Data Wrangling in R

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PRINCETON UNIVERSITY

COMPASS Workshops

Computing for Data Analysis in the Social Sciences

- Free, open-source statistical programming and data analysis workshops using R and RStudio
- Open to everyone with a Princeton ID
- No programming experience is necessary or expected
- Attendees should bring a laptop computer to fully participate in the workshops

https://compass-workshops.github.io/info/

People

- **Teaching Staff**
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  - Yunkyu Sohn (Research Associate, Department of Politics)
- **Faculty Sponsors**
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  - Matthew Salganik (Professor, Department of Sociology)

Todays' Contents

1. Before You Begin
2. Today's Project
3. Things to Cover
4. Learning by Doing
5. Research Questions

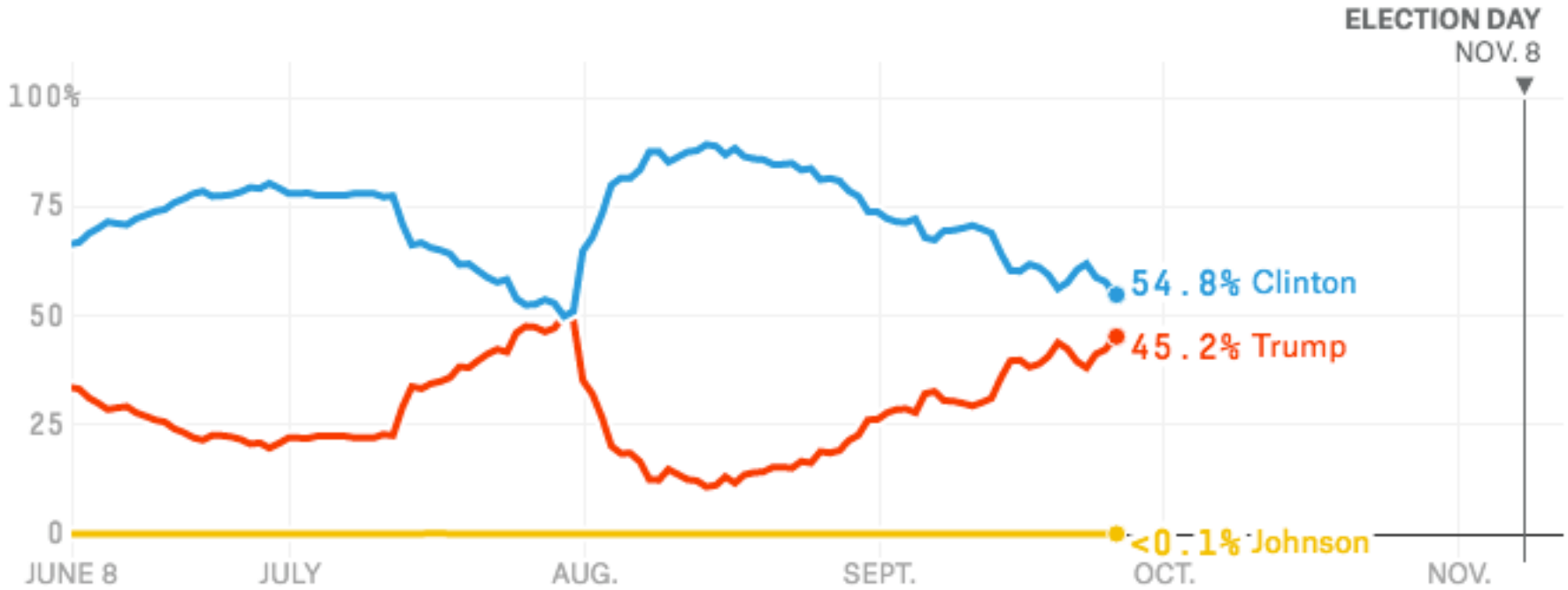
Before You Begin

1. You should have a computer with Internet connection.
2. You should have R and RStudio (latest version preferred) installed.
3. Download Slides and Data for Week 2 (right click -> save as) at https://compass-workshops.github.io/info/
4. Start Rstudio

That's all!

