

Bush 631-603: Quantitative Methods

Lecture 4 (02.08.2022): Measurement vol. I

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What is today's plan?

- ▶ From concepts to measures.
- ▶ Why measurement? and its challenges.
- ▶ Visualizing data: plots.
- ▶ Methods: Surveys.
- ▶ R work: summary(), NAs, barplot, histogram, boxplot.
- ▶ Research task I details.

Your research interests

Topics in INTA:

- ▶ Diplomacy.
- ▶ Trade.
- ▶ Conflict / wars.
- ▶ Terrorism.
- ▶ Development.
- ▶ Foreign Aid.

Measurement



Measurement

Why?

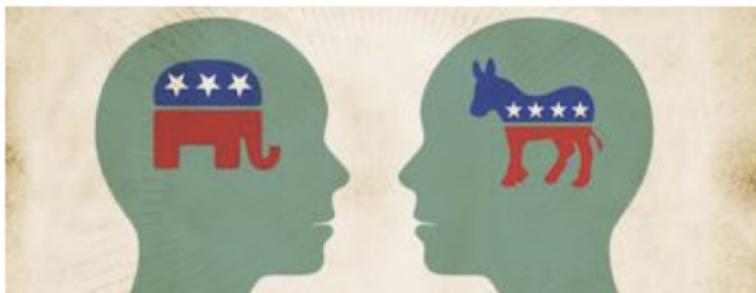
- ▶ Social science: develop and test causal theories.
- ▶ Leader background and conflict behavior.
- ▶ Minimum wage and levels of full-time employment?
- ▶ Concepts: level of unemployment, leader background, public approval.

How?

Measures - the context of theoretical concepts

Measures

- ▶ Some are easy → age, place of residence.
- ▶ Others?



On a scale from 1 to 7, where 1 is extremely liberal, 7 is extremely conservative, and 4 is exactly in the middle, where would you place yourself?

Extremely liberal 1	2	3	In the middle 4	5	6	Extremely conservative 7
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>

Measuring democracy

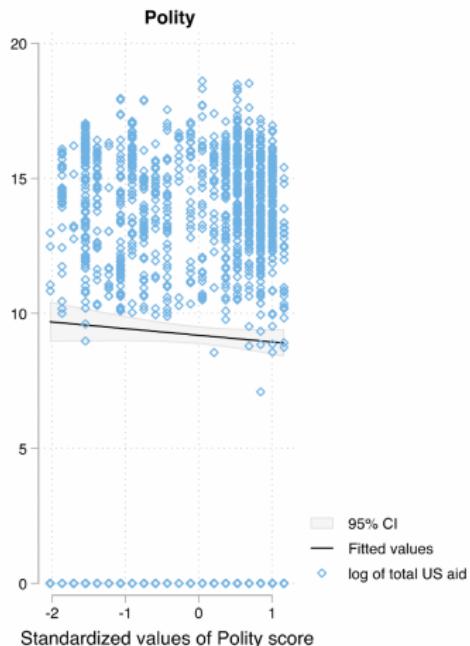
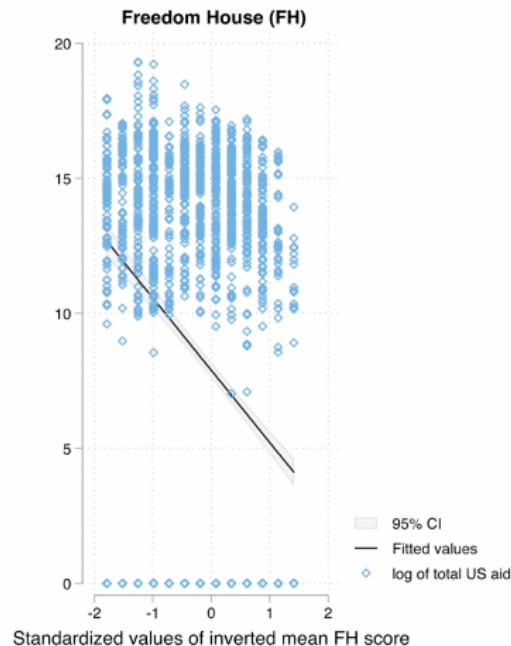
- ▶ How do we measure 'levels' of democratic regimes?

TWO SCALES



Measuring Democracies

- ▶ Does aid helps democracy promotion?



Measuring regime types

Why the differences?

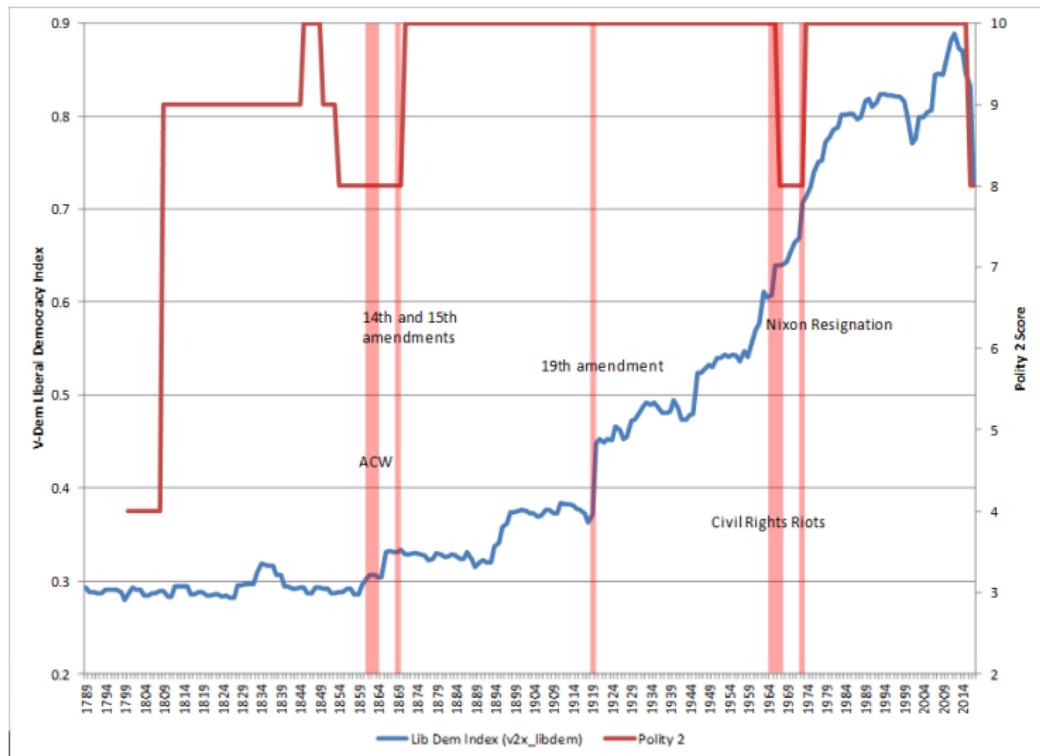
Freedom House Scale (Link) - personal and civil rights:

1. Political pluralism.
2. Electoral process and function of government.
3. Personal autonomy and individual rights.
4. Organizational rights.
5. Rule of law.

Polity V Scale (Link) - institutional features:

1. Openness and competitiveness of elections.
2. Executive constraints.
3. Regulation of participation.

Polity V Scale: USA



Polity V Scale

Problematic measurement:

- ▶ US & its allies
- ▶ Adversaries like Russia.
- ▶ Dynamic but inconsistent (Colgan 2019 Link).

