Class06: R Functions

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In this class we will develop out own R function to calculate average grades in a fictional class.

We will start with a simplified version of the problem, just calculating the average grade of one student

Simplified Version

```r
# Example input vectors to start with

student1 <- c(100, 100, 100, 100, 100, 100, 100, 90)
student2 <- c(100, NA, 90, 90, 90, 90, 97, 80)
student3 <- c(90, NA, NA, NA, NA, NA, NA, NA)
```

We are going to start by calculating the average score of the homeworks.

```r
mean(student1)
```

```
[1] 98.75
```

To get the minimum score we can use which.mean.

```r
student1
```

```
[1] 100 100 100 100 100 100 100  90
```

```r
which.min(student1)
```

```
[1] 8
```

I can do the average of the first 7 homework scores:

```
mean(student1[1:7])
```

```
[1] 100
```

Another way to select the first 7 homework scores:

```
student1[1:7]
```

```
[1] 100 100 100 100 100 100 100
```

```
student1[-8]
```

```
[1] 100 100 100 100 100 100 100
```

Another way to drop the lowest score:

```
#goes through student1 scores and removes the minimum value
student1_drop_lowest <- student1[-which.min(student1)]
```

I can get the mean of the homework scores after dropping the lowest score by doing.

```
 mean(student1_drop_lowest)
```

```
[1] 100
```

We have our first working snippet of code!

Let's try to generalize it to student2:

```
student2 <- c(100, NA, 90, 90, 90, 90, 97, 80)
student2_drop_lowest<-student2[-which.min(student2)]
student2_drop_lowest
```

```
[1] 100  NA  90  90  90  90  97
```

There is a way to calculate the mean droppping missing values

```r
student3 <- c(90, NA, NA, NA, NA, NA, NA, NA)
mean(student3, na.rm = TRUE)
```

```
[1] 90
```

We want to know the position of the NAs. So, for student2we can use the following.

```r
student2 <- c(100, NA, 90, 90, 90, 90, 97, 80)
which(is.na(student2))
```

```
[1] 2
```

For student 3:

```r
which(is.na(student3))
```

```
[1] 2 3 4 5 6 7 8
```

For student 2:

```r
student2
```

```
[1] 100  NA  90  90  90  90  97  80
```

```r
which(is.na(student2))
```

```
[1] 2
```

```r
student2[ is.na(student2) ] <- 0
student2
```

```
[1] 100   0  90  90  90  90  97  80
```

If I use the same for student 3

```
student3[ is.na(student3) ] <- 0
student3
```

```
[1] 90  0  0  0  0  0  0  0
```

```
mean(student3)
```

```
[1] 11.25
```

This is going to be our final working snippet of code for all students (with and without NA values)

```
student3 <- c(90, NA, NA, NA, NA, NA, NA, NA)
student3[is.na(student3)] <- 0
student3_drop_lowest <- student3[-which.min(student3)]
mean(student3_drop_lowest)
```

```
[1] 12.85714
```

Q1

We can write it as a function:

```
 #creating a function that requires an array x
grade <- function(x)
{
  #finds the index of the value that is NA and then changes it to 0
  x[is.na(x)] <- 0
  #creates a variable that stores the average of student scores without the lowest score
  x_drop_lowest <- x[-which.min(x)]
  mean(x_drop_lowest) }
```

Let's apply the function

```
grade(student1)
```

```
[1] 100
```

```
grade(student2)
```

```
[1] 91
```

```
grade(student3)
```

```
[1] 12.85714
```

Let’s apply our function to a gradebook from this URL: “https://tinyurl.com/gradeinput”

```
 URL <- "https://tinyurl.com/gradeinput"
 gradebook <- read.csv(URL, row.names = 1)
 head(gradebook)
```

```
          hw1 hw2 hw3 hw4 hw5
student-1 100  73 100  88  79
student-2  85  64  78  89  78
student-3  83  69  77 100  77
student-4  88  NA  73 100  76
student-5  88 100  75  86  79
student-6  89  78 100  89  77
```

