

# Session one

Mees van der Ent

10/12/2021

```
wd <- getwd()
data_dir <- paste(wd, "/data/", sep="")
out_dir <- paste(wd, "/out/", sep="")
```

## Chapter 1

### 1.1: Common exercise

Create two arrays x and y and plot as coordinates in scatterplot.

```
x <- c(2, 4, 7, 10)
y <- c(1, 10, 11, 18)
```

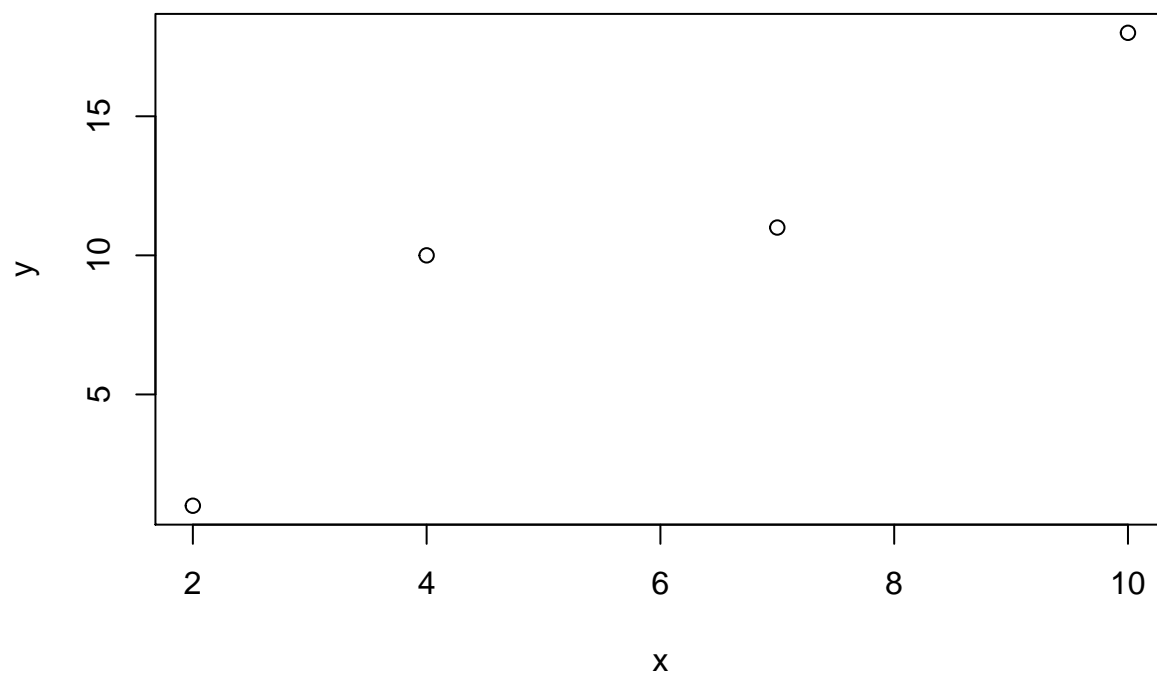
x

```
## [1]  2  4  7 10
```

y

```
## [1]  1 10 11 18
```

```
plot(x, y)
```



## Chapter 2

### 2.1: Vectors

- Create the object test1 with numbers 1.5, 0.7, 45.6.
- Create a vector y1 with the numbers from 1 to 10.
- Create a logical vector y2 from y1. An element of y2 should be TRUE if the corresponding element of y1 is larger than 5.
- How many elements from y1 has a value larger than 5?

```
test1 <- c(1.5, 0.7, 45.6)
y1 <- 1:10

y2 <- y1>5
sum(y2)
```

```
## [1] 5
```

### 2.2: creating sequences

- Create a vector x with elements (1, 2, 3, . . . , 100)

```
x <- 1:100
x
```

```
## [1] 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
## [19] 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36
## [37] 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54
## [55] 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72
## [73] 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90
## [91] 91 92 93 94 95 96 97 98 99 100
```

- Create a vector y with elements (0, 5, 10, 15, . . . , 500)

```
y <- seq(from=0, to=500, by=5)
y
```

```
## [1] 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85
## [19] 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175
## [37] 180 185 190 195 200 205 210 215 220 225 230 235 240 245 250 255 260 265
## [55] 270 275 280 285 290 295 300 305 310 315 320 325 330 335 340 345 350 355
## [73] 360 365 370 375 380 385 390 395 400 405 410 415 420 425 430 435 440 445
## [91] 450 455 460 465 470 475 480 485 490 495 500
```

