Design and Analysis of Sample Surveys

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Class 14b: Review

Class 1a: Introduction

- Goal: learning about the population
- Intermediate steps:
  - Sample to population (sampling)
  - Survey response to question of interest (measurement)

Happiness and the Tea Party movement

- A Brooks *New York Times* op-ed:

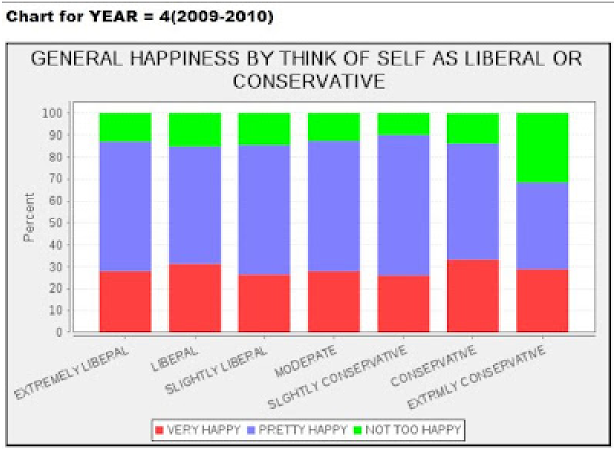
  > *People at the extremes are happier than political moderates . . . . none, it seems, are happier than the Tea Partiers . . .*

- But sociologist Jay Livingston writes:

  > *The GSS does not offer "bitter" or "Tea Party" as choices, but extreme conservatives are nearly three times as likely as others to be "not too happy."*

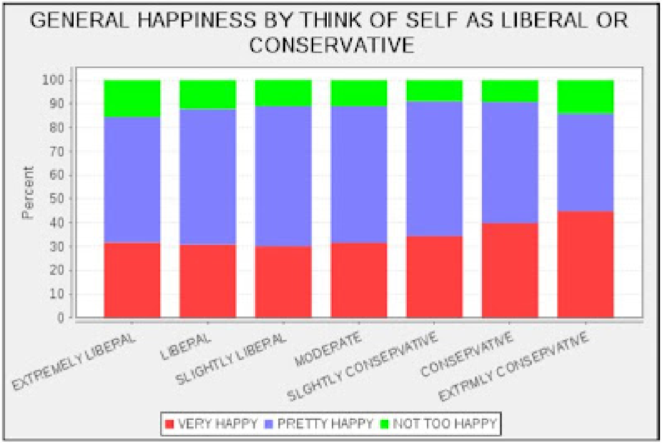
- Let's look at the data!

Data from General Social Survey



- Is this just sampling variation?
  - Sample size for “Extremely Conservative” here is 80
  - Thus the standard error for that green bar on the right is approx $\sqrt{0.3 \cdot 0.7/80} = 0.05$

How did Brooks get this wrong?



- Averaging over all the years, conservatives seem pretty happy!
- The importance of descriptive inference
    - Be careful about explaining patterns that aren't real!

Class 1b: Statistical inference and linear regression

- $\sqrt{p(1-p)/n}$ or $\sigma/\sqrt{n}$
- $\sqrt{\sigma_1^2/n_1+\sigma_2^2/n_2}$
- Sample size calculations
- $(y+2)/(n+4)$
- Weighted averages
- Living with uncertainty

Linear regression

- Interpreting coefficients
- Building models
- The role of statistical significance

