# Usefull Base R

## Looking up functions

You can look up how a function works with the ? function. If you do not know the functions used in this task you can easily look them up!

```
?data()
```

## Saving and loading

### Saving things to read them in R later

You can save a lot of time, when you save your processed R files after certain steps. This way you do not have to rerun all your steps everytime again. There are 2 base R functions to save R objects, in a way that you can reopen them directly as R objects again. - save() and load() can be used to save .RData files - saveRDS(), readRDS() are used for .rds files

#### Task 1

Use the data(iris) data set or any other data set you like. Save the file once as a RData and as a rds and relaod. What is the difference, between the file types?

```
data(iris)
iris
```

```
##     Sepal.Length Sepal.Width Petal.Length Petal.Width    Species
## 1            5.1         3.5          1.4         0.2     setosa
## 2            4.9         3.0          1.4         0.2     setosa
## 3            4.7         3.2          1.3         0.2     setosa
## 4            4.6         3.1          1.5         0.2     setosa
## 5            5.0         3.6          1.4         0.2     setosa
## 6            5.4         3.9          1.7         0.4     setosa
## 7            4.6         3.4          1.4         0.3     setosa
## 8            5.0         3.4          1.5         0.2     setosa
## 9            4.4         2.9          1.4         0.2     setosa
## 10           4.9         3.1          1.5         0.1     setosa
## 11           5.4         3.7          1.5         0.2     setosa
## 12           4.8         3.4          1.6         0.2     setosa
## 13           4.8         3.0          1.4         0.1     setosa
## 14           4.3         3.0          1.1         0.1     setosa
## 15           5.8         4.0          1.2         0.2     setosa
## 16           5.7         4.4          1.5         0.4     setosa
## 17           5.4         3.9          1.3         0.4     setosa
## 18           5.1         3.5          1.4         0.3     setosa
## 19           5.7         3.8          1.7         0.3     setosa
## 20           5.1         3.8          1.5         0.3     setosa
## 21           5.4         3.4          1.7         0.2     setosa
## 22           5.1         3.7          1.5         0.4     setosa
```

```
## 23          4.6         3.6          1.0         0.2     setosa
## 24          5.1         3.3          1.7         0.5     setosa
## 25          4.8         3.4          1.9         0.2     setosa
## 26          5.0         3.0          1.6         0.2     setosa
## 27          5.0         3.4          1.6         0.4     setosa
## 28          5.2         3.5          1.5         0.2     setosa
## 29          5.2         3.4          1.4         0.2     setosa
## 30          4.7         3.2          1.6         0.2     setosa
## 31          4.8         3.1          1.6         0.2     setosa
## 32          5.4         3.4          1.5         0.4     setosa
## 33          5.2         4.1          1.5         0.1     setosa
## 34          5.5         4.2          1.4         0.2     setosa
## 35          4.9         3.1          1.5         0.2     setosa
## 36          5.0         3.2          1.2         0.2     setosa
## 37          5.5         3.5          1.3         0.2     setosa
## 38          4.9         3.6          1.4         0.1     setosa
## 39          4.4         3.0          1.3         0.2     setosa
## 40          5.1         3.4          1.5         0.2     setosa
## 41          5.0         3.5          1.3         0.3     setosa
## 42          4.5         2.3          1.3         0.3     setosa
## 43          4.4         3.2          1.3         0.2     setosa
## 44          5.0         3.5          1.6         0.6     setosa
## 45          5.1         3.8          1.9         0.4     setosa
## 46          4.8         3.0          1.4         0.3     setosa
## 47          5.1         3.8          1.6         0.2     setosa
## 48          4.6         3.2          1.4         0.2     setosa
## 49          5.3         3.7          1.5         0.2     setosa
## 50          5.0         3.3          1.4         0.2     setosa
## 51          7.0         3.2          4.7         1.4 versicolor
## 52          6.4         3.2          4.5         1.5 versicolor
## 53          6.9         3.1          4.9         1.5 versicolor
## 54          5.5         2.3          4.0         1.3 versicolor
## 55          6.5         2.8          4.6         1.5 versicolor
## 56          5.7         2.8          4.5         1.3 versicolor
## 57          6.3         3.3          4.7         1.6 versicolor
## 58          4.9         2.4          3.3         1.0 versicolor
## 59          6.6         2.9          4.6         1.3 versicolor
## 60          5.2         2.7          3.9         1.4 versicolor
## 61          5.0         2.0          3.5         1.0 versicolor
## 62          5.9         3.0          4.2         1.5 versicolor
## 63          6.0         2.2          4.0         1.0 versicolor
## 64          6.1         2.9          4.7         1.4 versicolor
## 65          5.6         2.9          3.6         1.3 versicolor
## 66          6.7         3.1          4.4         1.4 versicolor
## 67          5.6         3.0          4.5         1.5 versicolor
## 68          5.8         2.7          4.1         1.0 versicolor
## 69          6.2         2.2          4.5         1.5 versicolor
## 70          5.6         2.5          3.9         1.1 versicolor
## 71          5.9         3.2          4.8         1.8 versicolor
## 72          6.1         2.8          4.0         1.3 versicolor
## 73          6.3         2.5          4.9         1.5 versicolor
## 74          6.1         2.8          4.7         1.2 versicolor
## 75          6.4         2.9          4.3         1.3 versicolor
## 76          6.6         3.0          4.4         1.4 versicolor
```

