class06

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In this class, we will develop our 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 for one student.

Simplified version

```
# 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.

```
mean(student1)
```

```
[1] 98.75
```

to get the minimum score, we can use `which.min`.

```
student1
```

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

```
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 homeworks:

```
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:

```
student1_drop_lowest= student1[-which.min(student1)]
student1_drop_lowest
```

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

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

```
mean(student1_drop_lowest)
```

```
[1] 100
```

We have our first working snippet of code!

Student 2:

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

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

Let's try to generalize it to student 2:

```
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 dropping the missing values (or NA).

```
student2 <- c(100, NA, 90, 90, 90, 90, 97, 80)
mean(student2,na.rm=TRUE)
```

```
[1] 91
```

This looks good for student2. however, for student3…

```
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 NA's. So for student2, we can use the following:

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

```
[1] 2
```

for student 3:

```
student3 <- c(90, NA, NA, NA, NA, NA, NA, NA)
which(is.na(student3))
```

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

for considering missing values, we can mask the NA with zeros

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

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

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

```
[1] 2
```

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

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

If i use the same for student3:

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

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

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

```r
student3_drop_lowest= student3[-which.min(student3)]
student3_drop_lowest
```

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

```r
mean(student3_drop_lowest)
```

```
[1] 12.85714
```

let's build a function:

```r
x <- (c(100,75,50, NA))
x[is.na(x)] <- 0
x_drop_lowest <- x[-which.min(x)]
mean (x_drop_lowest)
```

```
[1] 75
```

Function grade

we can write it as a function:

```r
#' calculate the average score for a vector of hw scores, dropping the lowest score,
#' and considering NA values as scores.
#'
#' @param x A numeric vector of scores
#'
#' @return the average value of hw scores
#' @export
#'
#' @examples
#'
#' student <- c('100','50',NA)
#' grade (student)
#'
grade<- function(x){
  #Mask NA values with 0
  x[is.na(x)] <- 0
  #drop lowest score
  x_drop_lowest <- x[-which.min(x)]
  mean (x_drop_lowest)

}
```

lets apply the function

```r
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)

grade(student1)
```

```
[1] 100
```

```
grade(student2)
```

```
[1] 91
```

```
grade(student3)
```

```
[1] 12.85714
```

Question 1

let't 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 
```

Question 2

Using your grade() function and the supplied gradebook, Who is the top scoring student overall in the gradebook?

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

```
[1] 94.5
```

the maximum score is 94.5

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

```
student-18
        18
```

Student 18 got the max overall score.

Question 3

From your analysis of the gradebook, which homework was toughest on students (i.e. obtained the lowest scores overall?

First we are going to mask the NA values with 0s.

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

Now, we apply the mean function to the gradebook.

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

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

The toughest hw is hw2 considering the mean and missing hw's as 0.

Maybe having zeros is too strict and is not a good representation of the hw difficulty.

One thing we can do is remove the missing values

```
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 
```

instead of assigning 0's to missing values, if we dont consider missing values, the toughest hw will be hw 3.

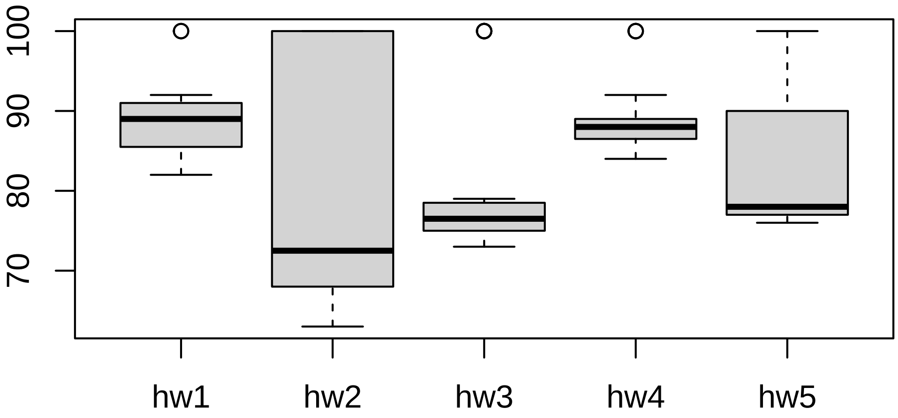
if we use the median instead of the mean as a measure of overall score:

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

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

if we use some plot…

```
boxplot(gradebook)
```



Question 4

From your analysis of the gradebook, which homework was most predictive of overall score (i.e. highest correlation with average grade score)?

```
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
```

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

```
[1] 0.4250204
```

```
gradebook[is.na(gradebook)] <- 0
apply(gradebook,2,cor,y=overall_grades)
```

```
      hw1       hw2       hw3       hw4       hw5
0.4250204 0.1767780 0.3042561 0.3810884 0.6325982
```

the max value is…

```
which.max(apply(gradebook,2,cor,y=overall_grades))
```

```
hw5
  5
```

hw 5 is most predictive of overall score