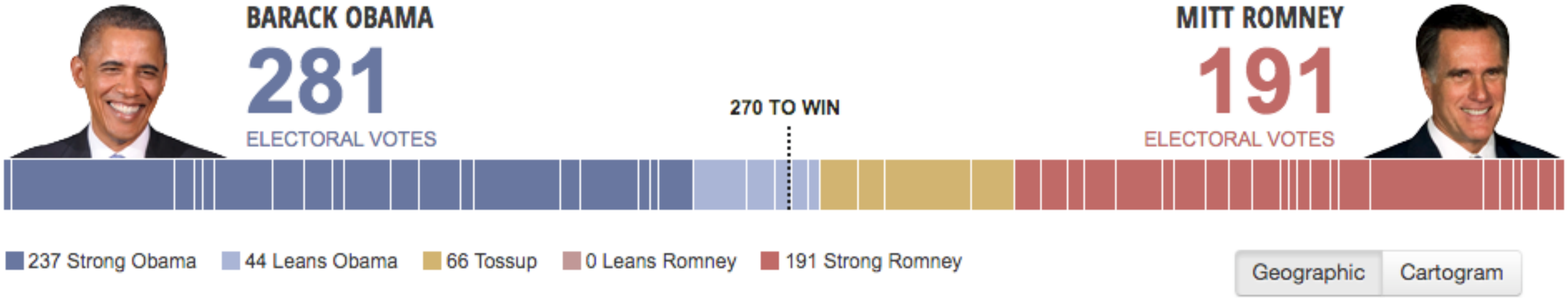
Today’s Project

Election Prediction = Data + Statistics



FiveThirtyEight

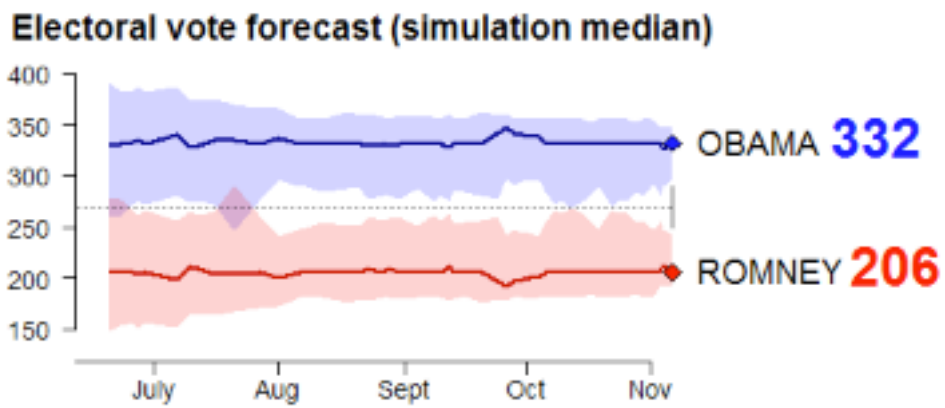
Election Prediction = Data + Statistics



HUFFPOST POLLSTER

Get the latest polls and public opinion updates in your inbox daily

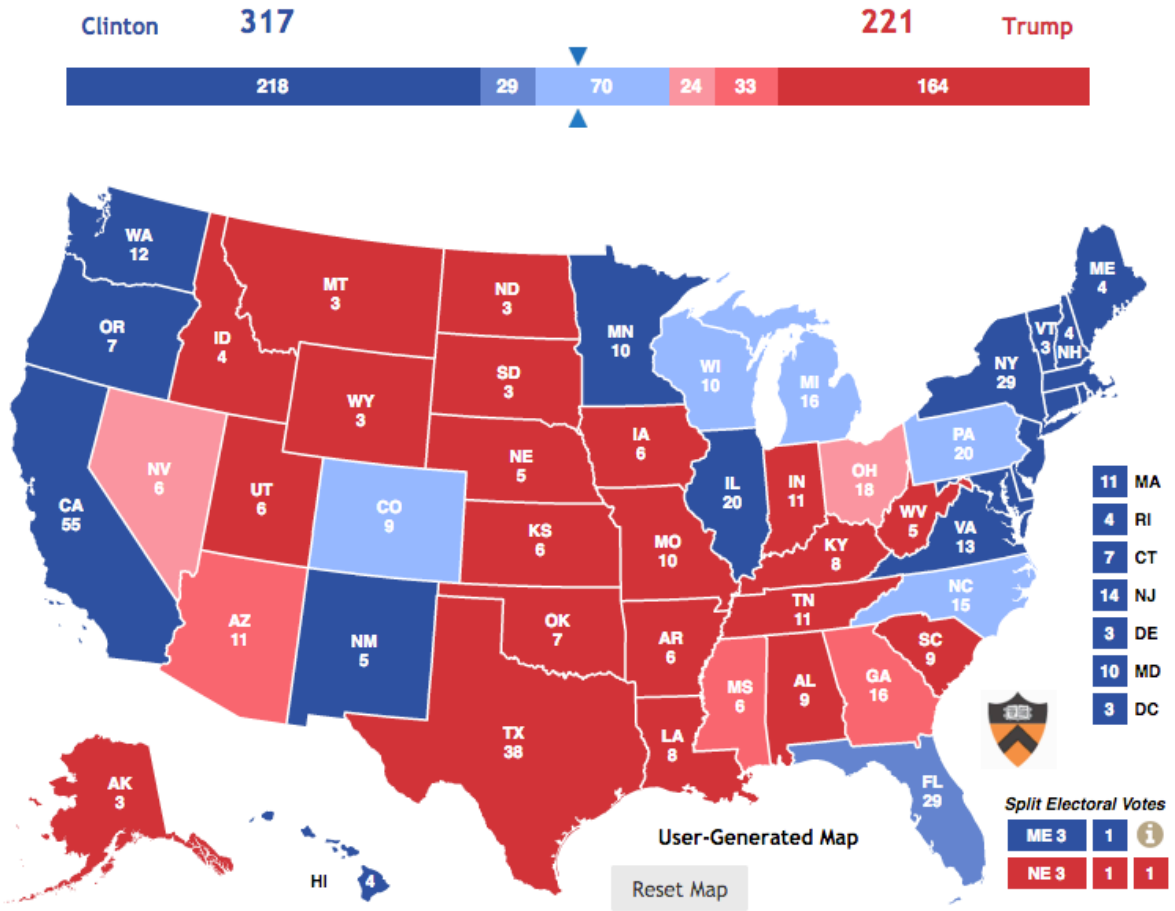
Election Prediction = Data + Statistics



VOTAMATIC

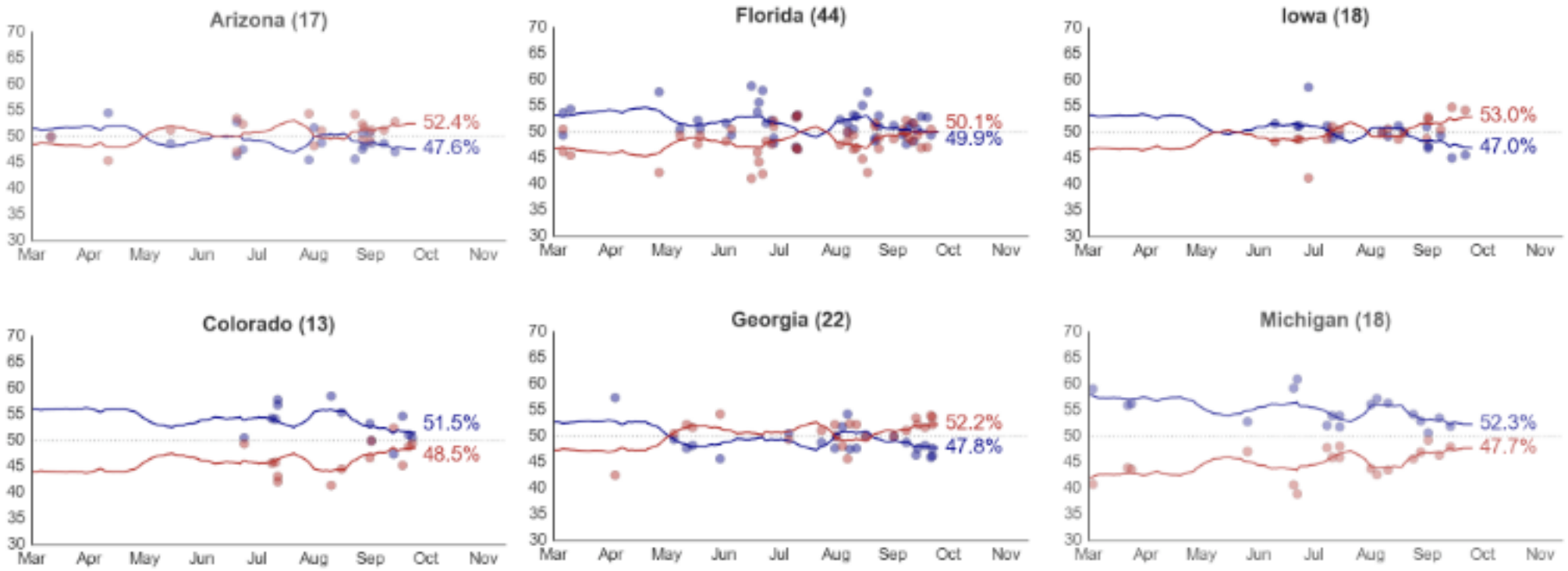
Polling Analysis and Election Forecasting