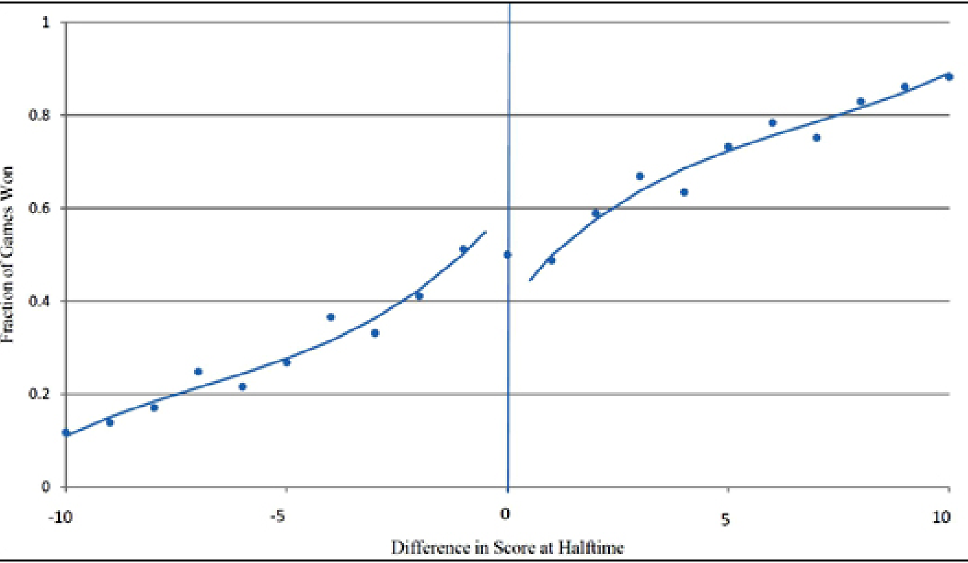
Class 2a: Logistic regression

- Logistic curve
- Divide-by-4 rule
- Latent continuous variable
- Choice models

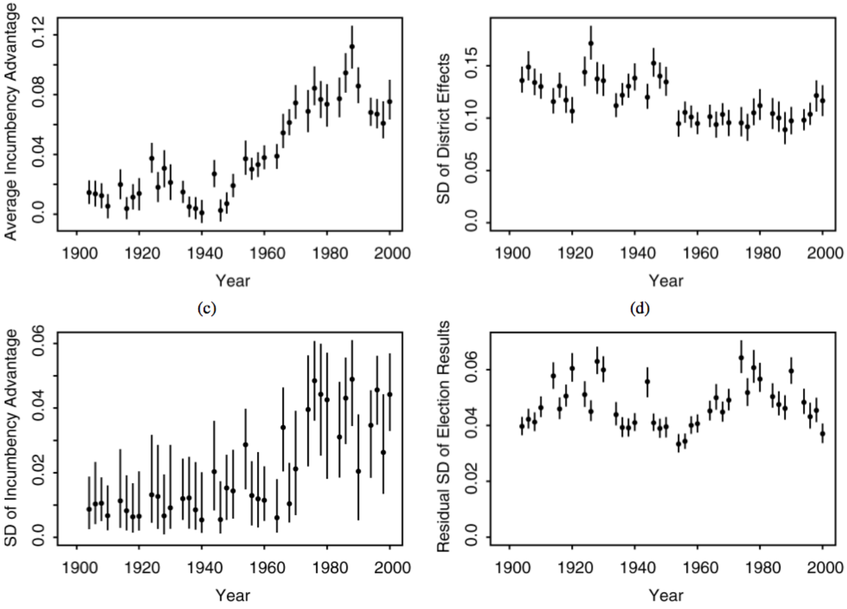
Class 2b: The challenge of estimating small effects

- The statistical significance filter
- When possible, study large effects
- Study effects in context

Business-relevant examples . . .



