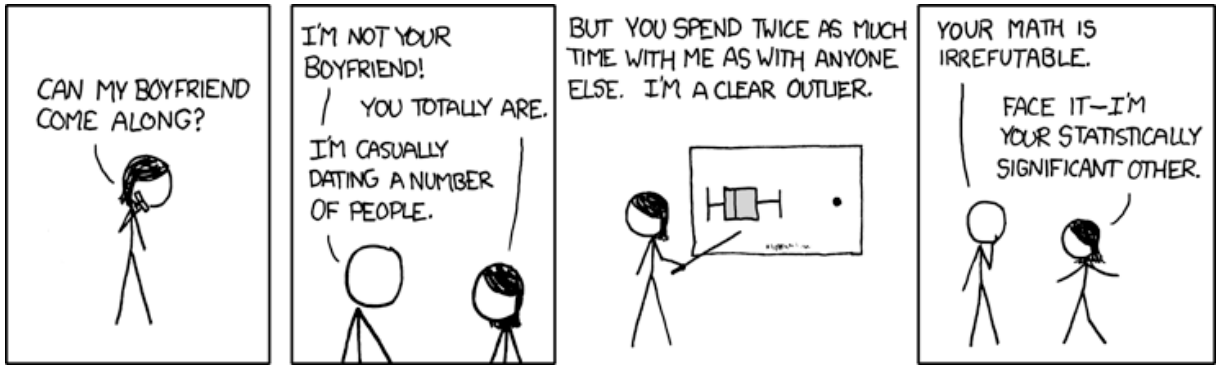


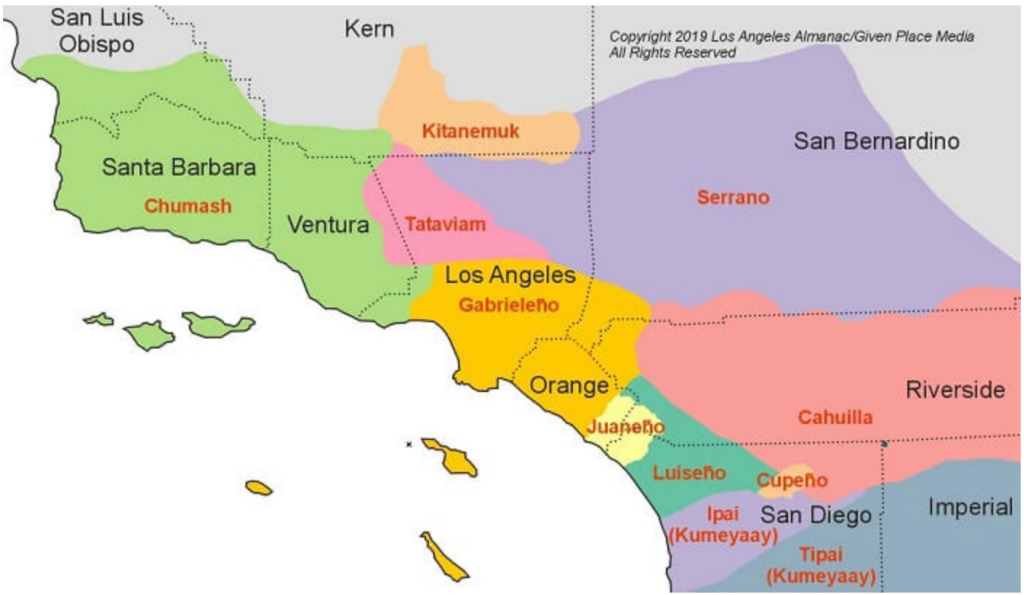
Image credit: xkcd.com "Boyfriend"

Jo Hardin
Pomona College
August 5, 2023

Teaching Introduction to Statistics

This land acknowledgment recognizes systemic and institutional systems of power that have oppressed Indigenous peoples, with many of the same systems in place today that continue to marginalize those with less power.

