Statistical Inference via Data Science: A ModernDive into R & the Tidyverse

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UBC Statistics
Vancouver BC Canada

Tuesday May 19, 2020

Slides available at twitter.com/rudeboybert

Statistical inference **via** data science…

Guiding Paper

“Mere Renovation is Too Little Too Late: We Need to Rethink Our Undergraduate Curriculum from the Ground Up” by Cobb RIP🕯️ (TAS 2015)

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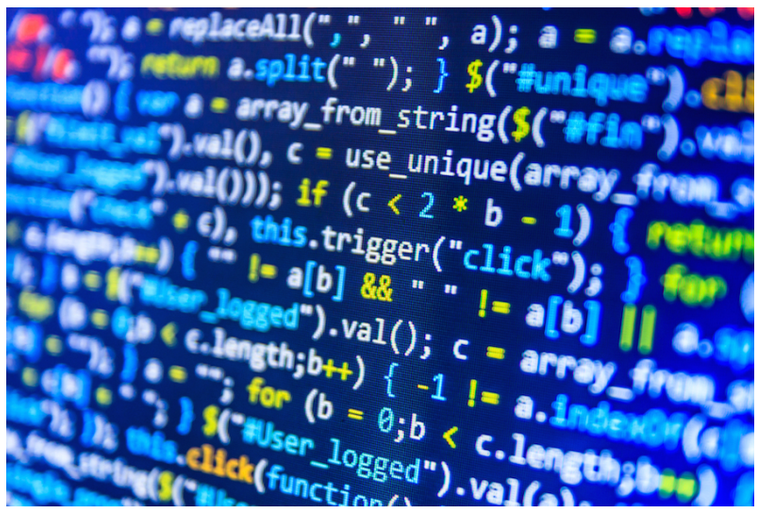

My ideal pathway for Intro Stats

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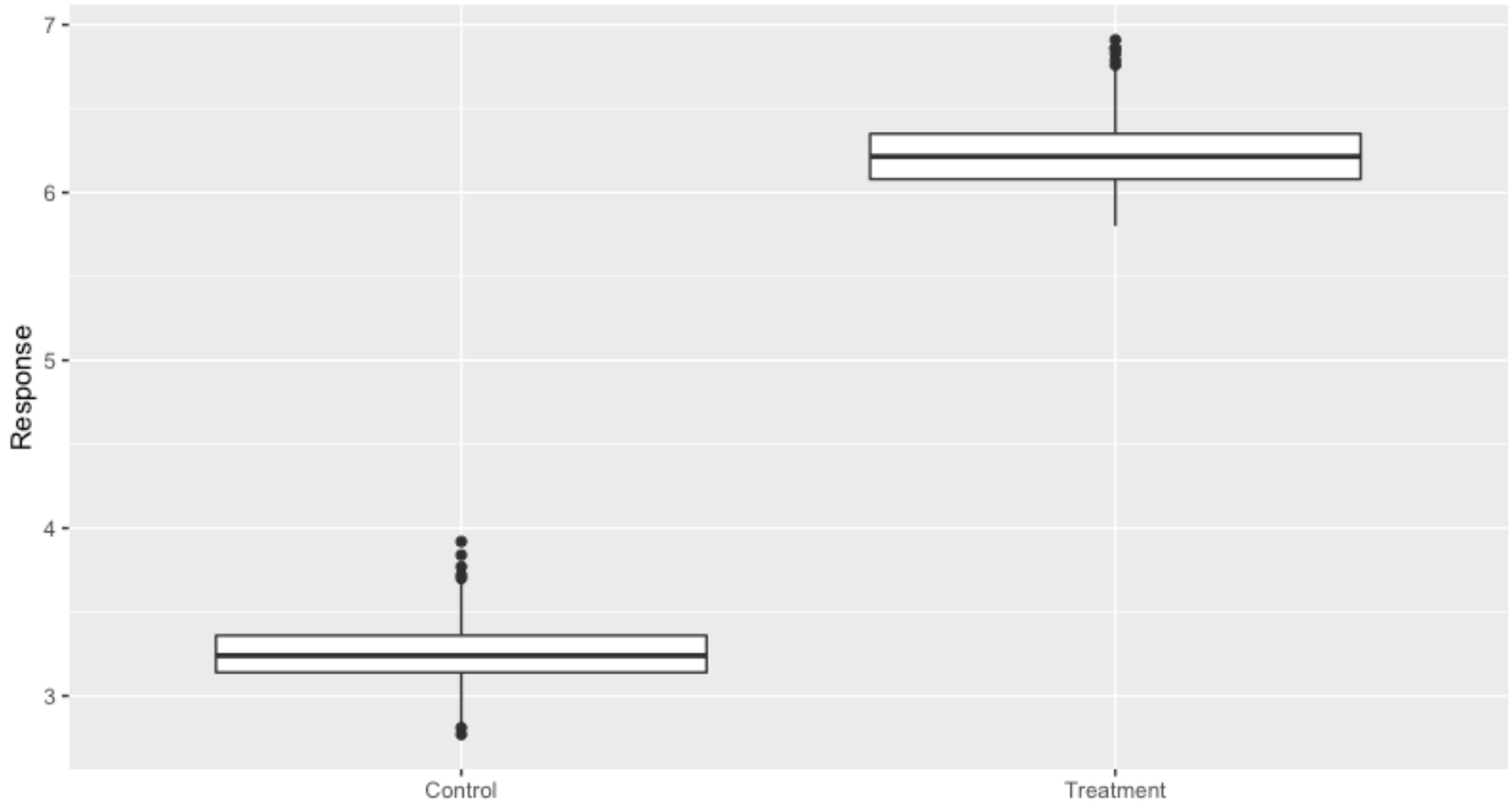

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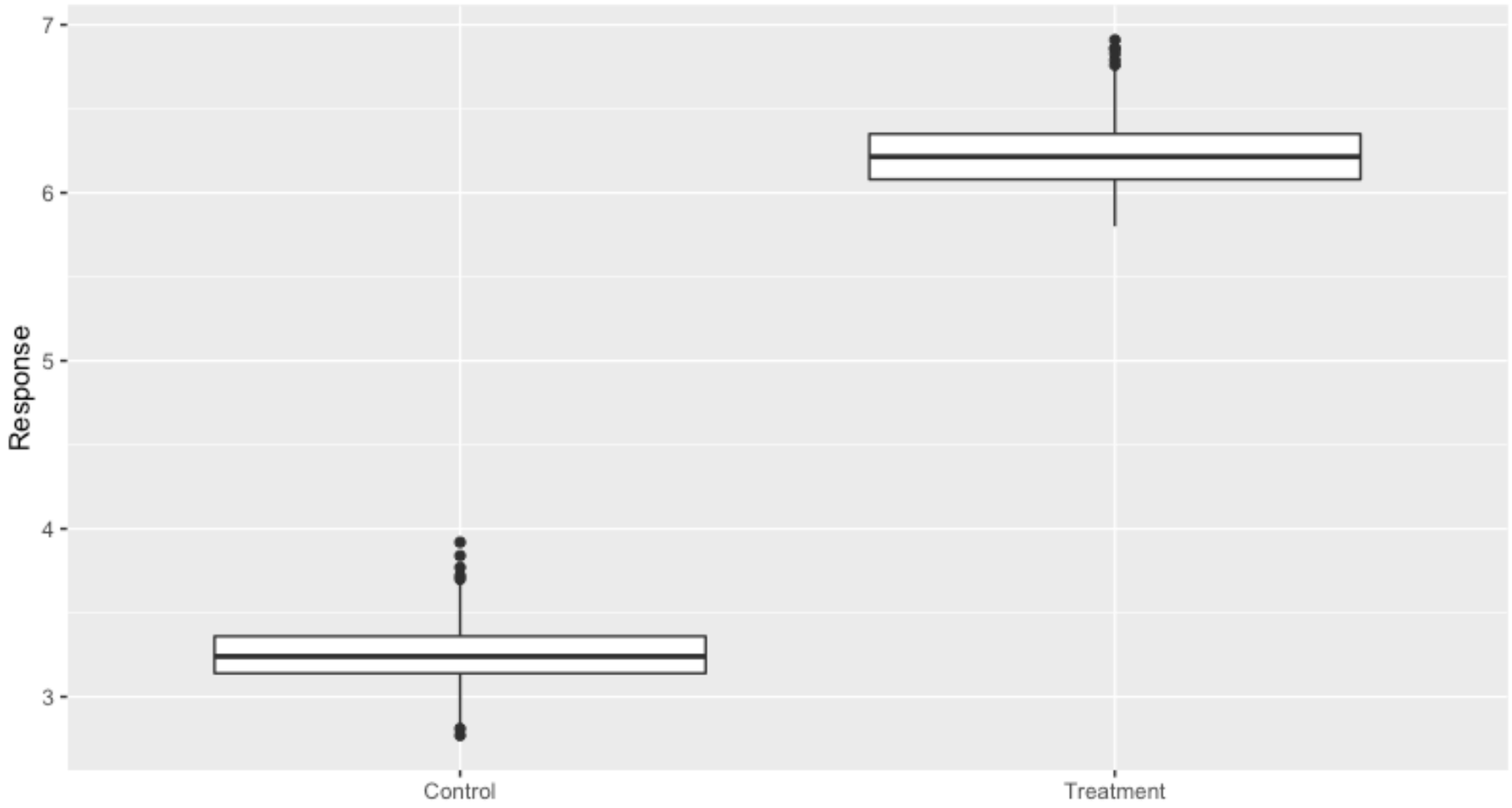