```
## 77          6.8         2.8          4.8         1.4 versicolor
## 78          6.7         3.0          5.0         1.7 versicolor
## 79          6.0         2.9          4.5         1.5 versicolor
## 80          5.7         2.6          3.5         1.0 versicolor
## 81          5.5         2.4          3.8         1.1 versicolor
## 82          5.5         2.4          3.7         1.0 versicolor
## 83          5.8         2.7          3.9         1.2 versicolor
## 84          6.0         2.7          5.1         1.6 versicolor
## 85          5.4         3.0          4.5         1.5 versicolor
## 86          6.0         3.4          4.5         1.6 versicolor
## 87          6.7         3.1          4.7         1.5 versicolor
## 88          6.3         2.3          4.4         1.3 versicolor
## 89          5.6         3.0          4.1         1.3 versicolor
## 90          5.5         2.5          4.0         1.3 versicolor
## 91          5.5         2.6          4.4         1.2 versicolor
## 92          6.1         3.0          4.6         1.4 versicolor
## 93          5.8         2.6          4.0         1.2 versicolor
## 94          5.0         2.3          3.3         1.0 versicolor
## 95          5.6         2.7          4.2         1.3 versicolor
## 96          5.7         3.0          4.2         1.2 versicolor
## 97          5.7         2.9          4.2         1.3 versicolor
## 98          6.2         2.9          4.3         1.3 versicolor
## 99          5.1         2.5          3.0         1.1 versicolor
## 100         5.7         2.8          4.1         1.3 versicolor
## 101         6.3         3.3          6.0         2.5  virginica
## 102         5.8         2.7          5.1         1.9  virginica
## 103         7.1         3.0          5.9         2.1  virginica
## 104         6.3         2.9          5.6         1.8  virginica
## 105         6.5         3.0          5.8         2.2  virginica
## 106         7.6         3.0          6.6         2.1  virginica
## 107         4.9         2.5          4.5         1.7  virginica
## 108         7.3         2.9          6.3         1.8  virginica
## 109         6.7         2.5          5.8         1.8  virginica
## 110         7.2         3.6          6.1         2.5  virginica
## 111         6.5         3.2          5.1         2.0  virginica
## 112         6.4         2.7          5.3         1.9  virginica
## 113         6.8         3.0          5.5         2.1  virginica
## 114         5.7         2.5          5.0         2.0  virginica
## 115         5.8         2.8          5.1         2.4  virginica
## 116         6.4         3.2          5.3         2.3  virginica
## 117         6.5         3.0          5.5         1.8  virginica
## 118         7.7         3.8          6.7         2.2  virginica
## 119         7.7         2.6          6.9         2.3  virginica
## 120         6.0         2.2          5.0         1.5  virginica
## 121         6.9         3.2          5.7         2.3  virginica
## 122         5.6         2.8          4.9         2.0  virginica
## 123         7.7         2.8          6.7         2.0  virginica
## 124         6.3         2.7          4.9         1.8  virginica
## 125         6.7         3.3          5.7         2.1  virginica
## 126         7.2         3.2          6.0         1.8  virginica
## 127         6.2         2.8          4.8         1.8  virginica
## 128         6.1         3.0          4.9         1.8  virginica
## 129         6.4         2.8          5.6         2.1  virginica
## 130         7.2         3.0          5.8         1.6  virginica
```

```
## 131          7.4         2.8          6.1         1.9  virginica
## 132          7.9         3.8          6.4         2.0  virginica
## 133          6.4         2.8          5.6         2.2  virginica
## 134          6.3         2.8          5.1         1.5  virginica
## 135          6.1         2.6          5.6         1.4  virginica
## 136          7.7         3.0          6.1         2.3  virginica
## 137          6.3         3.4          5.6         2.4  virginica
## 138          6.4         3.1          5.5         1.8  virginica
## 139          6.0         3.0          4.8         1.8  virginica
## 140          6.9         3.1          5.4         2.1  virginica
## 141          6.7         3.1          5.6         2.4  virginica
## 142          6.9         3.1          5.1         2.3  virginica
## 143          5.8         2.7          5.1         1.9  virginica
## 144          6.8         3.2          5.9         2.3  virginica
## 145          6.7         3.3          5.7         2.5  virginica
## 146          6.7         3.0          5.2         2.3  virginica
## 147          6.3         2.5          5.0         1.9  virginica
## 148          6.5         3.0          5.2         2.0  virginica
## 149          6.2         3.4          5.4         2.3  virginica
## 150          5.9         3.0          5.1         1.8  virginica
```

```r
# .R file
outpath <- "/Users/melinaklostermann/Documents/non-project-R/Coding_tasks/Zarnack_CodingTasks/Useful Ba
save(iris, file =  paste0(outpath,"iris.R") )

remove(iris)
load(paste0(outpath,"iris.R"))

# .rds file
saveRDS(iris, file = paste0(outpath,"iris.rds"))
iris_2 <- readRDS(paste0(outpath,"iris.rds"))  # rds files can be stored under a different name when re
```