Original People of Los Angeles County



Map of territories of Orignal Peoples with county boundaries in Southern California, Los Angeles Almanac, 2019.
Information sources: *Handbook of North American Indians, Vol. 8, California*, William C. Sturtevant (Gen. Editor) & Robert F. Heizer (Vol. Editor), 1978, Smithsonian Institute, and Dr. E. Gary Stickel, Ph.D. (UCLA), Tribal Archeologist, Kizh Nation / Gabrieleno Band of Mission Indians.

image credit: http://www.laalmanac.com/history/hi05.php

First time through: focus on class time

- organize the topics before the semester starts
- make sure the class time runs smoothly (prepare your lecture!)
- use HW assignments from the text
- give in-class exams (use gradescope to grade)
- do web searches for “t-test quiz”
- projects / extensive HW / solutions / etc. come at the next iteration of the class

#1 hardest thing to teach

sampling distributions
are confusing

- use tactile activities
- use applets
- use R
- use theory

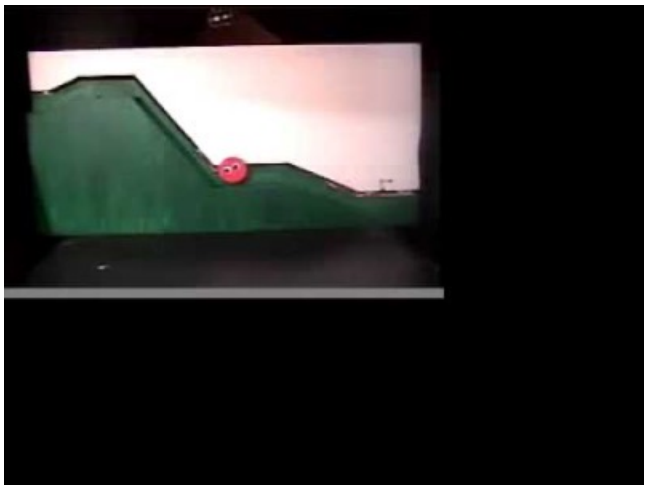
Helper babies

Taken from ISCAM Investigation 1.1
Beth Chance and Allan Rossman

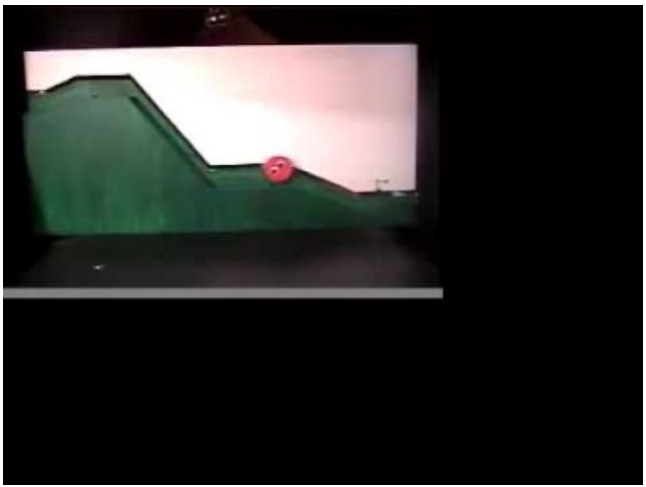
Social evaluation by preverbal infants

J. Kiley Hamlin, Karen Wynn & Paul Bloom

Nature **450**, 557–559 (2007) | Cite this article

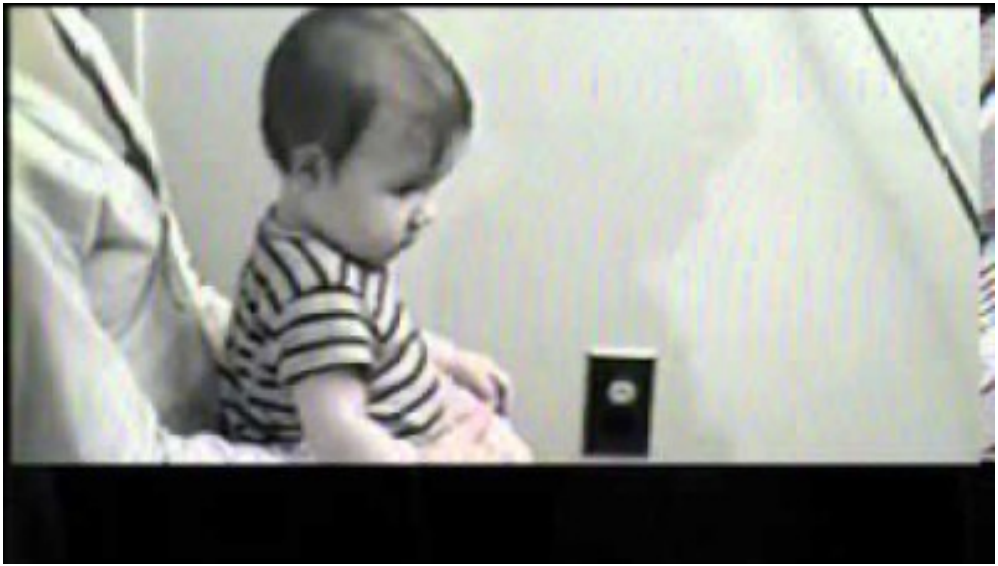


https://www.youtube.com/watch?v=WqEV9Otdp58



https://www.youtube.com/watch?v=YX6PTixcS5I

Babies: 14 of 16 chose the helper shape



https://www.youtube.com/watch?v=dijiqWrUOx0

Why might a baby choose a helper shape?

- like the color blue
- parents give indication
- random chance
- babies taught to like helper
- babies inherently like helper
- like triangles
- …

Why might a baby choose a helper shape?

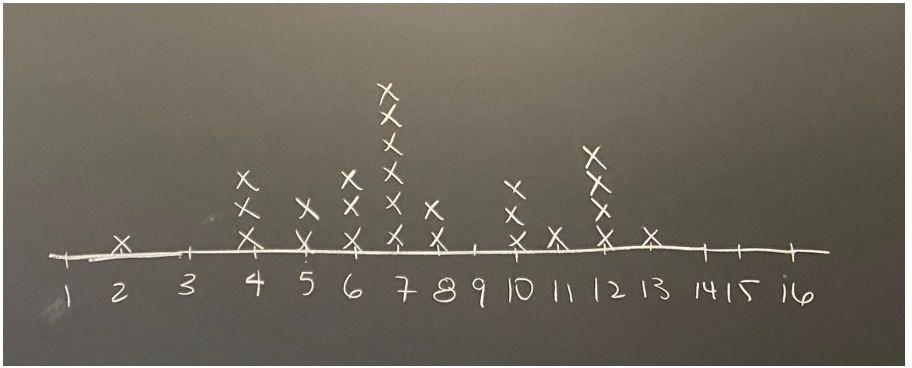
Experimental Design	Research Question	Random Chance
• like the color blue • like triangles • parents give indication	• babies taught to like helper • babies inherently like helper	• random chance

clicker questions

Tactile

- 14 out of 16 babies chose the helper

- give each student a coin
- have them come up with what to do



Applet

One Proportion

Describe process:

Probability of heads: 0.5

Number of tosses: 16

Number of repetitions: 200

☑ Show animation

Draw Samples

Total Repetitions = 200

Choose statistic:

◉ Number of heads

○ Proportion of heads

Count samples

As extreme as ≥ 14

Count

Proportion of repetitions:
0 / 200 = 0

Options:

☐ Two-sided

☐ Exact Binomial

☐ Normal Approximation

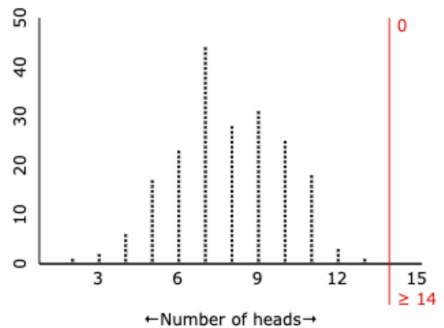
Reset Clear counts

Most recent results

Number of Heads = 6

Number of Tails = 10

☐ Summary Statistics



☐ Show previous results

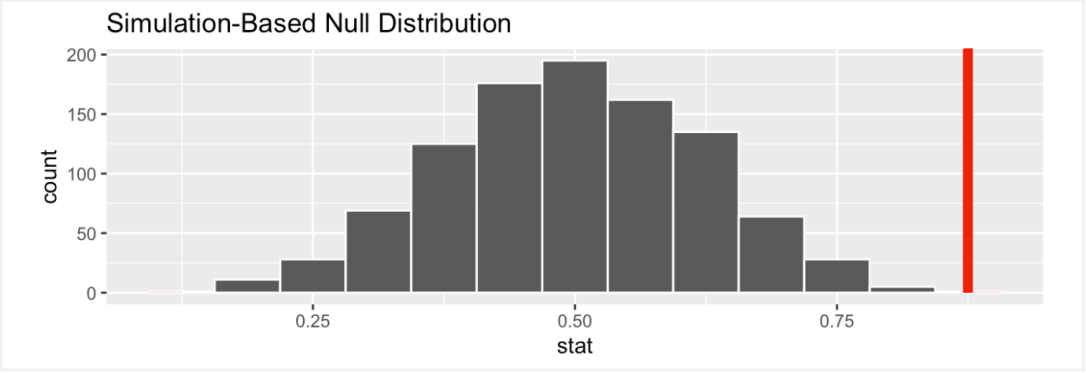
☐ Show sliders

http://www.rossmanchance.com/applets/2021/oneprop/OneProp.htm

R

```r
null_help <- Infants %>%
  specify(response = choice, success = "helper") %>%
  hypothesize(null = "point", p = .5) %>%
  generate(reps = 1000, type = "simulate") %>%
  calculate(stat = "prop")

# then visualize the null sampling distribution & p-value
visualize(null_help, bins = 13) +
  shade_p_value(obs_stat = p_obs, direction = "two_sided")
```



http://st47s.com/Math58/Notes/intro.html#ex:helper

https://infer.netlify.app/

Theory

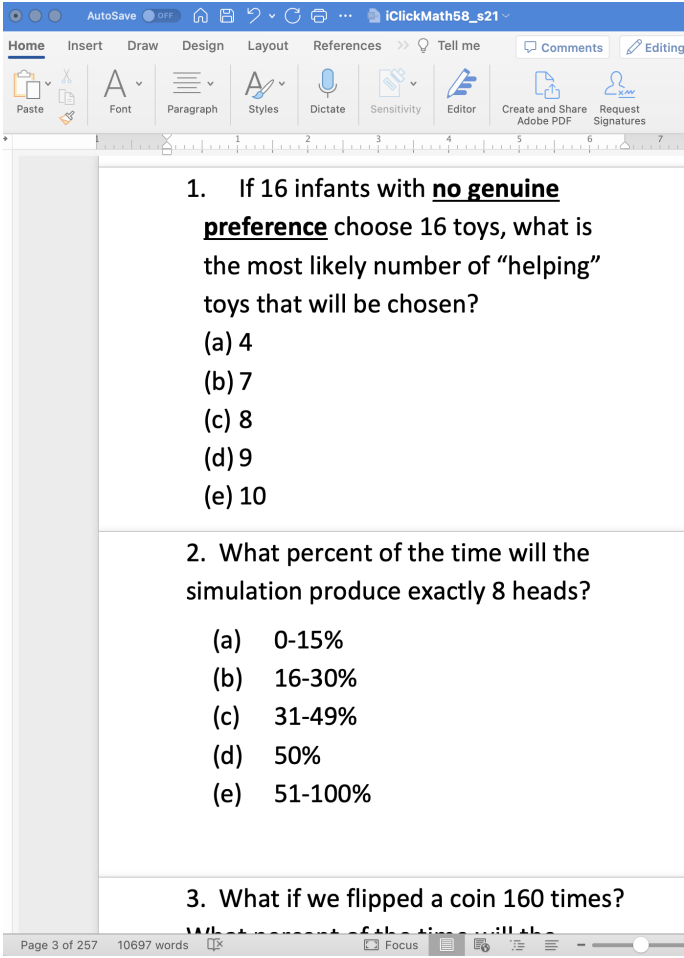
- not yet, according to my schedule of topics.