Versus just saying: "The p-value is 0!"

Ch2,4,5 Data Wrangling, Importing, “Tidy”

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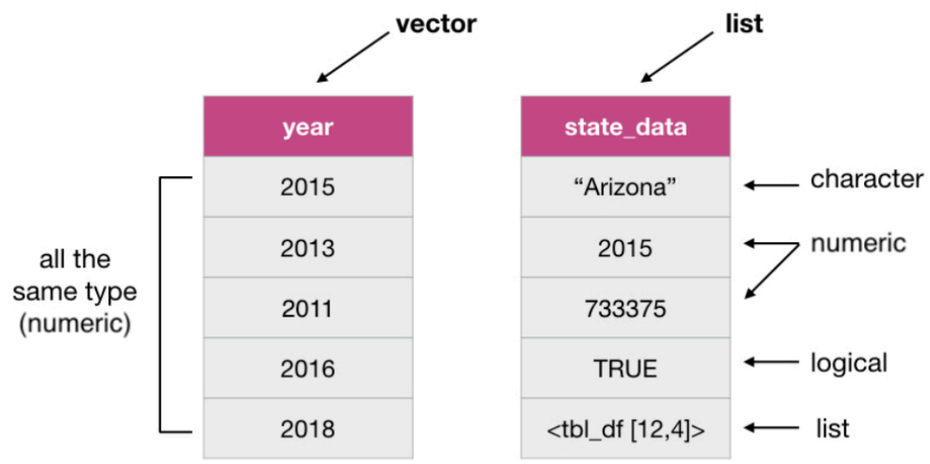
vector of type char | vector of type numeric | vector of type logical

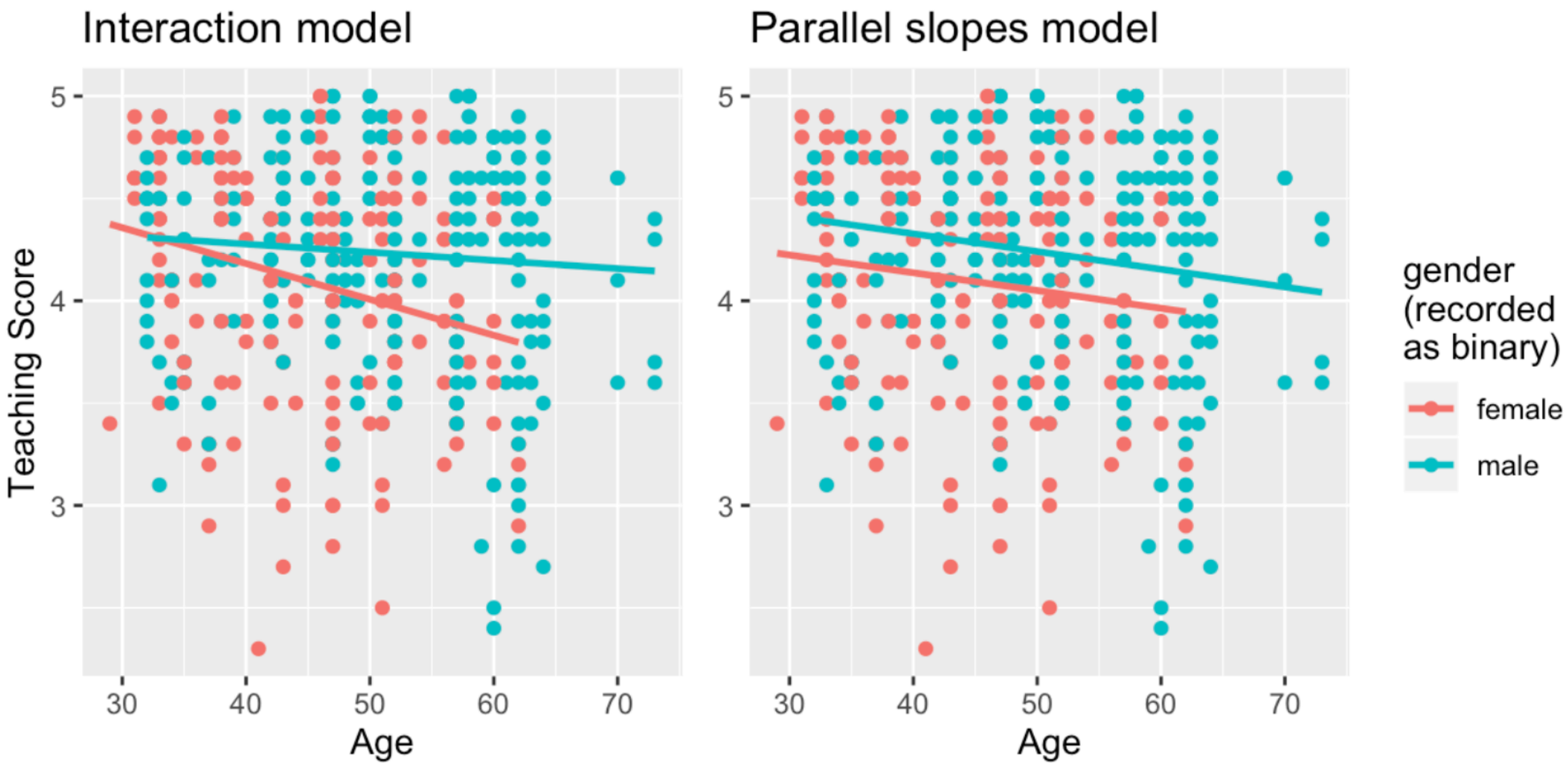
state	year	voted
AK	2016	TRUE
AL	2016	TRUE
AR	2016	TRUE
AZ	2016	TRUE
CA	2016	TRUE
CO	2016	TRUE
CT	2016	TRUE
DC	2016	TRUE
DE	2016	TRUE
FL	2016	TRUE
GA	2016	TRUE
HI	2016	TRUE
IA	2016	TRUE