For one period, 1997–2003, Iran's Polity score jumped massively, by nine points. What accounts for this change? It coincides with the presidency of Khatami, a pro-Western reformer. Khatami tried to befriend the United States and reorient Iranian foreign policy. He also campaigned to make the government more accountable to the people. He did not, however, change or even seek to change the constitution or any of the key institutions or processes of the regime, saying, “there will not be a democratic regime in the true sense of the word.”⁹ Moreover, even his limited reform efforts failed.

Measures & Definitions

Operational definition: the way we describe (represent) the relevant concept in the data (indicators/variables used).

Example: *US president approval*

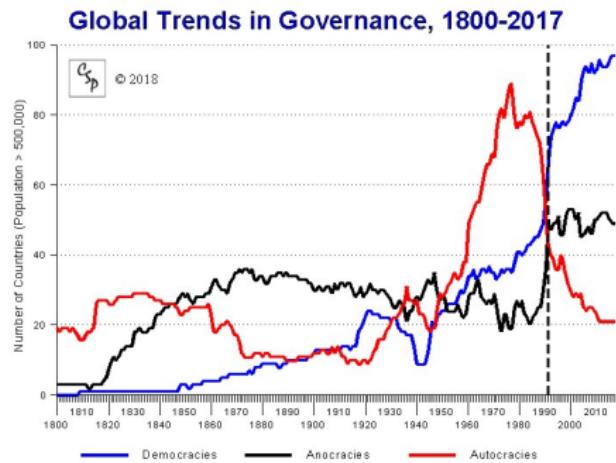
- ▶ Conceptual definition: the extent to which US adults support the actions and policies of the current US president.
- ▶ Operational definition: “On a scale from 1 to 5, where 1 is least supportive and 5 is more supportive, how much would you say you support the job that Joe Biden is doing as president?” (survey/poll item).

Measurement Errors

The chance that there is some variation in the measures we use for our concepts.

Sources of errors:

- ▶ Data entry or respondent errors.
- ▶ Systematic Bias: US, Russia, Iran 'fluctuations'.



Variables

- ▶ Measures of concepts.
- ▶ Many values → variables.
- ▶ Rebel background: 0,1.
- ▶ GDP/Cap; MID involvement over 5 years.
- ▶ Internationalism categories.

Types of variables

- ▶ Dependent variable (Y):
 - ▶ The explained outcome.
 - ▶ Response variable.
- ▶ Independent variable (X):
 - ▶ Determinant of the DV.
 - ▶ Explanatory / predictor variables.
 - ▶ Indicator for our main theory (explanation).
- ▶ Control variables (Z):
 - ▶ Additional predictors.
 - ▶ Pre-treatment variables.
 - ▶ Confounders.

Fit the variables

► Oil, democracy and development (2001)

Name	Description
cty_name	Country name
year	Year
logGDPcp	Logged GDP per capita
regime	A measure of a country's level of democracy: -10 (authoritarian) to 10 (democratic)
oil	Amount of oil exports as a percentage of the country's GDP
metal	Amount of non-fuel mineral exports as a percentage of the country's GDP
illit	Percentage of the population that is illiterate
life	Life expectancy in the country

Measurement Tools: Surveys

People across world greatly concerned about climate change and willing to make sacrifices to address it, but there is less confidence in efforts to solve the problem

Personal impact of global climate change



Action to address global climate change



Note: Percentages are medians based on 17 publics.

Source: Spring 2021 Global Attitudes Survey. Q31, Q32, Q33b, Q35.

"In Response to Climate Change, Citizens in Advanced Economies Are Willing To Alter How They Live and Work"

Terrorism: Public Survey (2016)

- ▶ ISTPP project: national security.
- ▶ Multiple attitude measures: concern, likelihood.
- ▶ Compare types of terrorism: cyber, conventional.

CaseID	concern_bomb	concern_cyber	severity_bomb	severity_cyber	publicKnow_bomb	publicKnow_cyber	expertKnow_bomb	expertKnow_cyber	cas_bomb	cas_cyber
1	2	2	1	4	2	2	2	2	4	2
2	3	2	3	3	3	3	3	3	2	3
3	4	2	2	4	1	1	1	2	4	5
4	5	3	4	3	3	2	2	2	3	5
5	6	2	2	3	3	3	3	3	3	4
6	7	3	1	3	2	1	1	1	2	3
7	8	2	2	3	2	1	2	2	2	2
8	9	1	1	1	2	2	2	3	3	2
9	10	4	4	4	3	4	2	4	3	5
0	11	3	2	4	3	4	2	4	4	5
1	12	4	2	3	3	1	3	3	4	5
2	13	2	2	4	3	2	1	2	2	4
3	14	3	2	4	3	2	3	3	3	5
4	15	2	1	4	2	3	3	3	2	4

Terrorism Survey

```
# Proportions: concerns about types of terrorism
prop.table(table(conventional = mydata$concern_bomb,
                 cyber = mydata$concern_cyber))

##          cyber
## conventional      1          2          3          4
##               1 0.100177830 0.019561352 0.003556609 0.000000000
##               2 0.065797273 0.296976882 0.074096028 0.007705987
##               3 0.012448133 0.103141672 0.148784825 0.034380557
##               4 0.002963841 0.010077060 0.036751630 0.083580320
```

Terrorism Survey

- ▶ Individual characteristics, policy preferences.

```
# Proportions: damages from attack and respondent gender  
prop.table(table(Lethality = mydata$severity_bomb,  
                  Gender = mydata$PPGENDER))
```

```
##             Gender  
## Lethality      0          1  
##             1 0.01837582 0.01422644  
##             2 0.08891523 0.05690575  
##             3 0.17783047 0.18612922  
##             4 0.19383521 0.26378186
```

```
# Proportions: Likelihood of attach and airport  
prop.table(table(Attack_Coming = mydata$likely_bomb,  
                  Airport_Checks = mydata$Pol_screenUS))
```

```
##             Airport_Checks  
## Attack_Coming      1          2          3          4          5  
##             1 0.016806723 0.014405762 0.045018007 0.024609844 0.020408163  
##             2 0.023409364 0.054621849 0.111644658 0.105642257 0.081032413  
##             3 0.014405762 0.036014406 0.086434574 0.124249700 0.091836735  
##             4 0.008403361 0.007202881 0.022809124 0.036014406 0.075030012
```

Missing data: Non-response

Why NAs?

- ▶ Refuse to answer.
 - ▶ Don't know the answer.