## Using paste to get you paths and file names cleaned up

When you save something you have to specify a path. This can get messy if you save 10 files and afterwards decide to move the output folder somewhere else. Paste allows you to add strings together. You can in the beginning of your script define the output path once and then refere to this every time you save something. You can also paste certain variables like a cutoff into the file name, so you recognise it later.

### Task 2

- Define a output folder for this coding task. And save the files from task 1 in there using paste(). You can use sep to define how the parts inside paste should be conctet.
- Often it is most usefull to use paste0. What does it do?
- Use Sys.Date() to add the date to your filenames

```r
# example
# outpath = "my/output/path/"

paste(outpath, "file1", "RData", sep = ".")
```

```
## [1] "/Users/melinaklostermann/Documents/non-project-R/Coding_tasks/Zarnack_CodingTasks/Useful BaseR/
```

```r
paste(outpath, "file1", Sys.Date(), "RData", sep = ".")
```

```
## [1] "/Users/melinaklostermann/Documents/non-project-R/Coding_tasks/Zarnack_CodingTasks/Useful BaseR/
```

## Reading from and saving to table documents

During you project you might get data files in table formats that you want to read int R. And maybe you want to save some of your results in a common table format like .txt or .csv.

### Task 3

Use the given coding-task.txt and coding-task.csv to familarise yourself with the functions below. What options do the functions have and what do they do?

```
read.table()
read.csv()
read.delim()

write.table()
write.csv()
```

```
# write.table(iris, file = paste0("/Users/melinaklostermann/Documents/non-project-R/Coding_tasks/Zarnac
t1 <- read.table(paste0("/Users/melinaklostermann/Documents/non-project-R/Coding_tasks/Zarnack_CodingTa

# write.csv(iris, file = paste0("/Users/melinaklostermann/Documents/non-project-R/Coding_tasks/Zarnack_
t2 <- read.csv(paste0("/Users/melinaklostermann/Documents/non-project-R/Coding_tasks/Zarnack_CodingTask
```

## Saving figures

If you make plots with ggplot the easies way to save the plot is with ggsave(). However some packages like clusterProfiler and UpsetR do not output a ggplot format. You can save these (and potentially also all ggplots) by turning on a pdf or png device with pdf() or png(). It is important that you turn of the device afterwards (dev.off()). You can specify the figure height, width, poinsize and fontsize for the machine

```
pdf(paste0(outpath,"plot.pdf"))
hist(iris$Sepal.Width)
dev.off()
```

```
## pdf
##   2
```

```
png(paste0(outpath,"plot.png"))
hist(iris$Sepal.Width)
dev.off()
```

```
## pdf
##   2
```