VS



An aside: Ch6+7 Linear Regression

“Visual” model selection using teaching evals data



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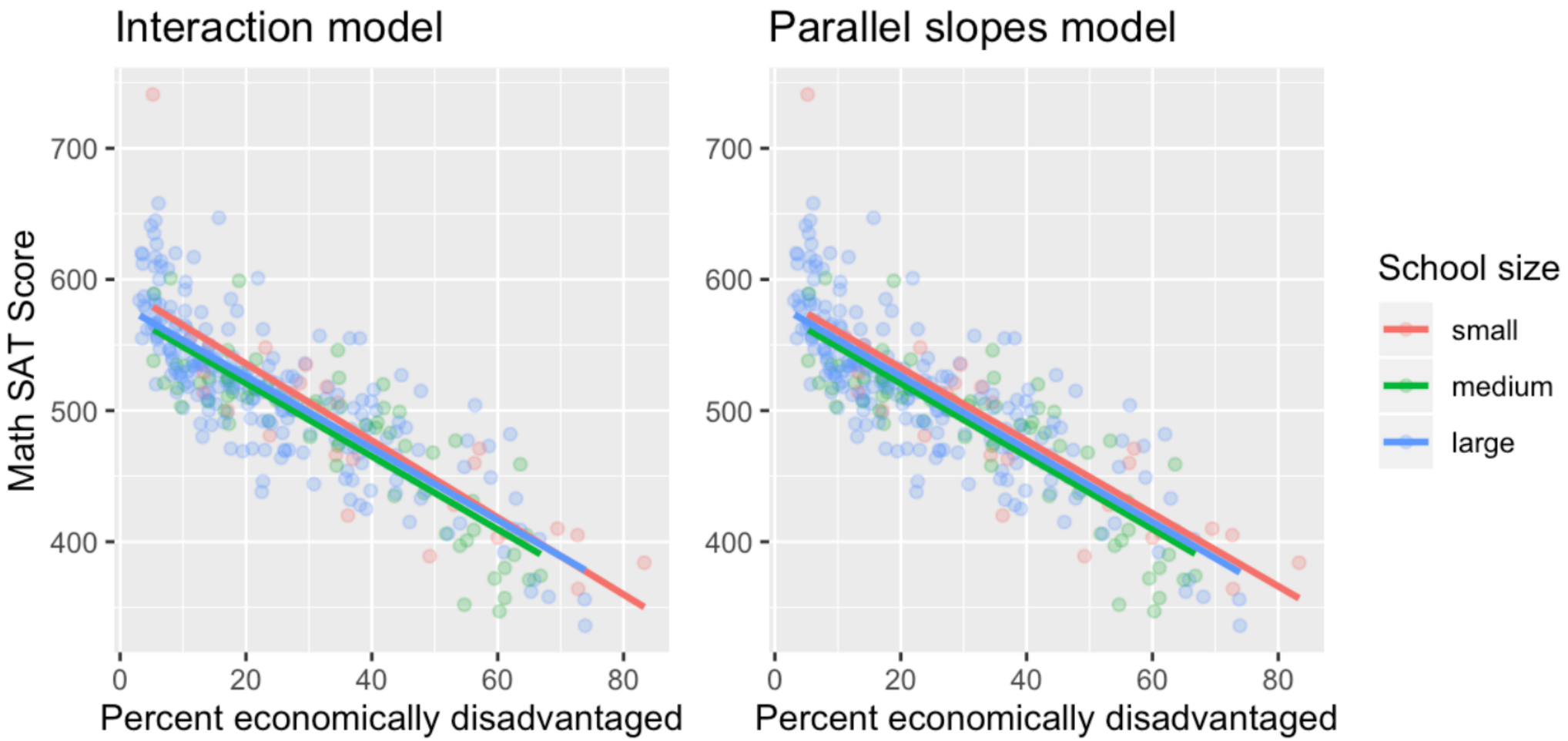
“Visual” model selection using 2017 MA Public HS Data



My ideal pathway for Intro Stats

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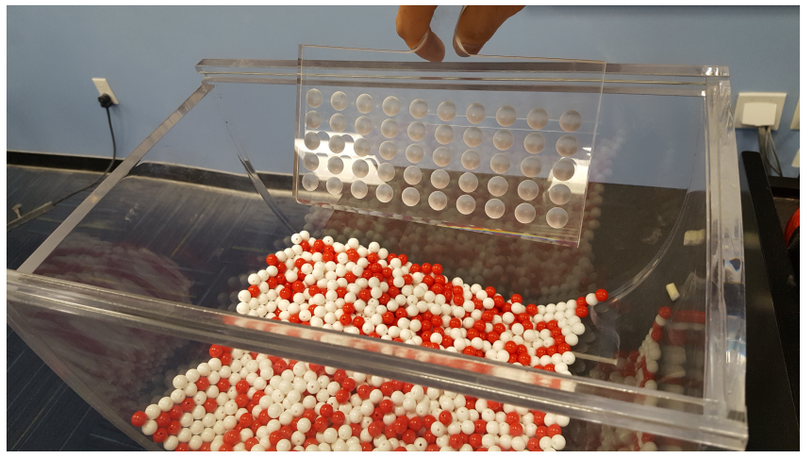
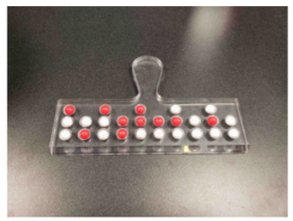
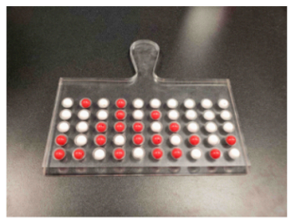
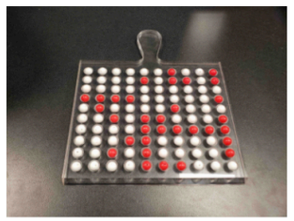
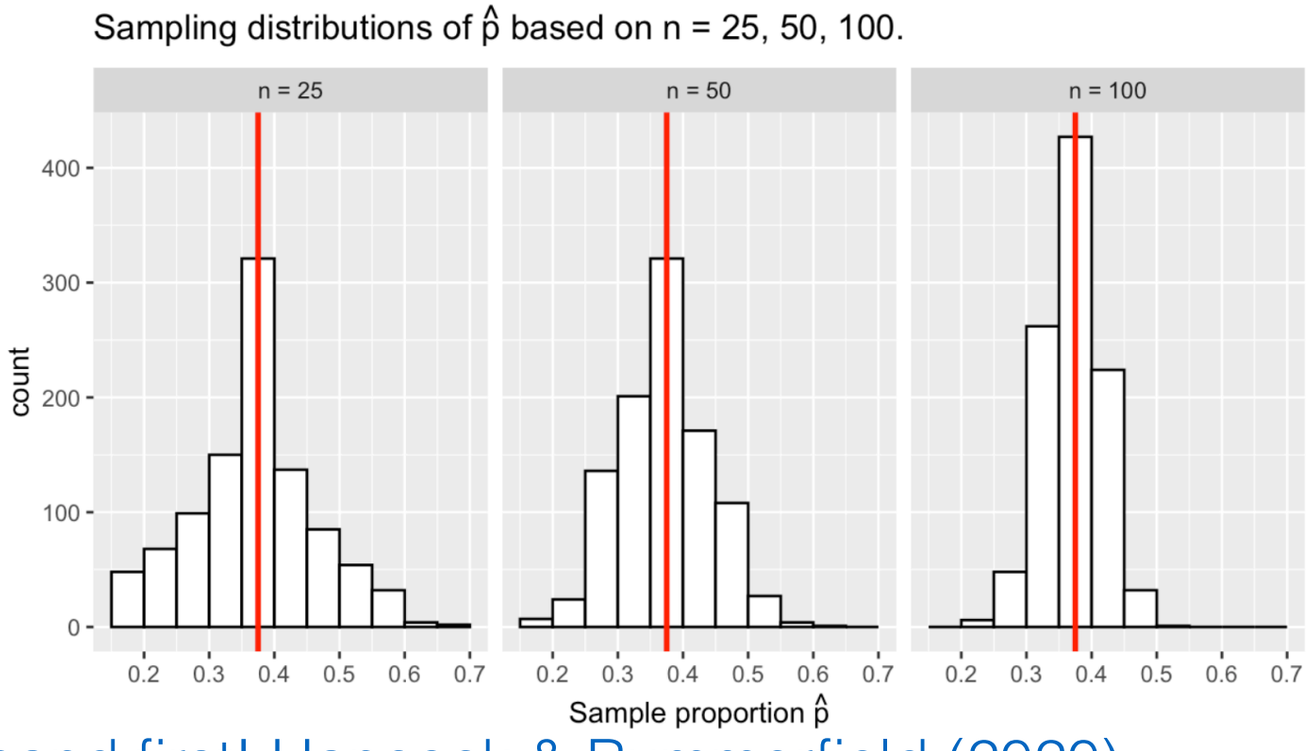
Ch7 Sampling