NAs in our survey data

```
# Responses to item: likelihood of attack (observations 1-15)  
head(mydata$likely_bomb, n = 15)
```

```
# [1] 2 3 2 3 2 4 2 1 4 3 NA 2 4 3 3
```

```
# Responses to item: support using force (observations 1-15)
# Using logical values
head(is.na(mydata$Pol_force), n=15)
```

NAs in our data

- ▶ Aggregate view of missing values in data.
- ▶ Syntax: `function(is.na(data$variable))`

```
# Sum of NAs per variable/item  
sum(is.na(mydata$likely_bomb))
```

```
## [1] 53
```

```
# Proportion of NAs per variable/item  
mean(is.na(mydata$likely_bomb))
```

```
## [1] 0.03063584
```

NAs in our data

- ▶ Proportions of NA across variables

```
prop.table(table(Attack_Coming = mydata$likely_bomb,
                Airport_Checks = mydata$Pol_screenUS, exclude = NULL))

##          Airport_Checks
## Attack_Coming      1       2       3       4
##           1 0.0161849711 0.0138728324 0.0433526012 0.0236994220 0.01965317
##           2 0.0225433526 0.0526011561 0.1075144509 0.1017341040 0.07803468
##           3 0.0138728324 0.0346820809 0.0832369942 0.1196531792 0.08843930
##           4 0.0080924855 0.0069364162 0.0219653179 0.0346820809 0.07225433
##           <NA> 0.0005780347 0.0005780347 0.0040462428 0.0011560694 0.00173410
##          Airport_Checks
## Attack_Coming      <NA>
##           1 0.0034682081
##           2 0.0017341040
##           3 0.0005780347
##           4 0.0005780347
##           <NA> 0.0225433526
```

Study surveys with NAs

- ▶ NAs interfere with our analysis
- ▶ Return NA value.
- ▶ Must be accounted for in selected function.

```
# Calculate mean of variable with NAs: return NA  
mean(mydata$Pol_survMus1)
```

```
## [1] NA
```

```
# Calculate mean of variable with NAs: accounting for missing  
mean(mydata$Pol_survMus1, na.rm = TRUE)
```

```
## [1] 2.067584
```

Study surveys with NAs

Removing missing values

- ▶ *Listwise deletion*: remove all observation with at-least one NA.
- ▶ May substantially reduce the data.

```
# Losing observations: full dataset  
nrow(mydata)
```

```
## [1] 1730  
mydata.del <- na.omit(mydata)  
nrow(mydata.del)
```

```
## [1] 1519  
# Losing observations: single variable  
length(mydata$concern_bomb)
```

```
## [1] 1730  
length(na.omit(mydata$concern_bomb))  
  
## [1] 1690
```

Visual display of data

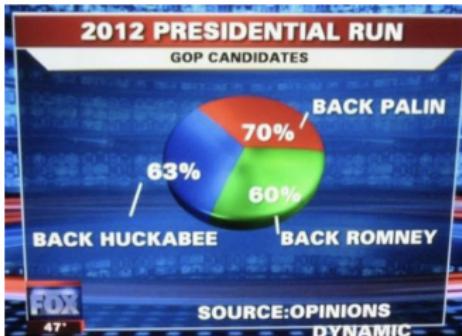
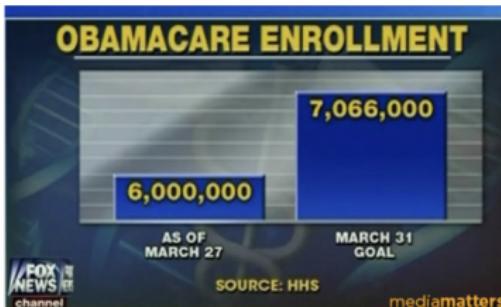
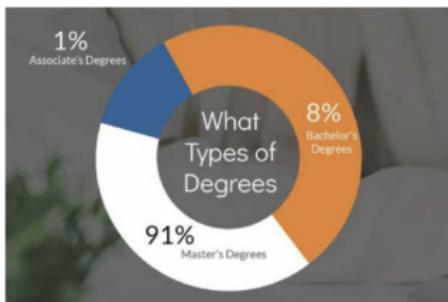
Numerical display of data:

- ▶ Summaries: mean, median.
- ▶ Specific values: max, min.
- ▶ Distributions: range, SD.

Visuals: plots, graphs

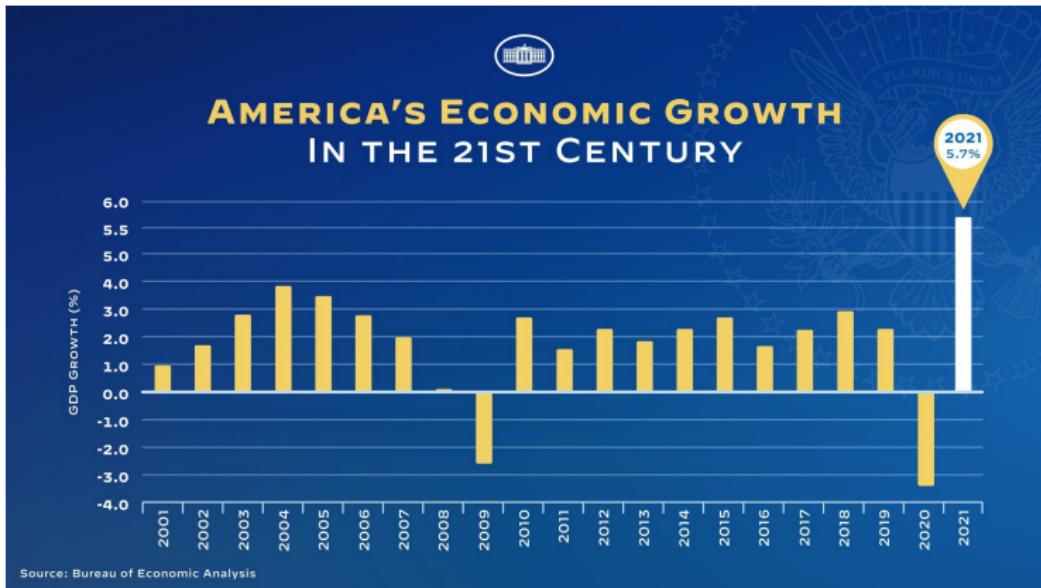
- ▶ More comprehensive.
- ▶ Highlight important elements.
- ▶ Great for presentation.
- ▶ Audience focus on important insights

Visuals: please don't...



Visuals

This is an official government product. . .



Visuals: Much better

Countries connected to their primary trading partner in 2020

Exports + imports. Data: International Monetary Fund. Flags were not available for countries in black.



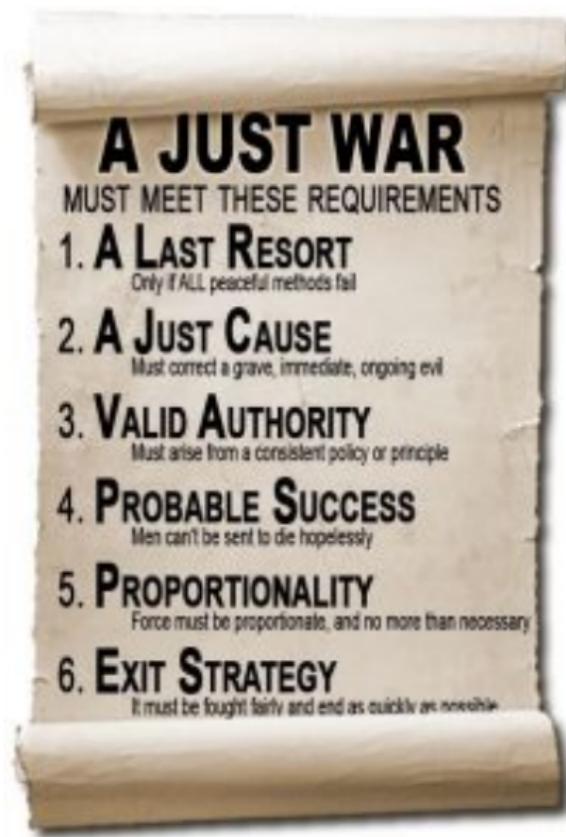
@sundellviz

Visuals

BAR PLOT

- ▶ Useful for factor variables
- ▶ Shows counts and proportion for multiple categories
- ▶ How many men/women?
- ▶ Proportion of college graduates in our data?