date	topic	agenda	readings	article (Tues)	assignments
Week 1 1.17.23	Intro + variables & studies SLR	• course info • tests • studies • causation	Introduction Studies ISCAM 1.1 IMS 1 + 2	none Felicity Enders	WU1 WU2 HW 0 pdf HW 0 Rmd
Week 2 1.24.23	Correlation + Least squares	• correlation • linear model • R^2	Cor Least Sq ISCAM 5.6, 5.7, 5.8 IMS 7 guess corr least sq	AstraZeneca W.E.B. Du Bois	WU3 WU4 HW 1 pdf HW 1 Rmd Lab 1 pdf Lab 1 Rmd
Week 3 1.31.23	Hyp Test + Randomization Test	• structure of hypothesis testing	Tests 2x2 Rand IMS 11	chocolate Regina Nuzzo	WU5 WU6 HW 2 pdf HW 2 Rmd Lab 2 pdf Lab 2 Rmd
Week 4 2.7.23	Bootstrapping	• boot samp dist • boot CI	Bootstrapping Boot CIs StatKey CIs IMS 12	confounding David Blackwell	WU7 WU8 HW 3 pdf HW 3 Rmd Lab 3 pdf Lab 3 Rmd
Week 5 2.14.23	normality + CLT	• normal dist • CLT • Z-score • empirical rule • conf int • norm prob • hyp test	CLT Norm dist Samp Dist IMS	efficacy vaccines Florence Nightingale	WU9 WU10 HW 4 pdf HW 4 Rmd Lab 4 pdf Lab 4 Rmd

https://m58-intro-stats.netlify.app/

Clicker questions

- I never track student responses (I don't assess)
- The best Q are those that most people get wrong
- Can ask Q spontaneously
- Very important when students are sleepy