A shovel with 25 slots	A shovel with 50 slots	A shovel with 100 slots
		



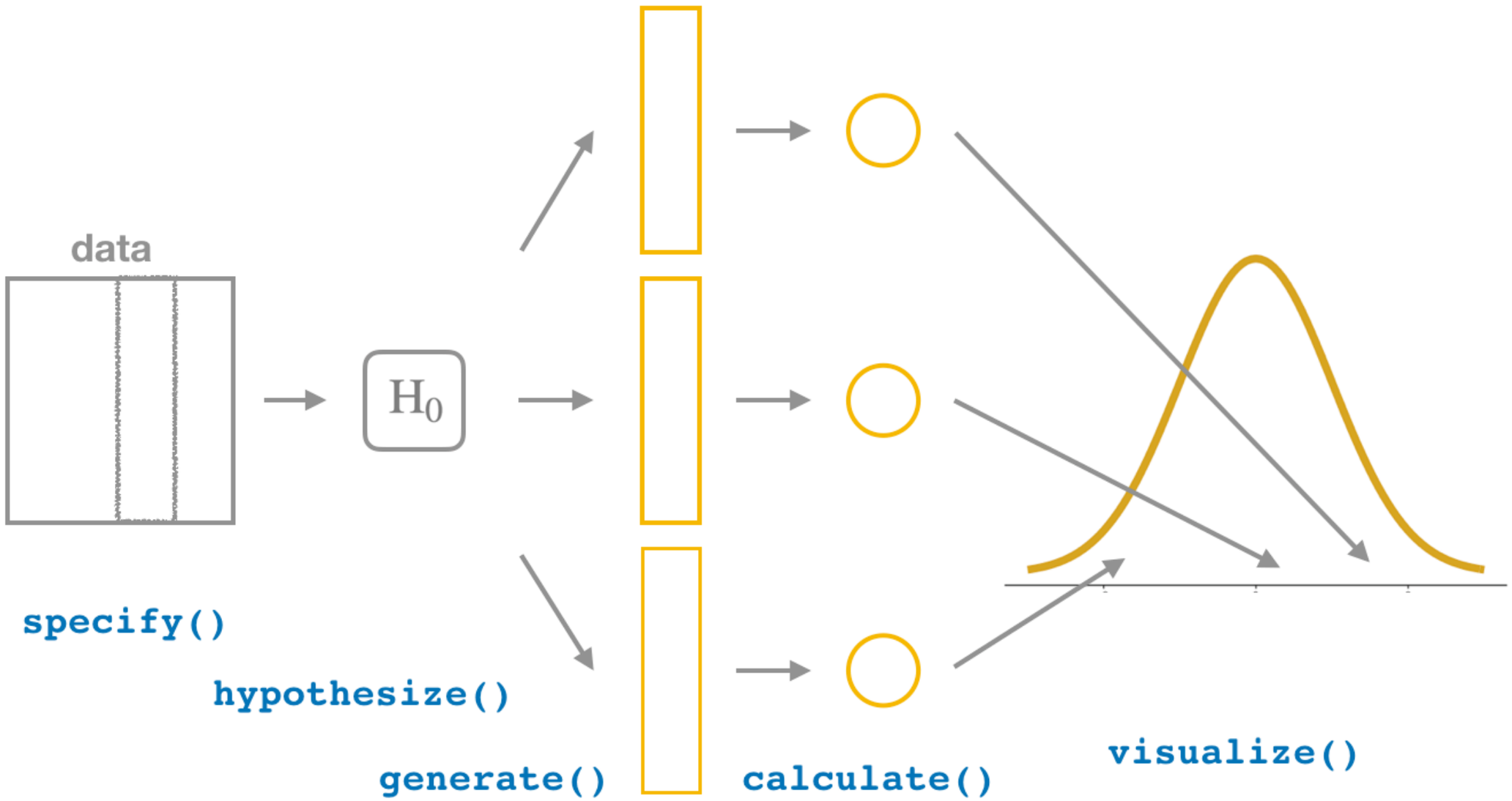
From: [Do things by hand first! Hancock & Rummerfield (2020)]

Sampling Scenarios Covered

TABLE 7.5: Scenarios of sampling for inference

Scenario	Population parameter	Notation	Point estimate	Symbol(s)
1	Population proportion	p	Sample proportion	$\hat{p}$
2	Population mean	μ	Sample mean	$\overline{x}$ or $\widehat{\mu}$
3	Difference in population proportions	$p_1 - p_2$	Difference in sample proportions	$\hat{p}_1 - \hat{p}_2$
4	Difference in population means	$\mu_1 - \mu_2$	Difference in sample means	$\overline{x}_1 - \overline{x}_2$
5	Population regression slope	β_1	Fitted regression slope	b_1 or $\widehat{\beta}_1$

infer package for “tidy” statistical inference



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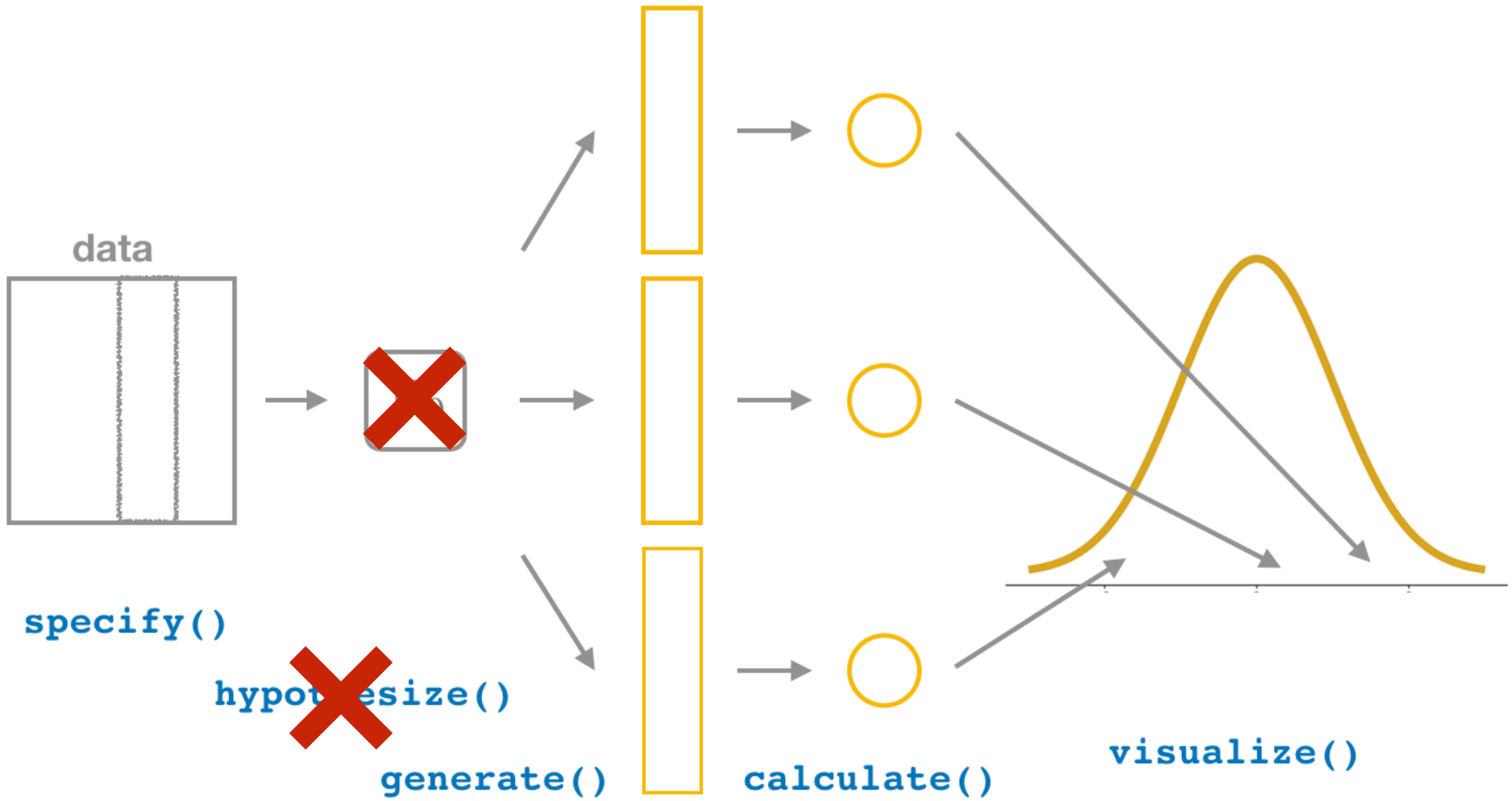

Skip this step for confidence intervals

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Ch8 What is mean year of all 🇺🇸 pennies?