Let’s apply my function grade to the gradebook using apply and running it by rows using MARGIN = 1.

```
apply(gradebook,1,grade)
```

```
 student-1  student-2  student-3  student-4  student-5  student-6  student-7 
     91.75      82.50      84.25      84.25      88.25      89.00      94.00 
 student-8  student-9 student-10 student-11 student-12 student-13 student-14 
     93.75      87.75      79.00      86.00      91.75      92.25      87.75 
student-15 student-16 student-17 student-18 student-19 student-20 
     78.75      89.50      88.00      94.50      82.75      82.75 
```

Q2

We can write it as a function

```r
max(apply(gradebook,1,grade))
```

```
[1] 94.5
```

The maximum score is 94.5

```r
which.max(apply(gradebook,1,grade))
```

```
student-18
        18
```

The student getting the maximum overall score was student 18.

Q3

First we are going to mask NA values with zeros

```r
#replacing all NAs with 0 but applying it to dataframe instead of array
gradebook[is.na(gradebook)] <- 0
```

Now we apply the mean function to the gradebook

```r
apply(gradebook,2,mean)
```

```
  hw1   hw2   hw3   hw4   hw5 
89.00 72.80 80.80 85.15 79.25 
```

The toughest homework will be homework 2 considering the mean and considering the missing homework as 0.

Having zeros for missing homework is too strict and is not a good representation of the homework difficulty.

One thing we can do is remove the missing values.

```r
gradebook<- read.csv(URL, row.names = 1)
apply(gradebook,2,mean,na.rm = TRUE)
```

```
     hw1      hw2      hw3      hw4      hw5 
89.00000 80.88889 80.80000 89.63158 83.42105 
```

Q4. From your analysis of the gradebook, which homework was most predictive of overall score

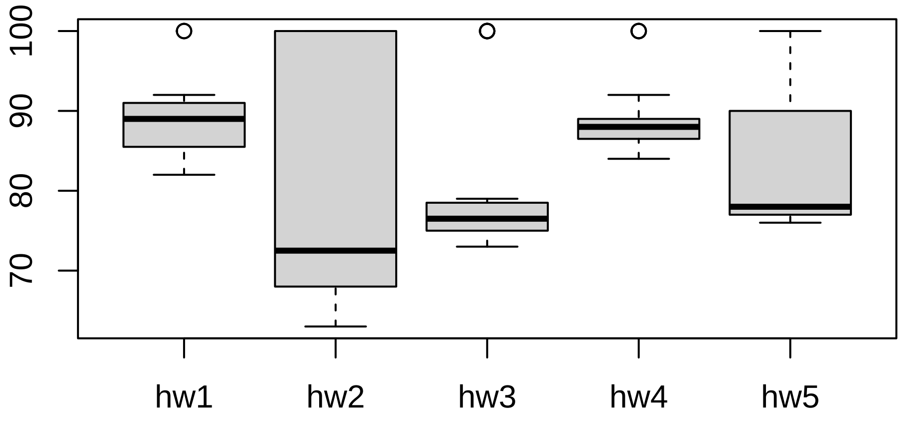
(i.e. highest correlation with average grade score)?

If we use the median instead of the mean as a measure of overall score:

```
apply(gradebook, 2, median, na.rm = TRUE)
```

```
 hw1  hw2  hw3  hw4  hw5 
89.0 72.5 76.5 88.0 78.0 
```

```
boxplot(gradebook)
```



```
overall_grades <- apply(gradebook, 1, grade)
overall_grades
```

```
 student-1  student-2  student-3  student-4  student-5  student-6  student-7 
     91.75      82.50      84.25      84.25      88.25      89.00      94.00 
 student-8  student-9 student-10 student-11 student-12 student-13 student-14 
     93.75      87.75      79.00      86.00      91.75      92.25      87.75 
student-15 student-16 student-17 student-18 student-19 student-20 
     78.75      89.50      88.00      94.50      82.75      82.75 
```

```r
cor(gradebook$hw1, overall_grades)
```

```
[1] 0.4250204
```

```r
apply(gradebook,2,cor, y = overall_grades)
```

```
      hw1       hw2       hw3       hw4       hw5 
0.4250204        NA 0.3042561        NA        NA 
```

```r
apply(gradebook,2,cor, y = overall_grades)
```

```
      hw1       hw2       hw3       hw4       hw5 
0.4250204        NA 0.3042561        NA        NA 
```