Bush 631-600: Quantitative Methods

Lecture 1 (08.30.2022): Introduction

Rotem Dvir

The Bush school of Government and Public Policy

Texas A&M University

Fall 2022

What is today's plan?

- Introductions.
- What is this class?
- Syllabus 'deep dive'.
- Programming with R.

Introductions

- Rotem Dvir: PhD in political science (Texas A&M, 2021).
- Major field: International Relations.
- Focus: International security and foreign policy.

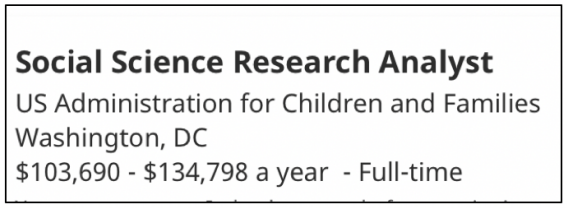
- Assistant research scientist - ISTPP, Bush School.
- Study public policy: health care, tech, critical infrastructure.
- More? Check my website (Link)

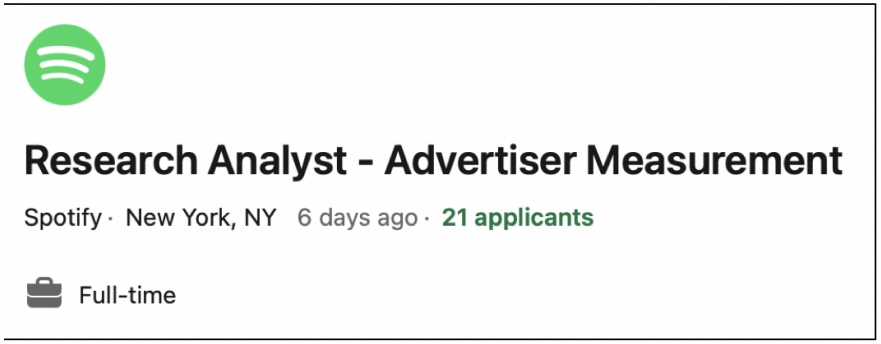
Bush 631: What are we doing here?

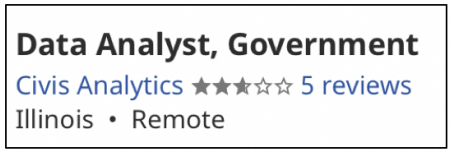
- Quantitative social science.
- Investigate social, economic and political world.

Quantitative Social Science

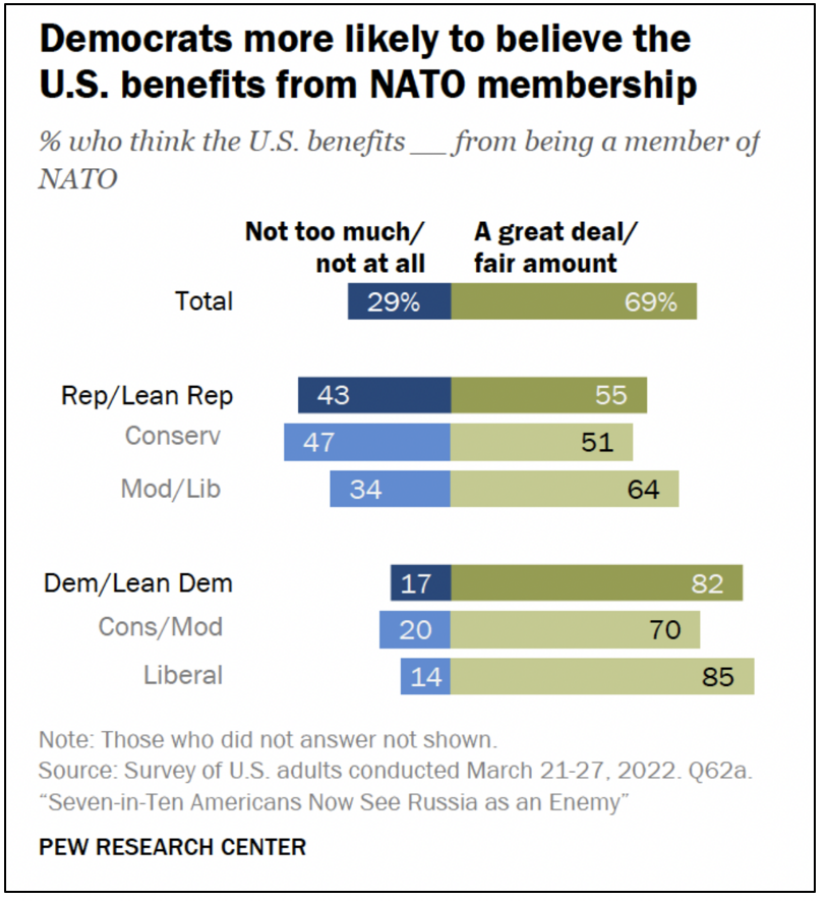
- Data science: Facebook, Twitter, Tiktok, Google
- Non-profits, government agencies: conduct policy evaluation with data.

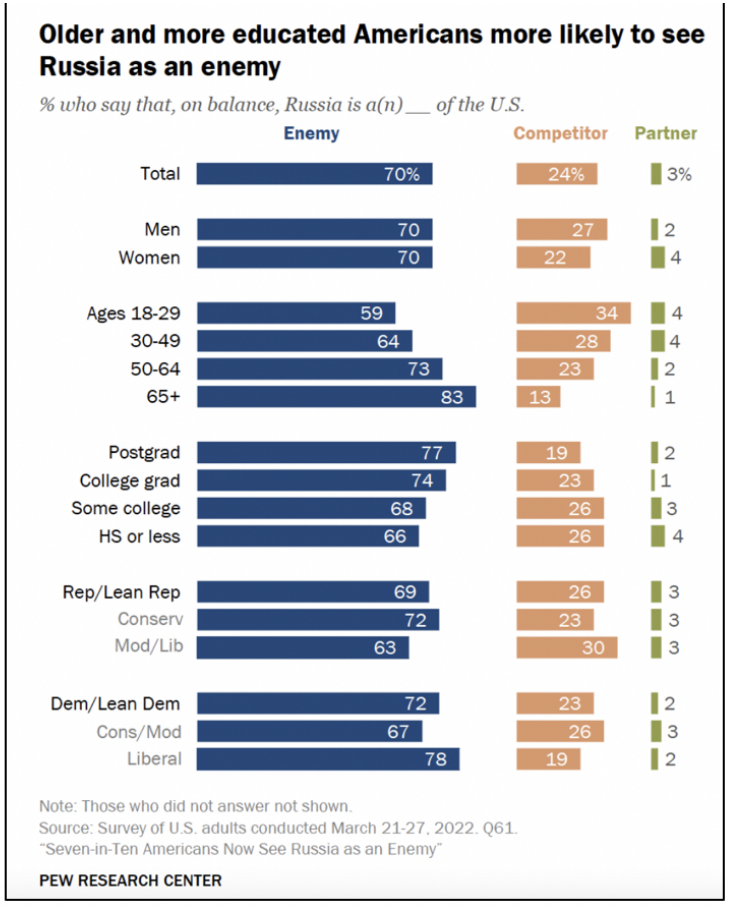






Studying global issues with data





Data driven Policymaking

Human choices research and data

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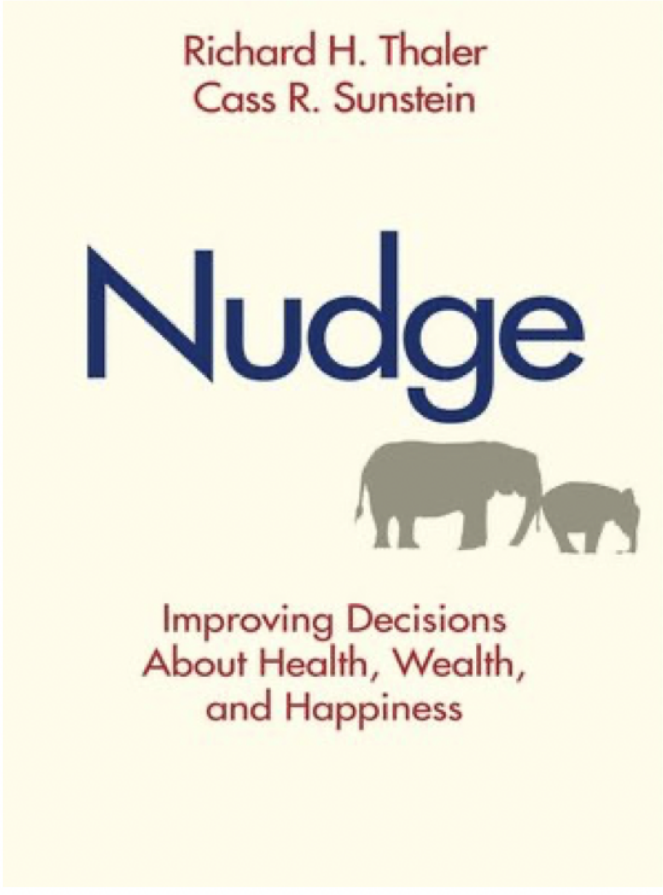
Status-quo bias

