STA 235H - Multiple Regression: Overview and Analysis

Fall 2021

McCombs School of Business, UT Austin

Before we start...

Feedback/Questions on the JITT:

- Students not very familiar with STA 301 topics. E.g.:
    - Took it a year ago.
    - Online classes did not facilitate learning.
    - Didn't take STA 301.

No need to remember everything from STA 301

Intuition about regression + R basics

Check the course website for resources!

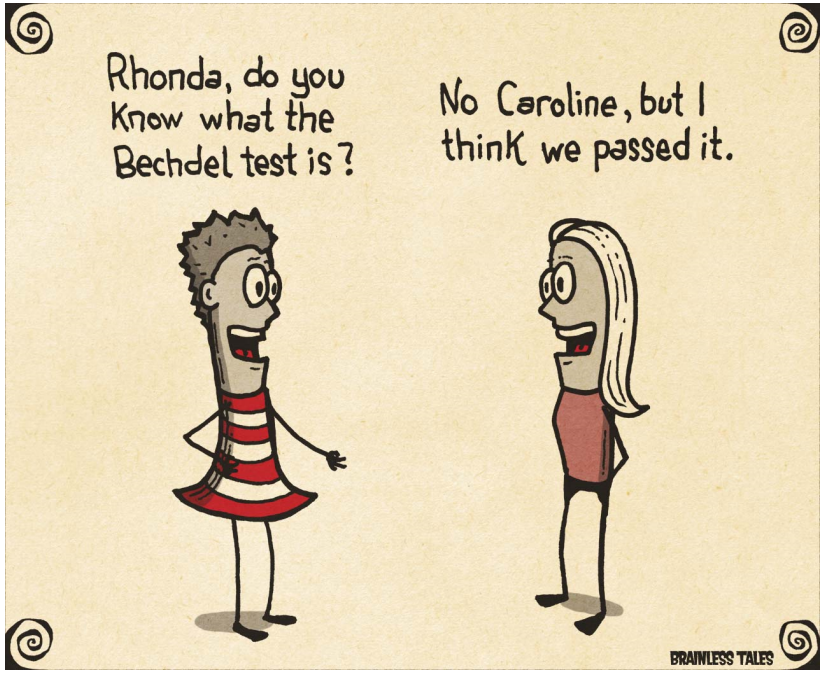
Today

- Quick multiple regression review
  - Continuation from last week (outliers, comparing effect sizes)
- Interpreting regressions:
  - Interaction models
- Potential issues in regressions:
  - Multicolinearity
  - Heteroskedasticity

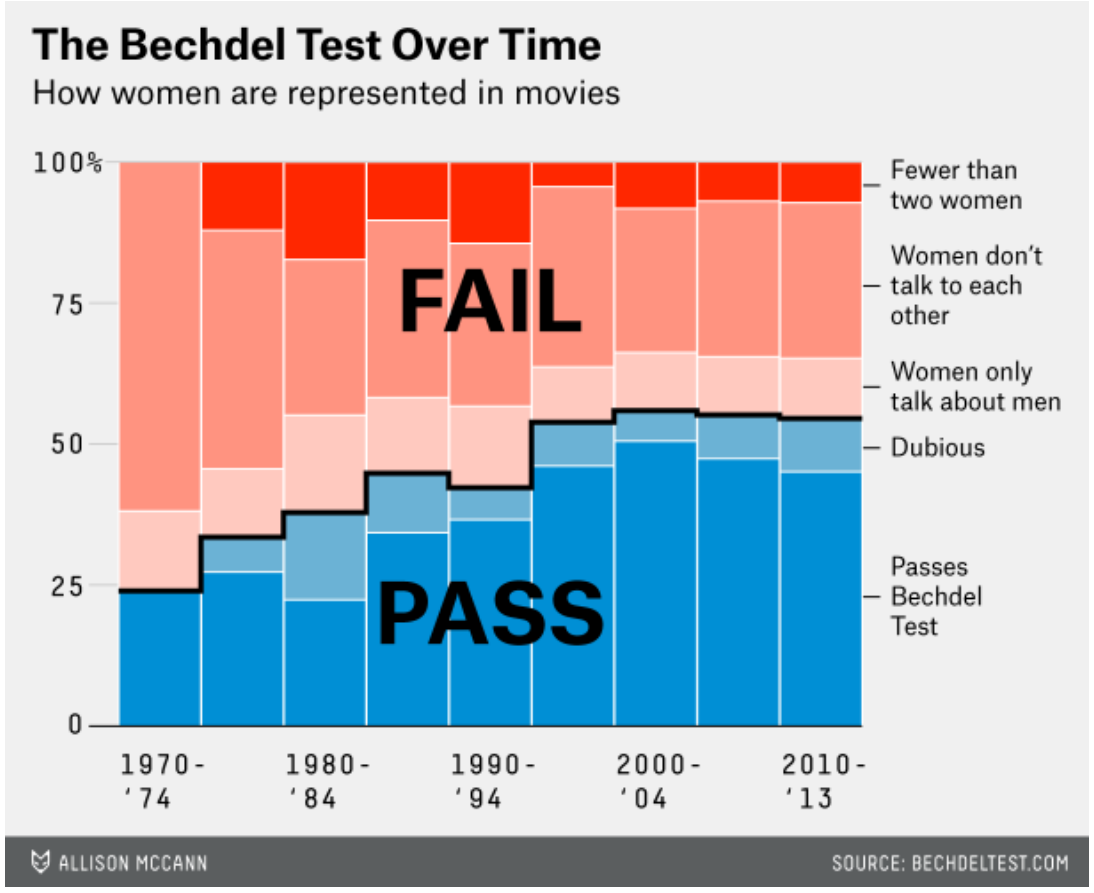
Let's introduce an example: The Bechdel Test