- Create a vector z1 with elements (1, 1, 1, 2, 2, 2, . . . , 50, 50, 50)

```
z1 <- rep(1:50, rep(3, 50))
z1
```

```
## [1] 1 1 1 2 2 2 3 3 3 4 4 4 5 5 5 6 6 6 7 7 7 8 8 8 9
## [26] 9 9 10 10 10 11 11 11 12 12 12 13 13 13 14 14 14 15 15 15 16 16 16 17 17
## [51] 17 18 18 18 19 19 19 20 20 20 21 21 21 22 22 22 23 23 23 24 24 24 25 25 25
## [76] 26 26 26 27 27 27 28 28 28 29 29 29 30 30 30 31 31 31 32 32 32 33 33 33 34
## [101] 34 34 35 35 35 36 36 36 37 37 37 38 38 38 39 39 39 40 40 40 41 41 41 42 42
## [126] 42 43 43 43 44 44 44 45 45 45 46 46 46 47 47 47 48 48 48 49 49 49 50 50 50
```

- Create a vector z2 with elements (1, 2, 2, 3, 3, 3, . . . , 10)

```
z2 <- rep(1:10, 1:10)
z2
```

```
## [1] 1 2 2 3 3 3 4 4 4 4 5 5 5 5 5 6 6 6 6 6 6 7 7 7 7
## [26] 7 7 7 8 8 8 8 8 8 8 9 9 9 9 9 9 9 9 9 10 10 10 10 10
## [51] 10 10 10 10 10
```

e. Create a vector `z3` with elements (1, 2, 2, 3, 4, 4, 5, 6, 6, . . . , 50, 50)

```
z3 <- rep(1:50, rep(1:2, 25))
z3
```

```
## [1] 1 2 2 3 4 4 5 6 6 7 8 8 9 10 10 11 12 12 13 14 14 15 16 16 17
## [26] 18 18 19 20 20 21 22 22 23 24 24 25 26 26 27 28 28 29 30 30 31 32 32 33 34
## [51] 34 35 36 36 37 38 38 39 40 40 41 42 42 43 44 44 45 46 46 47 48 48 49 50 50
```

## 2.3: Matrix creation

a. Create a vector with 100 random normal numbers and use that to generate a 10 by 10 matrix. Call this matrix `mat1`. Hint: to generate a random normal vector, use the function `rnorm()`.

```
rand_dist <- rnorm(100)
mat1 <- matrix(rand_dist, nrow=10, ncol=10)
mat1
```

```
##           [,1]      [,2]      [,3]      [,4]      [,5]      [,6]
## [1,]  1.76972056  0.1066272 -0.5822947 -0.5444114 -0.9101484 -1.5244607
## [2,] -0.19368711  0.1672482 -2.1847663  1.5820951 -0.5792591 -1.1860579
## [3,]  0.28627582  1.0940354  1.2540010 -0.4689964 -0.4777311  1.9878073
## [4,]  1.39959481 -0.3947231  1.1401150  1.7574878  0.9502652 -0.7829709
## [5,]  0.06367158 -1.9357050 -1.5386055 -0.9869152 -0.5747571 -0.3391438
## [6,]  0.27254144 -0.6866730  0.2250626 -0.6672510 -0.7942621  0.7419401
## [7,]  0.67962349 -1.6838702  0.2086517  0.5217072 -1.2110516 -0.7687601
## [8,]  0.17860369  1.7495436 -1.5484795  0.2140396 -1.4689728  0.8895314
## [9,]  1.49787394  0.2974700  1.6157902 -1.2145974  1.4719233 -0.1071349
## [10,] -0.10553776 -0.7567884  0.4179345  0.5872573  0.6291263  0.9366244
##           [,7]      [,8]      [,9]      [,10]
## [1,] -1.06186589 -1.7900403  1.3179666  0.2255377
## [2,] -1.76446810 -2.1842383 -0.7508153 -0.2858404
## [3,]  0.46332793 -0.8881573 -0.2980079 -0.2867790
## [4,] -0.70373929  0.7557709  0.2246154 -0.3157211
## [5,] -0.50218888  0.3747701 -0.9446924  1.1908891
## [6,]  0.38161918 -1.7692956  0.0674258  0.6774273
## [7,] -0.68155909  0.5365458 -1.8124563  0.4066860
## [8,]  0.08814964 -1.3720997 -0.8718403 -0.8275745
## [9,] -0.60964132  0.9487590 -0.9639625 -0.2846929
## [10,] -0.05606630  0.8542954  0.6426272  0.7835820
```

