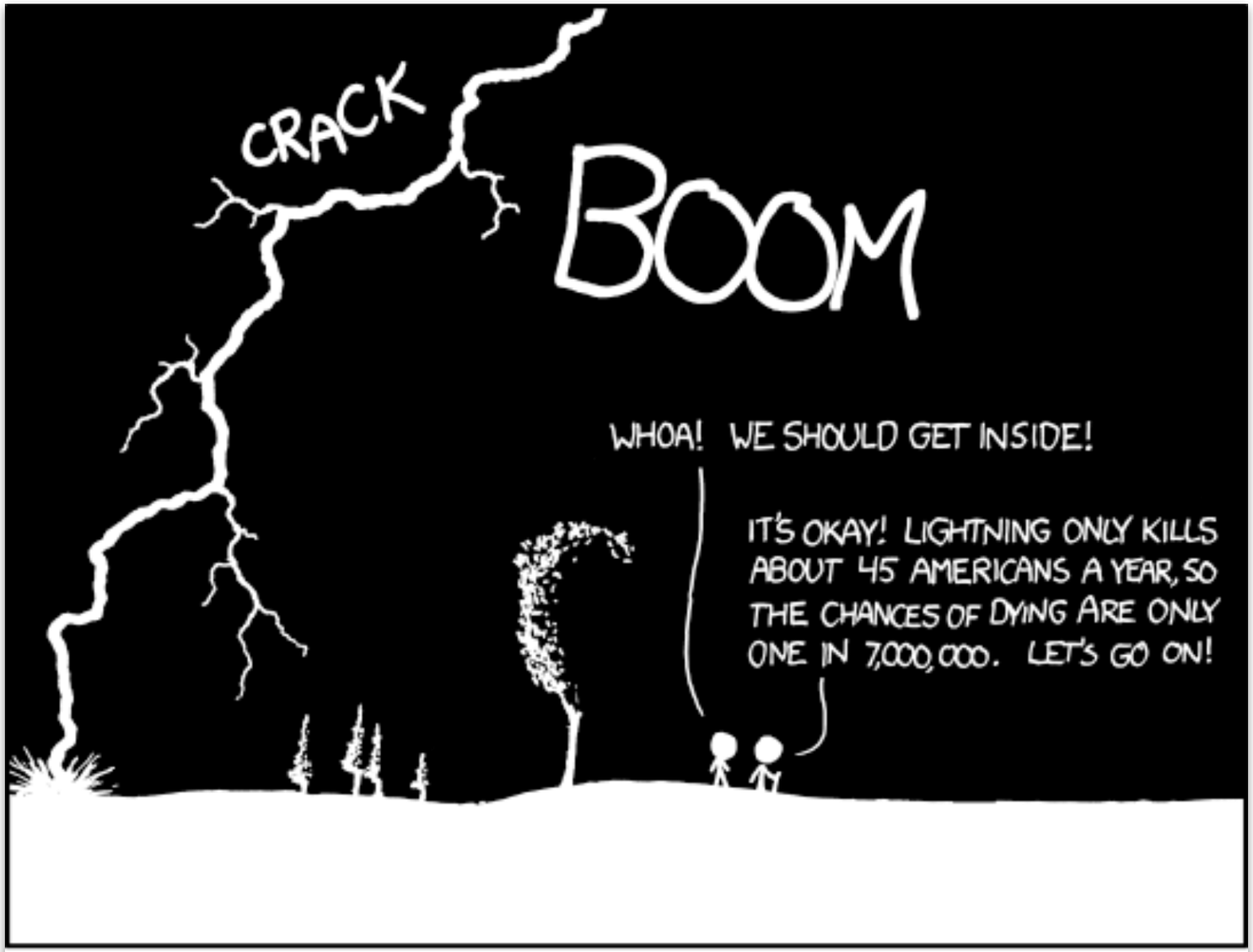
PSYCH 252: Statistical Methods for Behavioral and Social Sciences

Introduction



xkcd

01/07/2019

Outline

- Introduction
- **What** will we learn?
- **How** will we learn?
- Some general thoughts
- Feedback

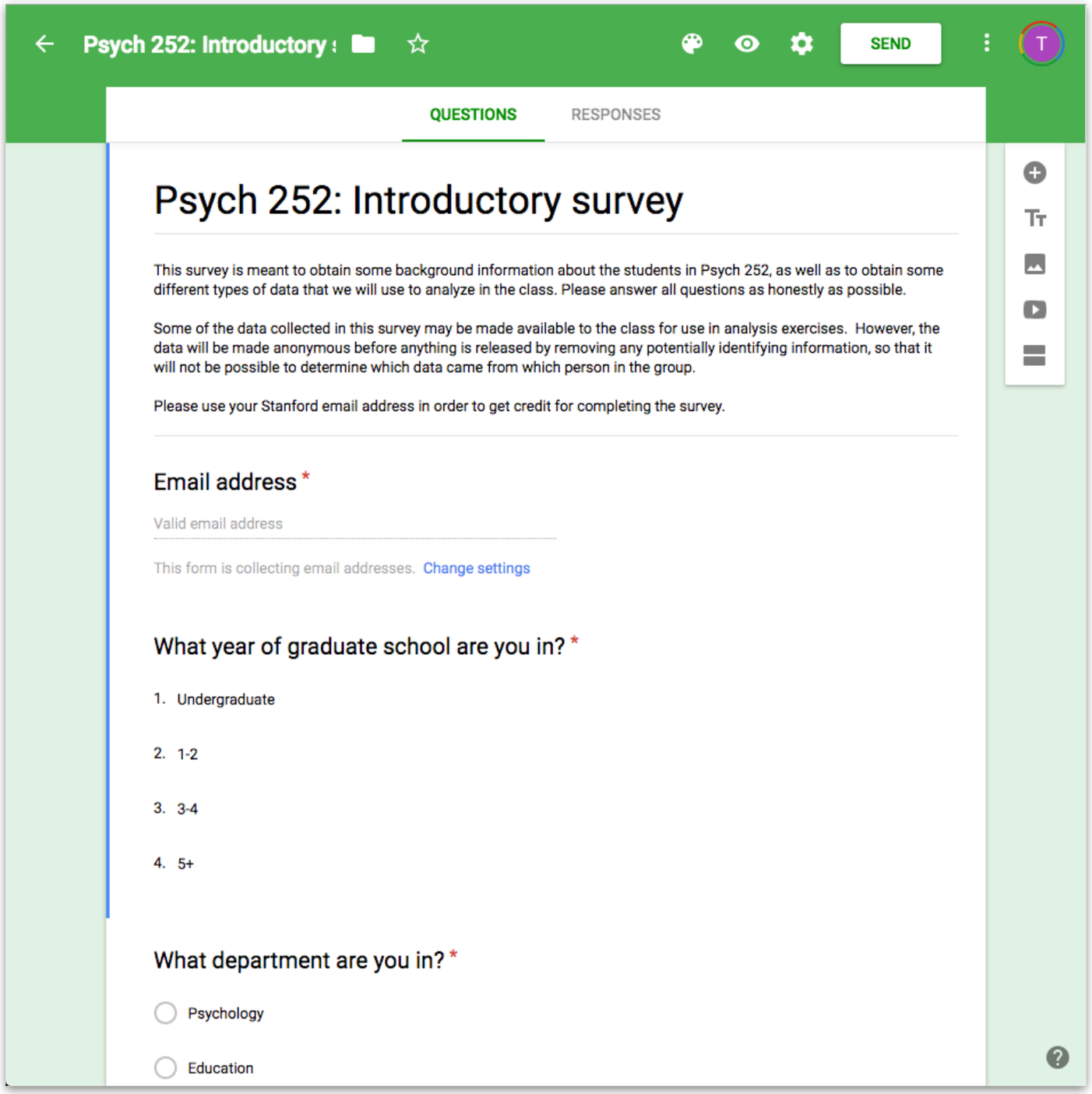
Introduction

Introduction

1. What did you do during the winter break?

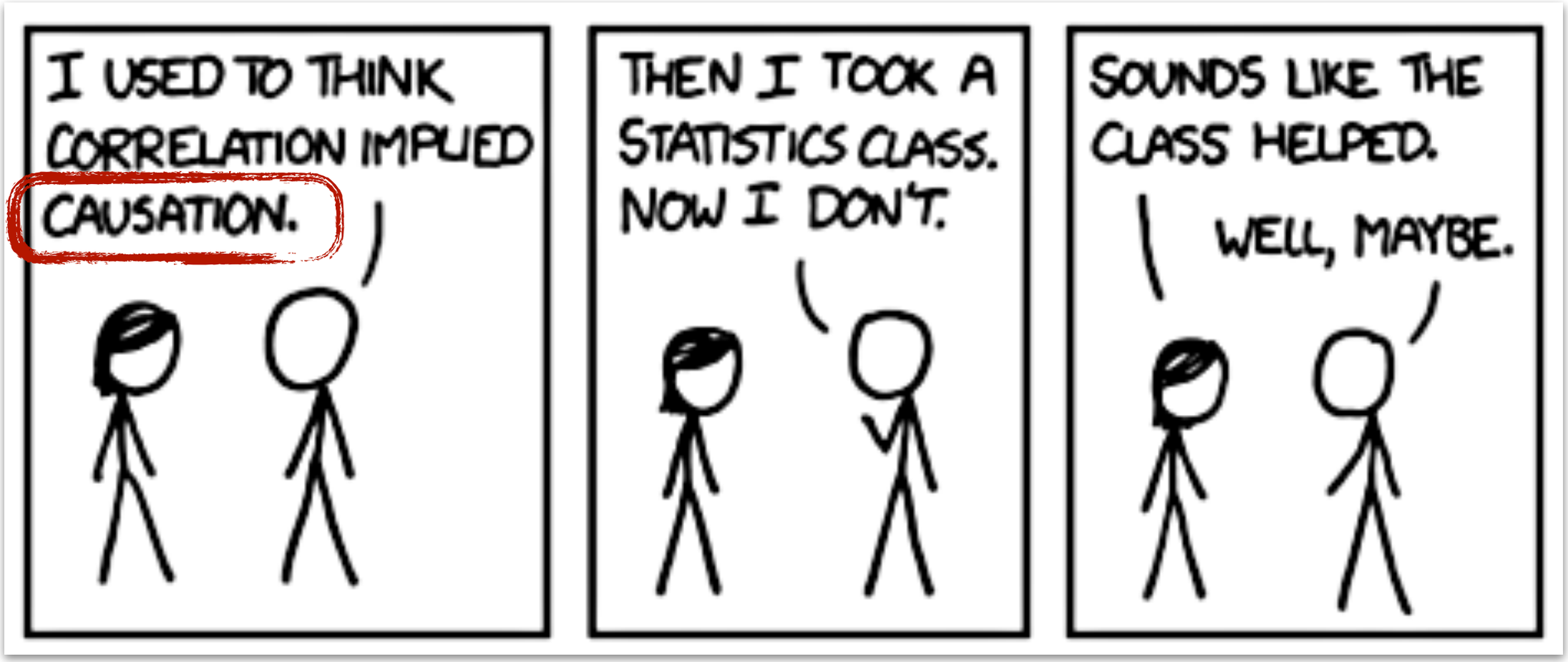
2. What are you hoping to get out of this course?

Introduction



(announcement soon via Canvas)

Tobias Gerstenberg (he/him/his)



xkcd

Tobias Gerstenberg (he/him/his)

- I am leading the

  CiCL Causality in Cognition Lab

  (http://cicl.stanford.edu/).

- The lab studies the role of causality in our understanding of the world, and of each other.

1. How does the mind learn to represent the causal structure of the world?
2. What is the relationship between causal thinking and counterfactual simulation?
3. How do we hold others responsible for the outcomes of their actions?

Tobi Gerstenberg

Role:	Instructor
Email:	gerstenberg@stanford.edu
Office:	302
Office hours:	Monday 2-3pm

We formalize people's mental models as **computational models**.

We use a combination of large-scale **online experiments**, **interactive experiments** in the lab, and **eye-tracking experiments**.

Shao-Fang (Pam) Wang (she/her/hers)

- 4th year PhD student working with Dr. Anthony Wagner.

- I am interested in how interactions between the cortex and hippocampus contribute to cortical plasticity during learning. I use lab- and web-based behavioral tests, computational modeling, EEG, and fMRI.

- B.S. in Biology from National Taiwan University.

Shao-Fang (Pam) Wang

Role:	Teaching assistant
Email:	shaofang@stanford.edu
Office:	409
Office hours:	Wednesday 1-2pm
Section:	Wednesday 2:30-3:20pm in 160-326

Andrew Lampinen (he/him/his)

- I am interested in knowledge transfer, meta-learning, abstraction, and flexibility.

- I explore these issues from perspectives ranging from educational psychology to theoretical machine learning.

- I rely on statistically-based cognitive models like deep neural networks, as well as statistical techniques for analyzing and comparing the behavior of computational models and human subjects.

Andrew Lampinen

Role:	Teaching assistant
Email:	lampinen@stanford.edu
Office:	316
Office hours:	Friday 12:30-1:30pm
Section:	Friday 1:30-2:20pm in 160-314

Mona Rosenke (she/her/hers)

will give a quick intro this Wednesday

What will we learn?

What will we learn?

Weeks 1-3 **1. Use R!**

- Data visualization
- Data manipulation/wrangling
- Understand key statistical concepts
  - Simulation, manipulation, visualization

2. Build models

Weeks 4-7
- Formulate hypotheses as statistical models

Weeks 8-9
- Bayesian statistics

3. Report results

all the time (& Week 10)
- Reproducible research

Use R!

Why  ?

