# Teaching R in DASC 1104

## R Part I

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# Materials

- Available on gitHub at XXXXXX

# Guiding principles

- Make the initial burden to working with real data as minimal as possible
- Teach a **process** of working with data more than the actual programming
    - Focus on actions/principles rather than specific syntax
    - More than in other programming classes, focus on reproducibility
- Great resources for learning R/python/git/shell
    - https://software-carpentry.org/lessons/index.html
- Scaffold Learning objectives and provide many examples
    - Here is a dataset -- Generate a scatterplot of mpg vs. engine displacement (demo with `mtcars`)
    - Start with simple examples and show how to build
    - Encourage student participation by working examples alongside

# Guiding principles

- Allow for student creativity and spontaneity
  - Different from typical programming classes
  - Here is a dataset -- Create two visualizations that tell me something interesting about it
- Focus on the high-level concepts before getting into the details
  - Some low level knowledge is ok -- variable types
  - Other low level knowledge not needed at this stage
    - Parsing files one line at a time, etc.

# The Rstudio IDE

- I recommend the RStudio IDE, but you do not have to.
    - Allows for R and python code development
- Can be installed locally or on a server (I use a SSO server option)
- RStudio Cloud provides a remote-hosting option for teaching

# Project-oriented workflows

- Especially useful for students with less comp-sci experience
- Makes file path management easier
- References here and here and here

# What does this code do?

```
library(tidyverse)
setwd("~/Documents/John/hw-1")
dat <- read_csv("my-secrets.csv")
```

- What might be the issue with this code?

# Hands-on experience project management in Rstudio

- Use of Rstudio projects (5-10 minutes)
- Use of the `here` library and the `here()` function
- Namespaces in `R`
- Generate "data file" in excel, load and process the data
- For more details, see Lecture 9 in unit 4

# The Two Towers

- The R language has split into two dialects "base R" and the "tidyverse"
- Much has been written about this difference
- Having learned Base R first and `tidyverse` second -- I am a strong proponent of the `tidyverse` -- there is a strong movement to translate this syntax to python
    - Most of my students would agree that `tidyverse` is the way to go
    - Many python users also agree

# The Rings of Power

```
library(tidyverse)
library(palmerpenguins)
glimpse(penguins)
```

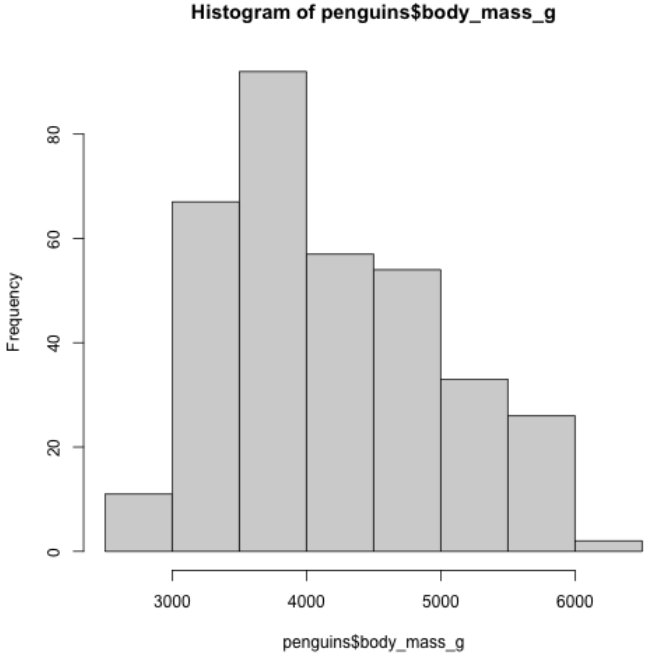
```
## Rows: 344
## Columns: 8
## $ species           <fct> Adelie, Adelie, Adelie, Adelie, Adelie, Adelie, Adel…
## $ island            <fct> Torgersen, Torgersen, Torgersen, Torgersen, Torgerse…
## $ bill_length_mm    <dbl> 39.1, 39.5, 40.3, NA, 36.7, 39.3, 38.9, 39.2, 34.1, …
## $ bill_depth_mm     <dbl> 18.7, 17.4, 18.0, NA, 19.3, 20.6, 17.8, 19.6, 18.1, …
## $ flipper_length_mm <int> 181, 186, 195, NA, 193, 190, 181, 195, 193, 190, 186…
## $ body_mass_g       <int> 3750, 3800, 3250, NA, 3450, 3650, 3625, 4675, 3475, …
## $ sex               <fct> male, female, female, NA, female, male, female, male…
## $ year              <int> 2007, 2007, 2007, 2007, 2007, 2007, 2007, 2007, 2007…
```

