Week 4 Gradebook

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Introduction of **R functions** and how to write our own functions.

Questions to answer:

Q1. Write a function grade() to determine an overall grade from a vector of student homework assignment scores dropping the lowest single score. If a student misses a homework (i.e. has an NA value) this can be used as a score to be potentially dropped. Your final function should be adquately explained with code comments and be able to work on an example class gradebook such as this one in CSV format: "https://tinyurl.com/gradeinput" [3pts]

```
# 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)
```

Follow the guidelines from class - Write a working snipet of code that solves a simple problem

```
student1 <- c(100, 100, 100, 100, 100, 100, 100, 90)

mean(student1)
```

```
## [1] 98.75
```

But. . . We need to drop the lowest score. First, we need to identify the lowest score.

```
min(student1)
```

```
## [1] 90
```

```
#Which element of the vector is the lowest?
which.min(student1)
```

```
## [1] 8
```

I want to drop the lowest score from my mean calculation.

```r
#This is the first working snipet.
mean(student1[-which.min(student1)])
```

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

Here are the other students.

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

```
## [1] 91
```

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

```
## [1] 90
```

But this is not fair. Another approach is to mask all NA values with 0. First we need to find all NA values of the vector.

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

```
## [1] FALSE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE
```

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

```
## [1] 2
```

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

```
## [1] FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
```

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

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

Now we have identified the NA elements we want to mask them by making them 0.

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

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

```r
mean(x)
```

```
## [1] 79.625
```

Now dropping the lowest score.

```r
mean(x[-which.min(x)])
```

```
## [1] 91
```

Now here is a full working snipet.

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

```
## [1] 12.85714
```

```r
##Now we make our function
```

Take the snipet and turn it into a function where every function has 3 parts. -A name, 'grade()' -Input arguments -The body

Question 1 Answer:

```r
#' Calculate average score for a vector of students hw scores dropping the lowest score.
#'Missing values will be treated as 0.
#' @param x A numeric of hw scores
#'
#' @return Average score
#' @export
#'
#' @examples
#' student <- c(100,NA,90,97)
#' grade(student)
#'
grade <- function(x) {
  #'mask NA with 0 to treat missing values as 0
    x[is.na(x)]<-0
    #'exclude the lowest score from mean
    mean(x[-which.min(x)])
}
```

```r
grade(student1)
```

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

```r
grade(student2)
```

```
## [1] 91
```

```r
grade(student3)
```

```
## [1] 12.85714
```

Now we can use the function on our "real" whole class data from this CSV format file: "https://tinyurl.com/gradeinput"

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

```r
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:Using your grade() function and the supplied gradebook, Who is the top scoring student overall in the gradebook? [3pts]

To answer this we run the apply() function and save the results.

```r
results<- apply(gradebook,1,grade)
sort(results)
```

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

Q2 Answer:

```r
which.max(results)
```

```
## student-18
##         18
```

Q3:From your analysis of the gradebook, which homework was toughest on students (i.e. obtained the lowest scores overall? [2pts]

```r
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
## student-7   89 100  74  87 100
## student-8   89 100  76  86 100
## student-9   86 100  77  88  77
## student-10  89  72  79  NA  76
## student-11  82  66  78  84 100
## student-12 100  70  75  92 100
## student-13  89 100  76 100  80
## student-14  85 100  77  89  76
## student-15  85  65  76  89  NA
## student-16  92 100  74  89  77
## student-17  88  63 100  86  78
## student-18  91  NA 100  87 100
## student-19  91  68  75  86  79
## student-20  91  68  76  88  76
```

```
ave.scores <- apply(gradebook,2,mean, na.rm=TRUE)
ave.scores
```

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

```
which.min(ave.scores)
```

```
## hw3
##   3
```

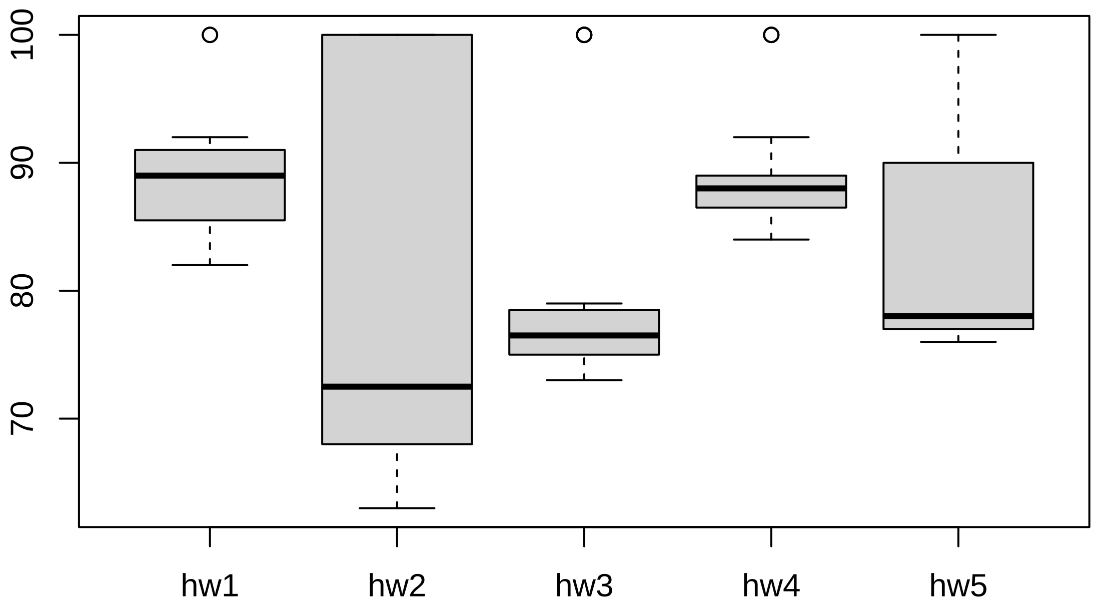
```
med.scores<- apply(gradebook,2,median,na.rm=TRUE)
med.scores
```

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

```
which.min(med.scores)
```

```
## hw2
##   2
```

```
boxplot(gradebook)
```



Q3 Answer: HW 3 since there is greater variation in HW2.

Q4. Optional Extension: From your analysis of the gradebook, which homework was most predictive of overall score (i.e. highest correlation with average grade score)? [1pt]

```
masked.gradebook<-gradebook
masked.gradebook[is.na(masked.gradebook)]<-0
masked.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   0  73 100  76
## student-5   88 100  75  86  79
## student-6   89  78 100  89  77
## student-7   89 100  74  87 100
## student-8   89 100  76  86 100
## student-9   86 100  77  88  77
## student-10  89  72  79   0  76
## student-11  82  66  78  84 100
## student-12 100  70  75  92 100
## student-13  89 100  76 100  80
## student-14  85 100  77  89  76
## student-15  85  65  76  89   0
## student-16  92 100  74  89  77
## student-17  88  63 100  86  78
## student-18  91   0 100  87 100
## student-19  91  68  75  86  79
## student-20  91  68  76  88  76
```

```
cor(results,masked.gradebook)
```

```
##            hw1      hw2       hw3       hw4       hw5
## [1,] 0.4250204 0.176778 0.3042561 0.3810884 0.6325982
```

```
apply(masked.gradebook,2,cor, x=results)
```

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

Q4 Answer: HW5 with a correlation value of 0.6325982

Q5. Make sure you save your Quarto document and can click the "Render" (or Rmark- down"Knit") button to generate a PDF foramt report without errors. Finally, submit your PDF to gradescope. [1pt]