

Bush 631-603: Quantitative Methods

Lecture 4 (02.07.2023): Measurement vol. I

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What is today's plan?

- ▶ R class task II: Grouping data
- ▶ From concepts to measures.
- ▶ Why measurement? and its challenges.
- ▶ Visualizing data: plots.
- ▶ R Tech: introducing R Markdown
- ▶ Methods: Surveys.
- ▶ R work: summary(), NAs, barplot, histogram, boxplot.

Working with R - Class Task II

Data (BAAD v.2): 140 insurgent groups (1998-2012).

- ▶ Upload data - STATA file!!
- ▶ Create subsets for cross-tabs and diff-in-means:
 1. 2 subsets: group operate in Iraq / Somalia
 2. Tab group size and stick strategy for Iraqi groups
 3. Diff-in-means of total fatalities b-w Iraq and Somalia
- ▶ Use prop.table() for proportions of groups with religious ideology

Measurement



Measurement

Why?

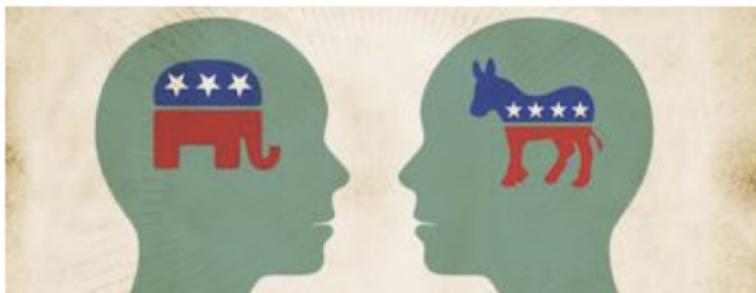
- ▶ Social science: develop and test causal theories.
- ▶ Leader background and conflict behavior.
- ▶ Minimum wage and levels of full-time employment?
- ▶ Concepts: level of unemployment, leader background, public approval.

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

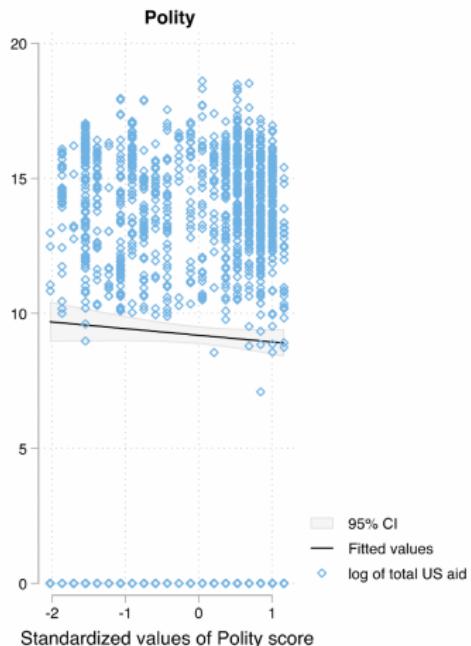
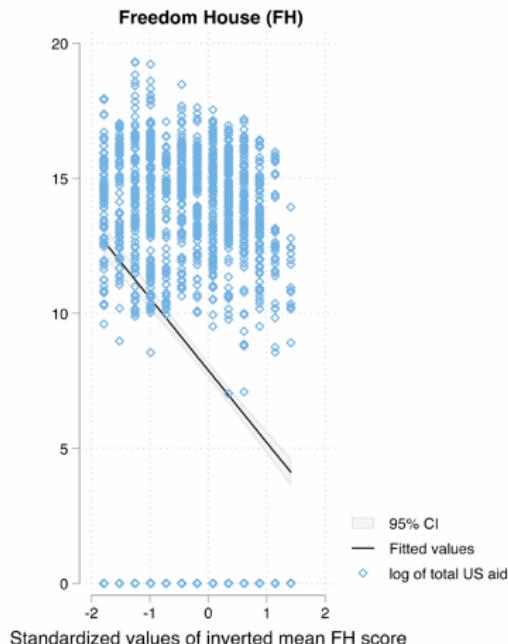
- ▶ How do we measure 'levels' of democratic regimes?

TWO SCALES



Measuring Democracies

- ▶ Does aid helps democracy promotion?



Measuring regime types

Why the differences?

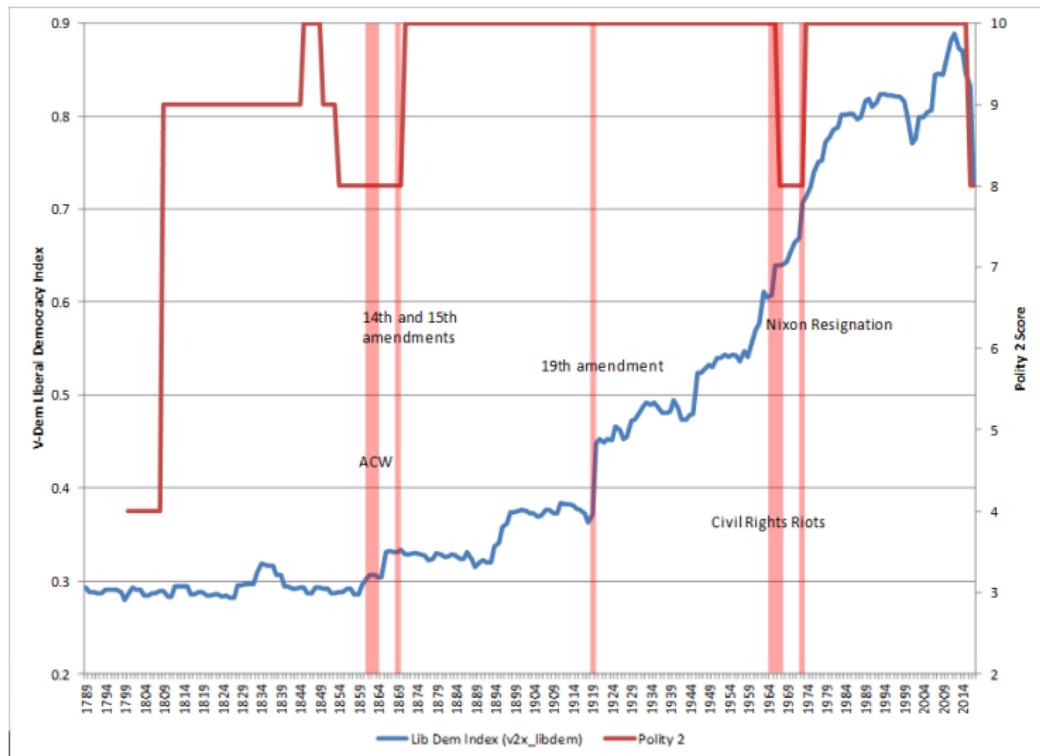
Freedom House Scale (Link) - personal and civil rights:

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*

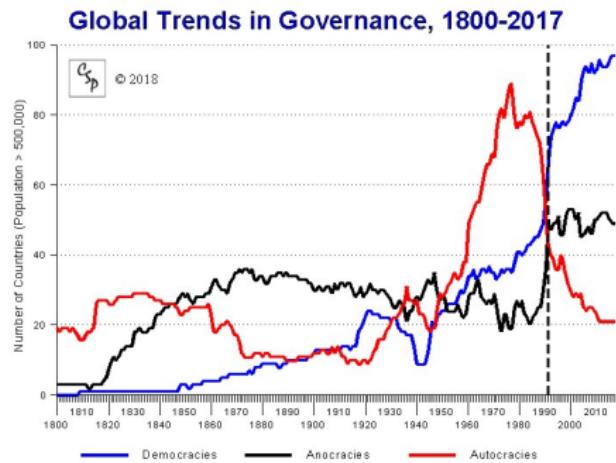
- ▶ Conceptual definition: the extent to which US adults support the actions and policies of the current US president.
- ▶ Operational definition: “On a scale from 1 to 5, where 1 is least supportive and 5 is more supportive, how much would you say you support the job that Joe Biden is doing as president?”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

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 - Cross Tabs

```
# 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 - Cross Tabs

- ▶ 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?
- ▶ Item nonresponse: Refusal to answer.
- ▶ Examples: income, national origin, religion.
- ▶ Misreporting: not true attitude.
- ▶ *Social desirability bias*.
- ▶ Problematic issues: racial prejudice, corruption, etc.
- ▶ No access to data / no data: unemployment in developing countries.
- ▶ Don't know the answer / no opinion . . .

Missing data: Non-response

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=10)
```

```
## [1] FALSE TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
```

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

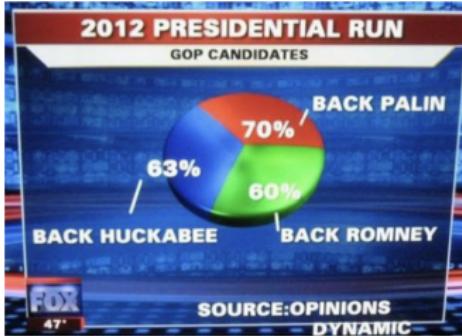
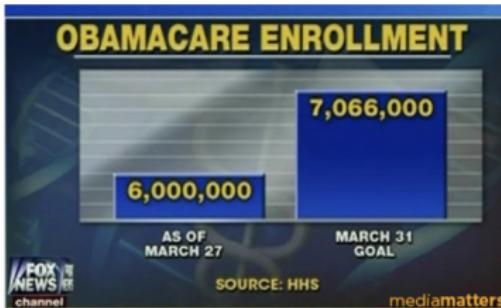
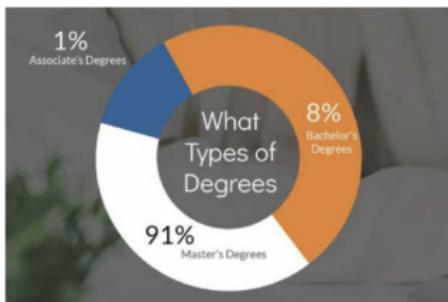
Numerical display of data:

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

Visuals: plots, graphs

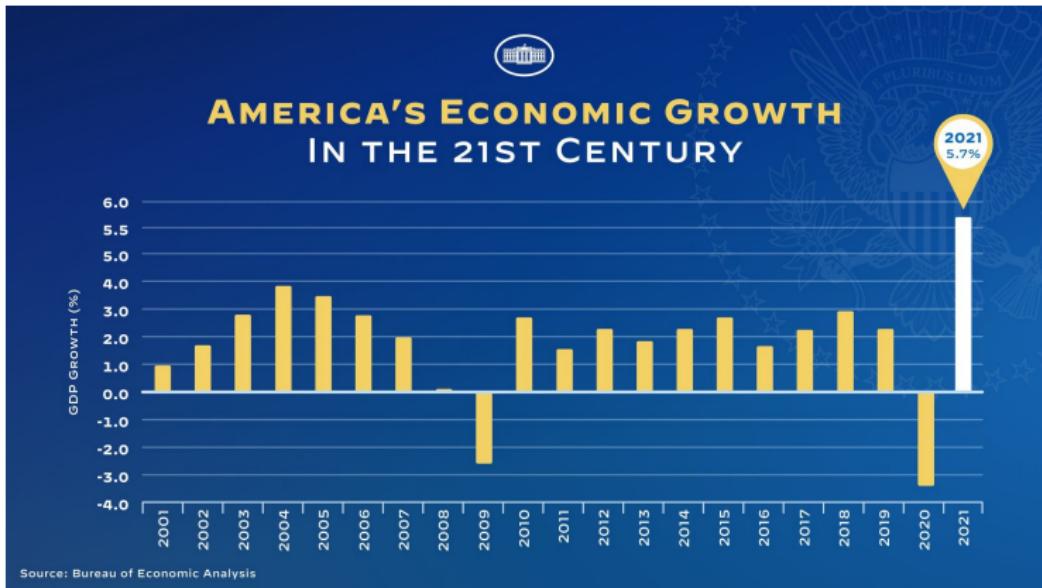
- ▶ More comprehensive.
- ▶ Highlight important elements.
- ▶ Great for presentation.
- ▶ Audience focus on important insights

Visuals: please don't...