Election Prediction = Data + Statistics

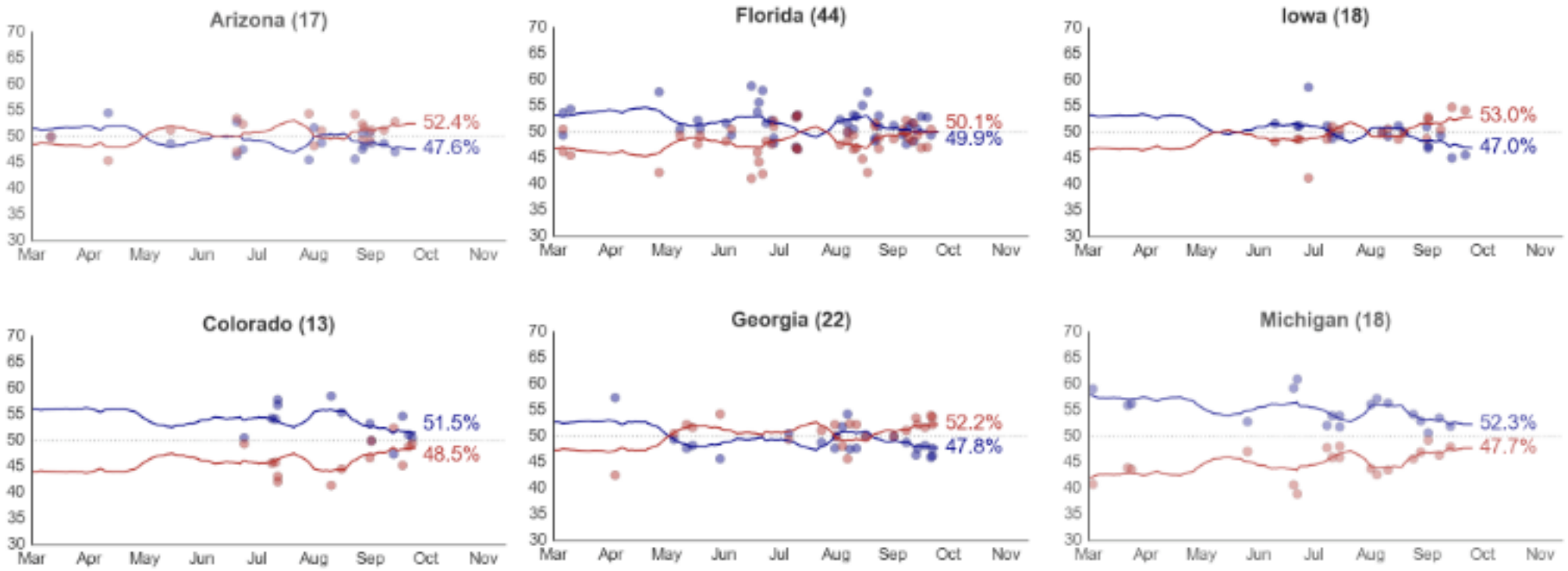


Princeton Election Consortium

Generic Approach to Election Prediction

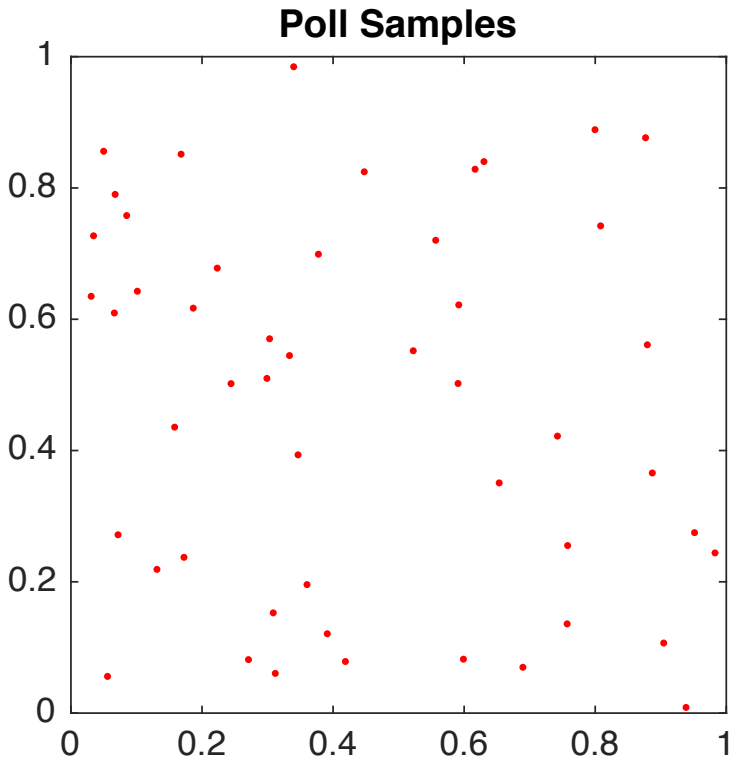


Generic Approach to Election Prediction

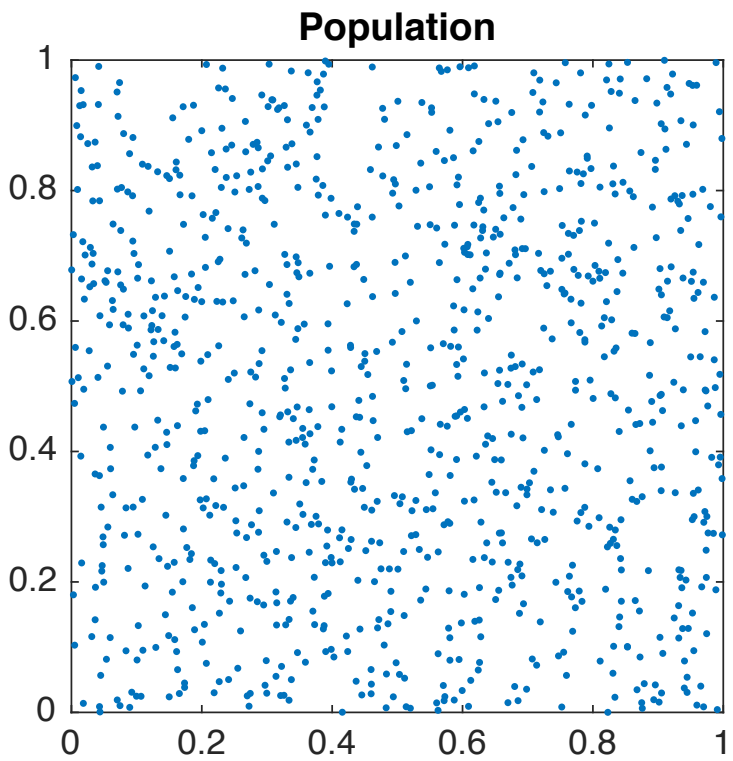


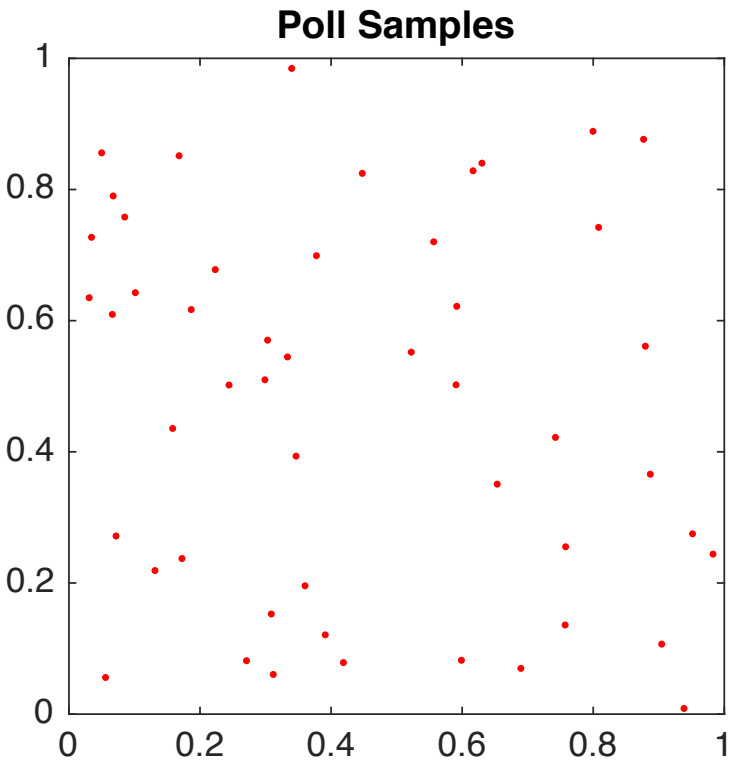
Statistical **aggregation** of state **poll** results over time

Election Prediction = Data + Statistics



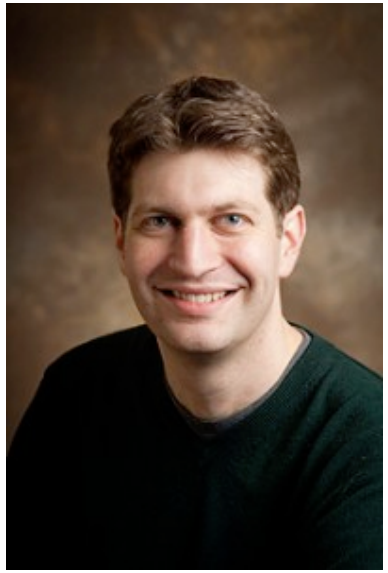
Election Prediction = Data + Statistics





