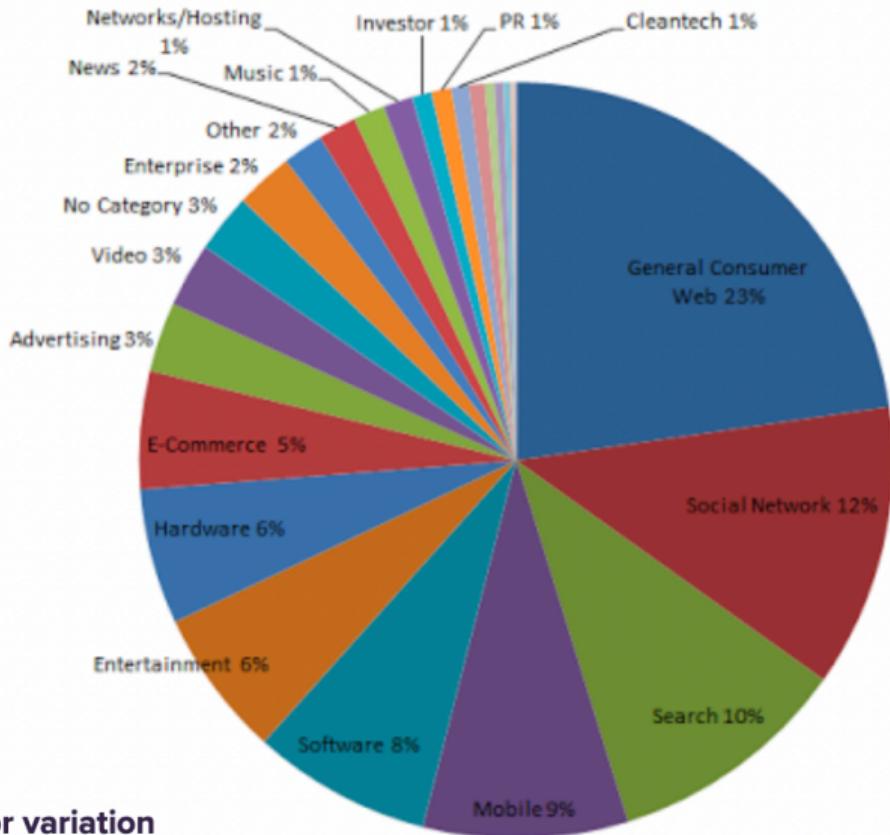


Figure 1 Monthly (aggregate) distribution of viral pathogens, March 1, 2007-Feb 28, 2011.

