

Exercises for the course
“An introduction to R”

Exercise session Data types and structures: Wednesday - March 4, 2020

Exercise 1: *Vectors are used for everything in R. So handling vectors is the first thing to learn.*

- Define the variable `v1` as the vector

$$(3, 7, -4, 0)$$

View the vector by entering `v1` on the R command line.

- Define the variable `v2` as the vector

$$(1, 2, 3, \dots, 48, 49, 50)$$

- Define the variable `v3` as the vector

$$(3, 7, -4, 0, 1, 2, 3, \dots, 48, 49, 50)$$

You may use `v1` and `v2` for this.

- Define the variable `v4` as the vector

$$(0.0, 0.1, 0.2, 0.3, \dots, 1.8, 1.9, 2.0)$$

- Sum over all elements of `v1`. Sum over all elements of `v2`.
- What is the product of all elements of the vector

$$(10, 11, 12, 13, \dots, 19, 20)?$$

Exercise 2: *Here is more practice in handling vectors.*

- Define the vector `data` as

```
data <- 90*1:100 - (1:100)^2 + 1000
```

- What is the length of the vector `data`?
- What is the first, the seventeenth and the last entry of the vector `data`?
- What is the *maximum* of the vector `data`? At *which* index is the *maximum* attained?
- Plot the vector `data` with `plot(data)` and visually confirm your last result.
- At *which* indices are the entries of `data` between 2000 and 2500?
- Define a vector `half` that contains only the last half of the elements of `data`. Hint: you can use negative integers to perform this task.

Exercise 3: Lists

- Define the list `myList` as

```
myList <- list(1:6, c("a", "b"), c(FALSE, TRUE, TRUE))
```

- What is the element with index 2 in `myList`?
- Which type of data is the element with index 3 in `myList`?

Exercise 4: Matrices

- Define a new matrix `m` by

```
m <- matrix( 11:35, nrow=5, byrow=TRUE )
```

- What is the entry in the third row and fourth column?
- Define a new submatrix `sub` that contains the elements of rows 2 to 4 and columns 3 to 5.
- Assign the names 'Variable1', 'Variable2' and 'Variable3' to the columns of `sub`.

Exercise 5: Create the following matrices:

$$\begin{pmatrix} 1 & 3 & 5 \\ 2 & 4 & 6 \end{pmatrix} \quad \begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix} \quad \begin{pmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \end{pmatrix} \quad \begin{pmatrix} 2 & 3 & 4 \\ 7 & 8 & 9 \end{pmatrix}$$

$$\begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \quad \begin{pmatrix} 0 & 1 & 1 & 1 \\ 1 & 0 & 1 & 1 \\ 1 & 1 & 0 & 1 \\ 1 & 1 & 1 & 0 \end{pmatrix} \quad \begin{pmatrix} 1 & 4 & 9 & 16 \\ 1 & 4 & 9 & 16 \\ 1 & 4 & 9 & 16 \\ 1 & 4 & 9 & 16 \end{pmatrix}$$

Exercise 6: *Data frames are the typical R representation of data sets. Here we create a data frame "by hand" to become familiar with data frames.*

Use the command `data.frame()` to create a data frame `results` with the following entries

name	degree	grade
Leonie	Bachelor	2.3
Luca	Master	3.0
Leon	Bachelor	2.0
Lea	Bachelor	1.3
Luis	Master	2.7
Laura	Master	1.0

- Get an overview of `results` with the commands `names()`, `str()` and `summary()`.
- Use the `$` operator to extract the column 'grade' from 'results'.
- Which command returns the fifth element of the vector 'grade'?
- Create a new data frame `students` that contains only the vectors 'name' and 'degree'. Do not use the command `data.frame()` for this task.
- We wish to change 'degree' into 'deg' to save typing work. Use the command `names()` to accomplish this change. You might need to consult the help page `?names` to find out how to do this.