# The Rings of Power

- Create a histogram of `body_mass_g`

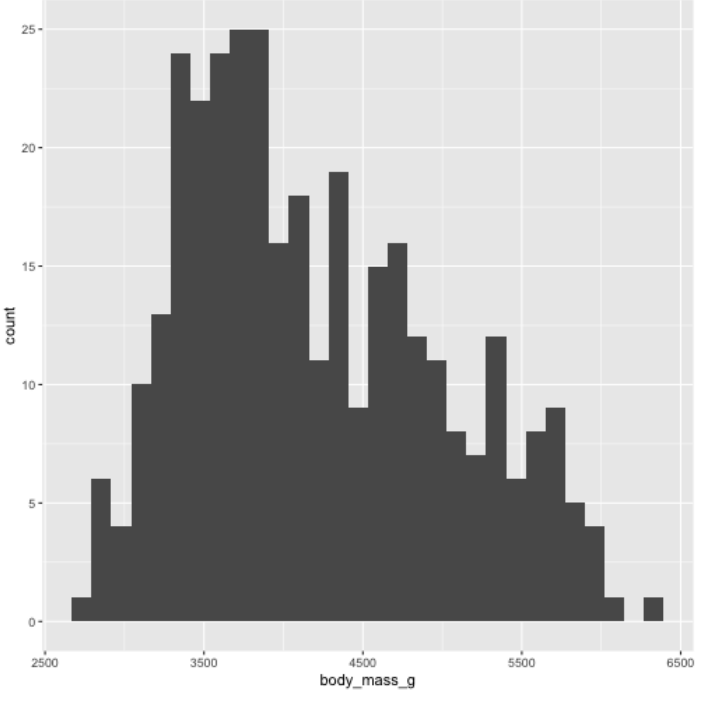
- Using base R

```
hist(penguins$body_mass_g)
```




- Using `tidyverse`

```
ggplot(penguins, aes(x = body_mass_g)) +
  geom_histogram()
```