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> library(moderndive)
> pennies_sample
# A tibble: 50 x 2
      ID  year
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 2     2  1986
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library(tidyverse)
library(infer)

pennies_sample %>%
  specify(response = year) %>%
  generate(reps = 1000) %>%
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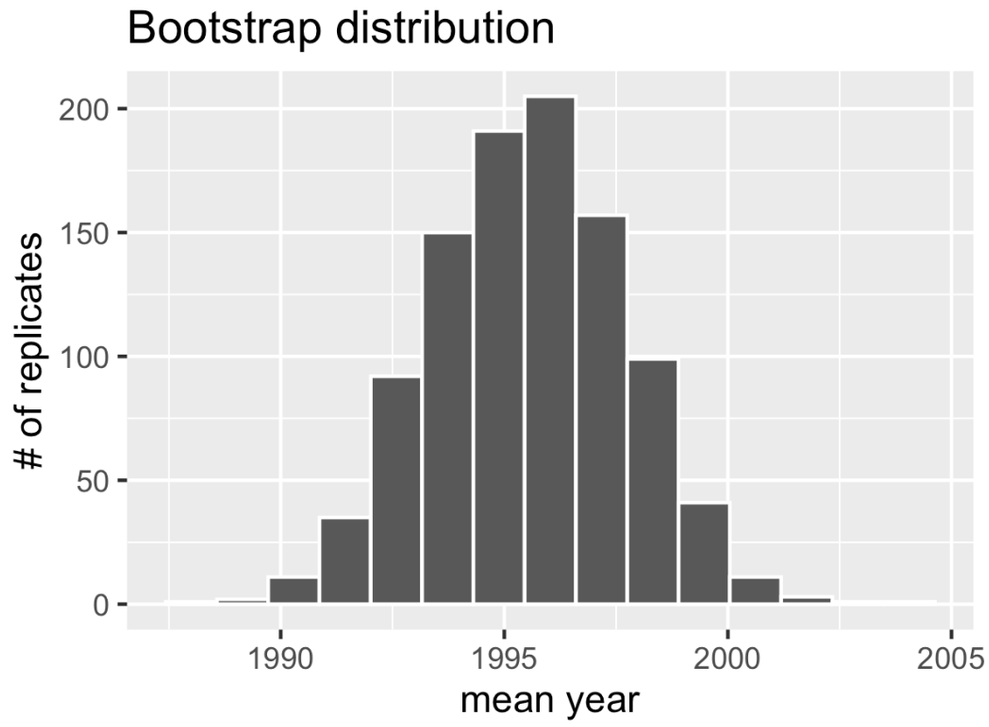

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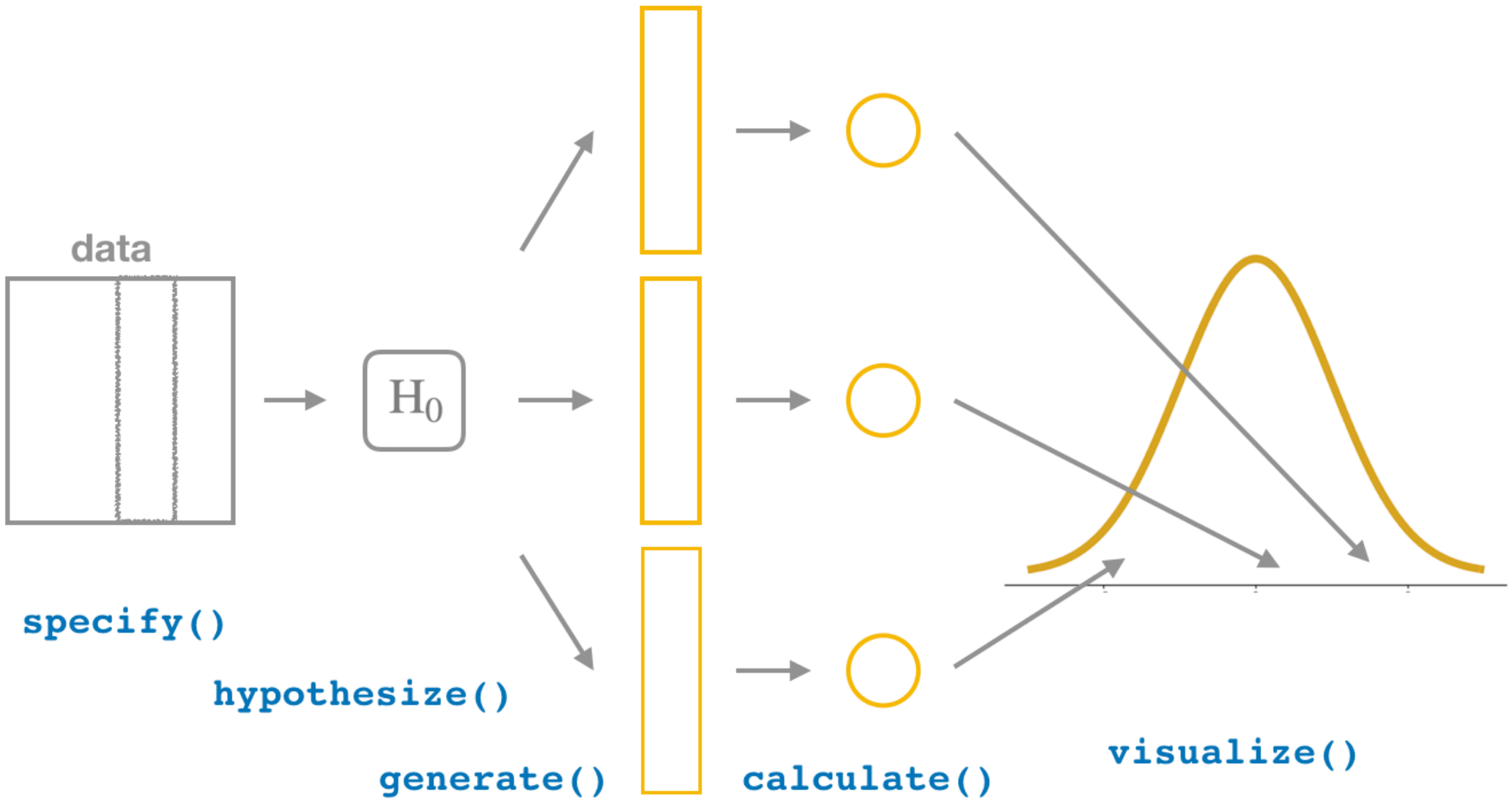

