STATS 250 Lab 02

Basics of Data with R

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Week of 09/4/2020

Reminders

Your tasks for the week running Friday 9/4 - Friday 9/11 (plus an extra):

Task	Due Date	Submission
Homework 1	Friday 9/11 8AM ET	course.work
Lab 1	Friday 9/11 8AM ET	Canvas
Lab 2	Friday 9/11 8AM ET	Canvas
Student Survey	Friday 9/18 8AM ET (1st wave)	Qualtrics Email*

* If you added the class after 8/29, you will be in a later "wave" of the student survey and will get an email soon. Your due date will also be extended appropriately.

Who are you?

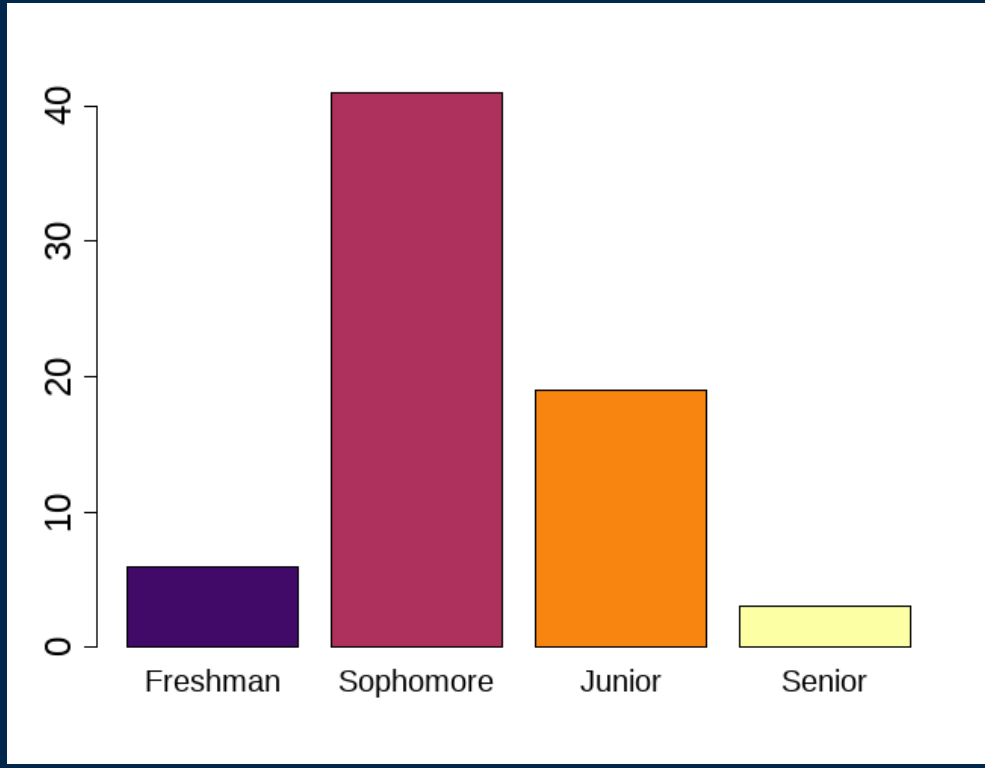
Favorite TV Shows

1. The Office
2. Bojack Horseman
3. Game of Thrones
4. Grey's Anatomy

Top Majors

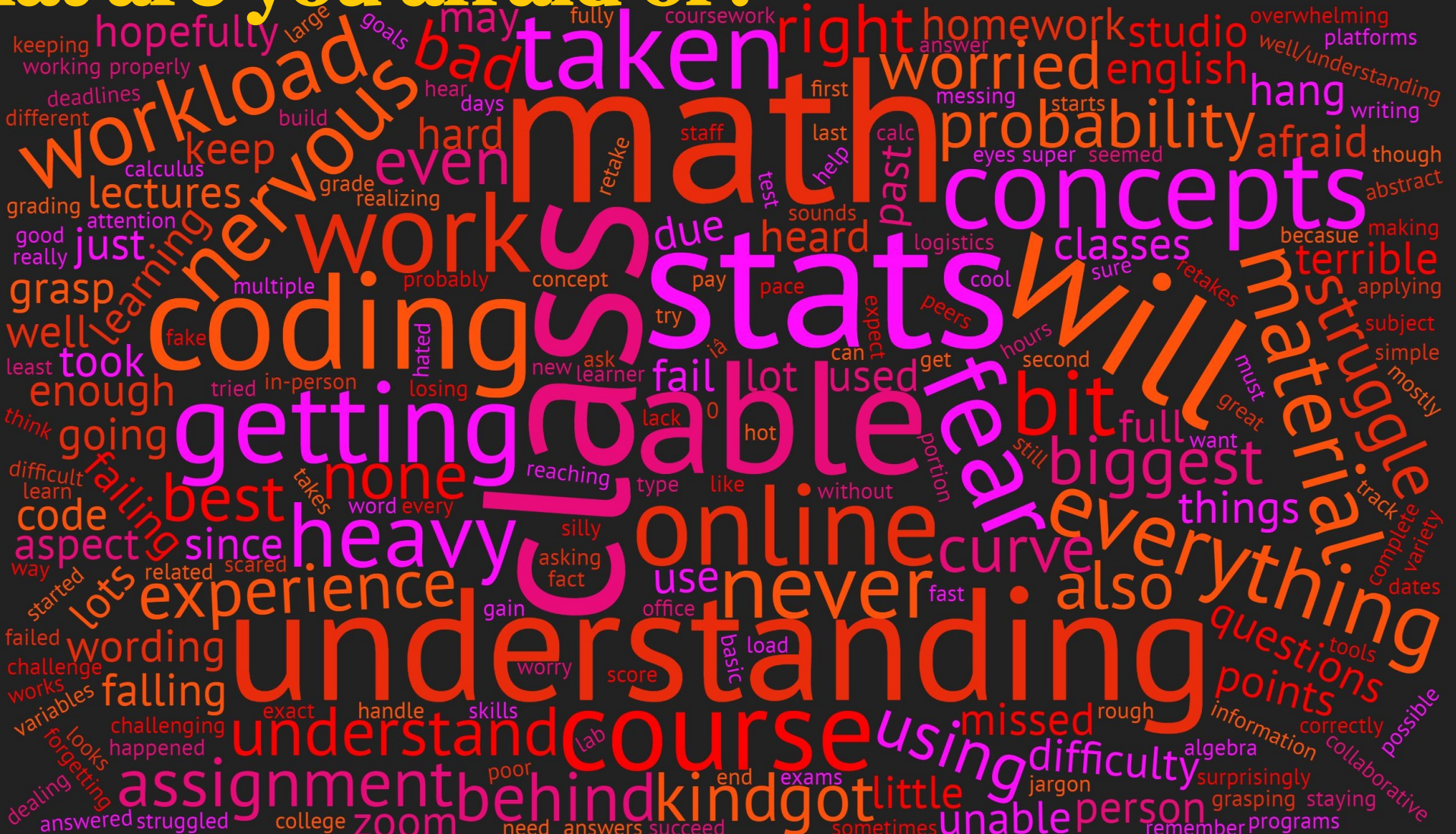
1. Computer Science
2. BCN
3. Economics
4. Neuroscience

Year at U-M



Why are you taking this class?

What are you afraid of?



Notes on common fears

Math

- **This is not a math class.** The focus is not on doing algebra or manipulating formulas. There are numbers, but we're more interested in *conceptual understanding* of statistical ideas.
- **It's okay if you haven't taken stats before.** 63% of students in class didn't take stats in high school.

Notes on common fears

Math

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Coding

- **This is not a coding class.** You'll learn some things about coding, but the focus is **not** on learning to code. Once you get the basics of R, we'll turn more towards statistics.
- Learning to code is about **trial and error**. Stick with it!
- I've been using R for a decade and I Google stuff *constantly*.

Notes on common fears

Staying on Track

- **Spend at least 20-30 minutes on statistics every day.** Reviewing material in small chunks will help reinforce the concepts (and make exam prep easier!)
- **Use resources.** eCoach has to-do lists for each week, and the Canvas homepage has one too!

Notes on common fears

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"I'm bad at stats/math/etc"

- **FALSE.** Success in this course reflects *effort* not baseline ability.
- You *will* make mistakes, but *that's how humans learn*.
- YOU 👏 CAN 👏 DO 👏 IT

Notes on common fears

Remote learning

- **Reasonable!** These are challenging times. Try to make the best of it, but we're all going to struggle with it.
- **Your humanity comes first**
- Remember that **I am here to help**

Notes on common fears

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Picky wording

- **Generally a thing of the past.**
- Focus on conveying your ideas as precisely as you can

"I'm going to fail the class"

- Reframe "I have to get X grade" to "I *want* to get X grade"

This Week's Learning Objectives

Statistical Learning Objectives

1. Understand the structure of data (observations and variables)
2. Think about the scope of a data set: what questions can and cannot be answered with a particular data set?

