

# **Intro to R**

Introduction

# Welcome to class!

1. Introductions
2. Class overview
3. Getting R up and running



[Photo by [Belinda Fewings](#) on [Unsplash](#)]

**Before we start ..**

Poll: How are you feeling right now?

# About Us

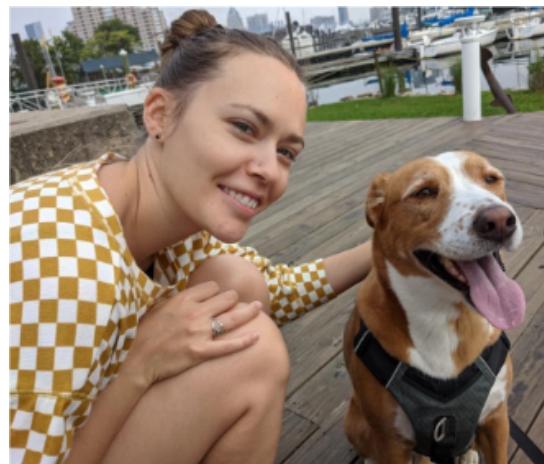
## Carrie Wright (she/her)

Senior Staff Scientist, Fred Hutchinson Cancer Center

Associate, Department of Biostatistics, JHSPH

PhD in Biomedical Sciences

Email: [cwright60@jhu.edu](mailto:cwright60@jhu.edu) Web: <https://carriewright11.github.io>



# About Us

**Ava Hoffman (she/her)**

Senior Staff Scientist, Fred Hutchinson Cancer Center

Associate, Department of Biostatistics, JHSPH

PhD in Ecology

Email: [ava.hoffman@jhu.edu](mailto:ava.hoffman@jhu.edu) Web: <https://avahoffman.com>



# About Us

## Clif McKee (he/him)

Research Associate, Department of Epidemiology, JHSPH

Masters and PhD in Ecology

Email: [cmckee7@jhu.edu](mailto:cmckee7@jhu.edu) Web: <http://clifmckee.github.io>



## About Us - TAs

**Rupshikha Sen**

MSc Graduate Student, Department of Epidemiology, BSPH

DDS, The Dayananda Sagar Institutions, Bangalore

Email: [rsen6@jhmi.edu](mailto:rsen6@jhmi.edu)

## About you!

Please introduce yourself!

Find the “introductions” channel on Slack: <https://intro-to-r-june2023.slack.com/>

# The Learning Curve

Learning a programming language can be very intense and sometimes overwhelming.

We recommend fully diving in and minimizing other commitments to get the most out of this course.

We want you to succeed – We will get through this together!



## What is R?

- R is a language and environment for statistical computing and graphics developed in 1991
- R is the open source implementation of the [S language](#), which was developed by [Bell laboratories](#) in the 70s.
- The aim of the S language, as expressed by John Chambers, is “to turn ideas into software, quickly and faithfully”



[source: <http://www.r-project.org/>, [https://en.wikipedia.org/wiki/S\\_\(programming\\_language\)](https://en.wikipedia.org/wiki/S_(programming_language)),  
[https://en.wikipedia.org/wiki/Bell\\_Labs](https://en.wikipedia.org/wiki/Bell_Labs))]

## What is R?

- Ross Ihaka and Robert Gentleman at the University of Auckland, New Zealand developed R
- R is both open source and open development



[source: <http://www.r-project.org/>, [https://en.wikipedia.org/wiki/R\\_\(programming\\_language\)](https://en.wikipedia.org/wiki/R_(programming_language))]

# Why R?

- Free (open source)
- High level language designed for statistical computing
- Powerful and flexible - especially for data wrangling and visualization
- Extensive add-on software (packages)
- Strong community



R-Ladies - a  
non-profit civil  
society  
community

[source: <https://rladies-baltimore.github.io/>]

## Why not R?

- Little centralized support, relies on online community and package developers
- Annoying to update
- Slower, and more memory intensive, than the more traditional programming languages (C, Perl, Python)



[[source -School vector created by nizovatina - www.freepik.com](#)]

# Introductions

What do you hope to get out of the class?

Why do you want to use R?



[Photo by [Nick Fewings](#) on [Unsplash](#)]

## Course Website

[http://jhudatascience.org/intro\\_to\\_r](http://jhudatascience.org/intro_to_r)

Materials will be uploaded the night before class. We are constantly trying to improve content! Please refresh/download materials before class.