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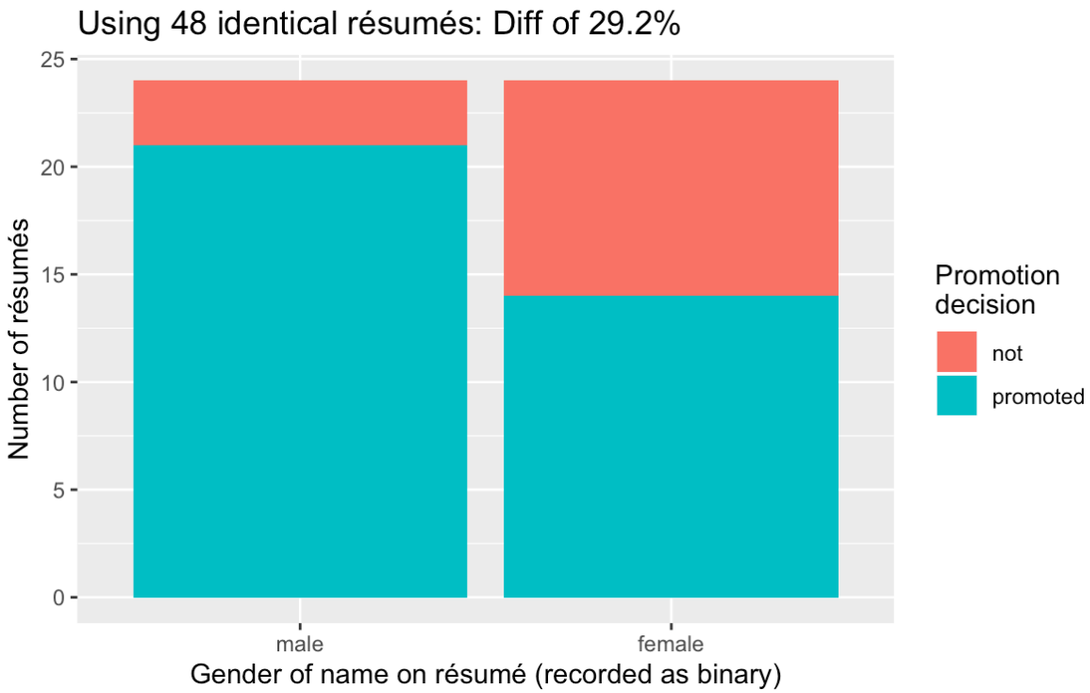

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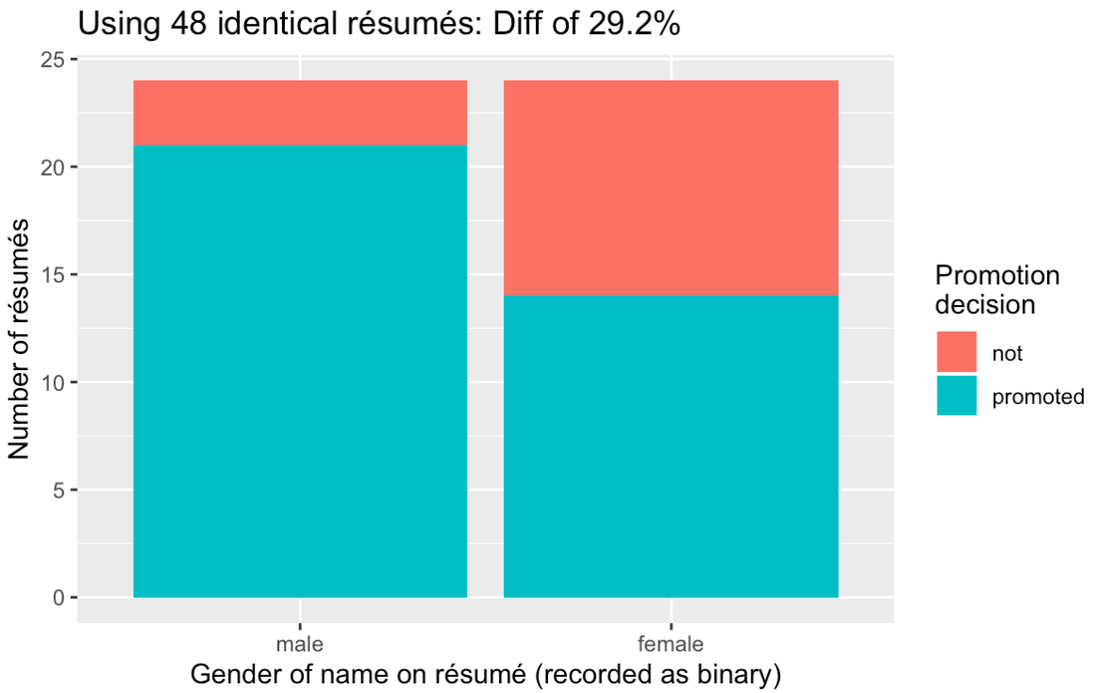


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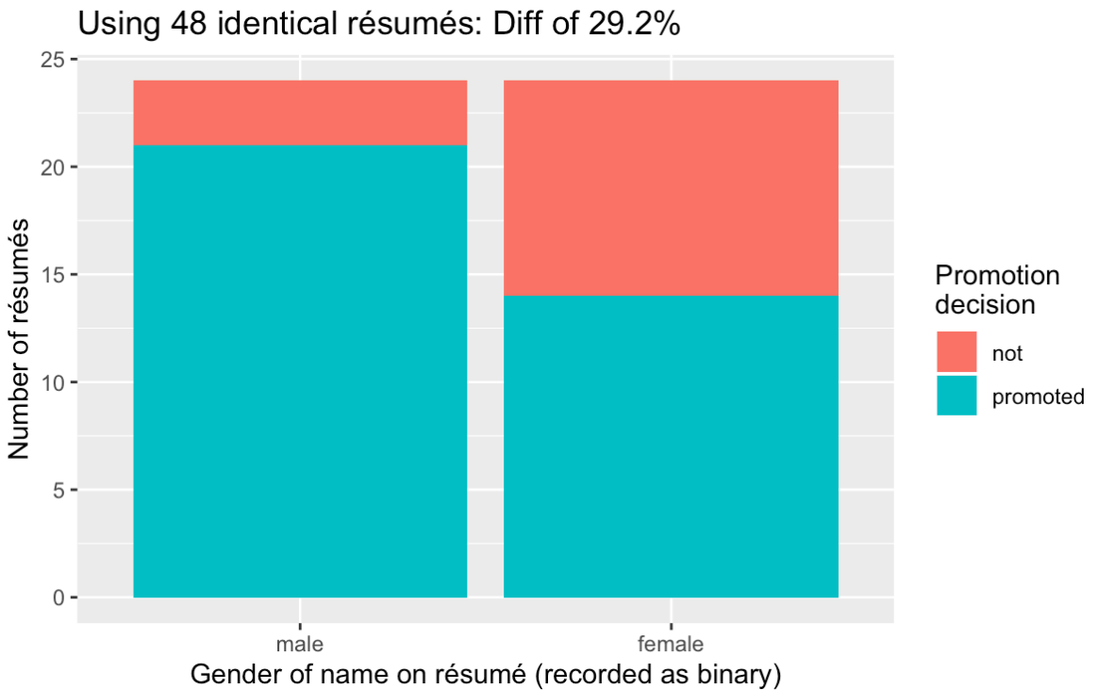