- Three criteria:

    1. At least two named women
    2. Who talk to each other
    3. About something besides a man



Do movies pass the test?



Is it convenient for my movie to pass the Bechdel test?

- I'm a profit-maximizing investor and want to know whether it's in my best interest to switch a male for a female character.
    - What is the simplest model you would fit?

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$$Revenue = \alpha + \beta Bechdel + \varepsilon$$

Is this right?

What should we do before we ran any model?

Inspect your data!

vtable() can be of help

```
library(tidyverse)
library(vtable)

rawData <- read.csv("https://raw.githubusercontent.com/maibennett/sta235/main/exampleSite/content/Cl

# Select movies post 1990
rawData <- rawData %>% filter(Year>1989)

# Create return on Investment (ROI) measures
# Passes Bechdel test:
rawData <- rawData %>% mutate(ROI = Revenue/Budget, #  Total ROI
                              pass_bechdel = ifelse(rating==3, "PASS", "FAIL"))

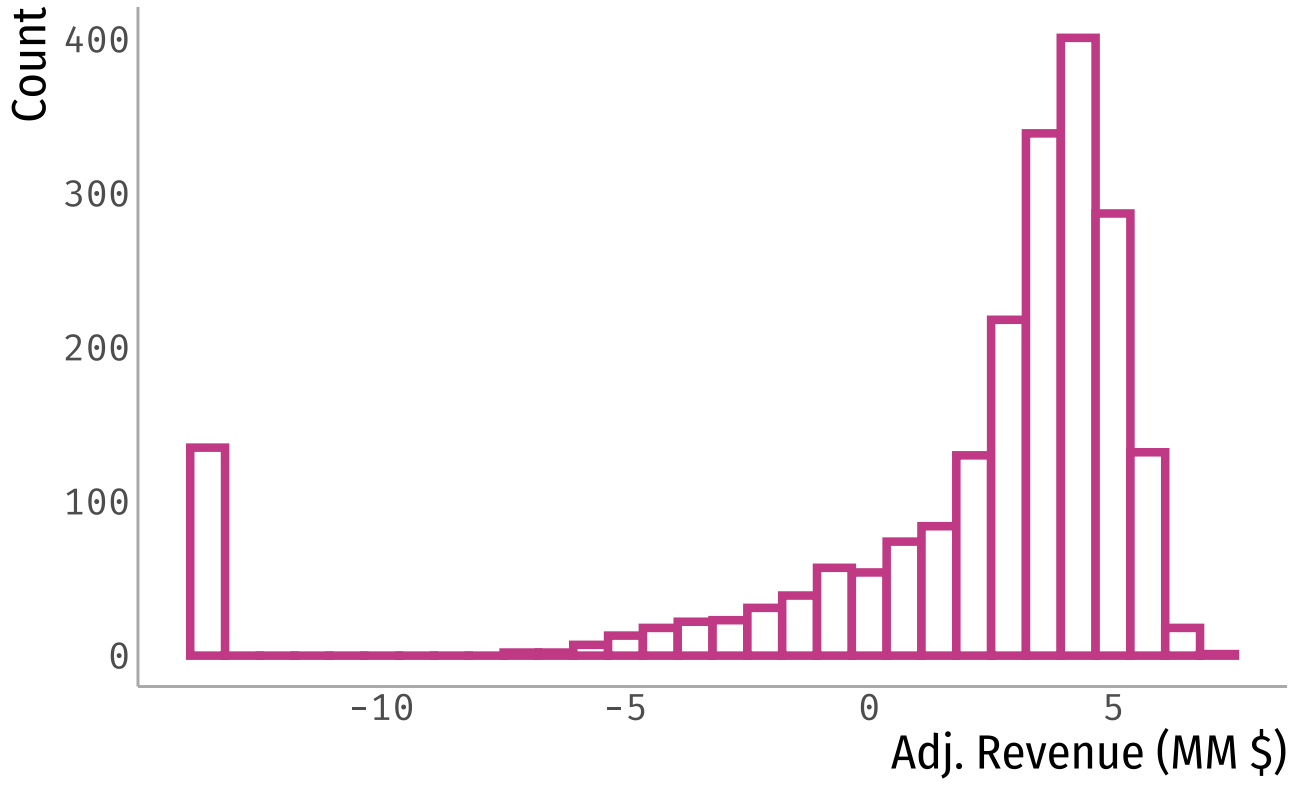
vtable(rawData)
```

Look at the data

Look at the data

What can you say about this variable?