## Learning Objectives

- Understanding basic programming syntax
- Reading data into R
- Recoding and manipulating data
- Using add-on packages (more on what this is soon!)
- Making exploratory plots
- Performing basic statistical tests
- Writing R functions

## Course Format

- Lecture with slides, interactive
- Lab/Practical experience
- Two 10 min breaks each day - timing may vary
- June 12-16 and 20-23, 2023 1:30 p.m. - 5:00 p.m. ET on Zoom
- In recognition of [Juneteenth](#), there will be **no class on Monday June 19th, 2023.**
- Last two classes will focus on final project

## CoursePlus

<https://courseplus.jhu.edu/core/index.cfm/go/syl:syl.public.view/coid/20767/>

- Surveys throughout the class for the instructors
- Upload homework

End of class Survey from JHU - link in email.



[source - Banner vector created by pch.vector - www.freepik.com]

## Grading

1. Attendance/Participation: 20% - this can be asynchronous - just some sort of interaction with the instructors/TAs (turning in assignments, emailing etc.)
2. Homework: 3 x 15%
3. Final “Project”: 35%

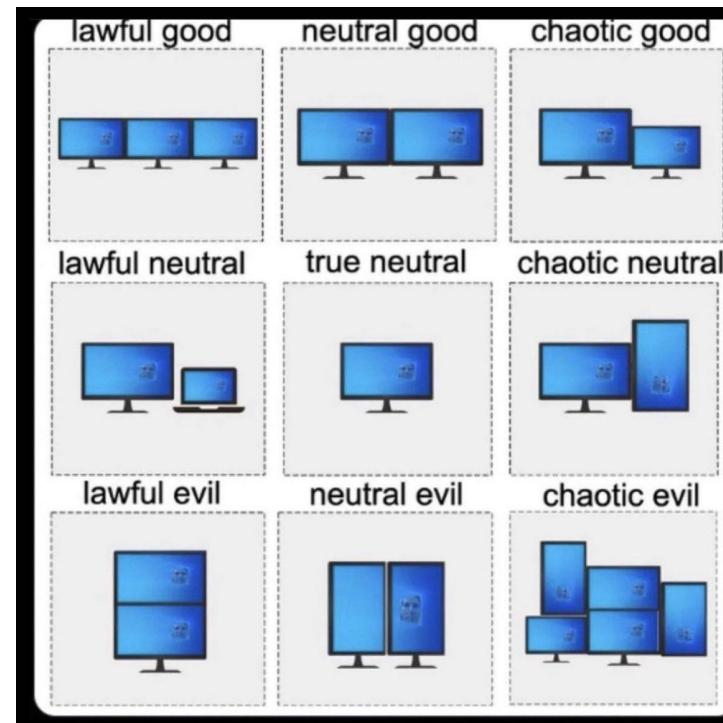
Homework and Final Project due by **June 30th at 11:59pm ET.**

If you turn homework in earlier this can allow us to potentially give you feedback earlier.

Note: Only people taking the course for credit must turn in the assignments. However, we will evaluate all submitted assignments in case others would like feedback on their work.

# Your Setup

If you can, we suggest working virtually with a **large monitor or two screens**. This setup allows you to follow along on Zoom while also doing the hands-on coding.



[[source - reddit.com](#)]

# Installing R

- Install the [latest R version](#) (4.3.0 (called 'Already Tomorrow') as of April 21, 2023)
- [Install RStudio](#)

More detailed instructions [on the website](#).

RStudio is an **integrated development environment** (IDE) that makes it easier to work with R.

More on that soon!

## Getting files from downloads

This course will involve moving files around on your computer and downloading files.

If you are new to this - check out these videos.

If you have a PC: <https://youtu.be/we6vwB7DsNU>

If you have a Mac: <https://www.youtube.com/watch?v=Ao9e0cDzMrE>

You can find these on the resource page of the website.

# Basic terms

R jargon: <https://link.springer.com/content/pdf/bbm%3A978-1-4419-1318-0%2F1.pdf>

**Package** - a package in R is a bundle or “package” of code (and or possibly data) that can be loaded together for easy repeated use or for **sharing** with others.

Packages are analogous to a software application like Microsoft Word on your computer. Your operating system allows you to use it, just like having R installed (and other required packages) allows you to use packages.