b. Add an extra row to `mat1` with the numbers 1 to 10 which will be the new first row. Also add the row with numbers 10 to 1 which will be the last row.

```
mat2 <- rbind(1:10, mat1, 10:1)
mat2
```

```
##           [,1]      [,2]      [,3]      [,4]      [,5]      [,6]
## [1,]  1.00000000  2.0000000  3.0000000  4.0000000  5.0000000  6.0000000
## [2,]  1.76972056  0.1066272 -0.5822947 -0.5444114 -0.9101484 -1.5244607
## [3,] -0.19368711  0.1672482 -2.1847663  1.5820951 -0.5792591 -1.1860579
## [4,]  0.28627582  1.0940354  1.2540010 -0.4689964 -0.4777311  1.9878073
## [5,]  1.39959481 -0.3947231  1.1401150  1.7574878  0.9502652 -0.7829709
## [6,]  0.06367158 -1.9357050 -1.5386055 -0.9869152 -0.5747571 -0.3391438
```

```
## [7,] 0.27254144 -0.6866730 0.2250626 -0.6672510 -0.7942621 0.7419401
## [8,] 0.67962349 -1.6838702 0.2086517 0.5217072 -1.2110516 -0.7687601
## [9,] 0.17860369 1.7495436 -1.5484795 0.2140396 -1.4689728 0.8895314
## [10,] 1.49787394 0.2974700 1.6157902 -1.2145974 1.4719233 -0.1071349
## [11,] -0.10553776 -0.7567884 0.4179345 0.5872573 0.6291263 0.9366244
## [12,] 10.00000000 9.0000000 8.0000000 7.0000000 6.0000000 5.0000000
##      [,7]      [,8]      [,9]     [,10]
## [1,] 7.00000000 8.0000000 9.0000000 10.0000000
## [2,] -1.06186589 -1.7900403 1.3179666 0.2255377
## [3,] -1.76446810 -2.1842383 -0.7508153 -0.2858404
## [4,] 0.46332793 -0.8881573 -0.2980079 -0.2867790
## [5,] -0.70373929 0.7557709 0.2246154 -0.3157211
## [6,] -0.50218888 0.3747701 -0.9446924 1.1908891
## [7,] 0.38161918 -1.7692956 0.0674258 0.6774273
## [8,] -0.68155909 0.5365458 -1.8124563 0.4066860
## [9,] 0.08814964 -1.3720997 -0.8718403 -0.8275745
## [10,] -0.60964132 0.9487590 -0.9639625 -0.2846929
## [11,] -0.05606630 0.8542954 0.6426272 0.7835820
## [12,] 4.00000000 3.0000000 2.0000000 1.0000000
```

c. Add an extra column to the matrix obtained in step b with the number 1 to 12 (as first column).

```
mat3 <- cbind(1:12, mat2)
mat3
```

```
##      [,1]      [,2]      [,3]      [,4]      [,5]      [,6]      [,7]
## [1,] 1 1.00000000 2.0000000 3.0000000 4.0000000 5.0000000 6.0000000
## [2,] 2 1.76972056 0.1066272 -0.5822947 -0.5444114 -0.9101484 -1.5244607
## [3,] 3 -0.19368711 0.1672482 -2.1847663 1.5820951 -0.5792591 -1.1860579
## [4,] 4 0.28627582 1.0940354 1.2540010 -0.4689964 -0.4777311 1.9878073
## [5,] 5 1.39959481 -0.3947231 1.1401150 1.7574878 0.9502652 -0.7829709
## [6,] 6 0.06367158 -1.9357050 -1.5386055 -0.9869152 -0.5747571 -0.3391438
## [7,] 7 0.27254144 -0.6866730 0.2250626 -0.6672510 -0.7942621 0.7419401
## [8,] 8 0.67962349 -1.6838702 0.2086517 0.5217072 -1.2110516 -0.7687601
## [9,] 9 0.17860369 1.7495436 -1.5484795 0.2140396 -1.4689728 0.8895314
## [10,] 10 1.49787394 0.2974700 1.6157902 -1.2145974 1.4719233 -0.1071349
## [11,] 11 -0.10553776 -0.7567884 0.4179345 0.5872573 0.6291263 0.9366244
## [12,] 12 10.00000000 9.0000000 8.0000000 7.0000000 6.0000000 5.0000000
##      [,8]      [,9]      [,10]     [,11]
## [1,] 7.00000000 8.0000000 9.0000000 10.0000000
## [2,] -1.06186589 -1.7900403 1.3179666 0.2255377
## [3,] -1.76446810 -2.1842383 -0.7508153 -0.2858404
## [4,] 0.46332793 -0.8881573 -0.2980079 -0.2867790
## [5,] -0.70373929 0.7557709 0.2246154 -0.3157211
## [6,] -0.50218888 0.3747701 -0.9446924 1.1908891
## [7,] 0.38161918 -1.7692956 0.0674258 0.6774273
## [8,] -0.68155909 0.5365458 -1.8124563 0.4066860
## [9,] 0.08814964 -1.3720997 -0.8718403 -0.8275745
## [10,] -0.60964132 0.9487590 -0.9639625 -0.2846929
## [11,] -0.05606630 0.8542954 0.6426272 0.7835820
## [12,] 4.00000000 3.0000000 2.0000000 1.0000000
```