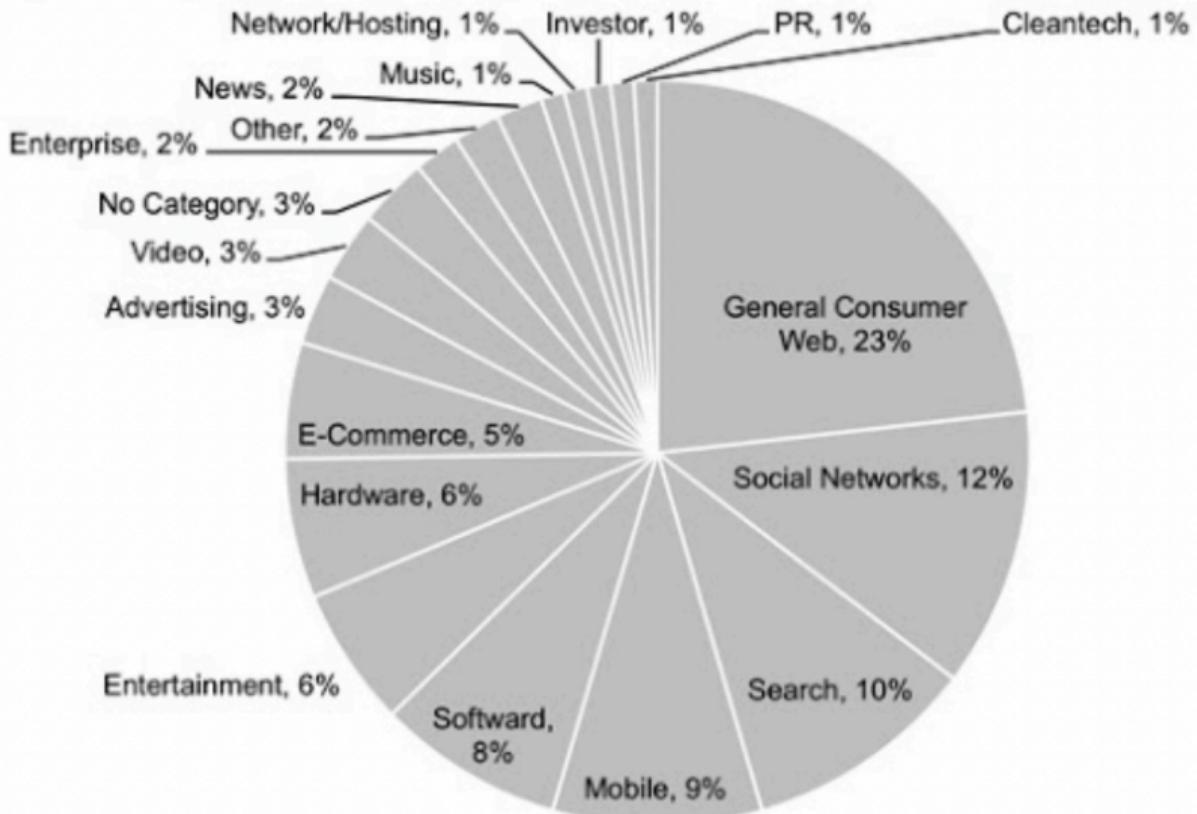


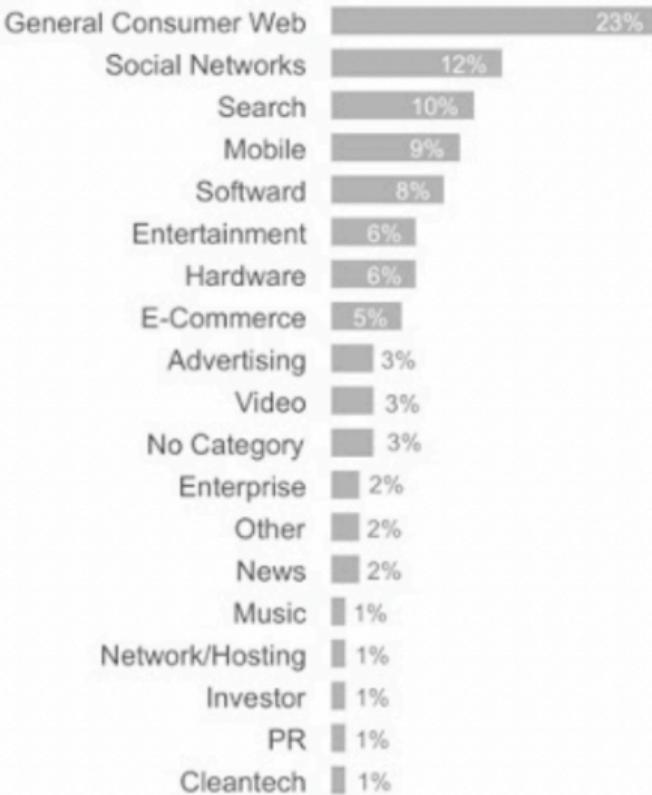


Meaningless color variation

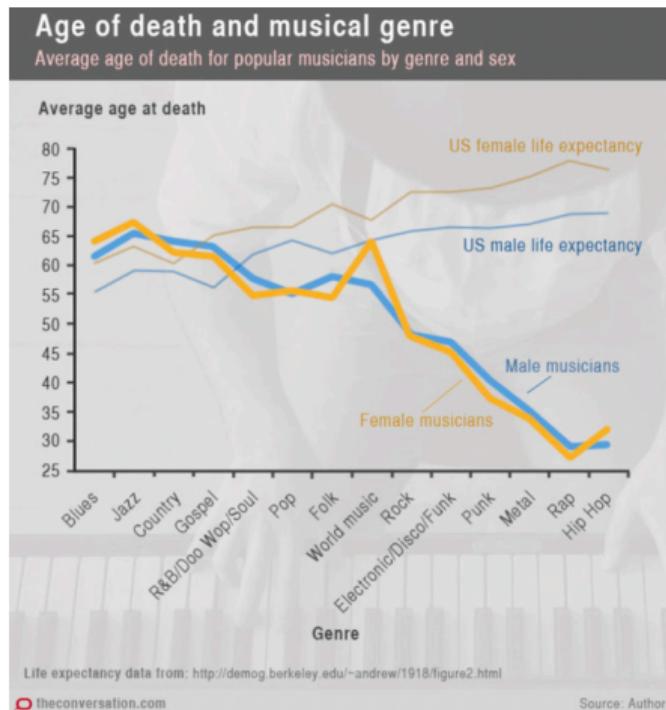


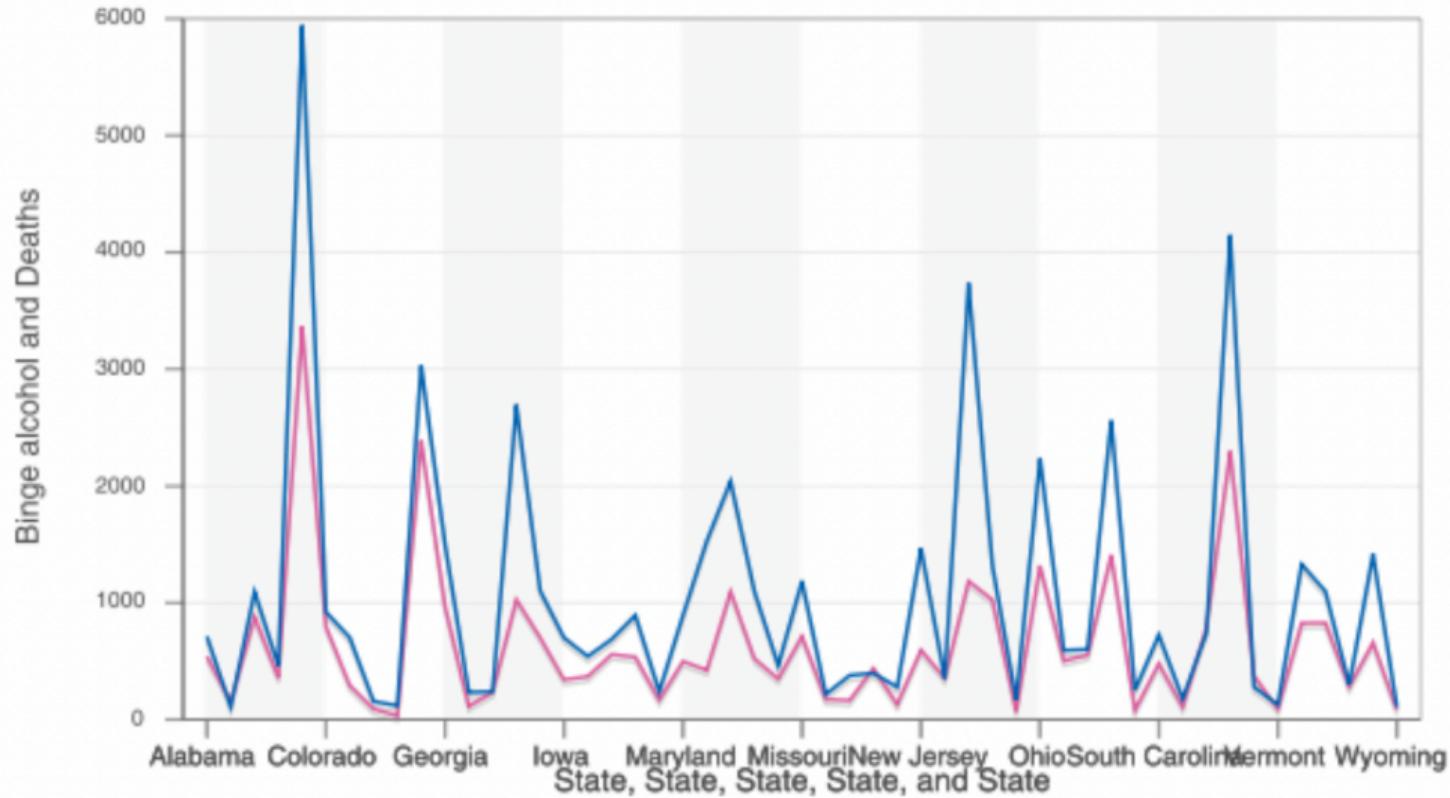
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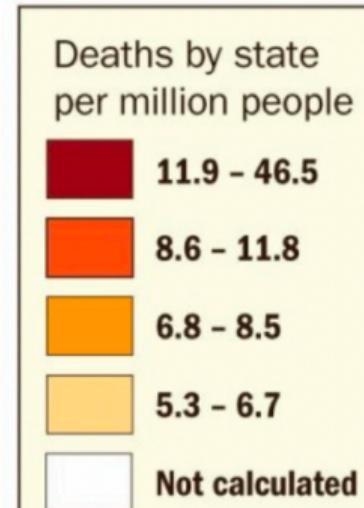
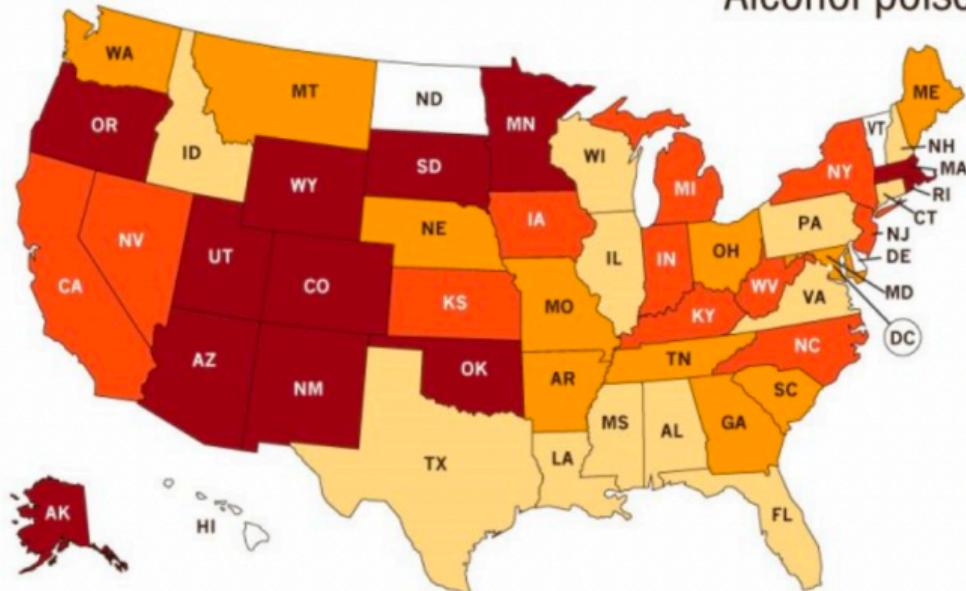


Example of **survivorship bias** here – discuss where and how ...





Alcohol poisoning deaths vary by state



SOURCE: National Center for Health Statistics Mortality Multiple Cause Files, 2010-2012.