R Learning Objectives

1. Learn how to "assign" information to "objects" in R
2. See how R "reads in" a data set from a file
3. Be able to identify the names of variables contained in a data set
4. Make a frequency table for one or two variables

R Markdown Tips 

- Please don't modify the pre-written chunks of code!
- When copying and pasting code, only take the code
- Don't delete any blank lines
- Always have a blank line after a chunk

RStudio Cloud

https://rstudio.cloud

Log in with Google using your U-M Account

Search for the project called lab02-FA20 and click START

If you haven't created an account yet, do so at https://bit.ly/250millerfa20rsc

RStudio Desktop

Download materials from the Lab 2 Assignment on Canvas

Unzip the folder, then open lab02-FA20.Rproj to open up RStudio.

Let's get started!

Assignment

R can do a lot of stuff, and we usually want to "save" results to use later.

The way we tell R to remember something is to *assign* that thing a name.

```
x <- 6
```

The arrow is R's *assignment operator*: "x *gets* 6". R now remembers that x is equal to 6.

```
x
```

```
[1] 6
```

Important note: R is "case-sensitive"

R treats lower-case and upper-case letters as *different things*. Check it out:

```
# lower-case x; this is 6
x
```

```
[1] 6
```

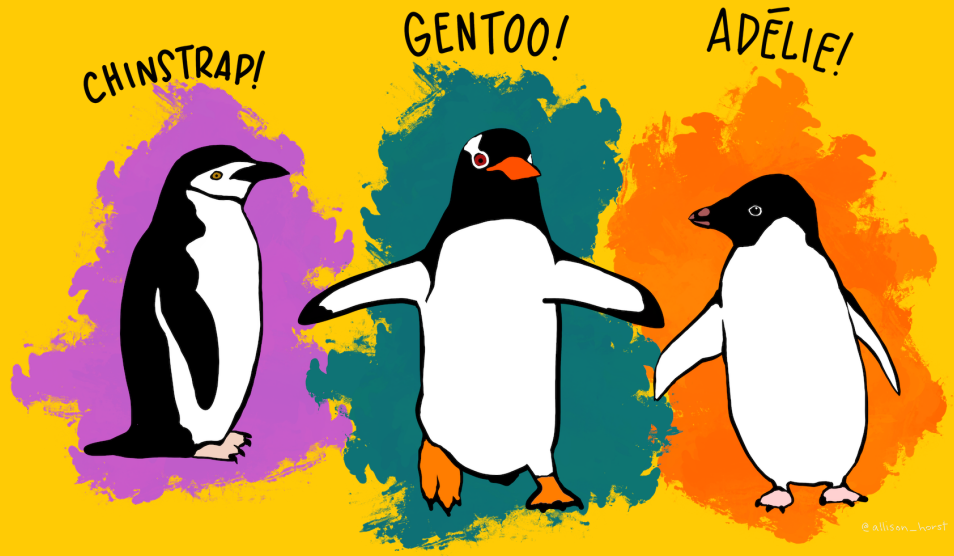
```
# upper-case X; this doesn't exist
X
```

```
Error in eval(expr, envir, enclos): object 'X' not found
```

Palmer Penguins Data

We're going to learn about some basic R functions using a data set on 333 penguins living on 3 islands in the Palmer Archipelago in Antarctica.

Data were made available by Dr. Kristen Gorman and the Palmer Station, Antarctica Long Term Ecological Research area, a member of the Long Term Ecological Research Network. The data were prepared by Dr. Allison Horst



Reading in a CSV file

Remember this code?

```
penguins <- read.csv(url("https://raw.githubusercontent.com/STATS250SBI/palmerpenguins/master/inst/e
```

Notice the assignment operator? "`penguins` *gets* `read.csv` *of* [blah blah blah]"

Reading in a CSV file

Remember this code?

```
penguins <- read.csv(url("https://raw.githubusercontent.com/STATS250SBI/palmerpenguins/master/inst/e
```