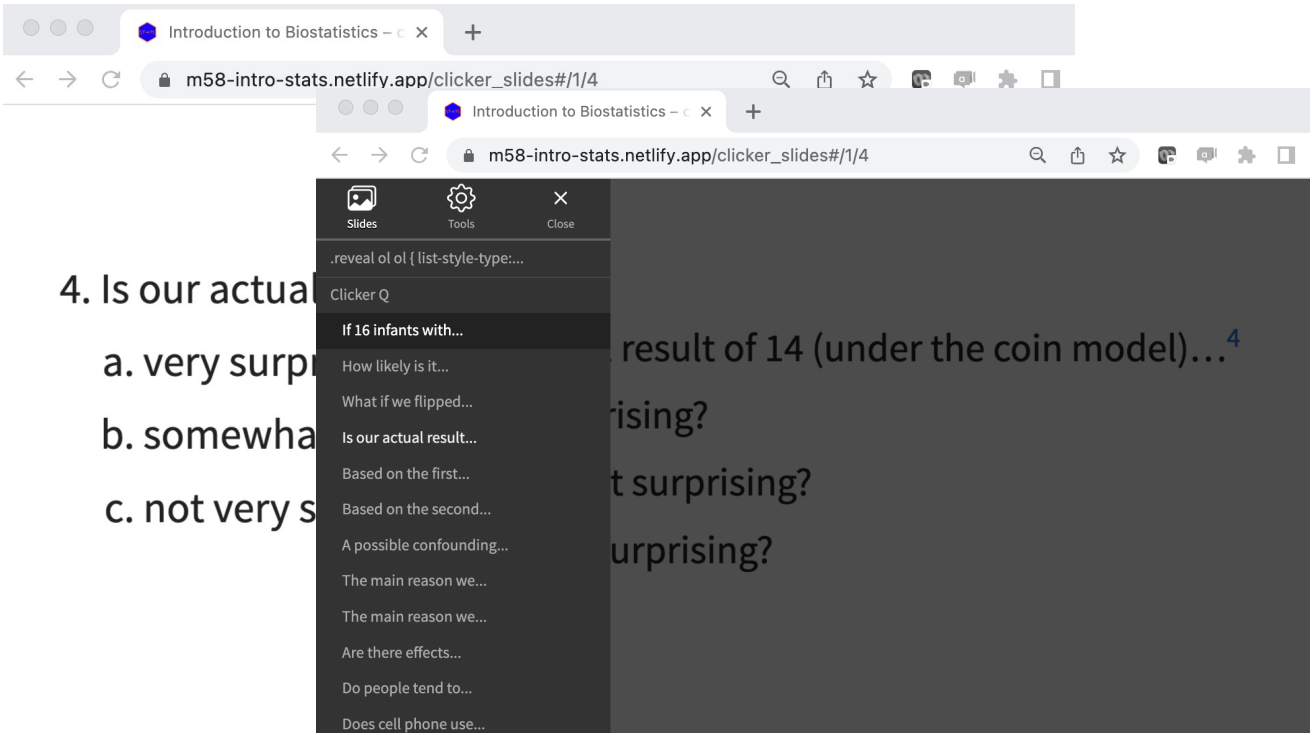


Clicker questions have evolved

4. Is our actual result of 14 (under the coin model)…[4]
    a. very surprising?
    b. somewhat surprising?
    c. not very surprising?

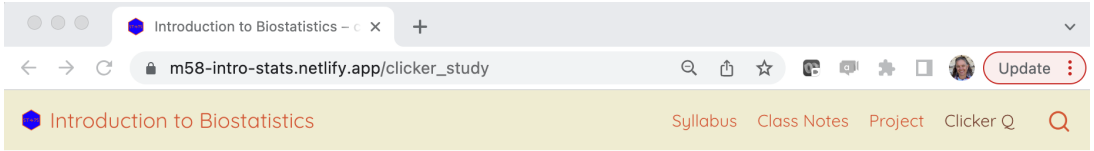
https://m58-intro-stats.netlify.app/clicker_slides

Clicker questions have evolved



https://m58-intro-stats.netlify.app/clicker_slides

Different versions of the clicker questions



Clicker Q