Example: incumbency advantage over time



(c)

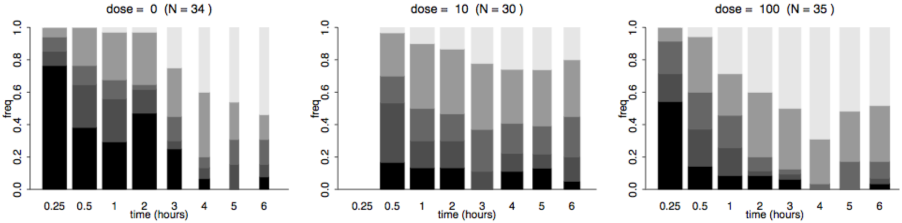
(d)

Class 3a: Nonresponse and survey adjustment

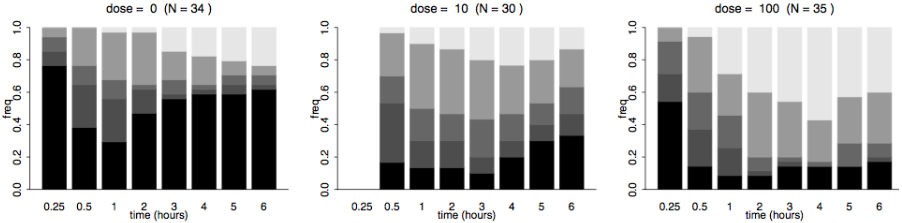
- Unit nonresponse
- Item nonresponse
- Intentional missing data
- Structural missing data

Observed and completed data

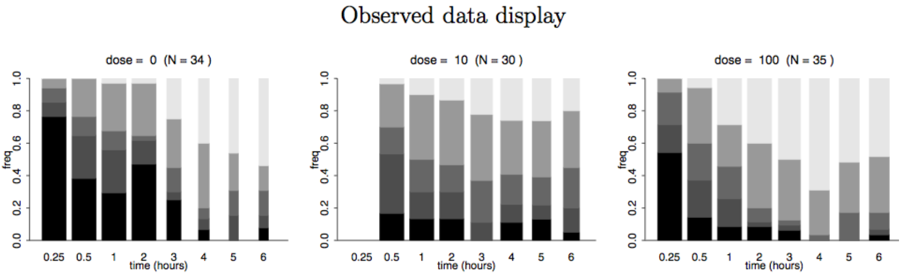
Observed data display

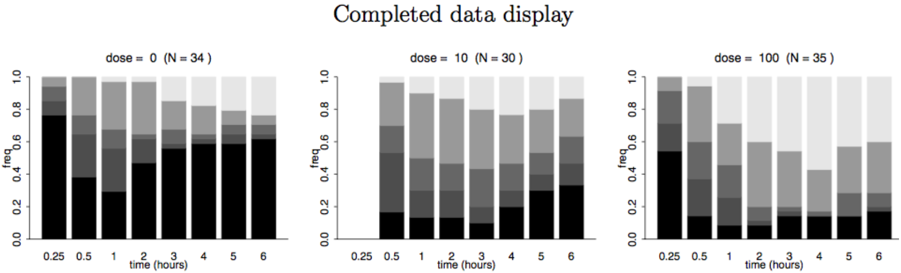


Completed data display



Observed and completed data





Class 3b: Adjusting for nonresponse

- Subsetting and imputation for item nonresponse
- Poststratification and weighting for unit nonresponse

Class 4a: Weighting and poststratification

- Where do weights come from?
- Poststratification identity: $\theta = \frac{\sum_j N_j \theta_j}{\sum_j N_j}$
- Challenges in weighting
- Challenges in poststratification
- Weighted regression using the "survey" package in R

Example: CBS/New York Times pre-election polls

```
  id     org  y state edu age adults weight
6140  cbsnyt NA     7   3   1      2    923
6141  cbsnyt  1    39   4   2      2    558
6142  cbsnyt  0    31   2   4      1    448
6143  cbsnyt  0     7   3   1      2    923
6144  cbsnyt  1    33   2   2      1    403
```

- The weight is listed as just another survey variable
- But they are actually constructed *after* the survey
- Weights $w_i = g(X_i, \theta)$

Class 4b: Ratio and regression estimation

- Ratio estimation of a ratio
- Ratio estimation of a population average
- Regression estimation
- Robustness through model and design