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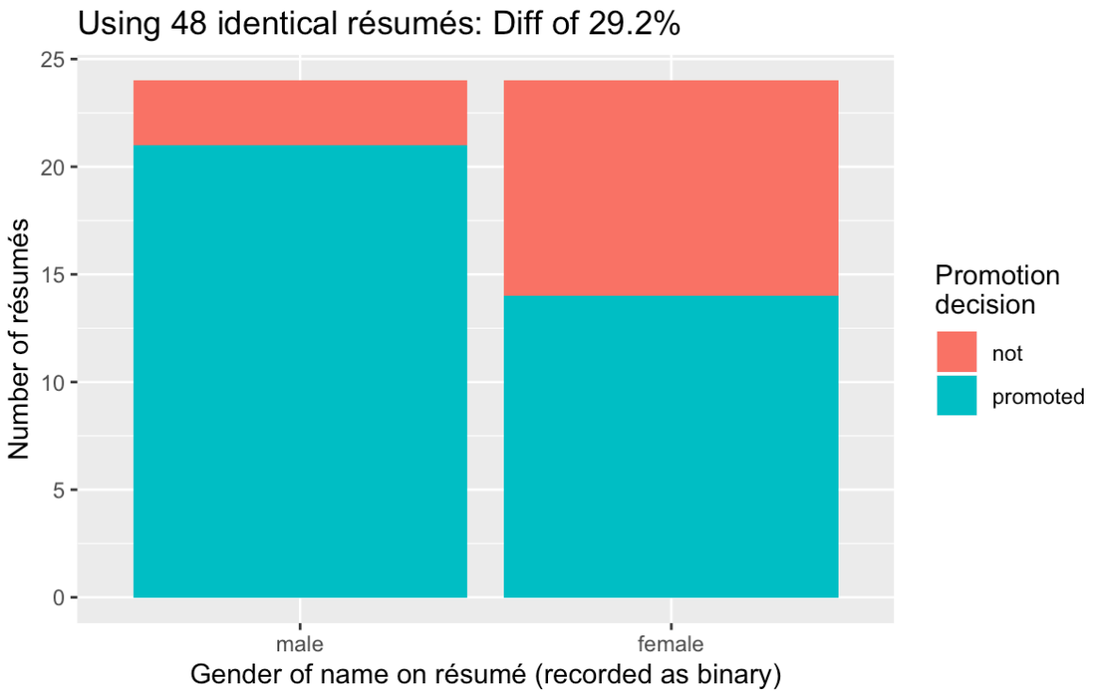


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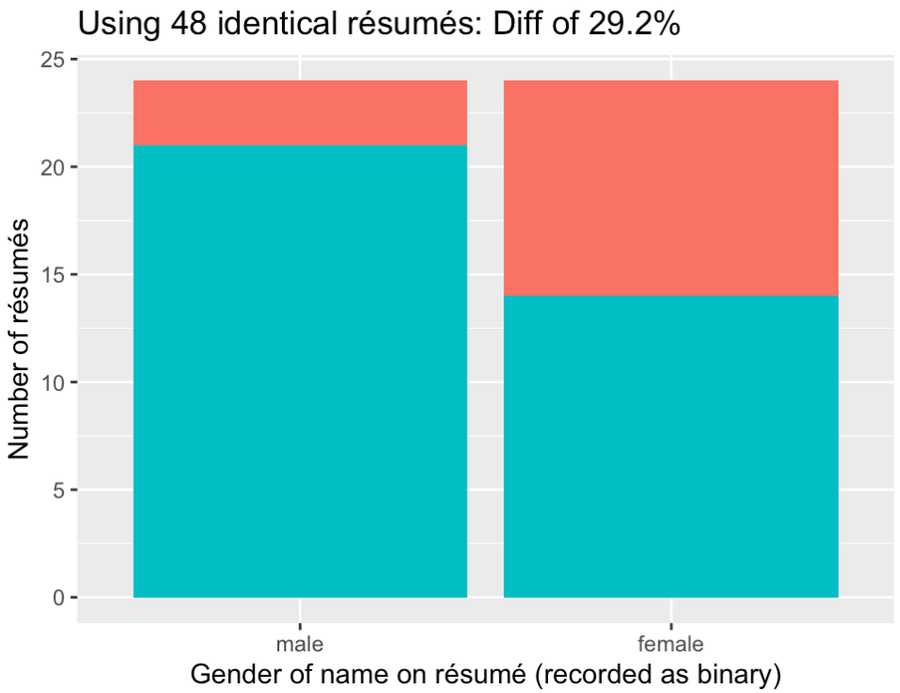


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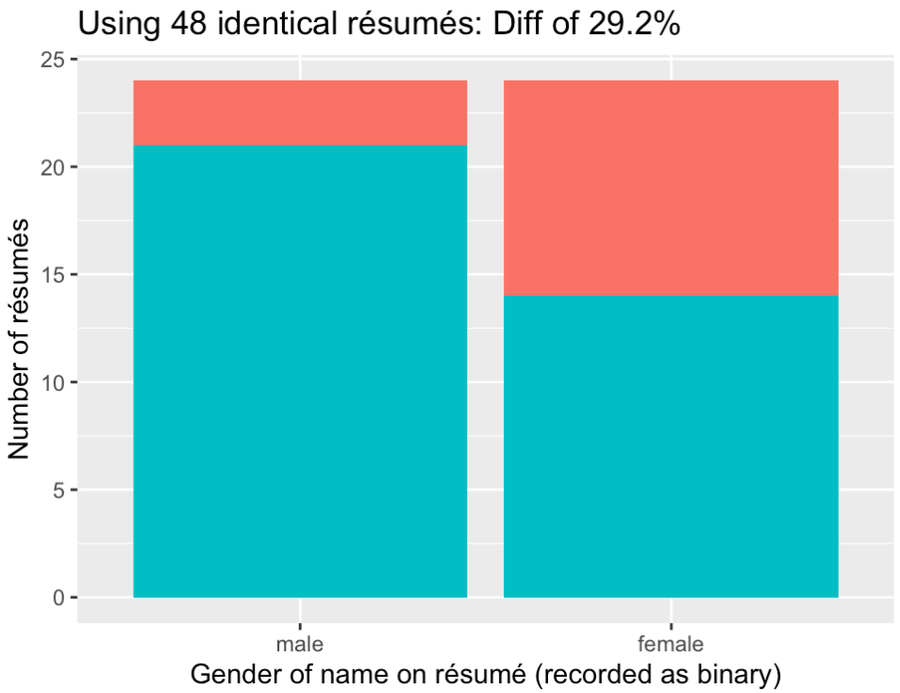