Notice the assignment operator? "`penguins` *gets* `read.csv` *of* [blah blah blah]"

`read.csv` *reads* in a .csv file (**c**omma **s**eparated **v**alues) and creates a `data.frame`

```
"species","island","bill_length_mm","bill_depth_mm","flipper_length_mm","body_mass_g","sex","year"
"Adelie","Torgersen",39.1,18.7,181,3750,"male",2007
"Adelie","Torgersen",39.5,17.4,186,3800,"female",2007
"Adelie","Torgersen",40.3,18,195,3250,"female",2007
"Adelie","Torgersen",36.7,19.3,193,3450,"female",2007
"Adelie","Torgersen",39.3,20.6,190,3650,"male",2007
"Adelie","Torgersen",38.9,17.8,181,3625,"female",2007
```

Recall: Use `head()` to peek at the data

```
head(penguins)
```

```
  species    island bill_length_mm bill_depth_mm flipper_length_mm body_mass_g
1  Adelie Torgersen           39.1          18.7               181        3750
2  Adelie Torgersen           39.5          17.4               186        3800
3  Adelie Torgersen           40.3          18.0               195        3250
4  Adelie Torgersen           36.7          19.3               193        3450
5  Adelie Torgersen           39.3          20.6               190        3650
6  Adelie Torgersen           38.9          17.8               181        3625
     sex year
1   male 2007
2 female 2007
3 female 2007
4 female 2007
5   male 2007
6 female 2007
```

Names in a dataset

When working with data in R, it's important to know *exactly what things are called*.

What if we just wanted to know the names of the variables that are contained in `penguins`?

```
names(penguins)
```

```
[1] "species"           "island"            "bill_length_mm"
[4] "bill_depth_mm"     "flipper_length_mm" "body_mass_g"
[7] "sex"               "year"
```

Naming things in R

When giving things names in R, you can only use a combination of letters, numbers, periods, and underscores, and the names have to start with a letter or a period. People tend to use underscores or periods instead of spaces.

```
tik tok <- 12
```

```
Error: <text>:1:5: unexpected symbol
1: tik tok
       ^
```

```
4eva <- 4 * 2
```

```
Error: <text>:1:1: unexpected input
1: 4ev
    ^
```

```
_hi_mom <- 5^2
```

```
Error: <text>:1:1: unexpected input
1: _
    ^
```

```
tiktok <- 12
forever <- 4 * 2
dear_mother <- 5^2
```

Exploring Data

To see a data frame's *structure*, use the function `str()` (pronounced "stir"):

```
str(penguins)
```

```
'data.frame':    333 obs. of  8 variables:
 $ species          : chr  "Adelie" "Adelie" "Adelie" "Adelie" ...
 $ island           : chr  "Torgersen" "Torgersen" "Torgersen" "Torgersen" ...
 $ bill_length_mm   : num  39.1 39.5 40.3 36.7 39.3 38.9 39.2 41.1 38.6 34.6 ...
 $ bill_depth_mm    : num  18.7 17.4 18 19.3 20.6 17.8 19.6 17.6 21.2 21.1 ...
 $ flipper_length_mm: int  181 186 195 193 190 181 195 182 191 198 ...
 $ body_mass_g      : int  3750 3800 3250 3450 3650 3625 4675 3200 3800 4400 ...
 $ sex              : chr  "male" "female" "female" "female" ...
 $ year             : int  2007 2007 2007 2007 2007 2007 2007 2007 2007 2007 ...
```

Exploring Data

If you really only want the "dimension" of the data frame (i.e., how many rows and how many columns), you can use the `dim()` function:

```
dim(penguins)
```