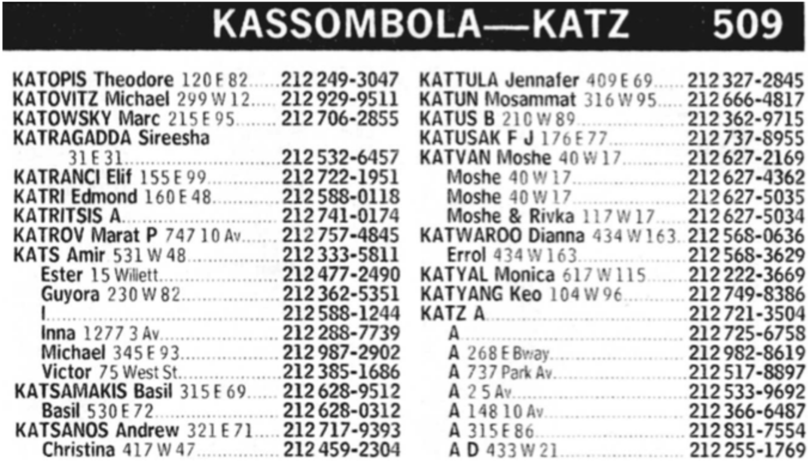
Regression estimation as a general framework

- Fit a regression, $y_i = a + bx_i + \text{error}$
- Regression estimate of $\overline{Y}$ is $\overline{y} + b\,(\overline{X} - \overline{x})$
- Special cases:
  - $b = 0$: unadjusted sample average
  - $b = \frac{\overline{y}}{\overline{x}}$: ratio estimation
  - $b = 1$: simple adjustment
- Regression estimation is valid for any b
  - Optimal for $b =$ least-squares estimate

Class 5a: Simple and stratified random sampling

- Sampling from a list
- Systematic sampling
- Stratified sampling
- Design and analysis

(A bit of) the population



KASSOMBOLA—KATZ 509

KATOPIS Theodore 120 E 82	212 249-3047
KATOVITZ Michael 299 W 12	212 929-9511
KATOWSKY Marc 215 E 95	212 706-2855
KATRAGADDA Sireesha 31 E 31	212 532-6457
KATRANCI Elif 155 E 99	212 722-1951
KATRI Edmond 160 E 48	212 588-0118
KATRITSIS A	212 741-0174
KATROV Marat P 747 10 Av	212 757-4845
KATS Amir 531 W 48	212 333-5811
Ester 15 Willett	212 477-2490
Guyora 230 W 82	212 362-5351
I	212 588-1244
Inna 1277 3 Av	212 288-7739
Michael 345 E 93	212 987-2902
Victor 75 West St	212 385-1686
KATSAMAKIS Basil 315 E 69	212 628-9512
Basil 530 E 72	212 628-0312
KATSANOS Andrew 321 E 71	212 717-9393
Christina 417 W 47	212 459-2304
KATTULA Jennafer 409 E 69	212 327-2845
KATUN Mosammat 316 W 95	212 666-4817
KATUS B 210 W 89	212 362-9715
KATUSAK F J 176 E 77	212 737-8955
KATVAN Moshe 40 W 17	212 627-2169
Moshe 40 W 17	212 627-4362
Moshe 40 W 17	212 627-5035
Moshe & Rivka 117 W 17	212 627-5034
KATWAROO Dianna 434 W 163	212 568-0636
Errol 434 W 163	212 568-3629
KATYAL Monica 617 W 115	212 222-3669
KATYANG Keo 104 W 96	212 749-8386
KATZ A	212 721-3504
A	212 725-6758
A 268 E Bway	212 982-8619
A 737 Park Av	212 517-8897
A 2 5 Av	212 533-9692
A 148 10 Av	212 366-6487
A 315 E 86	212 831-7554
A D 433 W 21	212 255-1769

Class 5b: Cluster sampling with equal cluster sizes

- Why do cluster sampling?
- Goal of equal-probability sampling
- Analysis of cluster data
- Design effects