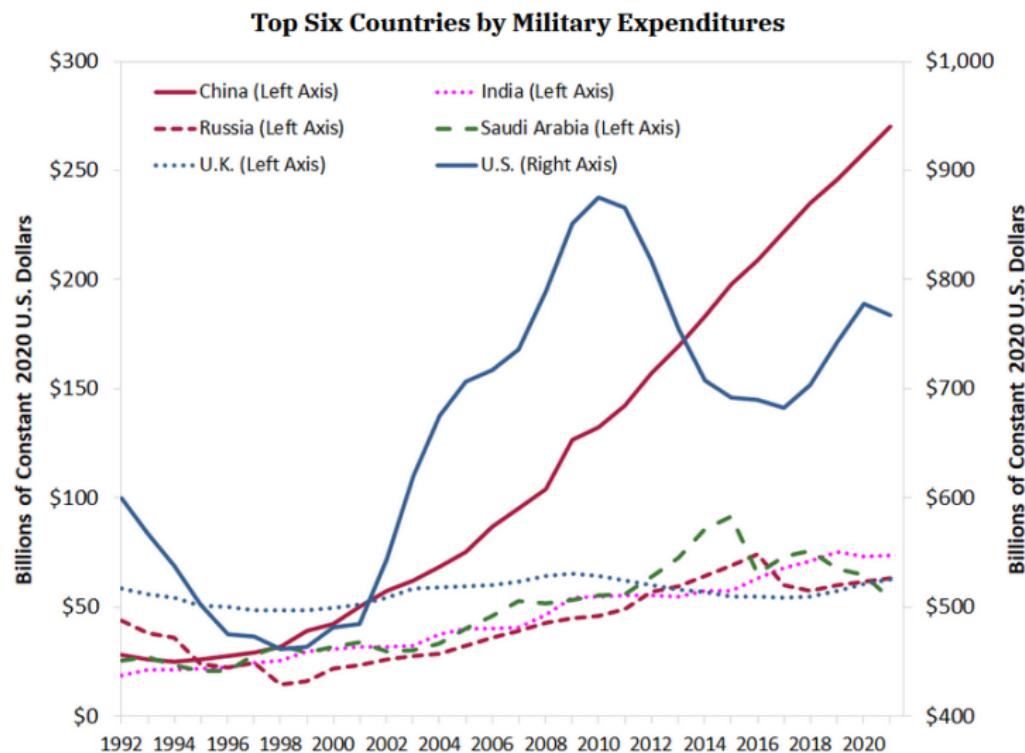
Visuals

This is an official government product. . .



Visuals

Another official doc... (SourceLink)



Visuals: One last gem

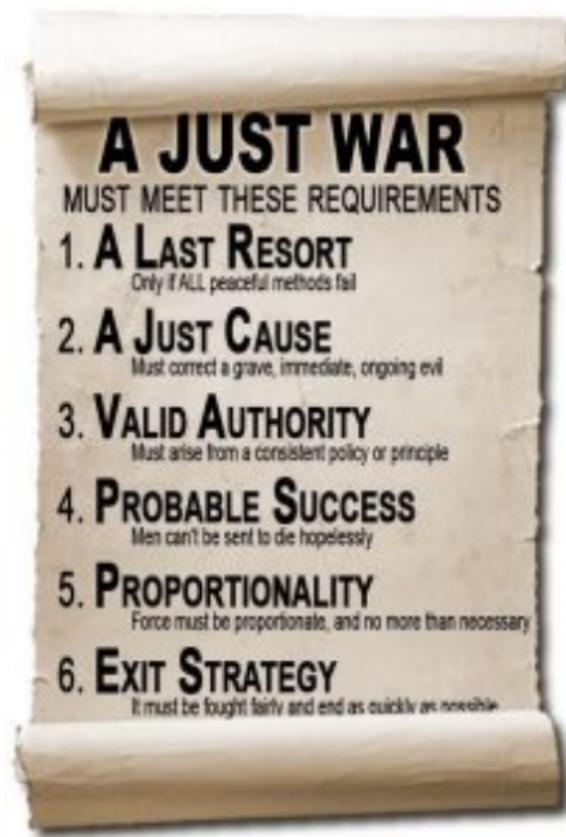


Visuals

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: ClipLink

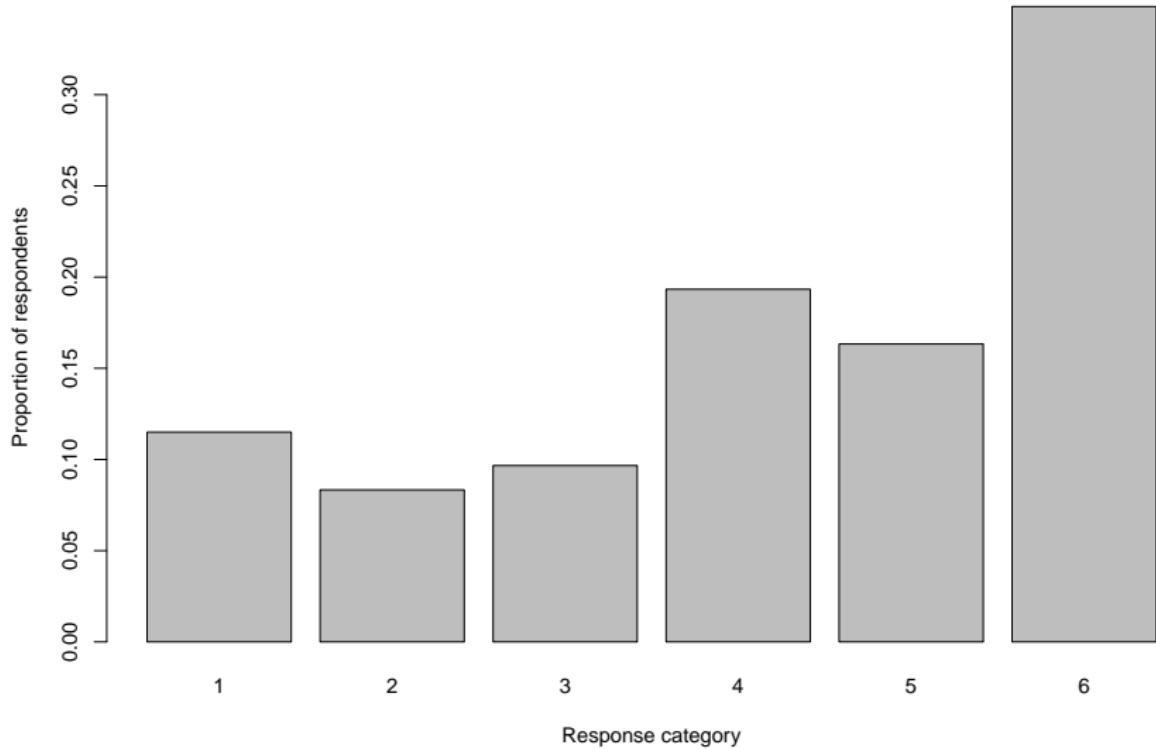


Iraq War (2003):