### Task 4

Save the histogram from the example above in a 5 x 5 pdf and a 10 x 5 png. Choose a usefull fontsize.

```
pdf(paste0(outpath,"plot.pdf"), width = 5, height = 5)
hist(iris$Sepal.Width)
dev.off()

png(paste0(outpath,"plot.png"), width = 10, height = 5)
hist(iris$Sepal.Width)
dev.off()
```

# What is inside an R object?

## First look

Usefull functions are

```
head(iris)
```

```
##   Sepal.Length Sepal.Width Petal.Length Petal.Width Species
## 1          5.1         3.5          1.4         0.2  setosa
## 2          4.9         3.0          1.4         0.2  setosa
## 3          4.7         3.2          1.3         0.2  setosa
## 4          4.6         3.1          1.5         0.2  setosa
## 5          5.0         3.6          1.4         0.2  setosa
## 6          5.4         3.9          1.7         0.4  setosa
```

```
tail(iris)
```

```
##     Sepal.Length Sepal.Width Petal.Length Petal.Width   Species
## 145          6.7         3.3          5.7         2.5 virginica
## 146          6.7         3.0          5.2         2.3 virginica
## 147          6.3         2.5          5.0         1.9 virginica
## 148          6.5         3.0          5.2         2.0 virginica
## 149          6.2         3.4          5.4         2.3 virginica
## 150          5.9         3.0          5.1         1.8 virginica
```

```
table(iris$Sepal.Length)
```

```
##
## 4.3 4.4 4.5 4.6 4.7 4.8 4.9   5 5.1 5.2 5.3 5.4 5.5 5.6 5.7 5.8 5.9   6 6.1 6.2
##   1   3   1   4   2   5   6  10   9   4   1   6   7   6   8   7   3   6   6   4
## 6.3 6.4 6.5 6.6 6.7 6.8 6.9   7 7.1 7.2 7.3 7.4 7.6 7.7 7.9
##   9   7   5   2   8   3   4   1   1   3   1   1   1   4   1
```

```
summary(iris)
```

```
##   Sepal.Length    Sepal.Width     Petal.Length    Petal.Width
##  Min.   :4.300   Min.   :2.000   Min.   :1.000   Min.   :0.100
##  1st Qu.:5.100   1st Qu.:2.800   1st Qu.:1.600   1st Qu.:0.300
##  Median :5.800   Median :3.000   Median :4.350   Median :1.300
##  Mean   :5.843   Mean   :3.057   Mean   :3.758   Mean   :1.199
##  3rd Qu.:6.400   3rd Qu.:3.300   3rd Qu.:5.100   3rd Qu.:1.800
##  Max.   :7.900   Max.   :4.400   Max.   :6.900   Max.   :2.500
##        Species
##  setosa    :50
##  versicolor:50
##  virginica :50
##
##
##
```

### Task 5

Try out the functions from above, that you do not know yet. Are there more functions of this kind that you would recommend?

## Logical commands and some math

There are some usefull logical commands, that allow you to check for certain occurences inside a huge data set, without scrolling through it.

```
any()
all()
which()

min()
max()
sum()

duplicated()
unique()

is.na()
is.finite()
is.infinite()
```

### Task 6

Find out the following for the Iris data set: - Are all Petal Lengths smaller then 7?

```
all(iris$Petal.Length < 7)
```

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

- Does one of the columns contain a zero?

```
any(iris$Petal.Length == 0 | iris$Sepal.Length ==0 | iris$Sepal.Width == 0 | iris$Petal.Length == 0)
```