## Basic terms

**Function** - a function is a piece of code that allows you to do something in R. You can write your own, use functions that come directly from installing R, or use functions from additional packages.

You can think of a function as **verb** in R.

A function might help you add numbers together, create a plot, or organize your data. More on that soon!

```
sum(1, 20234)
```

```
[1] 20235
```

## Basic terms

**Argument** - what you pass to a function

- can be data like the number 1 or 20234

```
sum(1, 20234)
```

```
[1] 20235
```

- can be options about how you want the function to work such as **digits**

```
round(0.627, digits = 2)
```

```
[1] 0.63
```

```
round(0.627, digits = 1)
```

```
[1] 0.6
```

## Basic terms

**Object** - an object is something that can be worked with or on in R - can be lots of different things! You can think of objects as **nouns** in R.

- a matrix of numbers
  - a plot
  - a function
  - data
- ... many more

## Variable and Sample

- **Variable:** something measured or counted that is a characteristic about a sample

examples: temperature, length, count, color, category

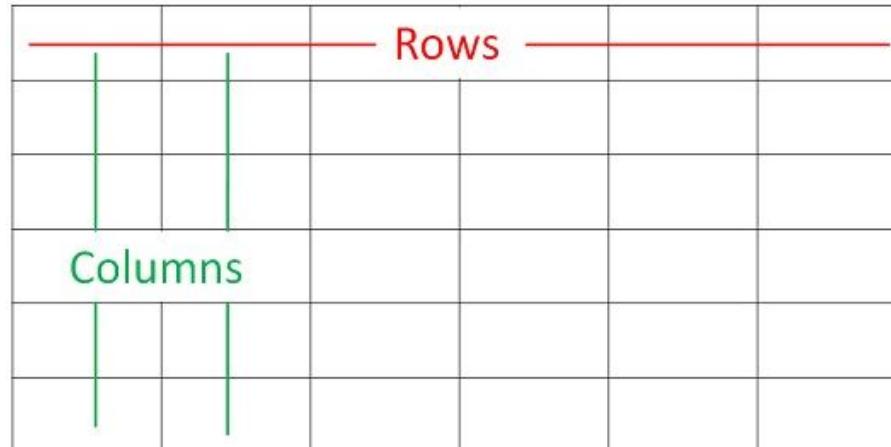
- **Sample:** individuals that you have data about -

examples: people, houses, viruses etc.

```
head(iris)
```

	Sepal.Length	Sepal.Width	Petal.Length	Petal.Width	Species
1	5.1	3.5	1.4	0.2	setosa
2	4.9	3.0	1.4	0.2	setosa
3	4.7	3.2	1.3	0.2	setosa
4	4.6	3.1	1.5	0.2	setosa
5	5.0	3.6	1.4	0.2	setosa
6	5.4	3.9	1.7	0.4	setosa

## Columns and Rows



[\[source\]](#)

Sample = Row

Variable = Column

Data objects that looks like this is often called a **data frame**.

Fancier versions from the tidyverse are called **tibbles** (more on that soon!).

# More on Functions and Packages

- When you download R, it has a “base” set of functions/packages (**base R**)
    - You can install additional packages for your uses from [CRAN](#) or [GitHub](#)
    - These additional packages are written by RStudio or R users/developers (like us)
    - There are also packages for bioinformatics available at [Bioconductor](#)



## Using Packages

- Not all packages available on CRAN or GitHub are trustworthy
- Posit makes [many useful packages](#)
- How to [trust](#) an R package

# Tidyverse and Base R: Two Dialects

We will mostly show you how to use tidyverse packages and functions.

This is a newer set of packages designed for data science that can make your code more **intuitive** as compared to the original older Base R.

## Tidyverse advantages:

- **consistent structure** - making it easier to learn how to use different packages
- particularly good for **wrangling** (manipulating, cleaning, joining) data
- more flexible for **visualizing** data

Packages for the tidyverse are managed by a team of respected data scientists at Posit.



See this [article](#) for more info.

## Package Installation

We will go through this in the lab.

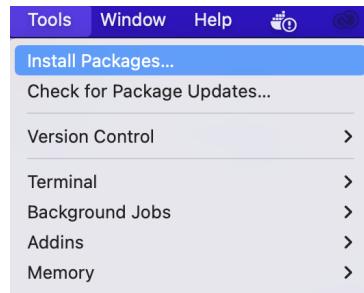
Differs depending on the source (CRAN, GitHub, etc)

Must be done **once** for each installation of R.