Class 6a: Cluster sampling with unequal cluster sizes

- Sampling with equal probability at both stages
- Sampling clusters with probability proportional to size
- Adjusting for unequal sampling probabilities
- Design effects

Class 6b: Inference for regression coefficients

- Option 1: weighted regression
- Option 2: unweighted regression, including in the model all variables that affect the probability of inclusion in the survey
- Discuss
- Population mean as a special case of a regression coefficient
- Population difference as a special case of a regression coefficient
- Practical limitations of weighting
- Practical limitations of modeling

Putting it all together

- Our ideal procedure:
  - As easy to use as hierarchical regression
  - Population info included using poststratification
- Smooth transition from classical weighting
  - Equivalent weights
  - When different methods give different results, we can track it back to an interaction

Class 7a: Survey interviewing

- Questions and answers in surveys
- Evaluating survey questions
- Survey interviewing
- Surveys vs. other sources of information (administrative data, economic activity, . . .)
- Conceptual or specification errors
- Sampling and nonsampling errors
- Errors of measurement, interviewers, question wording, . . .
- Errors in reporting

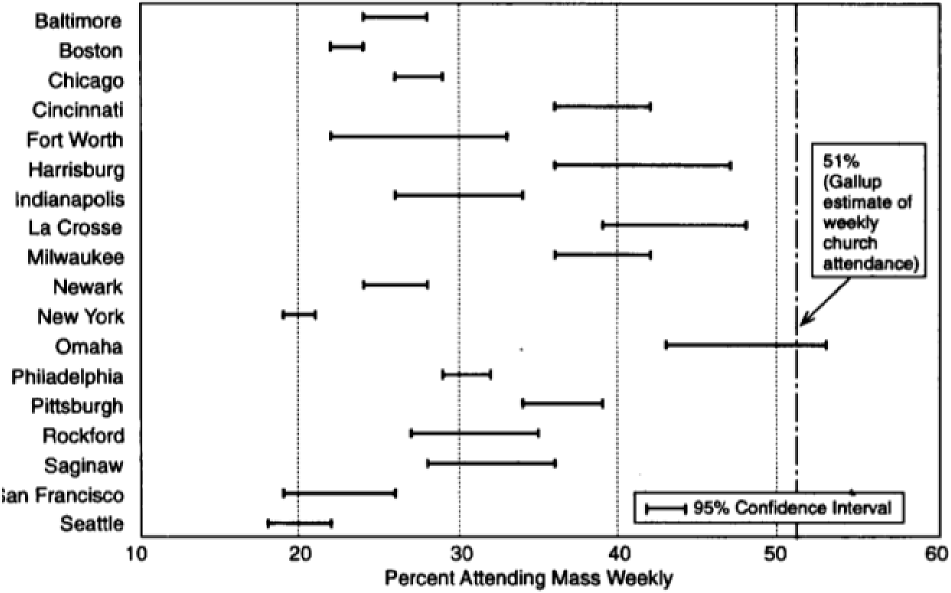
Class 7b: Challenges in survey measurement

- Difficulty of estimating small percentages
- Framing and question wording

Estimating measurement effects

- You are conducting a survey and are concerned about the possible effects of the wording of one particular question. You decide to do one of two experiments:
  - (a) Within-subject design: Put the two different wordings on the same survey form (randomizing the order of the two questions) and compare responses to the two wordings.
  - (b) Between-subject design: Randomly give one wording to half the respondents and the other wording to the other half. Compare the average responses under the two wordings.
- Give a reason why you might prefer design (a).
- Give a reason why you might prefer design (b).
- Computing standard errors for different designs

