R Module 1

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Chapter 1

Welcome!

Hi, and welcome to the R Module 1 course at Colorado State University!

This course is the first of three 1 credit courses intended to introduce the R programming language to those with little or no programming experience.

Through these Modules (courses), we'll explore how R can be used to do the following:

1. Perform basic computations and logic, just like any other programming language
2. Load, clean, analyze, and visualise data
3. Run scripts
4. Create reproducible reports so you can explain your work in a narrative form

In addition, you'll also be exposed to some aspects of the broader R community, including:

1. R as free, open source software
2. The RStudio free software
3. Publicly available packages which extend the capability of R
4. Events and community groups which advocate for the use of R and the support of R users

More detail will be provided in the Course Topics laid out in the next chapter.

1.0.1 How To Navigate This Book

To move quickly to different portions of the book, click on the appropriate chapter or section in the the table of contents on the left. The buttons at the top of the page allow you to show/hide the table of contents, search the book, change font settings, download a pdf or ebook copy of this book, or get hints

on various sections of the book. The faint left and right arrows at the sides of each page (or bottom of the page if it's narrow enough) allow you to step to the next/previous section. Here's what they look like:

Figure 1.1: Left and right navigation arrows

1.1 Associated CSU Course

This bookdown book is intended to accompany the associated course at Colorado State University, but the curriculum is free for anyone to access and use. If you're reading the PDF or EPUB version of this book, you can find the "live" version at https://csu-r.github.io/Module1/, and all of the source files for this book can be found at https://github.com/CSU-R/Module1.

Chapter 2

Course Preliminaries

This course is presented as a bookdown document, and is divided into chapters and sections Each week, you'll be expected to read through the chapter and complete any associated exercises, quizzes, or assignments.

2.0.1 Special Boxes

Throughout the book, you'll encounter special boxes, each with a special meaning. Here is an example of each type of box:

Reflect: This box will prompt you to pause and reflect on your experience and/or learning. No feedback will be given, but this may be graded on completion.

This box will signify a quiz or assignment which you will turn in for grading, on which the instructor will provide feedback.

This box is for checking your understanding, to make sure you are ready for what follows.

This box is for displaying/linking to videos in order to help illustrate or communicate concepts.

This box will warn you of possible problems or pitfalls you may encounter!

Bonus: This box is to provide material going beyond the main course content, or material which will be revisited later in more depth.

This box will prompt for your feedback on the organization of the course, so we can improve the material for everyone!

2.0.2 How This Book Displays Code

In addition, you may see R code either as part of a sentence like this: `1+1`, or as a separate block like so:

```
1+1
```

```
[1] 2
```

Sometimes (as in this example) we will also show the **output** , that is, the result of running the R code. In this case the code `1+1` produced the output `2`. If you hover over a code block with your mouse, you will see the option to copy the code to your clipboard, like this:

Figure 2.1: copying code from this book

This will be useful when you are asked to run code on your computer.

2.0.3 Next Steps

When you're ready, go to the next section to learn about the course syllabus and grading policies.

2.1 Course Topics & Syllabus

TODO: coming soon!

2.1.1 Schedule

Week	Weekday	Date	Reading	Assignments
1	Monday	July 13		
1	Wednesday	July 15		
1	Friday	July 17		
2	Monday	July 20		
2	Wednesday	July 22		
2	Friday	July 24		
3	Monday	July 27		
3	Wednesday	July 29		
3	Friday	July 31		
4	Monday	August 03		
4	Wednesday	August 05		
4	Friday	August 07		

2.1.2 Syllabus

2.1.3 Approach To Learning

- growth mindset
- do-first

2.1.4 Grading

2.2 Running your first R Code

Enough of the boring stuff, let's run some R code! Normally you will run R on your computer, but since you may not have R installed yet, let's run some R code using a website first. As you run code, you'll see some of the things R can do. In a browser, navigate to rdrr.io/snippets, where you'll see a box that looks like this:

The box comes with some code entered already, but we want to use our own code instead, so delete all the text, starting with `library(ggplot2)` and ending with `factor(cyl))`. In it's place, type `1+1`, then click the big green "Run" button. You should see the `[1] 2` displayed below. So if you give R a math expression, it will evaluate it and give the result. Note: the "correct answer" to $1 + 1$ is `2`, but the output also displays `[1]`, which we won't explain until later(TODO), so you can ignore that for now.

Next, delete the code you just wrote and type (or copy/paste) the following, and run it:

```
factorial(10)
```

Figure 2.2: rdrr code entry box

The result should be a very large number, which is equivalent to 10!, that is, $10 \times 9 \times 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1$. This is an example of an R *function*, which we will discuss more in Section (TODO: insert ref).

Aside from math, R can produce plots. Try copy/pasting the following code into the website:

```
x <- -10:10
plot(x, x^2)
```

You should see points in a scatter plot which follow a parabola. Here's a more complicated example, which you should copy/paste into the website and run:

```
library(ggplot2)
theme_set(theme_bw())
ggplot(mtcars, aes(y=mpg, fill=as.factor(cyl))) +
  geom_boxplot() +
  labs(title="Engine Fuel Efficiency vs. Number of Cylinders", y="MPG", fill="Cylinders
  theme(legend.position="bottom",
        axis.ticks.x = element_blank(),
        axis.text.x = element_blank())
```

R can be used to make many types of visualizations, which you will do more of in Section (TODO: insert ref).

