# Class 6: R Functions

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## Quick Rmarkdown intro

We can write text of course just like any file. We can **style text to be bold** or *italic*.

Do:

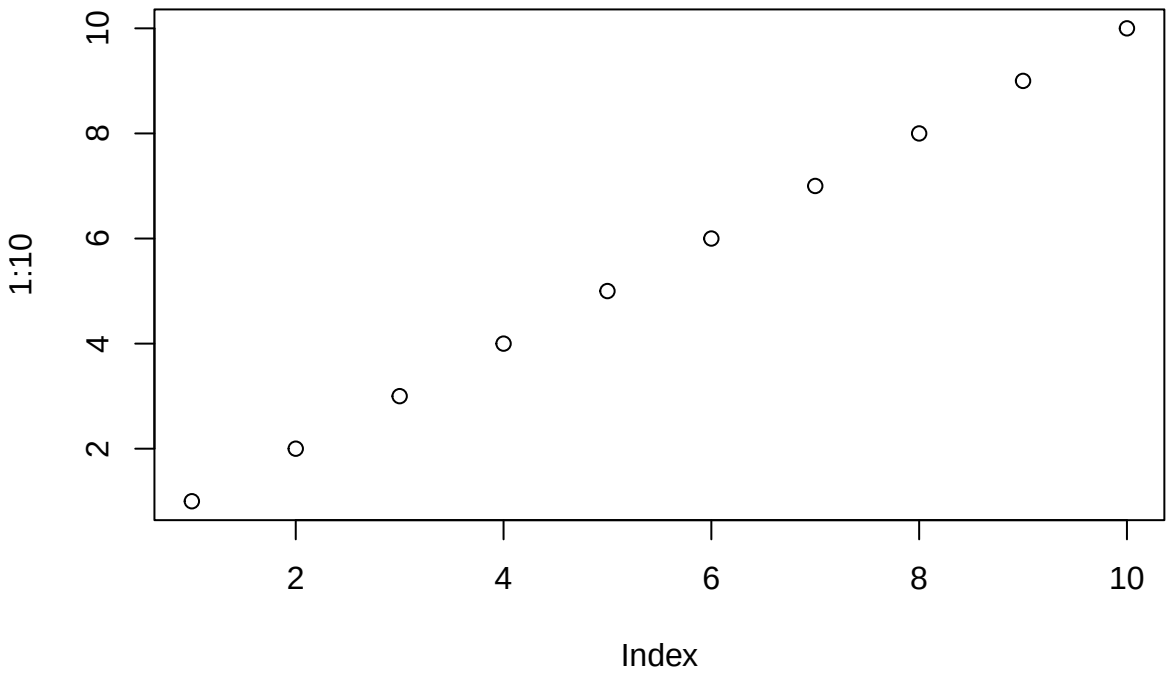
- this
- and that
- and another thing

This is more text
and this is a new line

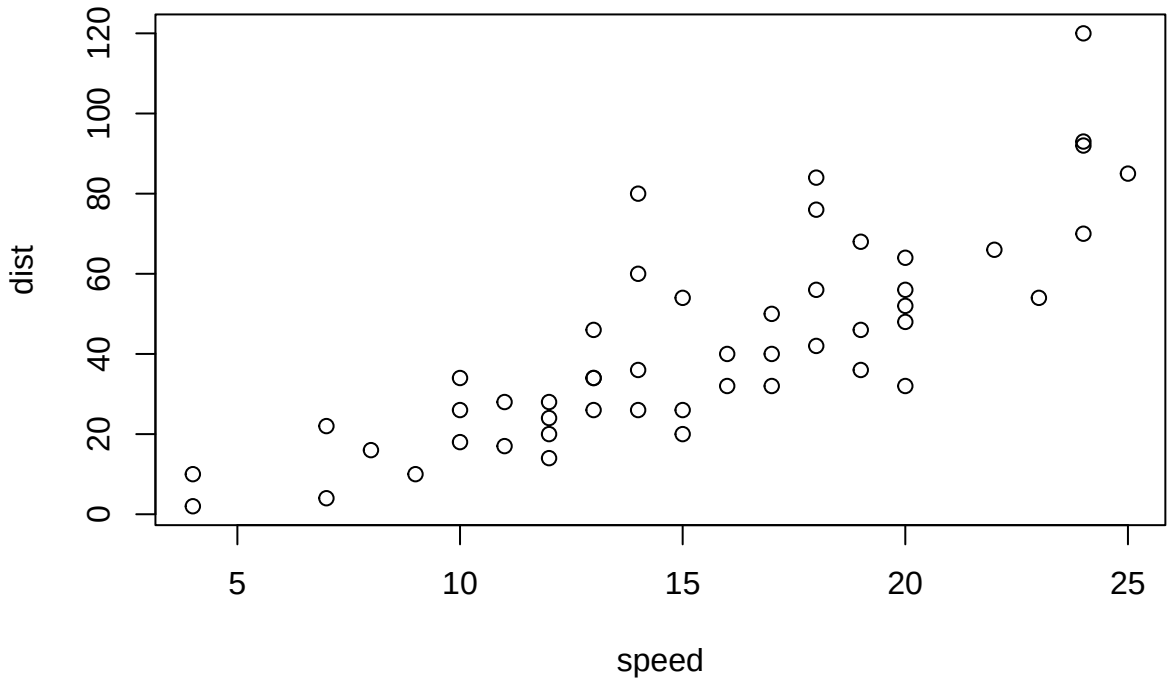
---

We can include some code:

```
plot(1:10)
```




```
# This is a comment and will not be passed to R
plot(cars)
```




## Time to write a function

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)
```

Find position of minimum value

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

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

Minus sign excludes value from element Find mean of vector which excludes lowest value

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

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

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

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

Does not work for student 2 because which.min(student2) returns 8, not 2

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

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

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

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

```
student3
```

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

is.na function: TRUE corresponds to the NA values

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

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

Find value of where is.na is TRUE

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

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

Replace NA with 0 and compute mean of the new vector minus the minimum value

```
student.prime <- student2
student.prime[is.na(student.prime)] = 0
mean(student.prime[-which.min(student.prime)])
```

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

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

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

Make code more simple

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

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

scenario: entering the data incorrectly (character instead of number)

```
student4 <- c(100, NA, 90, "90", 90, 90, 97, 80)
```

as.numeric changes values into numeric type

```
x <- student4
x <- as.numeric(x)
x[is.na(x)] = 0
mean(x[-which.min(x)])
```

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

Putting into a function. Components of functions: name, input args, body

```
grade <- function(x) {
  x <- as.numeric(x)
  x[is.na(x)] = 0
  mean(x[-which.min(x)])
}
```

call function - it works

```
grade(student1)
```

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

## Grade whole class

read notebook

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

apply grade function to each row in scores dataframe

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

```
##  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]

```
top_scoring_student <- which.max(ans)
top_scoring_student
```

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

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

use apply mean function on columns

```
apply(scores, 2, mean)
```

```
##  hw1  hw2  hw3  hw4  hw5
## 89.0   NA 80.8   NA   NA
```

use na.rm = TRUE to get rid of NA values

```
apply(scores, 2, mean, na.rm = TRUE)
```

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

but would be better to replace with zeros, then find which hw has the lowest mean

```
mask <- scores
mask[is.na(mask)] = 0
which.min(apply(mask, 2, mean))
```

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

hw2 has the lowest mean

> 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]

using cor function

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

```
## [1] 0.6325982
```

use apply to use cor function for every hw

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

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

hw5 is the best predictor

boxplot

```
boxplot(scores)
```