## 2.4: Working with data frames

a. Install and load the package *reshape*.

```
library(reshape)
```

```
## Warning: package 'reshape' was built under R version 3.4.4
```

b. Check the data description of this data frame.

```
?tips
```

c. Ask for the names of the variables in this data frame.

```
names(tips)
```

```
## [1] "total_bill" "tip"          "sex"          "smoker"       "day"
## [6] "time"       "size"
```

d. Take a subset of data tips which contains the observations from 1 until 20 and only the variables *tip*, *sex* and *day*.

```
tips_subset <- tips[1:20, c("tip", "sex", "day")]
tips_subset
```

```
##      tip    sex day
## 1  1.01 Female Sun
## 2  1.66  Male Sun
## 3  3.50  Male Sun
## 4  3.31  Male Sun
## 5  3.61 Female Sun
## 6  4.71  Male Sun
## 7  2.00  Male Sun
## 8  3.12  Male Sun
## 9  1.96  Male Sun
## 10 3.23  Male Sun
## 11 1.71  Male Sun
## 12 5.00 Female Sun
## 13 1.57  Male Sun
## 14 3.00  Male Sun
## 15 3.02 Female Sun
## 16 3.92  Male Sun
## 17 1.67 Female Sun
## 18 3.71  Male Sun
## 19 3.50 Female Sun
## 20 3.35  Male Sat
```

## Chapter 3

### 3.2: Importing an *Excel* file using R function

```
library(readxl)
```

```
## Warning: package 'readxl' was built under R version 3.4.4
```

```
titanic_file <- paste(data_dir, "titanic.xlsx", sep="")
```

```
titanic_df <- read_excel(titanic_file)
```

```
## readxl works best with a newer version of the tibble package.
```

```
## You currently have tibble v1.4.2.
```

```
## Falling back to column name repair from tibble <= v1.4.2.
```

```
## Message displays once per session.
```

```
titanic_df
```

```
## # A tibble: 2,201 x 4
##   class   age  sex survived
##   <dbl> <dbl> <dbl>   <dbl>
## 1     1     1    1         1
## 2     1     1    1         1
## 3     1     1    1         1
## 4     1     1    1         1
## 5     1     1    1         1
## 6     1     1    1         1
## 7     1     1    1         1
## 8     1     1    1         1
## 9     1     1    1         1
## 10    1     1    1         1
## # ... with 2,191 more rows
```

### 3.3: Export a data frame to an *xlsx* file

```
library(openxlsx)
```

```
## Warning: package 'openxlsx' was built under R version 3.4.4
```

```
write.xlsx(airquality, file=paste(out_dir, "airquality.xlsx", sep=""))
```

### 3.4: Importing a */txt/* file using the `read.table()` function

```
chol <- read.table(file=paste0(data_dir, "chol_R.txt"), header=TRUE)
chol
```

```
##   AGE HEIGHT WEIGHT CHOL  SMOKE BLOOD  MORT
## 1   20   176    77  195 nonsmo    b alive
## 2   53   167    56  250  sigare    o dead
## 3   44   170    80  304  sigare    a dead
## 4   37   173    89  178 nonsmo    o alive
## 5   26   170    71  206  sigare    o alive
## 6   41   165    62  284  sigare    o alive
## 7   39   174    75  232  sigare    o alive
## 8   28   171    68  152   pipe    a alive
## 9   33   180   100  209  sigare    a alive
## 10  39   166    74  150  sigare    a alive
## 11  43   176    63  280  sigare    o alive
## 12  42   172    53  232  sigare    a alive
## 13  34   165    69  237 nonsmo    b alive
## 14  54   164    82  379   pipe    o dead
## 15  21   167    76  168   pipe    a alive
## 16  37   168    86  307  sigare    o alive
## 17  37   171    86  322   pipe    o alive
## 18  30   181    74  191 nonsmo    a alive
## 19  42   172    70  209 nonsmo    o alive
## 20  41   178    84  195  sigare    a alive
## 21  21   175    79  235  sigare    o alive
## 22  35   187    89  232  sigare    a alive
```