How to do better



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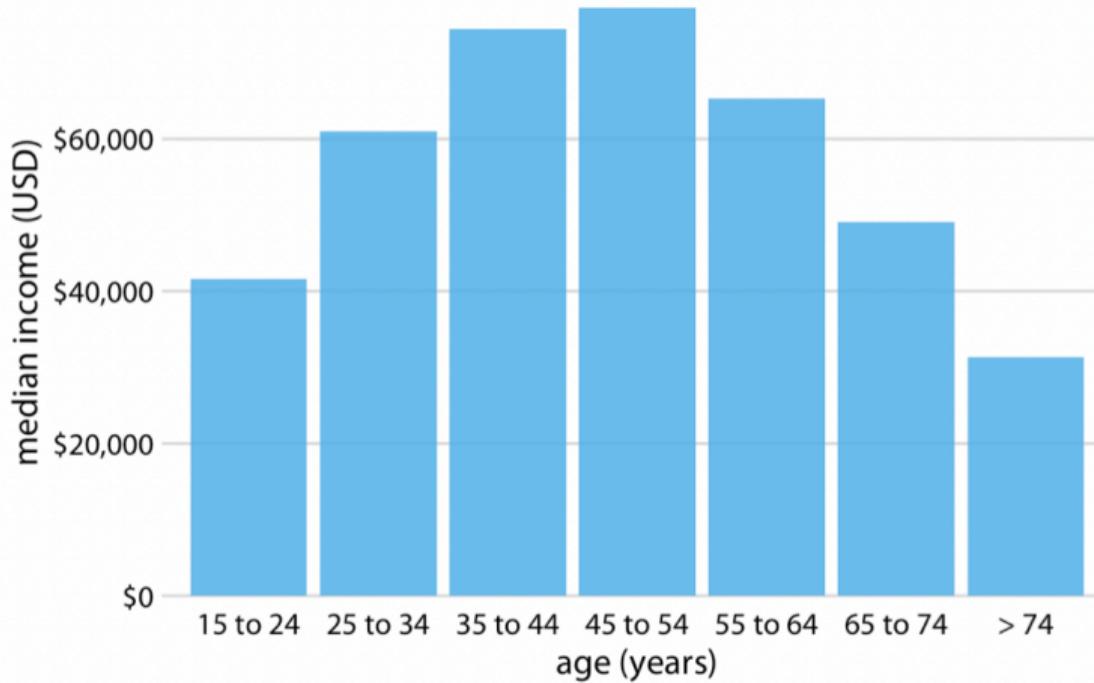
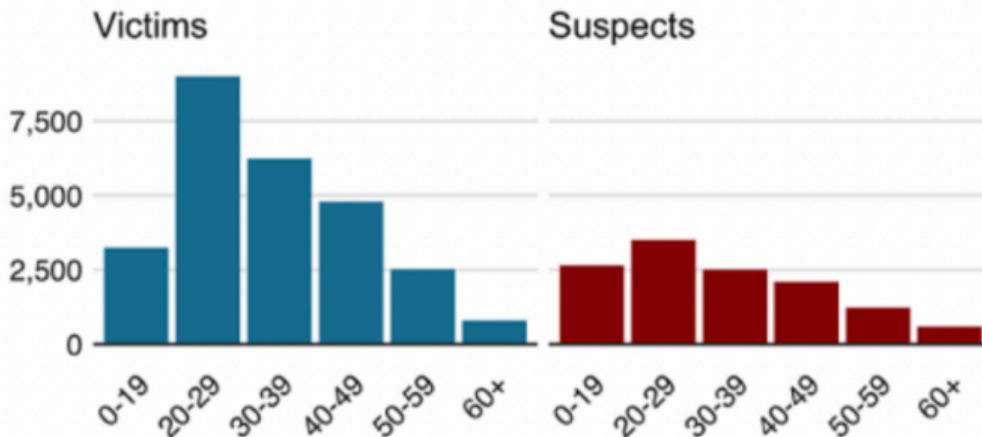


Figure 6.5: 2016 median U.S. annual household income versus age group. The 45–54 year age group has the highest median income. Data source: United States Census Bureau



Homophobic hate crimes are mainly committed by young people on young people

Number in each age group 2014 - 2017



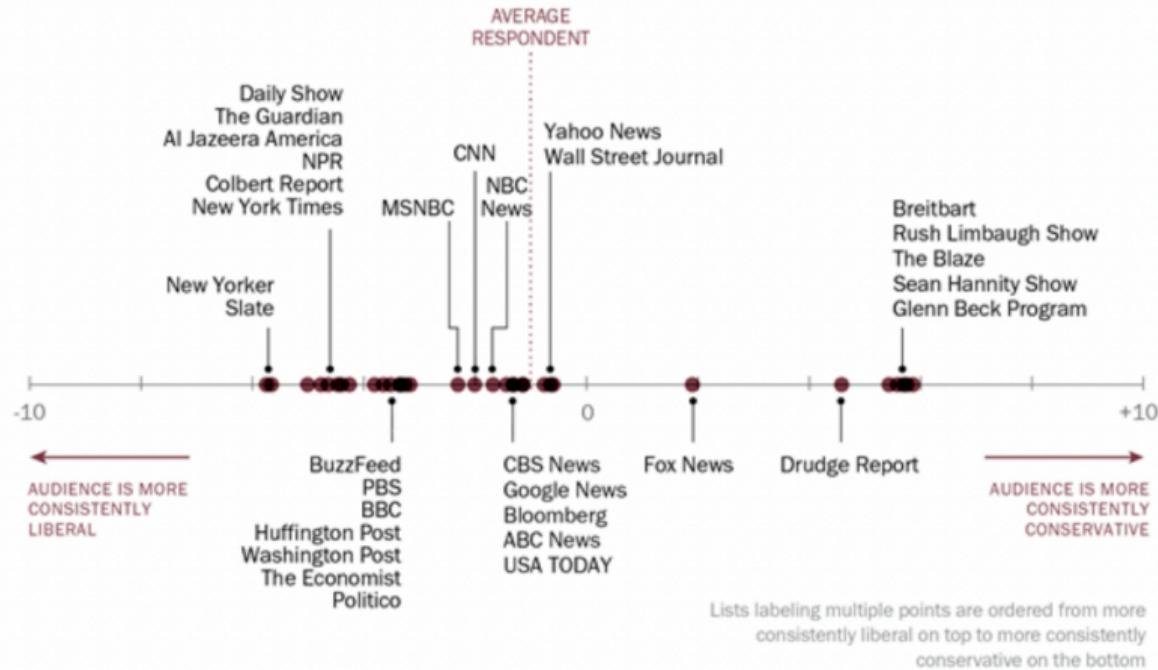
NB. Analysis excludes 3,474 victims and 2,003 suspects whose ages are unknown