☀ **Bonus:** This may be the first time you've seen R, so it's okay if you don't understand how to read this code. We'll talk more later about what each statement is doing, but for now, here is a brief description of some of the code above:

- `-10:10` This creates a sequence of numbers starting from -10 and ending at 10. That is, $-10, -9, -8, \ldots, 8, 9, 10$.
- `library` This is a function which loads an R *package*. R packages provide extra abilities to R.

2.3 What do you hope to get out of this course?

To close out this chapter, it would be healthy for you to reflect on what you'd like to get from this course. Take some time to think through each question below, and write down your answers. It is fine if your honest answer is *I don't know*. In that case, try to come up with some possible answers that *might* be true.

Reflect:

1. Why are you taking this course?
2. If this course is required for your major, how do you think it is supposed to benefit you in your studes?
3. What types of data sets related to your field of study may require data analysis?
4. What skills do you hope to develop in this course, and how might they be applied in your major and career?

TODO: canvas assignment?

Store your answers in a safe place, and refer to them periodically as you progress through the course. You may find that you aren't achieving your goals and that some adjustment to how you are approaching the course may be necessary. Or you may find that your goals have changed, which is fine! Just update your goals so that you have something to refer back to.

Chapter 3

Installing R

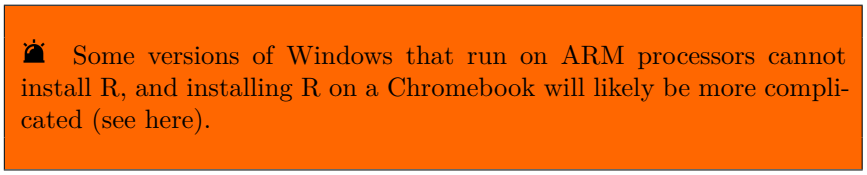
In the previous chapter, you ran R code on a website. The purpose of this chapter is to install R on your own computer, so that you can run R without needing access to the internet.

3.1 Computer Basics

If you're new to computers, this section will be important for you to get set up. If you understand the basics of operating systems, directory structures on your computer, and downloading/installing files, then you can safely skip to the next section.

3.1.1 Operating Systems

R works on Windows, Mac OS X, and several Linux-based operating systems, so if you have one of these operating systems, you'll be able install and use R. At least, this is mostly true.



3.1.2 Downloads and Installations

To install R, you'll have to download a file from the internet which performs the installation. After you install R, you shouldn't have to download anything to run R.

TODO: take out?

3.2 Install R & R Studio

You'll actually be installing *two* separate programs, both of which are free to use. The *first* is the R programming language. The *second* is a separate program called R Studio. R Studio will be the primary way in which you interact with R in this class, we will say more about this later.

3.2.1 Installing R

Installation will look slightly different depending on the operating system, but the major steps are the same.

- First, navigate to the CRAN Mirrors Site, which lists several locations from which R can be downloaded.
- Find a location near you (or not, this isn't critical) and click on the link to be brought to the mirror site.

From this point, this will change depending on your operating system.

3.2.1.1 Windows

- Click "Download R for Windows", then click "base".
- Finally, Click "Download R X.Y.Z for Windows", where X, Y, and Z will be numbers. These numbers indicate which version of R you'll be installing. As of the publishing of this book, R is on version `r_version`.
- any other settings. Your computer might prompt for the location on your computer that you would like to save the file. Select a location (reasonable options are your Downloads folder or the Desktop) and select "save".
- When the download completes, find the downloaded file in the File Explorer and double click to run it. This will start the installation process.
- Follow the on screen prompts. For the most part you can click "continue", "agree", "install" as appropriate, and you don't have to worry about changing any installation settings.

Create windows R install Video

3.2.1.2 Mac OS X

- Click "Download R for (Mac) OS X"
- Click "R-X.Y.Z.pkg", where X, Y, and Z will be numbers. These numbers indicate which version of R you'll be installing. As of the publishing of this book, R is on version `r_version`.
- Your computer might prompt for the location on your computer that you would like to save the file. Select a location and select "save".
- When the download completes, find the downloaded file in the Finder and double click to run it. This will start the installation process.

- Follow the on screen prompts. For the most part you can click “continue”, “agree”, “install” as appropriate, and you don’t have to worry about changing any installation settings.

?Ben? install from Mac OS X?

3.2.2 Installing R Studio

3.3 Successfull Installation

TODO: add some basic tasks here to make sure R and RStudio work. (screenshots?)

todo: video orienting to R Studio (Matt video?)

todo: create assessment

3.4 Running Code in RStudio Console

TODO: repeat online examples + Pull from here: https://geanders.github.io/RProgrammingForResearch/r-preliminaries.html

R comes pre-loaded with several datasets that are used in many examples. One is a set of 150 measurements of irises from 3 species. Use `mean(iris$Petal.Length)` to find out what the mean petal length is.

3.5 Workspace setup

3.5.1 Recommended Settings

- don’t save/load workspace
- how to adjust font size (in options and with ctrl +/-)
- dark mode!

3.5.2 Setting working directory

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