Visuals: INTA study



Ethics in combat

Sagan and Valentino (2018): public attitudes and ethics of war.

- ▶ Survey experiments.
- ▶ Combat scenarios → treatments.
- ▶ Support for action.

Ethics in combat

The virtue of proportional response

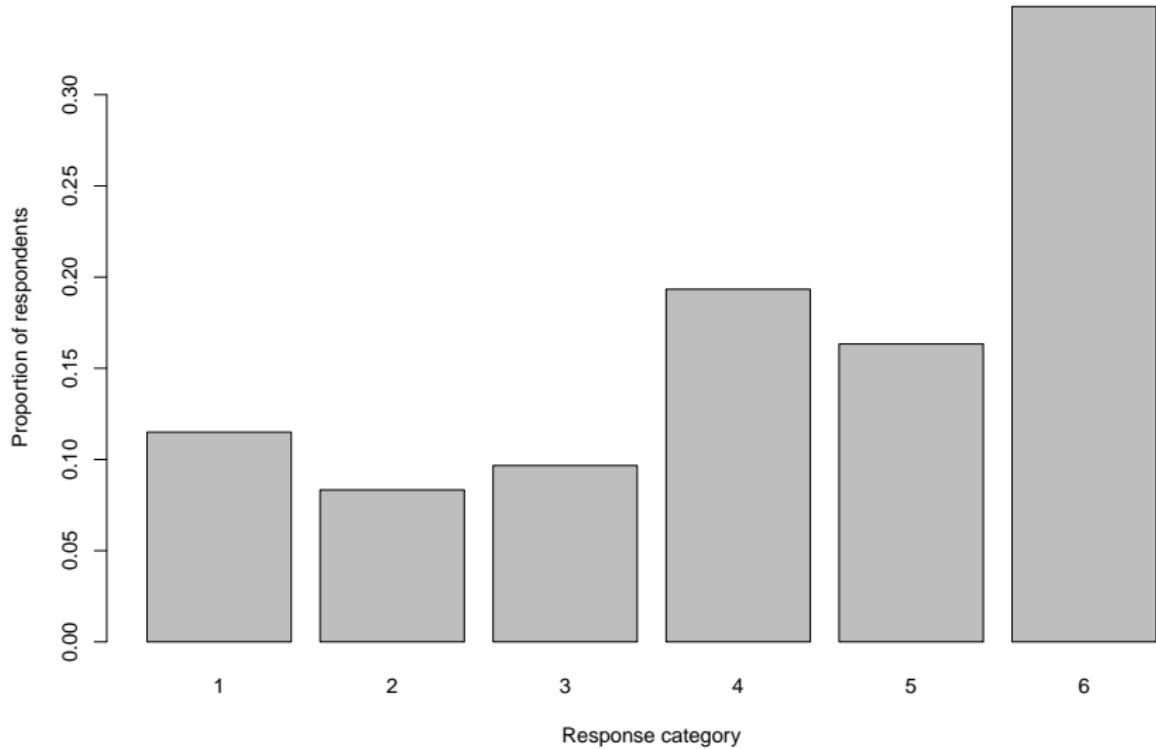


Iraq War (2003):

- ▶ Threshold for collateral Iraqi noncombatant deaths.
- ▶ Define “high” versus “low” value targets.
- ▶ “Due-care” principle (war in Afghanistan).

Just war: Public attitudes

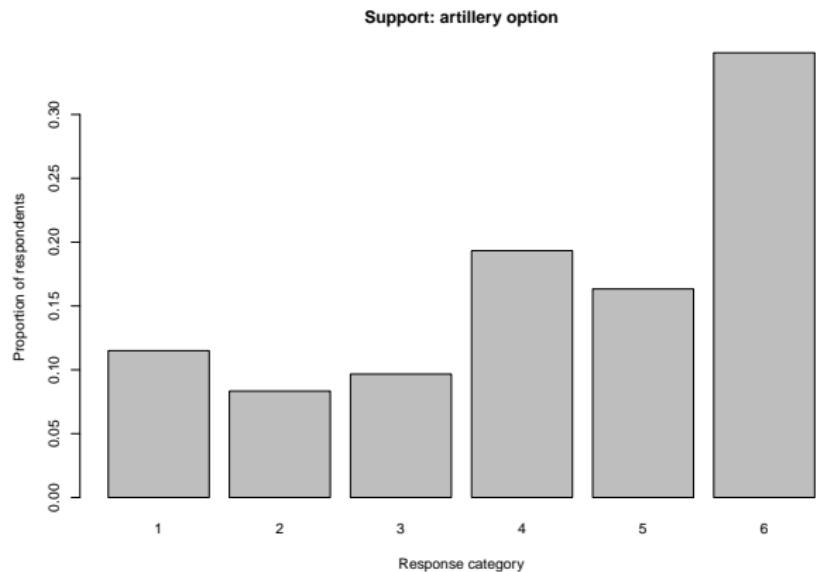
Support for using artillery option



Bar plot: Base R code

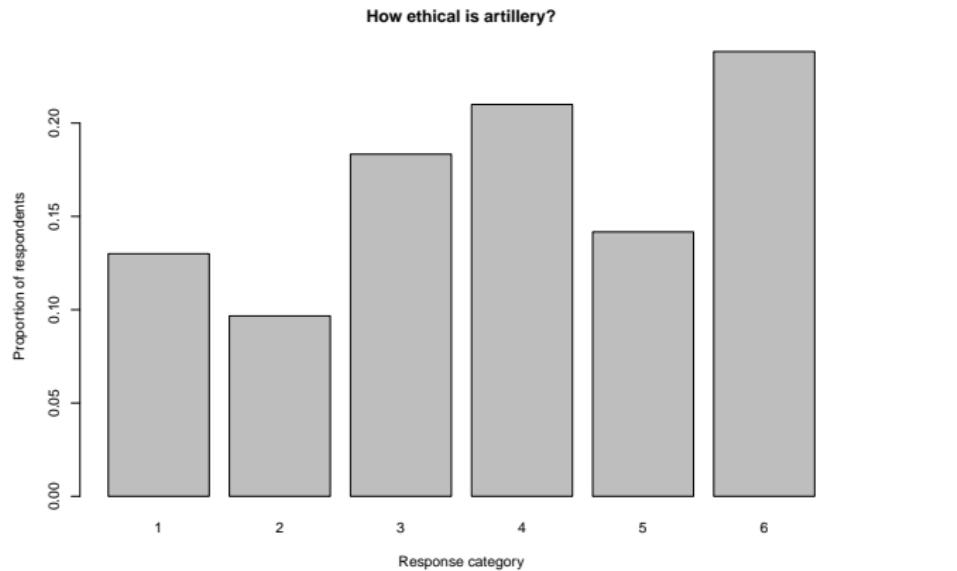
```
# Create proportions of support
artillery.tab <- prop.table(table(Support = wardata$artillery_approve,
                                   exclude = NULL))

# Create barplot
barplot(artillery.tab, main = "Support: artillery option",
        xlab = "Response category", ylab = "Proportion of respondents")
```