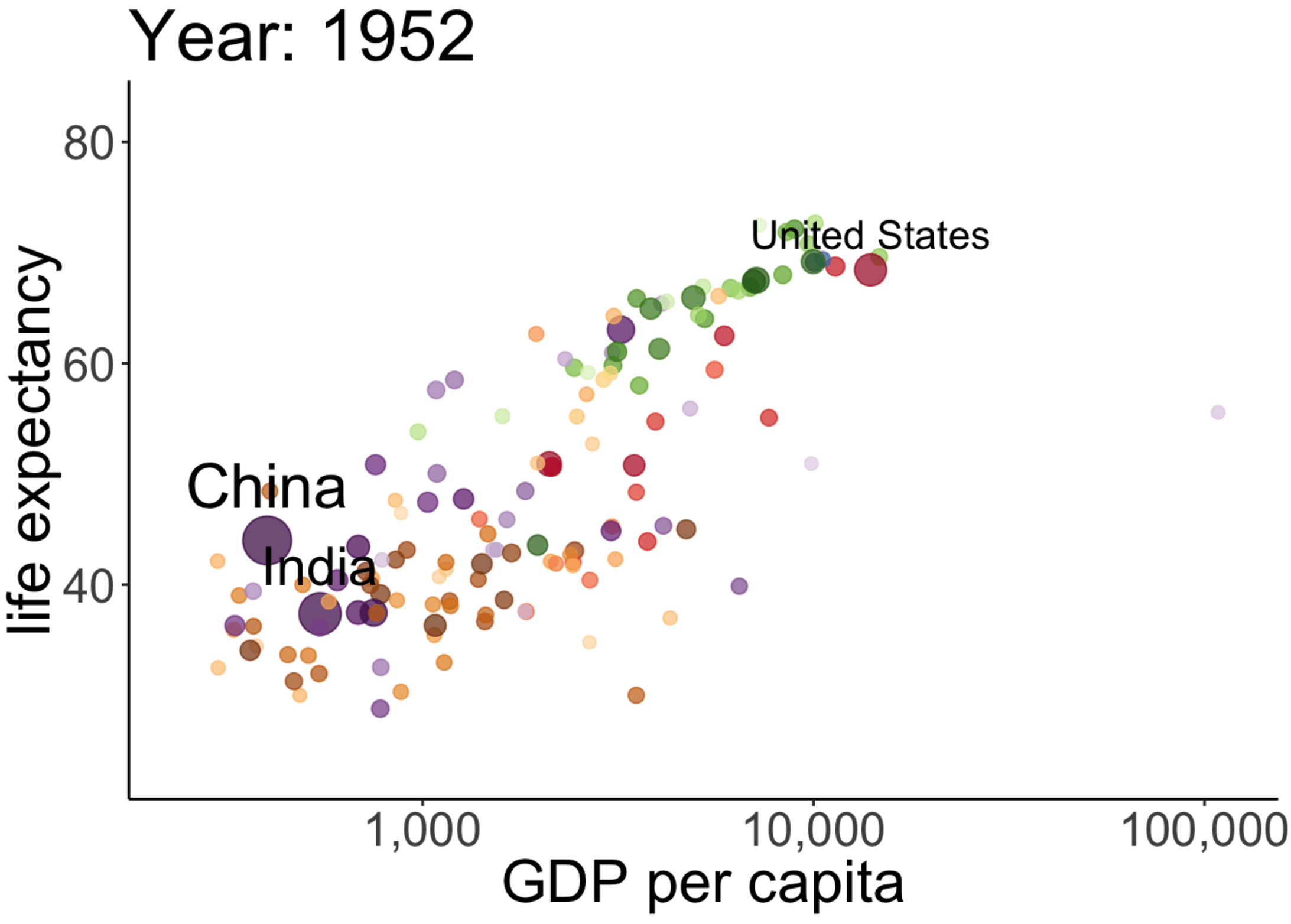
Visualization

Data manipulation

Statistical modeling

Communicating results

Why R ? **Visualization**



Why R ? Visualization

```
ggplot(gapminder, mapping = aes(x = gdpPercap, y = lifeExp, size = pop, color = country)) +
  geom_point(alpha = 0.7, show.legend = FALSE) +
  geom_text(data = gapminder %>% filter(country %in% c("United States", "China", "India")),
            mapping = aes(label = country),
            color = "black",
            vjust = -0.75,
            show.legend = FALSE) +
  scale_colour_manual(values = country_colors) +
  scale_size(range = c(2, 12)) +
  scale_x_log10() +
  labs(title = "Year: {frame_time}", x = "GDP per capita", y = "life expectancy") +
  transition_time(year) +
  ease_aes("linear")
```

Why R ? Data manipulation

Data Transformation with dplyr : : CHEAT SHEET

dplyr functions work with pipes and expect **tidy data**. In tidy data:

Each **variable** is in its own **column** & Each **observation**, or **case**, is in its own **row**

pipes

x %>% f(y) becomes **f(x, y)**

Summarise Cases

These apply **summary functions** to columns to create a new table of summary statistics. Summary functions take vectors as input and return one value (see back).

summary function

summarise(.data, …)
Compute table of summaries.
summarise(mtcars, avg = mean(mpg))

count(x, ..., wt = NULL, sort = FALSE)
Count number of rows in each group defined by the variables in … Also **tally**().
count(iris, Species)

VARIATIONS

summarise_all() - Apply funs to every column.
summarise_at() - Apply funs to specific columns.
summarise_if() - Apply funs to all cols of one type.

Group Cases

Use **group_by()** to create a "grouped" copy of a table. dplyr functions will manipulate each "group" separately and then combine the results.

```
mtcars %>%
group_by(cyl) %>%
summarise(avg = mean(mpg))
```

group_by(.data, ..., add = FALSE**)**
Returns copy of table grouped by …
g_iris <- group_by(iris, Species)

ungroup(x, …**)**
Returns ungrouped copy of table.
ungroup(g_iris)

Manipulate Cases

EXTRACT CASES

Row functions return a subset of rows as a new table.

filter(.data, …**)** Extract rows that meet logical criteria. *filter(iris, Sepal.Length > 7)*

distinct(.data, ..., .keep_all = FALSE**)** Remove rows with duplicate values.
distinct(iris, Species)

sample_frac(tbl, size = 1, replace = FALSE, weight = NULL, .env = parent.frame()**)** Randomly select fraction of rows.
sample_frac(iris, 0.5, replace = TRUE)

sample_n(tbl, size, replace = FALSE, weight = NULL, .env = parent.frame()**)** Randomly select size rows. *sample_n(iris, 10, replace = TRUE)*

slice(.data, …**)** Select rows by position.
slice(iris, 10:15)

top_n(x, n, wt**)** Select and order top n entries (by group if grouped data). *top_n(iris, 5, Sepal.Width)*

Logical and boolean operators to use with filter()

<	<=	is.na()	%in%	|	xor()
>	>=	!is.na()	!	&	

See **?base::logic** and **?Comparison** for help.

ARRANGE CASES

arrange(.data, …**)** Order rows by values of a column or columns (low to high), use with **desc()** to order from high to low.
arrange(mtcars, mpg)
arrange(mtcars, desc(mpg))

ADD CASES

add_row(.data, ..., .before = NULL, .after = NULL**)**
Add one or more rows to a table.
add_row(faithful, eruptions = 1, waiting = 1)

Manipulate Variables

EXTRACT VARIABLES

Column functions return a set of columns as a new vector or table.

pull(.data, var = -1**)** Extract column values as a vector. Choose by name or index.
pull(iris, Sepal.Length)

select(.data, …**)**
Extract columns as a table. Also **select_if()**.
select(iris, Sepal.Length, Species)

Use these helpers with select (),
e.g. select(iris, starts_with("Sepal"))

contains(match**)**	**num_range(**prefix, range**)**	**:**, e.g. mpg:cyl
ends_with(match**)**	**one_of(**…**)**	**-**, e.g, -Species
matches(match**)**	**starts_with(**match**)**	

MAKE NEW VARIABLES

These apply **vectorized functions** to columns. Vectorized funs take vectors as input and return vectors of the same length as output (see back).

vectorized function

mutate(.data, …**)**
Compute new column(s).
mutate(mtcars, gpm = 1/mpg)

transmute(.data, …**)**
Compute new column(s), drop others.
transmute(mtcars, gpm = 1/mpg)

mutate_all(.tbl, .funs, …**)** Apply funs to every column. Use with **funs()**. Also **mutate_if()**.
mutate_all(faithful, funs(log(.), log2(.)))
mutate_if(iris, is.numeric, funs(log(.)))

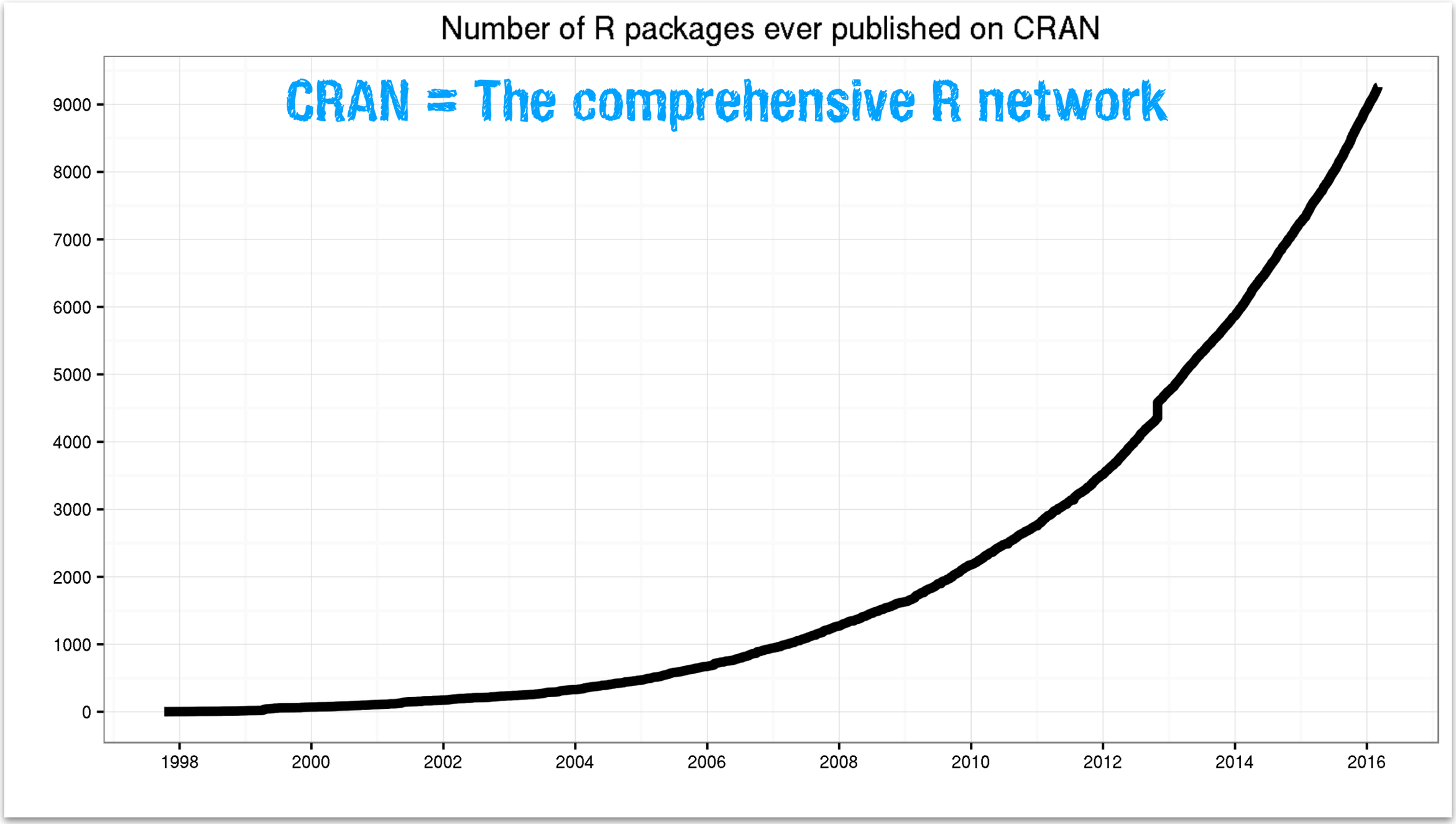
mutate_at(.tbl, .cols, .funs, …**)** Apply funs to specific columns. Use with **funs()**, **vars()** and the helper functions for select().
mutate_at(iris, vars(-Species), funs(log(.)))

add_column(.data, ..., .before = NULL, .after = NULL**)** Add new column(s). Also **add_count()**, **add_tally()**. *add_column(mtcars, new = 1:32)*

rename(.data, …**)** Rename columns.
rename(iris, Length = Sepal.Length)

RStudio

Why R ? Statistical modeling



This is what R was developed to do.
(and it continues to develop!!)

Why R ? Communicating results

01-intro.Rmd

Knit

```
# Introduction {#intro}

You can label chapter and section titles using `{#label}` after them,
do not manually label them, there will be automatic labels anyway, e.

Figures and tables with captions will be placed in `figure` and `tabl


```{r nice-fig, fig.cap='Here is a nice figure!', out.width='80%', fi
par(mar = c(4, 4, .1, .1))
plot(pressure, type = 'b', pch = 19)
```

Reference a figure by its code chunk label with the `fig:` prefix, e.
can reference tables generated from `knitr::kable()`, e.g., see Table

```{r nice-tab, tidy=FALSE}
knitr::kable(
  head(iris, 20), caption = 'Here is a nice table!',
  booktabs = TRUE
)
```

You can write citations, too. For example, we are using the **bookdow
was built on top of R Markdown and **knitr** [@xie2015].