to go with **Introduction to Modern Statistics** by Çentinkaya-Rundel & Hardin. Math 58B - Introduction to Biostatistics.

1. If 16 infants with **no genuine preference** choose 16 toys, what is the most likely number of "helping" toys that will be chosen?[1]
   a. 4
   b. 7
   c. 8
   d. 9
   e. 10

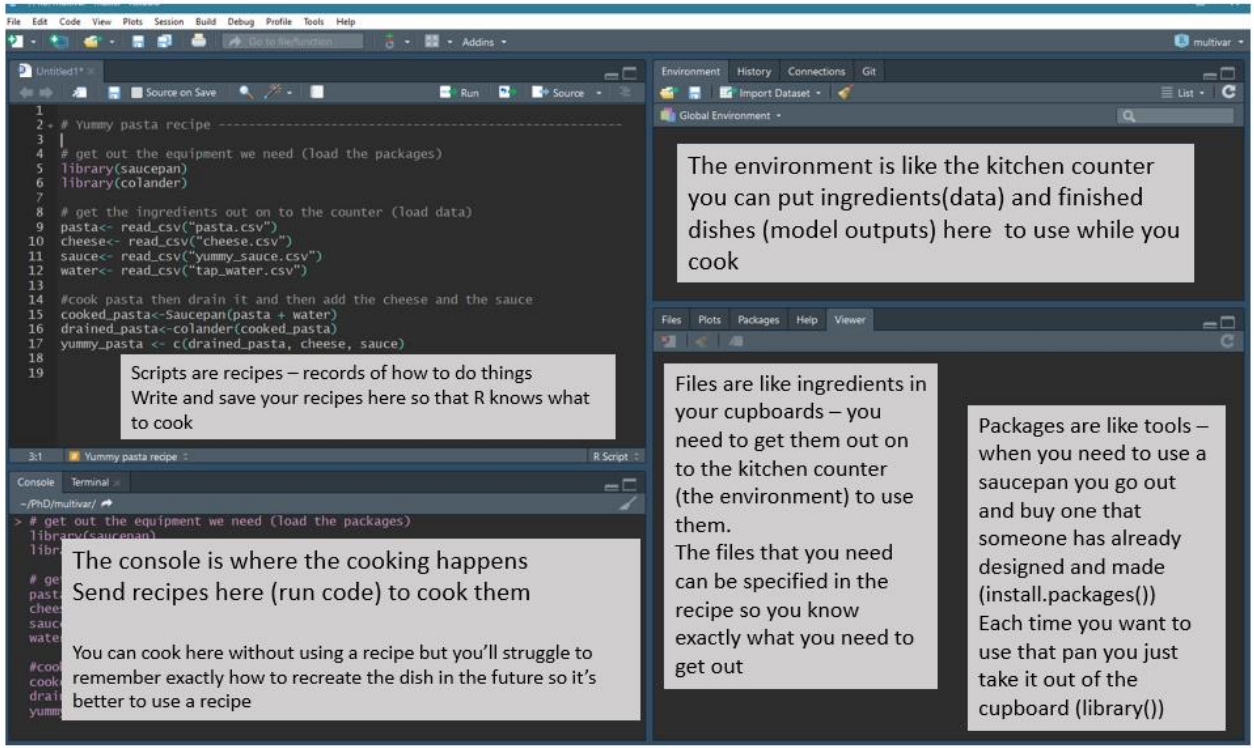
2. How likely is it that exactly 8 helpers will be chosen (if there is no preference)?[2]
   a. 0-15%
   b. 16-30%
   c. 31-49%
   d. 50%
   e. 51-100%