↓

Default options

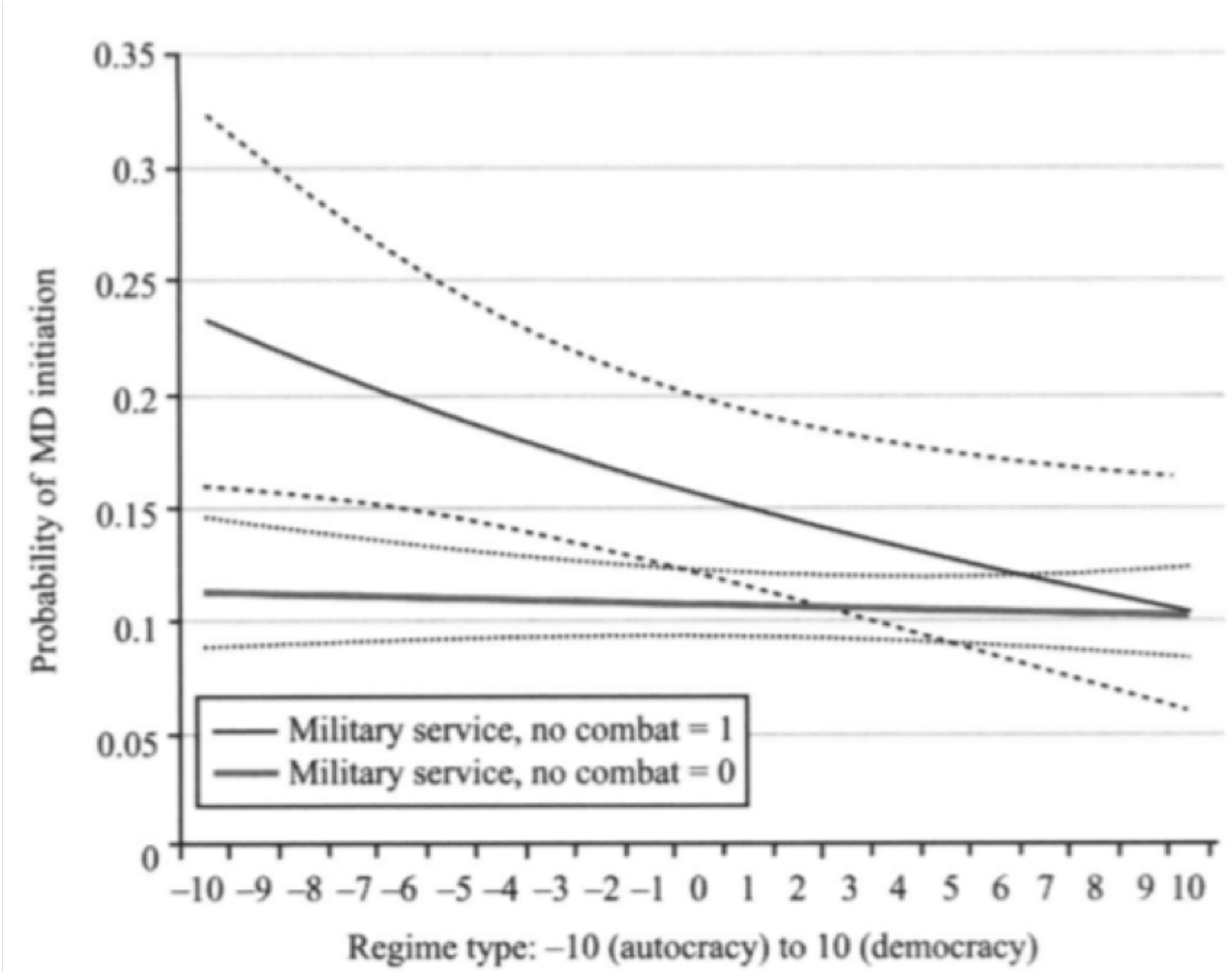
↓

Save for retirement: opt-out or opt-in?



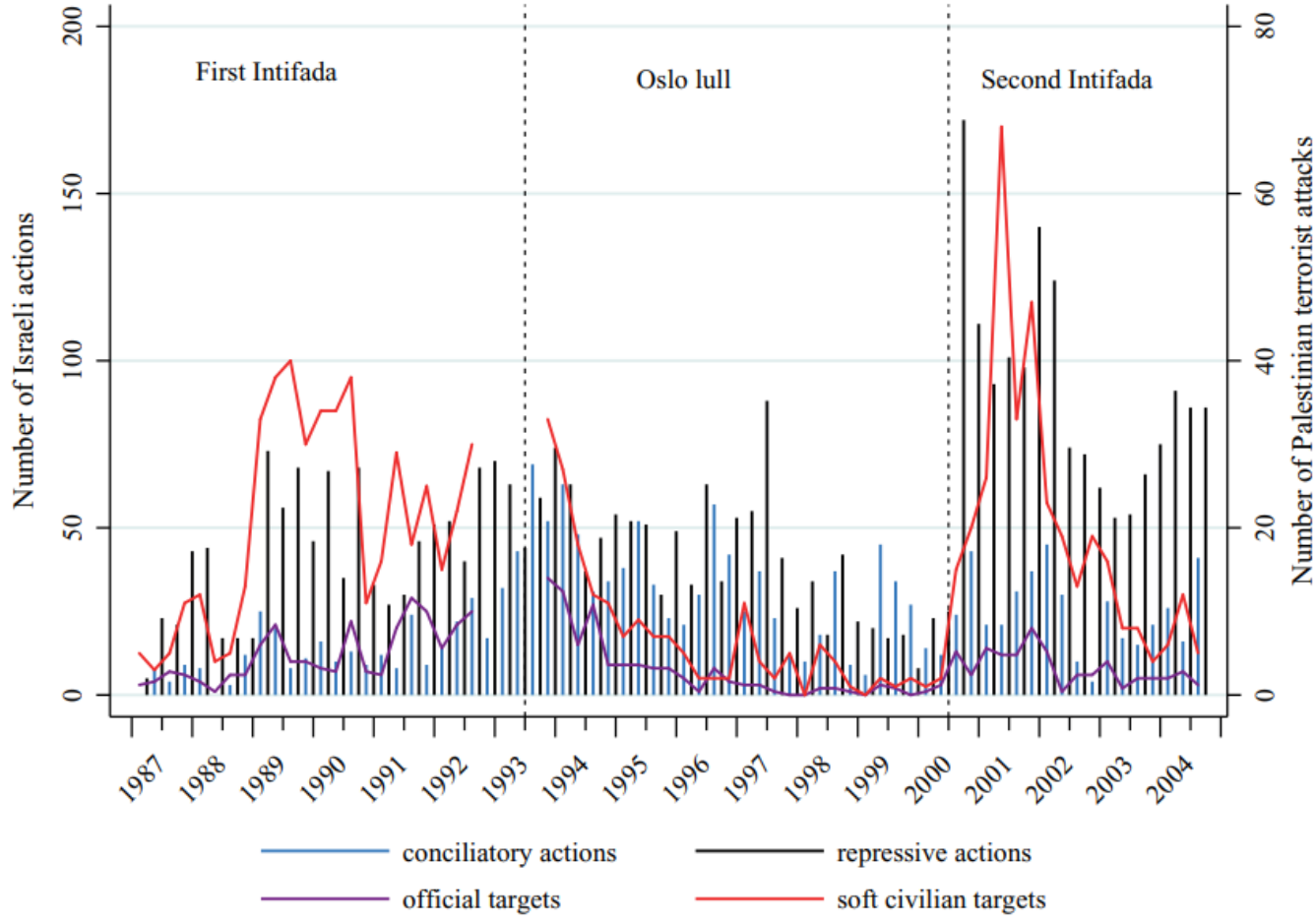
International Affairs research

- What drives the likelihood of international conflicts?
- The leaders? or the regimes?