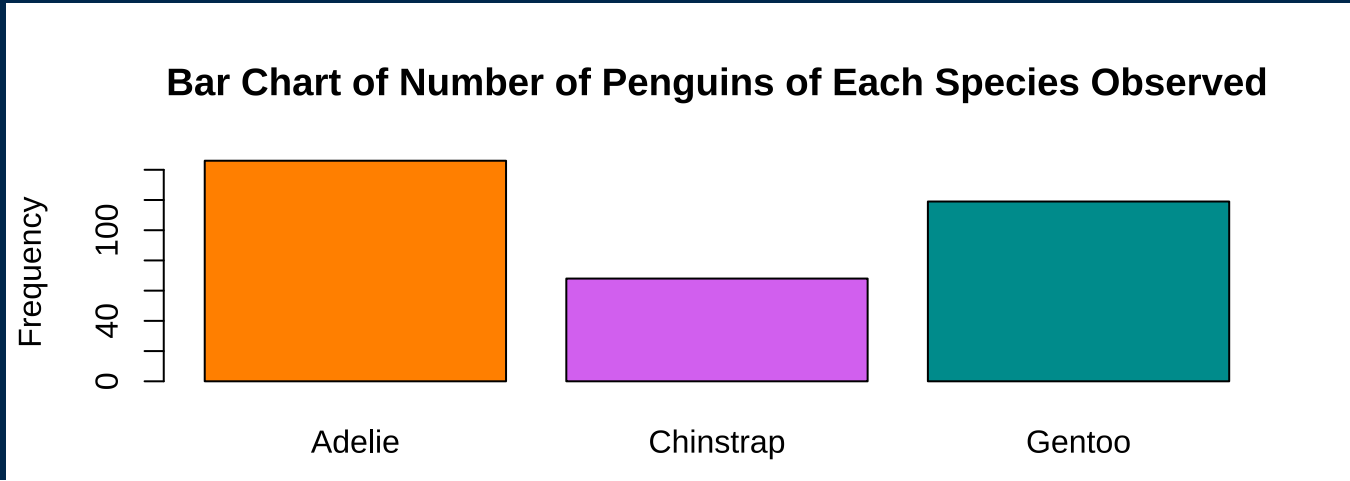
```
[1] 333   8
```

The results are given in the order "rows, columns" because data is **R**eally **C**ool (rows, columns).

Recall: Bar Charts in R 📊

In order to make this plot, we had to give `barplot()` a "frequency table" of the variable `species`.

```
barplot(table(penguins$species),
     xlab = "Species",
     ylab = "Frequency",
     main = "Bar Chart of Number of Penguins of Each Species Observed",
     col = c("darkorange1", "mediumorchid2", "darkcyan"))
```



Frequency Tables

A *frequency table* is a way to count the number of observations (rows) in the data that correspond to each level of a categorical variable.

To make a frequency table, use the `table()` function

```
table(penguins$species)
```

```
   Adelie Chinstrap    Gentoo
      146        68       119
```

The dollar sign ($) is how we tell R where to look for a particular variable.

```
table(penguins$species)
```

Inside `table()`, we need to tell R to look for the variable `species` inside the data.frame called `penguins`. If we don't include `penguins$`, watch what happens:

```
table(species)
```

```
Error in table(species): object 'species' not found
```

Two-Way Frequency Tables

We can make "two-way" frequency tables (sometimes called "contingency tables") to summarize counts for two categorical variables:

```
table(penguins$species, penguins$island)
```

```
           Biscoe Dream Torgersen
  Adelie       44    55        47
  Chinstrap     0    68         0
  Gentoo      119     0         0
```

Remember that data is **r**eally **c**ool, so the first variable you give to `table()` is in the **r**ows of the table, and the second is in the **c**olumns.

Notice that we separated the two variables inside of `table()` with a comma.

Now it's your turn!

Lab Project ⌨

Your tasks

- Complete the "Try It!" and "Discussion" portions of the lab assignment by copy/pasting and modifying appropriate code from earlier in the document.

How to get help

- Use the "labs" section of Piazza to ask questions and work with your peers.
- If you use Piazza, please note that in the "Collaborators" list at the top of the Try It section.
- If you're really stuck, email your lab instructor!

Lab Submission: Finding Your Report

Hit the Knit button one last time, then:

RStudio Cloud

1. In the Files pane, check the box next to `lab02report.html`
2. Click More > Export...
3. Click Download and save the file on your computer in a folder you'll remember and be able to find later.

RStudio Desktop (local)

1. Locate the `lab02report.html` file on your computer. The file will be saved in the location indicated at the top of the files pane.

Lab Submission: Canvas (Due 9/11 8a ET)

1. Click the "Assignments" panel on the left side of the page. Scroll to find "Lab 2", and open the assignment. Click "Submit Assignment".

2. Towards the bottom of the page, you'll be able to choose `lab02report.html` from the folder you saved it in from RStudio Cloud or noted if you're using RStudio Desktop. **You will only be able to upload a .html file -- do not upload any other file type.**

3. Click "Submit Assignment". You're done!