Lab 1

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Things to cover today

- R Studio
- R Studio Projects
- Installing packages (specifically *tidyverse*)
- Reading in data (very briefly)
- The `$` operator
- Super basics of manipulating data with dplyr
- R Markdown basics

R Studio

[demo]

- Customizing the look/feel
    - Theme
    - Syntax highlighting
    - Panes
- Keyboard shortcuts
- Snippets (briefly)

(consider the daily download version: https://www.rstudio.org/download/daily/desktop/)

R Studio Projects

- Start a new project and call it Lab 1.
- Once the Project has launched, create a new R script to save all your work for today. Run lines of code from the script with Command + Enter (mac) or Control + Enter (Windows).

[demo]

- This is really a note on working directories, reproducibility, and staying organized
- So, let's talk about each a bit, before talking about projects

What's a working directory?

- Where you're at on your computer.
- See where you're currently at by looking at the top of the console
  - Or run `getwd()` in the console
- You can change your working directory, with `setwd("path/to/files/")` but I'm going to recomend avoiding that - instead, use projects.
- Use `list.files()` to see the contents of your working directory (i.e., what your computer "sees")

What's different with projects?

- Your working directory is immediately wherever your project is.
- Use relative paths from there to read/save data

Create a new folder in Lab 1 called *data* and place the SEDA data there that you should have downloaded before class.

- You should now see a new folder called *data* within your *files* tab in R Studio. You can use this to load the data - but that's a crutch [demo].
- Look at `list.files()` again. You should see an object there called *data*. Try running `list.files("./data/")`. What do you see? (notice the quotes).

Packages

Getting started

- Install once with `install.packages()`
- Load each time with `library()`

```
# Install once
install.packages("tidyverse")

# Load each time
library(tidyverse)
```

SEDA data

- Mean test score records for every school district in the United States
- Grades 3-8
- Reading and Math
- Mapped to a common scale (equated via NAEP results)

Load the data

- We're going to use the *rio* package to load the data. Store it in an object called `d` with the following lines of code (note the relative path).

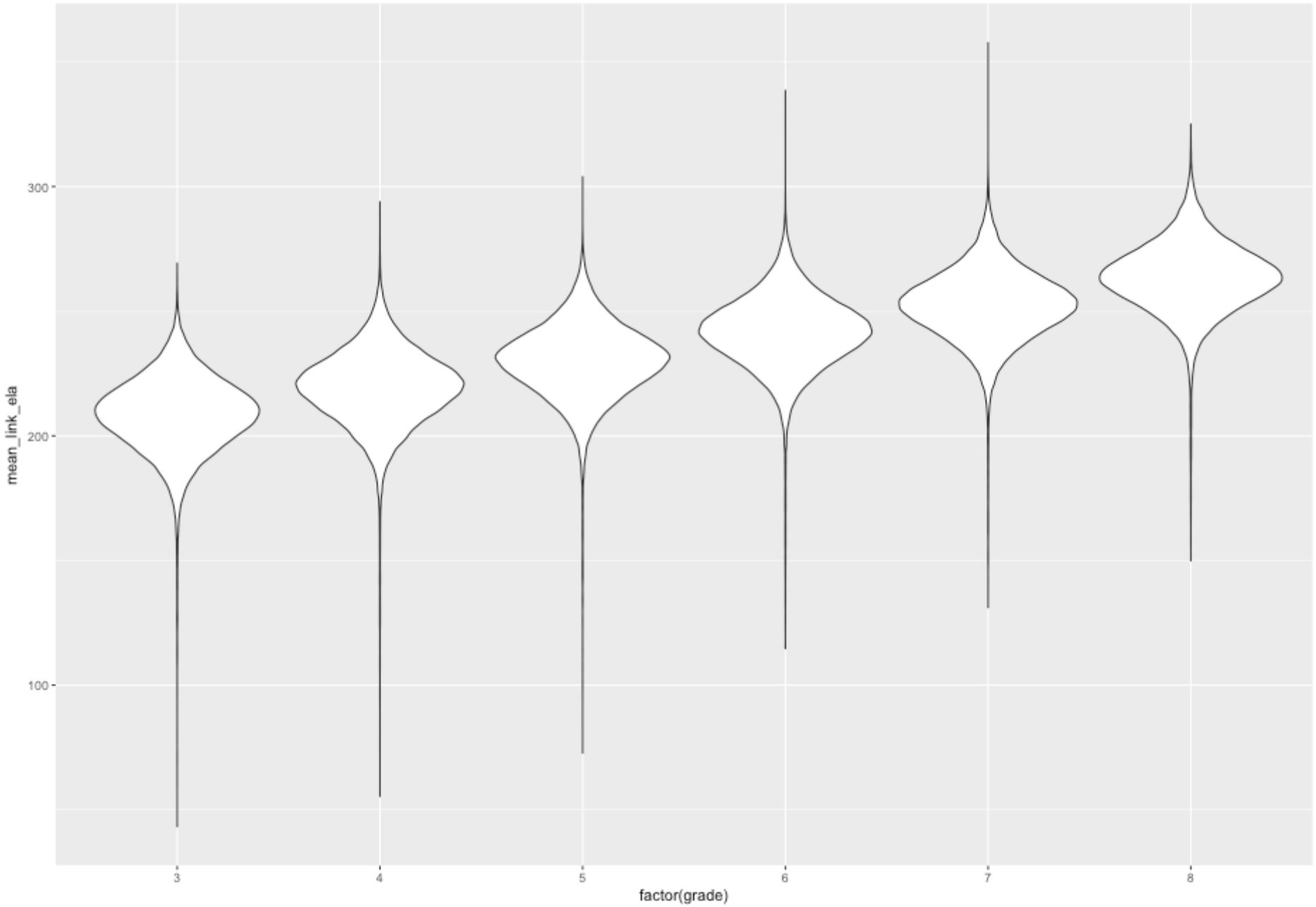
```
install.packages("rio")
library(rio)
d <- import("./data/seda.csv")
```

