# Math495, Spring 2022 - HW 0

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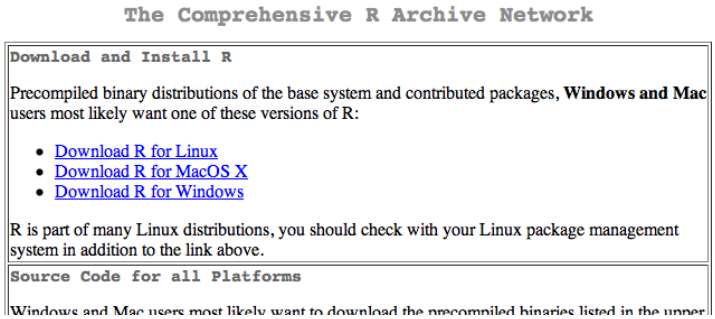
This homework assignment won't be collected, but do it as soon as possible. Its purpose is to have the R program up and running and getting a first taste of how to use it for basic math. You may ignore it if you have previous experience with R.

1. **Installation.** Choose an internet connected computer where you can install R. (The program is free and does not require any license to install.) To obtain and install it go to the *R Project for Statistical Computing* website, located at `http://www.r-project.org/`. On the left of the page click on the link `CRAN` under the heading "Download, Packages" and chose one of the many downloading sites. (Near the bottom of the page, under USA, you can find a Wash. U. site `http://cran.wustl.edu/` ) These sites will take you to a page that looks in part like this:


The Comprehensive R Archive Network

Download and Install R

Precompiled binary distributions of the base system and contributed packages, **Windows and Mac** users most likely want one of these versions of R:

- Download R for Linux
- Download R for MacOS X
- Download R for Windows

R is part of many Linux distributions, you should check with your Linux package management system in addition to the link above.

Source Code for all Platforms

Windows and Mac users most likely want to download the precompiled binaries listed in the upper

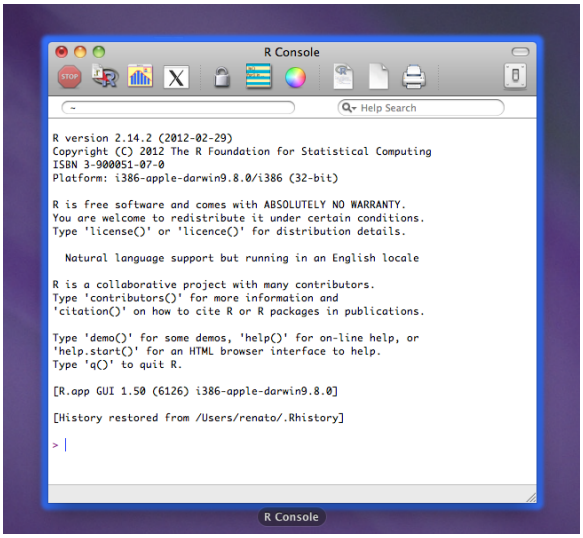
   From here follow the installation instructions. Once you have R successfully installed, open up the program. On my Mac, a window pops up that looks as follows:

   At the bottom of the window, notice the prompt symbol > indicating that R is ready to accept user input. Try writing something like `> 1+1` then hit return. Hopefully, R is now ready to do work.

2. Back on the left column of the R project page, look for the link "Manuals" under the heading "Documentation." You'll find there several manuals for R. The first one, entitled **An Introduction to R**, is a useful general reference. There is plenty of information about R online for all sorts of needs. You'll often need to look up online or in the manual basic commands or procedures for things we'll be doing on homework problem sets.

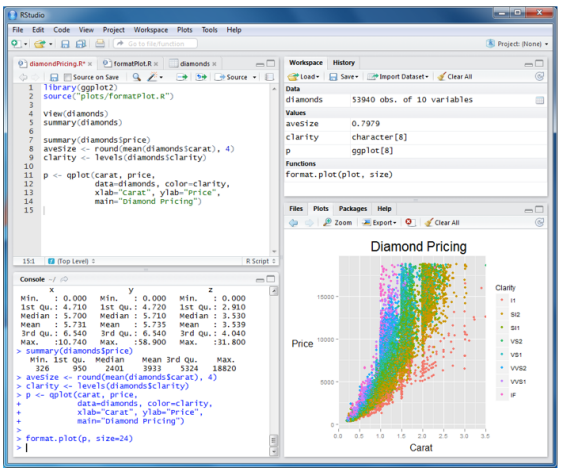
3. I personally like a user interface for R called RStudio. This is not strictly needed for anything we are going to do, but while you are browsing around for R related resources check it out at `http://www.rstudio.com/`. This is also a free program and easy to install on most computer platforms.