Source: BBC Freedom of Information requests to UK police forces



Ideological Placement of Each Source's Audience

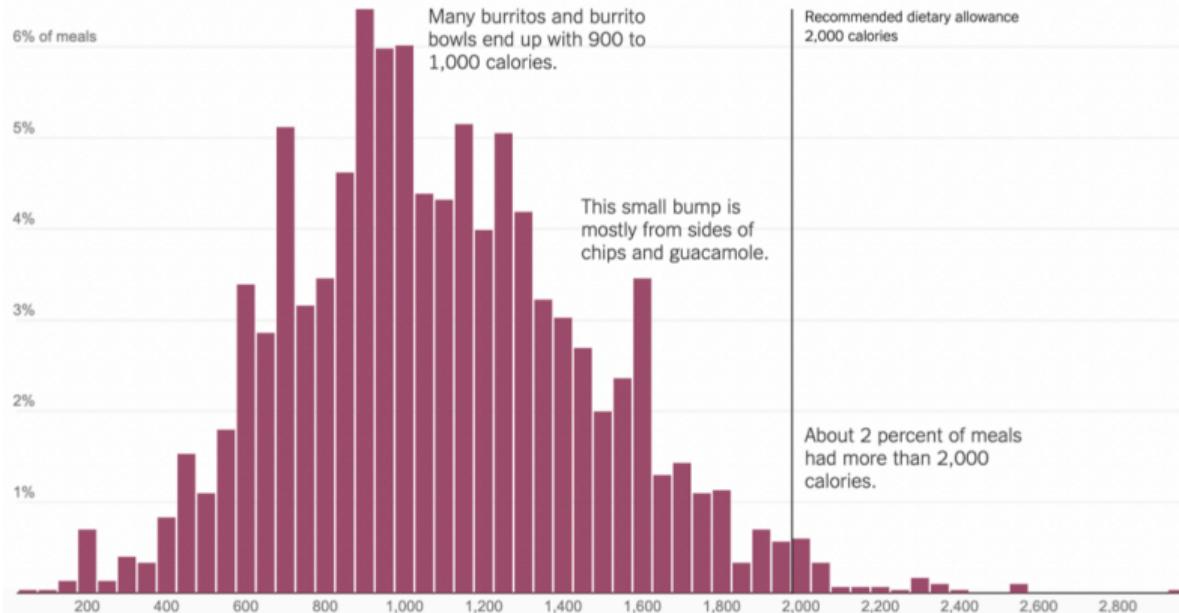
Average ideological placement on a 10-point scale of ideological consistency of those who got news from each source in the past week...

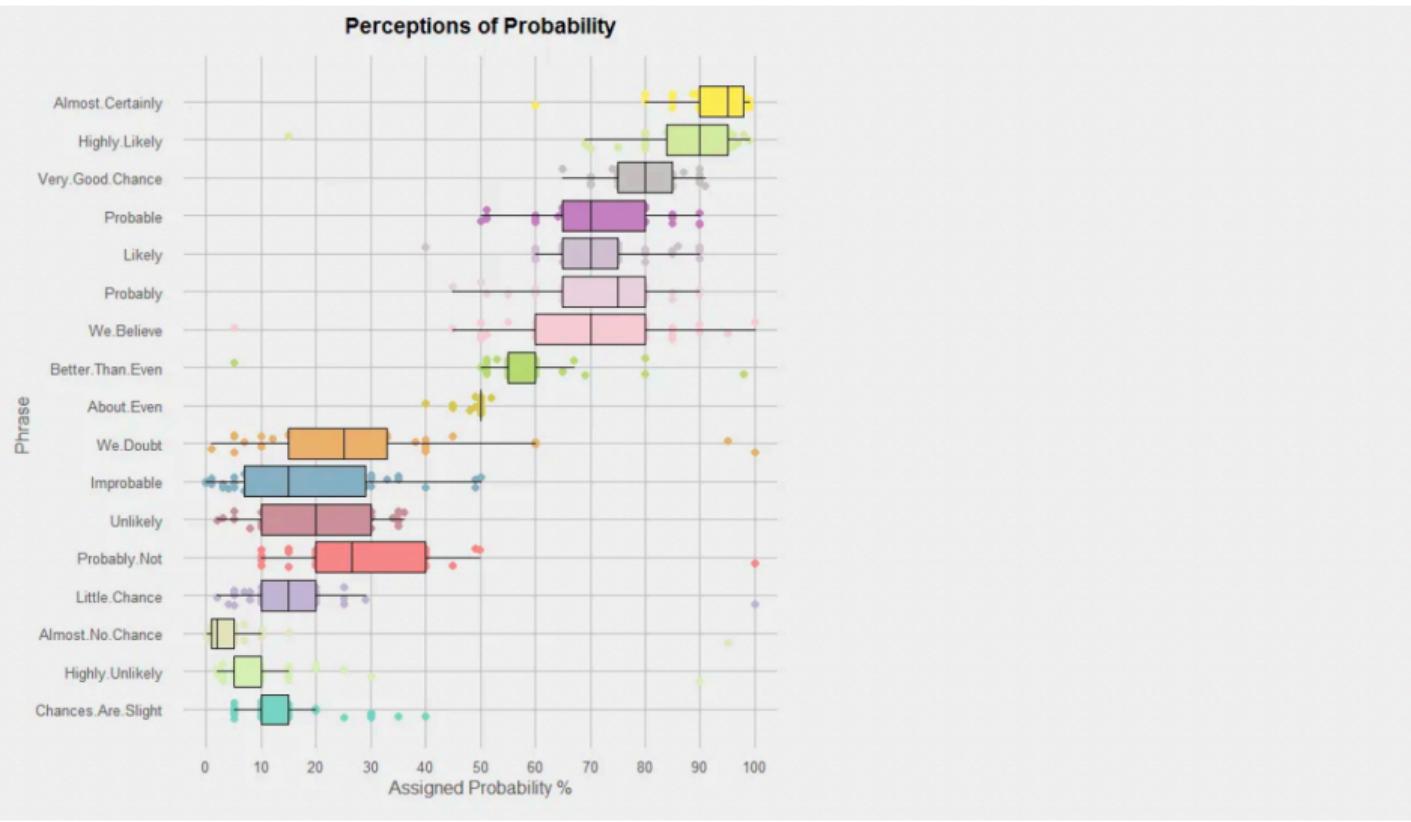


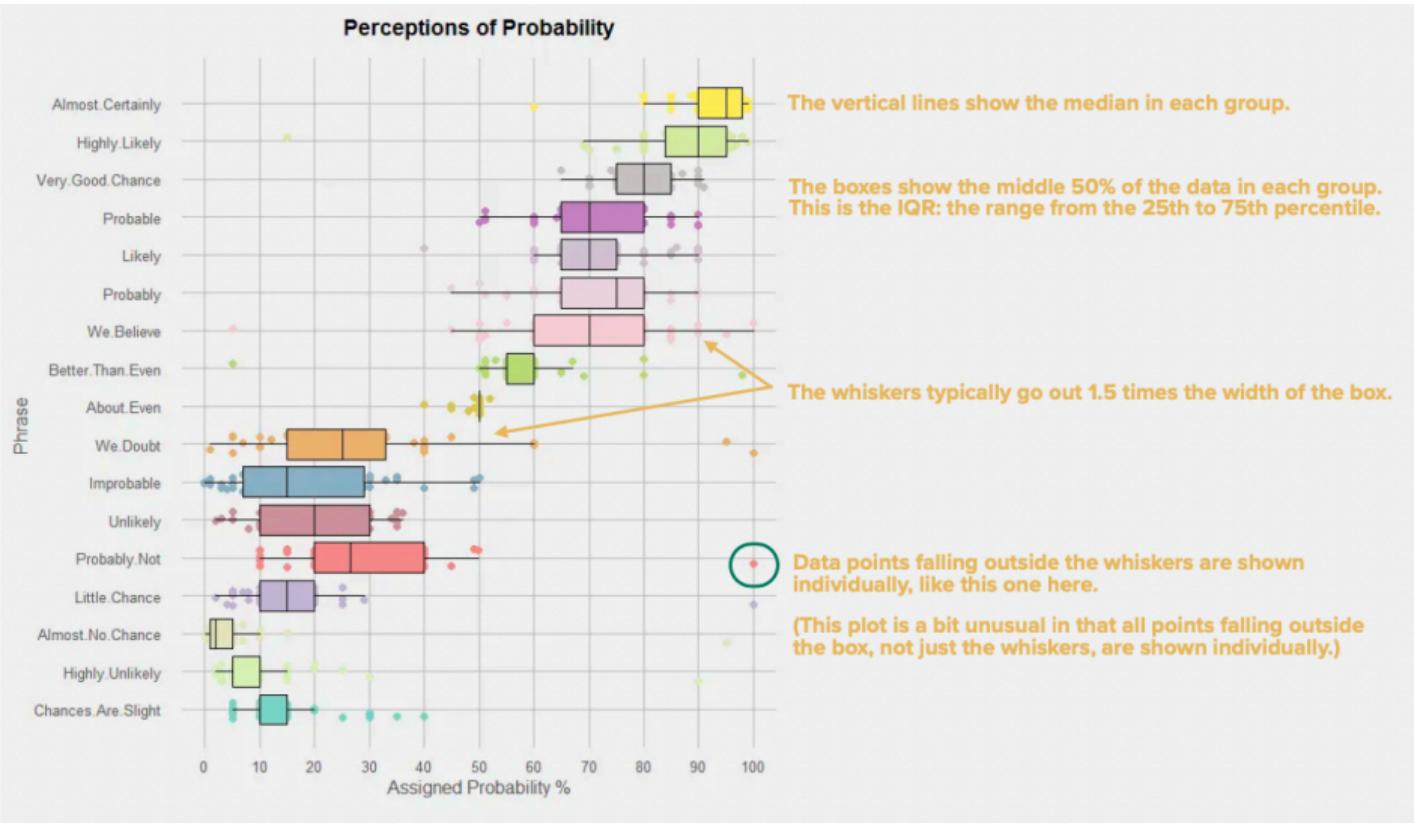
At Chipotle, How Many Calories Do People Really Eat?

