Introduction

Goals for semester

- Analyze and interpret general(ized) linear models (aka regression models; aka ANOVA)
- Be able to graph your data
- Identify and diagnose problems when they arise

Important links

- Class Website
- Slack Workspace; here for answering questions, posting stats/R memes and gifs, building community
- Canvas; where you'll turn in your homeworks
- LSR & ISLR; textbooks
- Example data from class can be found on our GitHub site in the `data` folder.

Important information

- **Most important information is on the slides**
- Readings serve to *supplement* and enhance
  - There are some exceptions; 2-3 readings will be required
- Important equations will be presented via slides

Two types of people

- This class is going too slow vs going too fast
- If too fast: ASK QUESTIONS AND COME TO CHECK-INS. Also spend lots of time outside of class; learning takes time.
- If too slow: ASK QUESTIONS AND COME TO CHECK-INS. There are lots of interesting extensions to these models. I can give you extra readings, or at least point you down a cool path.

Two AIs

- Ke Ning
- Ran Zhang

Both incredible. USE THEM TO YOUR ADVANTAGE! **Set up meetings with them**. Ask them R questions.

Goals for today

- Quick Review of last semester
- Overview of this semester
- Syllabus

Pragmatics

What you *need* to know:

- R, RStudio
- Rmarkdown (look at cheatsheets!) and how these convert or "knit" into html/pdf files
- Keep it visual: `ggplot`

What you *should* know or strive to learn:

- Keep organized: R Projects
- Keeping track/sharing: osf, github (recommended)
- Keep it simple and readable: `dplyr` & `tidyverse` (recommended)

Visualizing data

- Histograms, probability mass function
- Density plot, probability density function, cumulative density function
- Representing your results through bar, box, & violin plots

- Suggestions:

    1. Avoid wow graphs
    2. Use interpretable scales
    3. LABEL. YOUR. AXES.
    4. Always provide a dispersion estimate
    5. If possible include raw data and/or the distribution

What did we cover last semester?

- A lot!
- Lots of theoretical probability distributions
- Lots of NHST, the good the bad and the ugly
- Lots of statistical tests
  - All had assumptions, most had some modifications (homogeneity of variances etc.)

Running models

$$Y = X + E$$

Dependent variable = Independent Variable(s) + Error

Sum of Squares total = Sums of Squares between + Sums of Squares within

Every model we run this semester will be in the form of $Y = X + E$. Last semester, every model you ran was in the form of $Y = X + E$. You just didn't know it.

```
t.1 <- t.test(y ~ x, data = d)
# y is cont and x is a categorical/nominal (dichotomous) fact
```

Comparing models

$$SSW(restricted) - SSW(full)/stuff$$

- The full is equivalent to $Y = X + E$ and the restricted is equivalent to $Y = E$
- We compared them to ask which E was larger
- The only difference between these two models is our X variable (our IVs). The result is we are asking whether X helps explain variance in Y
- Equivalent to asking whether X reduces variance that is *unexplained*

Theoretical probability distributions

- How you collect & measure your variables determine your analytic tool options
- For IVs, how you measure changes the name of the analysis but not really much else. For DVs, data generating process defines appropriate analyses
- Binomial, poisson, negative binomial, normal (Gaussian), *t*, *F*, χ^2...
- THIS DOES NOT MEAN WE *NEED* TO HAVE A NORMAL DISTRIBUTION IN OUR DATA

Many distributions

- Population distribution -> sample distribution -> sampling distribution
- Standard error is the standard deviation of the sampling distribution

p-values, NHST, and standard operating procedures

- $p(D|H_0)$, not $p(H_0|D)$
- Type 1 & 2 errors, power, family wise error
- Issues with NHST
- Questionable research practices & researcher degrees of freedom

Effect size and CIs

- There is imprecision in all that you do. **Document it.**
- Interpretation and utility of CI?
- Common effect size metrics?
- How does the CI relate to the sample and sampling distribution?

How to succeed (in class)

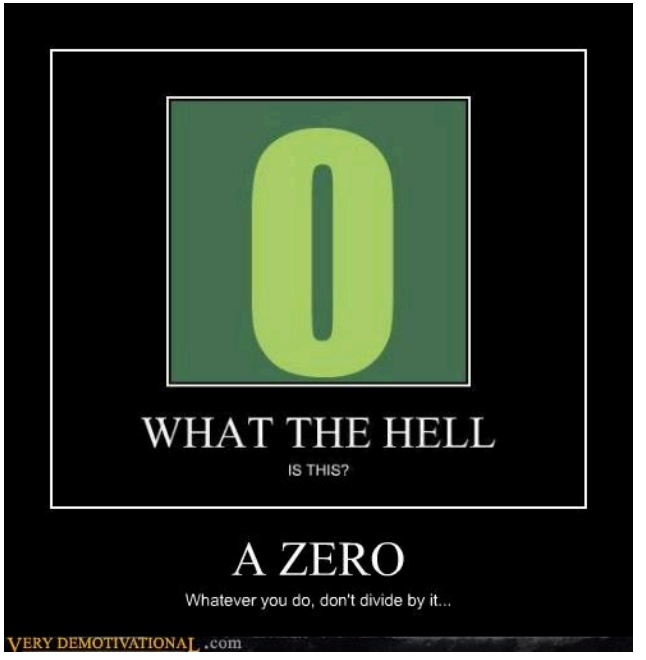
- Go through slides, work through code
- Apply concepts to your own work
- Devote time

Relationships & Models

Theme 1: Tell me Y

Relationships & Models

Theme 2: What does 0 mean?



Next time

REQUIRED READING

- You *must* read the Human Fallibility paper. Come prepared. We are not critiquing methods here/trying to tear it apart. We are going to use it as a jumping off point for introspection on how we do our own research.
- I will be emailing you your group and your topic. I will explain everything when we get to class. However, when you come to class on Thursday, please go sit with your group.