Class 6: R Functions

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Today we will explore R functions.

We will start with calculating a grade for these example students.

```
# 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 could use the mean() fxn to calculate and avg

```
mean(student1)
```

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

```
mean(student2, na.rm = TRUE)
```

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

How does the is.na() fxn work? Let's try it on student2

```
student2
```

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

```
is.na(student2)
```

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

We can use this result to get at our NA values (i.e. the TRUE positions)

```
student2[is.na(student2)]
```

```
## [1] NA
```

```
x<- 1:5
x
```

```
## [1] 1 2 3 4 5
```

```
x[x>2] <-100
x
```

```
## [1]   1   2 100 100 100
```

Put these two things together - mean() is.na() fxn

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

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

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

```
## [1] 11.25
```

Now we want to fnd the lowest score

```
student1
```

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

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

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

The which.min() fxn tells us where the smallest value is.

```
student1[-8]
```

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

```
mean(student1[-which.min(student1)])
```

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

Store the student grades into a variable. Convert all NA scores to 0. Remove the lowest score and find the mean from the new list.

```
x<- student2
x[is.na(x)]<-0
x<- x[-which.min(x)]
mean(x)
```

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

We are close to our working code snippet that will be the body of our first function.

```
# First set NA values to 0
x[is.na(x)]<-0
# Remove lowest score and calculate mean
mean( x[-which.min(x)])
```

```
## [1] 92.83333
```

Now we can turn this into out first function. We will call this function 'grade()' All functions include -a name -a body -the arguments

```
grade <- function(x){
  # First set NA values to 0
  x[is.na(x)]<-0
  # Remove lowest score and calculate mean
  mean( x[-which.min(x)])
}
```

Let's try it out

```
grade(student1)
```

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

```
grade(student2)
```

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

```
grade(student3)
```

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

> 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"

```
gradebook<- read.csv("https://tinyurl.com/gradeinput", 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
```

We can use the 'apply()' fxn to grade the whole class

```
# apply( x, 1, FUN)
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
```

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

Q2. Using your grade() function and the supplied gradebook, Who is the top scoring student overall in the gradebook?

```
which.max(scores)
```

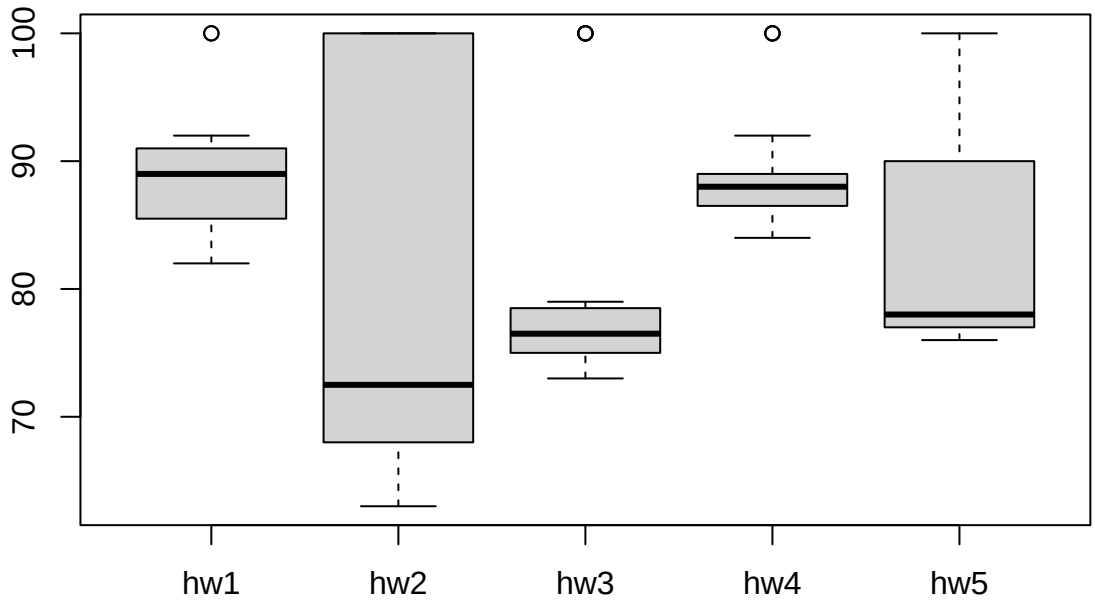
```
## student-18
##         18
```

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

```
avg.hw<- apply(gradebook, 2, median, na.rm=TRUE)
which.min(avg.hw)
```

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

```
boxplot(gradebook)
```



>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)?

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

```
## [1] 0.4250204
```

Now apply over all columns (i.e. homeworks)

```
apply(gradebook, 2, cor, scores)
```

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

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

```
##            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
```

```
apply(mask, 2, cor, scores)
```

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

Q5. Make sure you save your Rmarkdown document and can click the "Knit" button to generate a PDF format report without errors. Finally, submit your PDF to gradescope.