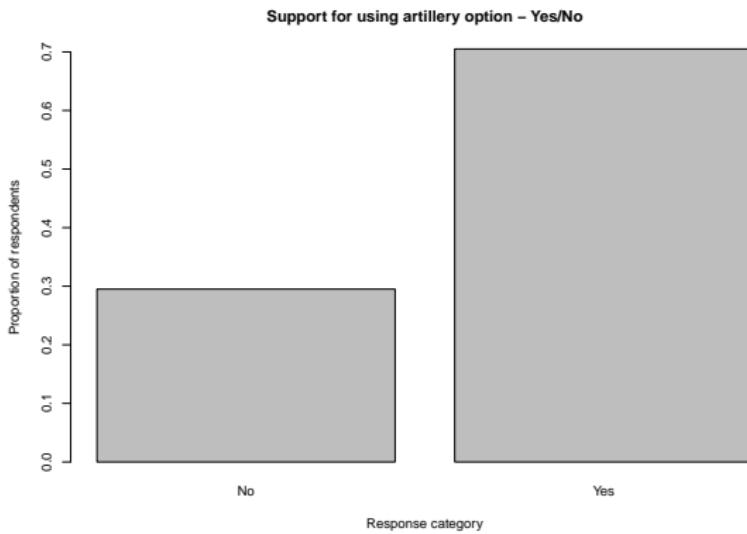
Artillery option: Ethical?

```
artillery.ethic <- prop.table(table(Support = wardata$artillery_ethical,  
                                   exclude = NULL))  
barplot(artillery.ethic, main = "How ethical is artillery?",  
        xlab = "Response category", ylab = "Proportion of respondents")
```



Survey responses: Binary measure

```
artillery.binary <- prop.table(table(Support_Artillery = wardata$approve_artill
                                exclude = NULL))
barplot(artillery.binary, main = "Support for using artillery option - Yes/No",
        xlab = "Response category", ylab = "Proportion of respondents",
        names.arg = c("No", "Yes"))
```

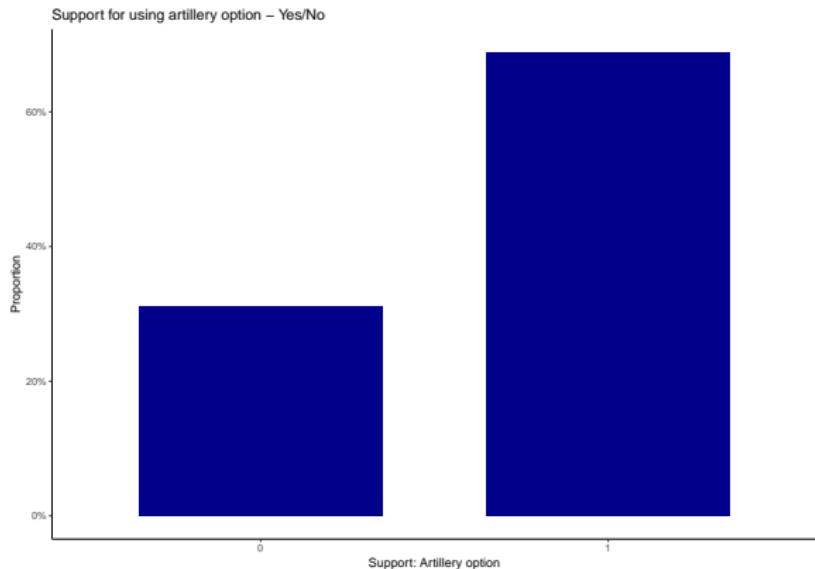


Plotting alternative



Bar-plot with tidyverse

```
ggplot(wardata, aes(x=factor(prefer_artillery_dummy))) +  
  geom_bar(aes(y =(..count..)/sum(..count..)), width = 0.7, fill = "darkblue")  
  xlab("Support: Artillery option") + ylab("Proportion") +  
  scale_y_continuous(labels=scales::percent) +  
  ggtitle("Support for using artillery option - Yes/No") + theme_classic()
```



Visual options

HISTOGRAM

- ▶ Useful for numeric values.
- ▶ Plotting the distribution of variable.

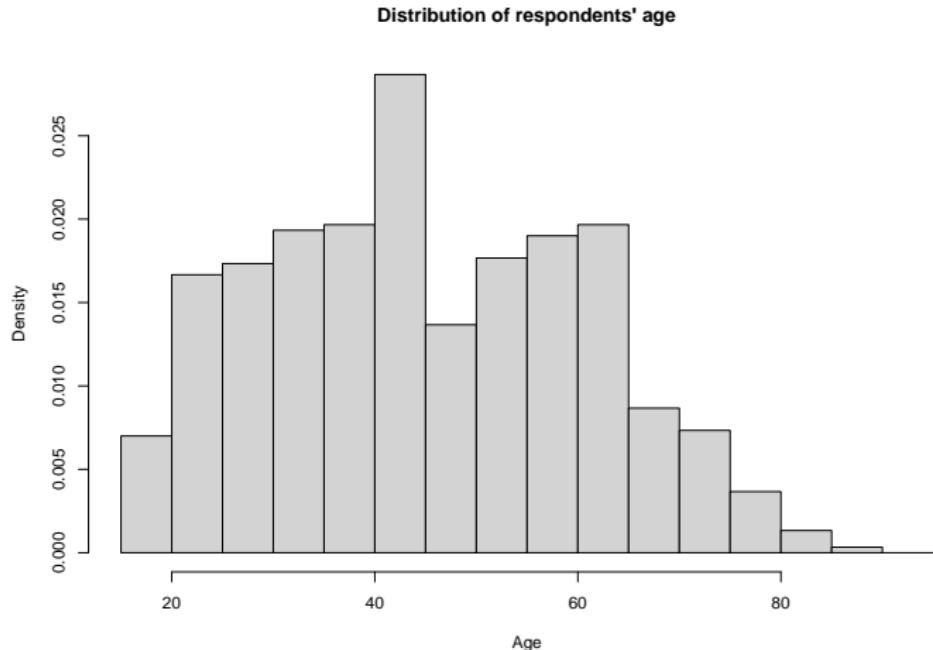
```
# Distribution of respondents' age  
wardata$age <- (2014 - wardata$birthyr)  
summary(wardata$age)
```

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
##	18.00	33.00	44.00	45.39	58.00	88.00

- ▶ Create bins along values of interest.
- ▶ 5-year bins: [15,20), [20,25), [25,30), ... [90,95]

Histogram: Base R

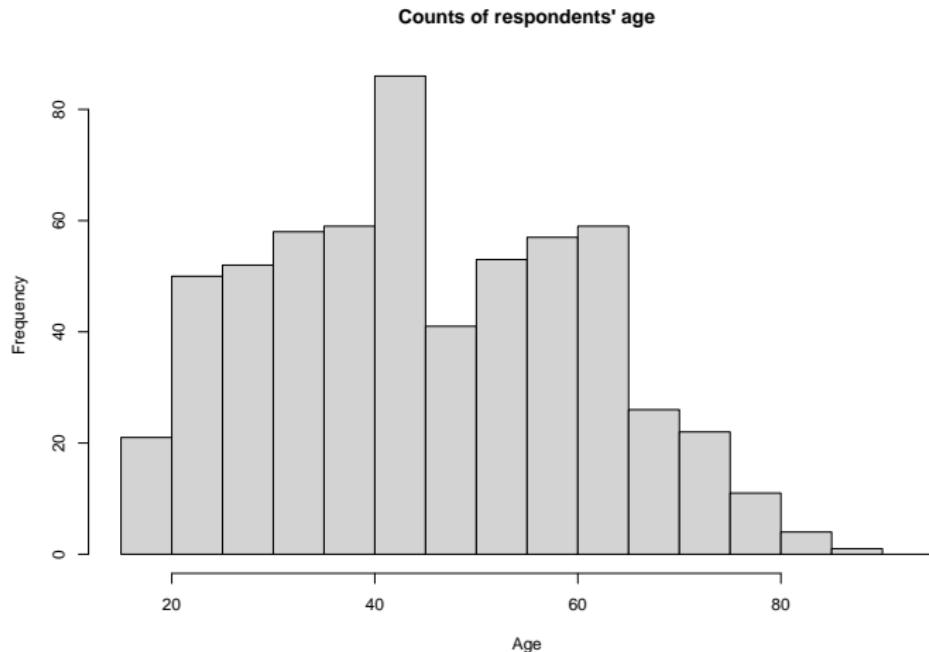
```
hist(wardata$age, freq = FALSE, breaks = seq(from = 15, to = 95, by = 5),  
     xlab = "Age",  
     main = "Distribution of respondents' age")
```



