A gentle introduction to R and RStudio

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R is a programming language that is used by scientists in a wide variety of fields. It is open source (free to use and driven by community development) and installable on all major operating systems. RStudio is a separate installation from the R language, and is a desktop program that provides a graphical wrapper to the R language. The technical term for this type of program is *integrated development environment* (IDE), and it makes life much easier when using R. This document will get you up and running in R and RStudio on your personal machine. You will need installation permission on your computer (if installing on your home computer you will almost certainly have this).

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1 Installation

Depending on download and computer speed, you should plan to spend about 15 minutes installing both R and RStudio. The LaTeX download is much larger, and could take longer if you are not on fast internet.

1.1 R

We will use R for calculations, statistical analyses, and plotting data. R is generally more powerful than Excel or other 'point-and-click' programs, and once you generate code to perform a certain calculation or generate a graph, you may quicly reuse that code throughout the semester.

There are numerous online resources (including YouTube videos) that outline how to install R. Below are general instructions for a normal installation in Windows 10.

1. Navigate to the R project homepage.
2. Click on the **CRAN** link under the **Download** header on the left side of the page. **CRAN** is an archival network that stores R and the majority of 3rd-party packages.
3. Choose your operating system, and then click through using either the **base** hyperlink or the **install R for the first time** hyperlink (they take you to the same place).
4. Click **Download R**, which will download an executable into your downloads folder.
5. Run this executable file, which will take you through the R installation process. Keep all defaults.

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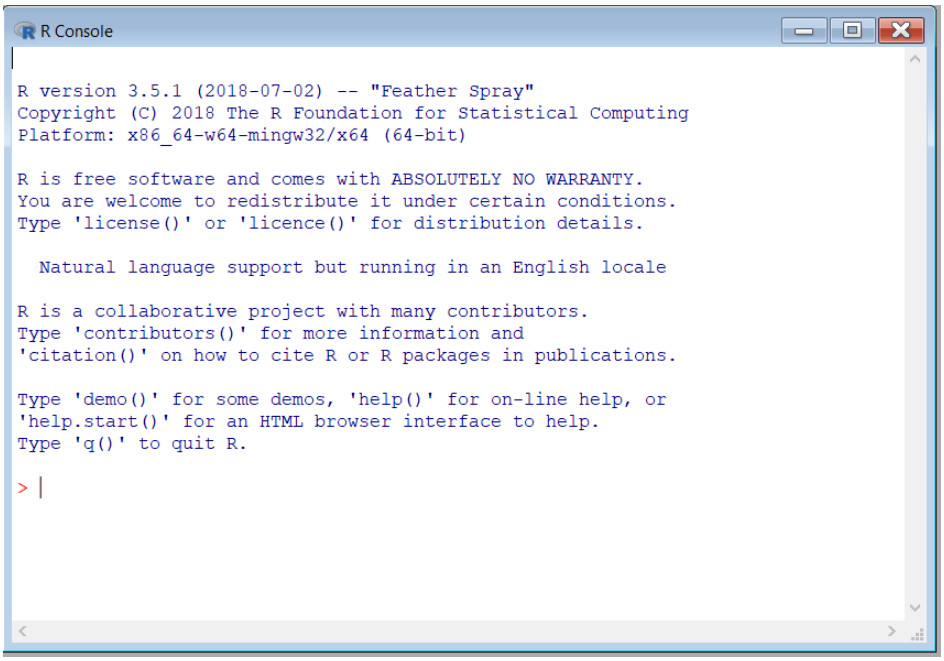

Figure 1: This is the R console, which you may open after installing R. The text that appears is non-editable, and includes some basic information about the current version of R you have installed (the R team gets creative with their version names). You may start scripting by typing next to the red greater-than sign. While completely functional, the R console lacks many 'bells-and-whistles' that a full IDE provides.

You now have the R language installed on your computer. If you were to open R, and base R terminal would appear (Fig. 1) At its simplest, R is run from this command line window. You could dive in and start scripting immediatly, but there are programs that make navigating and writing in the R language a much more pleasant experience (i.e. R Markdown).

1.2 RStudio

RStudio is a free, open-source **integrated development environment** (IDE) that significantly improves the R experience. It is a excellent text-editor, provides ways to import data into the R environment without writing code, and exports figures and documents. And again, if you prefer a visual walkthrough, there are many good YouTube videos that cover this installation.

1. Navigate to the R Studio homepage.
2. Click **Download R Studio**
3. **Download** the free RStudio open source license. The other options add functionality for large teams of researchers, which we do not need for this lab.
4. Choose your operating system under **Installers for Supported Platforms**, which will download an executable file to your downloads folder.
5. Run this executable file, which will take you through the RStudio installation. Keep all defaults.

2 Getting started in RStudio

After installation open RStudio ().

2.1 LaTeX download

LaTeX is a document preparation system for high-quality typesetting. Some people write in raw LaTeX, but RStudio provides a simpler Markdown language that is both easier to read and easier to learn.

RStudio recommends a complete installation of MiKTex, and if you do not have a LaTeX distribution installed, Rstudio will throw an error when you try to *knit* your document and direct you toward the downloads page for your operating system (Figure here). You will download a copy of the installer program from the MiKTex website, and when you run that program it will download and install the actual LaTeX distribution. **CAUTION**: the LaTeX distribution is a rather large collection of files. Make sure you are on the fastest internet available to you, and that your roommate is not in the middle of an online game. I will also have a USB thumb-drive with this download in lab that you can transfer to your personal computer.

1. Open the MiKTex installer.
2. Accept copying conditions.
3. Choose the **Download MiKTex** option and click next. In lab, I will also have a USB thumb-drive with this download.
4. Choose **Complete MiKTex** and click next. This means you will not have to install different packages piecemeal every time you need a new function.
5. Choose a download mirror somewhere in the United States and click next. *http* vs *https* does not really matter.
6. Accept the default installation directory and click next.
7. Click **Start**, which will begin the download. This is a rather large series of files. So go take a coffee break.

3 Using R

If you think you might perform a task more than once or twice, it is probably worth automating it. For this lab, you will find yourself repeating several tasks on the computer (doing simple calculations, plotting the results of those calculations, and performing simple statistical tests). The lab manual will cover specific requirements for any given lab, but if you get stuck refer back to this section for the basics.

3.1 Obligatory 'hello world' example

Programming tutorials have a ubiquitous and questionably useful history of including the 'hello-world' example as the first venture into whatever language the tutorial is presenting. Far be it from me to rob you of this experience. the `print()` command tells the R Console to return whatever text supplied in the `()` portion of the command. Try entering the code below to verify R is indeed awake at the wheel.

```
print("Hello world")
```

```
## [1] "Hello world"
```

Congratulations, you have sucessfully convinced the computer to do your bidding.