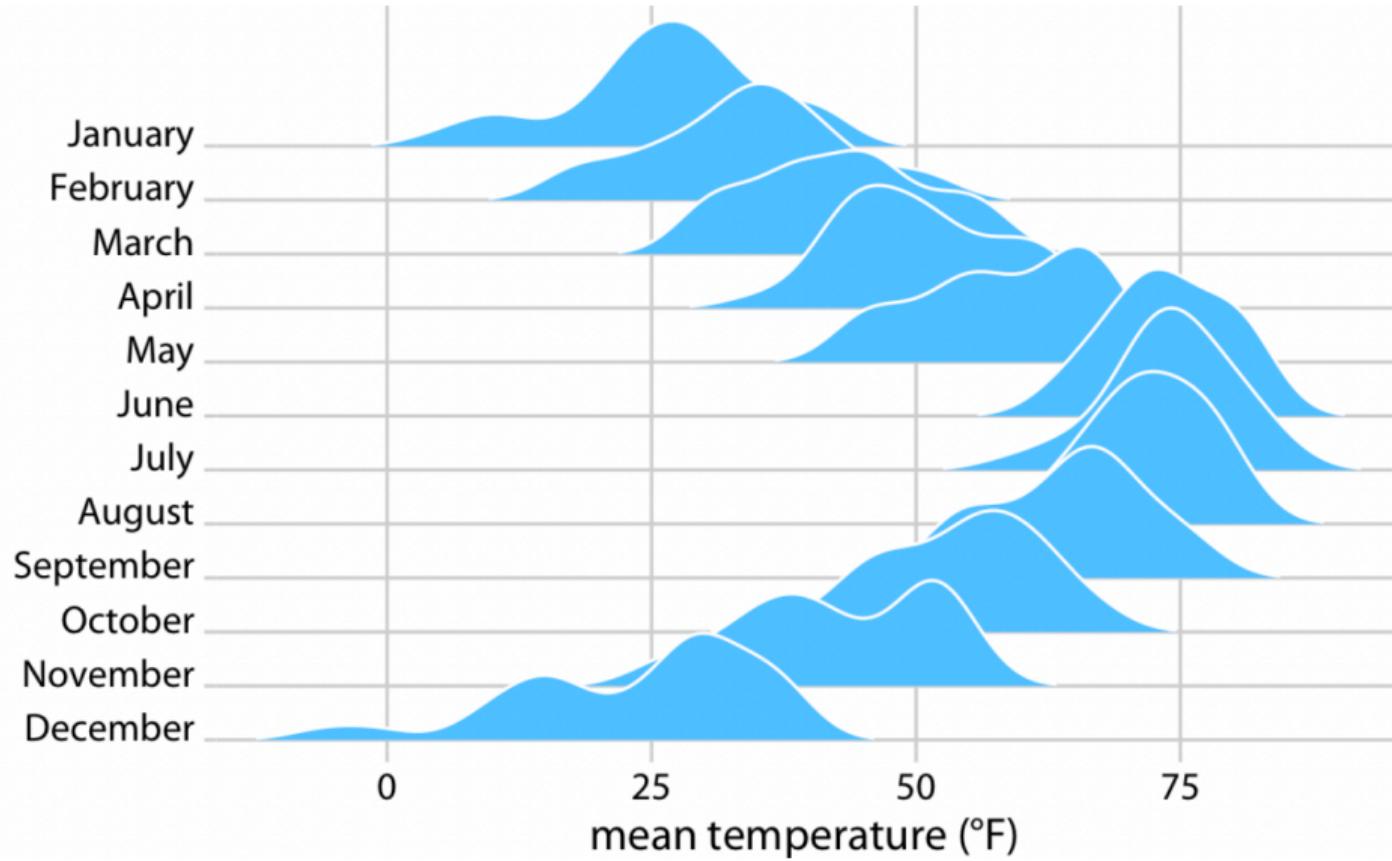
By KEVIN QUEALY, AMANDA COX and JOSH KATZ FEB. 17, 2015

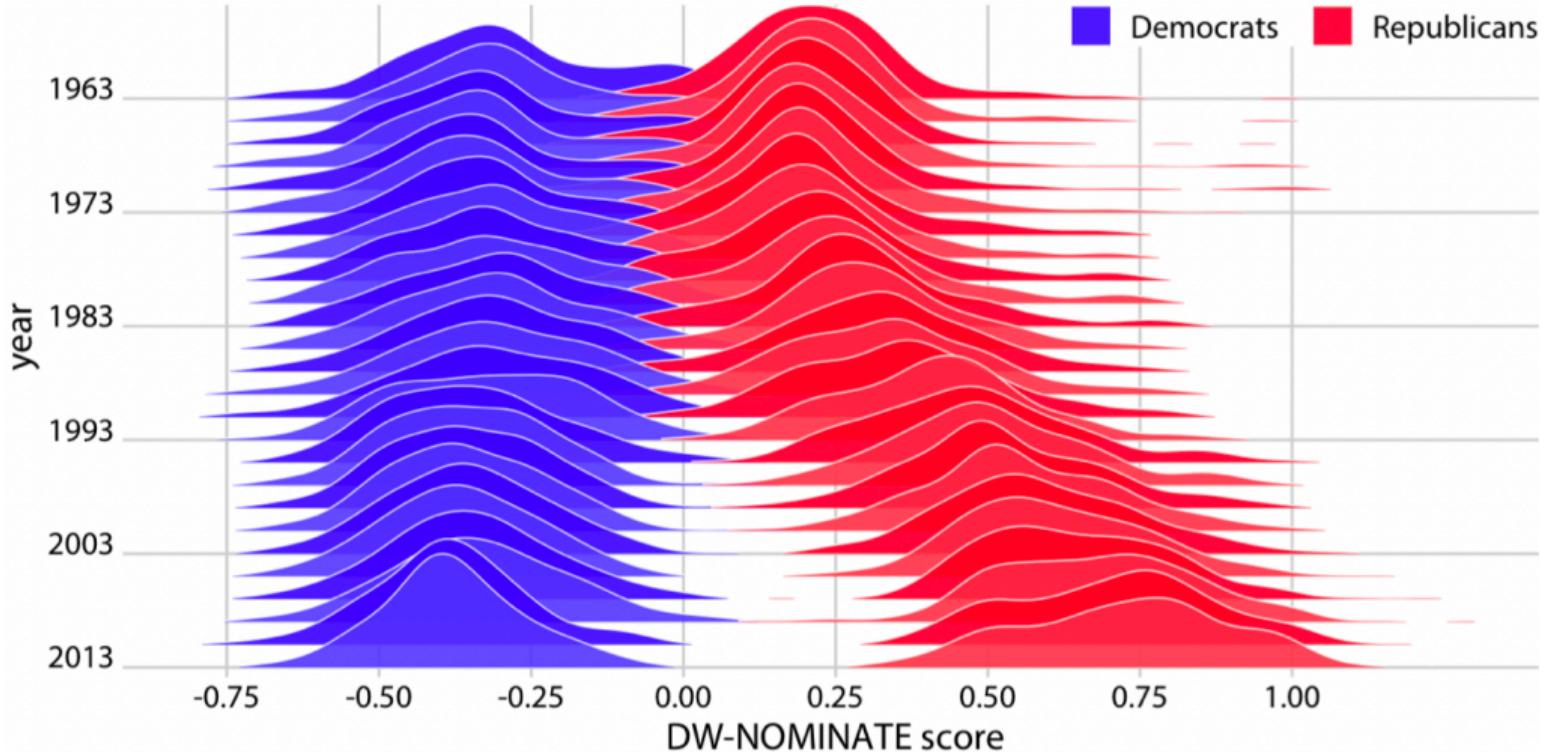
Most meals have more than 1,000 calories and almost a full day's worth of sodium. [RELATED ARTICLE](#)