|       |    |     |     |     |        |         |
|-------|----|-----|-----|-----|--------|---------|
| ## 23 | 48 | 170 | 72  | 455 | pipe   | a alive |
| ## 24 | 40 | 181 | 86  | 193 | pipe   | o alive |
| ## 25 | 34 | 179 | 70  | 271 | pipe   | a alive |
| ## 26 | 38 | 170 | 78  | 260 | nonsmo | a alive |
| ## 27 | 53 | 170 | 82  | 269 | sigare | b alive |
| ## 28 | 37 | 178 | 72  | 220 | sigare | a alive |
| ## 29 | 28 | 175 | 81  | 178 | pipe   | o alive |
| ## 30 | 21 | 185 | 80  | 154 | sigare | a alive |
| ## 31 | 34 | 173 | 83  | 277 | nonsmo | b alive |
| ## 32 | 30 | 179 | 75  | 225 | sigare | a alive |
| ## 33 | 20 | 173 | 75  | 195 | sigare | a alive |
| ## 34 | 34 | 179 | 79  | 214 | sigare | a alive |
| ## 35 | 19 | 176 | 77  | 175 | nonsmo | b alive |
| ## 36 | 38 | 179 | 79  | 107 | sigare | a alive |
| ## 37 | 19 | 174 | 74  | 252 | sigare | a alive |
| ## 38 | 34 | 172 | 71  | 217 | sigare | o alive |
| ## 39 | 34 | 182 | 83  | 222 | sigare | a alive |
| ## 40 | 35 | 156 | 77  | 234 | nonsmo | a alive |
| ## 41 | 48 | 168 | 53  | 280 | sigare | a dead  |
| ## 42 | 37 | 173 | 77  | 266 | sigare | o alive |
| ## 43 | 37 | 173 | 83  | 278 | sigare | a alive |
| ## 44 | 54 | 177 | 90  | 285 | sigare | o alive |
| ## 45 | 29 | 179 | 80  | 257 | nonsmo | a alive |
| ## 46 | 19 | 175 | 61  | 195 | nonsmo | a alive |
| ## 47 | 48 | 168 | 86  | 230 | sigare | b dead  |
| ## 48 | 42 | 170 | 78  | 218 | sigare | o alive |
| ## 49 | 28 | 169 | 96  | 189 | pipe   | b alive |
| ## 50 | 47 | 177 | 81  | 258 | pipe   | o alive |
| ## 51 | 29 | 172 | 72  | 173 | nonsmo | a dead  |
| ## 52 | 21 | 189 | 73  | 138 | sigare | o alive |
| ## 53 | 19 | 178 | 70  | 171 | sigare | a alive |
| ## 54 | 24 | 170 | 74  | 256 | pipe   | a alive |
| ## 55 | 27 | 166 | 69  | 270 | pipe   | o alive |
| ## 56 | 52 | 170 | 77  | 250 | pipe   | a alive |
| ## 57 | 30 | 170 | 74  | 205 | sigare | o alive |
| ## 58 | 24 | 179 | 79  | 178 | sigare | o alive |
| ## 59 | 49 | 168 | 74  | 296 | pipe   | a alive |
| ## 60 | 48 | 175 | 97  | 252 | sigare | a alive |
| ## 61 | 37 | 191 | 92  | 235 | pipe   | a alive |
| ## 62 | 49 | 182 | 101 | 235 | sigare | o dead  |
| ## 63 | 51 | 174 | 82  | 248 | nonsmo | o alive |
| ## 64 | 45 | 176 | 76  | 297 | sigare | b alive |
| ## 65 | 40 | 172 | 93  | 287 | sigare | b dead  |
| ## 66 | 50 | 167 | 65  | 240 | sigare | b alive |
| ## 67 | 39 | 163 | 76  | 223 | pipe   | o dead  |
| ## 68 | 37 | 171 | 84  | 330 | nonsmo | o alive |
| ## 69 | 25 | 175 | 68  | 214 | nonsmo | o alive |
| ## 70 | 24 | 170 | 64  | 233 | nonsmo | a alive |
| ## 71 | 45 | 170 | 79  | 295 | sigare | o alive |
| ## 72 | 25 | 172 | 74  | 240 | pipe   | a alive |
| ## 73 | 35 | 178 | 67  | 256 | sigare | a alive |
| ## 74 | 34 | 170 | 69  | 207 | sigare | b alive |
| ## 75 | 22 | 175 | 96  | 255 | sigare | o alive |
| ## 76 | 42 | 173 | 86  | 245 | pipe   | a alive |