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

Just war: Public attitudes

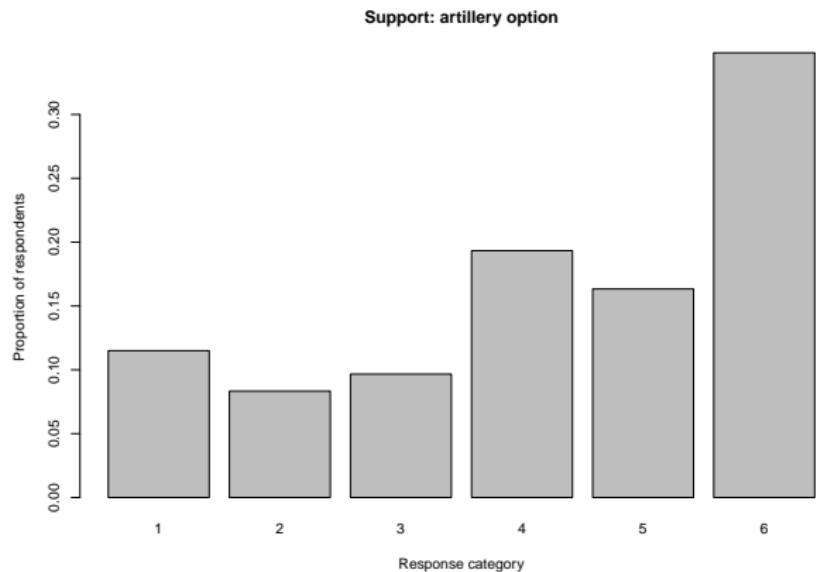
Support for using artillery option



Bar plot: Base R code

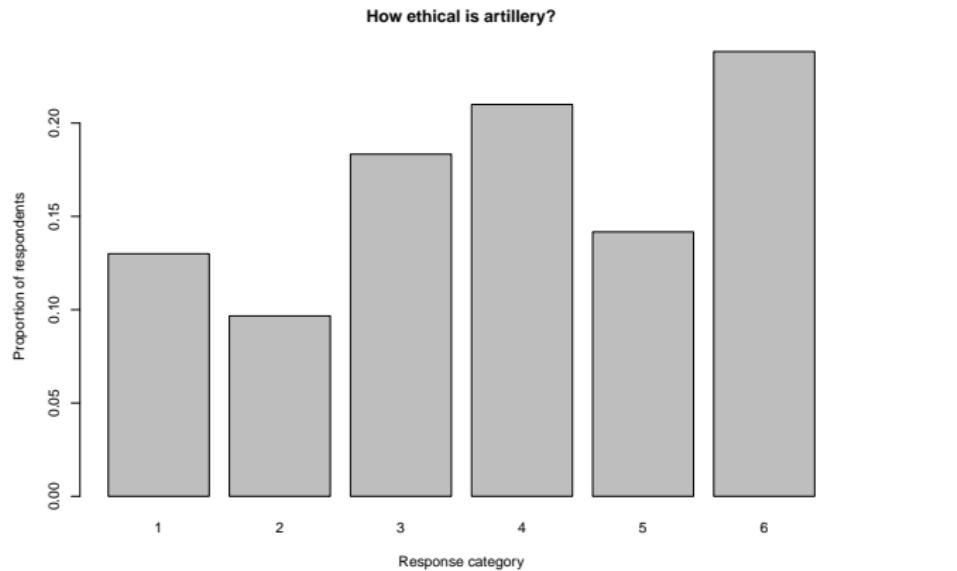
```
# Create proportions of support
artillery.tab <- prop.table(table(Support = wardata$artillery_approve,
                                   exclude = NULL))

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



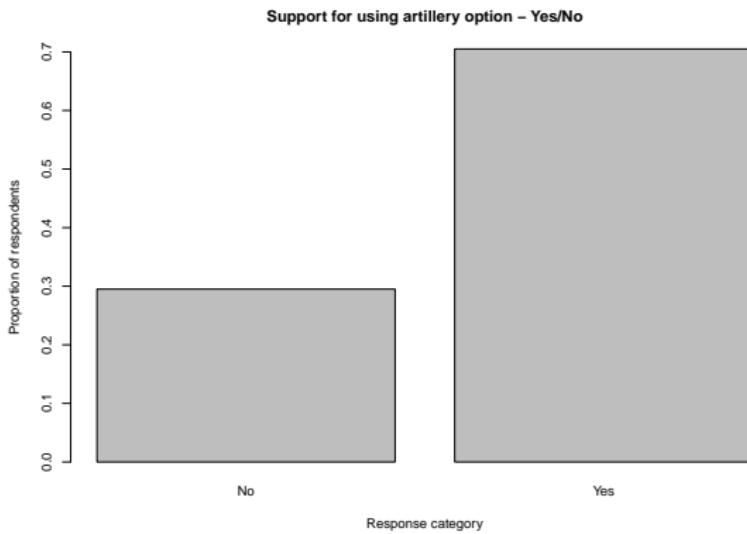
Artillery option: Ethical?

```
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



Visuals with tidyverse

Building a (gg)plot...

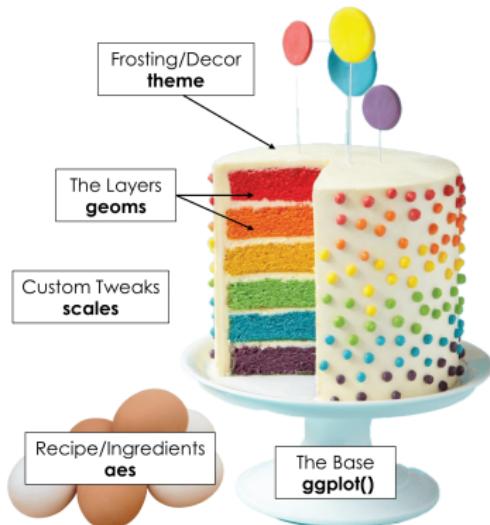
ggplot is a little bit like cake...

We always start by setting up the foundation with **ggplot()**

We specify our ingredients (data variables) with an **aes mapping**

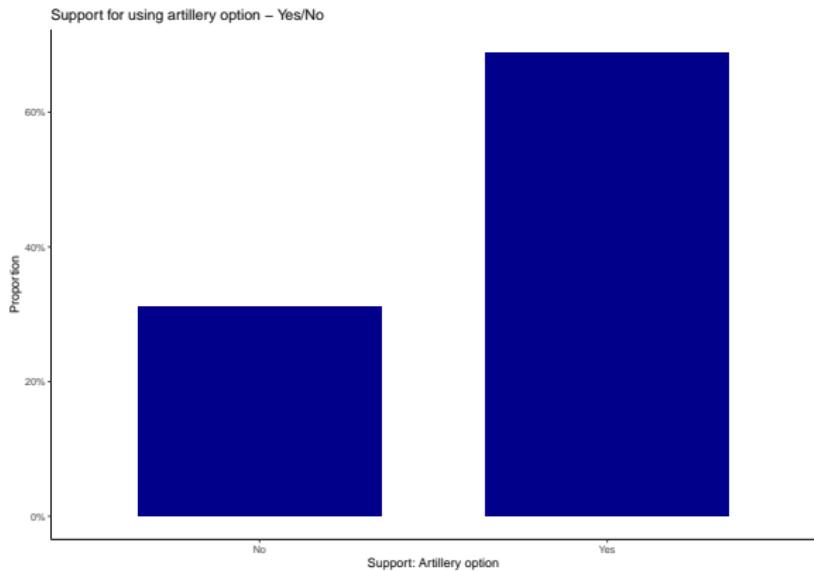
We can create layers to our plot with **geoms**

We can style our **cake** ggplot with **themes**. We have out-of-the-box options, or we can go totally custom!