```{r stats-help, fig.cap='Stats cheatsheet',fig.align='center',echo=
knitr::include_graphics('figures/cheatsheets/stats-help.jpg')
```

See figure \@ref(fig:stats-help)


```{r klippy, echo=FALSE, include=TRUE}
klippy::klippy()
```
```

R Markdown

Chapter 1 Introduction

You can label chapter and section titles using `{#label}` after them, e.g., we can reference Chapter 1. If you do not manually label them, there will be automatic labels anyway, e.g., Chapter ??.

Figures and tables with captions will be placed in `figure` and `table` environments, respectively.

```
par(mar = c(4, 4, .1, .1))
plot(pressure, type = 'b', pch = 19)
```

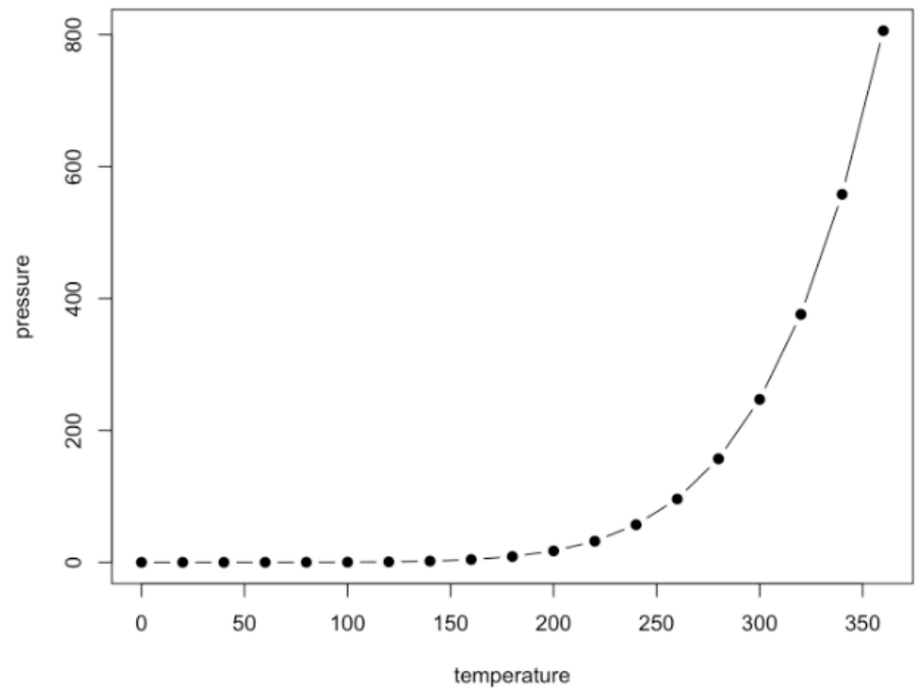
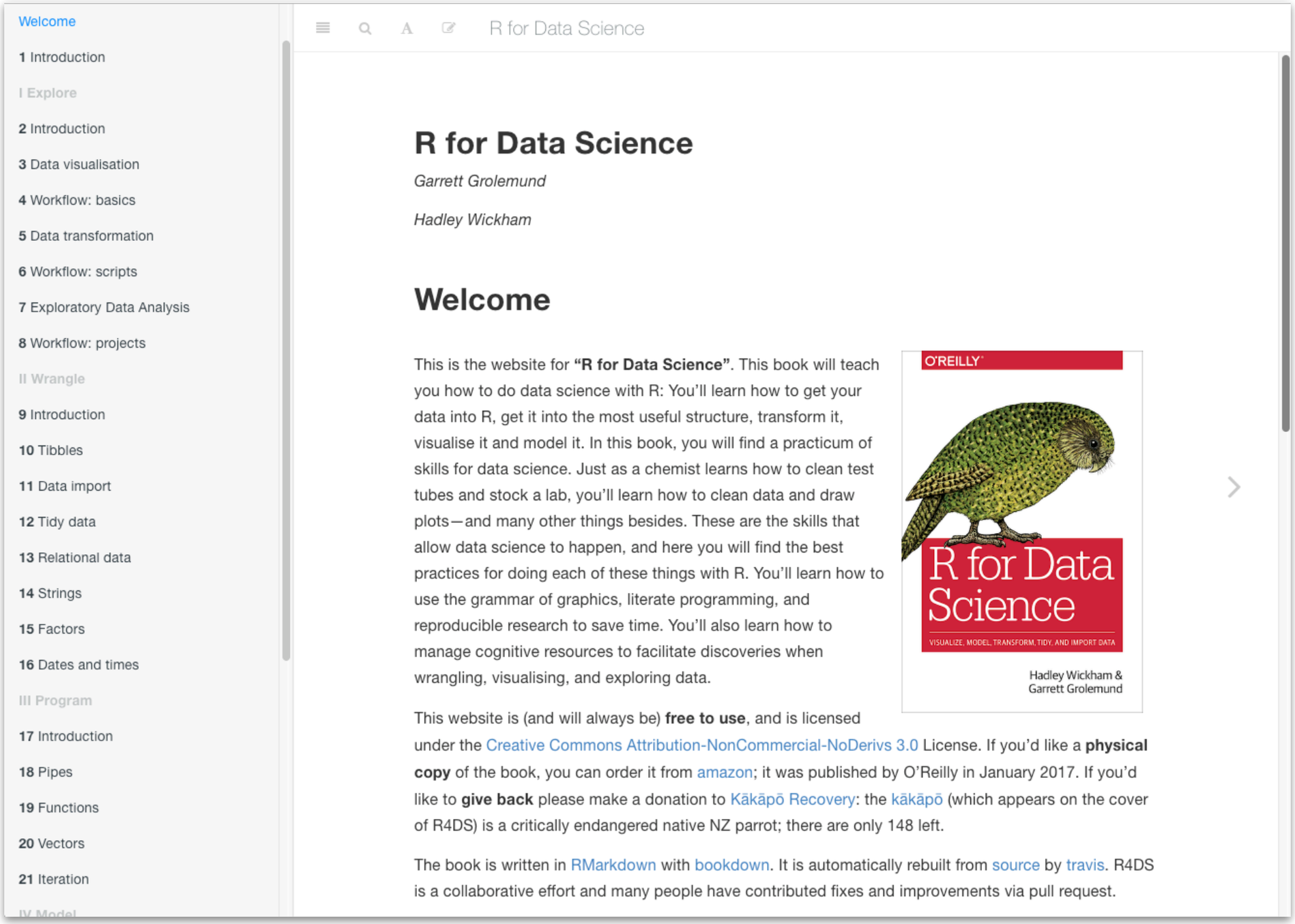


Figure 1.1: Here is a nice figure!

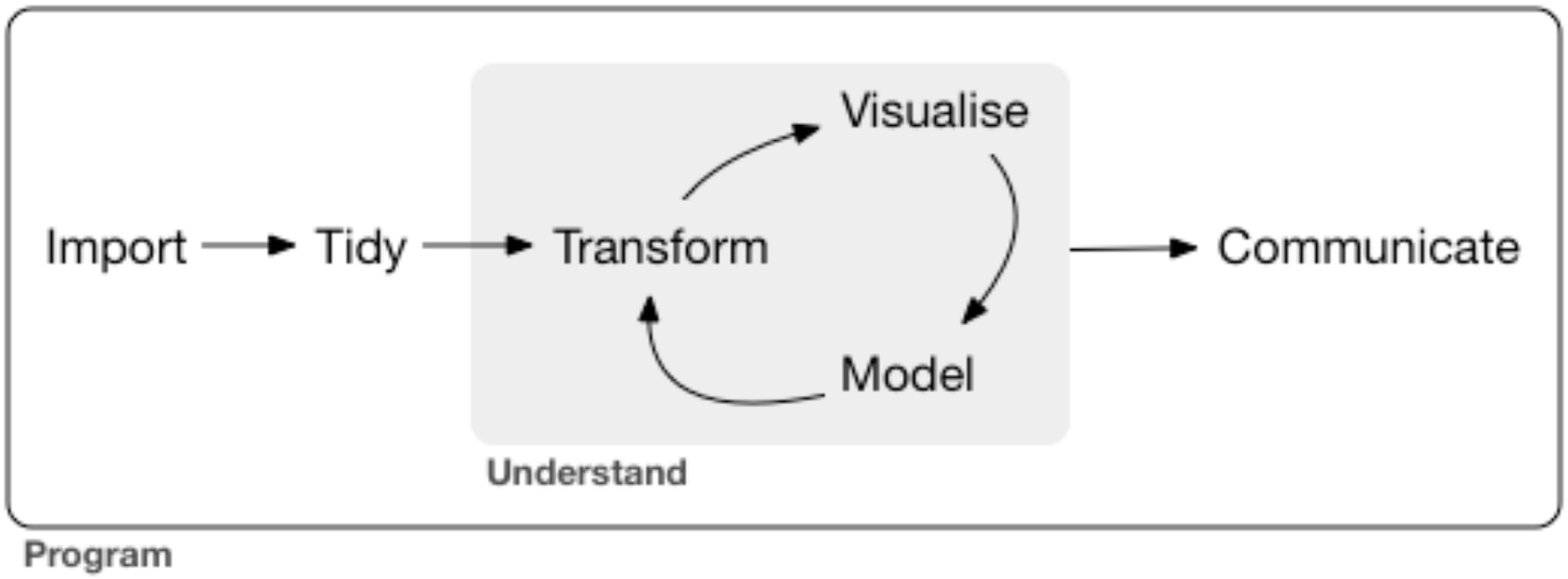
Reference a figure by its code chunk label with the `fig:` prefix, e.g., see Figure 1.1. Similarly, you can reference tables generated from `knitr::kable()`, e.g., see Table 1.1.

Why R ? Communicating results



https://r4ds.had.co.nz/

Why  ? **Tidyverse**



- *Import*: get data into R
- *Tidy*: clean and format the data
- *Transform*: select variables, create new ones, group and summarize
- *Visualize*: "look" at the data in different ways
- *Model*: answer questions about the data
- *Communicate*: write reproducible research reports

Grolemund & Wickham (2016). R for data science: import, tidy, transform, visualize, and model data

Why  ? **Also ...**

- Many of us here at Stanford use it.
- R has a nice online community. **#rstats**
- RStudio is a great IDE (Integrated Development Environment)!
- We use R to better understand statistics

Why  ? **Also ...**

instead of

$$\sum_{\mu,\nu,\lambda} \hat{M}^{(3)}_{\mu\nu\lambda} F_{\mu\nu\lambda} = \hat{M}^{(3)}_{000} F_{000} + 3\sum_i \hat{M}^{(3)}_{00(ii)} F_{00(ii)} + 3\sum_i \hat{M}^{(3)}_{0ii} F_{0ii} + 3\sum_i \hat{M}^{(3)}_{0(ii)(ii)} F_{0(ii)(ii)}$$
$$+ 6\sum_{i<j} \hat{M}^{(3)}_{0(ii)(jj)} F_{0(ii)(jj)} + 3\sum_{i<j} \hat{M}^{(3)}_{0(ij)(ij)} F_{0(ij)(ij)} + 3\sum_{i\neq j} \hat{M}^{(3)}_{ii(jj)} F_{ii(jj)} + 6\sum_{i<j} \hat{M}^{(3)}_{ij(ij)} F_{ij(ij)} + \cdots$$
$$= S^{(0)} F_{000} - \frac{2S^{(1)}}{d}\frac{\sigma_1^2}{\sigma_0^2}\left(2\sum_i F_{00(ii)} - \sum_i F_{0ii}\right) - \frac{2S^{(2)}}{d^2(d+2)}\frac{\sigma_1^4}{\sigma_0^4}$$
$$\times \left[3(d-1)\sum_i F_{0(ii)(ii)} - 6\sum_{i<j} F_{0(ii)(jj)} + \frac{3d}{2}\sum_{i<j} F_{0(ij)(ij)} + (d+2)\sum_{i\neq j} F_{ii(jj)} - (d+2)\sum_{i<j} F_{ij(ij)}\right]$$
$$+ \frac{3S_2^{(2)}}{d(d+2)}\frac{\sigma_1^4}{\sigma_0^4}\left(3\sum_i F_{0(ii)(ii)} + 2\sum_{i<j} F_{0(ii)(jj)} + \sum_{i<j} F_{0(ij)(ij)}\right) + \cdots. \qquad (85)$$

(google search "complicated statistical equation")