Measurement: Church attendance

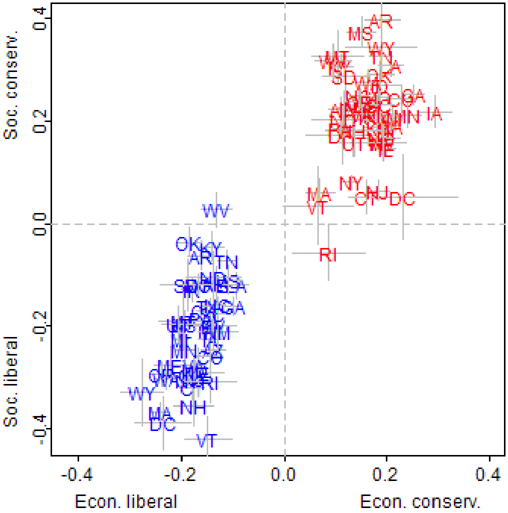


Class 8a: Using surveys to answer questions in political science

- Political attitudes and behavior
- Comparing different groups

Democrats and Republicans separately in 2000

Average economic and social ideology scores
among Bush voters (red) and Gore voters (blue) in each state



Class 8b: Conducting a survey in the real world

- Research goals
- Population, frame, and sampling design
- Constructing and testing the survey instrument
- Sampling and data collection
- Collection of auxiliary data
- Data cleaning and manipulation
- Data analysis

