Exercise 1.1 - Introduction to R in Ecology, Part 1

Jelena H. Pantel

2023-10-12 18:56:15.474944

Exercise 1. Simple calculation and variable assignment

1. Open RStudio. The console window gives you some information about the version of R you are running, and it gives the prompt `<`. This prompt is waiting for you to input a command. Let's use R as a simple calculator: type `2+3` and hit *enter*. What you should see is the following:

```
2 + 3
```

```
## [1] 5
```

2. Please create a new variable called a and assign the value 5 to that variable using the `<-` assignment operator. Then add `a+5` in the console. Make sure the displayed answer is 10.

3. Let's work with a *vector* in R. First, create a new variable called b and assign it 3 values: 5, 13, and 2 (hint: use the `c()` command - see help file by typing `?c` in the console). Then index the 3rd value using `b[3]` (make sure the value of `2` is displayed). Finally, use `b[3] <- 16` to change the 3rd value of b to 16.

4. Let's use some built in functions in base R. Please use the `sqrt` command to calculate $\sqrt{16}$ and $\sqrt{67}$.

Exercise 2. Creating and saving an R script

5. R scripts: In RStudio, go to *File, New File, R script.* A new document will appear. This is ultimately an open text document where you can write, save, and execute R code. Type the following into the R script:

```
# A new R Script by YOUR NAME 12-10-2023
a <- c(5, 13, 2, NA)
mean(a)
`?`(mean  # Sorry for the typo, this should read as ?mean - I am having some trouble with R Markdown
)
mean(a, na.rm = TRUE)
```

Create a folder on your local hard drive dedicated to this course. You can save the R Script there. Name the file "script1.R", and save it in the folder dedicated to this class. For example, my file is located here: `Users/jhpantel/Documents/EcoMod/script1.R`. When I navigate to that folder, I can see the R script in the file directory. Close the file in RStudio (you can click the 'X' next to the file name in the top left of the RStudio file pane). Go to the bottom right pane, click on the 'Files' tab, and navigate to the directory where you saved your *script.R* file. Make sure you can open the file from here (by clicking on the file).

You can save all of your work during this class using .R scripts.

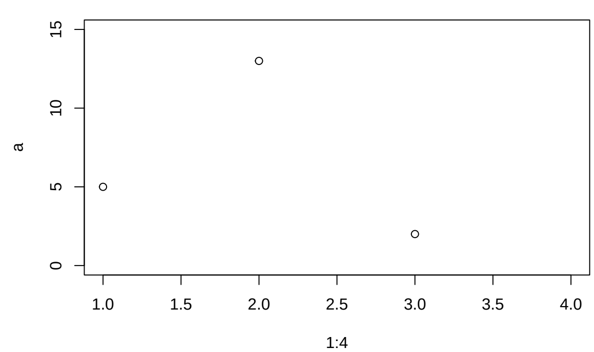
6. R Markdown

- In RStudio, go to *File, New File, R Markdown.* For *Title*, enter *script1*. You can enter your name in *Author* and today's date for *Date* (unless you do not have a *Date* field, then you can skip this). Keep everything set to the default selection, and click 'OK'.
- Go to Line 18 of this R Markdown file - delete `cars`
- On line 19, delete the existing code line and insert the following:

```
a <- c(5, 13, 2, NA)
mean(a)
mean(a, na.rm = TRUE)
```

- Then delete everything else from Line #22 onwards ("## Including plots" etc).
- Click on the green right-facing arrow ("play") button to the right of the red text - this will execute the code in this section (this section is referred to as a "code chunk"). You can see the output below the code chunk.
- Save the R Markdown file as "script1.Rmd".
- Let's add 1 more code chunk below the existing code chunk. In RStudio, go to 'Code, Insert Chunk'. Paste the following code inside the code chunk:

```
a <- c(5, 13, 2, NA)
plot(1:4, a, ylim = c(0, 15))
```



- Finally, see how you can use RMarkdown to make attractive code-based documents. Click on the small blue yarn ball - you will "knit" your R Markdown document to an HTML output ('Knit to HTML'). See the attractive output format! (You can also knit to a PDF - but you may need to install a few more things to get this to work, we can discuss. Of course the document you are looking at was created using R Markdown and LaTEX).
- If you want to learn more about formatting document in R Markdown, see the R Markdown Cheat Sheet at https://www.rstudio.com/wp-content/uploads/2015/02/rmarkdown-cheatsheet.pdf

Exercise 3. Working with functions

7. We used different built-in R functions such as `sqrt` and `mean`. Every function begins by typing the designated function name, opening a parentheses `(`, entering the *arguments* the function needs to execute the function, and closing the parentheses `)`. The executed function returns the value of the calculations and operations done inside the function.