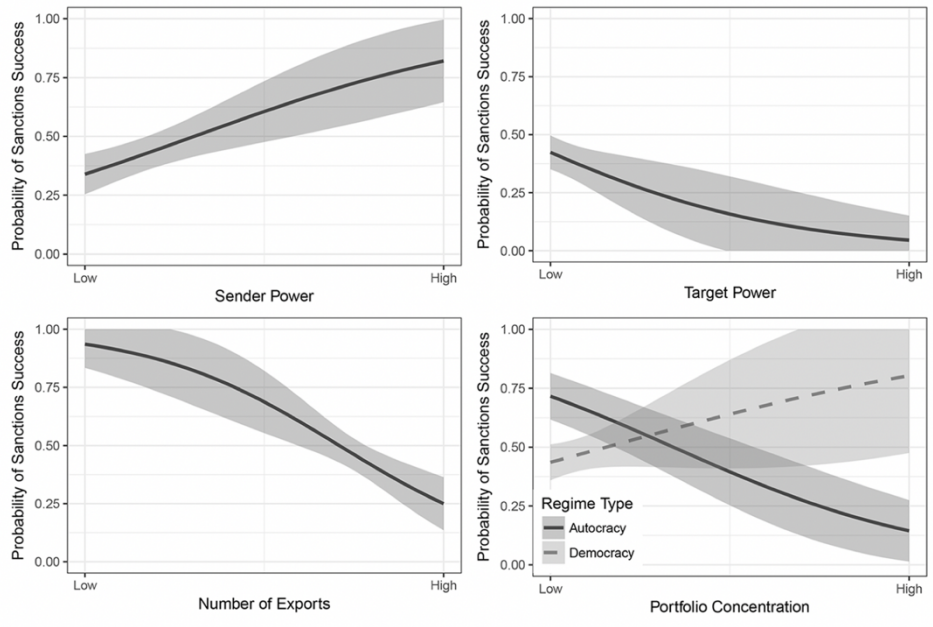
International Affairs research

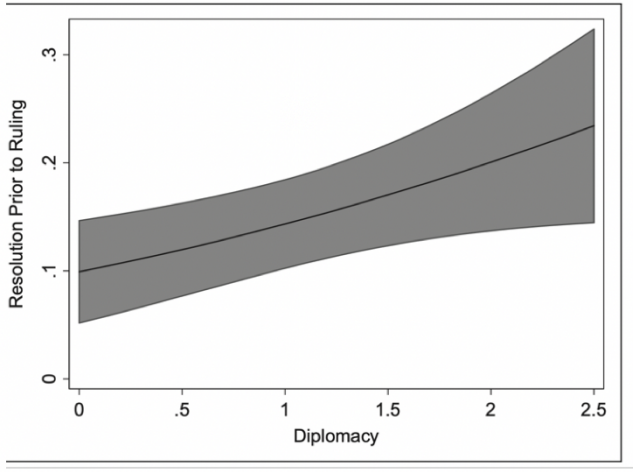
- Counter terrorism strategies and organizational responses.



International Affairs research

- Diplomacy; Political economy: global trade flows, sanctions, foreign aid.



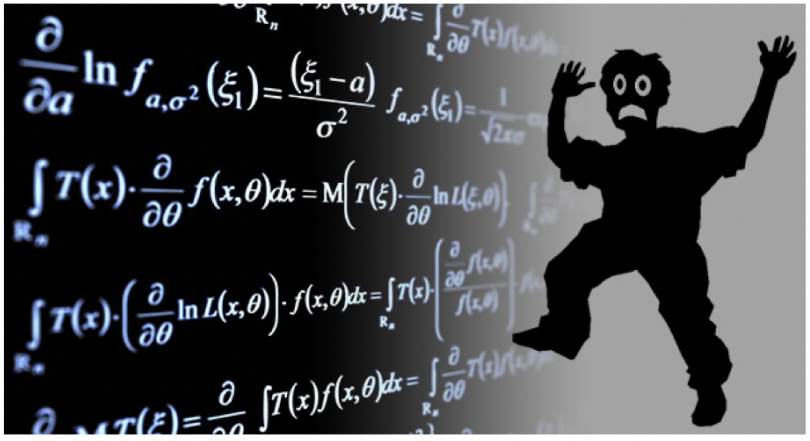


Quant methods

Study public policy with stats and math...

How many of you are here?

And here?



Quant methods

Why should I take this class?

- Skills to explore important questions:
  - Do economic sanctions work? when? why not?
  - Who support and who rejects free trade? why?
  - Why does leader decapitation limited as a counter-terrorism strategy?
- Transferable skills across industries:
  - Programming.
  - Data analysis.
  - Design social science research.
  - Writing professional docx: reports, briefs, executive summary.
  - Visualizing - plots, figures, infographics.
- You have to? :)

How are we doing it?

- Two interconnected paths:
  1. Theory and research design.
  2. Hands-on data analysis using R.

Important to remember

First - we design our research to answer the question(s)...
Then, we use programming (with R) for analysis
We end-up with (hopefully..:) relevant insights

Syllabus ‘deep dive’

Remember - it’s all in the syllabus. . .

Syllabus 'deep dive'

The essentials:

- When: Tuesdays, 4:30-7:20pm
- Where: Allen 1003

Office hours:

- Tuesday & Thursday 9:30-11:00am.
- My office: Allen 3029.
- Email, Zoom meeting.

Why office hours? Have you watched? (Link)

Syllabus 'deep dive'

Lectures:

- Be ready - read before class.
- Required readings - QSS book (all marked on syllabus).
- Recommended readings - should I read? what are they?
- Taking notes in class.
- Programming practice: HW and class assignments.

Course material and resources:

- Website: slides, R code, tasks instructions, other resources.
- Canvas: announcements, assignments, course material.
- Email if you need help.

Syllabus 'deep dive'

Attendance:

- Joint effort to learn methods.
- 5% of final grade.
- 1 unexcused absence. Then what?
- Notify me **before** you miss class.

Remember COVID???

- Please don't come to class if you're sick/tested positive.
- Follow A&M guidelines (forms, quarantine).
- University accepted excused absence.

Syllabus 'deep dive'

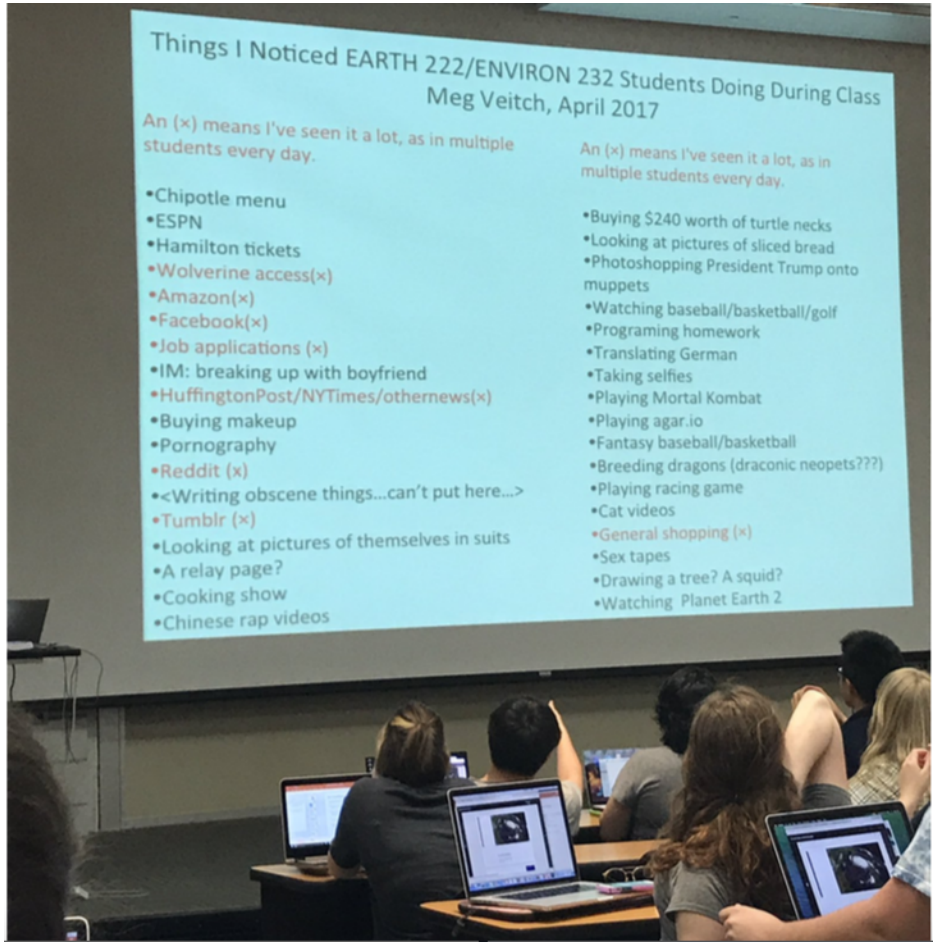
Grading and assignments:

1. Attendance (5%).
2. Home assignments (Swirl - R) (10%).
3. Research design task with R (10%).
4. Research design in class - 4 tasks (10%).
5. Course project - proposal (10%).
6. Course project - data report (15%).
7. Course project - poster/infographic (25%)
8. Course project - executive summary (10%).
9. Course project - peer review and feedback (5%).

Syllabus ‘deep dive’

Other issues:

- Make-up policy; Plagiarism.
- Electronics in class.