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) +  
  scale_x_discrete(labels = c("0"="No", "1"="Yes")) +  
  ggtitle("Support for using artillery option - Yes/No") + theme_classic()
```



Visual options

HISTOGRAM

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

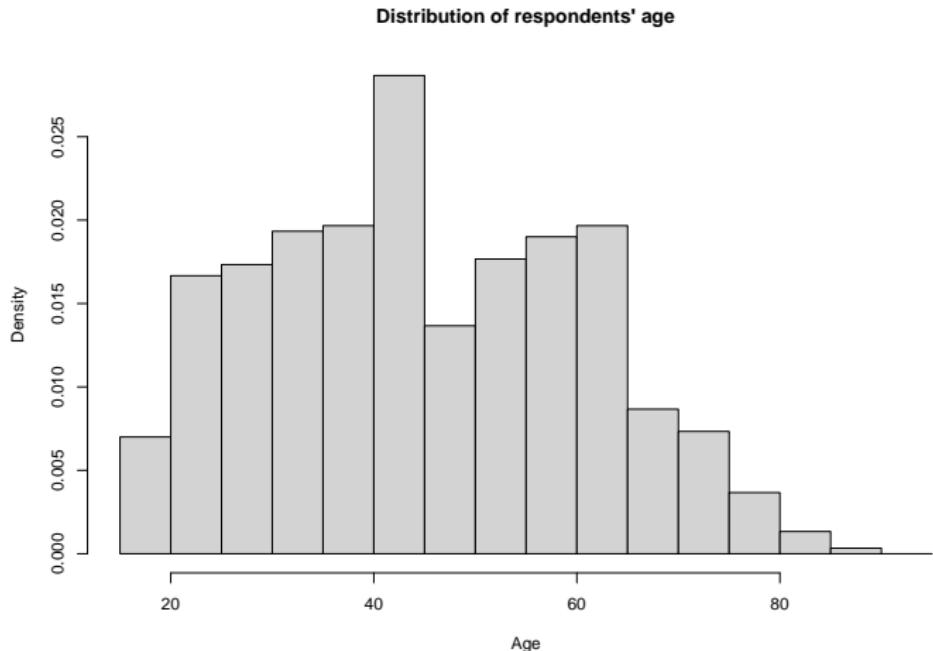
```
# Distribution of respondents' age  
wardata$age <- (2014 - wardata$birthyr)  
summary(wardata$age)
```

	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

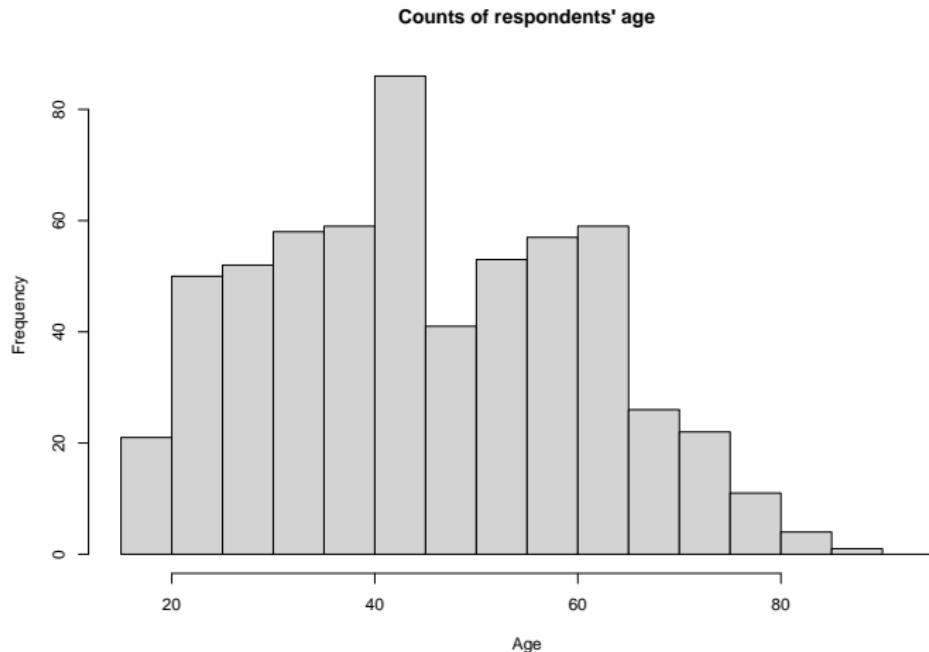
```
hist(wardata$age, freq = FALSE, breaks = seq(from = 15, to = 95, by = 5),  
     xlab = "Age",  
     main = "Distribution of respondents' age")
```



Histogram

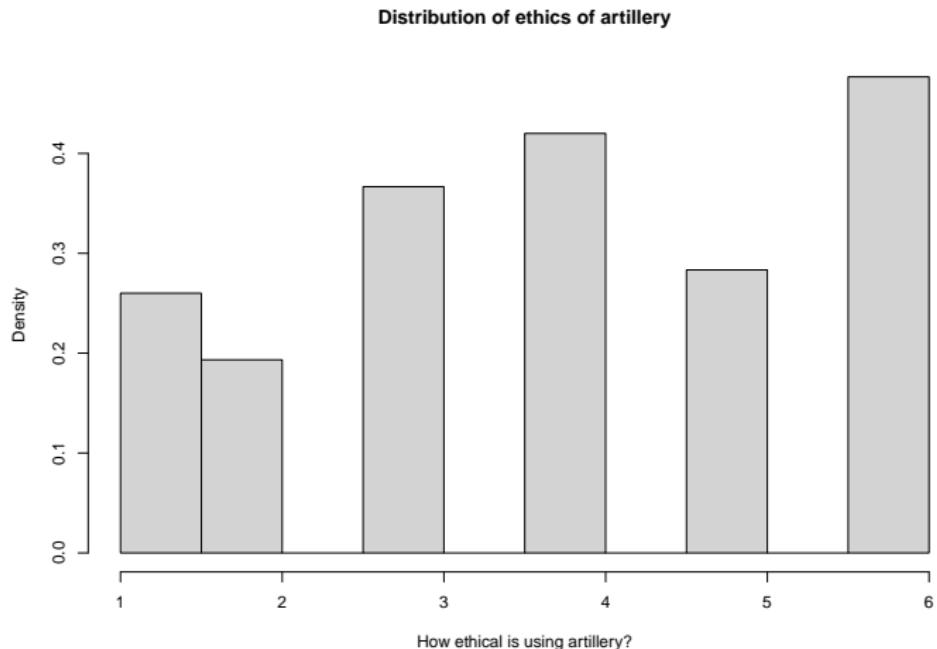
Counts instead of density

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



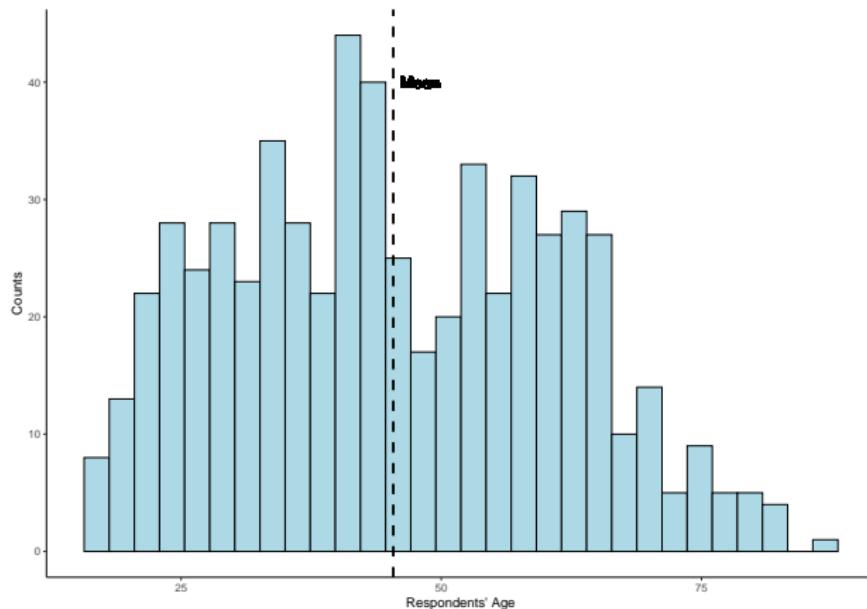
Artillery ethical?

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



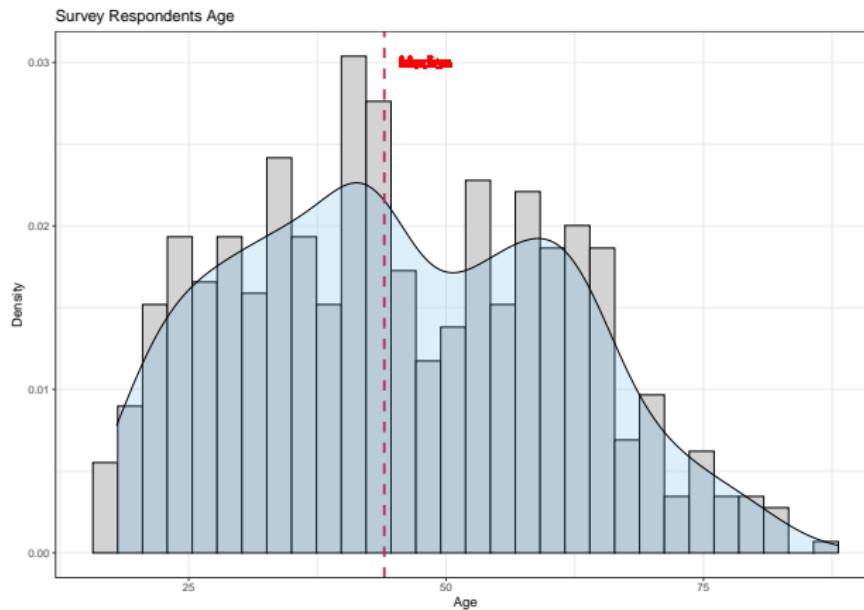
Histogram: Tidyverse

