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! Where possible, write your answer down on the worksheet. You might also wish to create a directory called Practical3 in your MAS1343 directory.

1 Practice questions

1. Default arguments

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

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

2. Basic functions

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

- a) Why does line 7 above give 5 and not zero?
- b) Delete line 3 in the above listing. Now change the function to allow v to be passed as an argument, i.e. we can write Fun3 (5). Call this function to make sure it works.
- c) 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. In this and future practicals, it is crucial that you do this step correctly or you will get a mark of zero.

Save the function Fun2 in a file called practice.R. You should only save Fun2 - nothing more, nothing less! You will now upload this file to NESS using the following steps - first of all, you must log-in to NESS. Then...

- Select "MAS1343" at the top of the screen.
- Select "Practice" from the drop-down "Coursework" menu at the left-hand-side.
- Click on "Coursework" underneath this, and then choose "Submit".
- "Browse" for the R program in the "Files to be submitted box".
- Click "Submit your work".

4. if statements

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

- a) Call Fun4 a few times with different values of x.
- b) Change Fun4 so that it returns 0, if *x* is greater than 5.
- c) Change Fun4 so that it returns 0, if *x* is greater than or equal to 5.
- d) Change Fun4 so that it:
 - returns 1 if *x* is positive;
 - returns –1 if *x* is negative;
 - returns 0 if *x* is zero.
- e) Suppose that x is a vector. Change the function so that it returns 0 if the **mean** (x) is greater than 0.
- f) 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

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

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

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

a) 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. 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.

Assignment

Preliminaries

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

practical3.R

You will upload this file to NESS using the following steps:

- Choose "Coursework" from the top-level menu.
- Choose "MAS1343" from the drop-down Module box.
- Choose "Practical 3" from the drop-down Coursework box.
- Click "Submit" on the side menu.
- Browse for the R program in the files to be submitted box.
- Click "Submit your work".

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**, or **var**.

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 MyMean2. This function has two arguments, x and nonzero, where nonzero has the default value TRUE. This function should return
 - \bar{x} if nonzero = FALSE
 - \bar{x} of all x's > 0 if nonzero = TRUE
- 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 if odd.
- 5. 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.

Example function calls

```
> set.seed(1)
> x = runif(20, -1, 1)
> MySD(x)
[1] 0.5722358
> y = runif(20, -1, 1)
> MyDifference(x, y)
[1] 0.1625699
> MyMean2(x, nonzero=FALSE)
[1] 0.1103342
> MyMean2(x, nonzero=TRUE)
[1] 0.5559767
> IsEven(5)
[1] FALSE
> IsEven(6)
[1] TRUE
> MyMedian(x)
[1] 0.2019674
```

Checking your function

In the mas1343 package, there are two useful functions to check your file

```
> library(mas1343)
> ##Make sure you file is named correctly first
> CheckFunctionName("practical3.R")
> CheckFunctionName("C:/My Documents/R/practical3.r")
> CheckFunctionName("practical3.r")
> ##Can your file be loaded
> ##This doesn't check if your functions are correct
> CheckFunctionLoading("practical3.R")
```

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

- 1. You file should only include functions. It can include additional, helper functions such as MyMean
- 2. Your file should not include function checks
- 3. Your file should not include set.seed
- 4. Your file should have any R statements outside of your function definitions