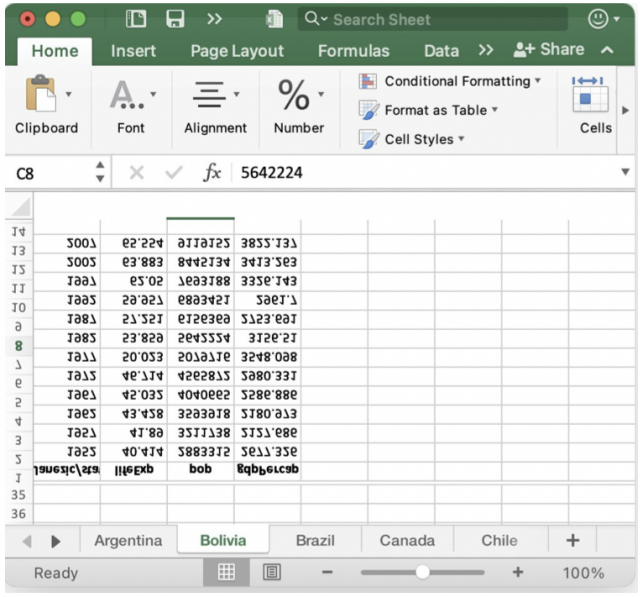
Syllabus 'deep dive'

Topics overview:

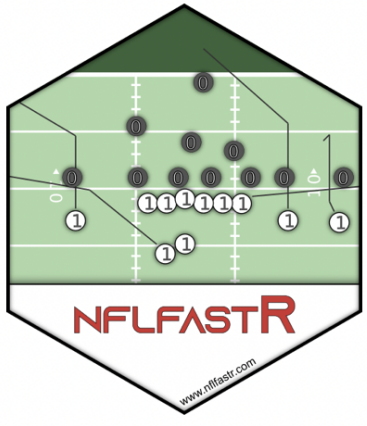
1. Introduction and R basics.
2. Causality (2 weeks).
3. Measurement (2 weeks).
4. Prediction (3 weeks).
5. Probability (2 weeks).
6. Estimation and uncertainty (3 weeks).
7. Summary.

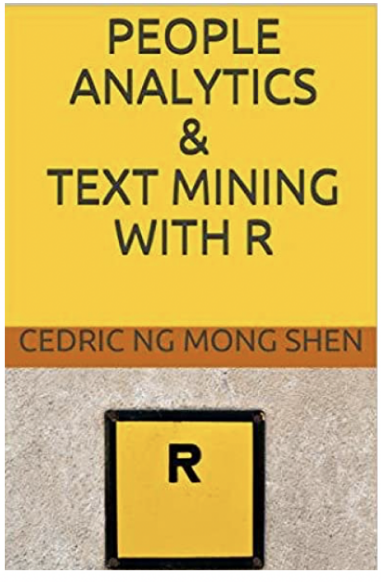
Introduction to R

- Why R, isn't excel easier?
- Well...