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

- Are there any rows with a Sepal Length of 5.8.
- Which rows contain the versicolor species?

```
which(iris$Species == "versicolor")
```

```
##  [1]  51  52  53  54  55  56  57  58  59  60  61  62  63  64  65  66  67  68  69
## [20]  70  71  72  73  74  75  76  77  78  79  80  81  82  83  84  85  86  87  88
## [39]  89  90  91  92  93  94  95  96  97  98  99 100
```

```
iris[which(iris$Species == "versicolor"),]
```

```
##     Sepal.Length Sepal.Width Petal.Length Petal.Width    Species
## 51           7.0         3.2          4.7         1.4 versicolor
## 52           6.4         3.2          4.5         1.5 versicolor
## 53           6.9         3.1          4.9         1.5 versicolor
## 54           5.5         2.3          4.0         1.3 versicolor
## 55           6.5         2.8          4.6         1.5 versicolor
## 56           5.7         2.8          4.5         1.3 versicolor
## 57           6.3         3.3          4.7         1.6 versicolor
## 58           4.9         2.4          3.3         1.0 versicolor
## 59           6.6         2.9          4.6         1.3 versicolor
## 60           5.2         2.7          3.9         1.4 versicolor
## 61           5.0         2.0          3.5         1.0 versicolor
## 62           5.9         3.0          4.2         1.5 versicolor
```

```
## 63          6.0         2.2          4.0         1.0 versicolor
## 64          6.1         2.9          4.7         1.4 versicolor
## 65          5.6         2.9          3.6         1.3 versicolor
## 66          6.7         3.1          4.4         1.4 versicolor
## 67          5.6         3.0          4.5         1.5 versicolor
## 68          5.8         2.7          4.1         1.0 versicolor
## 69          6.2         2.2          4.5         1.5 versicolor
## 70          5.6         2.5          3.9         1.1 versicolor
## 71          5.9         3.2          4.8         1.8 versicolor
## 72          6.1         2.8          4.0         1.3 versicolor
## 73          6.3         2.5          4.9         1.5 versicolor
## 74          6.1         2.8          4.7         1.2 versicolor
## 75          6.4         2.9          4.3         1.3 versicolor
## 76          6.6         3.0          4.4         1.4 versicolor
## 77          6.8         2.8          4.8         1.4 versicolor
## 78          6.7         3.0          5.0         1.7 versicolor
## 79          6.0         2.9          4.5         1.5 versicolor
## 80          5.7         2.6          3.5         1.0 versicolor
## 81          5.5         2.4          3.8         1.1 versicolor
## 82          5.5         2.4          3.7         1.0 versicolor
## 83          5.8         2.7          3.9         1.2 versicolor
## 84          6.0         2.7          5.1         1.6 versicolor
## 85          5.4         3.0          4.5         1.5 versicolor
## 86          6.0         3.4          4.5         1.6 versicolor
## 87          6.7         3.1          4.7         1.5 versicolor
## 88          6.3         2.3          4.4         1.3 versicolor
## 89          5.6         3.0          4.1         1.3 versicolor
## 90          5.5         2.5          4.0         1.3 versicolor
## 91          5.5         2.6          4.4         1.2 versicolor
## 92          6.1         3.0          4.6         1.4 versicolor
## 93          5.8         2.6          4.0         1.2 versicolor
## 94          5.0         2.3          3.3         1.0 versicolor
## 95          5.6         2.7          4.2         1.3 versicolor
## 96          5.7         3.0          4.2         1.2 versicolor
## 97          5.7         2.9          4.2         1.3 versicolor
## 98          6.2         2.9          4.3         1.3 versicolor
## 99          5.1         2.5          3.0         1.1 versicolor
## 100         5.7         2.8          4.1         1.3 versicolor
```

- Which rows d not belng to the versicolor species?

```
which(iris$Species != "versicolor")
```

```
##   [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  50 101 102 103 104
##  [55] 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122
##  [73] 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140
##  [91] 141 142 143 144 145 146 147 148 149 150
```

- Which row contains the maximum/minimum Petal width?

```
max(iris$Petal.Width)
```

```
## [1] 2.5
```

```r
which.max(iris$Petal.Width)
```

```
## [1] 101
```

```r
iris[which.max(iris$Petal.Width),]
```

```
##     Sepal.Length Sepal.Width Petal.Length Petal.Width   Species
## 101          6.3         3.3            6         2.5 virginica
```

- How many Sepal width are bigger then 4? How many are exactly 3?

```r
sum(iris$Sepal.Width > 4)
```

```
## [1] 3
```

```r
sum(iris$Sepal.Width == 3)
```

```
## [1] 26
```