|        |    |     |     |     |        |    |       |
|--------|----|-----|-----|-----|--------|----|-------|
| ## 77  | 20 | 171 | 69  | 235 | sigare | a  | alive |
| ## 78  | 35 | 160 | 59  | 254 | sigare | o  | alive |
| ## 79  | 24 | 173 | 71  | 218 | pipe   | a  | alive |
| ## 80  | 24 | 176 | 66  | 176 | nonsmo | a  | alive |
| ## 81  | 20 | 167 | 63  | 202 | sigare | o  | alive |
| ## 82  | 37 | 185 | 110 | 254 | pipe   | a  | alive |
| ## 83  | 50 | 177 | 97  | 282 | sigare | o  | alive |
| ## 84  | 38 | 167 | 75  | 275 | pipe   | ab | alive |
| ## 85  | 47 | 178 | 94  | 189 | sigare | a  | alive |
| ## 86  | 32 | 180 | 69  | 217 | sigare | ab | alive |
| ## 87  | 23 | 181 | 70  | 232 | pipe   | o  | alive |
| ## 88  | 22 | 175 | 80  | 223 | sigare | o  | alive |
| ## 89  | 52 | 166 | 72  | 242 | nonsmo | a  | dead  |
| ## 90  | 30 | 174 | 74  | 247 | sigare | a  | alive |
| ## 91  | 18 | 177 | 76  | 214 | sigare | o  | alive |
| ## 92  | 40 | 170 | 65  | 178 | sigare | a  | alive |
| ## 93  | 40 | 164 | 65  | 238 | nonsmo | a  | alive |
| ## 94  | 40 | 164 | 62  | 246 | sigare | ab | dead  |
| ## 95  | 39 | 170 | 80  | 218 | sigare | o  | alive |
| ## 96  | 48 | 171 | 73  | 236 | nonsmo | b  | alive |
| ## 97  | 20 | 176 | 77  | 230 | sigare | a  | alive |
| ## 98  | 26 | 168 | 75  | 201 | sigare | o  | alive |
| ## 99  | 42 | 168 | 66  | 282 | sigare | o  | alive |
| ## 100 | 50 | 175 | 87  | 300 | sigare | a  | dead  |
| ## 101 | 52 | 162 | 70  | 268 | sigare | o  | alive |
| ## 102 | 20 | 179 | 84  | 239 | pipe   | o  | alive |
| ## 103 | 21 | 161 | 63  | 254 | sigare | a  | alive |
| ## 104 | 21 | 170 | 58  | 200 | sigare | o  | alive |
| ## 105 | 41 | 165 | 67  | 330 | sigare | a  | alive |
| ## 106 | 52 | 175 | 84  | 227 | pipe   | o  | alive |
| ## 107 | 40 | 172 | 75  | 214 | nonsmo | o  | alive |
| ## 108 | 48 | 166 | 75  | 285 | sigare | a  | dead  |
| ## 109 | 37 | 174 | 69  | 260 | sigare | b  | alive |
| ## 110 | 36 | 170 | 81  | 190 | nonsmo | o  | dead  |
| ## 111 | 40 | 183 | 73  | 178 | sigare | b  | alive |
| ## 112 | 33 | 186 | 96  | 234 | sigare | a  | dead  |
| ## 113 | 38 | 173 | 77  | 222 | nonsmo | a  | dead  |
| ## 114 | 39 | 173 | 81  | 297 | sigare | o  | alive |
| ## 115 | 48 | 164 | 67  | 325 | sigare | a  | alive |
| ## 116 | 48 | 169 | 80  | 219 | nonsmo | o  | alive |
| ## 117 | 32 | 165 | 94  | 204 | sigare | a  | alive |
| ## 118 | 39 | 170 | 64  | 218 | sigare | a  | alive |
| ## 119 | 36 | 171 | 64  | 216 | pipe   | o  | alive |
| ## 120 | 42 | 167 | 89  | 228 | pipe   | o  | dead  |
| ## 121 | 42 | 164 | 68  | 272 | nonsmo | o  | alive |
| ## 122 | 37 | 174 | 70  | 267 | pipe   | o  | dead  |
| ## 123 | 25 | 174 | 76  | 195 | sigare | o  | alive |
| ## 124 | 37 | 162 | 72  | 264 | pipe   | o  | alive |
| ## 125 | 42 | 176 | 99  | 264 | pipe   | a  | alive |
| ## 126 | 43 | 159 | 57  | 280 | sigare | o  | alive |
| ## 127 | 55 | 160 | 63  | 317 | sigare | o  | alive |
| ## 128 | 49 | 167 | 72  | 244 | nonsmo | o  | alive |
| ## 129 | 34 | 172 | 77  | 260 | pipe   | o  | alive |
| ## 130 | 34 | 182 | 81  | 204 | nonsmo | o  | alive |