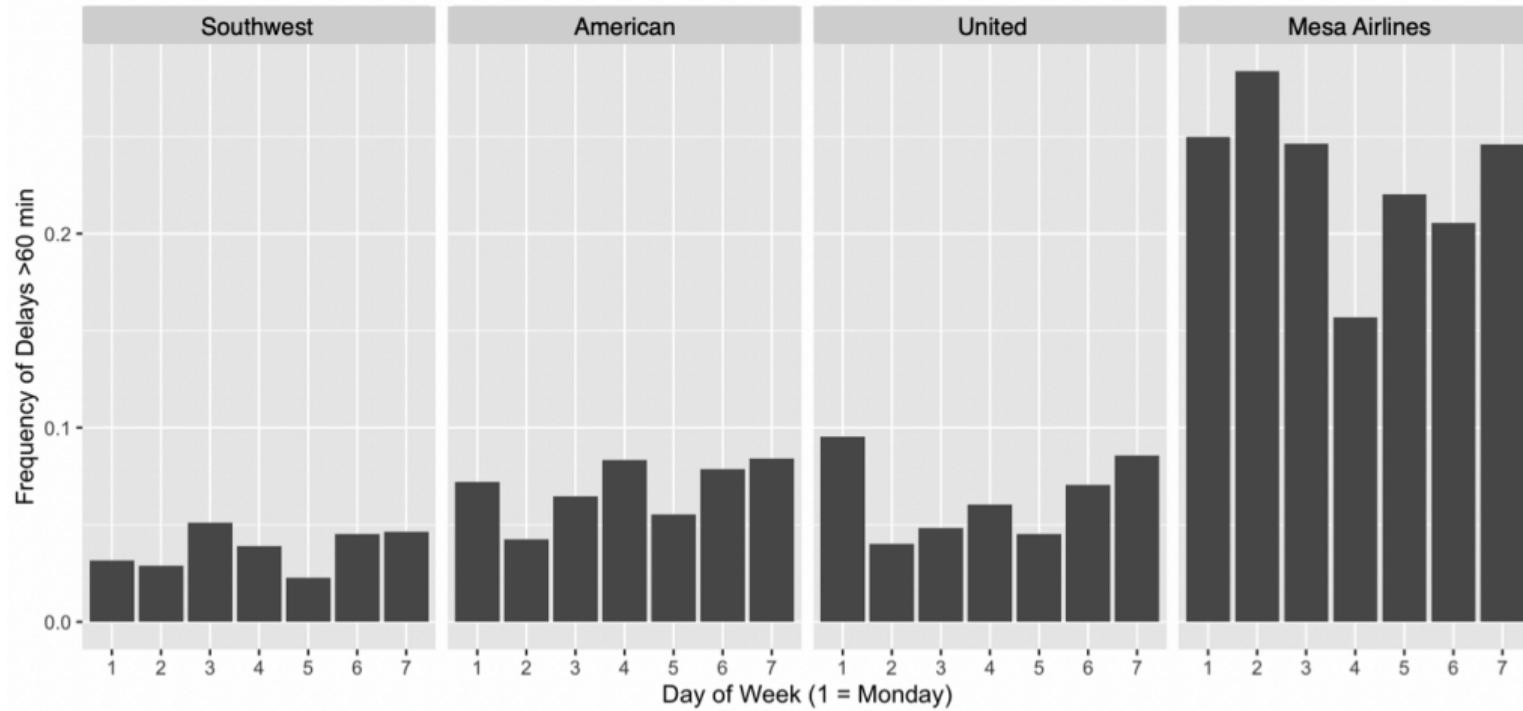




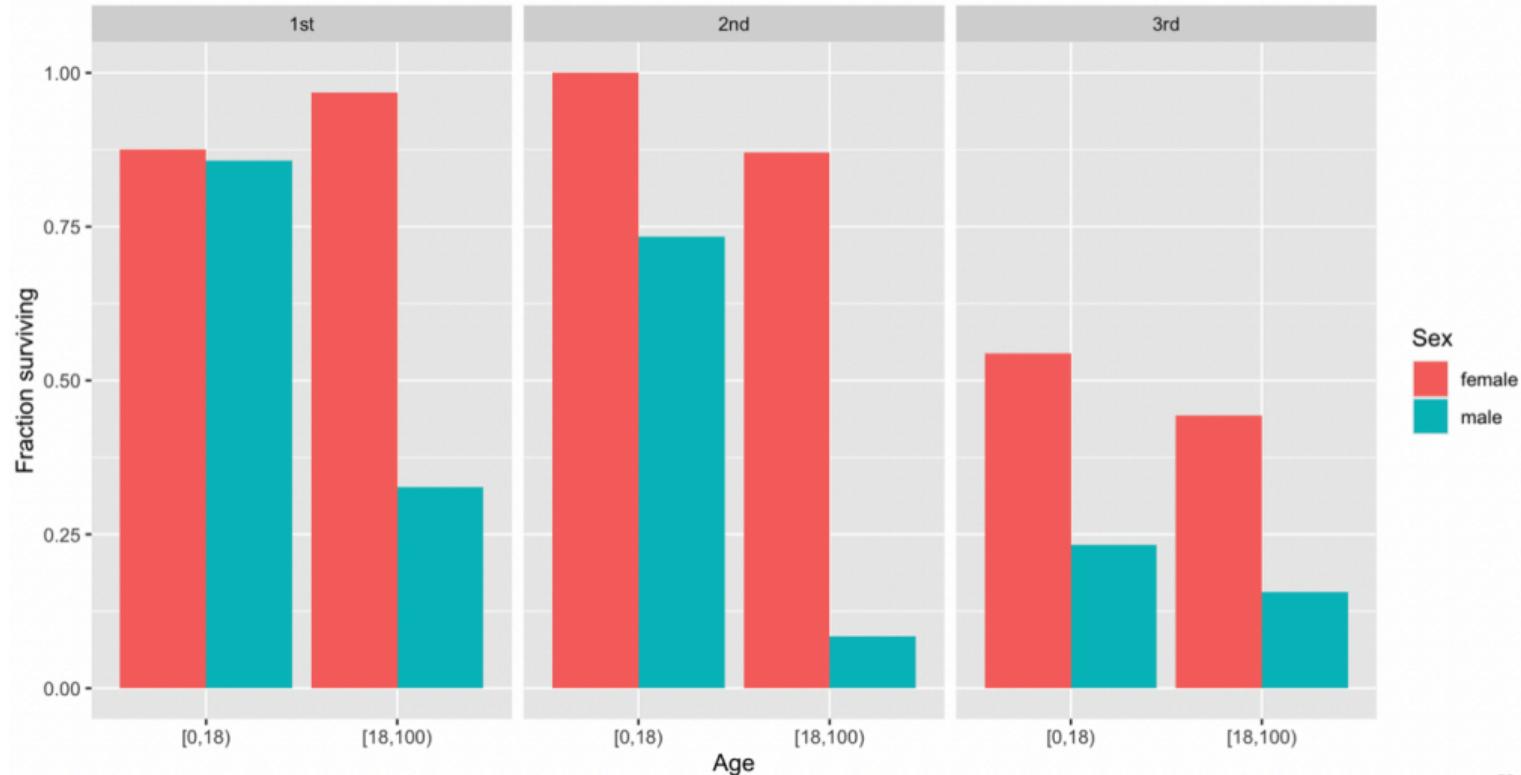




ABIA Delays by Airline and Day of Week (2011)