- Which petal witdh are duplicated/unique?

```r
duplicated(iris$Petal.Width)
```

```
##   [1] FALSE  TRUE  TRUE  TRUE  TRUE FALSE FALSE  TRUE  TRUE FALSE  TRUE  TRUE
##  [13]  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE
##  [25]  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
##  [37]  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE
##  [49]  TRUE  TRUE FALSE FALSE  TRUE FALSE  TRUE  TRUE FALSE FALSE  TRUE  TRUE
##  [61]  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE FALSE  TRUE
##  [73]  TRUE FALSE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
##  [85]  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
##  [97]  TRUE  TRUE  TRUE  TRUE FALSE FALSE FALSE  TRUE FALSE  TRUE  TRUE  TRUE
## [109]  TRUE  TRUE FALSE  TRUE  TRUE  TRUE FALSE FALSE  TRUE  TRUE  TRUE  TRUE
## [121]  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## [133]  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
## [145]  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE
```

```r
unique(iris$Petal.Width)
```

```
##  [1] 0.2 0.4 0.3 0.1 0.5 0.6 1.4 1.5 1.3 1.6 1.0 1.1 1.8 1.2 1.7 2.5 1.9 2.1 2.2
## [20] 2.0 2.4 2.3
```

```r
!duplicated(iris$Petal.Width)
```

```
##   [1]  TRUE FALSE FALSE FALSE FALSE  TRUE  TRUE FALSE FALSE  TRUE FALSE FALSE
##  [13] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE  TRUE
##  [25] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [37] FALSE FALSE FALSE FALSE FALSE FALSE FALSE  TRUE FALSE FALSE FALSE FALSE
##  [49] FALSE FALSE  TRUE  TRUE FALSE  TRUE FALSE FALSE  TRUE  TRUE FALSE FALSE
##  [61] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE  TRUE  TRUE FALSE
##  [73] FALSE  TRUE FALSE FALSE FALSE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE
##  [85] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
##  [97] FALSE FALSE FALSE FALSE  TRUE  TRUE  TRUE FALSE  TRUE FALSE FALSE FALSE
## [109] FALSE FALSE  TRUE FALSE FALSE FALSE  TRUE  TRUE FALSE FALSE FALSE FALSE
## [121] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
## [133] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
## [145] FALSE FALSE FALSE FALSE FALSE FALSE
```

```r
which(duplicated(iris$Petal.Width))
```

```
##   [1]   2   3   4   5   8   9  11  12  13  14  15  16  17  18  19  20  21  22
##  [19]  23  25  26  27  28  29  30  31  32  33  34  35  36  37  38  39  40  41
##  [37]  42  43  45  46  47  48  49  50  53  55  56  59  60  61  62  63  64  65
##  [55]  66  67  68  69  72  73  75  76  77  79  80  81  82  83  84  85  86  87
##  [73]  88  89  90  91  92  93  94  95  96  97  98  99 100 104 106 107 108 109
##  [91] 110 112 113 114 117 118 119 120 121 122 123 124 125 126 127 128 129 130
## [109] 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148
## [127] 149 150
```

```
sum(duplicated(iris$Petal.Width))
```

```
## [1] 128
```

```
table(duplicated(iris$Petal.Width))
```

```
##
## FALSE  TRUE
##    22   128
```

- Does the sepal length contain an NA or infitite value?

```
any(is.na(iris$Sepal.Length))
```

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

```
any(is.infinite(iris$Sepal.Length))
```

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

- Are all petal lengths finite numbers?

```
all(is.finite(iris$Petal.Length))
```

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

## Random sampling

You can use the following function to randomly draw from a vector.

```
set.seed()
sample()
runif()
```

### Task 7

- Use sample to extract 5 random flowers species from the iris species column.

```
sample(iris$Species,5)
```

```
## [1] versicolor setosa     setosa     setosa     versicolor
## Levels: setosa versicolor virginica
```

- Use sample and runif to get 4 random numbers between 1 and 20. What is the difference? What happens if you rerun the command?

```
sample(1:20,4)
```

```
## [1] 17  6  5 12
```

```
runif(4,1,20)
```

```
## [1] 13.01283 10.42451 11.29704 13.30185
```

```
sample(1:20,4)
```

```
## [1] 17 19 15 18
```

```
runif(4,1,20)
```

```
## [1]  8.536191 12.261810  7.963118  3.752528
```

- Now rerun the command again two times but use set.seed to get the same result both times

```
set.seed(3)
sample(1:20,4)
```

```
## [1]  5 12  7  4
```

```
runif(4,1,20)
```

```
## [1] 12.483487  3.368035  6.597418 11.974588
```

```
set.seed(3)
sample(1:20,4)
```

```
## [1]  5 12  7  4
```

```
runif(4,1,20)
```

```
## [1] 12.483487  3.368035  6.597418 11.974588
```

## Checking versions

When you write a thesis you should write the versions of R, RStudio and all used packages. This is how you can look them up quickly:

```
R.version()
package_version()
RStudio.Version()
```