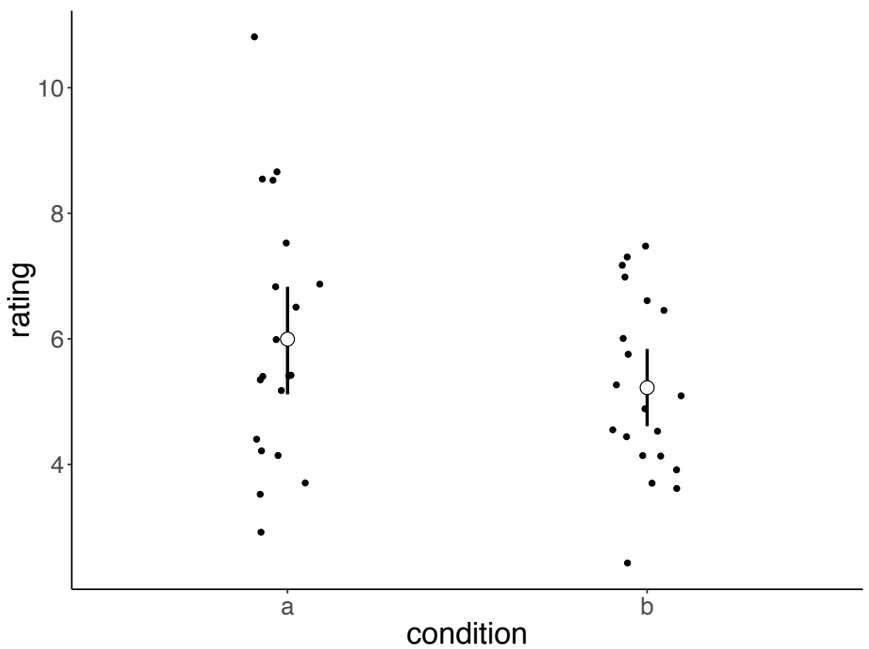
d_f	Level of Significance for Directional Test (t_{crit})					
	∝=0.10	∝=0.05	∝=0.025	∝=0.01	∝=0.005	∝=0.0005
	Level of Significance for Non-directional Test (t_{crit})					
	∝=0.20	∝=0.10	∝=0.05	∝=0.02	∝=0.01	∝=0.001
1	3.0780	6.3140	12.7100	31.8200	63.6600	636.6000
2	1.8860	2.9200	4.3030	6.9650	9.9250	31.6000
3	1.6380	2.3530	3.1820	4.5410	5.8410	12.9200
4	1.5330	2.1320	2.7760	3.7470	4.6040	8.6100
5	1.4760	2.0150	2.5710	3.3650	4.0320	6.8690
6	1.4400	1.9430	2.4470	3.1430	3.7070	5.9590
7	1.4150	1.8950	2.3650	2.9980	3.4990	5.4080
8	1.3970	1.8600	2.3060	2.8960	3.3550	5.0410
9	1.3830	1.8330	2.2620	2.8210	3.2500	4.7810
10	1.3720	1.8120	2.2280	2.7640	3.1690	4.5870
11	1.3630	1.7960	2.2010	2.7180	3.1060	4.4370
12	1.3560	1.7820	2.1790	2.6810	3.0550	4.3180
13	1.3500	1.7710	2.1600	2.6500	3.0120	4.2210
14	1.3450	1.7610	2.1450	2.6240	2.9770	4.1400
15	1.3410	1.7530	2.1310	2.6020	2.9470	4.0730

we'll do

```r
set.seed(0)
df.data = tibble(
  a = rnorm(20, mean = 6, sd = 2),
  b = rnorm(20, mean = 5, sd = 2)
) %>%
  gather("condition", "rating")

df.data %>%
  group_by(condition) %>%
  summarize(rating.mean = mean(rating),
            rating.sd = sd(rating)) %>%
  kable()

# calculate the difference between conditions
difference.actual = df.data %>%
  group_by(condition) %>%
  summarize(rating.mean = mean(rating)) %>%
  pull(rating.mean) %>%
  diff() %>%
  -.
```



But what about python™ ?

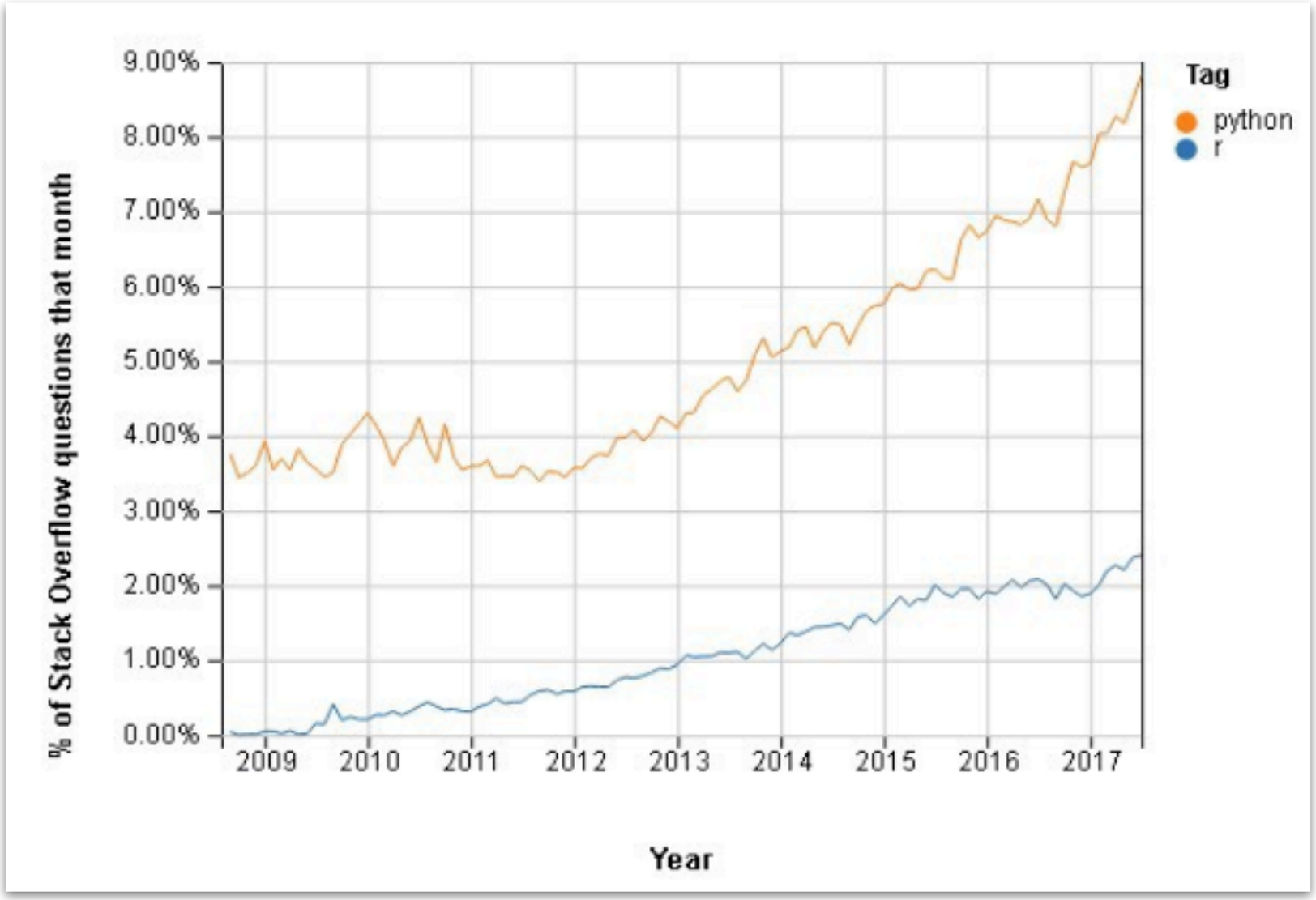
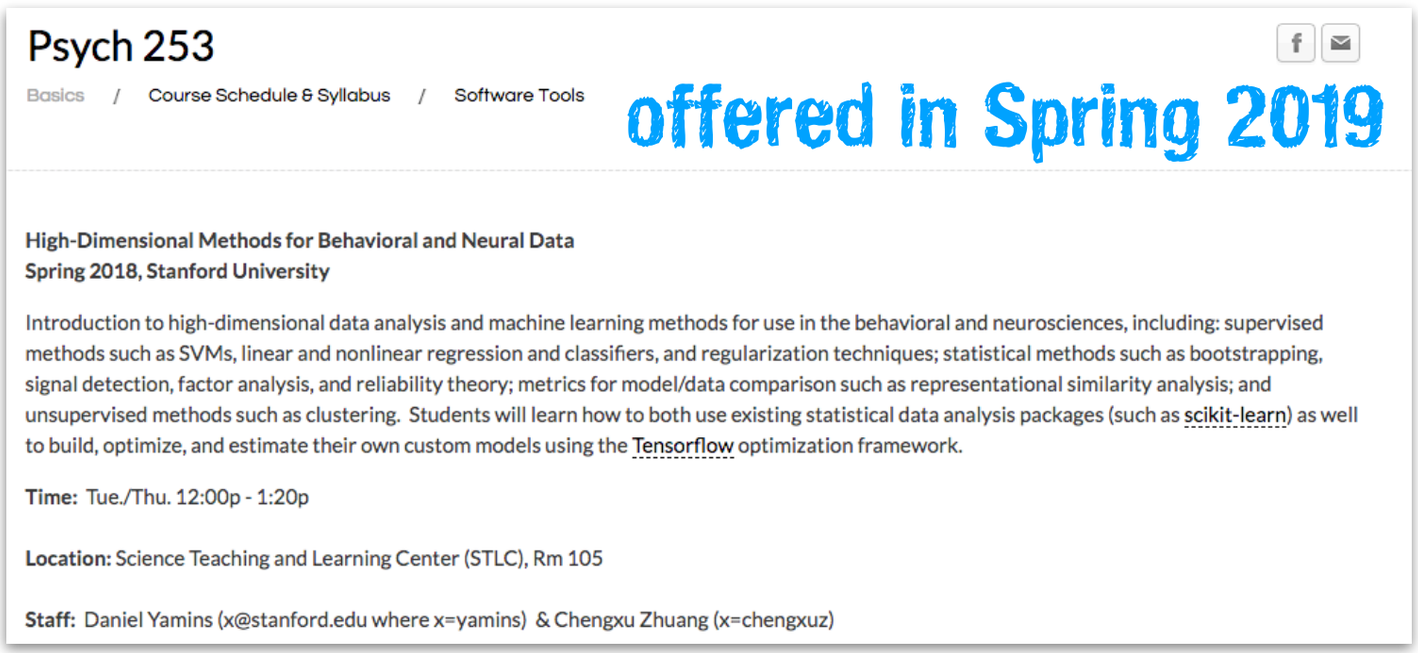


Image Source: https://dzone.com/articles/r-or-python-data-scientists-delight

But what about python™ ?

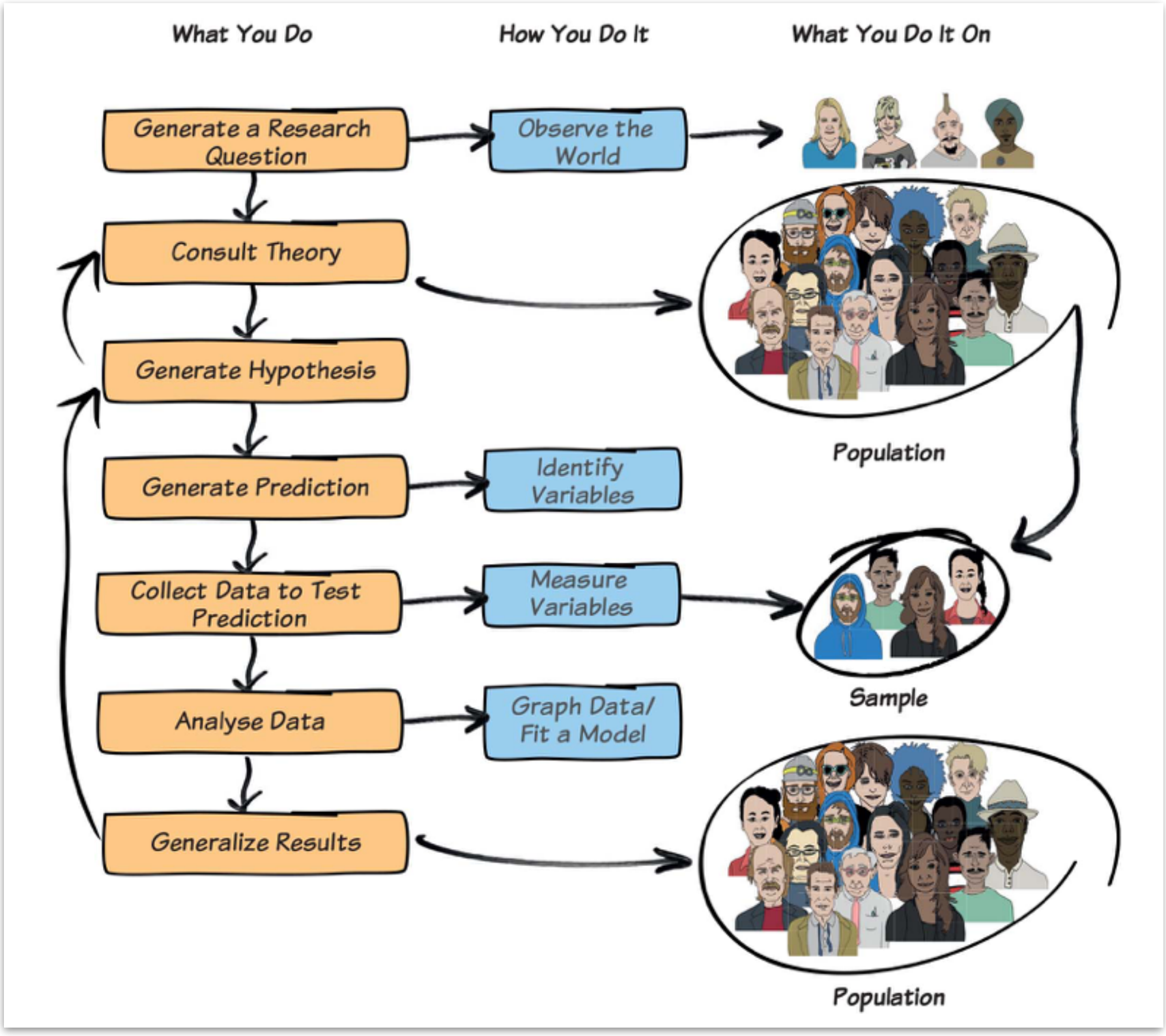
- You should learn python, too! :)
- Python is the more general purpose programming language.
- Python is great for machine learning (e.g. neural networks and deep learning).

- You can learn about all of these things in **Psych 253**!