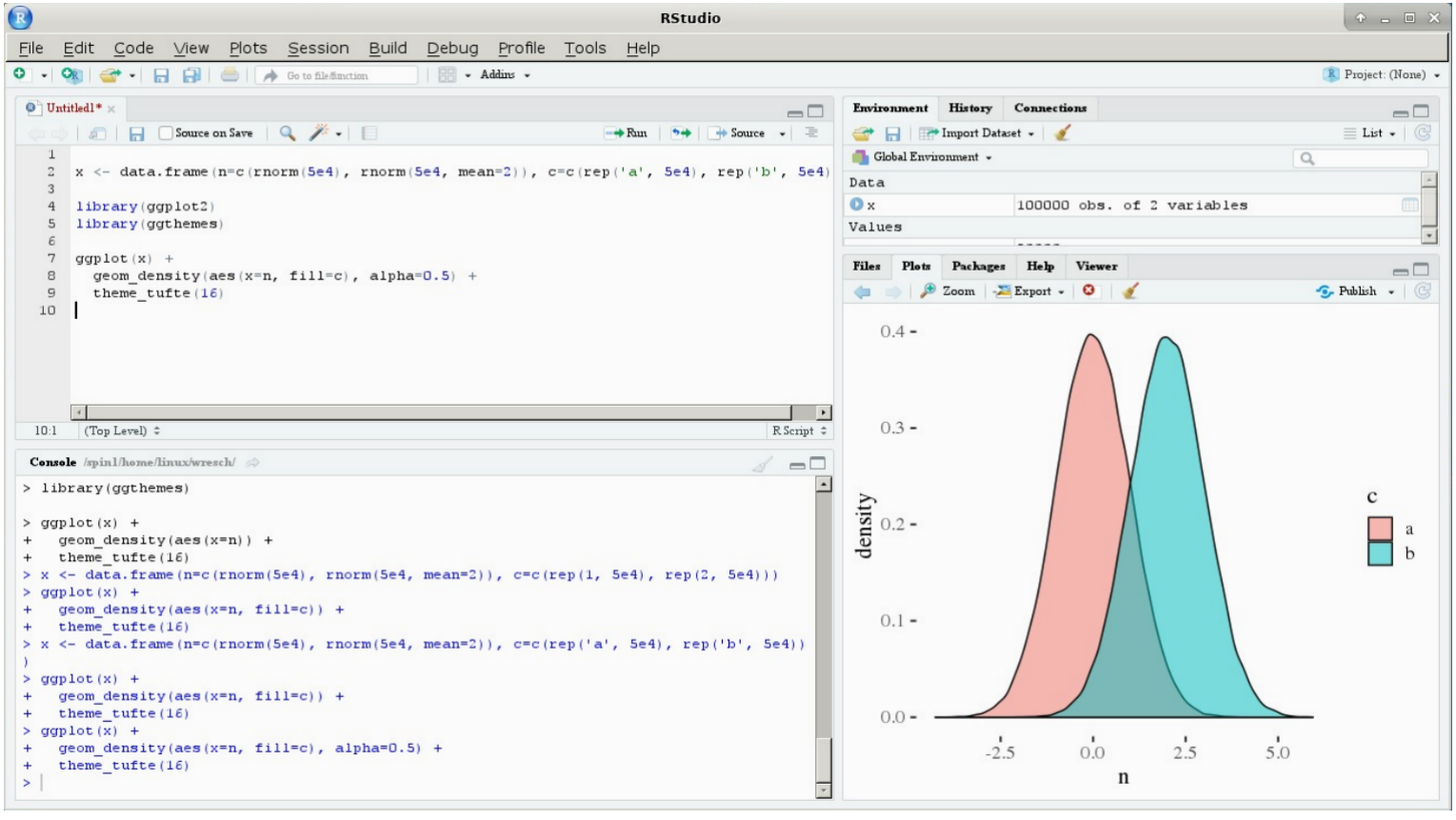


Introduction to R

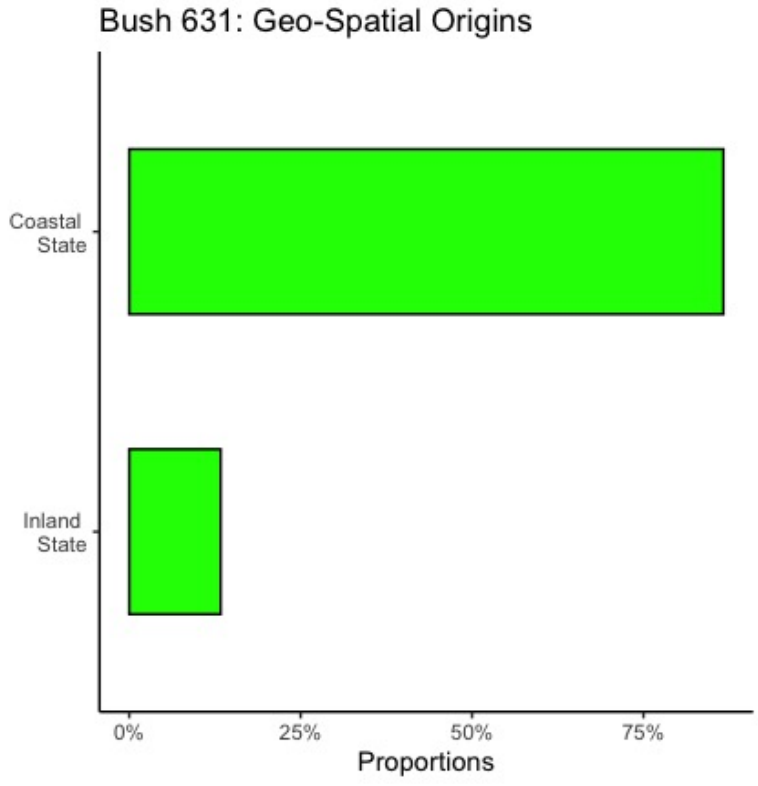


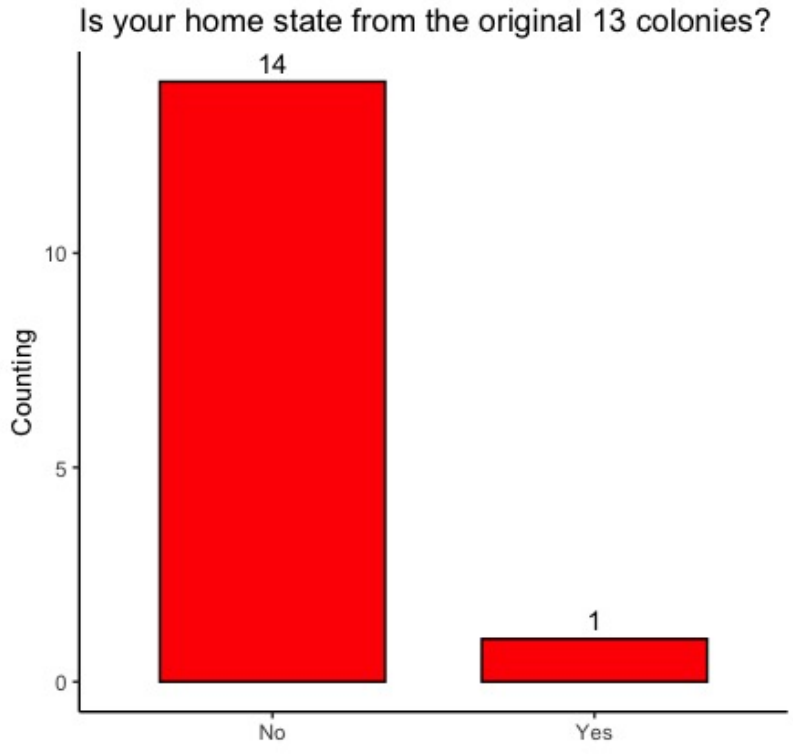


Introduction to R

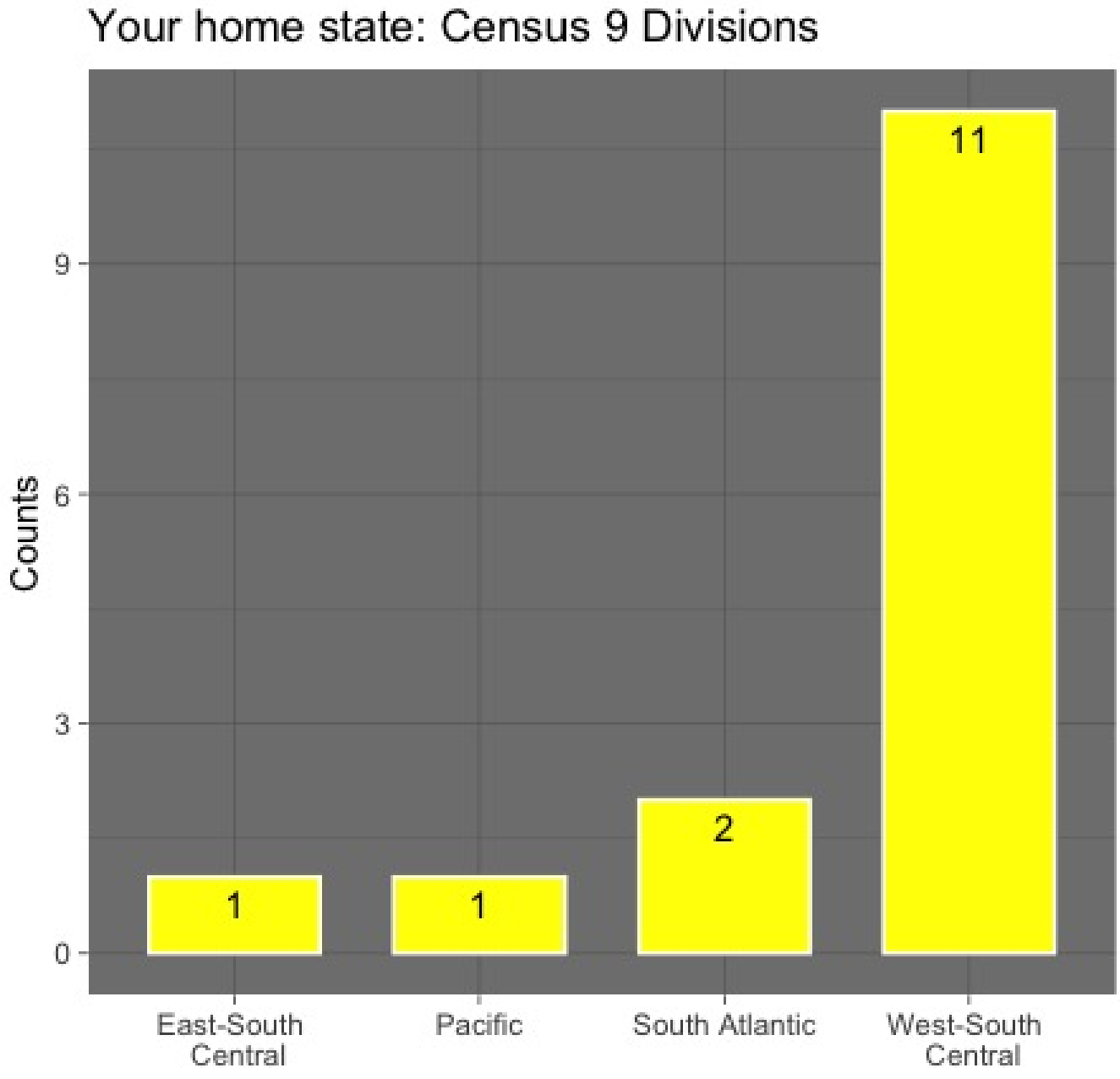


Syllabus Task with R

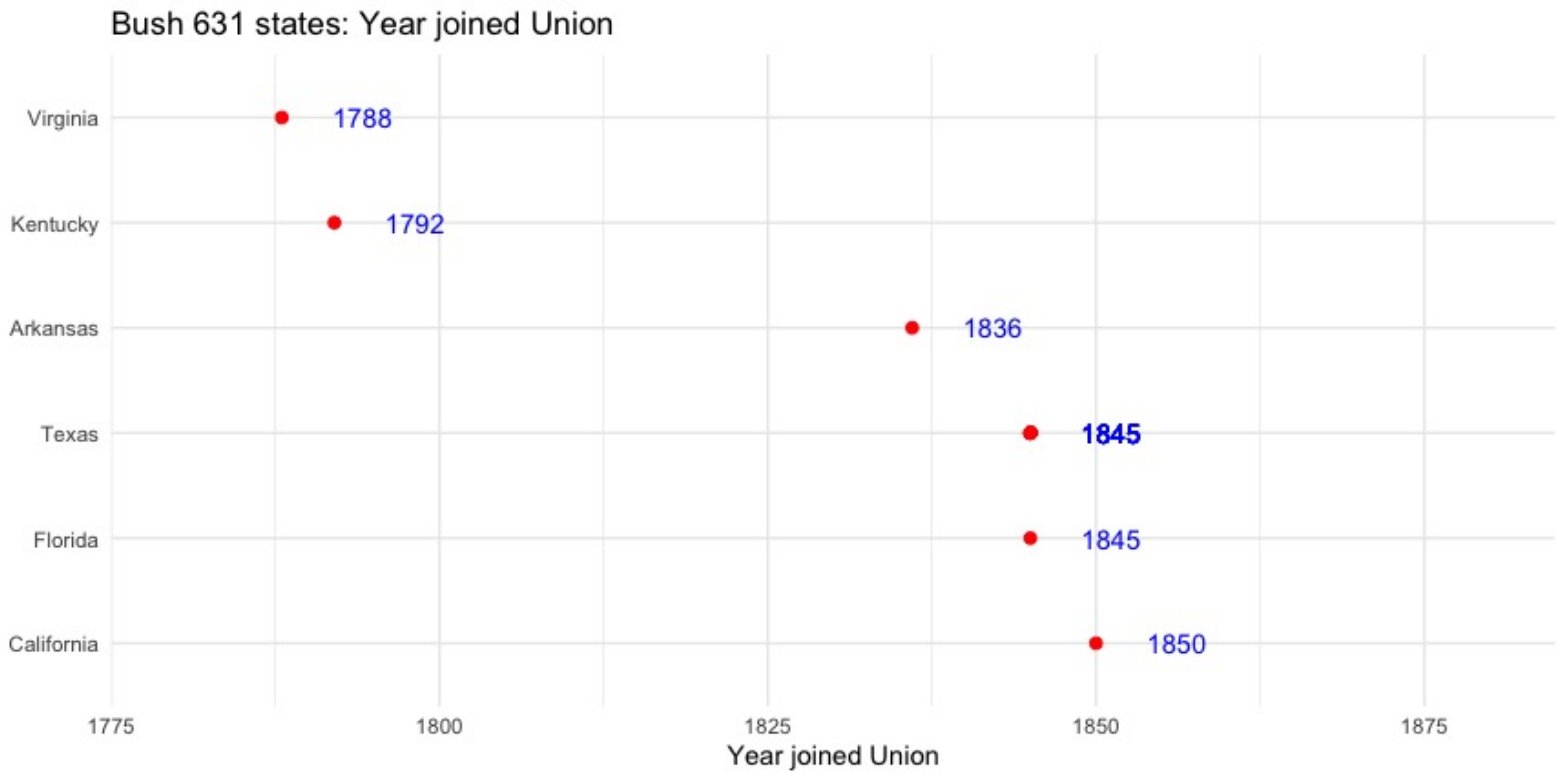




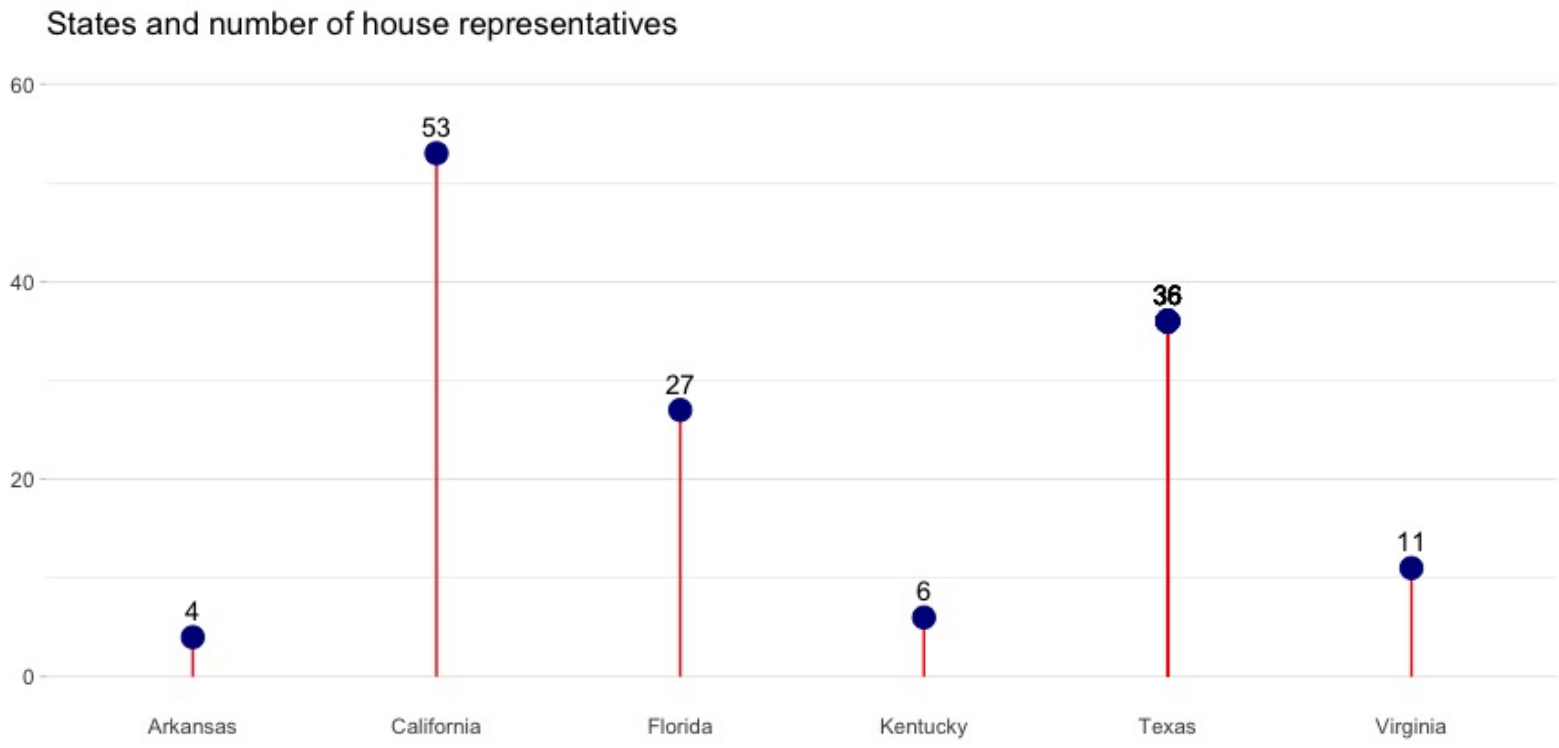
Syllabus Task with R



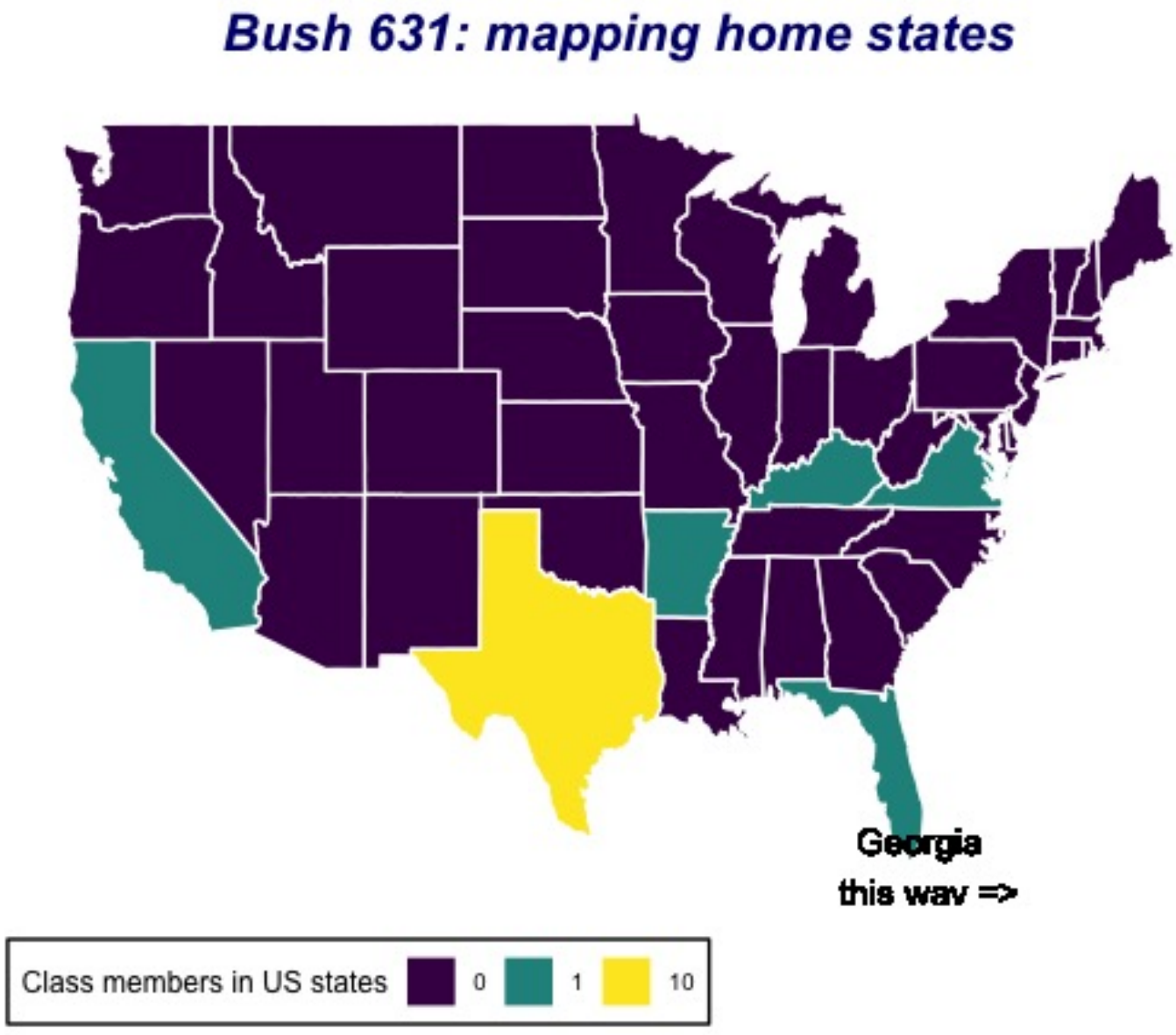
Syllabus Task with R



Syllabus Task with R



Syllabus Task with R



Programming with R

Basic math tool

```
255+345
```

```
## [1] 600
```

```
255*345
```

```
## [1] 87975
```

```
255/345
```

```
## [1] 0.7391304
```

```
345/(2*255)
```

```
## [1] 0.6764706
```

```
sqrt(255)
```

```
## [1] 15.96872
```

Programming with R

Objects: storing information (number, string)

```
number <- 5
number
```

```
## [1] 5
```

```
no_number <- "5"
no_number
```

```
## [1] "5"
```

```
letter <- "W"
letter
```

```
## [1] "W"
```

```
word <- "Aggies"
word
```

```
## [1] "Aggies"
```

Programming with R

Objects: math results

```
result <- 2+5
result
```

```
## [1] 7
```

```
sqrt(result)
```

```
## [1] 2.645751
```

Potential Errors

no_number/5
Error in no_number/5 : non-numeric argument to binary operator

Result/5
Error: object 'Result' not found

Class: category/type of object

```
class(result)
```

```
## [1] "numeric"
```

```
class(letter)
```

```
## [1] "character"
```

```
class(word)
```

```
## [1] "character"
```

```
class(sqrt)
```

```
## [1] "function"
```