3. What if we flipped a coin 160 times? What percent of the time will the simulation flip exactly 80 heads?[3]
   a. 0-15%

can put the solution into the footnote

https://m58-intro-stats.netlify.app/clicker_study

Rstudio & R



- Reinforces concepts
- Important skills
- Super fun
- Scaffold assignments

Worksheets

Taken from ISCAM Investigation 4.3
Beth Chance and Allan Rossman

Psychologist Stanley Coren has conducted several studies investigating the life expectancy of lefthanders compared to right-handers, believing that the stress of being left-handed in a right-handed world leads to earlier deaths among the left-handers. In one study Coren and Halpern (1991) sent surveys to thousands of next-of-kin of recently deceased southern Californians and asked whether the person had been right-handed or left-handed. They were very careful in how they collected their data. First, they consulted a bereavement counselor who suggested that they not contact anyone unless at least 9 months had passed since the death. The counselor also suggested that they make the contact as gentle as possible and not follow up or press people for responses. The researchers also decided that they would not contact next of kin if the death had been a result of murder or suicide or if the deceased was a child age 6 or younger. They received 987 replies and found that the average age of right-handed people at death was 75 years and for left-handed people it was 66 years.

Worksheets

text jhardin447 to 37607 → once to join.

then submit a word or two with your reflection on the worksheet

Worksheets

- participation points
- read / feedback every day
- a method for learning names
- students get to know each other

The Islands

Life on an Island: a Simulated Population to Support Student Projects in Statistics