Build models

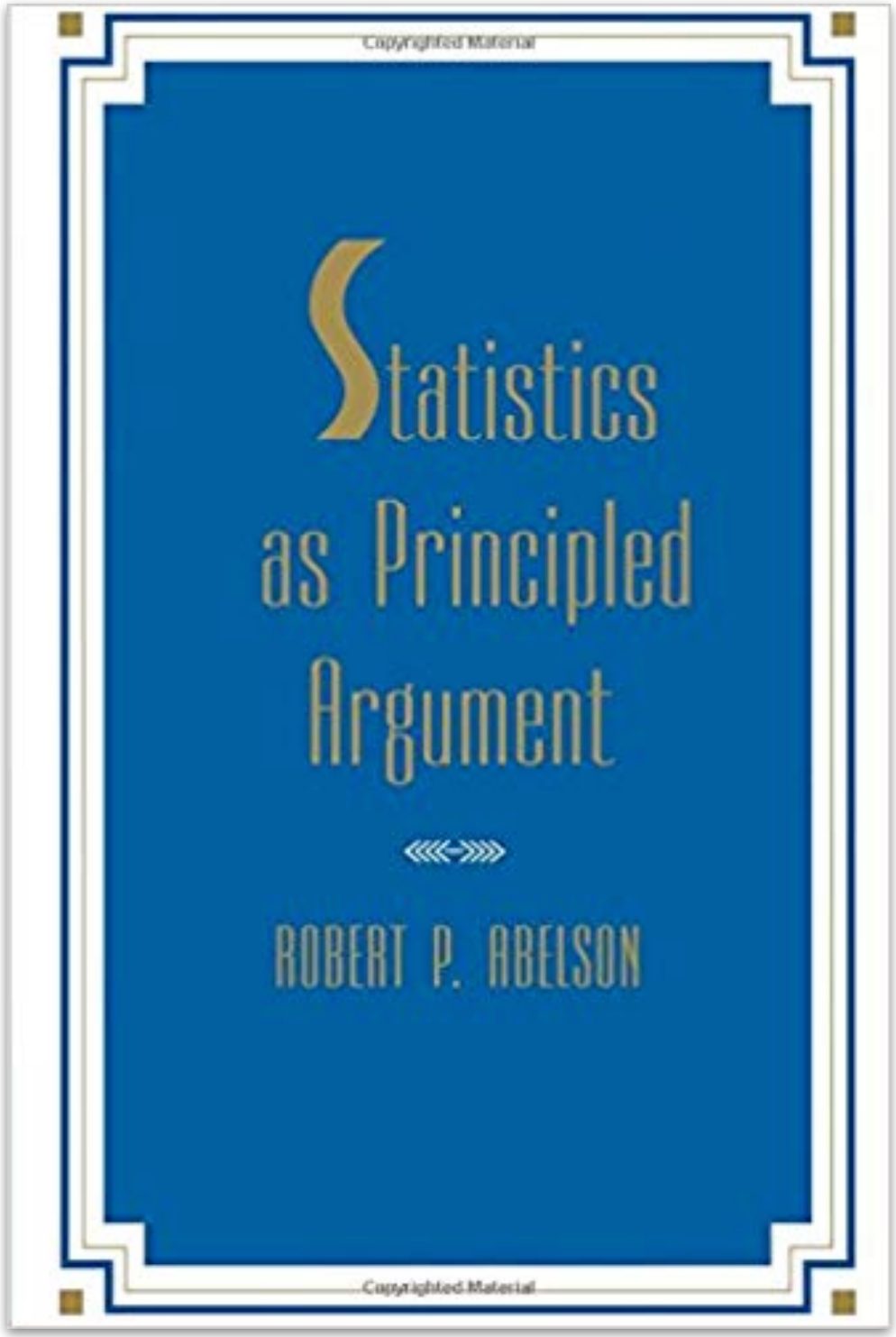
The research process



Statistics as argument

Researchers use empirical observations (data) for making arguments about research questions.

Statistics is part of a narrative and requires **figures**, context, rhetoric, prose, ...

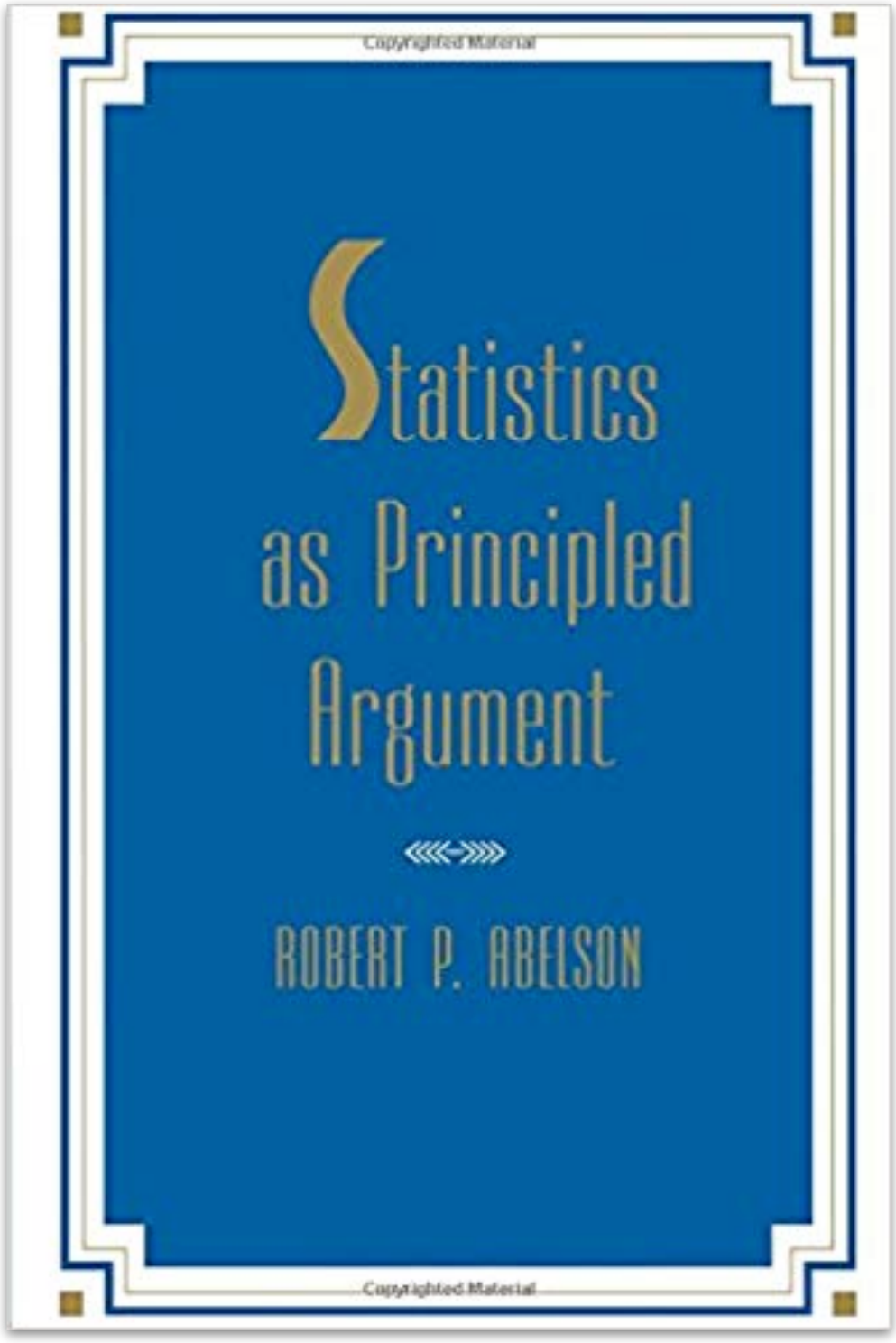


Abelson, R. P. (1995). *Statistics as principled argument*. New York: Psychology Press.

Statistics as argument

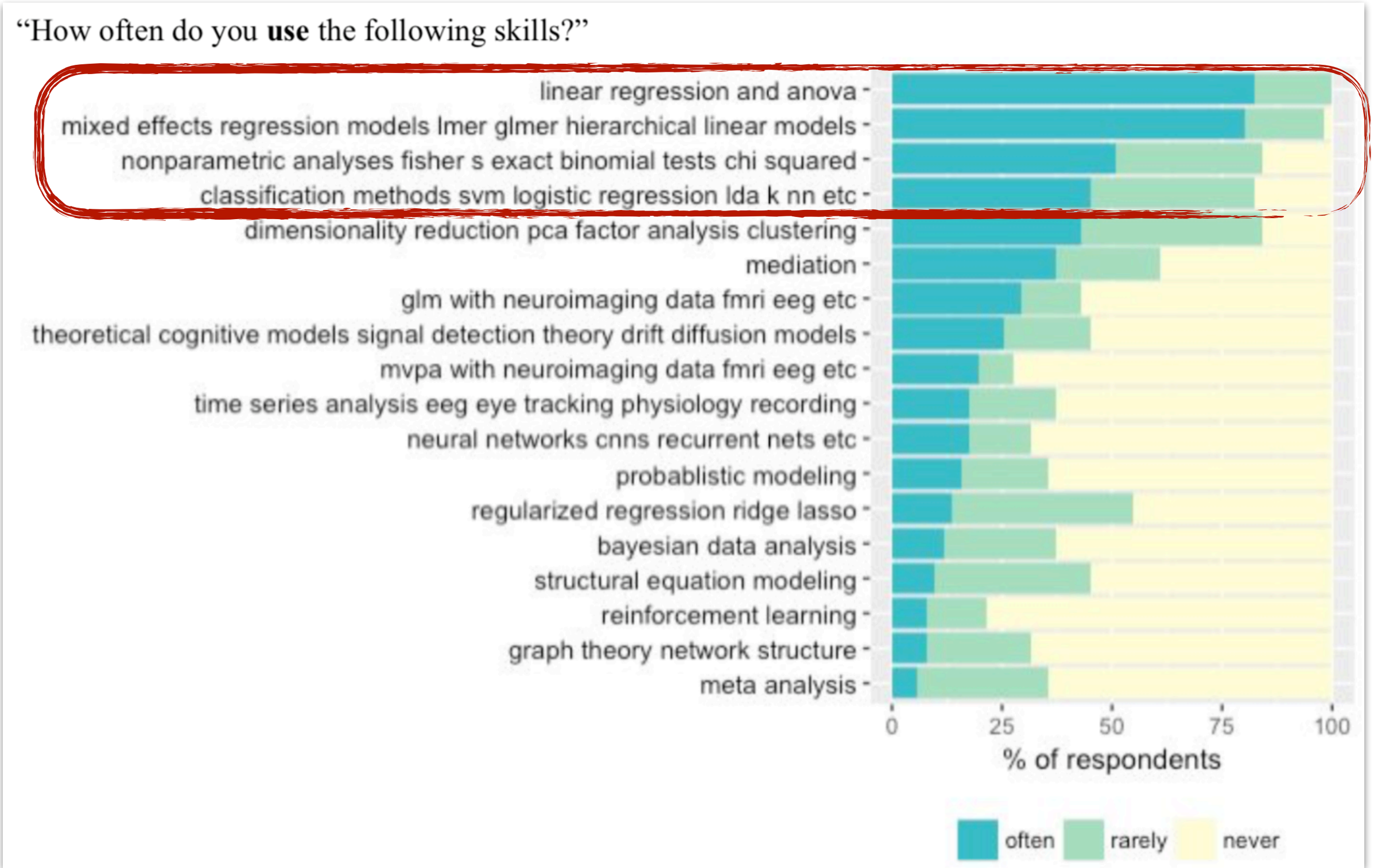
5 criteria make statistical arguments persuasive, or **MAGIC**:

- ***Magnitude***: Larger effects are more persuasive
- ***Articulation***: Understandability of results
- ***Generality***: How much does the effect depend on contextual factors
- ***Interestingness***: Change what people believe about an important issue
- ***Credibility***: Believability of a research claim, methodological soundness, and theoretical coherence

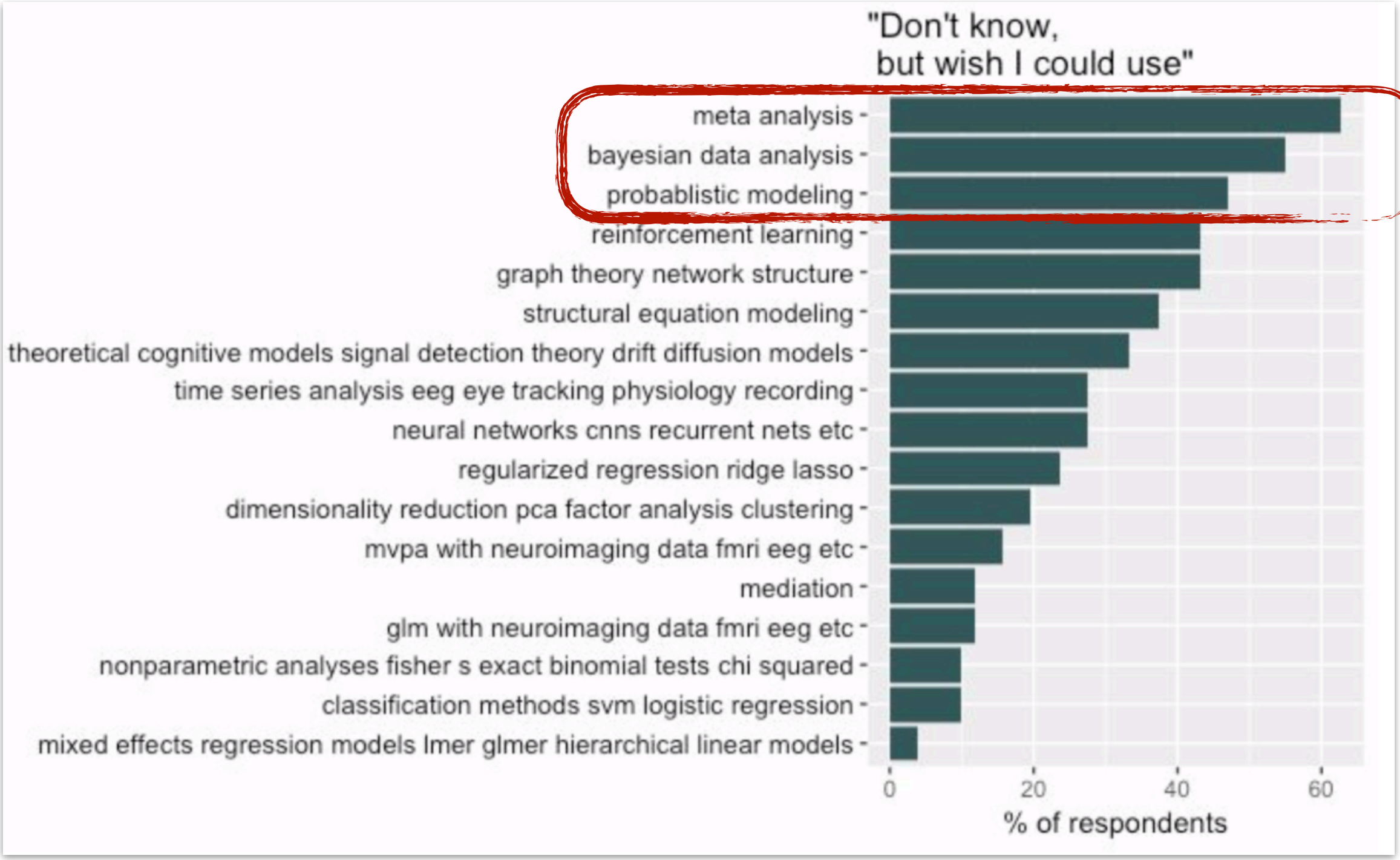


Abelson, R. P. (1995). *Statistics as principled argument*. New York: Psychology Press.