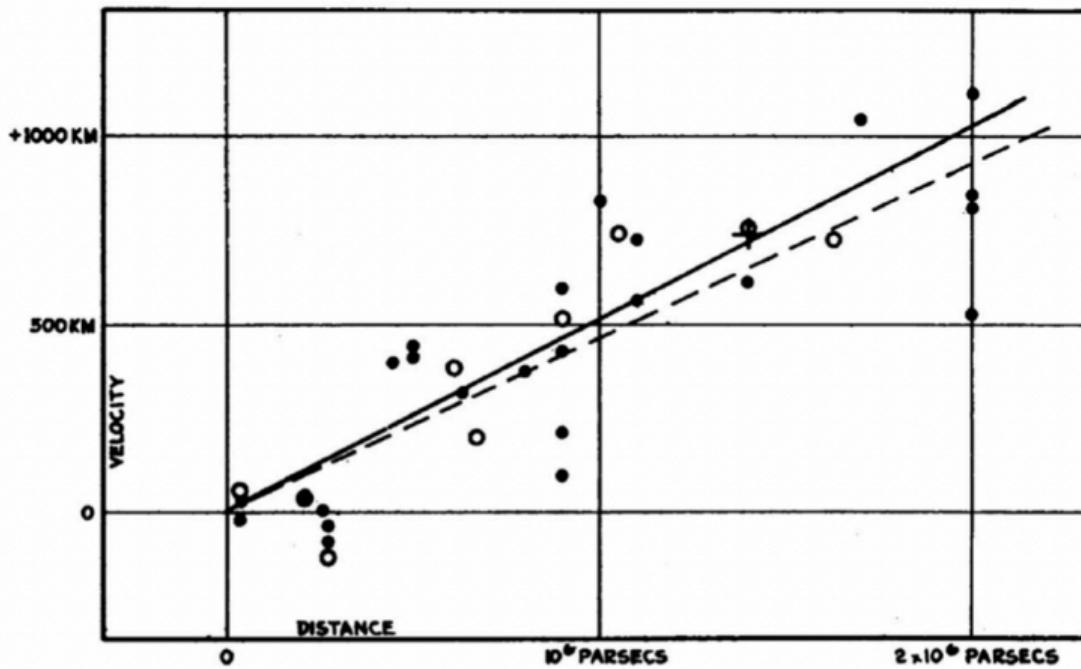
Survival on the Titanic by Age, Sex, and Passenger Class



66



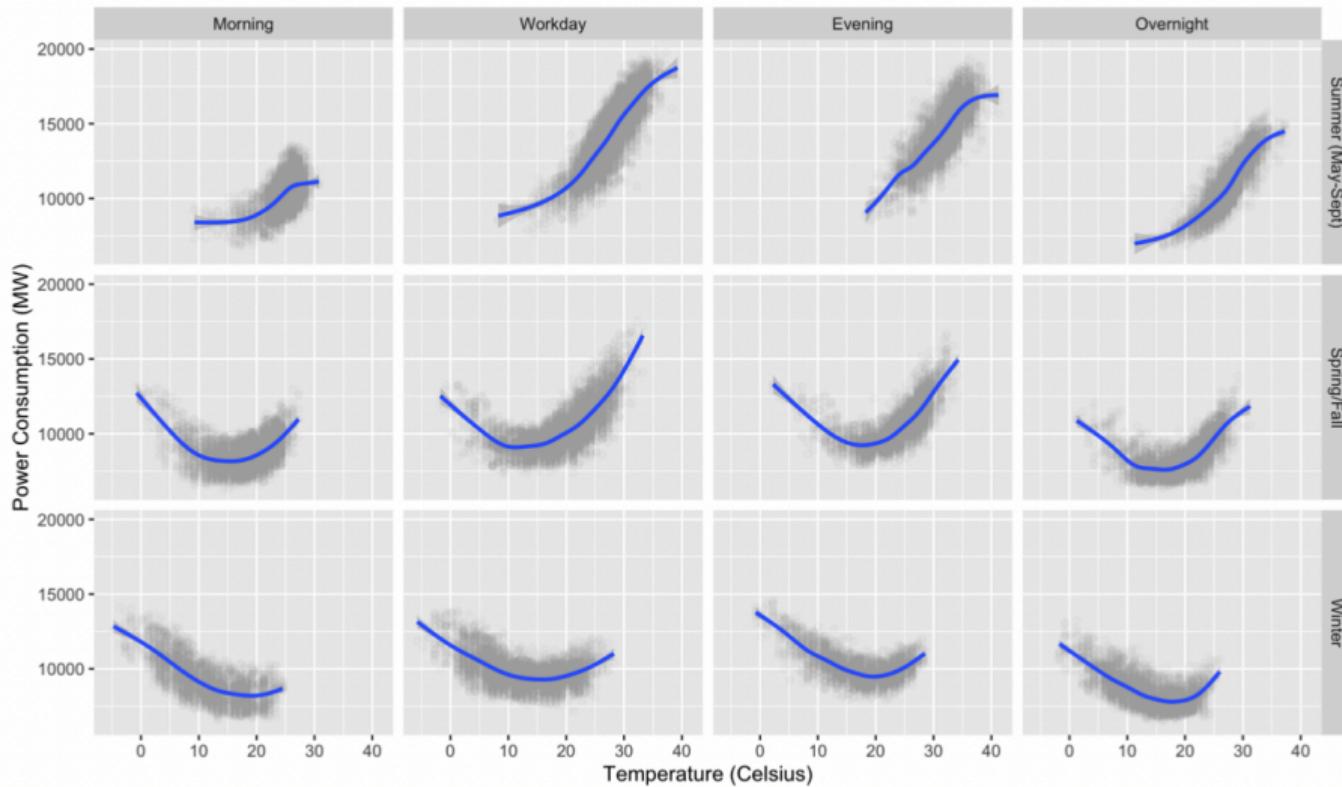
Velocity-Distance Relation among Extra-Galactic Nebulae.