|        |    |     |     |     |        |    |       |
|--------|----|-----|-----|-----|--------|----|-------|
| ## 131 | 19 | 166 | 65  | 195 | nonsmo | o  | alive |
| ## 132 | 37 | 180 | 85  | 240 | nonsmo | o  | alive |
| ## 133 | 41 | 165 | 76  | 260 | nonsmo | b  | alive |
| ## 134 | 19 | 170 | 68  | 195 | nonsmo | o  | alive |
| ## 135 | 30 | 171 | 72  | 247 | pipe   | o  | alive |
| ## 136 | 37 | 172 | 81  | 294 | nonsmo | o  | alive |
| ## 137 | 27 | 168 | 58  | 250 | sigare | a  | alive |
| ## 138 | 41 | 161 | 75  | 229 | nonsmo | a  | alive |
| ## 139 | 34 | 191 | 99  | 213 | sigare | a  | dead  |
| ## 140 | 44 | 163 | 64  | 226 | pipe   | a  | alive |
| ## 141 | 26 | 168 | 73  | 160 | sigare | o  | alive |
| ## 142 | 30 | 183 | 92  | 203 | sigare | o  | alive |
| ## 143 | 29 | 186 | 92  | 221 | pipe   | o  | alive |
| ## 144 | 26 | 163 | 71  | 264 | pipe   | a  | alive |
| ## 145 | 36 | 171 | 71  | 201 | pipe   | o  | alive |
| ## 146 | 38 | 171 | 73  | 305 | sigare | o  | alive |
| ## 147 | 40 | 179 | 68  | 225 | sigare | o  | alive |
| ## 148 | 40 | 175 | 80  | 247 | sigare | a  | alive |
| ## 149 | 39 | 172 | 68  | 280 | sigare | a  | dead  |
| ## 150 | 30 | 178 | 110 | 179 | pipe   | a  | alive |
| ## 151 | 37 | 170 | 60  | 200 | sigare | o  | alive |
| ## 152 | 37 | 180 | 88  | 238 | nonsmo | o  | alive |
| ## 153 | 22 | 169 | 71  | 226 | nonsmo | a  | alive |
| ## 154 | 19 | 175 | 66  | 244 | nonsmo | o  | alive |
| ## 155 | 21 | 176 | 65  | 210 | pipe   | o  | alive |
| ## 156 | 38 | 169 | 73  | 198 | sigare | a  | alive |
| ## 157 | 47 | 187 | 87  | 271 | sigare | a  | dead  |
| ## 158 | 39 | 167 | 68  | 286 | nonsmo | ab | alive |
| ## 159 | 26 | 183 | 91  | 186 | nonsmo | a  | alive |
| ## 160 | 40 | 170 | 81  | 206 | sigare | o  | alive |
| ## 161 | 46 | 169 | 82  | 224 | nonsmo | a  | alive |
| ## 162 | 28 | 175 | 86  | 233 | sigare | a  | alive |
| ## 163 | 37 | 165 | 77  | 218 | nonsmo | ab | alive |
| ## 164 | 34 | 175 | 67  | 170 | nonsmo | a  | alive |
| ## 165 | 33 | 178 | 83  | 239 | sigare | o  | alive |
| ## 166 | 19 | 185 | 79  | 166 | pipe   | b  | alive |
| ## 167 | 21 | 186 | 90  | 196 | sigare | o  | alive |
| ## 168 | 24 | 173 | 85  | 206 | sigare | o  | alive |
| ## 169 | 39 | 175 | 70  | 185 | sigare | o  | alive |
| ## 170 | 32 | 170 | 65  | 187 | sigare | o  | alive |
| ## 171 | 32 | 156 | 70  | 255 | sigare | a  | dead  |
| ## 172 | 39 | 168 | 64  | 205 | sigare | o  | alive |
| ## 173 | 32 | 170 | 73  | 245 | nonsmo | b  | alive |
| ## 174 | 31 | 173 | 87  | 215 | sigare | a  | alive |
| ## 175 | 20 | 177 | 81  | 230 | nonsmo | o  | alive |
| ## 176 | 42 | 165 | 76  | 196 | sigare | o  | alive |
| ## 177 | 37 | 166 | 63  | 227 | sigare | a  | dead  |
| ## 178 | 47 | 162 | 63  | 334 | sigare | a  | alive |
| ## 179 | 44 | 173 | 73  | 304 | sigare | o  | alive |
| ## 180 | 43 | 177 | 77  | 259 | sigare | b  | alive |
| ## 181 | 58 | 172 | 86  | 180 | pipe   | o  | alive |
| ## 182 | 19 | 188 | 83  | 130 | sigare | a  | alive |
| ## 183 | 41 | 172 | 77  | 234 | nonsmo | o  | alive |
| ## 184 | 41 | 168 | 66  | 246 | sigare | o  | dead  |

```
## 185 50 156 61 206 sigare o alive
## 186 39 168 68 230 sigare b alive
## 187 41 179 74 221 nonsmo a alive
## 188 49 161 61 268 pipe b alive
## 189 35 176 73 234 sigare o alive
## 190 37 173 67 259 sigare o alive
## 191 49 160 74 191 nonsmo a alive
## 192 34 179 78 189 nonsmo o alive
## 193 31 166 68 200 sigare a alive
## 194 37 159 82 256 nonsmo a alive
## 195 43 175 80 219 sigare o alive
## 196 35 174 57 222 pipe a alive
## 197 38 172 91 227 nonsmo b alive
## 198 26 170 60 167 sigare a alive
## 199 39 165 74 259 sigare o alive
## 200 49 178 81 275 pipe b alive
```