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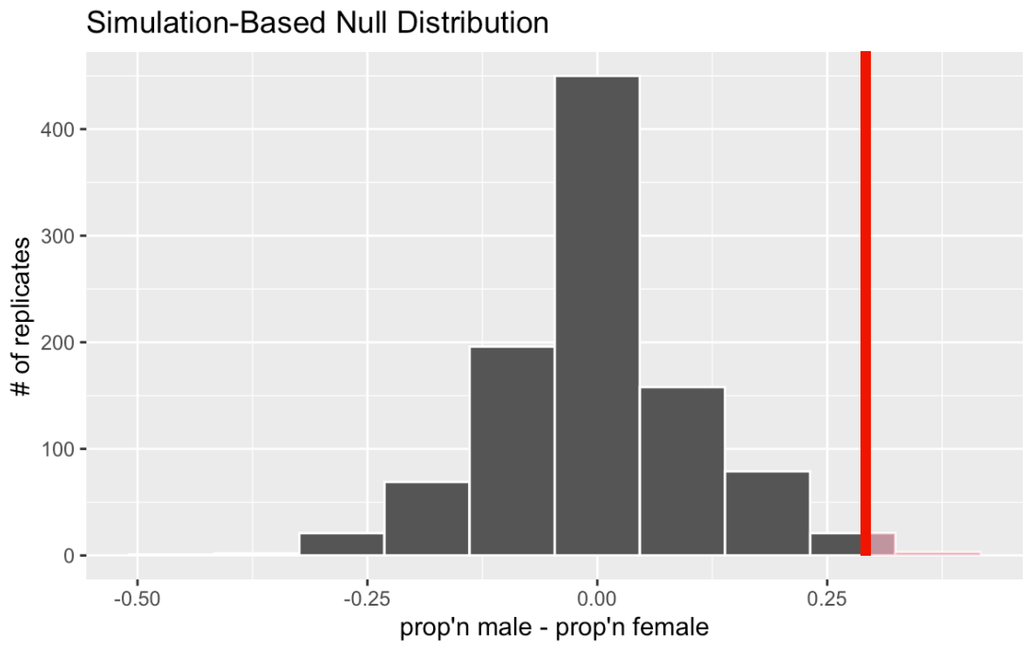
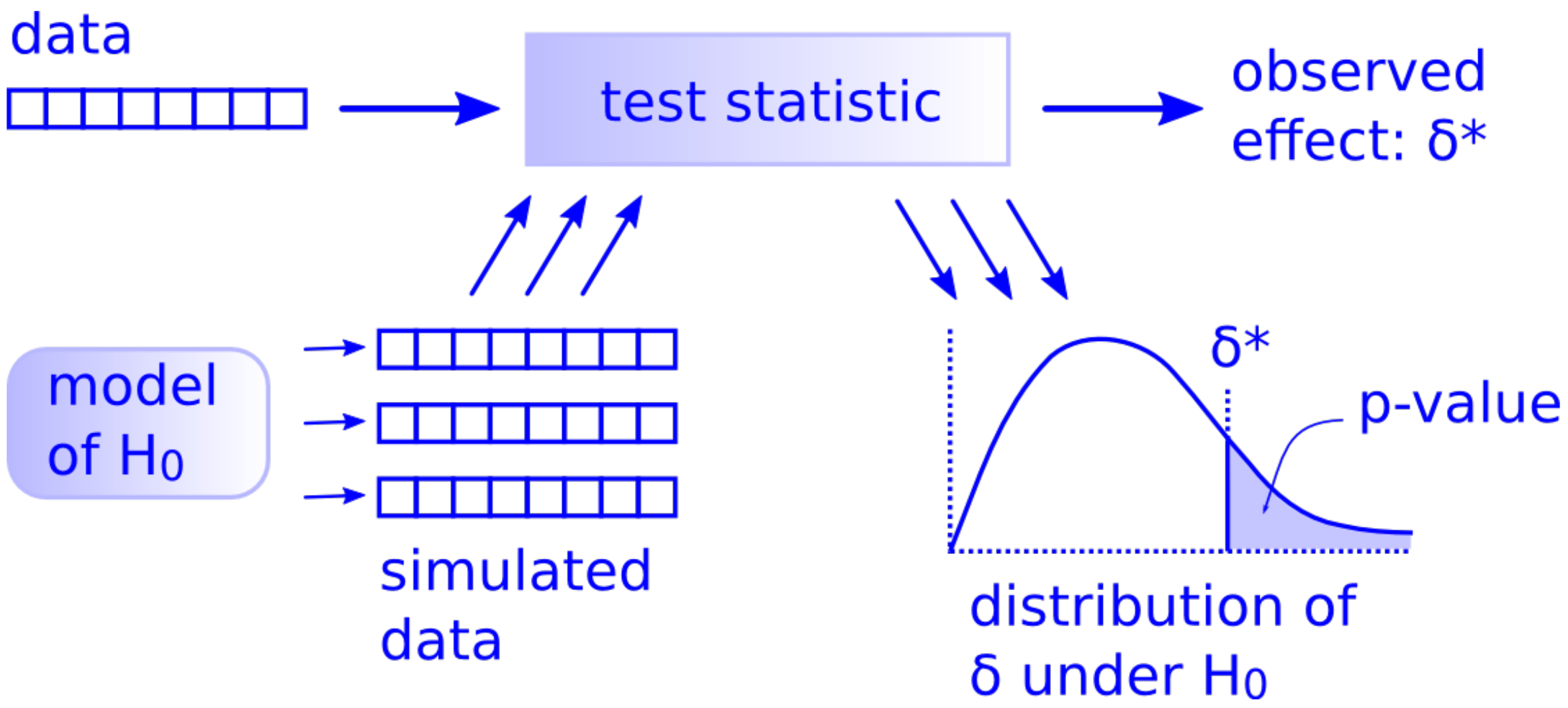


“There is only one test”



From: [Downey blogpost]

Ch10 Revisit Regression

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3. **Bridge the gap between simulation-based inference & traditional asymptotic-based inference**

How to make room for data science

In a single term course:

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In a multi-term course:

1. Drop all probability theory
2. Drop asymptotic theory in favor of simulation based inference
3. Introduce the “There is only one test” framework and tell students it’s true
4. De-emphasize χ^2 tests & ANOVA

When you have room for data science

In a multi-term course:

1. ***Cover* probability theory: distributions, z-scores**
2. Drop asymptotic theory in favor of simulation based inference
3. Introduce the “There is only one test” framework and tell students it’s true
4. De-emphasize χ^2 tests & ANOVA

When you have room for data science

In a multi-term course:

1. ***Cover* probability theory: distributions, z-scores**
2. ***Make explicit connections* between asymptotic theory & simulation based inference**
3. Introduce the “There is only one test” framework and tell students it’s true
4. De-emphasize χ^2 tests & ANOVA

When you have room for data science

In a multi-term course:

1. ***Cover* probability theory: distributions, z-scores**
2. ***Make explicit connections* between asymptotic theory & simulation based inference**
3. ***Repeatedly go thru* "There is only one test" framework & *convince* students it's true**
4. De-emphasize χ^2 tests & ANOVA

When you have room for data science

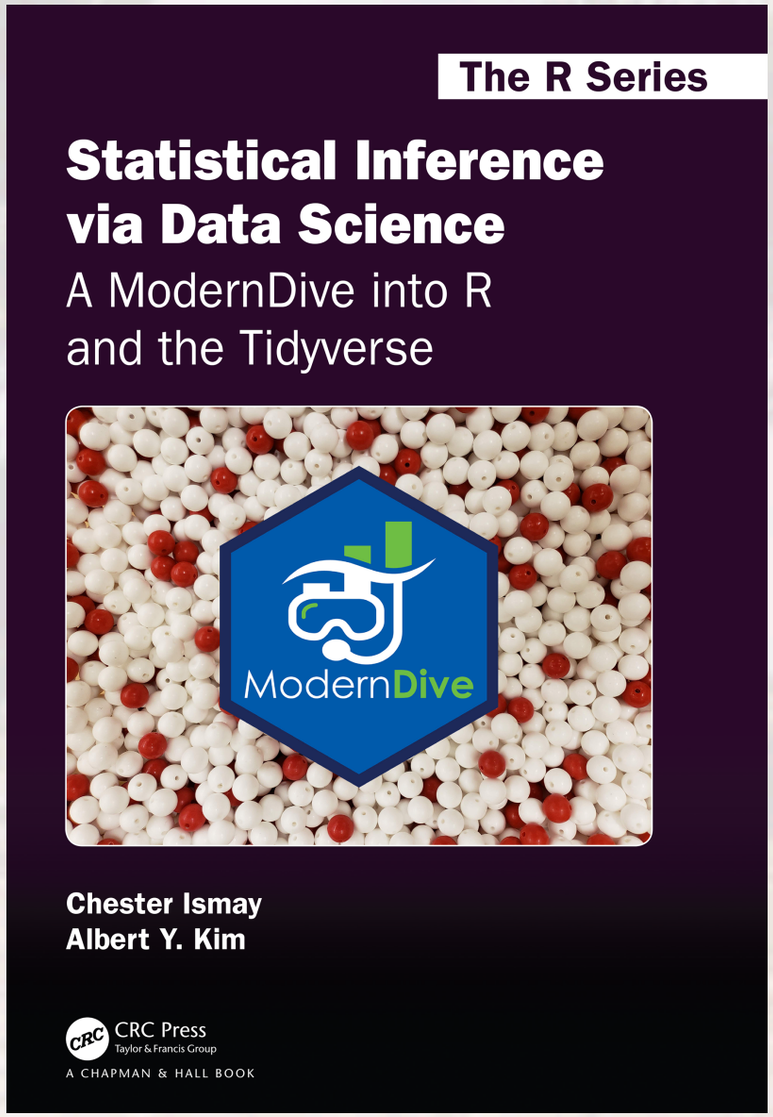
In a multi-term course:

1. ***Cover* probability theory: distributions, z-scores**
2. ***Make explicit connections* between asymptotic theory & simulation based inference**
3. ***Repeatedly go thru* "There is only one test" framework & *convince* students it's true**
4. ***Cover* χ^2 tests & ANOVA as *case studies***

Currently in ModernDive

From: Connecting simulation w/ traditional Lock^3 (2018)

For more info check out:



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My ideal pathway for Intro Stats

1. Develop a minimally viable "data science" toolbox *then*
2. Build intuition for statistical inference by teaching simulation-based methods using these tools *then*
3. Bridge the gap between simulation-based inference & traditional asymptotic-based inference

Why tidyverse?

From: Connecting simulation w/ traditional Lock^3 (2018)