

Practical 3: Functions and loops

In the questions below, the important part is **understanding** what's going on rather than just typing the **R** commands. Make sure you answer the questions under each piece of **R** code. If you can't answer the question, then ask! **When trying out the code below, do not include the plus symbols!**

1 Practice questions

1. Default arguments

```
> Fun1 = function(x=10) {  
+   return(x)  
+ }  
> Fun2 = function(x) {  
+   return(x)  
+ }
```

- Why does typing `Fun1()` work, but typing `Fun2()` give an error message?
- Change `Fun1` so that it returns $\sqrt{x}$.

2. Basic functions

```
> v = 5  
> Fun3 = function() {  
+   v = 0  
+   return(v)  
+ }  
> Fun3()  
> v
```

- Why does line 7 above give 5 and not zero?
 - Delete line 3 in the above listing. Now change the function to allow `v` to be passed as an argument, i.e. we can run `Fun3(5)`. Call this function to make sure it works.
 - Now make the argument have a default value of 0.
3. This question makes sure that you can save a file and upload it to NESS. It is crucial you can do this for the assignment questions later on. Suppose you wanted to save `Fun1` and `Fun2`, from the exercises above, for submission as part of an assignment. In the text editor window (top left), make sure you delete all code except that for `Fun1` and `Fun2`. Now click on the disk icon at the top of the text editor window and then save the file as “practice”. This will automatically save the file as an **R** file, called “practice.R”. You will now upload this file to NESS using the following steps – first of all, you must log-in to NESS. Then...
- Select “MAS1802” at the top of the screen.
 - Select “Submit” from the drop-down “Coursework” menu at the left-hand-side.
 - Choose “Practice” from the box which says “Please select an exercise”.
 - “Browse” for your saved R file in the “Files to be submitted box”.
 - Click “Submit your work” at the bottom of the screen.

4. if statements

```
> Fun4 = function(x) {
+   if(x==5) {
+     y = 0
+   } else {
+     y = 1
+   }
+   return(y)
+ }
```

- Call `Fun4` a few times with different values of x .
- Change `Fun4` so that it returns 0, if x is greater than 5.
- Change `Fun4` so that it returns 0, if x is greater than or equal to 5.
- Change `Fun4` so that it:
 - returns 1 if x is positive;
 - returns -1 if x is negative;
 - returns 0 if x is zero.
- Suppose that x is a vector. Change the function so that it returns 0 if `mean(x)` is greater than 0.
- Change `Fun4` so that if x is positive, it returns $\sqrt{x}$.

5. for loops

```
> total = 0
> for(i in 1:5) {
+   total = total + i
+ }
> total
```

The **for** loop above calculates

$$\sum_{i=1}^5 i.$$

- What is the final value of `total` in the above piece of code?
- Change the code above to calculate the following summations:

$$(i) \sum_{i=1}^{20} (i+1) \quad (ii) \sum_{j=-10}^{15} j \quad (iii) \sum_{j=-10}^{10} \exp(j^{1/j}) \quad (iv) 0, 3, 6, 9, \dots, 24 \quad (v) \sum_{j=0}^{20} \frac{1}{2^j}.$$

6. More for loops

```
> a = 2
> total = 0
> for(blob in a:5) {
+   total = total + blob
+ }
```

- Delete line 1 above and put the code in a function called `Fun5`, where a is passed as an argument, i.e. we can call `Fun5(1)`

- b) Alter the code so that the **for** loop goes from a to b, rather than a to 5. Allow b to be passed as an argument, i.e. so we can call `Fun5(1, 5)`.
- c) Change `Fun5` so that it has default arguments of `a=1` and `b=10`.

7. The following function calculates the sum of a vector:

```
> Fun6 = function(x) {  
+   n = length(x)  
+   total = 0  
+   for(i in 1:n) {  
+     total = total + x[i]  
+   }  
+   return(total)  
+ }
```

Alter `Fun6` to calculate the mean of the vector `x`. Do not use the built-in mean function. Test your function.

The assignment questions are on the next page

Assignment

Preliminaries

For the questions below you will need to save your **R** code in a single file called

`practical3.R`

You will upload this file to NESS in the same way you uploaded the practice file to NESS in question 3. From your NESS homepage:

- Choose ‘MAS1802’ from the module selection boxes at the top of the page.
- From the “Coursework” menu down the left-hand-side, choose “Submit”.
- From the list in the box in the middle of the screen, select “Computer practical 3”.
- Browse for your R file in the “Files to be submitted box”.
- Enter your email address to receive a submission confirmation receipt.
- Click “Submit your work” at the bottom of the page.

Warning: If you save your file incorrectly, you will receive zero marks for this practical!

Questions

In this section do not use the built-in **R** functions **sum**, **mean**, **median**, **sd**, **var** or **summary**.

1. Write a function called `MySD` that calculates the sample standard deviation, i.e.

$$\sqrt{\frac{1}{n-1} \sum_{i=1}^n (x_i - \bar{x})^2}.$$

This function should have a single argument x .

2. Write a function called `MyDifference` that takes two vector arguments, x and y , and calculates the differences in means, i.e.

$$\bar{x} - \bar{y}.$$

3. Write a function called `MyMedian`. This function has a single argument x and returns the median value of a vector. You may use the built-in function **sort** to help you.
4. Write a function called `IsEven`. This function has a single argument x and returns `TRUE` if the number is even and `FALSE` if the number is odd.

What should (and shouldn't) be in your file

1. Your file should only include functions. It can include additional helper functions, such as `MyMean` (Hint: see question 7)
2. Your file should not include function checks
3. Any statements – e.g. function descriptions – should be included after the `#` symbol