Class 6: R Functions

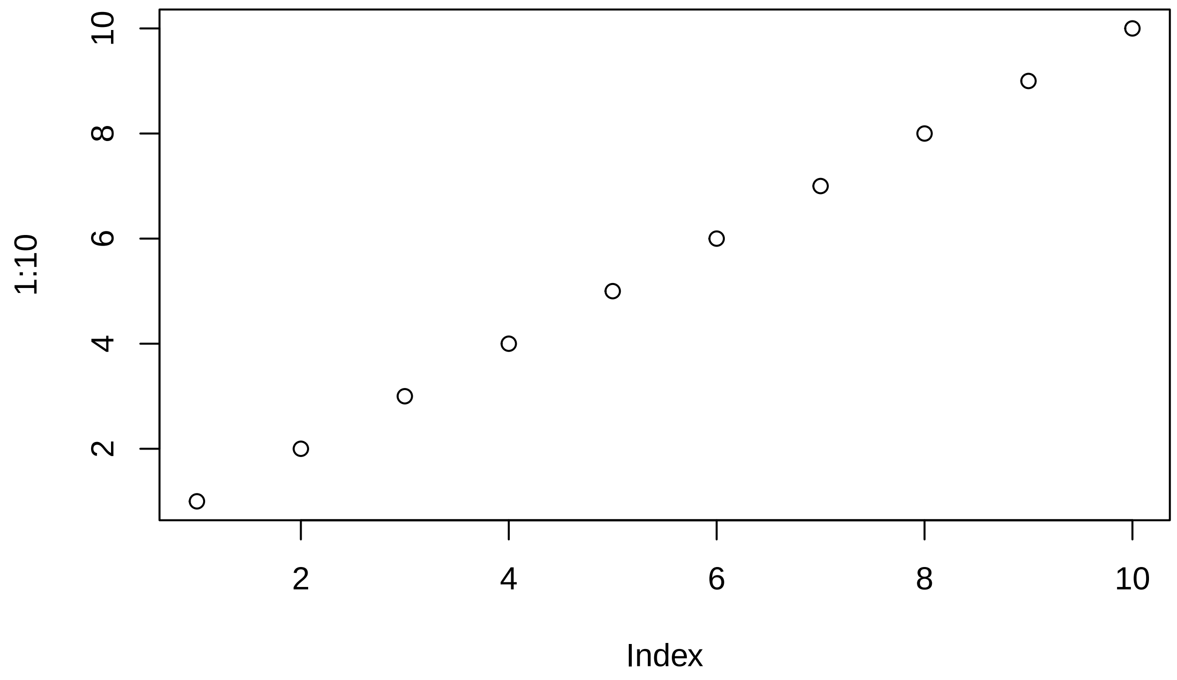
Ethan Harding (PID: A15468670)

10/14/2021

A play with Rmarkdown

This is some plain text. I can make things **bold**. I can also make things *italicized*

```
# This is a code chunk
plot(1:10)
```



R functions

In today's class we are going to write a function together that grades some students' work.

Questions for today:

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)
```

Let's start with student1 and find their average score.

```
mean(student1)
```

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

But we want to drop the lowest score... We could try the **min()** function

```
min(student1)
```

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

The **which.min()** function looks useful:

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

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

which.min() gives the position of the lowest score

```
# This would be the lowest score
student1[ which.min(student1) ]
```

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

To drop the lowest value, I can use minus

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

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

Let's now use *mean()* to get the average minus the lowest score.

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

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

Let's look at student2 now

```
student2
```

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

This will not work because of the *NA*, which is a missing homework

```
mean(student2[ -which.min(student2)] )
```

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

We need to remove the NA elements of the vector

```
#which.min(student2)
mean(student2[ -which.min(student2) ], na.rm=TRUE)
```

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

This is not what we want, we want to drop the *NA*, but this dropped the 80 (the lowest number and not the NA).

Let's look at student 3.

```
student3
```

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

```
mean(student3[ -which.min(student3) ], na.rm=TRUE)
```

```
## [1] NaN
```

One new idea/approach is to replace the NA (missing homework) with zero.

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

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

The **is.na()** function returns a logical vector where TRUE elemtns represent where the NA values are.

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

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

Now let's make the NA value into a zero.

```
student.prime <- student2
student.prime
```

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

```
student.prime[ which(is.na(student.prime)) ] = 0
student.prime
```

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

Now we need to put this all together to get the average score dropping the lowest where we map the NA values to zero.

```
student.prime <- student2
student.prime
```

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

```
student.prime[ which(is.na(student.prime)) ] = 0
student.prime
```

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

```
mean(student.prime[ -which.min(student.prime) ])
```

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

```
student.prime
```

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

```
mean(c(100, 90, 90, 90, 90, 97, 80))
```

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

Let's make sure this works for student3 as well.

```
student.prime <- student3
student.prime[ which(is.na(student.prime)) ] = 0
mean(student.prime[ -which.min(student.prime) ])
```

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

We got our working snippet! Let's simplify it to create a function out of it

```
x <- student3
# Map NA values to zero
x[ which(is.na(x)) ] = 0
#Find the mean without the lowest value
mean(x[ -which.min(x) ])
```

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

Now we can use this as the body of the function We can highlight the code we want to use as the body of the function, click on *code*, then *extract function*

```r
x <- student3
grade <- function(x) {
  # Make sure our scores are all numbers
  x <- as.numeric(x)
  # Map NA values to zero
  x[ which(is.na(x)) ] = 0
  #Find the mean without the lowest value
  mean(x[ -which.min(x) ])
}
```

```r
grade(student1)
```

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

```r
grade(student2)
```

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

```r
grade(student3)
```

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

Now read the full gradebook CSV file.

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

```
##            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
```

Use for one student

```
scores[10,]
```

```
##            hw1 hw2 hw3 hw4 hw5
## student-10  89  72  79  NA  76
```

```
# Row number corresponds to a student number
grade(as.numeric(scores[10,]))
```

```
## [1] 79
```

> **Q2.** Using your grade() function and the supplied gradebook, Who is the top scoring student overall in the gradebook? [3pts]

Apply the grade function to the gradebook by using **apply()** function.

```
gradebook.scores <- apply(scores, 1, grade)
# apply(X, MARGIN, FUN)
# X: array / matrix
# MARGIN: 1=row, 2=columns
# FUN: function to be applied
gradebook.scores
```

```
##  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
```

Use **which.max()** to find the highest scoring student.

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

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

Student 18 is the top scoring student overall in the gradebook.

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

Use the **apply()** function to find the average of each homework grade to determine the lowest scoring homework, the apply() function can be used over the columns by changing the margin argument to 2.

```
scores.hw <- apply(scores, 2, mean, na.rm=TRUE)
# We are using Margin=2 to apply the mean function to the columns, which would average the homework sco
scores.hw
```

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

```r
# use which.min() to find the lowest average homework score
which.min(scores.hw)
```

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

HW 3 was the toughest on students.