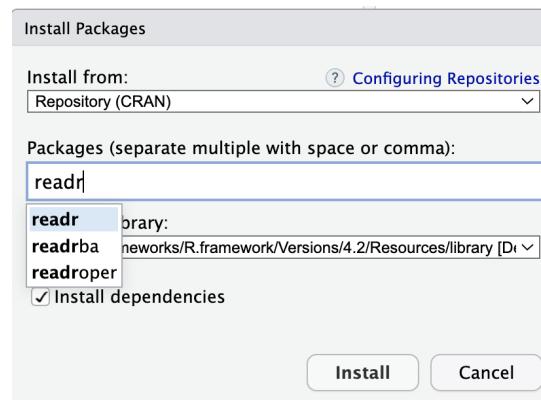
# Installing Packages: Dropdown Menu

You can install packages from CRAN using the tool menu in RStudio:

tools > Install Packages



Type in the package name to install.



## Installing Packages: Using Code

We use a function called `install.packages()` for CRAN packages.

Here is an example where we “install” the `dplyr` package:

```
install.packages("dplyr")
```

The package name is enclosed in quotation marks.

## Loading packages

After installing packages, you will need to “load” them into memory so that you can use them.

This must be done **every time** you start R.

We use a function called **library** to load packages.

Here is an example where we “load” the **dplyr** package:

```
library(dplyr)
```

Quotation marks are optional.

# Installing + Loading packages

Install package

Once per R version

Can go in the console

```
install.packages("dplyr")
```

Load package

Every R session

At the top of your code

```
library(dplyr)
```

vs

## Useful (+ mostly Free) Resources

Found on our website under the Resources tab:

[https://jhudatascience.org/intro\\_to\\_r/resources.html](https://jhudatascience.org/intro_to_r/resources.html)

- videos from previous offerings of the class
- cheatsheets from the class

# Useful (+ mostly Free) Resources

## Want more?

- Tidyverse Skills for Data Science Book:  
<https://jhubdatascience.org/tidyversecourse/> (more about the tidyverse, some modeling, and machine learning)
- Tidyverse Skills for Data Science Course:  
<https://www.coursera.org/specializations/tidyverse-data-science-r>  
(same content with quizzes, can get certificate with \$)
- R for Data Science: <http://r4ds.had.co.nz/>  
(great general information)
- R basics by Rafael A. Irizarry: <https://rafalab.github.io/dsbook/r-basics.html>  
(great general information)
- Open Case Studies: <https://www.opencasestudies.org/>  
(resource for specific public health cases with statistical implementation and interpretation)
- Dataquest: <https://www.dataquest.io/>  
(general interactive resource)

# Useful (+ mostly Free) Resources

## Need help?

- Various “Cheat Sheets”: <https://www.rstudio.com/resources/cheatsheets/>
- R reference card: <http://cran.r-project.org/doc/contrib/Short-refcard.pdf>
- R jargon: <https://link.springer.com/content/pdf/bbm%3A978-1-4419-1318-0%2F1.pdf>
- R vs Stata: <https://link.springer.com/content/pdf/bbm%3A978-1-4419-1318-0%2F1.pdf>
- R terminology: <https://cran.r-project.org/doc/manuals/r-release/R-lang.pdf>

# Useful (+ mostly Free) Resources

## Interested in Reproducibility?

Check out Candace's courses:

- Introduction:

[https://jhudatascience.org/Reproducibility\\_in\\_Cancer\\_Informatics/](https://jhudatascience.org/Reproducibility_in_Cancer_Informatics/)

- Advanced:

[https://jhudatascience.org/Adv\\_Reproducibility\\_in\\_Cancer\\_Informatics/](https://jhudatascience.org/Adv_Reproducibility_in_Cancer_Informatics/)

## Summary

- R is a powerful data visualization and analysis software language.
- Add-on **packages** like the `tidyverse` can help make R more intuitive.
- **Functions** (like verbs) perform specific tasks in R and are found within packages.
- **Arguments** within functions specify how to perform a function.
- **Objects** (like nouns) are data or variables.
- We will be both installing and loading packages.
- Materials will be updated frequently as we improve it. Please use the **surveys** available on CoursePlus so you can provide feedback!
- Lots of **resources** can be found on the website.

[Class Website](#)

# Website tour!

[Class Website](#)



Image by [Gerd Altmann](#) from [Pixabay](#)