Vectors: array to store data

```
v1 <- c(1,2,3,4)
v1
```

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

```
v2 <- c("A","B","C","D")
v2
```

```
## [1] "A" "B" "C" "D"
```

```
v3 <- c(11,12,13)
v_join1 <- c(v1,v2)
v_join1
```

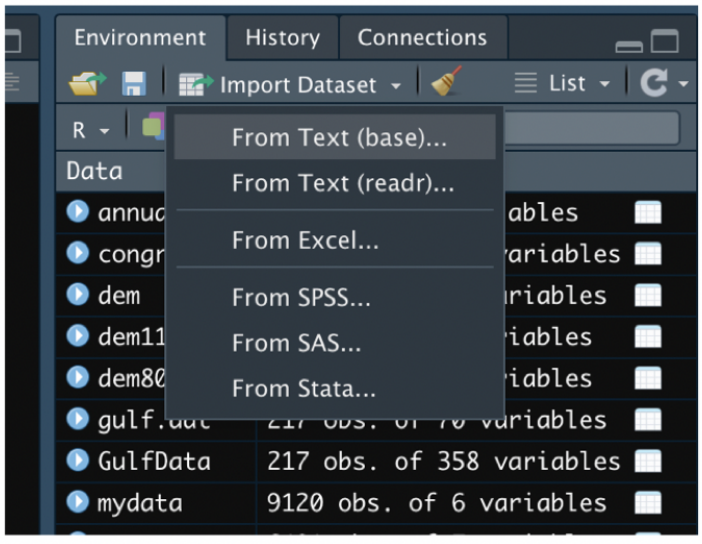
```
## [1] "1" "2" "3" "4" "A" "B" "C" "D"
```

```
v_join2 <- c(v1,v3)
v_join2
```

```
## [1]  1  2  3  4 11 12 13
```

Working with data

1) Drop-down menu



2) Direct coding

```
190 library(readxl)
191 ags <- read_excel("~/Dropbox/TAMU/Bush631_QuantMethods/ags.xlsx")
192 View(ags)
```

(a) Use the read_ function
(b) View – opens the data file for viewing

Our data

	Year	Wins	Losses	Pct	Coaching	Bowl
1	2021	8	4	0.667	Jimbo Fisher (8–4)	Gator Bowl–Did not play
2	2020	9	1	0.900	Jimbo Fisher (9–1)	Orange Bowl–W
3	2019	8	5	0.615	Jimbo Fisher (8–5)	Texas Bowl–W
4	2018	9	4	0.692	Jimbo Fisher (9–4)	Gator Bowl–W
5	2017	7	6	0.538	Jeff Banks (0–1), Kevin Sumlin (7–5)	Belk Bowl–L
6	2016	8	5	0.615	Kevin Sumlin (8–5)	Texas Bowl–L
7	2015	8	5	0.615	Kevin Sumlin (8–5)	Music City Bowl–L
8	2014	8	5	0.615	Kevin Sumlin (8–5)	Liberty Bowl–W
9	2013	9	4	0.692	Kevin Sumlin (9–4)	Chick–fil–A Bowl–W
10	2012	11	2	0.846	Kevin Sumlin (11–2)	Cotton Bowl–W
11	2011	7	6	0.538	Mike Sherman (6–6), Tim DeRuyter (1–0)	Meineke Car Care Bowl of Texas–W
12	2010	9	4	0.692	Mike Sherman (9–4)	Cotton Bowl–L
13	2009	6	7	0.462	Mike Sherman (6–7)	Independence Bowl–L
14	2008	4	8	0.333	Mike Sherman (4–8)	*NA*
15	2007	7	6	0.538	Dennis Franchione (7–6)	Alamo Bowl–L
16	2006	9	4	0.692	Dennis Franchione (9–4)	Holiday Bowl–L
17	2005	5	6	0.455	Dennis Franchione (5–6)	*NA*
18	2004	7	5	0.583	Dennis Franchione (7–5)	Cotton Bowl–L
19	2003	4	8	0.333	Dennis Franchione (4–8)	*NA*
20	2002	6	6	0.500	R.C. Slocum (6–6)	*NA*

Working with data: **Indexing**

```
ags[1,]
```

```
## # A tibble: 1 x 6
##    Year  Wins Losses   Pct Coaching           Bowl
##   <dbl> <dbl>  <dbl> <dbl> <chr>              <chr>
## 1  2021     8      4 0.667 Jimbo Fisher (8-4) Gator Bowl-Did not play
```

```
ags[,1]
```

```
## # A tibble: 119 x 1
##     Year
##    <dbl>
##  1  2021
##  2  2020
##  3  2019
##  4  2018
##  5  2017
##  6  2016
##  7  2015
##  8  2014
##  9  2013
## 10  2012
## # ... with 109 more rows
## # i Use `print(n = ...)` to see more rows
```

Working with data: **Indexing**

```
ags[c(1,2,4),]
```

```
## # A tibble: 3 x 6
##    Year  Wins Losses   Pct Coaching           Bowl
##   <dbl> <dbl>  <dbl> <dbl> <chr>              <chr>
## 1  2021     8      4 0.667 Jimbo Fisher (8-4) Gator Bowl-Did not play
## 2  2020     9      1 0.9   Jimbo Fisher (9-1) Orange Bowl-W
## 3  2018     9      4 0.692 Jimbo Fisher (9-4) Gator Bowl-W
```

```
ags[1:3]
```

```
## # A tibble: 119 x 3
##     Year  Wins Losses
##    <dbl> <dbl>  <dbl>
##  1  2021     8      4
##  2  2020     9      1
##  3  2019     8      5
##  4  2018     9      4
##  5  2017     7      6
##  6  2016     8      5
##  7  2015     8      5
##  8  2014     8      5
##  9  2013     9      4
## 10  2012    11      2
## # ... with 109 more rows
## # i Use `print(n = ...)` to see more rows
```

Working with data: **Indexing**

```
ags[c("Coaching")]
```

```
## # A tibble: 119 x 1
##    Coaching
##    <chr>
##  1 Jimbo Fisher (8-4)
##  2 Jimbo Fisher (9-1)
##  3 Jimbo Fisher (8-5)
##  4 Jimbo Fisher (9-4)
##  5 Jeff Banks (0-1), Kevin Sumlin (7-5)
##  6 Kevin Sumlin (8-5)
##  7 Kevin Sumlin (8-5)
##  8 Kevin Sumlin (8-5)
##  9 Kevin Sumlin (9-4)
## 10 Kevin Sumlin (11-2)
## # ... with 109 more rows
## # i Use `print(n = ...)` to see more rows
```

```
ags[1:10, c("Year","Bowl")]
```

```
## # A tibble: 10 x 2
##     Year Bowl
##    <dbl> <chr>
##  1  2021 Gator Bowl-Did not play
##  2  2020 Orange Bowl-W
##  3  2019 Texas Bowl-W
##  4  2018 Gator Bowl-W
##  5  2017 Belk Bowl-L
##  6  2016 Texas Bowl-L
##  7  2015 Music City Bowl-L
##  8  2014 Liberty Bowl-W
##  9  2013 Chick-fil-A Bowl-W
## 10  2012 Cotton Bowl-W
```

Working with data: *using the $ sign*

```
ags$Year[5]
```

```
## [1] 2017
```

```
ags$Coaching[1:5]
```

```
## [1] "Jimbo Fisher (8-4)"
## [2] "Jimbo Fisher (9-1)"
## [3] "Jimbo Fisher (8-5)"
## [4] "Jimbo Fisher (9-4)"
## [5] "Jeff Banks (0-1), Kevin Sumlin (7-5)"
```

Math operations and data vectors

```
ags_win_p <- ags$Pct * 100

ags_win_p
```

```
##   [1]  66.7  90.0  61.5  69.2  53.8  61.5  61.5  61.5  69.2  84.6  53.8  69.2
##  [13]  46.2  33.3  53.8  69.2  45.5  58.3  33.3  50.0  66.7  58.3  66.7  78.6
##  [25]  69.2  50.0  75.0  95.5  83.3  92.3  83.3  73.1  66.7  58.3  83.3  75.0
##  [37]  83.3  54.5  50.0  45.5  58.3  36.4  54.5  66.7  66.7  83.3  83.3  72.7
##  [49]  45.5  27.3  45.5  18.2  30.0  30.0  63.6  45.0  30.0  10.0  25.0  30.0
##  [61]  45.0  25.0  30.0  40.0  72.7  95.0  75.0  10.0  45.0  35.0  60.0  63.6
##  [73]  15.0   5.0  35.0  40.0  60.0  63.6  75.0  45.0  81.8  90.0 100.0  50.0
##  [85]  66.7  70.8  30.0  27.3  65.0  50.0  70.0  22.2  55.6  55.0  94.4  61.1
##  [97]  83.3  75.0  61.1  55.6  77.8  81.3 100.0  85.7 100.0  66.7  75.0  81.3
## [109]  44.4  88.9  85.7  88.9  93.8  37.5  81.3  85.7  77.8  66.7  68.2
```

Functions

Multiple functions for data summary:

- length (of vector)
- min & max values (for the whole vector)
- mean
- range
- sum

Functions: code examples

```
length(ags)
```

```
## [1] 6
```

```
min(ags$Losses)
```

```
## [1] 0
```

```
max(ags$Wins)
```

```
## [1] 12
```

```
mean(ags$Wins)
```

```
## [1] 6.252101
```

```
mean(ags$Pct)
```

```
## [1] 0.6058151
```

```
range(ags$Wins)
```

```
## [1]  0 12
```

```
range(ags$Coaching)
```

```
## [1] "Bear Bryant (1-9)"    "Walter Bachman (7-2)"
```

```
sum(ags$Wins) / length(ags$Wins)
```

```
## [1] 6.252101
```

Functions: code examples

```
sec <- seq(from = 2012, to = 2021, by = 1)
sec_coach <- ags$Coaching[10:1]
names(sec_coach) <- sec
sec_coach
```

```
##                                2012                                2013
##                "Kevin Sumlin (11-2)"               "Kevin Sumlin (9-4)"
##                                2014                                2015
##                 "Kevin Sumlin (8-5)"               "Kevin Sumlin (8-5)"
##                                2016                                2017
##                 "Kevin Sumlin (8-5)" "Jeff Banks (0-1), Kevin Sumlin (7-5)"
##                                2018                                2019
##                 "Jimbo Fisher (9-4)"               "Jimbo Fisher (8-5)"
##                                2020                                2021
##                 "Jimbo Fisher (9-1)"               "Jimbo Fisher (8-4)"
```

Functions: do-it-yourself

```
# my function: input = number of wins; output ??
jimbo.summary <- function(x){
  total_w <- sum(x)
  avg_w <- mean(x)
  most_w <- max(x)
  out <- c(total_w,avg_w,most_w)
  names(out) <- c("total wins","avergae # wins","most wins")
  return(out)
}
```

My *jimbo* function: the output

```
# a vector with Jimbo's number of wins in Aggieland
jimbo <- c(8,9,8,9)

# Run the function
jimbo.summary(jimbo)
```

```
##     total wins avergae # wins       most wins
##           34.0             8.5             9.0
```

Our Aggie data

```
names(ags)
```

```
## [1] "Year"     "Wins"     "Losses"   "Pct"      "Coaching" "Bowl"
```

```
nrow(ags)
```

```
## [1] 119
```

```
ncol(ags)
```

```
## [1] 6
```

```
dim(ags)
```

```
## [1] 119   6
```

Our Aggie data

```
summary(ags)
```

```
##       Year           Wins            Losses           Pct        
##  Min.   :1903   Min.   : 0.000   Min.   :0.000   Min.   :0.0500  
##  1st Qu.:1932   1st Qu.: 4.000   1st Qu.:2.000   1st Qu.:0.4550  
##  Median :1962   Median : 6.000   Median :4.000   Median :0.6360  
##  Mean   :1962   Mean   : 6.252   Mean   :4.017   Mean   :0.6058  
##  3rd Qu.:1992   3rd Qu.: 8.000   3rd Qu.:6.000   3rd Qu.:0.7640  
##  Max.   :2021   Max.   :12.000   Max.   :9.000   Max.   :1.0000  
##    Coaching             Bowl          
##  Length:119         Length:119         
##  Class :character   Class :character   
##  Mode  :character   Mode  :character   
##                                        
##                                        
##
```

Working with datafiles: **Indexing**

```
ags[1:5, "Wins"]
```

```
## # A tibble: 5 x 1
##    Wins
##   <dbl>
## 1     8
## 2     9
## 3     8
## 4     9
## 5     7
```

```
ags[c(1:5),]
```

```
## # A tibble: 5 x 6
##    Year  Wins Losses   Pct Coaching                           Bowl
##   <dbl> <dbl>  <dbl> <dbl> <chr>                              <chr>
## 1  2021     8      4 0.667 Jimbo Fisher (8-4)                 Gator Bowl-Did ~
## 2  2020     9      1 0.9   Jimbo Fisher (9-1)                 Orange Bowl-W
## 3  2019     8      5 0.615 Jimbo Fisher (8-5)                 Texas Bowl-W
## 4  2018     9      4 0.692 Jimbo Fisher (9-4)                 Gator Bowl-W
## 5  2017     7      6 0.538 Jeff Banks (0-1), Kevin Sumlin (7-5) Belk Bowl-L
```

Working with data: the $ sign and Indexing

```
ags$Coaching[seq(from = 1, to = nrow(ags), by = 3)]
```

```
##  [1] "Jimbo Fisher (8-4)"      "Jimbo Fisher (9-4)"
##  [3] "Kevin Sumlin (8-5)"      "Kevin Sumlin (11-2)"
##  [5] "Mike Sherman (6-7)"      "Dennis Franchione (9-4)"
##  [7] "Dennis Franchione (4-8)" "R.C. Slocum (7-5)"
##  [9] "R.C. Slocum (9-4)"       "R.C. Slocum (10-0-1)"
## [11] "R.C. Slocum (10-2)"      "Jackie Sherrill (7-5)"
## [13] "Jackie Sherrill (10-2)"  "Jackie Sherrill (5-6)"
## [15] "Tom Wilson (6-5)"        "Emory Bellard (10-2)"
## [17] "Emory Bellard (5-6)"     "Gene Stallings (2-9)"
## [19] "Gene Stallings (7-4)"    "Hank Foldberg (1-9)"
## [21] "Jim Myers (4-5-1)"       "Jim Myers (4-6)"
## [23] "Bear Bryant (7-2-1)"     "Ray George (3-6-1)"
## [25] "Harry Stiteler (1-8-1)"  "Homer Norton (4-6)"
## [27] "Homer Norton (7-2-1)"    "Homer Norton (9-1)"
## [29] "Homer Norton (5-2-2)"    "Homer Norton (2-7-2)"
## [31] "Madison Bell (7-3)"      "Dana Bible (5-4-1)"
## [33] "Dana Bible (7-1-1)"      "Dana Bible (5-4)"
## [35] "Dana Bible (10-0)"       "E.H. Harlan (6-3)"
## [37] "Charley Moran (3-4-2)"   "Charley Moran (8-1)"
## [39] "L.L. Larson (6-1-1)"     "J.E. Platt (4-2)"
```

Working with data: missing values

	Year	Wins	Losses	Pct	Coaching	Bowl
25	1996	6	6	0.500	R.C. Slocum (6–6)	*NA*
26	1995	9	3	0.750	R.C. Slocum (9–3)	Alamo Bowl–W
27	1994	10	0	0.955	R.C. Slocum (10–0–1)	*NA*
28	1993	10	2	0.833	R.C. Slocum (10–2)	Cotton Bowl–L
29	1992	12	1	0.923	R.C. Slocum (12–1)	Cotton Bowl–L
30	1991	10	2	0.833	R.C. Slocum (10–2)	Cotton Bowl–L
31	1990	9	3	0.731	R.C. Slocum (9–3–1)	Holiday Bowl–W
32	1989	8	4	0.667	R.C. Slocum (8–4)	Sun Bowl–L
33	1988	7	5	0.583	Jackie Sherrill (7–5)	*NA*
34	1987	10	2	0.833	Jackie Sherrill (10–2)	Cotton Bowl–W
35	1986	9	3	0.750	Jackie Sherrill (9–3)	Cotton Bowl–L
36	1985	10	2	0.833	Jackie Sherrill (10–2)	Cotton Bowl–W
37	1984	6	5	0.545	Jackie Sherrill (6–5)	*NA*
38	1983	5	5	0.500	Jackie Sherrill (5–5–1)	*NA*

How to deal with NAs?

```
# create vector of values 1-10, add NA to it
mis_vec <- c(1:10,NA)
mis_vec
```

```
##  [1]  1  2  3  4  5  6  7  8  9 10 NA
```

```
# calculate mean of vector
mean(mis_vec)
```

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

```
# better...
mean(mis_vec, na.rm = TRUE)
```

```
## [1] 5.5
```

Saving

Coding:

- We use script files - reproducing code.
- Save with the menu / disk sign on RStudio.
- File extension (name.R) is saved in your preferred directory.

Data files:

- If we changed the data, we can save the edited file.
- Use menu (save as. . .).
- Code: write.csv(file_name, “selected_name.csv”)
- Data is saved in your preferred directory.

Packages

- Essential component of programming in R.
- User-generated 'stacks' of code/data.

- Free to download.

- Must be uploaded prior to use:
  - use the *library(package_name)* command.

Wrapping up week 1

Summary:

- What is Bush631?
- Why do I need to learn stats and research methods?
- Syllabus 'deep dive'.
- Intro to R: objects, vectors, functions, using data.

Homework assignments

Swirl tasks:

- Short practice of using R.
- Completed in RStudio **console**.
- Not sure how to answer? check the book.
- Submit **lessons 1-3 before** next class:

1. Basic Building Blocks.
2. Workspace and Files
3. Sequences of Numbers

Swirl task submit - how?

For each lesson ↓