```
ggplot(wardata, aes(x=age)) +  
  geom_histogram(color="black", fill="lightblue") +  
  geom_vline(aes(xintercept=mean(age)),  
             color="black", linetype="dashed", size=1) +  
  geom_text(x = 48, y = 40, label = "Mean", size = 4.5) +  
  ylab("Counts") + xlab("Respondents' Age") + theme_classic()
```



Histogram: Tidyverse

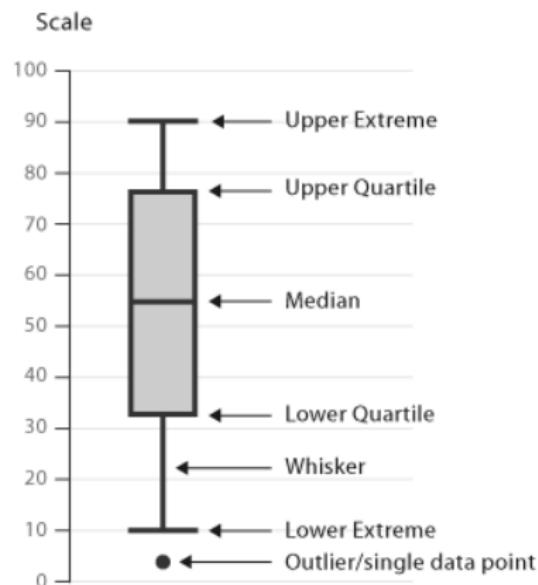
```
ggplot(wardata, aes(x=age)) +  
  geom_histogram(aes(y=..density..), colour="black", fill="lightgrey") +  
  geom_density(alpha=.2, fill="#56B4E9") +  
  geom_vline(aes(xintercept=median(age)),  
             color="maroon", linetype="dashed", size=1) +  
  geom_text(x = 48, y = 0.03, label = "Median", col = "red", size = 4.5) +  
  xlab("Age") + ylab("Density") + theme_bw() + ggtitle("Survey Respondents Age")
```



Visual Options

BOXPLOT

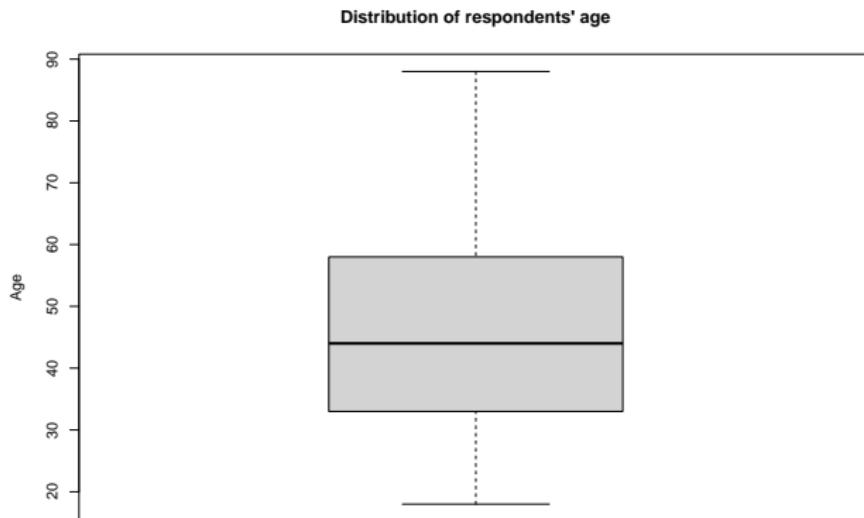
- Useful for a single variable distribution.
- Comparing multiple variables.



Exploring variables with boxplots

Base R: single variable

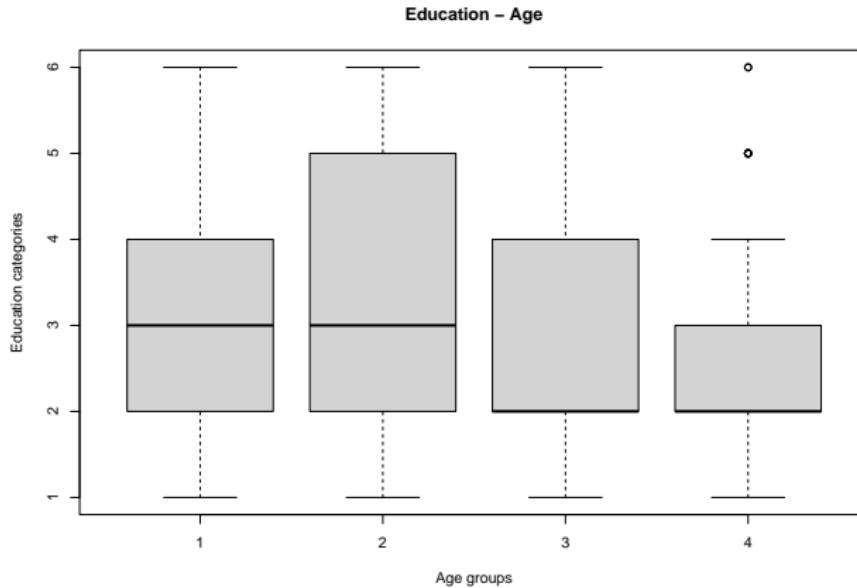
```
boxplot(wardata$age, ylab = "Age",  
       main = "Distribution of respondents' age")
```



Comparing variables: Boxplots

Education and Age: Base R

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



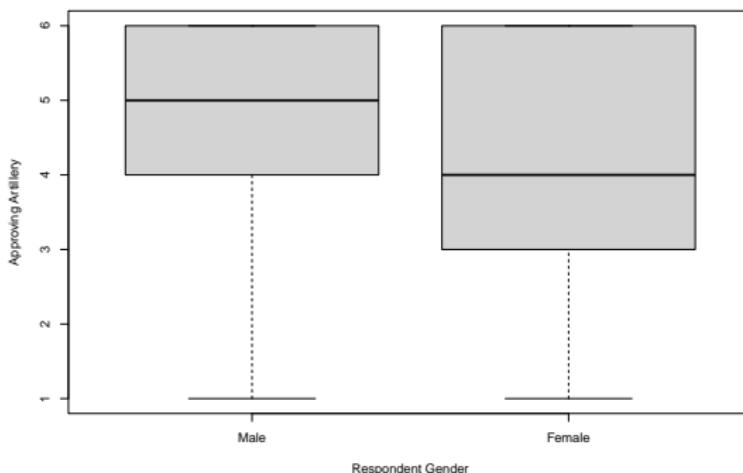
Comparing variables: Boxplots

Gender and using artillery

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

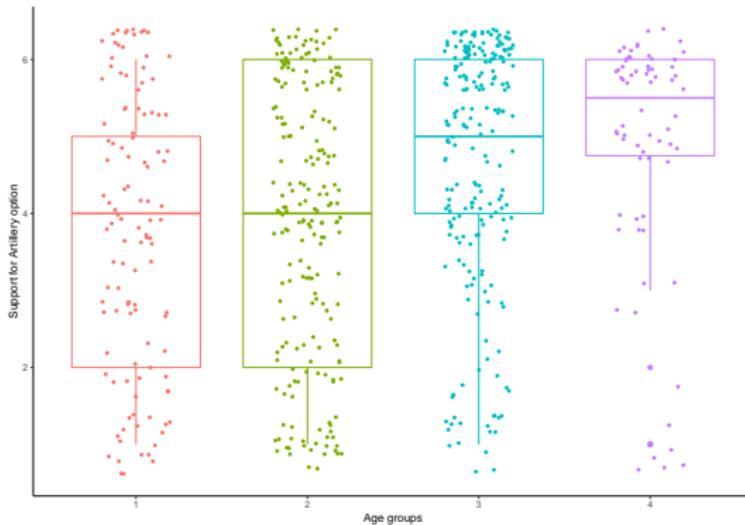
```
##      1      2  
## 4.538182 4.009231
```