Psychology grad student survey

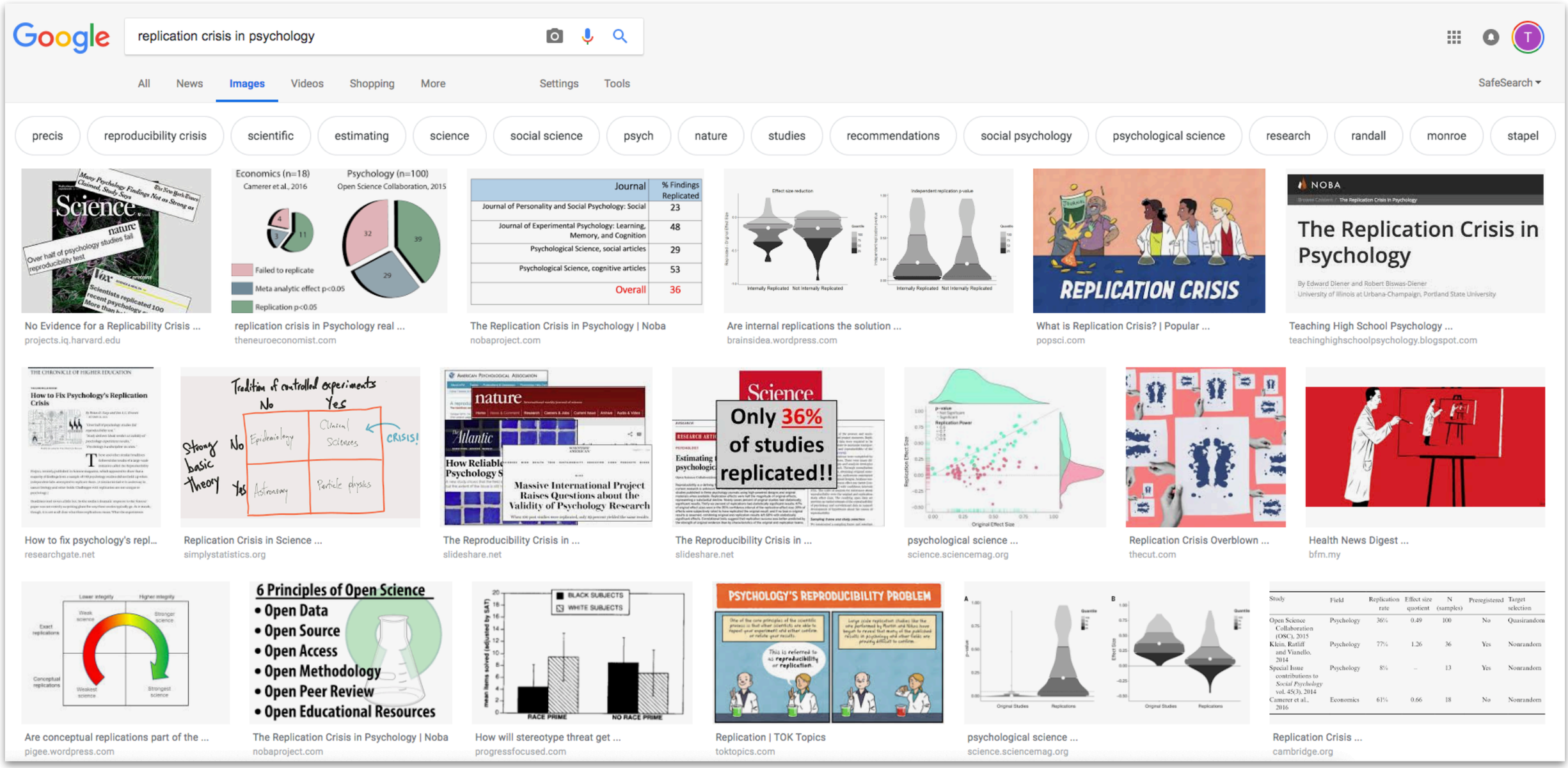


Psychology grad student survey



Report results

Replication crisis



No Evidence for a Replicability Crisis ...
projects.iq.harvard.edu

replication crisis in Psychology real ...
theneuroeconomist.com

The Replication Crisis in Psychology | Noba
nobaproject.com

Are internal replications the solution ...
brainsidea.wordpress.com

What is Replication Crisis? | Popular ...
popsci.com

Teaching High School Psychology ...
teachinghighschoolpsychology.blogspot.com

How to fix psychology's repl...
researchgate.net

Replication Crisis in Science ...
simplystatistics.org

The Reproducibility Crisis in ...
slideshare.net

The Reproducibility Crisis in ...
slideshare.net

psychological science ...
science.sciencemag.org

Replication Crisis Overblown ...
thecut.com

Health News Digest ...
bfm.my

Are conceptual replications part of the ...
pigee.wordpress.com

The Replication Crisis in Psychology | Noba
nobaproject.com

How will stereotype threat get ...
progressfocused.com

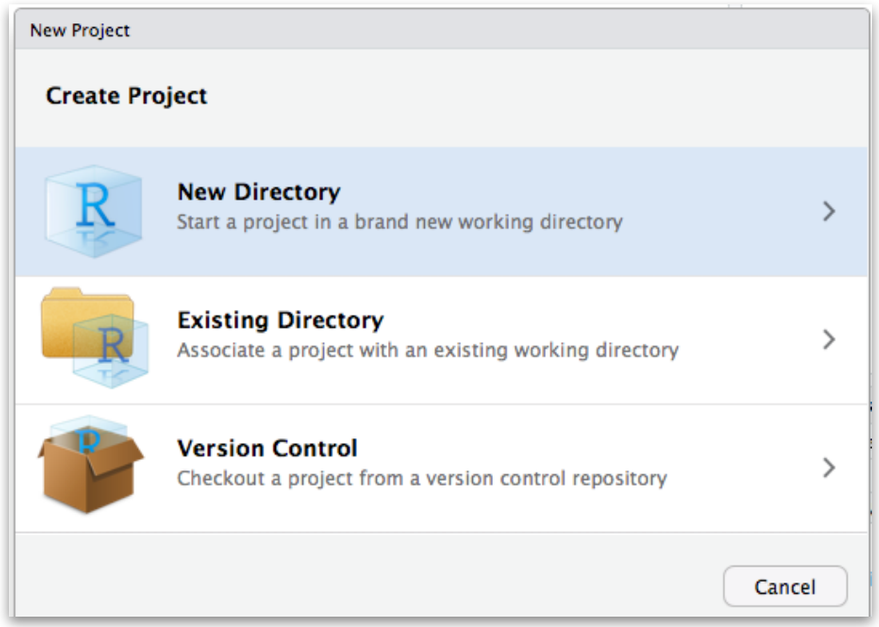
Replication | TOK Topics
toktopics.com

psychological science ...
science.sciencemag.org

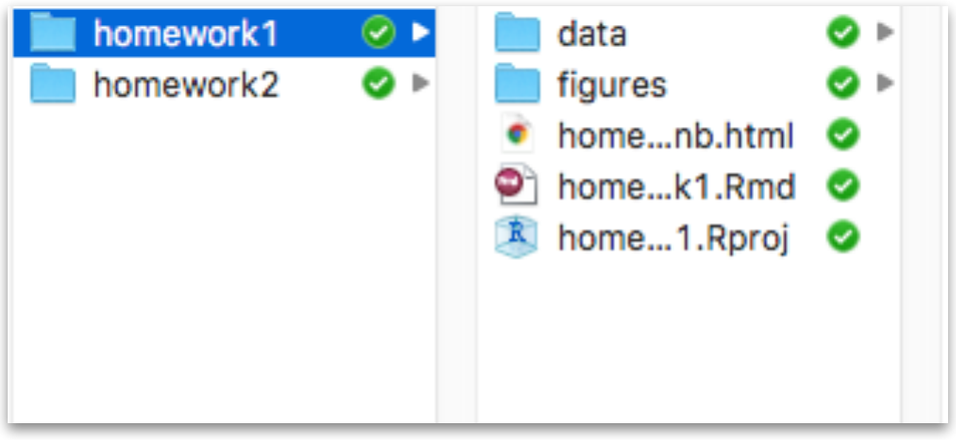
Replication Crisis ...
cambridge.org

Project organization

- Use **R Projects**
  - makes sure that the working directory is set correctly
  - allows you to work on multiple projects at the same time



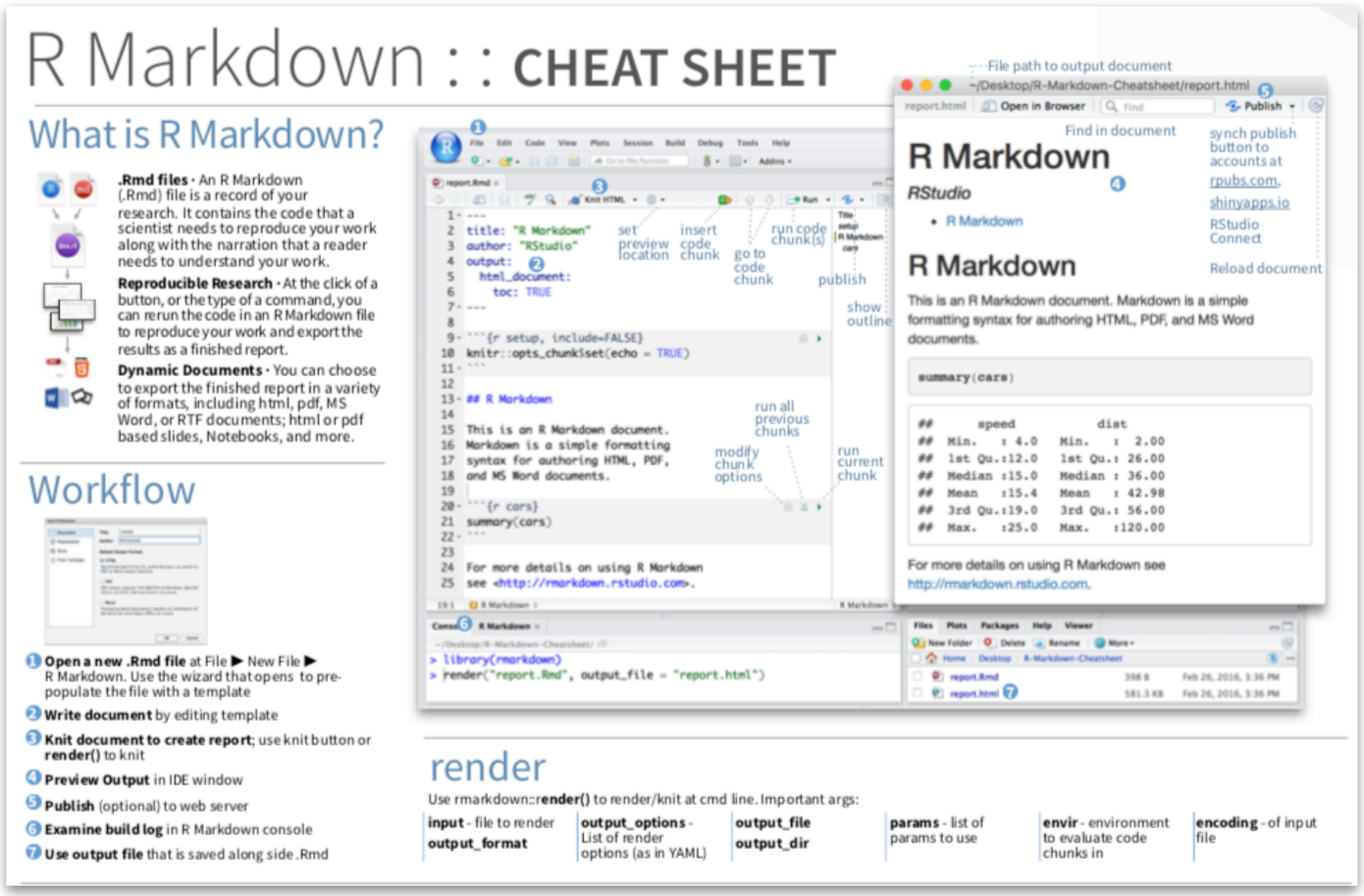
- **Organize** the folder structure
- Use **relative paths**