Histogram

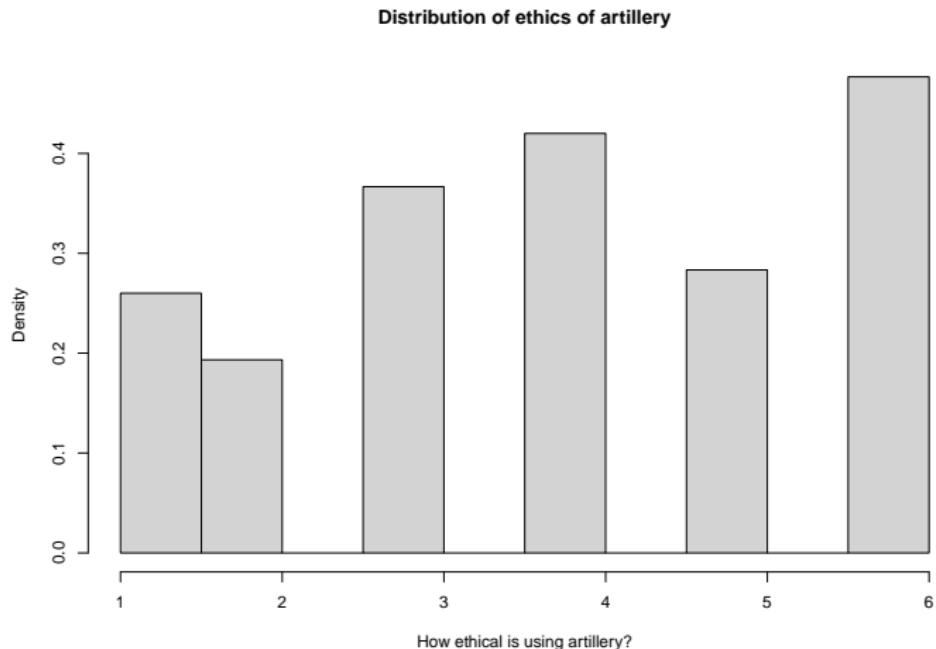
Counts instead of density

```
hist(wardata$age, freq = TRUE, breaks = seq(from = 15, to = 95, by = 5),  
     xlab = "Age",  
     main = "Counts of respondents' age")
```



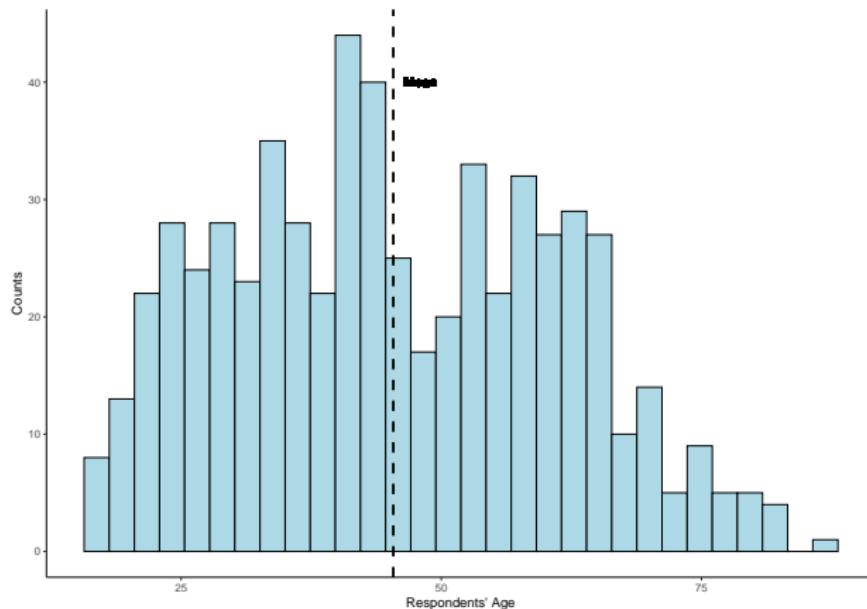
Artillery ethical?

```
hist(wardata$artillery_ethical, freq = FALSE,  
     xlab = "How ethical is using artillery?",  
     main = "Distribution of ethics of artillery")
```



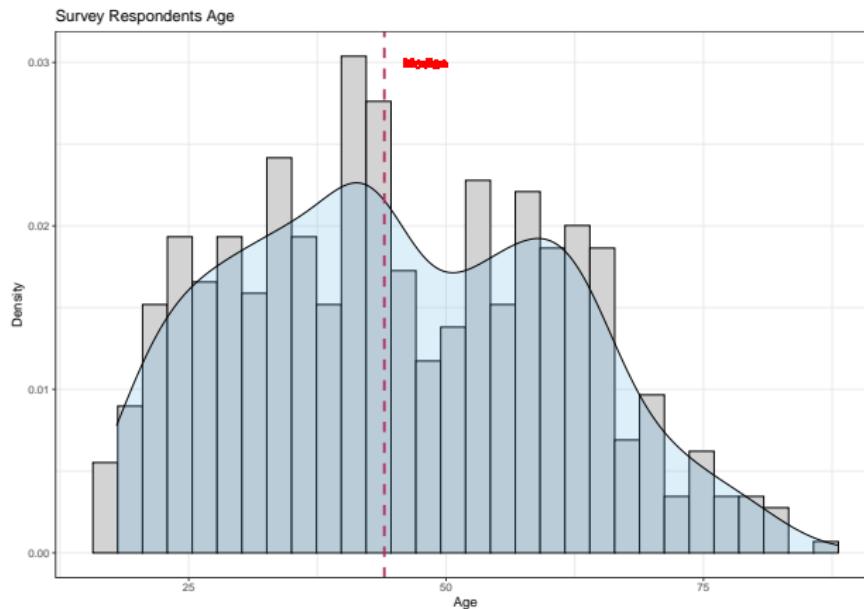
Histogram: Tidyverse

```
ggplot(wardata, aes(x=age)) +  
  geom_histogram(color="black", fill="lightblue") +  
  theme_classic() + ylab("Counts") + xlab("Respondents' Age") +  
  geom_vline(aes(xintercept=mean(age)),  
             color="black", linetype="dashed", size=1) +  
  geom_text(x = 48, y = 40, label = "Mean")
```