- It may seem like nothing happens. Try running `d`. This will print whatever is stored in the object to the console (not technically, but close enough).

Let's try it out!

- Load the *tidyverse* package and try to run the following code. What do you see? What do you make of it? (we'll talk about the mechanics behind this a lot more later)

```
ggplot(data = d, aes(x = factor(grade), y = mean_link_ela)) +
  geom_violin()
```


mean_link_ela
300
200
100
3
4
5
6
7
8
factor(grade)

tidyverse packages

ggplot2 is one of the tidyverse packages. When you load the tidyverse, you actually load a bunch of R packages. It is shorthand for:

```
library(ggplot2)
library(tibble)
library(tidyr)
library(readr)
library(purrr)
library(dplyr)
```

We'll talk about each of these packages (except *purrrr*, which we'll probably only touch on near the end of the course), and you could load only one if that's all you need. But for much applied work it's easiest to just load them all.

How do we access variables?

- Generally, in this course, *tidyverse* tools
- Sometimes `$`

```
d$leaname
```

```
##  [1] "ALABAMA YOUTH SERVICES" "ALABAMA YOUTH SERVICES"
##  [3] "ALABAMA YOUTH SERVICES" "ALBERTVILLE CITY"
##  [5] "ALBERTVILLE CITY"       "ALBERTVILLE CITY"
##  [7] "ALBERTVILLE CITY"       "ALBERTVILLE CITY"
##  [9] "ALBERTVILLE CITY"       "ALBERTVILLE CITY"
## [11] "ALBERTVILLE CITY"       "ALBERTVILLE CITY"
## [13] "ALBERTVILLE CITY"       "ALBERTVILLE CITY"
## [15] "ALBERTVILLE CITY"
```

Look at the structure of an object

```
str(d)
```

```
## 'data.frame':    326246 obs. of  10 variables:
##  $ leaid         : int  100002 100002 100002 100005 100005 100005 100005 100005 100005 100(
##  $ leaname       : chr  "ALABAMA YOUTH SERVICES" "ALABAMA YOUTH SERVICES" "ALABAMA YOUTH SE
##  $ fips          : int  1 1 1 1 1 1 1 1 1 1 ...
##  $ stateabb      : chr  "AL" "AL" "AL" "AL" ...
##  $ year          : int  2009 2011 2012 2009 2009 2009 2009 2009 2009 2010 ...
##  $ grade         : int  8 8 8 3 4 5 6 7 8 3 ...
##  $ mean_link_ela : num  211 232 226 204 207 ...
##  $ se_link_ela   : num  6.72 6.74 6.66 2.75 2.94 ...
##  $ mean_link_math: num  221 NA 233 216 223 ...
##  $ se_link_math  : num  7.06 NA 6.98 2.01 2.34 ...
```

