

# Coding Lab: Why code? and getting situated

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# Intro to coding lab

- ▶ Why are we here?
- ▶ What are we going to do?
- ▶ A quick introduction to R and R Studio and the tidyverse

## Why coding?

Many public policy jobs and the Harris curriculum rely on programming

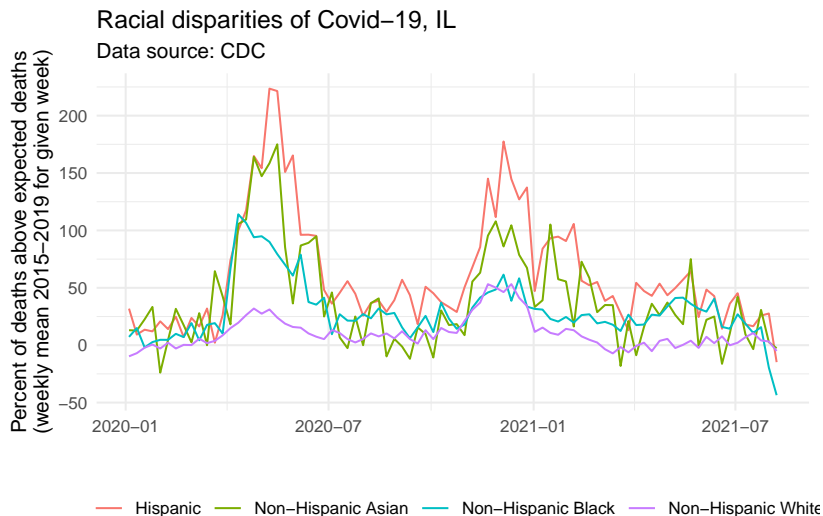
- ▶ to quickly engage with policy data
- ▶ to complete statistical analyses

## Why R?

- ▶ Great data manipulation and visualization suite
- ▶ Strong statistical packages (e.g. program evaluation, machine learning)
- ▶ Complete programming language with low barriers to entry
- ▶ Open source and free

# An example

I wanted to understand racial disparities of Covid-19.



# What will we cover?

Foundations:

0. R, RStudio and packages
1. Reading files, and manipulating data with `dplyr`
2. Vectors and data types
3. If statements
4. Analyzing data with groups
5. Loops
6. Functions
7. Graphing with `ggplot` (Extra lesson)

*Fall Coding Lab condenses material into 5 lessons*

In stats 1 and other courses, you will build off of these lessons:

- ▶ extend your capabilities with the functions we teach you
- ▶ introduce statistics functions
- ▶ introduce new packages and tools based on needs

# Learning philosophy

- ▶ We learn coding by experimenting with code.
- ▶ Coding requires a different modality of thinking
- ▶ Coding can be frustrating
- ▶ We develop self-sufficiency by learning where to get help and how to ask for help
- ▶ Coding lab is for you.

# How will we progress?

1. Video lectures:
  - ▶ Have R open. Pause regularly.
  - ▶ Focus on main idea first.
2. Practice in labs (most important part):
  - ▶ You learn coding by coding.
  - ▶ Break up into small groups and work on problems with peer and TA support
3. Q and A (live session):
  - ▶ Please send me questions ahead of class
  - ▶ May include additional practice problems.
4. Final project: (see next slide)



## Final project:

You'll know you're ready for policy school coding, if you can open a data set of interest to you and produce meaningful analysis. For the final project, you will:

- ▶ Pick a data set aligned with your policy interests (or not)
- ▶ Use programming skills to engage with data and make a data visualization showing something you learned from the data.

## Getting help

- ▶ R's ? documentation is very good, esp. for tidyverse code.
- ▶ Rstudio has useful cheatsheets for dplyr and ggplot
  - ▶ In the menu bar, select help > cheatsheets
- ▶ Get situated with R for Data Science <https://r4ds.had.co.nz/>
- ▶ google and stackoverflow are your friends for idiosyncratic problems
  - ▶ googling is its own skill
  - ▶ add "in R tidyverse" to your searches for better targeted help

# A quick introduction to R and R Studio and the tidyverse

We will

- ▶ Discuss what Rstudio is
- ▶ Introduce minimal information to get started working with R
- ▶ Learn how to install and load packages
- ▶ Discuss what the tidyverse is

# What is RStudio?

R Studio is an “integrated development environment” for R.