Using Statistics to infer latent population preference

Generic Approach to Election Prediction




Statistical **aggregation** of state **poll** results over time

After 60 minutes, You will be able to

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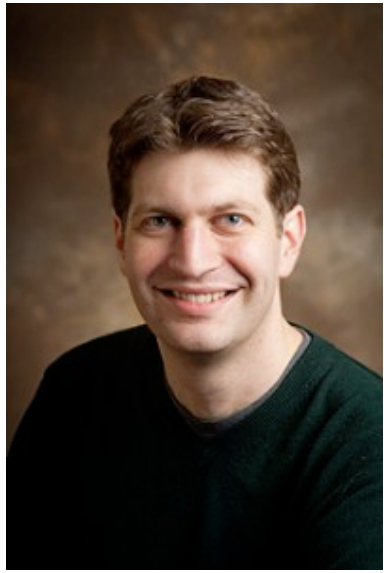
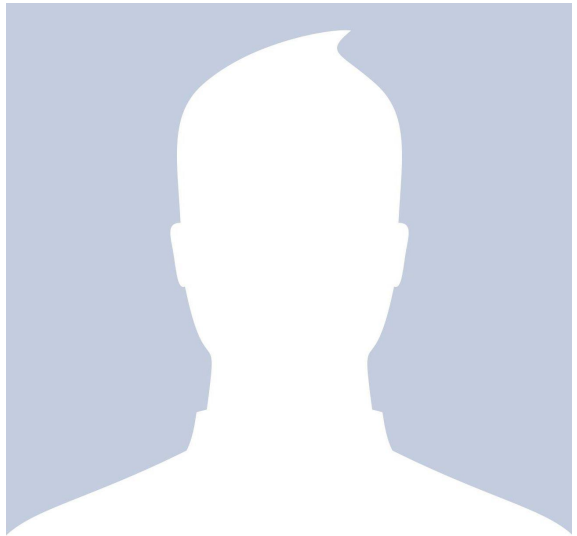




Yourself

After 60 minutes, You will be able to

conduct preliminary poll analysis from scratch!

After 60 minutes, You will be able to

conduct preliminary poll analysis from scratch!