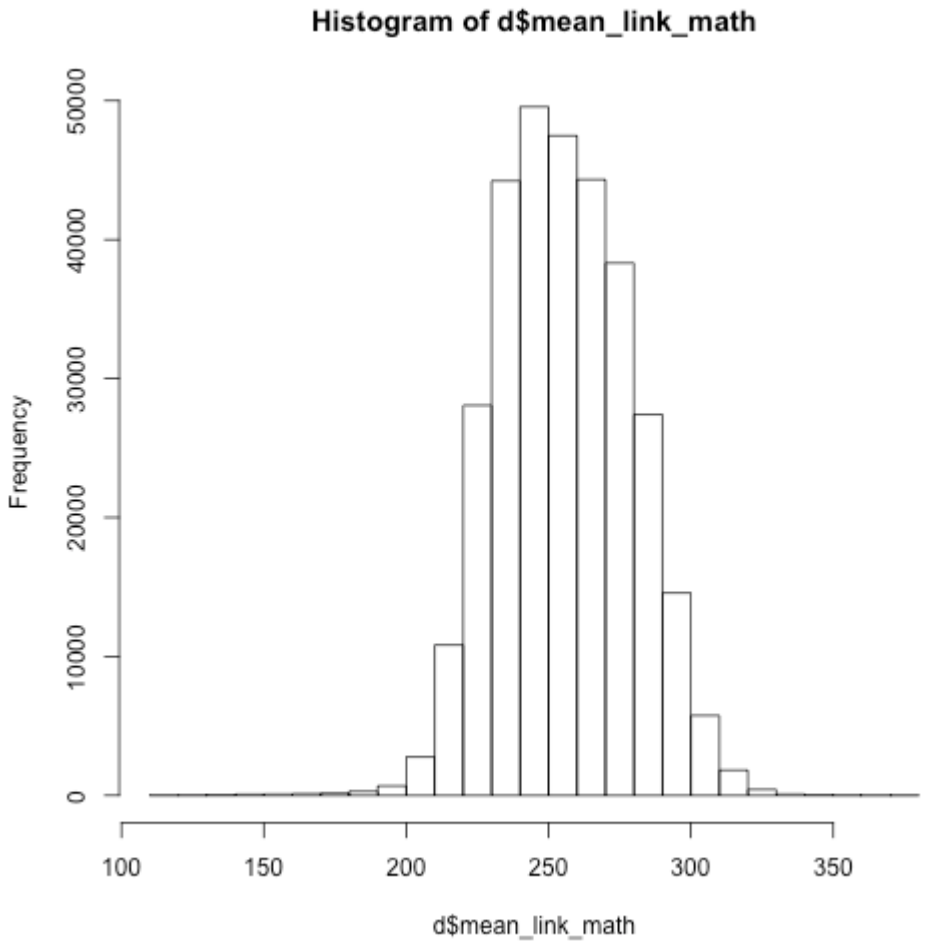
When $?

Quick and dirty

```
table(d$year)
```

```
##
##  2009  2010  2011  2012  2013
## 64961 65482 65651 65498 64654
```

```
hist(d$mean_link_math)
```



Your turn

- Run `table` on *grade*
- Produce a histogram of *mean_link_ela*

demo

Some *dplyr*

- Subset rows with `filter`

  Subset the data for Oregon districts only

```
oregon <- filter(d, stateabb == "OR")
oregon
```

```
##        leaid                        leaname fips stateabb year grade
## 1    4100014                VALE SD 84    41       OR 2009     3
## 2    4100014                VALE SD 84    41       OR 2009     4
## 3    4100014                VALE SD 84    41       OR 2009     5
## 4    4100014                VALE SD 84    41       OR 2009     6
## 5    4100014                VALE SD 84    41       OR 2009     7
## 6    4100014                VALE SD 84    41       OR 2009     8
## 7    4100014                VALE SD 84    41       OR 2010     3
## 8    4100014                VALE SD 84    41       OR 2010     4
## 9    4100014                VALE SD 84    41       OR 2010     5
## 10   4100014                VALE SD 84    41       OR 2010     6
## 11   4100014                VALE SD 84    41       OR 2010     7
## 12   4100014                VALE SD 84    41       OR 2010     8
## 13   4100014                VALE SD 84    41       OR 2011     3
## 14   4100014                VALE SD 84    41       OR 2011     4
```

Filter math scores greater than 1 SD above the mean

```
high_scores <- filter(d, mean_link_math >
                           ( mean(mean_link_math, na.rm = TRUE) +
                               sd(mean_link_math, na.rm = TRUE) )
                     )
high_scores
```

```
##         leaid                                                leaname
## 1      100007                                           HOOVER CITY
## 2      100007                                           HOOVER CITY
## 3      100007                                           HOOVER CITY
## 4      100007                                           HOOVER CITY
## 5      100007                                           HOOVER CITY
## 6      100007                                           HOOVER CITY
## 7      100008                                          MADISON CITY
## 8      100008                                          MADISON CITY
## 9      100008                                          MADISON CITY
## 10     100008                                          MADISON CITY
## 11     100008                                          MADISON CITY
## 12     100008                                          MADISON CITY
## 13     100008                                          MADISON CITY
## 14     100008                                          MADISON CITY
## 15     100008                                          MADISON CITY
```

Multi-condition filter

Filter Oregon districts in 2010 with a score above the grand mean in math

```
high_or_2010 <- filter(d,
                  stateabb == "OR" &
                  year == 2010 &
                  mean_link_math > mean(mean_link_math, na.rm = TRUE))
high_or_2010
```

```
##       leaid                          leaname fips stateabb year grade
## 1   4100014                    VALE SD 84    41       OR 2010     6
## 2   4100014                    VALE SD 84    41       OR 2010     7
## 3   4100014                    VALE SD 84    41       OR 2010     8
## 4   4100015                  GERVAIS SD 1    41       OR 2010     7
## 5   4100015                  GERVAIS SD 1    41       OR 2010     8
## 6   4100016          YAMHILL CARLTON SD 1    41       OR 2010     7
## 7   4100016          YAMHILL CARLTON SD 1    41       OR 2010     8
## 8   4100019              HARRISBURG SD 7J    41       OR 2010     7
## 9   4100019              HARRISBURG SD 7J    41       OR 2010     8
## 10  4100020         NORTH SANTIAM SD 29J    41       OR 2010     4
## 11  4100020         NORTH SANTIAM SD 29J    41       OR 2010     5
## 12  4100020         NORTH SANTIAM SD 29J    41       OR 2010     6
```