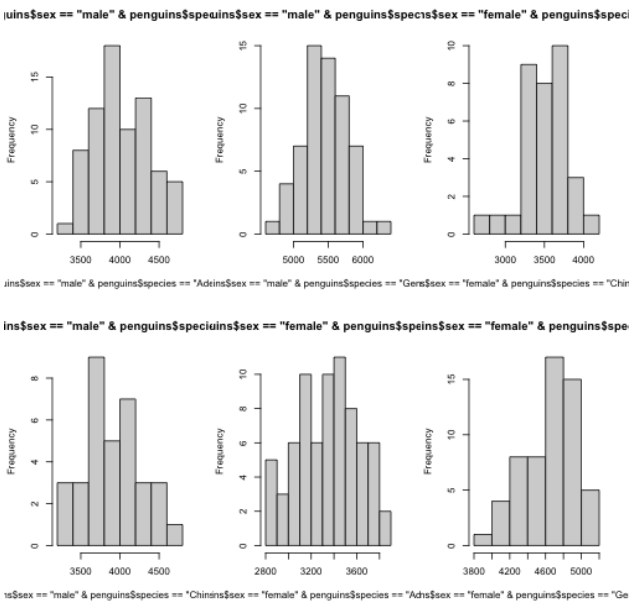


# But they were all of them decieved

- Create a histogram of `body_mass_g` for each `species` and `sex`

- Using base R

```
layout(matrix(1:6, 2, 3))
hist(penguins[penguins$sex == "male" & penguins$species =
hist(penguins[penguins$sex == "male" & penguins$species =
hist(penguins[penguins$sex == "male" & penguins$species =
hist(penguins[penguins$sex == "female" & penguins$species
hist(penguins[penguins$sex == "female" & penguins$species
hist(penguins[penguins$sex == "female" & penguins$species
```




- Using `tidyverse`

```
ggplot(penguins, aes(x = body_mass_g)) +
  geom_histogram() +
  facet_grid(sex ~ species)
```

# For in secret the Dark Lord Sauron forged in secret a Master Ring, to control all others.

- How many penguins are in the dataset of each `sex` and `species`?

```
with(penguins, table(sex, species))
```

```
##         species
## sex      Adelie Chinstrap Gentoo
##   female     73        34     58
##   male       73        34     61
```

```
penguins %>%
  count(sex, species)
```

```
## # A tibble: 8 x 3
##   sex    species       n
##   <fct>  <fct>     <int>
## 1 female Adelie       73
## 2 female Chinstrap    34
## 3 female Gentoo       58
## 4 male   Adelie       73
## 5 male   Chinstrap    34
## 6 male   Gentoo       61
## 7 <NA>   Adelie        6
## 8 <NA>   Gentoo        5
```

- Where did the `NA` values go?

# One ring to rule them all!

- What does this code do?

```
aggregate(airquality[, "Ozone"],
          list(Month = airquality[, "Month"]),
          mean, na.rm = TRUE)
```

```
##   Month        x
## 1     5 23.61538
## 2     6 29.44444
## 3     7 59.11538
## 4     8 59.96154
## 5     9 31.44828
```

```
airquality %>%
  group_by(Month) %>%
    summarize(mean_o3 = mean(Ozone, na.rm = TRUE))
```

```
## # A tibble: 5 x 2
##   Month mean_o3
##   <int>   <dbl>
## 1     5    23.6
## 2     6    29.4
## 3     7    59.1
## 4     8    60.0
## 5     9    31.4
```

- Which example is more **human readable?**

# Working with RMarkdown

- Demo with RMarkdown examples (15-20 minutes)

- Code chunks
- Running code (ctrl-enter, run all above)
- installing vs. loading packages
- Restarting the R environment and clearing variables
    - Do this often
- **Settings**--don't save your workspace
- Plain text, math equations, and communication
- Code chunk options
- File paths and loading data
- Managing the project environment
- Formatting and troubleshooting
- The tinytex/latex problem
    - `install.packages('tinytex')
    - `tinytex::install_tinytex()`
- python code in RMarkdown
- sourcing in scripts
- live preview (I'm learning this in real time)
- Getting help with `?`

# What to teach

- Programming concepts are important
  - loops, data structures, functions
- But, I **don't** teach R as if it were a programming language
  - R is a programming language for **data science**
  - Many "real" programmers don't like R because it is not a "progamming first" language
    - R is a **data-science** first language, don't get mad when it isn't what you want it to be
  - Show how to do data science using R as a tool
- Lead with data visualization, follow up with data manipulation

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# Explore for meaningful datasets to use

1) Tidy Tuesday

# Focus on basic syntax and datatypes (demo)

## Typically in class, I include code in the slides, but not here

- vectors
- matrices
- arrays
- lists
- factors
- data.frames

# Atomic types (demo)

- logical/boolean
- numeric
- integer
- complex (not covered)
- character/string

# Working with data

- what are data.frames?
- accessing rows/columns with `[`
- accessing variables with `[`
- accessing variables with `$`