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Contents

1) R language essentials

```
# R can be used as a calculator
2 + 2
```

```
## [1] 4
```

```
exp(0)
```

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

```
log(1)
```

```
## [1] 0
```

```
# Assigning a value to the object x
x <- 15

# To remove the object
rm(x)

# R handle data vectors as single objects. We can easily create data vectors
x <- c(1, 2, 3)

# We can check the names of the objects stored in the environment
ls()
```

```
## [1] "x"
```

```
# To remove all objects from the environment
rm(list = ls())

# R can easily create sequences of numbers
a <- 1:10
b <- seq(from = 1, to = 10, by = 1)

# Generating random numbers from a normal distribution specifying mean and standard deviation; to obtai
set.seed(1234)

rnorm(n = 10, mean = 0, sd = 1)
```

```
##  [1] -1.2070657  0.2774292  1.0844412 -2.3456977  0.4291247  0.5060559
##  [7] -0.5747400 -0.5466319 -0.5644520 -0.8900378
```

```
# Assigning (a vector of) random numbers to an object called y
y <- rnorm(10, 0, 1)

# Length of the vector y
length(y)
```

```
## [1] 10
```

```
# Logical operations. The operator "==" force R to make a "true or false" judgment
2 + 3 == 5
```

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

```
sqrt(25) == 4
```

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

```
# Other classical operators
100 >= 100
```

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

```
99 > 100
```

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

```
99 != 100
```

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

```
!(1==1) # One is not equal to one -> FALSE!
```

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

```
(1==1) | (2==3) # One is equal to one OR two is equal to three -> TRUE!
```

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

```
(1==1) & (2==3) # One is equal to one AND two is equal to three -> FALSE!
```

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

2) Matrix operations

R can perform standard matrix algebra operations. We can use matrix algebra functions in R to solve our problem from class.

$$7x + 5y - 3z = 163x - 5y + 2z = -85x + 3y - 7z = 0$$

First, we rewrite the system using matrix and vector notation:

$$\mathbf{A} = \begin{bmatrix} 7 & 5 & -3 \\ 3 & -5 & 2 \\ 5 & 3 & -7 \end{bmatrix} \mathbf{b} = \begin{bmatrix} x \\ y \\ z \end{bmatrix} \mathbf{r} = \begin{bmatrix} 16 \\ -8 \\ 0 \end{bmatrix}$$

In order to obtain the result vector b, we have to rearrange the model performing some simple matrix algebra operations.

$$\mathbf{A}^{-1}\mathbf{A}\mathbf{b} = \mathbf{A}^{-1}\mathbf{r} \text{remember that} \mathbf{A}^{-1}\mathbf{A} = \mathbf{I}\mathbf{b} = \mathbf{A}^{-1}\mathbf{r}$$

We are now ready to solve our system of equations using R:

```
data <- c(7, 5, -3, 3, -5, 2, 5, 3, -7)

A <- matrix(data, nrow = 3, ncol = 3, byrow = TRUE)

r <- c(16, -8, 0)

b <- solve(A) %*% r

b
```

```
##      [,1]
## [1,]    1
## [2,]    3
## [3,]    2
```