Select specific columns

Select *leaid*, *year*, *grade*, and math variables

```
math <- select(d, leaid, grade, year, contains("math"))
math
```

```
##          leaid grade year mean_link_math se_link_math
## 1       100002     8 2009       220.6698    7.0649977
## 2       100002     8 2011             NA           NA
## 3       100002     8 2012       233.1264    6.9755855
## 4       100005     3 2009       216.3612    2.0081453
## 5       100005     4 2009       223.0344    2.3392658
## 6       100005     5 2009       230.4161    2.2901359
## 7       100005     6 2009       239.6713    2.2888308
## 8       100005     7 2009       263.6110    2.7867444
## 9       100005     8 2009       263.2226    2.5224493
## 10      100005     3 2010       229.3067    2.6386807
## 11      100005     4 2010       234.4490    2.4732106
## 12      100005     5 2010       237.2106    2.6199555
## 13      100005     6 2010       251.1274    2.3663089
## 14      100005     7 2010       258.1433    2.7989073
## 15      100005     8 2010       267.7738    2.6511655
```

Your turn

Create a dataset that has the following properties

- Only California school districts in Grades 3-5.
- Only the 2012 school year
- Includes *leaname*, *grade* ELA mean and standard error

demo

A few notes on base R

- In base R, you generally subset with `[]`.
- The one place I will often use this in this class is with renaming variables

```
names(d)[1]
```

```
## [1] "leaid"
```

```
names(d)
```

```
##  [1] "leaid"          "leaname"        "fips"           "stateabb"
##  [5] "year"           "grade"          "mean_link_ela"  "se_link_ela"
##  [9] "mean_link_math" "se_link_math"
```

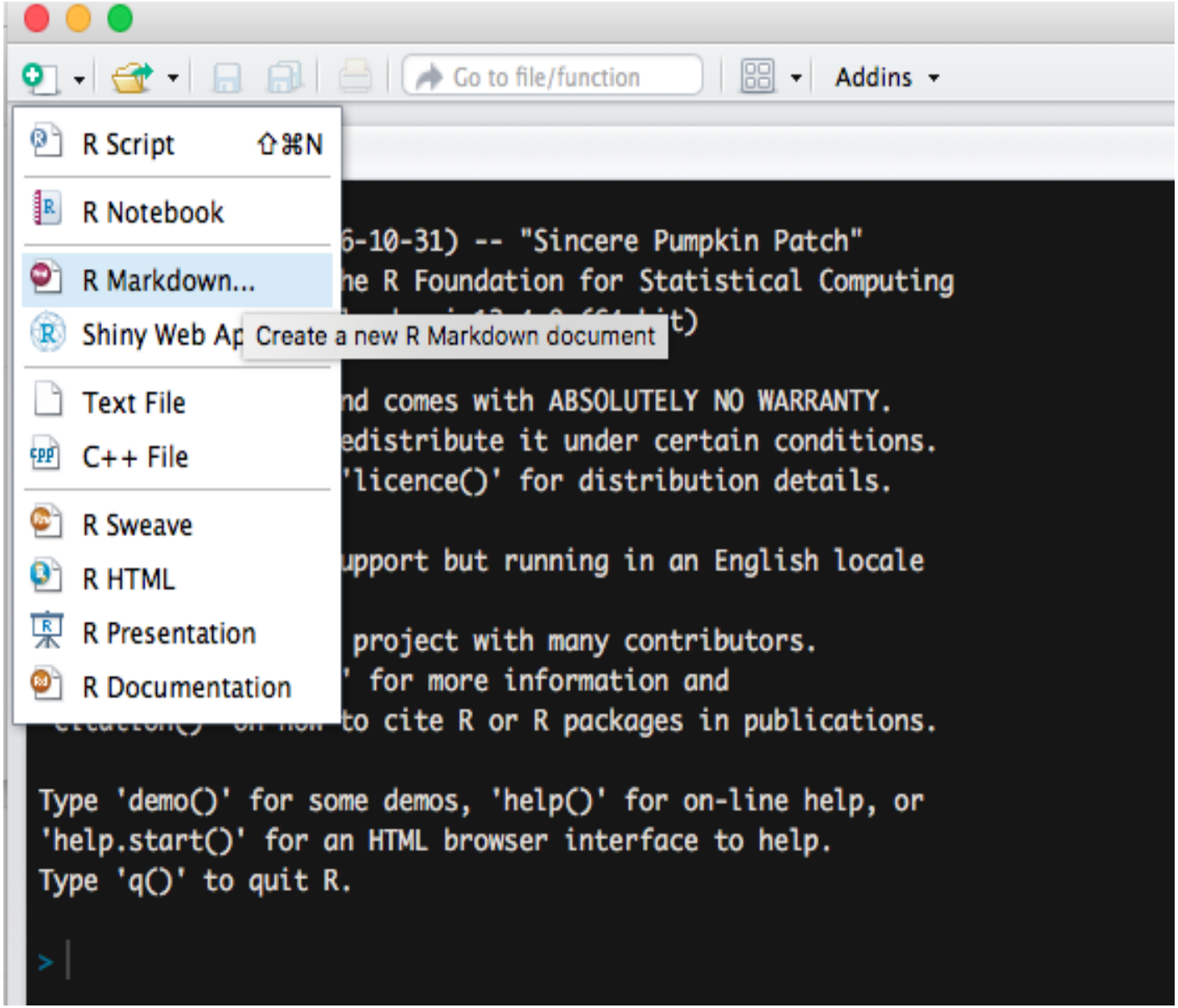
So if I wanted to rename the first two columns

```
names(d)[1:2] <- c("distid", "distname")
head(d)
```

```
##   distid              distname fips stateabb year grade mean_link_ela
## 1 100002 ALABAMA YOUTH SERVICES    1       AL 2009     8      210.5474
## 2 100002 ALABAMA YOUTH SERVICES    1       AL 2011     8      231.6601
## 3 100002 ALABAMA YOUTH SERVICES    1       AL 2012     8      226.1813
## 4 100005       ALBERTVILLE CITY    1       AL 2009     3      204.4659
## 5 100005       ALBERTVILLE CITY    1       AL 2009     4      207.4045
## 6 100005       ALBERTVILLE CITY    1       AL 2009     5      216.8594
##   se_link_ela mean_link_math se_link_math
## 1    6.723581       220.6698     7.064998
## 2    6.741922             NA           NA
## 3    6.657756       233.1264     6.975586
## 4    2.747565       216.3612     2.008145
## 5    2.939638       223.0344     2.339266
## 6    2.599224       230.4161     2.290136
```