### 3.5: Export a data frame to a *.txt* file

```
write.table(
  chol,
  file=paste0(out_dir, "chol_export.txt"),
  quote=FALSE,
  sep=" ",
  row.names=FALSE,
  col.names = TRUE)
```

## Chapter 4: Functions

1. Write a function which gives the most elementary statistics for a sample  $x$ : min, median, max, mean, sd and length. Apply your function on a vector  $x$  with values from 25 to 80.

```
elem_stat <- function(array){
  array_min <- min(array)
  array_max <- max(array)
  array_median <- median(array)
  array_mean <- mean(array)
  array_sd <- sd(array)
  array_length <- length(array)
  stats <- c(array_min, array_max, array_median, array_mean, array_sd, array_length)

  return(stats)
}

test_array <- 25:80
elem_stat(test_array)
```

```
## [1] 25.00000 80.00000 52.50000 52.50000 16.30951 56.00000
```

2. Write a function `fun1` which produces the text 'Non-negative number' if you apply `fun1` to a positive number and 'negative number' if you apply `fun1` to a negative number. You can make use of the `ifelse` function in R. Apply this function to the values 9 and -13.

```
fun1 <- function(n){
  if(n>=0){
    print("Non-negative number")
  } else{
    print("Negative number")
  }
}

x <- 9; fun1(x)
```

```
## [1] "Non-negative number"
```

```
x <- -13; fun1(x)
```

```
## [1] "Negative number"
```

3. Write a function to solve an equation of second degree ( $ax^2 + bx + c = 0$ ).

```
determinant <- function(a, b, c){
  return(b^2 - (4*a*c))
}

solve_second_deg <- function(a, b, c){
  d <- determinant(a, b, c)
  if(d>0){
    x1 <- (-b + sqrt(d)) / (2 * a)
    x2 <- (-b - sqrt(d)) / (2 * a)
    return(c(x1, x2))
  } else if(d==0){
    return((-b + sqrt(d)) / (2 * a))
  } else{
    print("determinant < 0")
  }
}
```

```

    }
  }

  fun_second_fun <- function(x, a, b, c){
    y <- a*x^2 + b*x + c
    return(y)
  }

  my_second_fun <- function(x){
    return(fun_second_fun(x, -8, 6, 4))
  }

  print(solve_second_deg(-8, 6, 4))

## [1] -0.4253905  1.1753905
plot(my_second_fun(seq(from=-2, to=2, by=0.01)), type="l")

```

