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)
+   }
```

   a) Why does typing `Fun1()` work, but typing `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 run `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. 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)
+ }
```

   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 **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:

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

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. 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 if 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