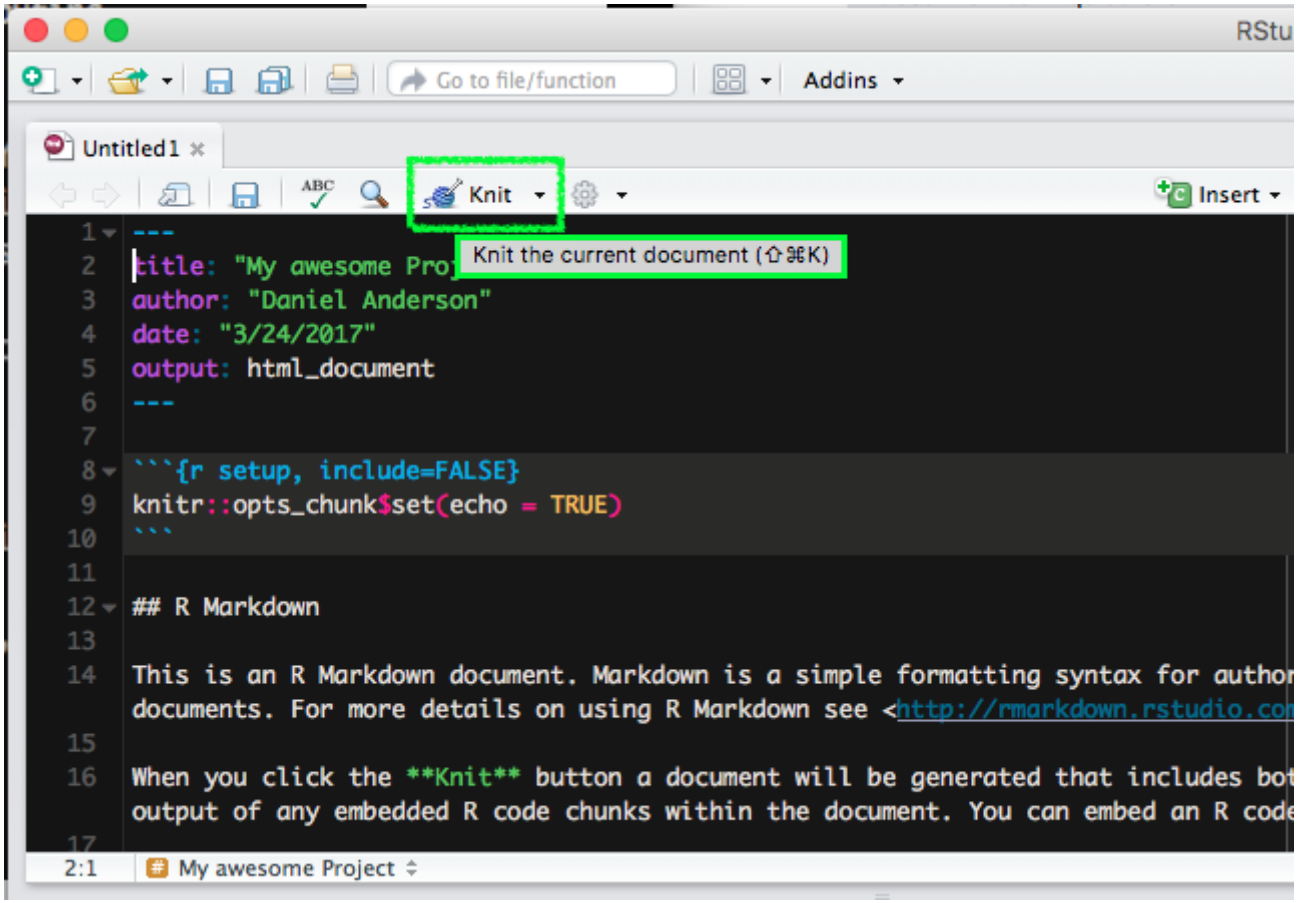
From within your R Studio Project:

R Markdown



First thing: Render!

[demo]



YAML Front Matter

```
---
title: Example Markdown document
author: Daniel Anderson
date: "2015-09-17"
---
```

- Three dashes before and after the YAML fields
- Case sensitive
- Many other fields are possible.
    - For example, you may want to include an `output:` argument (`pdf_document`, `html_document`, `word_document`). Must be specified as it is rendered, if not supplied.

Code chunks versus text

````
---
title: "My awesome Project"
author: "Daniel Anderson"
date: "3/24/2017"
output: html_document
---

## R Markdown

Text here

```{r cars}
# Code here
summary(cars)
```

More text here

```{r pressure, echo=FALSE}
# More code here
plot(pressure)
```

Yet more text...
````

Code chunks

Start a code chunk with ```{r}, then produce some r code, then close the chunk with three additional back ticks ```.

````
```{r}
a <- 3
b <- 5

a + b * (exp(a)/b)
```
````

```
a <- 3
b <- 5


a + b * (exp(a)/b)
```

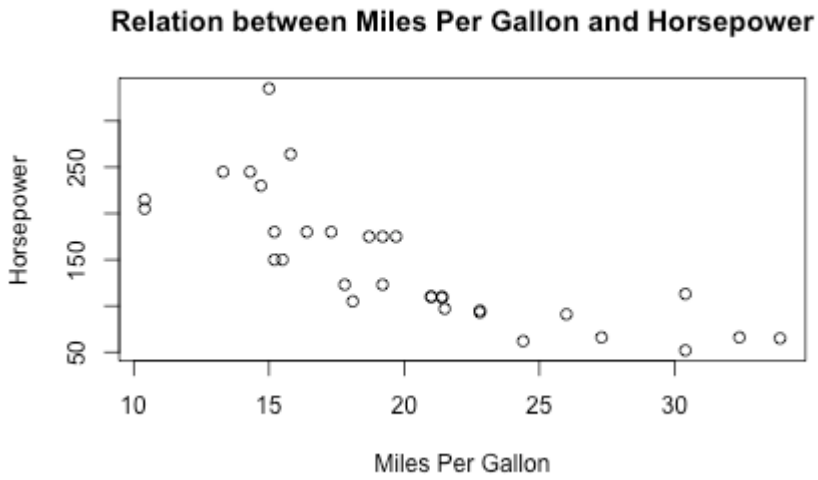
```
## [1] 23.08554
```

You can show code without evaluating it, using `eval = FALSE`.

````
```{r, eval = FALSE}
a + b * (exp(a)/b)
```
````

Alternatively, you can evaluate the code without displaying it, using `echo = FALSE`.

````
```{r, echo = FALSE}
data(mtcars)
with(mtcars, plot(mpg, hp,
    xlab = "Miles Per Gallon",
    ylab = "Horsepower",
    main = "Relation between Miles Per Gallon and Horsepower"))
```
````

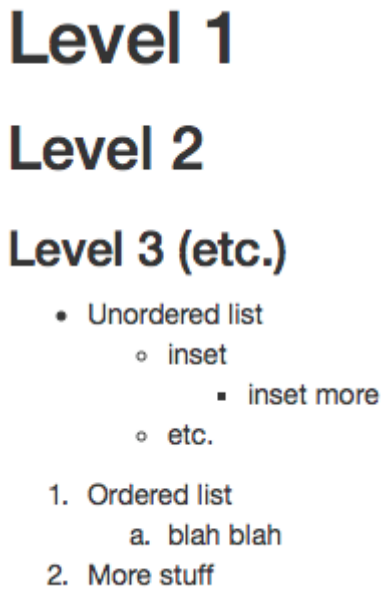


Headings and Lists (not R-lists, but text lists)

```
# Level 1
## Level 2
### Level 3 (etc.)
```

```
* Unordered list
  - inset
    + inset more
  - etc.

1. Ordered list
  a. blah blah
2. More stuff
```



Inline code

A single back tick followed by `r` prooduces inline code to be evaluated.

```
This is an example of inline code, where I want to refer to the sum of `a` and
  `b`, which is `r a + b`.
```

This is an example of inline code, where I want to refer to the sum of `a` and `b`, which is 8.