- Obtain a very similar dataset used in popular prediction sites
- Learn how to do basic data import/manipulation using this dataset
- Do elementary data analysis

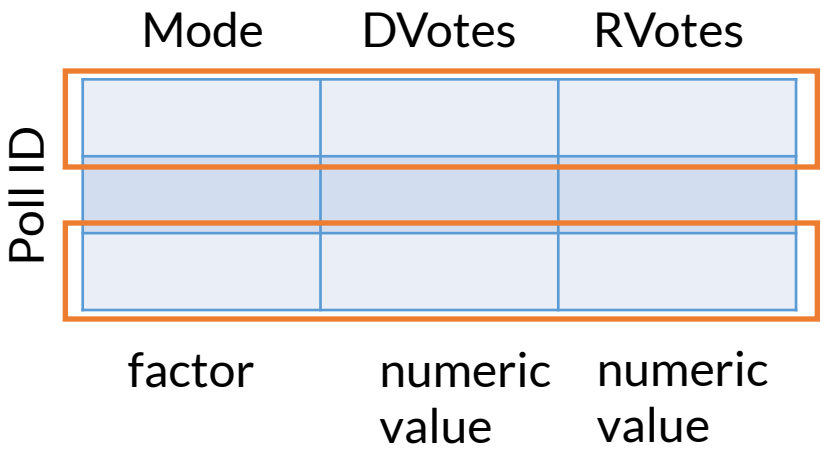
by learning Data Wrangling techniques

Things to Cover --- R functionality

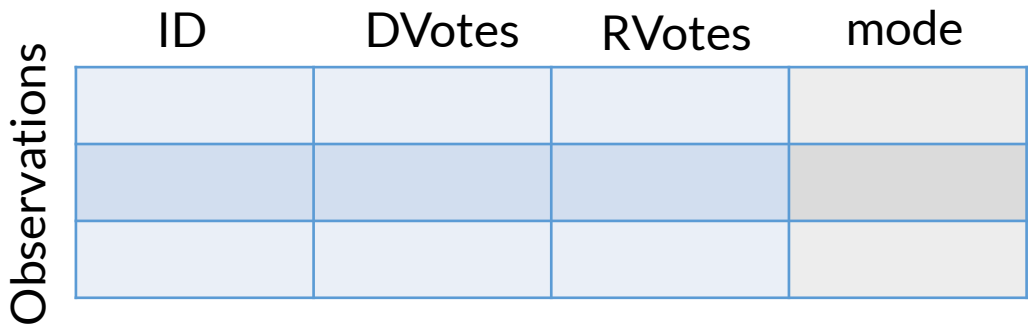
- Data acquisition from the Internet and import to R
- Undersanding R data structures
- Subsetting Observations
- Subsetting Variables
- Subsetting Both Observations and Variables
- Summarizing Data
- Creating and Renaming Variables
- Merging Data Sets

Things to Cover --- R functionality (in short)

- Subsetting



- Merging



Dataset for Today

- https://compass-workshops.github.io/info/ : Week 2 Data
- Dataset downloaded on September 26th, 2016 from HuffPost Pollster

Not for today

You can Download by Yourself

Google

huffpost pollster

HuffPost Pollster - Polls and Charts - Election Results
elections.huffingtonpost.com/pollster ▾ 이 페이지 번역하기
Polls, charts, forecasts and data about upcoming elections, Obama, Congress, Democrats, Republicans, politics, health care and the economy.

2016 General Election: Trump ...
Polls and chart for 2016 General Election: Trump vs. Clinton. See ...

polls
Polls, charts, forecasts and data about upcoming elections ...

2016 National Republican ...
Polls and chart for 2016 National Republican Primary. See the ...

2016 General Election: Trump ...
Polls and chart for 2016 General Election: Trump vs. Clinton vs ...

2016 National Democratic ...
Polls and chart for 2016 National Democratic Primary. See the ...

Obama Job Approval
Polls and chart for Obama Job Approval. See the latest ...

Not for today

You can Download by Yourself

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huffpost pollster

HuffPost Pollster - Polls and Charts - Election Results
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2016 National Democratic ...
Polls and chart for 2016 National Democratic Primary. See the ...

Obama Job Approval
Polls and chart for Obama Job Approval. See the latest ...

Not for today

You can Download by Yourself

McClatchy/Marist Sep 15 – Sep 20 758 Likely Voters	41	**48**	9	2	Clinton +7

SHOW MORE ▼

RSS | CSV | CSV (Slim) | JSON | API Docs
House Effects: CSV

1. Right click on CSV
2. Save as to a preferred location

Make sure you know the location!

Attendance Survey

Get back to RStudio: Loading your Dataset

Task 1: Convert the CSV (Comma Separated Values) File into an R object.

Other datatypes can be imported similarly: e.g. read.dta, read.spss

readr package for large datasets

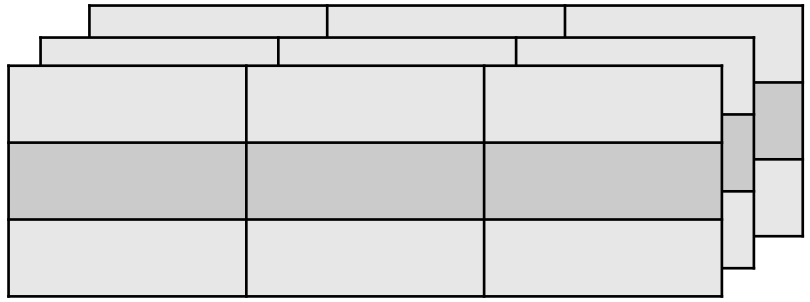
```
rm(list=ls())
## Delete your workspace
getwd()
## Check your current working directory
setwd("<location of your dataset>")
## Set your working directory
poll <- read.csv("09262016.csv")
## Load data
```