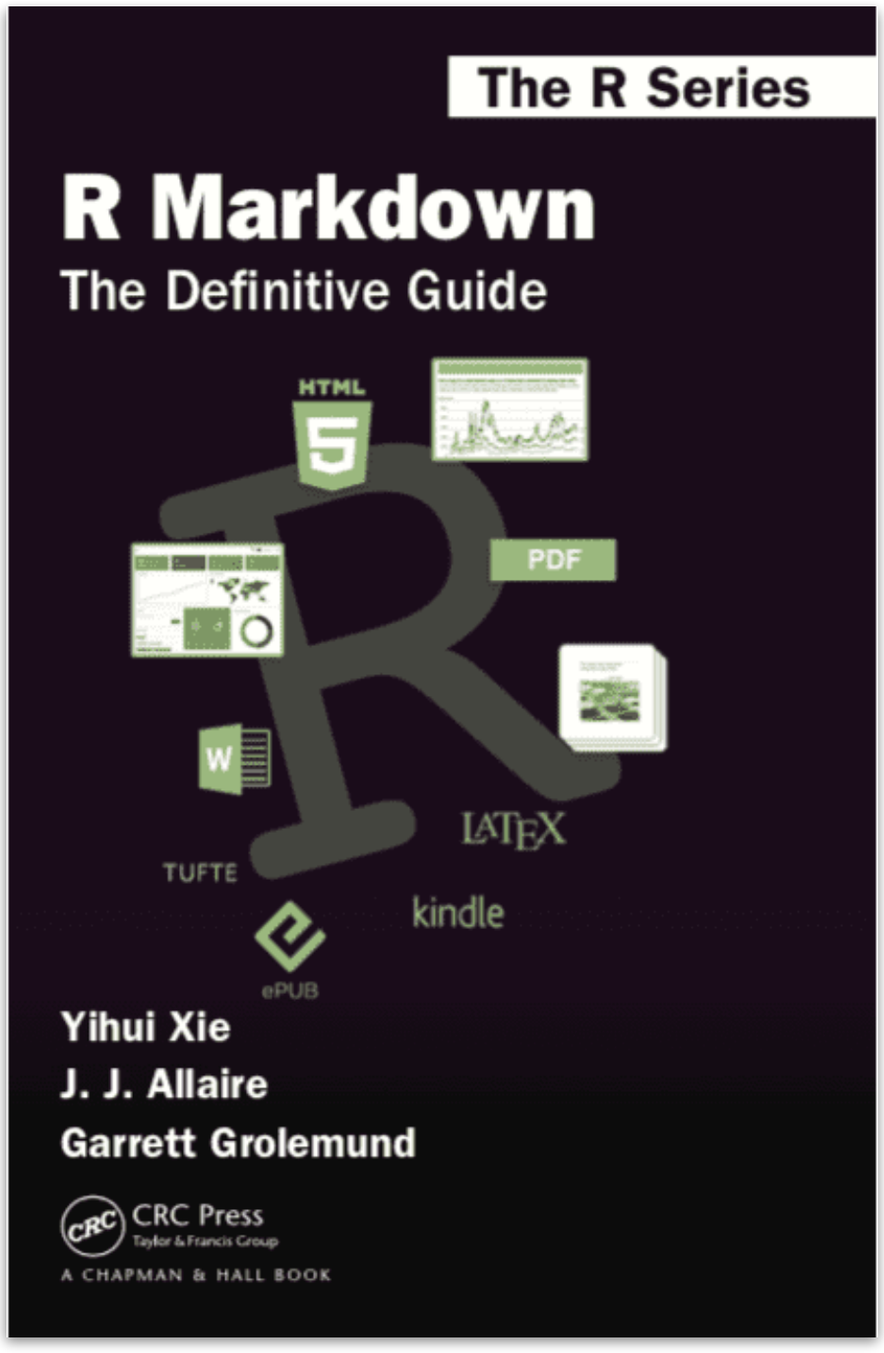
✓
```
1 read_csv("data/dataset.csv")
```

✗
```
1 read_csv("~/tobi/Documents/work/homework/data/
dataset.csv")
```

R Markdown

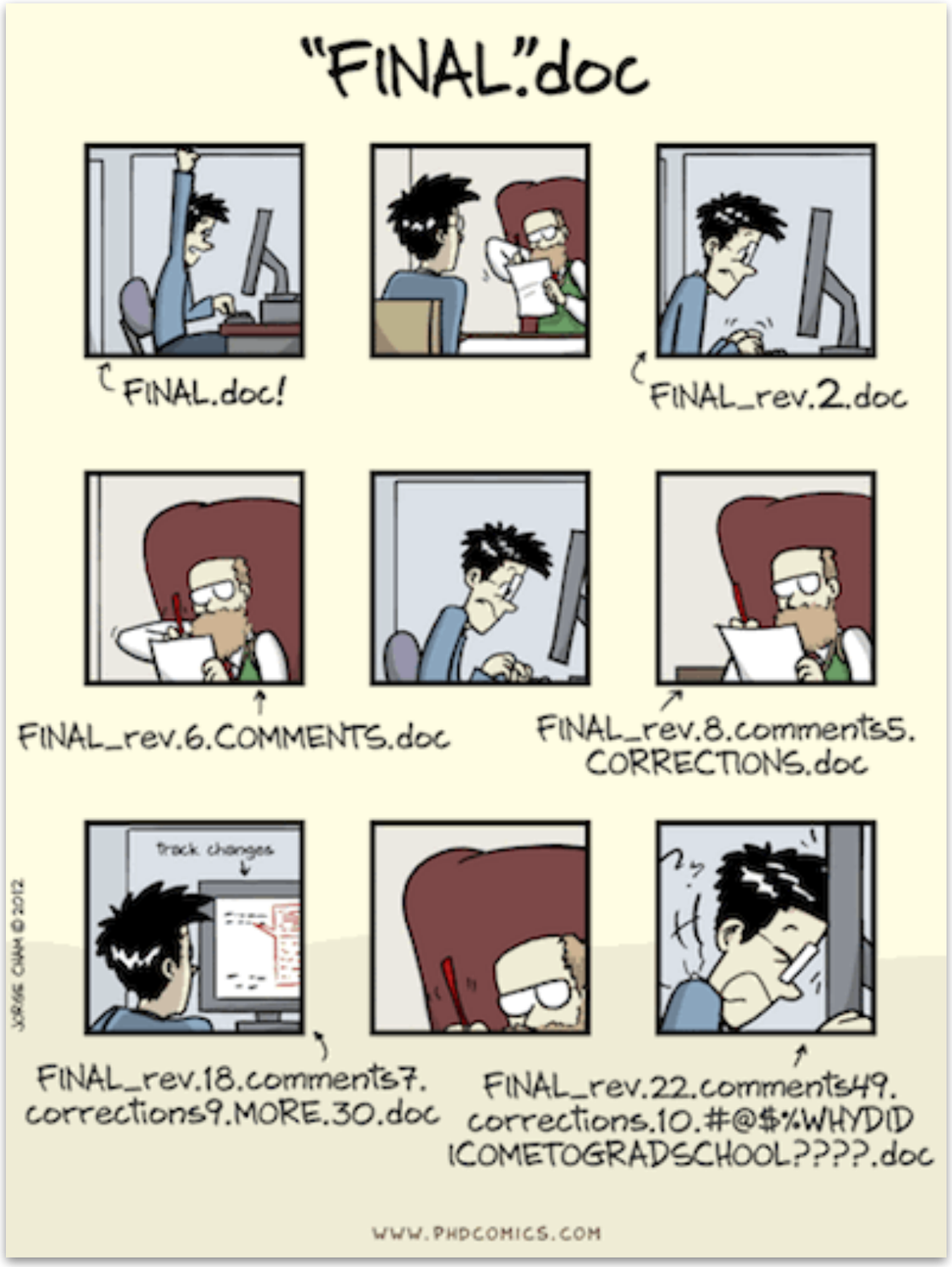


https://github.com/rstudio/cheatsheets/raw/master/rmarkdown-2.0.pdf



https://bookdown.org/yihui/rmarkdown/

R Markdown



- if we use a word document ... :
  - figures change
  - results change
  - copy and paste is error prone
- in R Markdown ... :
  - figures and statistics are updated
  - no need for copy and paste
  - everything in one place
  - even better with version control (e.g. via github)

How will we learn?

How will we learn?

- Lectures
- Sections
- Homework
- Midterm exam
- Final project
- Grading
- Office hours

How will we learn?

- **Lectures**
  - Monday, Wednesday, Friday @ 10:30am
  - get familiar with R and RStudio
    - visualization
    - data manipulation
    - simulation
  - introduce and discuss statistical methods

How will we learn?

- **Sections**

	Andrew Lampinen	Shao-Fang (Pam) Wang
		
Role:	Teaching assistant	Teaching assistant
Email:	lampinen@stanford.edu	shaofang@stanford.edu
Office:	316	409
Office hours:	Friday 12:30-1:30pm	Wednesday 1-2pm
Section:	Friday 1:30-2:20pm in 160-314	Wednesday 2:30-3:20pm in 160-326

How will we learn?

- **Sections**
  - work through and expand on the materials introduced in class
  - hands on exercises in smaller groups
  - learning by doing!

How will we learn?

- **Homework**
  - one assignment per week
  - you can work in groups (indicate who you worked with)
  - download and submit via Canvas
  - homework will be available online after class on Wednesdays, and is due **Tuesdays 8pm** the week after

How will we learn?

- **Midterm exam**
  - like a homework assignment, but:
    - you have to work on it **on your own**
    - you'll **have 24h** to complete the exam
    - you can use any resources you like

How will we learn?

- **Final project**
  - you can work in groups of up to 3 members
  - everyone in the group will receive the same grade
  - the expectations for the project scale with the size of the group

How will we learn?

- **Final project**
  - structure:
    1. short written project proposal
    2. oral presentation
    3. written report

How will we learn?

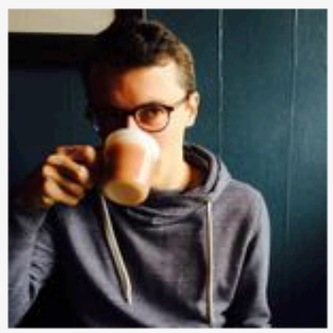
- **Final project**
  - substantive report based on an interesting data set
  - demonstrate what's been learned in class: visualization, data manipulation, statistical modeling, reporting of results
  - publish the project on github (make sure it's reproducible)
    - more information soon ...

How will we learn?

- **Grading**
  - Homework: 40% (the homework with the lowest score doesn't count)
  - Midterm: 20%
  - Final project: 40%
    - Proposal: 5%
    - Presentation: 10%
    - Report: 25%
- Extra credit
  - Piazza: 2%
  - Datacamp: 2%

How will we learn?

- **Office hours**

	Tobi Gerstenberg	Andrew Lampinen	Shao-Fang (Pam) Wang	Mona Rosenke
				
Role:	Instructor	Teaching assistant	Teaching assistant	Teaching assistant
Email:	gerstenberg@stanford.edu	lampinen@stanford.edu	shaofang@stanford.edu	rosenke@stanford.edu
Office:	302	316	409	424
Office hours:	Monday 2-3pm	Friday 12:30-1:30pm	Wednesday 1-2pm	Tuesday 4:30-5:30pm
Section:		Friday 1:30-2:20pm	Wednesday 2:30-3:20pm	

Tools we will use in class

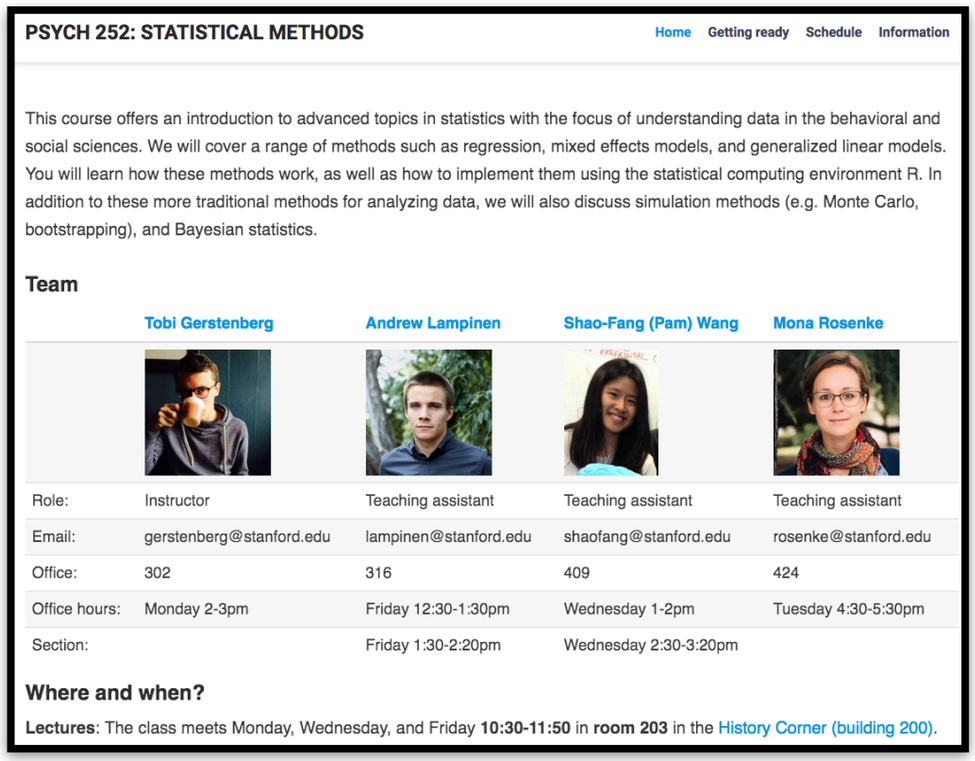
- Canvas
- Course homepage
- RStudio
- PollEverywhere
- Datacamp
- Piazza
- Free online books

Tools we will use in class

- **Canvas**
  - **We** will:
    - send announcements
    - upload:
      - slides
      - code
      - assignments
  - **You** will:
    - read announcements :)
    - upload homework

Tools we will use in class

- **Course homepage**
  - general information
  - schedule with links to materials (will keep being updated)
  - **https://psych252.github.io/**
  - you can access it via canvas



PSYCH 252: STATISTICAL METHODS

Home | Getting ready | Schedule | Information

This course offers an introduction to advanced topics in statistics with the focus of understanding data in the behavioral and social sciences. We will cover a range of methods such as regression, mixed effects models, and generalized linear models. You will learn how these methods work, as well as how to implement them using the statistical computing environment R. In addition to these more traditional methods for analyzing data, we will also discuss simulation methods (e.g. Monte Carlo, bootstrapping), and Bayesian statistics.