Final Product

ExampleRMarkdown.Rmd

```
---
title: Example Markdown document
author: Daniel Anderson
date: "`r Sys.Date()`"
---

# Level 1

## Level 2

### Level 3 (etc.)


* Unordered list
  - inset
    + inset more
  - etc.

1. Ordered list
   a. blah blah
2. More stuff

```{r}
a <- 3
b <- 5

a + b * (exp(a)/b)
```

This is an example of inline code, where I want to refer to the sum of `a` and
  `b`, which is `r a + b`.

You can show code without evaluating it, using `eval = FALSE`.

```{r, eval = FALSE}
a + b * (exp(a)/b)
```

Alternatively, you can evaluate the code without displaying it

```{r, echo = FALSE}
data(mtcars)
with(mtcars, plot(mpg, hp,
    xlab = "Miles Per Gallon",
    ylab = "Horsepower",
    main = "Relation between Miles Per Gallon and Horsepower"))
```
```

file:///Users/Daniel/Dropbox/Teaching/Rcourse/Week1/ExampleR

irst Row Apple Gmail MidMathDev UO Mail Facebook espn Duckweb Blackboard Wells Farg

r - How to add whitespace to an RMarkdown docume... Exampl

Example Markdown document

Daniel Anderson

2015-09-17

Level 1

Level 2

Level 3 (etc.)

- Unordered list
- inset
  - inset more
- etc.

1. Ordered list

a. blah blah

2. More stuff

```
a <- 3
b <- 5

a + b * (exp(a)/b)
```

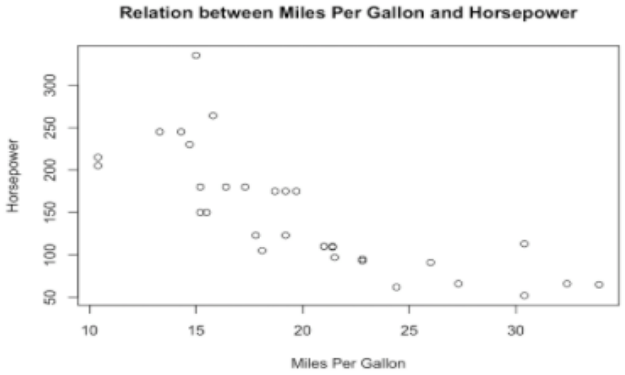
```
## [1] 23.08554
```

This is an example of inline code, where I want to refer to the sum of `a` and `b`, which is 8.

You can show code without evaluating it, using `eval = FALSE`.

```
a + b * (exp(a)/b)
```