- ▶ It provides a console to access R directly.
- ▶ A text editor to write R scripts and work with Rmds
- ▶ An environment and history tab that provide useful information about what objects you have in your R session
- ▶ A help / plots / files / packages etc. section

## Basic syntax: Variable assignment

We use `<-` for assigning variables in R.

```
my_number <- 4  
my_number
```

```
## [1] 4
```

## Variable assignment

We can re-assign a variable as we wish. This is useful if we want to try the same math with various different numbers.

```
my_number <- 2  
my_output <- sqrt((12 * my_number) + 1)
```

## Variable assignment

We assign all sorts of objects to names including data sets and statistical models so that we can refer to them later.

- ▶ use names that are meaningful

```
model_fit <- lm(mpg ~ disp + cyl + hp, mtcars)
```

```
summary(model_fit)
```

```
##
```

```
## Call:
```

```
## lm(formula = mpg ~ disp + cyl + hp, data = mtcars)
```

```
##
```

```
## Residuals:
```

```
##      Min       1Q   Median       3Q      Max
## -4.0889 -2.0845 -0.7745  1.3972  6.9183
```

```
##
```

```
## Coefficients:
```

```
##              Estimate Std. Error t value Pr(>|t|)
```

```
## (Intercept)  24.18409      0.50072   48.165 1.54e-13 ***
```

## Using functions

Functions are procedures that take an input and provide an output.

```
sqrt(4)
```

```
## [1] 2
```

```
median(c(3, 4, 5, 6, 7 ))
```

```
## [1] 5
```



# Function arguments

Function inputs are called arguments.

Functions know what the argument is supposed to do based on

- ▶ name
- ▶ position

```
f <- function(x, y) {  
  2 * x + y  
}
```

```
f(7, 0)
```

```
## [1] 14
```

```
f(y = 7, x = 0)
```

```
## [1] 7
```

## Finding help with ?

```
?sum
```

- ▶ Description

sum returns the sum of all the values present in its arguments.

- ▶ Usage (API)

```
sum(..., na.rm = FALSE)
```

- ▶ Arguments

... numeric or complex or logical vectors.

- ▶ Examples (scroll down!)

```
sum(1, 2, 3, 4, 5)
```

## what are packages?

A package makes a new set of functions available to you.

Benefits: - Don't need to code everything from scratch - Often functions are optimized using C or C++ code to speed up certain steps.

Analogy:

- base R comes with screw drivers and hand saws.
- packages give you power tools

## installing and loading packages

To use a package we need to:

- ▶ install it once from the internet

```
install.packages("readxl") # do this one time  
                             # directly in console
```

- ▶ load it *each time* we restart R

```
library(readxl) # add this to your script / Rmd  
                # everytime you want to use  
read_xlsx("some_data.xls")
```

- ▶ `package::command()` lets you call a function without loading the library

```
readxl::read_xlsx("some_data.xls")
```

## common package error

The package 'haven' provides a function to read dta files called `read_dta()`. What goes wrong here?

```
install.packages("haven")  
our_data <- read_dta("my_file.dta")  
  
Error in read_dta("my_file.dta") :  
  could not find function "read_dta"
```

## common package error

We need to load the package using `library()`!

```
library(haven)  
our_data <- read_dta("my_file.dta")
```

## tidyverse: set of useful packages

Think of the tidyverse packages providing a new dialect for R.

```
library(tidyverse)
```

```
## -- Attaching packages -----  
## v ggplot2 3.3.0 v purrr 0.3.4  
## v tibble 2.1.3 v dplyr 0.8.5  
## v tidyr 1.0.2 v stringr 1.4.0  
## v readr 1.3.1 v forcats 0.5.0  
  
## -- Conflicts -----  
## x dplyr::filter() masks stats::filter()  
## x dplyr::lag() masks stats::lag()
```

## Recap: Intro to R, RStudio and the tidyverse

After going through this video, you should understand how to

- ▶ navigate and use Rstudio's features
  - ▶ particularly, the console, the text editor and help
- ▶ assign objects to names with `<-`
- ▶ use functions by providing inputs and learn more with `?`
- ▶ `install.packages()` (once) and then load them with `library()` (each time you restart R)