R Data Structures

Vector

Matrix

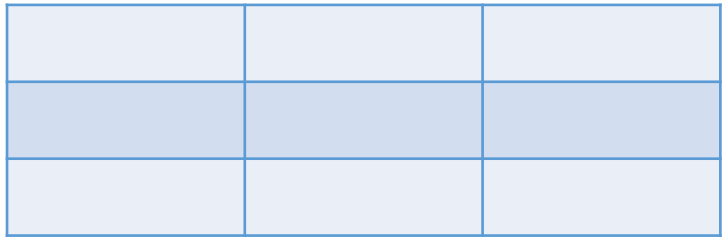
Array



Data frame

Variables with heterogeneous elements

Observations



e.g. Data frame for a poll dataset

Poll ID

Mode	DVotes	RVotes
factor	numeric value	numeric value

Quick Inspection of Poll Data Frame

Environment History Presentation

Import Dataset List

Global Environment

```
poll                    1187 obs. of 17 variables
  Pollster : Factor w/ 43 levels "ABC/Post","AP-GfK (web)",..: 42 22 22 22 …
  Start.Date : Factor w/ 227 levels "2015-05-19","2015-06-20",..: 227 227 2…
  End.Date : Factor w/ 207 levels "2015-05-26","2015-06-22",..: 207 207 207…
  Entry.Date.Time..ET. : Factor w/ 334 levels "2015-05-28T21:52:59Z",..: 33…
  Number.of.Observations: int NA 1712 621 548 543 1712 621 548 543 651 ...
  Population : Factor w/ 9 levels "Adults","Likely Voters",..: 6 2 3 5 4 2 …
  Mode : Factor w/ 5 levels "Automated Phone",..: 2 2 2 2 2 2 2 2 2 4 ...
  Trump : num 41 42 8 82 41 39 7 79 35 44 ...
  Clinton : num 44 44 84 8 33 38 80 6 23 46 ...
  Other : num 3 NA NA NA NA 4 2 1 9 1 ...
  Undecided : num 7 4 7 11 26 10 7 6 16 4 ...
  Pollster.URL : Factor w/ 334 levels "http://elections.huffingtonpost.com/…
  Source.URL : Factor w/ 306 levels " https://today.yougov.com/news/2016/06…
  Partisan : Factor w/ 3 levels "Nonpartisan",..: 1 1 1 1 1 1 1 1 1 1 ...
  Affiliation : Factor w/ 4 levels "Dem","None","Other",..: 2 2 2 2 2 2 2 2…
  Question.Text : Factor w/ 53 levels "","And if the election for President…
  Question.Iteration : int 1 1 1 1 1 2 2 2 2 1 ...
```

Quick Inspection of Poll Data Frame

```
View(poll)
## Spreadsheet-style data viewer
summary(poll)
## Summarize variables on your console
names(poll)
## Names of all variables
dim(poll)
nrow(poll)
ncol(poll)
## Dimensional information
head(poll)
tail(poll)
```

Communicating with Your Data

- How to select a specific variable of interest?: Use $

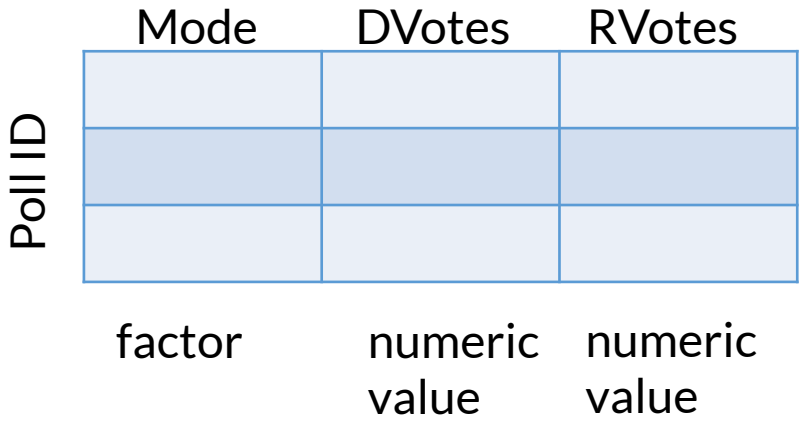
```
poll$VariableName
```

- e.g. If you want to select the Affiliation variable

```
poll$Affiliation
```

Create a Data Frame

Data frame

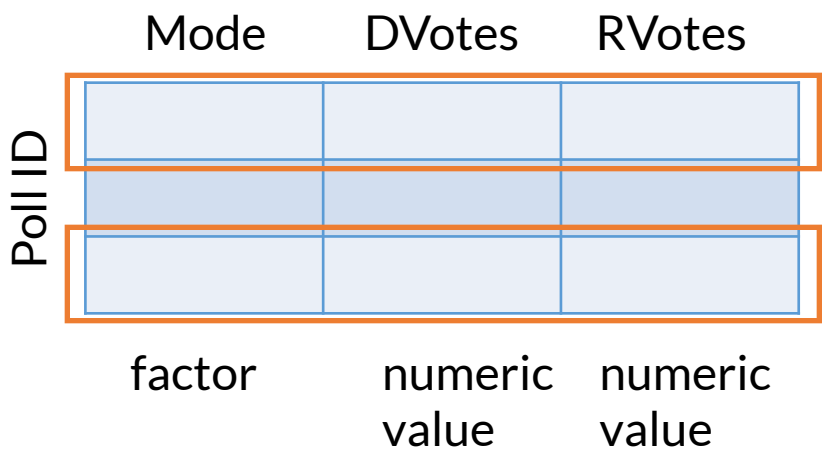


Create a data frame for **toy example**

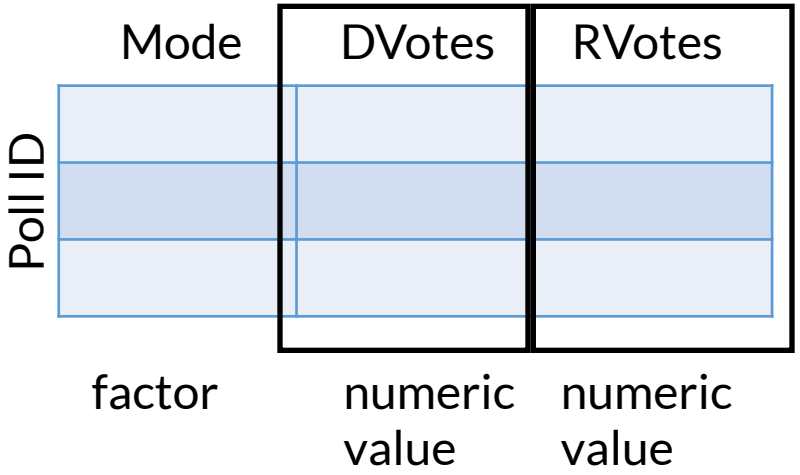
```
dfex <- data.frame(mode = c("phone","Internet","Internet"),
DVotes = c(40,50,60), RVotes = c(60,50,40))
dfex
```