Team

	Tobi Gerstenberg	Andrew Lampinen	Shao-Fang (Pam) Wang	Mona Rosenke
Role:	Instructor	Teaching assistant	Teaching assistant	Teaching assistant
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Section:		Friday 1:30-2:20pm	Wednesday 2:30-3:20pm	

Where and when?

Lectures: The class meets Monday, Wednesday, and Friday **10:30-11:50** in **room 203** in the History Corner (building 200).

Tools we will use in class

- **RStudio**
  - write code
  - make beautiful plots
  - understand statistical concepts
  - implement statistical models
  - write homework assignments using R Markdown
  - contribute to reproducible research

Tools we will use in class

- **PollEverywhere**
  - quick polls in class
  - feedback at the end of class
  - address: **pollev.com/psych252**

How are you feeling today?

Tools we will use in class

- **DataCamp**
  - use your **stanford.edu** address to sign up!
  - if you haven't already, sign up here: **https://tinyurl.com/psych252datacamp**
  - get extra credit for taking courses

Schedule

Week	Day	Date	Topic	Content	Reading	Resources	Datacamp
1	M	7-Jan	Introduction	• Course introduction		• Cheatsheet R Studio • Cheatsheet R Markdown 1 • Cheatsheet R Markdown 2 • R Markdown for class reports	• Introduction to R • RStudio IDE 1 • RStudio IDE 2 • RMarkdown
	W	9-Jan	Visualization I	• Best practices • Introduction to RStudio • Introduction to `library(ggplot2)` • Reporting results using Rmarkdown	• Data visualization (#1) • Data visualization (#3)	• Cheatsheet ggplot2	• ggplot part 1 • ggplot part 2 • Reporting

Tools we will use in class

- **Piazza**
  - post your questions and answer your colleagues' questions (for extra credit, yay!)
  - form groups for the final project
  - sign up here: **https://tinyurl.com/psych252piazza**
  - access code**: sunnystats**

Tools we will use in class

- **Free online books**
  - we won't use a text book in class
  - statistics and data science are developing fast and I didn't find a single book that fit the bill
  - **but**: many great, free books online
  - **and**: I will point out suggested readings as we go along

Some **general thoughts**

Vision for this class

In "A Vision for Stanford", university president Marc Tessier-Lavigne states that Stanford wants to be

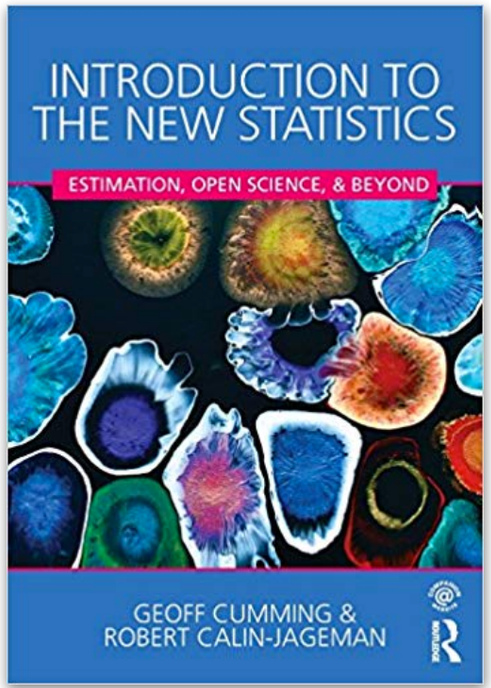
"an inspired, inclusive and collaborative community of diverse scholars, students and staff, where all are supported and empowered to thrive."

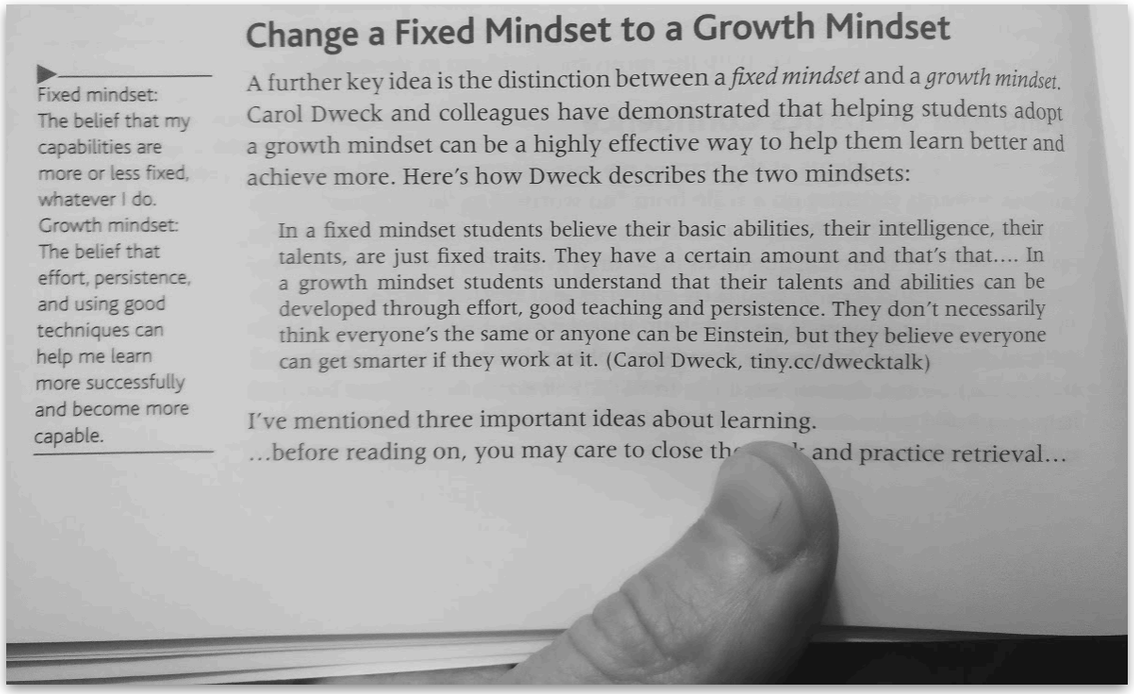
Let's try our best together in this class to make this happen!

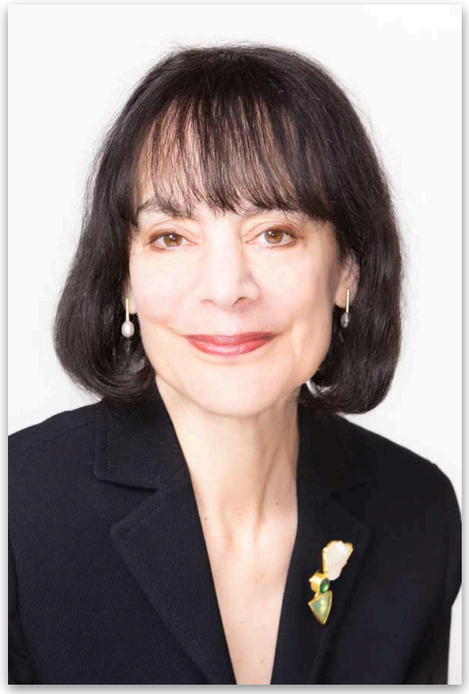
Fear of statistics

- I don't want to make a mistake ...
- What if my analysis script has bugs?
- Best response: openness!
- We will use **github** for the final projects.

Fear of statistics







my thumb

Carol Dweck

Try to adopt a growth mindset!

fixed mindset:
students believe their basic abilities, their intelligence, their talents, are just fixed traits.

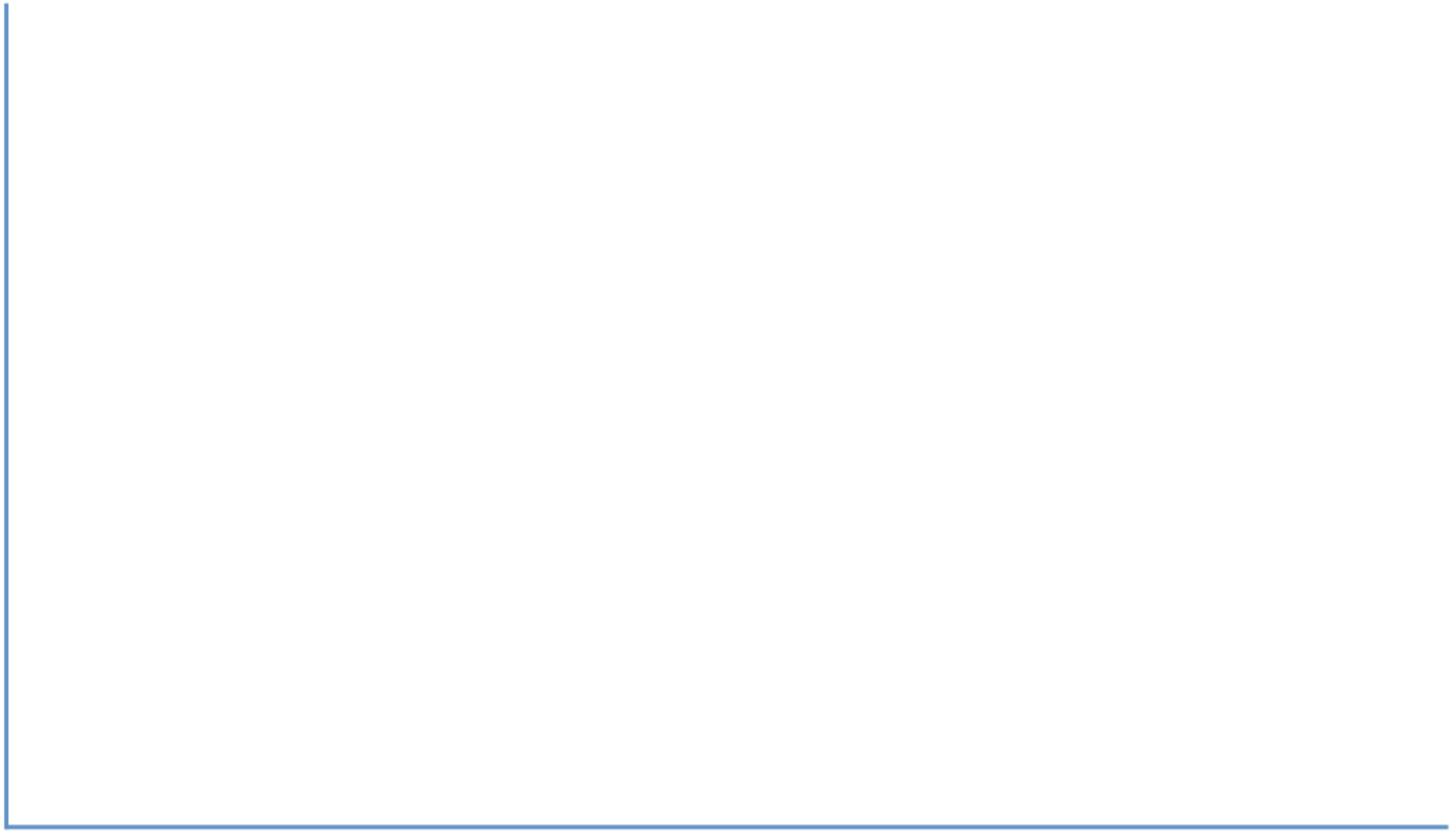
growth mindset:
students *understand* that their talents and abilities can be developed through effort, good teaching and persistence

Feedback

Feedback

- ask questions in class and/or come to us after class
- post questions on Piazza (you can post anonymously)
- send us an email (but use Piazza for questions about homework or class!)
- use anonymous feedback form (link at the bottom of the course website) https://tinyurl.com/psych252feedback
- come to office hours

How was the pace of today's class?



How happy were you with today's class overall?

What did you like about today's class? What could be improved next time?

Thank you to ...

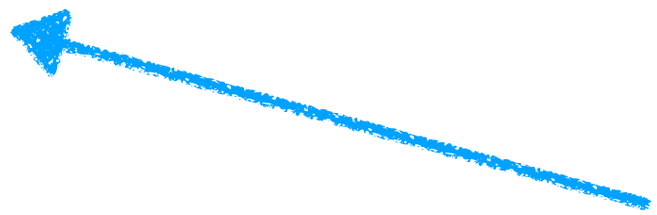
Alexandra Chouldechova
Ben Baumer
Benoit Monin
Datacamp
David Lagnado
Ewart Thomas
Henrik Singmann
Julian Jara-Ettinger
Kevin Smith
Maarten Speekenbrink
Matthew Salganik
Mika Braginsky
Mike Frank
Mine Çetinkaya-Rundel
Patrick Mair
Richard McElreath
Russ Poldrack
Stephen Dewitt
Tom Hardwicke

Thanks!

see you on **Wednesday**

bring a laptop

(with **R** and **RStudio** installed and up to date)



post on Piazza if you experience any problems