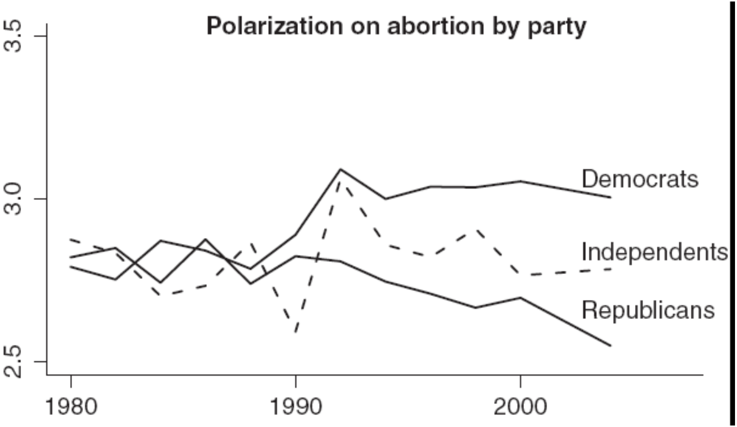
Class 9a: Voting

- Survey questions on demographics
- Political affiliation
- Issue attitudes

Class 9b: Public opinion

- Partisan polarization
- Elite and mass attitudes
- Uniform partisan swing

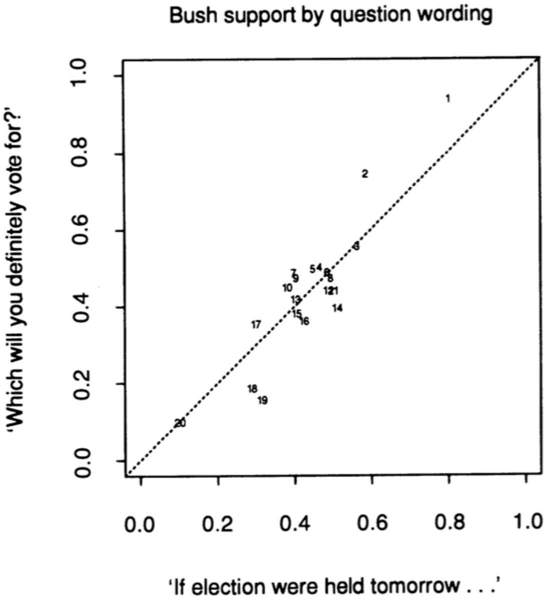
Political polarization since 1990



Class 10a: Political participation

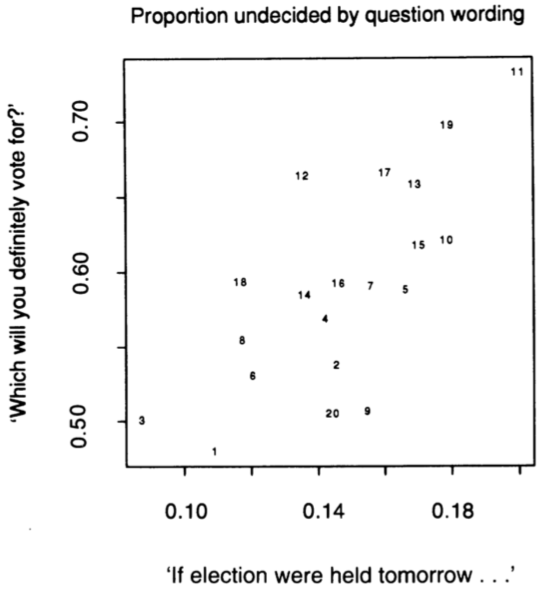
- Asking about voting
- Other forms of political participation
- Rationality of voting and responding to surveys
- Data sources

Question wording and vote intention

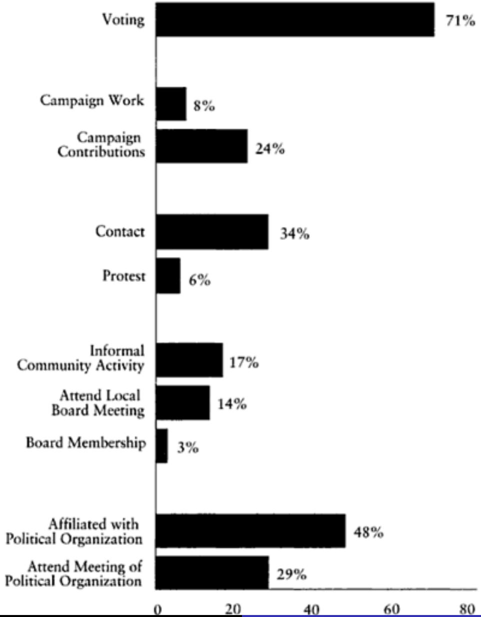


Bush support by question wording

Question wording and nonresponse



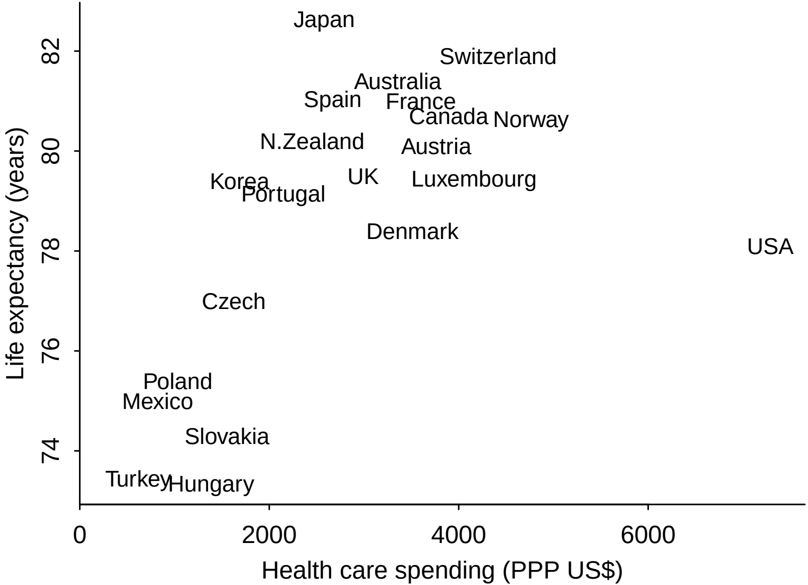
From Verba, Schlozman, Brady, *Voice and Equality* (1995)