Subsetting by Direct Indexing

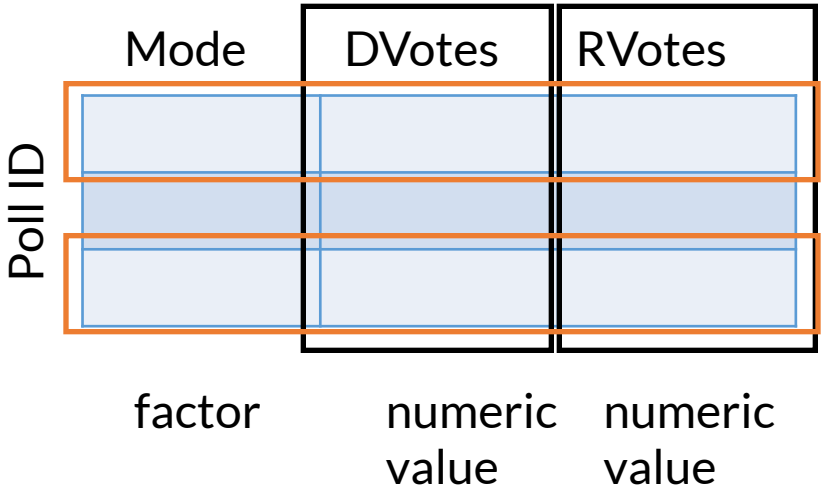
- Subsetting observations



- Subsetting variables

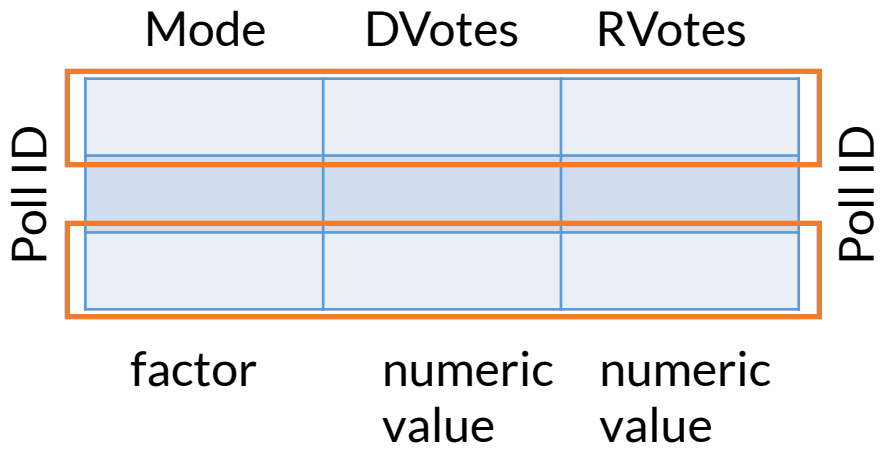


- Subsetting both



Subsetting by Direct Indexing

- Subsetting observations



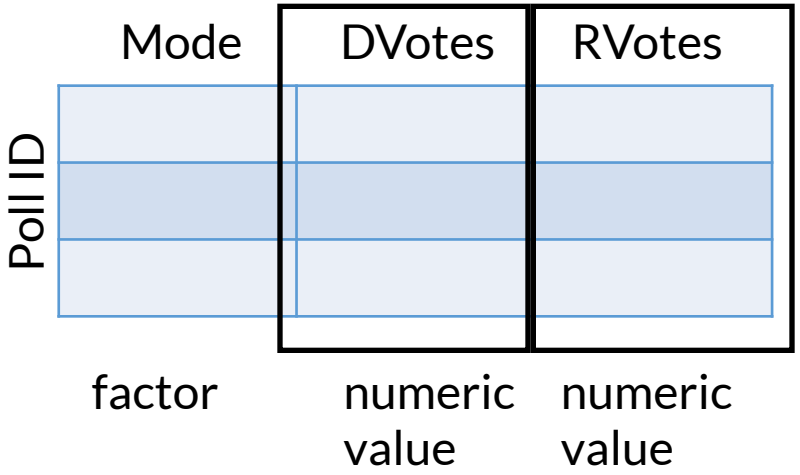

```
dfex[c(1,3),]
```

selecting rows

not selecting specific columns
= selecting all columns

Subsetting by Direct Indexing

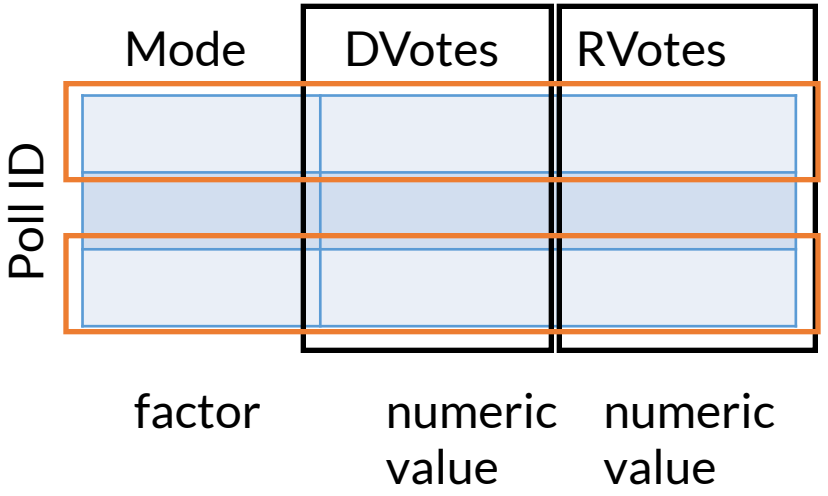
- Subsetting variables




```
dfex[,c(2,3)]
dfex[,c("DVotes","RVotes")]
```

Subsetting by Direct Indexing

- Subsetting both




```
dfex[c(1,3),c(2,3)]
dfex[c(1,3),c("DVotes","RVotes")]
```

Toy Example

Subsetting by Values

Poll ID	Mode	DVotes	RVotes
	Phone	40	60
	Internet	50	50
	Internet	60	40
	factor	numeric value	numeric value

- **DVotes>55**

Poll ID	Mode	DVotes	RVotes
	Phone	40	60
	Internet	50	50
	Internet	60	40
	factor	numeric value	numeric value

- **Mode=="Internet"**

Poll ID	Mode	DVotes	RVotes
	Phone	40	60
	Internet	50	50
	Internet	60	40
	factor	numeric value	numeric value

Logical Operators

- A list of TRUE FALSE indicators

TRUE	FALSE	TRUE

- Q) How to produce indicators under certain criteria?