2011 | Bulmer, Michael; Haladyn, J. Kimberly

Published Web Location https://doi.org/10.5070/T551000187

theislands.umn.edu/login.php

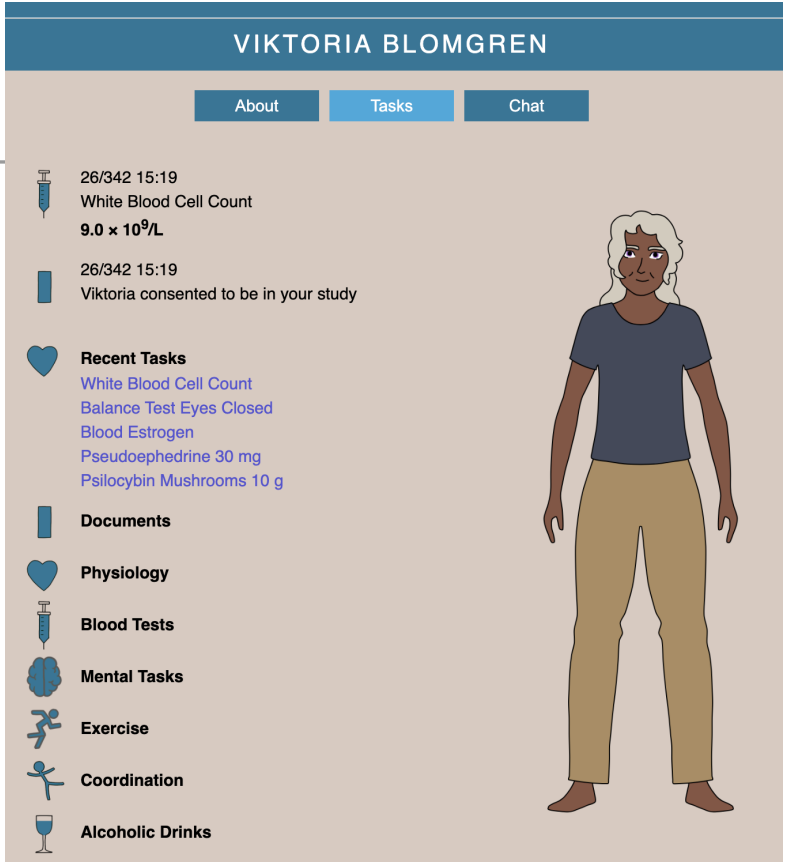
THE ISLANDS

Welcome to the home of the Islanders, a virtual human population that has been developed to support learning and teaching in experimental design, epidemiology and statistical reasoning.

The three Islands of Ironbard, Providence and Bonne Santé were settled by the survivors of simultaneous shipwrecks around 341 years ago. The initial settlements have grown and there are now twenty-seven villages with a combined population of over forty thousand Islanders for you to study. Login below to visit them.

The Islands

- Power analysis
- Reproducibility
- Ethical Concerns
- The entire pipeline



https://m58-intro-stats.netlify.app/project

Good luck!

- Use the PTT network
- Try new things, but don't overwhelm yourself
- Re-use what other people have done!
- If you don't know, say so and bring the answer to the next class.

Resources

- My Intro Stats website:
  https://m58-intro-stats.netlify.app/

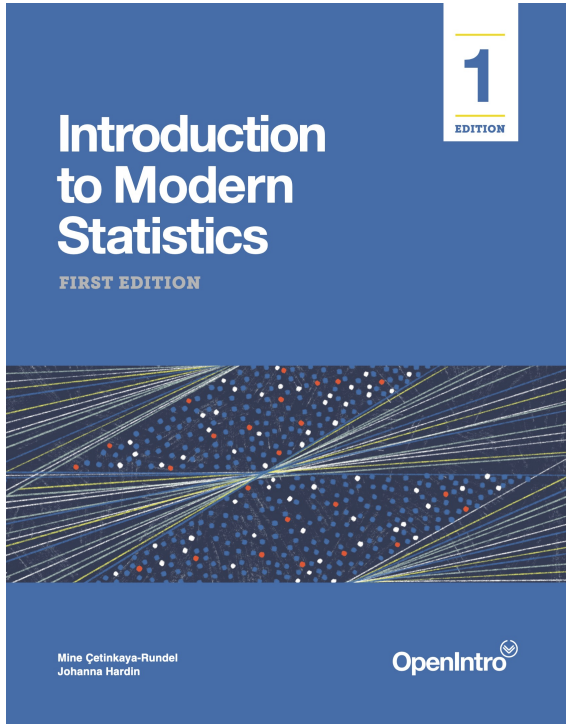
- Introduction to Modern Statistics
  (w Mine Çetinkaya-Rundel):
  https://openintro-ims.netlify.app/

- ISCAM applets:
  https://www.rossmanchance.com/applets/index2021.html

Passion Projects

JUSTICE
EQUITY
DIVERSITY
INCLUSION
OUTREACH GROUP

https://datascijedi.org/



CURV
connecting, uplifting, and recognizing voices

Keeping Busy with Data Science

image credit: Allison Horst

1. GitHub
2. Starting with R
3. Model data
4. Natural Language Processing
5. Practice doing data science
6. Interactive graphics
7. Art and R
8. Watch videos and take classes
9. Participate in the data science community
10. Write an R package

https://hardin47.netlify.app/blog/keep-busy-with-data-science/

Thank you

Image credit: Pomona College

jo.hardin@pomona.edu

https://github.com/hardin47

https://hardin47.netlify.app/