4. The first thing you can do with R is use it as an overgrown calculator. Try the following simple operations. Keep in mind that when assigning a value to a variable, say the value 2 to a variable you want to call *a* (something we need to do all the time), you can enter `a=2` or `a<-2`. (I find the latter a bit ugly and never use it.) Also note that when you type the assignment `a=2` and hit return, nothing apparently happens, but the value 2 has been saved somewhere with the label `a`. If now you write `a` and hit return, the value 2 will be displayed.




## Take control of your R code

RStudio is a free and open source integrated development environment for R. You can run it on your desktop (Windows, Mac, or Linux) or even over the web using RStudio Server.


Now use R to obtain the numerical value of each of the following expressions (see a short list of operations at the last page):

(a) $(144+32^5-7\times 41)\,/\,(5^4-56\times 12)$

(b) $\sin(2\pi/17)+\cos^3(\pi/5)+\sqrt{1+32^2}\exp(-7/32)$

(c) $\log\left(1+2^2+3^2+4^4+5^2\right)$

(d) Assign values: 2 to variable `a`, 3 to variable `b`, and 4 to variable `c`, then compute:

$$\frac{e^a+e^b+e^c}{a^2+b^2+c^2}$$

where $e = 2.718282...$ is the base of natural log.

5. Look up the usage of the command `seq` (you can use `?seq` or `help(seq)` to obtain help from within the R program.) Now determine what the following commands achieve:

```
> x=seq(from=0,to=4*pi,length.out=1000)
> y=sin(x)
> plot(x,y,type="l",main="graph of sin(x)")
```

What happens if you leave out `type="l"` of the plot command? What happens if you choose another number, say 5, for the parameter `length.out` ?

6. What does the following accomplish: `plot(cos,xlim=range(0,6*pi),type="l")`

7. And the following? (This involves a user defined function.)

```
> f=function(x) x^2-2*sin(x)-cos(x/3)
> plot(f,xlim=range(-2,2),type="l")
```

8. Draw a graph of the function $f(x)=\frac{1}{\sqrt{2\pi}}\exp\left(-x^2/2\right)$ over the interval $[-3,3]$.

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Here's a very short and incomplete list of elementary mathematical operations and functions with their respective R symbols, which I copied from one of the R cheat sheets in `http://devcheatsheet.com/tag/r/?page=1`

| Command | | Example | Result |
|---|---|---|---|
| **Operators** | | | |
| General | | | |
| <- | Assignment operator (suggested) | ans1 <- 1 | 1 |
| = | Assignment operator | ans2 = 1+1 | 2 |
| # | Comment | #This is a comment | |
| Mathematical | | | |
| + | Addition | 2.5+ans3 | 5.5 |
| - | Subtraction | ans3-2.5 | 0.5 |
| * | Scalar multiplication | 2*3 | 6 |
| / | Division operator | 6/2 | 3 |
| ^ | Exponentiation | 2^3 | 8 |
| Logical/Relational | | | |
| == | Equals | ans3==3 | TRUE |
| != | Not Equal | ans3!=3 | FALSE |
| > | Greater Than | ans3>3 | FALSE |
| >= | Greater Than or Equal To | ans3>=3 | TRUE |
| < | Less Than | ans3<3 | FALSE |
| <= | Less Than or Equal To | ans3<=3 | TRUE |
| \|\| | Or | ans1==2 \|\| ans2==2 | TRUE |
| \| | Or (use with vectors and matrices) | v2[v1==3 \| v1==4] | {3,5} |
| && | And | ans1==2 && ans2==2 | FALSE |
| & | And (use with vectors and matrices) | v2[v1==3 & v1==4] | {NA} |
| %*% | Matrix multiplication | mat1%*%mat1 | |
| **Functions** | | | |
| sqrt | Square root | sqrt(16) | 4 |
| exp | Exponentiation | exp(1) | 2.718282 |
| log | Natural log | log(2.718282) | 1 |
| sum | Sum | sum(2,3,4) | 9 |
| prod | Product | prod(2,3,4) | 24 |
| ceiling | Smallest integer ≥number | ceiling(2.1) | 2 |
| floor | Integer part of a number | floor(2.1) | 2 |
| abs | Absolute value | abs(-0.2) | 0.2 |
| sin | Sine | sin(pi/2) | 1 |
| cos | Cosine | cos(pi) | -1 |
| tan | Tangent | tan(pi/4) | 1 |
| table | Calculate frequency counts of a vector | table(v4) | 1 3 5<br>[3 3 3] |