We will learn to write our own function - see my example here: I create a function called `my_fun`, which takes two values (x and y), adds them together, and returns the added value.

```
my_fun <- function(x, y) {
    z <- x + y
    return(z)
}
my_fun(17, 3)
```

```
## [1] 20
```

Please choose two numbers for x and y, and use them to execute `my_fun(x,y)`.

8. Your turn! Write a function called `times_seven` - it should take a single argument, multiply that value by 7, and return the new value.
9. Write a function called `n1_subtract_n2` - it should take two arguments, and should subtract the second number from the first number, and return that value

Exercise 4. Working with for-loops

`for` loops are an incredibly useful programming skill. They are a way to repeat an operation or calculation for different values. A for-loop is one of the main ways of controlling operations in many programming languages, it is used to iterate (repeat) over a collection of objects, such as a vector, a list, a matrix, or a dataframe, and apply the same set of operations on each item of a given data structure. We use for-loops to keep our code clean and avoid unnecessary repetition of a code block.

The basic syntax of a for-loop in R is the following:

`for (variable in sequence) {`

`expression`

`}`

See the `for` loops I have written below:

```
# note how the loop changes the value of the variable x for
# each iteration of the loop: first x=1 and 'print(x)' is
# executed. Then x=2, then x=3, and so on.
for (x in 1:5) {
    print(x)
}
```

```
## [1] 1
## [1] 2
## [1] 3
## [1] 4
## [1] 5
```

```r
for (i in 1:5) {
    z <- i + 6
    print(z)
}
```

```
## [1] 7
## [1] 8
## [1] 9
## [1] 10
## [1] 11
```

```r
for (i in 1:5) {
    a[i] <- i
}
a
```

```
## [1] 1 2 3 4 5
```

```r
b <- c("I", "love", "R")
for (i in 1:length(b)) {
    print(b[i])
}
```

```
## [1] "I"
## [1] "love"
## [1] "R"
```

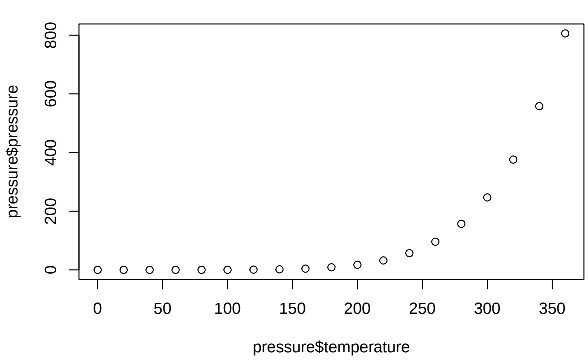
10. Your turn - For each of three values of volume, `v <- c(1.6,3,8)`, calculate the *mass*, where `m <- 2.65 * volume ^ 0.9`. Please calculate this in a loop. You can print the values within the loop.

Exercise 5. Make a lovely plot!

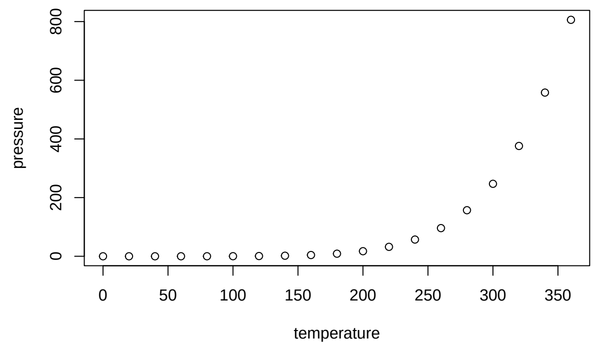
We can agree my scatter plot of `a` in #6 is not a very attractive or complex plot. Let's quickly use a built-in R dataset to improve our control over what our plots look like.

