

## BioSys PhD | Earthsystems PhD - Introduction to R

### GUIDED EXERCISES

#### Basic Operations

1. Create a vector `w` with the components 1,-1,2,-2.  
`w<-c(1,-1,2,-2)`
2. Print that vector in the R console.  
`w`
3. Obtain a description of `w` by using function `str()`.  
`str(w)`
4. Create vector `w+1` and print it in the R console.  
`x<-w+1; x`
5. Create vector (0, 1, 5, 10, 15, ..., 75) by using functions `c()` and `seq()`.  
`s<-seq(5,75,by=5)`  
`j<-c(0,1,s);j`
6. Construct an alphanumeric vector with the labels "Patient", "Entry number" and "Disease", with separator ":" and dimension 10.  
`S<-paste("Patient","Entry number","Disease",sep=":",1:10)`
7. Consider  $x = 4$  (`x<-4`), and check the following conditions:
  - a)  $x > 23$   
`a <- x>23`
  - b)  $x \in [-1, 10]$   
`b <- x>=-1 & x<=10`
  - c)  $x = 3$   
`c<-x==3`
  - d)  $x \leq 45$   
`d <- x<=45`

Indicate the logical conditions:

- (a)  $a \wedge b$   
`a&b`
- (b)  $b \vee c$   
`b|c`
- (c)  $d \wedge b$   
`d&b`

## Vectors, Matrices and Data Frames

8. Create a numeric vector, a *string* (character) vector and a logical vector:

```
num.vec <- c(3,4,2,6,20)
char.vec <- c("koala","kangaroo","monkey")
logic.vec <- c(F,F,T,T)
```

9. Create the vector  $\mathbf{y}=(0, 4, 2, 1, 0, 4, 0, 3, 0, 3, 3, 3, 4, 4, 2, 2, 0)$  and print it in the R console.

```
y<-c(0, 4, 2, 1, 0, 4, 0, 3, 0, 3, 3, 3, 4, 4, 2, 2, 0)
y
```

- (a) Search for elements of  $\mathbf{y}$  which are less or equal than 3.  
`y[y<=3]`
- (b) Search for elements of  $\mathbf{y}$  equal to 0.  
`y[y==0]`
- (c) Search for components different from 0.  
`y[y!=0]`
- (d) How many elements of  $\mathbf{y}$  are lower than 3?  
`length(y[y<3])`

10. Consider the following vector: (12,14,35,7,6,12,5,22,7,17,9,11).

- (a) Use this vector to build a matrix (by column) of order  $3 \times 4$  and print it in the R console.  
`m<-matrix(c(12,14,35,7,6,12,5,22,7,17,9,11),ncol=4)`  
`m`
- (b) What is the element of matrix  $\mathbf{m}$ , which is in position "line 2, column 3"?  
`m[2,3]`

11. Consider the following table:

student nr.	class	marks
2355	tp1	0.3
3456	tp1	9.3
2334	tp2	14.2
5456	tp3	15.0

- (a) Put the table into a data frame. `final.marks<- data.frame(stud  
= c(2355, 3456, 2334, 5456),  
class = c("tp1", "tp1", "tp2", "tp3"),  
marks = c(10.3,9.3,14.2,15))`  
`final.marks`
- (b) What is the element in line 2 and column 2?  
`final.marks[2,2]`
- (c) Access the column corresponding the students' number.  
`final.marks$stud`
- (d) What is the information obtained from the data frame `final.marks` when we execute the following commands?  
`final.marks[final.marks$marks > 10, ]`  
`final.marks[final.marks$marks > 14, "stud"]`  
`final.marks[final.marks$class == "tp1", c("stud", "marks")]`
- (e) Execute the function which allows you to access the columns of the data frame directly.  
`attach(final.marks)`
- (f) Insert a new column corresponding to the final results: "approved", "oral", "approved", "approved" (use function `edit()`).  
`final.marks<-edit(final.marks)`
- (g) Print the variables' names of the data frame.  
`names(final.marks)`

## Graphical Functions

12. Consider the data frame `births` of package `Epi`. This database concerns births of babies in a hospital in England.
  - (a) Identify the variables in the data frame `births`.  

```
library(Epi)
data(births)
str(births)
```
  - (b) Analyse the relation between the weight of babies and the gestational week, of the data frame `births`.  

```
attach(births)
plot(gestwks,bweight)
```
  - (c) Plot the age of the mother *vs.* the weight of the babies.  

```
plot(matage,bweight)
plot(matage,bweight,xlab="Mother age", ylab="Babies weight")
```
  - (d) Change the points color into green circles.  

```
plot(matage,bweight,pch=19,col="green")
```
  - (e) Consider the graph `'plot(gestwks,bweight)'`. Use different color for baby girls and baby boys:  

```
plot(gestwks,bweight)
points(gestwks[sex==1],bweight[sex==1],col="blue")
points(gestwks[sex==2],bweight[sex==2],col="red")
```
  - (f) Include a legend and a title.  

```
legend("topleft",pch=1,legend=c("Baby boys","Baby girls"),
col=c("blue","red"))
title("Birth weight vs. gestational week (500 births)")
```
  - (g) Save the graphic into a `.pdf` file.  
 Graph window - Export - Save as pdf

## Loops and Functions

13. (a) Create a loop, using the `for()` function, that, given a numeric vector prints a number per line along with its square and its cube.

```
x<-c(1,3,5) # for example
n<-length(x)
for(i in 1:n)
  cat(x[i], ' square =', x[i]^2, '; cube =', x[i]^3, "\n")
```

- (b) Use function `while()` in order to reach the same result.

```
i<-1 # initialize counter
while(i<(n+1))
{
  cat(x[i], ' square =', x[i]^2, '; cube =', x[i]^3, "\n")
  i<-i+1
}
```

14. Write a function that takes a single argument: a matrix. The function should return a matrix, identical to the original, but in which every odd number is duplicated. For example, the function applied to matrix

$$\begin{bmatrix} 1 & 1 & 3 \\ 5 & 2 & 6 \\ -2 & -1 & -3 \end{bmatrix}$$

is converted into

$$\begin{bmatrix} 2 & 2 & 6 \\ 10 & 2 & 6 \\ -2 & -2 & -6 \end{bmatrix}$$

```
Func <- function(mat)
{
  mat[mat%%2 == 1] <- 2 * mat[mat%%2 == 1]
  mat
}
mat<-matrix(c(1,5,-2,1,2,-1,3,6,-3),3,3)
Func(mat)
```

NOTE: The operator `%%` returns the remainder of division, e.g., `5%%2 = 1`.