

# Class 6: R functions

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## R Functions

Functions are how we get stuff done. We call functions to do everything useful in R.

One cool thing about R is that it makes writing your own functions comparatively easy.

All functions in R have at least three things:

- A **name** (we get to pick this)
- One or more **input arguments** (the input to our function)
- The **body** (lines of code that do the work)

```
funname <- function(input1, input2) {  
  # The body with R code  
}
```

Let's write a silly first function to add two numbers:

```
x <- 5  
y <- 1  
x + y
```

```
[1] 6
```

```
addme <- function(x,y=1) {  
  x + y  
}
```

```
addme(100,100)
```

```
[1] 200
```

```
addme(100)
```

```
[1] 101
```

## Lab for today

```
# Example input vectors as a start

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)
```

## Question 1

First finding the mean.

```
mean(student1)
```

```
[1] 98.75
```

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

```
[1] 91
```

```
mean(student3, na.rm= TRUE)
```

```
[1] 90
```

This isn't fair- there is no way student3 should have a mean of 90.

Come back to this NA problem. But things worked for student1.

We want to drop the lowest score before getting the `mean()`.

How do I find the lowest (minimum) score?

```
student1
```

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

```
min(student1)
```

```
[1] 90
```

I found the `which.min()` function. Maybe this is more useful?

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

```
[1] 8
```

Cool - it is the eighth element of the vector that has the lowest score. Can I remove this one?

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

```
[1] 90
```

Student1 grades with the lowest score dropped.

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

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

Mean of student1's scores with the lowest score dropped.

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

```
[1] 100
```

A more explicit way (as shown in class):

```
# Find the lowest score
ind <- which.min(student1)
# Remove lowest score and find the mean
mean(student1[-ind])
```

```
[1] 100
```

Use a common shortcut and use x as my input

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

```
[1] 100
```

We still have the problem of missing values.

One idea is to replace NA values with zero.

```
y <- 1:5
y==3
```

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

```
y[y==3]
```

```
[1] 3
```

```
y <- c(1,2,NA,4,5)
y == NA
```

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

```
y
```

```
[1] 1 2 NA 4 5
```

```
is.na(y)
```

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

How can I remove the NA elements from the vector? I need to flip the TRUE element

```
!c(F,F,F)
```

```
[1] TRUE TRUE TRUE
```

```
#y[is.na(y)]
```

```
y[!is.na(y)]
```

```
[1] 1 2 4 5
```

```
y[is.na(y)] <- 10000  
y
```

```
[1] 1 2 10000 4 5
```

Okay, let's solve this:

Last step now that I have my working code snippet is to make my `grade()` function

```
grade <- function(student1, student2, student3) {  
  x <- student1  
  
  # Change NA values to 0  
  x[is.na(x)] <- 0  
  mean(x[-which.min(x)])  
}
```

```
grade(student1)
```

```
[1] 100
```

```
grade(student2)
```

```
[1] 91
```

```
grade(student3)
```

```
[1] 12.85714
```

## Question 2: Who was the top scoring student?

Now read the online gradebook (CSV file)

```
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

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

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	

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

```
student-18
18
```

### Question 3: Which homework was the toughest on students?

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

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

```
which.min(hwresults)
```

```
hw3
3
```

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

```
      hw1      hw2      hw3      hw4      hw5
1780 1456 1616 1703 1585
```

### Question 4: Which homework was the most predictive (ie.highest correlation with average score)?

```
# Make all NA to zero
mask <- gradebook
mask[is.na(mask)] <- 0
#mask
```

We can use `cor()` function for correlation analysis.

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

```
[1] 0.4250204
```

This hw1 correlation indicates a relatively high correlation.

```
cor(mask$hw5, results)
```

```
[1] 0.6325982
```

```
cor(mask$hw3, results)
```

```
[1] 0.3042561
```

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

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

	hw1	hw2	hw3	hw4	hw5
	0.4250204	0.1767780	0.3042561	0.3810884	0.6325982