Histogram: Tidyverse

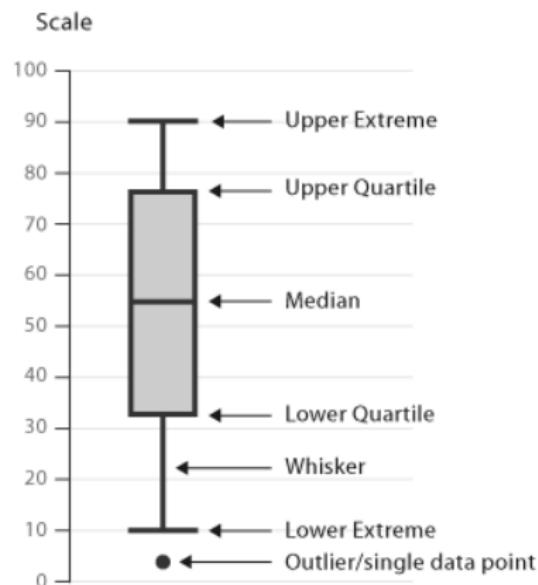
```
ggplot(wardata, aes(x=age)) +  
  geom_histogram(aes(y=..density..), colour="black", fill="lightgrey") +  
  geom_density(alpha=.2, fill="#56B4E9") +  
  xlab("Age") + ylab("Density") + theme_bw() + ggtitle("Survey Respondents Age") +  
  geom_vline(aes(xintercept=median(age)),  
            color="maroon", linetype="dashed", size=1) +  
  geom_text(x = 48, y = 0.03, label = "Median", col = "red")
```



Visual Options

BOXPLOT

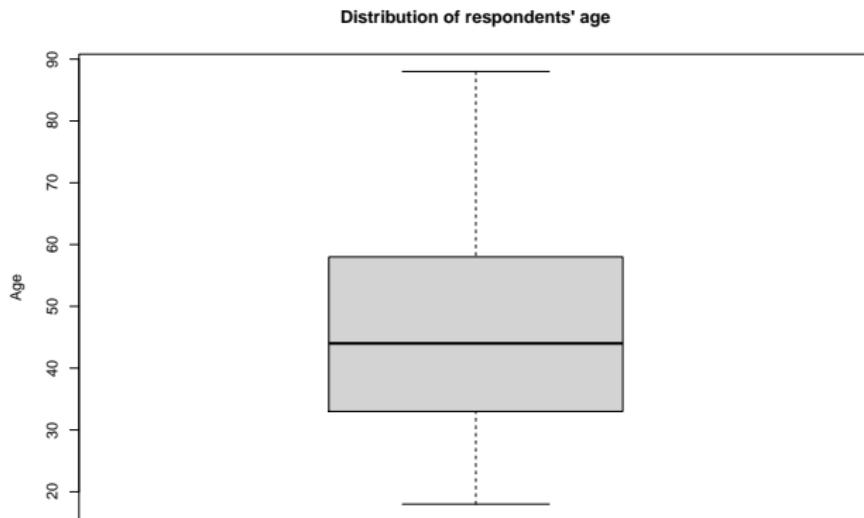
- Useful for a single variable distribution.
- Comparing multiple variables.



Exploring variables with boxplots

Base R: single variable

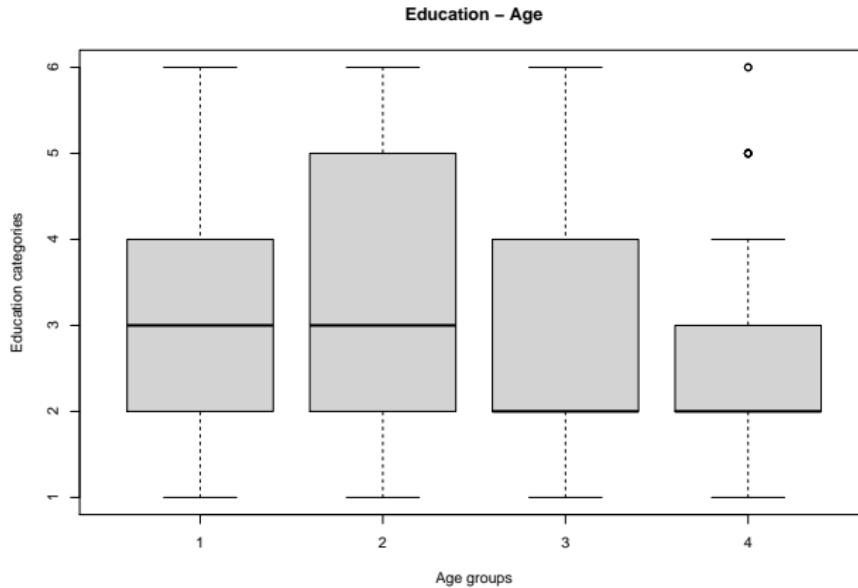
```
boxplot(wardata$age, ylab = "Age",  
       main = "Distribution of respondents' age")
```



Comparing variables: Boxplots

Education and Age: Base R

```
boxplot(educ ~ agegroup, data = wardata, xlab = "Age groups",
        ylab = "Education categories", main = "Education - Age")
```



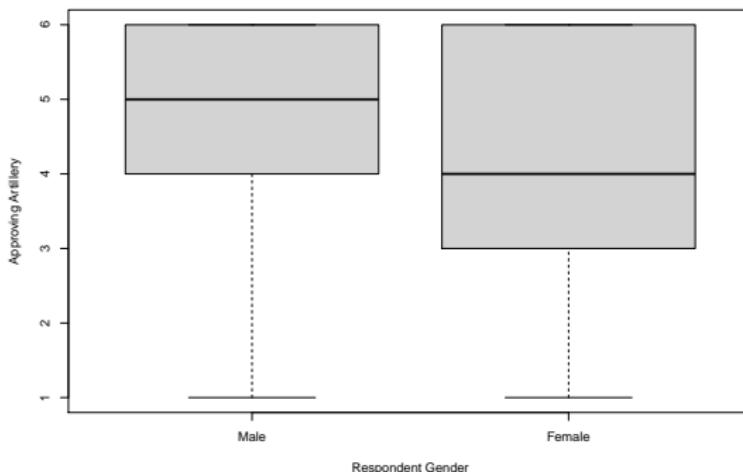
Comparing variables: Boxplots

Gender and using artillery

```
tapply(wardata$artillery_approve, wardata$gender, mean)
```

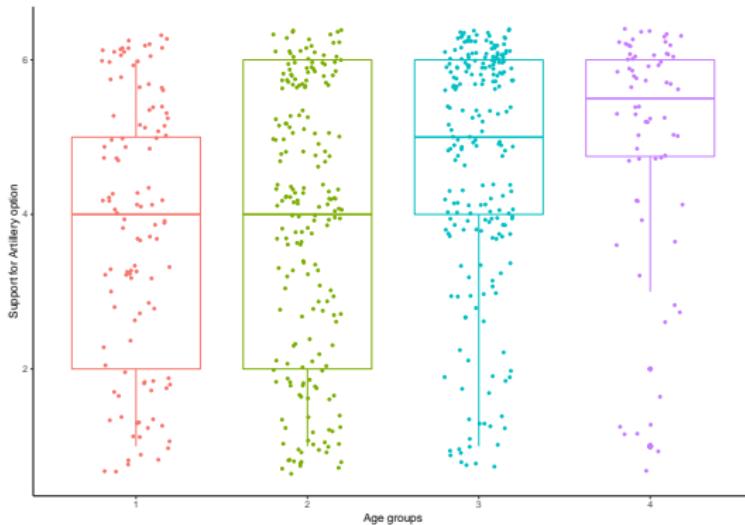
```
##      1      2  
## 4.538182 4.009231
```

```
boxplot(artillery_approve ~ gender, data = wardata, xlab = "Respondent Gender",  
       ylab = "Approving Artillery", names = c("Male", "Female"))
```