How Edwin Hubble proved that the universe was expanding

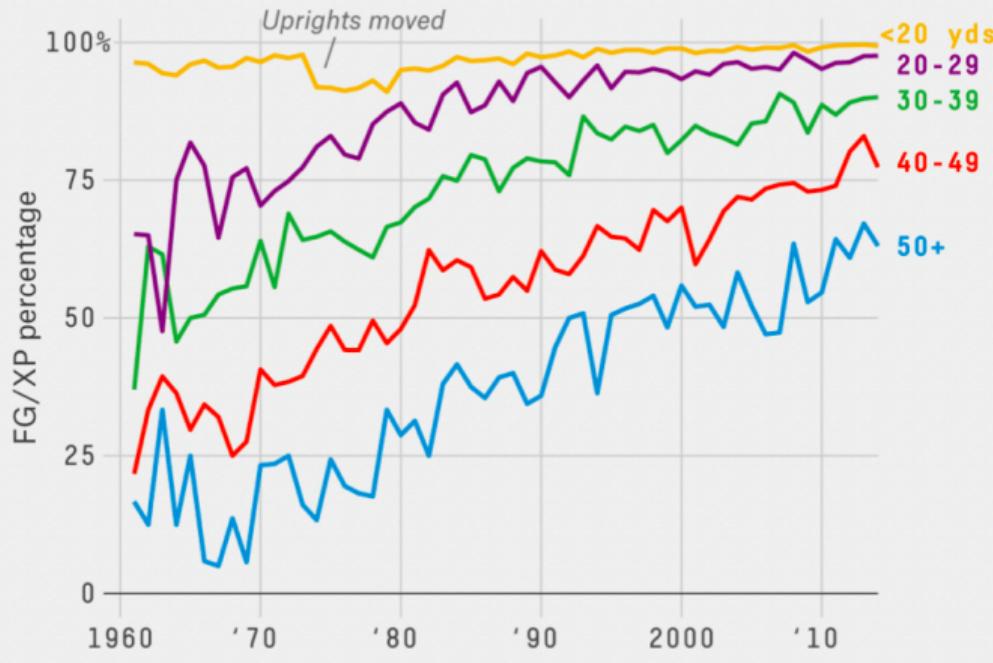


Power Consumption vs Temperature: Houston Metro Area

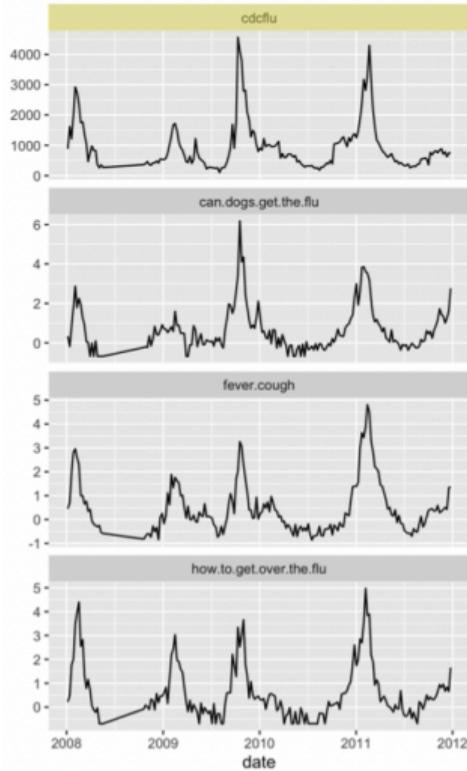


NFL Kickers Have Improved At Every Distance

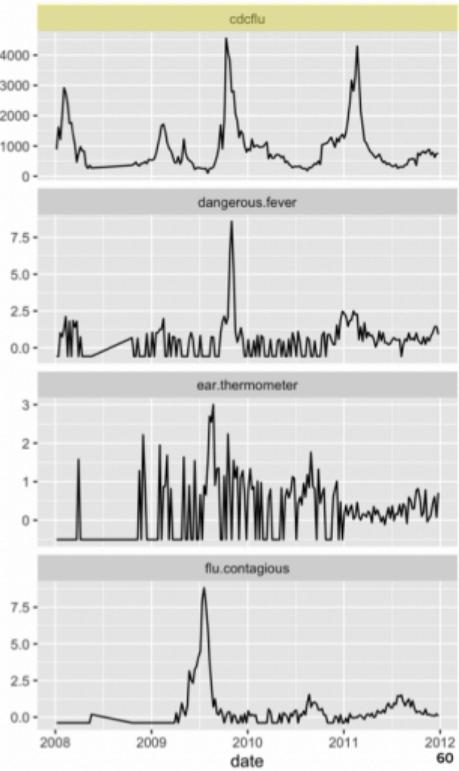
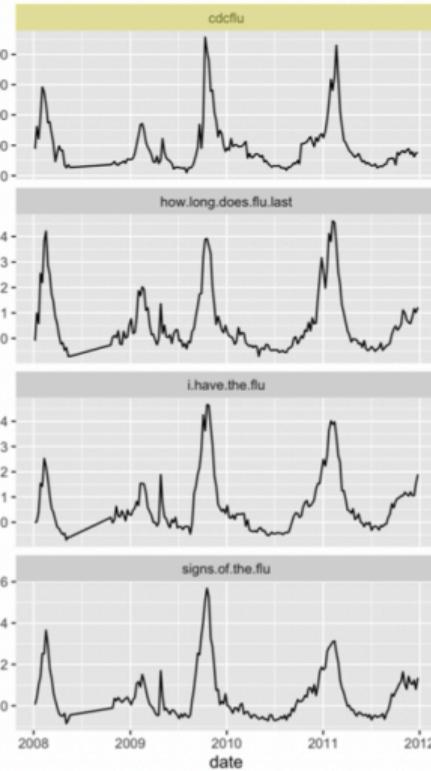
Field-goal and extra-point accuracy, 1961-2014



Some “obvious” Google search terms track CDC flu data well...

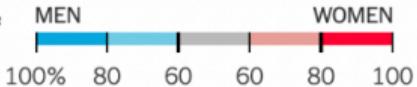


...and others don't.



	Jobs per 1,000 middle-class jobs				Jobs per 1,000 middle-class jobs		
	1980	2012	Change		1980	2012	Change
Top 20 occupations that gained share							
Registered nurses	19	39	+20	Machine operators and tenders, except precision	51	18	-33
Mathematical and computer scientists	6	25	+19	Production supervisors or foremen	33	11	-23
Supervisors and proprietors of sales jobs	18	34	+16	Construction trades, except electricians	38	24	-15
Adjusters and investigators	6	22	+15	Freight, stock and material handlers	25	11	-14
Managers and administrators	70	84	+14	Assemblers of electrical equipment	15	6	-9
Health technologists and technicians	8	21	+13	Precision metal working occupations	15	6	-9
Other teachers and counselors	7	19	+12	Vehicle and mobile equipment mechanics and repairers	31	22	-9
Elementary school teachers	41	51	+9	Truck, delivery and tractor drivers	39	31	-8
Health therapists	3	11	+8	Transportation occupations	14	7	-8
Accountants and auditors	15	23	+8	Material recording, scheduling and distributing clerks	23	16	-7
Health assistants	4	11	+7	Graders and sorters in manufacturing	13	6	-7
Writers, artists, entertainers and athletes	11	18	+7	Welders and metal cutters	11	5	-6
Legal assistants and aides	1	6	+6	Engineering and related technologists and technicians	17	10	-6
Personal service occupations	3	8	+5	Sales representatives, commodities	43	38	-5
Police and detectives	14	18	+4	Engineers	20	15	-5
Management analysts	1	6	+4	Mail and message distributing occupations	15	10	-5
Financial managers	6	10	+4	High school teachers	17	12	-5
Food preparation and service occupations	6	10	+4	Printing machine operators	6	2	-4
Financial specialists	5	9	+3	Precision workers, except metal	10	7	-3
Personnel and human resources specialists	7	9	+3	Janitors and other commercial building services	14	11	-3

Gender breakdown of each occupation



Good plots ...

- Make relevant comparisons and avoid irrelevant ones. Are truthful about magnitude.
- Minimize distractions.
- Introduce relevant conditioning variables.
- Stay firmly 2D (unless visualizing an actual 3D object, like a mountain or a building).
- Avoid meaningless variation (e.g. color differences that don't encode information).
- Have clear axis labels and informative titles/annotations.
- Highlight both overall trends and individual variation.
- Sometimes aren't plots at all – they're just tables.
- Are sensitive to the knowledge and limitations of the viewer.



Start with what's simple and effective

Simple and effective plots:

- Density plots (histograms, boxplots, violin plots)
- Barplots: to show summary statistics (means/counts/proportions) by group
- Scatter plots: to show how two numerical variables are related
- Line graphs: to show how one numerical variable changes continuously versus another (e.g. time)

Simple and effective strategies for enriching these plots:

- Variation in size, shape, and/or color (but be colorblind-friendly and don't go crazy)
- Faceting: showing the same basic plot across multiple conditions
- Labels