Logarithms to the rescue?



What to do with outliers?

1. Check them!
    - Make sure there's no coding error; try to understand what's happening there.

2a. If they are wrongly coded:

- You can remove them, always adding a note of why you did so. Issues with the analysis will come from sample selection.

2b. If they are correctly coded:

- Run analysis both with and without outliers (don't just drop them!). E.g. Results do not depend exclusively on a few observations.

Let's analyze some models

```
summary(lm(log(Adj_Revenue) ~ bechdel_test, data = bechdel))
```

```
##              Estimate Std. Error  t value Pr(>|t|)
## (Intercept)   17.0321     0.0808 210.9100        0
## bechdel_test  -0.4418     0.1079  -4.0954        0
```

- How do you interpret these results?
- What are the units for the dependent variable?

A side note on log-transformed variables...

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$$\log(\frac{y_1}{y_0}) = \hat{\beta}_1$$

$$\log(1 + \frac{y_1 - y_0}{y_0}) = \hat{\beta}_1$$

$$\rightarrow \frac{\Delta y}{y} = \exp(\hat{\hat{\beta}}_1) - 1$$

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- $(e^{\beta} - 1) \cdot 100 \rightarrow$ A movie that passes the Bechdel test is associated with a 36% decrease in Revenue

Negative effect of including more women?

What gives?

FiveThirtyEight

Politics Sports Science Podcasts Video

APR. 1, 2014, AT 1:52 PM

The Dollar-And-Cents Case Against Hollywood's Exclusion of Women

By Walt Hickey

Filed under Movies

Get the data on GitHub

A Walmart employee puts Lionsgate's "The Hunger Games: Catching Fire" Blu-ray Combo Pack and DVD on the rack prior to the midnight release at Walmart on March 6, 2014 in Orange, California. JEROD HARRIS / GETTY IMAGES

More variables

- Bechdel test could be capturing the effect of other variables:
  - What type of movies are the ones that pass the test?
  - What is their budget?

More variables

```
lm(log(Adj_Revenue) ~ bechdel_test + log(Adj_Budget) + Metascore + imdb, data = bechdel)
```

```
##                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)       1.3798     0.5126  2.6921   0.0072
## bechdel_test      0.2275     0.0665  3.4229   0.0006
## log(Adj_Budget)   0.8594     0.0256 33.6160   0.0000
## Metascore         0.1012     0.0293  3.4512   0.0006
## imdb              0.0864     0.0517  1.6716   0.0948
```

Positive and significant!

Comparing effect sizes

- Another investor says that it's better to bring in a better actor because it will increase ratings.
- How do you compare effect sizes?
    - How does one more point on IMDB compare to passing/failing the Bechdel test?

Standardized Partial Coefficients

- Main idea: Transform everything to the same scale (standard deviations)

$$X$$

$$\frac{X - \bar{X}}{\sigma_X}$$

- Will this change our estimates? How?

Transform the data

```
scale2 <- function(x, na.rm = FALSE) (x - mean(x, na.rm = na.rm)) / sd(x, na.rm)

bechdel_std <- bechdel %>% select(log_Adj_Revenue,log_Adj_Budget,
                                  bechdel_test, Metascore, imdb) %>%
  mutate_all(., ~scale2(.,na.rm=TRUE))

lm(log_Adj_Revenue~bechdel_test+log_Adj_Budget + Metascore + imdb,
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## (Intercept)      0.3384     0.0138 24.5385   0.0000
## bechdel_test     0.0476     0.0139  3.4229   0.0006
## log_Adj_Budget   0.4683     0.0139 33.6160   0.0000
## Metascore        0.0706     0.0205  3.4512   0.0006
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- Data can tell different stories depending on how you handle it.
    - Does that mean that we can get data to say anything?

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"If you torture the data long enough, it will confess to anything"

- Assumptions and measures matter.
- Plot your data!

References

- Heiss, A. (2020). "Course: Program Evaluation for Public Service". *Slides for Regression and Inference*.
- Ismay, C. & A. Kim. (2021). “Statistical Inference via Data Science”. Chapter 10.
- Keegan, B. (2018). "The Need for Openess in Data Journalism". *Github Repository*