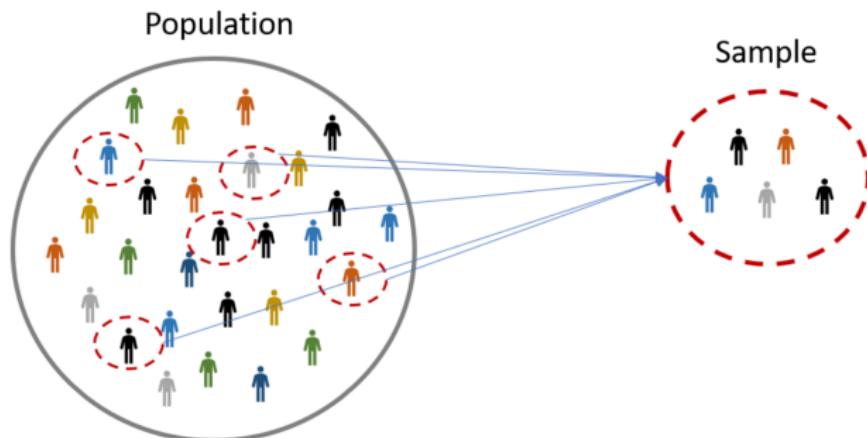
Boxplots: Artillery option and Age (tidyverse version)

```
ggplot(wardata, aes(x=factor(agegroup), y = artillery_approve,  
color = factor(agegroup))) +  
  geom_boxplot() +  
  geom_jitter(shape=16, position=position_jitter(0.2)) +  
  xlab("Age groups") + ylab("Support for Artillery option") +  
  theme_classic() + theme(legend.position = "none")
```



Surveys

- ▶ Sampling and randomization.
- ▶ *Probability sampling*



Sampling

- ▶ **Simple random sampling (SRS).**
- ▶ *Without replacement* procedure.



Apply SRS

- ▶ Obtain our sampling frame.
- ▶ Problems:
 - ▶ Address lists not updated.
 - ▶ Who uses land-lines?
 - ▶ Method of RDD - Random digit dialing.

How representative is our sample?

Data manipulations

Log transform: deal with outliers (extreme large values).

Skew the analysis of the data

```
summary(afghan$population)
```

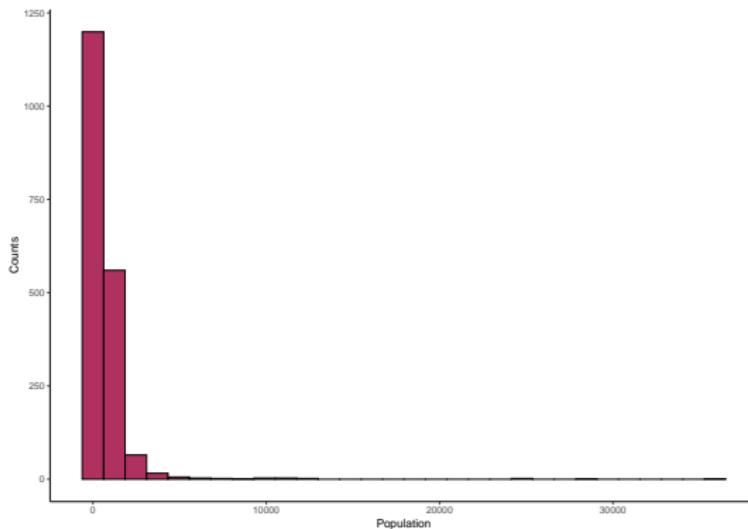
```
##      Min. 1st Qu. Median      Mean 3rd Qu.      Max.
##      4.0   239.0  450.0    746.1   823.2 35900.0
afghan$pop_out <- ifelse(afghan$population > 2000, 1, 0)
prop.table(table(outliers = afghan$pop_out))
```

```
## outliers
##          0           1
## 0.9527897 0.0472103
```

Outliers visual

Small number of villages with large population (> 2000)

```
ggplot(afghan, aes(x=population)) +  
  geom_histogram(color="black", fill="maroon") +  
  theme_classic() + ylab("Counts") + xlab("Population")
```

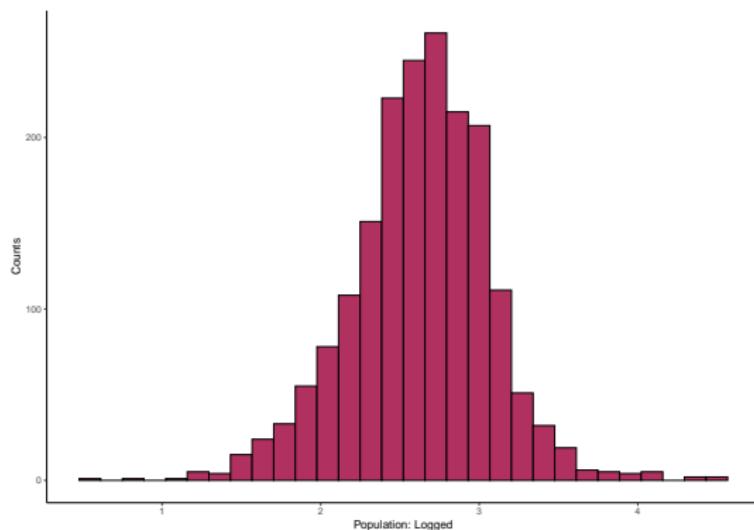


Log transform

Use natural log to reduce outliers effect

```
afghan$pop_1 <- log(afghan$population, 10)

ggplot(afghan, aes(x=pop_1)) +
  geom_histogram(color="black", fill="maroon") +
  theme_classic() + ylab("Counts") + xlab("Population: Logged")
```



Survey data problems

UNIT NONRESPONSE:

- ▶ Item nonresponse: Respondent refuses to answer.
- ▶ Ex. income, national origin, religion.
- ▶ Misreporting: not true attitude.
- ▶ *Social desirability bias.*
- ▶ Problematic issues: racial prejudice, corruption, etc.

Indirect data collection: List experiment

Background (all respondents)

I'm going to read you a list with the names of different groups and individuals on it. After I read the entire list, I'd like you to tell me how many of these groups and individuals you broadly support, meaning that you generally agree with the goals and policies of the group or individual. Please don't tell me which ones you generally agree with; only tell me how many groups or individuals you broadly support.

Treatment Group

Karzai Government; National Solidarity Program; Local Farmers; **ISAF (Taliban)**

Control Group

Karzai Government; National Solidarity Program; Local Farmers

Indirect data collection design

Ceiling and floor effects

```
table("response" = afghan$list.response,
      "group" = afghan$list.group)

##           group
## response control ISAF taliban
##       0      188   174      0
##       1      265   278    433
##       2      265   260    287
##       3      200   182    198
##       4        0    24      0
```

Foreign policy

Blair et al. (2014): about 5% support for ISAF.



Hearts & Minds
Strategy



Wrapping up Week 4

Summary:

- ▶ Measurement - why? what's so important? Errors in measurement.
- ▶ Operational and conceptual definitions.
- ▶ Surveys: sampling, randomization, challenges.
- ▶ Nonresponse, misreporting and list experiment design.
- ▶ Visuals: why? what not to do? types of plots.
- ▶ R work: counting NAs, na.omit(), plots using ggplot and base R, log transform.

Design task 1 next FRIDAY!!!