11. Use base R commands to improve the plot - we can add arguments to the plot command that change the plot visualization. Here we progressively alter arguments to `plot`

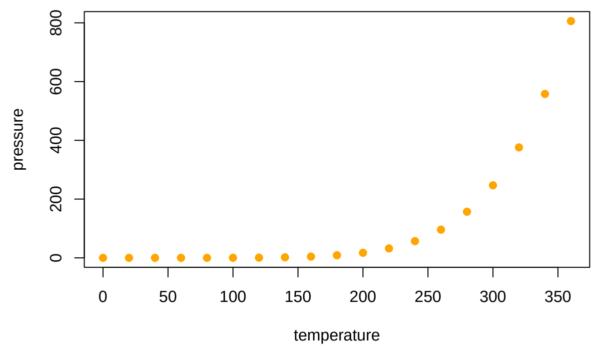
```r
plot(pressure$temperature, pressure$pressure)
```



```r
plot(pressure$temperature, pressure$pressure, xlab = "temperature",
    ylab = "pressure")
```



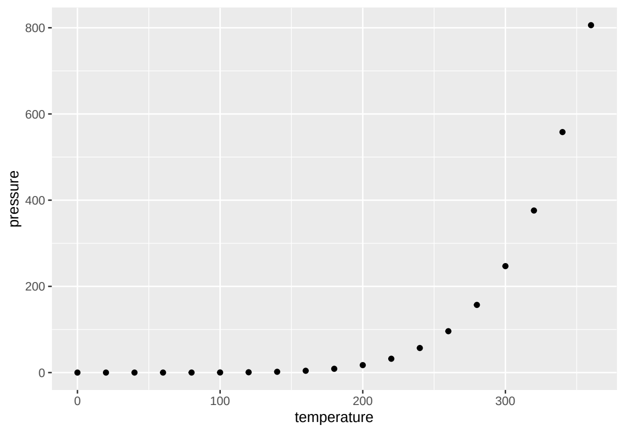

```r
plot(pressure$temperature, pressure$pressure, xlab = "temperature",
    ylab = "pressure", pch = 19, col = "orange")
```



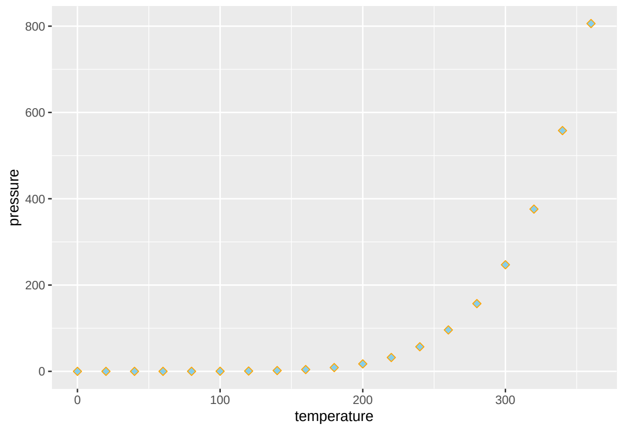
12. We can also use the plotting library (its really an entire plotting language embedded inside R) `ggplot2`. There are a few, more complicated steps needed to work with ggplot. We'll quickly make a scatterplot:

```r
library(ggplot2)
# if this doesn't work, you'll need to install the ggplot2
# package this way: install.packages(ggplot2)

# Basic scatter plot - supply the name of the dataframe,
# the x and y values from that dataframe, and use
# geom_point() to draw points
ggplot(pressure, aes(x = temperature, y = pressure)) + geom_point()
```




```r
# Change the point size, and shape
ggplot(pressure, aes(x = temperature, y = pressure)) + geom_point(size = 2,
    shape = 23, colour = "orange", fill = "skyblue")
```



13. Make your own plot of the following data:

```r
# We quickly generate some fake data
data1 <- rnorm(57, 245, 15)
data2 <- rnorm(57, data1 - 150, 11)
plot(data1, data2, xlab = "Variable 1", ylab = "Variable 2")
```