```
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")
```

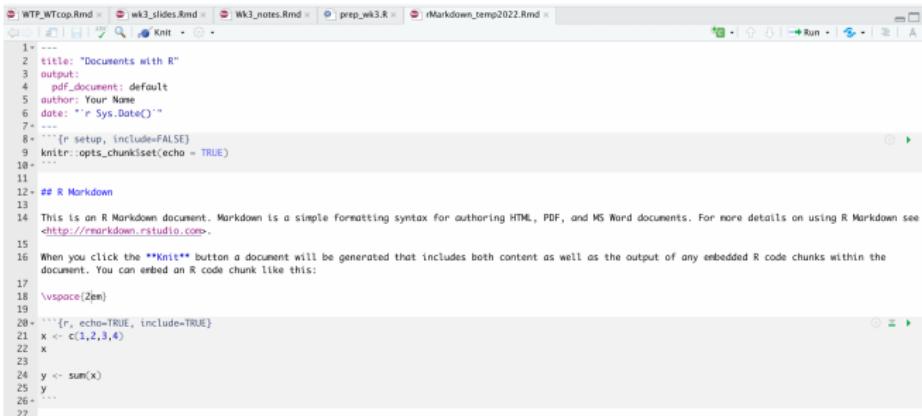


R logistics

- ▶ Writing reports and professional documents.
- ▶ R Markdown: mix of text and code to analyze data and produce content.
- ▶ Reproducible, automation, more efficient.
- ▶ Create PDF, html (and yes, also Word).

R Markdown

Replacing the script



The screenshot shows the RStudio interface with several tabs open at the top: WTP_WTCop.Rmd, wk3_slides.Rmd, Wk3_notes.Rmd, prep_wk3.R, and rMarkdown_temp2022.Rmd. The main editor area contains an R Markdown script:

```
1 ---
2   title: "Documents with R"
3   output:
4     pdf_document: default
5   author: Your Name
6   date: `r Sys.Date()`
7 ---
8 ```{r setup, include=FALSE}
9 knitr::opts_chunk$set(echo = TRUE)
10 -
11
12 ## R Markdown
13
14 This is an R Markdown document. Markdown is a simple formatting syntax for authoring HTML, PDF, and MS Word documents. For more details on using R Markdown see <http://rmarkdown.rstudio.com>.
15
16 When you click the **Knit** button a document will be generated that includes both content as well as the output of any embedded R code chunks within the document. You can embed an R code chunk like this:
17
18 \vspace[2em]
19
20 ```{r, echo=TRUE, include=TRUE}
21 x <- c(1,2,3,4)
22 x
23
24 y <- sum(x)
25 y
26 -
27
```

R Markdown

We get a PDF doc (text, data, plots and more)

Documents with R

Your Name

2022-01-28

R Markdown

This is an R Markdown document. Markdown is a simple formatting syntax for authoring HTML, PDF, and MS Word documents. For more details on using R Markdown see <http://rmarkdown.rstudio.com>.

When you click the **Knit** button a document will be generated that includes both content as well as the output of any embedded R code chunks within the document. You can embed an R code chunk like this:

```
x <- c(1,2,3,4)
x

## [1] 1 2 3 4
y <- sum(x)
y

## [1] 10
```

R Markdown

- ▶ Use the template for any document you write.
- ▶ Use the instructions file.
- ▶ Change in template:
 - ▶ Your name, date and project title.
 - ▶ Add data to work with (more packages if needed).
 - ▶ Main text - your project.
 - ▶ R code: change as needed.
- ▶ Do not change:
 - ▶ Setting in YAML & R code chunks

R Tech: R Markdown

First, type on the console:

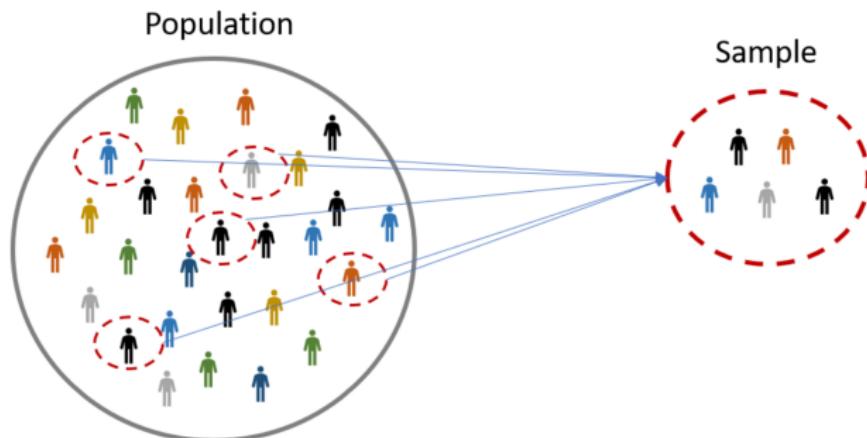
```
tinytex::install_tinytex()
```

Now,

- ▶ Open template file
- ▶ Edit name and doc title
- ▶ upload packages
- ▶ Write text into the white space
- ▶ Add code
- ▶ save and then knit

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

Outlier 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

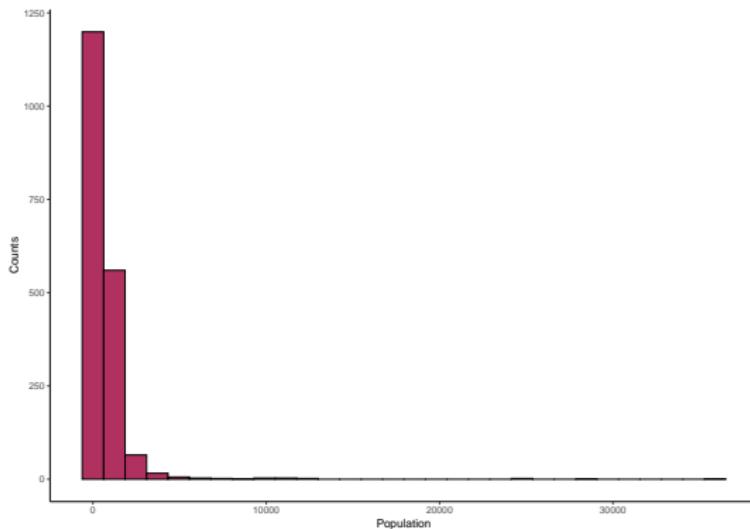
afghan$pop_out <- ifelse(afghan$population > 2000, 1,0)
prop.table(table(outliers = afghan$pop_out))

## 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")
```



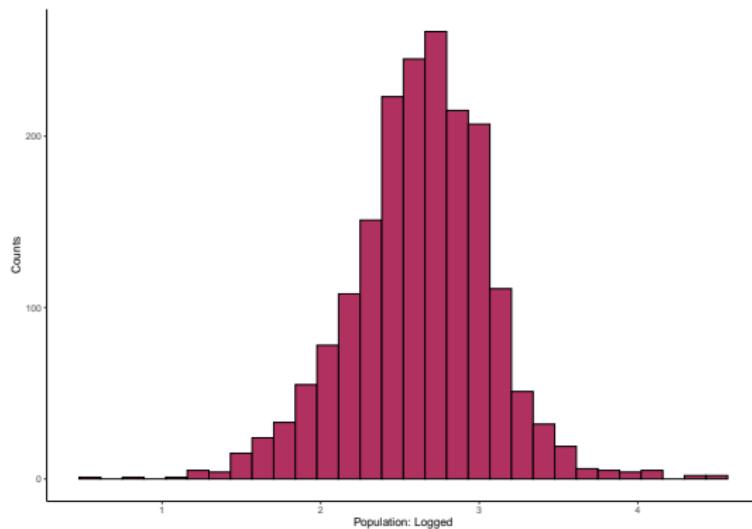
Log transform

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

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")
```



Wrapping up Week 4

Summary:

- ▶ Measurement - why? what's so important? Errors in measurement.
- ▶ Operational and conceptual definitions.
- ▶ Surveys: sampling, randomization, challenges.
- ▶ Visuals: why? what not to do? types of plots.
- ▶ R Markdown for dynamic documents (PDFs).
- ▶ R work: counting NAs, na.omit(), plots (ggplot/base R), log transform.
- ▶ R task: data analysis with Markdown - **due Feb. 24**