Exercises for the course

"An introduction to R"

Sheet 01

Exercise 1: Use R to calculate

$$3^7, \quad \binom{22}{17}, \quad 8!, \quad \sqrt{\pi}.$$

(2 points)

Exercise 2: *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
$$(1, 2, 3, \ldots, 48, 49, 50)$$
- Define the variable `v3` as the vector
$$(3, 7, -4, 0, 1, 2, 3, \ldots, 48, 49, 50)$$
You may use `v1` and `v2` for this.
- Define the variable `v4` as the vector
$$(0.0, 0.1, 0.2, 0.3, \ldots, 1.8, 1.9, 2.0)$$
- Define the variable `treatment` as a vector of length 100 with elements
$$(\text{"yes"},\text{"control"},\text{"yes"},\text{"control"},\ldots,\text{"yes"},\text{"control"})$$
- Define the variable `smoker` as a vector of length 99 with elements
$$(\text{"yes"},\text{"no"},\text{"no"},\text{"yes"},\text{"no"},\text{"no"},\ldots,\text{"yes"},\text{"no"},\text{"no"})$$
- Sum over all elements of `v1`. Sum over all elements of `v2`.
- What is the product of all elements of the vector
$$(10, 11, 12, 13, \ldots, 19, 20)?$$

(4 points)

Exercise 3: We assume the vectors `smoker` and `treatment` of Exercise 2 to be known. If you didn't do Exercise 2, then write down the respective R commands which answer the following questions. Define the vector

```
lifespan <- abs( round( 100*sin(1:99) )  )
```

- Suppose we have 99 individuals of which we have measured some quantity and stored in the vector `lifespan`. You may think of `lifespan` as the life span of the individuals but keep in mind that the data is self-generated and not meaningful. The vector `smoker` tells us which indvidual is smoker and which is non-smoker. Now we wish to study the measured quantity of all smokers. Define a new vector `x` which consists of all elements of `lifespan` at whose index in `smoker` is the element `"yes"`. What is the maximum of `lifespan` over all smokers?
- Define a new vector `y` of all even elements in `lifespan` which are greater than or equal to 16. What is the minimum of all these elements?
- Half of the individuals got a certain treatment. Produce a new vector consisting of the lifespans of all individuals which are smokers and got the treatment.
- Produce a new vector of the lifespans of individuals which are non-smokers or got the treatment ('or' is not exclusive).

(4 points)

Exercise 4: *It produces faster code and needs less typing to use* `sum()` *and* `prod()` *instead of using loops.*
Using the commands `sum()` and `prod()`, calculate

$$\sum_{i=30}^{200} i, \quad \sum_{i=1}^{100} \frac{1}{i}, \quad \sum_{i=0}^{100} i * e^{-i}, \quad \prod_{i=1}^{100} \left(2 \cdot i^2 - i\right)$$

(4 points)

Exercise 5: *The most important R command is* `help()`. *It is good to get used to it as soon as possible.*
The commands `signif()` and `expm1()` have not been discussed in the course. Use `help()` (or `?`) to learn how to use them.

- Produce a vector which contains each element of the vector $(1:100)^8$ rounded to 3 significant digits. Recall that e.g. 42598 rounded to 3 significant digits is $4.26 * 10^4$.
- For each element x_i of the vector $(10^{-2}, 10^{-3}, 10^{-4}, 10^{-5}, \ldots, 10^{-17}, 10^{-18})$ calculate

  $$e^{x_i} - 1$$

  first by using the R command `exp()` and then by using the R command `expm1()`. Which result do you trust more?

(4 points)