

# 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

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# About Us

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# About Us

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## About Us - TAs

**Padmashri Saravanan (she/they)**

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# About you!

Please introduce yourself!

Find the “introductions” channel on Slack: <https://intro-to-r-jan2023.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?

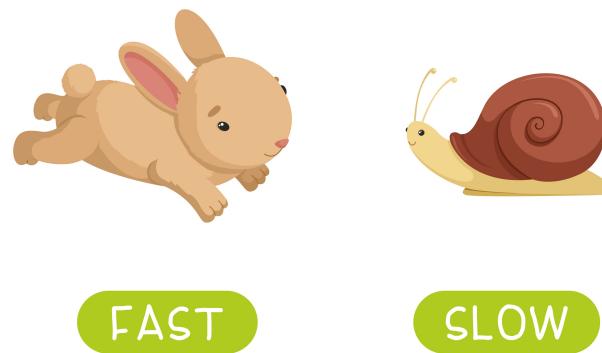
- Free (open source)
- High level language designed for statistical computing
- Powerful and flexible - especially for data wrangling and visualization
- Extensive add-on software (packages)
- Strong community



[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 (possibly “Interactive”)
- Lab/Practical experience
- Two 10 min breaks each day - timing may vary
- Jan 9-20, 2023, 1:30PM-5:00PM on Zoom
- No class on Jan 16th for Martin Luther King, Jr. Day
- Last two classes will focus on final project

# CoursePlus

<https://courseplus.jhu.edu/core/index.cfm/go/syl:syl.public.view/coid/17889/>

- Surveys throughout the class for the instructors
- Upload homework

End of class Survey - link in email.



[source - Banner vector created by pch.vector - [www.freepik.com](http://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 **Wednesday, Jan 25, 2023 at 11:59pm EST.**

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.

## Installing R

- Install the latest version from: <http://cran.r-project.org/>
- [Install RStudio](#)

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 sort of 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 particular 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

The diagram shows a 4x5 grid of cells. A red horizontal line labeled "Rows" spans the width of the grid, indicating the vertical dimension. Two green vertical lines labeled "Columns" indicate the horizontal dimension, positioned between the first and second columns and between the third and fourth columns.


[\[source\]](#)

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
- RStudio (the company) makes a lot of great packages
- Who wrote it? **Hadley Wickham** is a major authority on R (Employee and Developer at Posit - formerly called RStudio)
- How to trust an R package



(source: <https://fosstodon.org/@hadleywickham>)

# Tidyverse and Base R

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 RStudio.



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

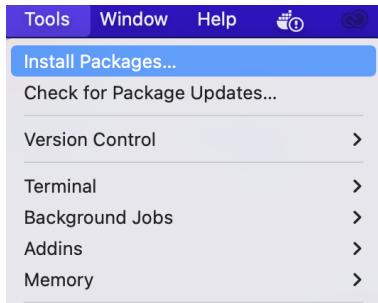
## Package Installation

We will go through this in the lab, but you only have to do it **once** for each installation of R. Depending on where the package comes from will change how you install the package. But typically for the tidyverse packages you will get them from CRAN.

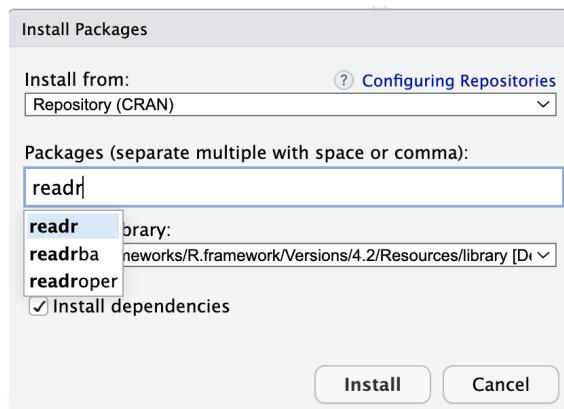
# Generally Installing Packages

You can also install packages from CRAN (not elsewhere as easily) using the tool menu in RStudio:

tools > Install Packages



Be sure to use the pull down menu to select the right place where the package is coming from, such as CRAN.



## Loading packages

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

This is typically done using a function called `library` to load the package.

Here we “load” the `dplyr` package:

```
library(dplyr)
```

We will cover this many times so just worry about the term “load” and the function `library` for now

## 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
- We will focus on **packages** (code shared among people) of the **tidyverse**, which helps make R more intuitive.
- We will also talk a bit about **base R** because some resources online and R users will use this.
- **Functions** (like verbs) perform specific tasks in R and are found within **packages**.
- **Arguments** within functions specify how a **function** is to be performed.
- **Objects** (like nouns) are what we are working with or on in R to modify
- Materials will be updated frequently as we improve it.
- Class **surveys** are 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](#)