Logical Operators

- Select a set of observations with a certain value: ==

```
poll$Affiliation == "Dem"
```

- Select a set of observations different from a certain value: !=

```
poll$Affiliation != "Dem"
```

- Select a set of observations with values larger/smaller than a certain value

```
poll$Clinton > 50
```

Logical Operators

- AND (&) and OR (I) operations
  - TRUE if and only if (TRUE, TRUE)

TRUE	FALSE	TRUE	&	TRUE	FALSE	FALSE	=	TRUE	FALSE	FALSE

  - TRUE if either one is TRUE: (TRUE, TRUE), (TRUE, FALSE)), (FALSE, TRUE)

TRUE	FALSE	TRUE	|	TRUE	FALSE	FALSE	=	TRUE	FALSE	TRUE

```
poll$Clinton >= 40 & poll$Clinton <= 60
```

```
poll$Affiliation == "Dem" | poll$Clinton > 50
```

Logical Operators

- By using the TRUE and FALSE indicators, you can choose a subset

e.g. `a=c(1,2,3)`

1	2	3

`a[c(TRUE,FALSE,TRUE)]`

1	2	3
TRUE	FALSE	TRUE

Index vector

1	3

e.g. `a=c(1,2,3)`

`a[a>2 | a<2]`

e.g. `a=c(1,2,3)`

`a[a!=2]`

Universal Routine

1. Select a subset with a particular trait
2. Drop/Replace the subset

Different Ways of Subsetting Data

0. Direct indexing

`a=c(1,2,3)`	1	2	3
`a[c(1,3)]`	1	3	

Different Ways of Subsetting Data

1. Logical indicator

`a=c(1,2,3)`	1	2	3
`a[a!=2]`	TRUE	FALSE	TRUE

1	3

```
test1 <- poll[poll$Clinton >= 40 & poll$Clinton <= 60,]
dim(test1)
summary(test1$Clinton)
```

Different Ways of Subsetting Data

2. subset function

```
New_Dataframe <- subset(dataframe,                    , select=                    )
```

```
test1 <- subset(poll,Clinton >= 40 & Clinton <= 60, select=c(Pollster, Clinton))
```

Subset observations

Subset variables

```
summary(test1$Clinton)
dim(test1)
names(test1)
```

Different Ways of Subsetting Data

2. subset function

```
test1 <- subset(poll,Clinton >= 40 & Clinton <= 60, select=c(Pollster,
Clinton))
summary(test1$Clinton)
dim(test1)
names(test1)
```

```
test2 <- subset(poll,Clinton >= 40 & Clinton <= 60,names(poll)!="Trump")
summary(test2$Clinton)
dim(test2)
names(test2)
```

Toy Example

Merging Data frames

Observations

ID	DVotes	RVotes

```
dfex1 <- data.frame(ID = c(1,2,3), DVotes = c(40,50,60),
RVotes = c(60,50,40))
dfex1
```

Observations

ID	mode

```
dfex2 <- data.frame(ID = c(1,3,2), mode =
c("phone","Internet","Internet"))
dfex2
```

Observations

ID	DVotes	RVotes	mode

```
dfex.total <- merge(dfex1,dfex2,by="ID")
dfex.total
```

Save Data Set

- Save a specific data structure as RData file.

```
save(poll, file="pollonly.Rdata")
dir()
```

- Save everything in the environment as RData file.

```
save.image("everything.RData")
```

- wite.csv, write.dta for exporting to other formats

Now Ready to Answer the Questions!

Question 1

- How has Clinton support rate evolved by respondent party affiliation?

poll$Population: Respondent type variable

```
summary(poll$Population)
poll_rep <- subset(poll, Population=="Likely Voters - Republican")
poll_dem <- subset(poll, Population=="Likely Voters - Democrat")
par(mfrow=c(1,2))
## 1 by 2 subplots
plot(as.Date(poll_rep$End.Date),poll_rep$Clinton, col = "red")
plot(as.Date(poll_dem$End.Date),poll_dem$Clinton, col = "blue")
## as.Date: Date operator for date variables
```

Create a Variable, Merge into Data Frame

- TrumpWin: Whether Trump won Clinton in each poll

```
TrumpWin <- (poll$Clinton < poll$Trump)
## Create an indicator variable for win/lose status
poll$TrumpWin <- TrumpWin
## Add the created variable to poll data frame
names(poll)[names(poll) == "TrumpWin"] <- "TW"
## Rename variable
```

Question 1.5

- How has Trump support (win) evolved by respondent party affiliation?

```
summary(poll$Population)
poll_rep <- subset(poll, Population=="Likely Voters - Republican")
poll_dem <- subset(poll, Population=="Likely Voters - Democrat")
par(mfrow=c(1,2))
## 1 by 2 subplots
plot(as.Date(poll_rep$End.Date),poll_rep$TW, col = "red")
## as.Date: Date operator for date variables
plot(as.Date(poll_dem$End.Date),poll_dem$TW, col = "blue")
```

Question 2

- Did partisan medias release different results from those by nonpartisan?

```
summary(poll$Affiliation)
summary(poll$Population)
poll.rep <- subset(poll, Affiliation=="Rep" & Population=="Likely Voters")
poll.dem <- subset(poll, Affiliation=="Dem" & Population=="Likely Voters")
poll.none <- subset(poll, Affiliation!="Rep" & Affiliation!="Dem" &
Population=="Likely Voters")
par(mfrow=c(1,3))
## 1 by 3 subplots
plot(as.Date(poll.rep$End.Date),poll.rep$Trump, col = "red")
plot(as.Date(poll.dem$End.Date),poll.dem$Trump, col = "blue")
plot(as.Date(poll.none$End.Date),poll.none$Trump, col = "green")
```

Question 3

What was the trend afterwards (e.g. the first debate)?

Question 3: Take Home

What was the trend afterwards (e.g. the first debate)?

You can see what happened by following the exactly same routine we did today by downloading the complete poll dataset.

1. Right click on CSV
2. Save as to a preferred location

More Interested Participants can check

https://www.rstudio.com/wp-content/uploads/2015/02/data-wrangling-cheatsheet.pdf

More Interested Participants can go to

HuffPost Pollster - Polls and Charts - Election Results
elections.huffingtonpost.com/pollster ▾ 이 페이지 번역하기
HuffPost Pollster tracks thousands of public polls to give you the latest data on elections, political opinions and more. Read our FAQ. Search all poll charts.

2016 General Election: Trump ...
Polls and chart for 2016 General Election: Trump vs. Clinton. See ...

2016 National Republican ...
Polls and chart for 2016 National Republican Primary. See the ...

2016 National Democratic ...
Polls and chart for 2016 National Democratic Primary. See the ...

polls
Polls, charts, forecasts and data about upcoming elections ...

2016 General Election: Trump ...
Polls and chart for 2016 General Election: Trump vs. Clinton vs ...

Obama Health Care Law ...
Polls and chart for Obama Health Care Law: Favor/Oppose. See ...

Poll records during the primary season

Detailed Poll Results by Demographics

YouGov | Economist/YouGov Poll
https://today.**yougov**.com/news/categories/economist/ ▾ YouGov ▾
This is a summary of a **YouGov**/Economist **Poll** conducted September 22-24, 2016. The sample is 1300 general population respondents with a Margin of Error .

Not provided in CSV format

YouGov US

Thank you