Class 10b: Understanding and displaying data

- Manipulating data in R
- Looking carefully at the data
- Effective graphing

Real simple


Japan
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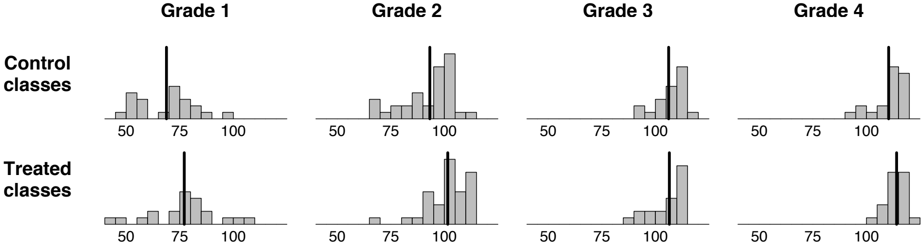
Canada
Norway
N.Zealand
Austria
Korea
UK
Luxembourg
Portugal
Denmark
USA
Czech
Poland
Mexico
Slovakia
Turkey
Hungary
82
80
78
76
74
Life expectancy (years)
0
2000
4000
6000
Health care spending (PPP US$)

Re-expression saves space and adds clarity



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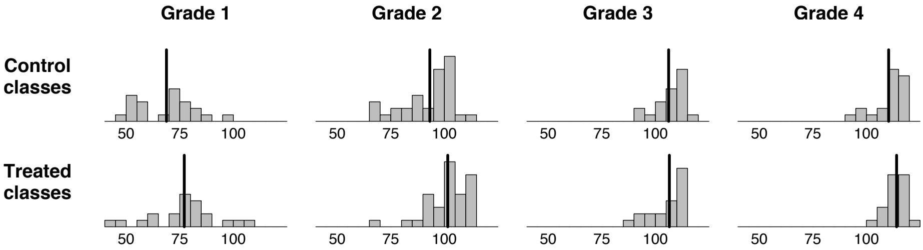
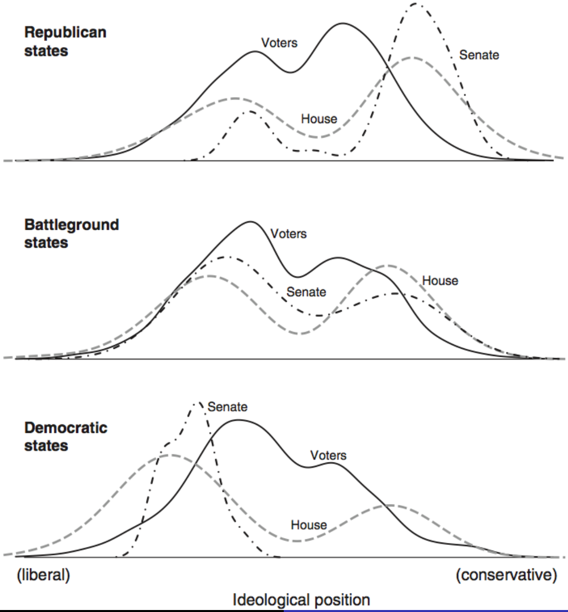


Class 11a: Bayesian inference

- Calibration of probabilities
- Combining prior and data information
- Example: forecasting
- MRP

Aligning voters with Congress



Class 11b: Ideal-point modeling

- Applications: ability testing, ranking
- Compare to ideal-point modeling
- Implications for education and for data collection more generally

Class 12a: Multilevel regression and poststratification

- State-level opinions
- Comparisons to state policies
- Demographic breakdowns
- Displaying inferences

Class 12b: Challenges in multilevel regression and poststratification

- Many factors, deep interactions
- Fitting and understanding models
- Adjusting for non-census variables
- Differential nonresponse within cells

Class 13a: Low response rates in U.S. surveys

- When does it matter?
- Validation of survey data
- Methods for increasing response rates

Class 13b: Surveys in less-developed countries

- Iraq mortality survey

Class 14a: Network sampling

- Fractal sampling
- Penumbra sampling
- Learning about networks
- Averaging over networks