Alternatively, you can evaluate the code without displaying it

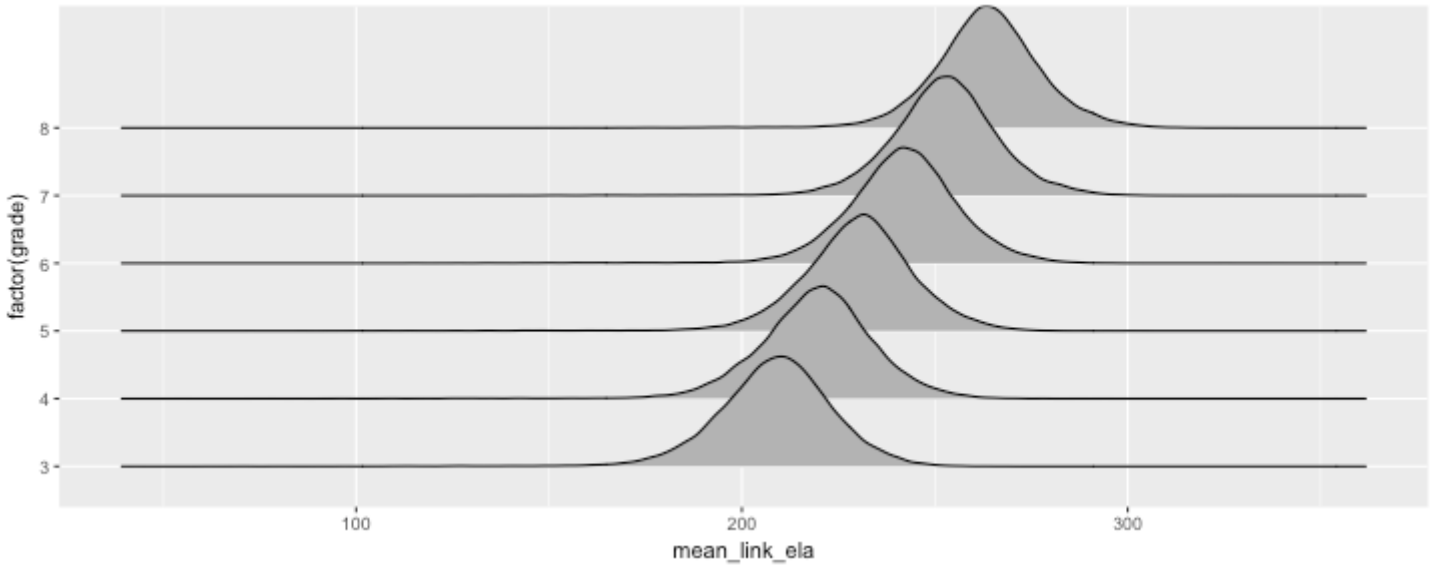


Brief aside

Alternative (better) represenation of the vizualization we produced earlier

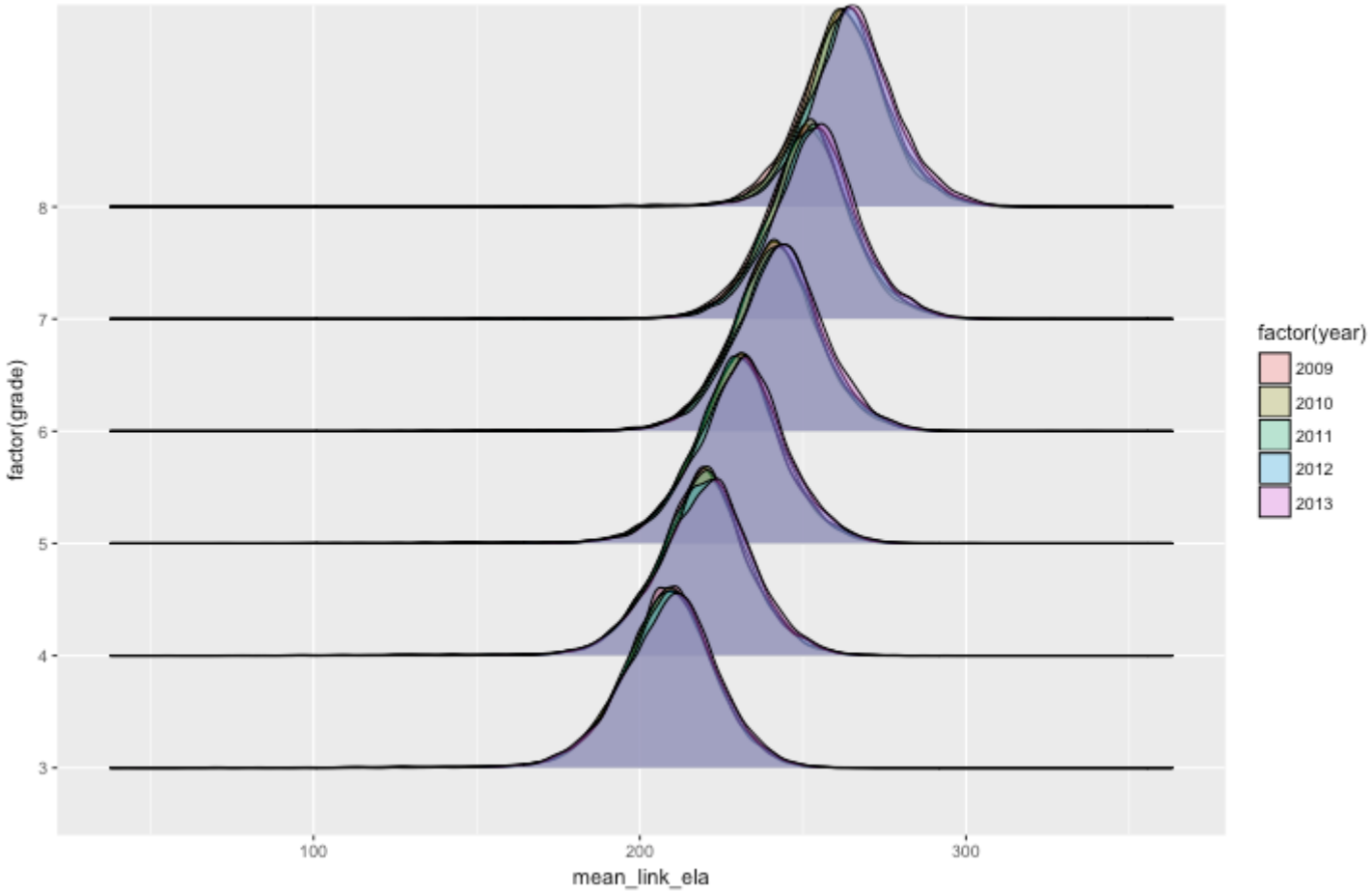
- Joy plots, or ridgline density plots
- Requires a *ggplot2* extenstion called *ggridges*

```
install.packages("ggridges")
library(ggridges)
ggplot(d, aes(x = mean_link_ela, y = factor(grade))) +
  geom_density_ridges()
```



Look at density plots by year

```
ggplot(d, aes(mean_link_ela, factor(grade), fill = factor(year))) +
  geom_density_ridges(alpha = 0.3)
```



Challenge