

R Basics

Md Rasheduzzaman

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Data types, vectors, functions, R packages

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0.1 R as Calculator

```
3+2 # Run
```

```
[1] 5
```

```
3-2
```

```
[1] 1
```

```
3*2
```

```
[1] 6
```

```
3/2
```

```
[1] 1.5
```

```
3%%2 #integer division
```

```
[1] 1
```

```
5%%3 #modulus division
```

```
[1] 2
```

```
(10 - 5) * (2 + 4) # Importance of brackets
```

```
[1] 30
```

```
10 - 5 * 2 + 4
```

```
[1] 4
```

```
(10 - 5) * (2 + 4) # The use of brackets change the order
```

```
[1] 30
```

```
#####
```

```
7/(1+3)
```

```
[1] 1.75
```

```
7/1+3
```

```
[1] 10
```

```
7/(1+3); 7/1+3
```

```
[1] 1.75
```

```
[1] 10
```

```
1+2; log(1); 1/10
```

```
[1] 3
```

```
[1] 0
```

```
[1] 0.1
```

```
#####  
## You can also give numbers a name,  
## known as variables
```

```
a=5  
a
```

```
[1] 5
```

```
a*7
```

```
[1] 35
```

```
a=a+10  
a
```

```
[1] 15
```

```
a*3
```

```
[1] 45
```

```
a=a+10  
b=a+10
```

```
a
```

```
[1] 25
```

```
a^2 #power/exponent 2 or square
```

```
[1] 625
```

```
a**2 #same as ^ (power)
```

```
[1] 625
```

```
#Task: normal division, integer division and modulus division of 7 and 3  
#####
```

```
7/3
```

```
[1] 2.333333
```

```
7%/%3
```

```
[1] 2
```

```
7%%%3
```

```
[1] 1
```

```
x=5/3 #normal division  
x
```

```
[1] 1.666667
```

```
y=5%/%3 #Integer division  
y
```

```
[1] 1
```

```
z=5%%%3 #modulus  
z
```

```
[1] 2
```

```
x=5/3
```

```
x
```

```
[1] 1.666667
```

```
floor(x)
```

```
[1] 1
```

```
# -> 1 ## previous largest integer/divident
```

```
ceiling(x)
```

```
[1] 2
```

```
# -> 2 ## next smallest integer/remainder
```

```
round(x) # -> 2 (decided based on the number)
```

```
[1] 2
```

```
x=5/4
```

```
x
```

```
[1] 1.25
```

```
floor(x)
```

```
[1] 1
```

```
ceiling(x) #in the form of nearby integer
```

```
[1] 2
```

```
x%%2
```

```
[1] 1.25
```

```
#Task;  
#make a variable having a value of 15  
#do different types of arithmetic operations
```

```
y=15  
y
```

```
[1] 15
```

```
y+5
```

```
[1] 20
```

```
y-5
```

```
[1] 10
```

```
y*5
```

```
[1] 75
```

```
y/5
```

```
[1] 3
```

```
(y+4)*(4-y)
```

```
[1] -209
```

```
y%%/%4
```

```
[1] 3
```

```
y%%4
```

```
[1] 3
```

```
floor(y/4)
```

```
[1] 3
```

```
ceiling(y/4)
```

```
[1] 4
```

```
y/4
```

```
[1] 3.75
```

```
round(y/4)
```

```
[1] 4
```

```
#####  
## Exercise :
```

```
(2+3) + (2*3) - (6/3) -3^2
```

```
[1] 0
```

```
#####  
##### logical operations #####
```

```
a=5
```

```
b=7
```

```
a=5
```

```
b=8
```

```
a==b #FALSE
```

```
[1] FALSE
```

```
a!=b # TRUE
```

```
[1] TRUE
```

```
a>b # FALSE and so on for the remaining
```

```
[1] FALSE
```

```
a<b
```

```
[1] TRUE
```

```
a>=b
```

```
[1] FALSE
```

```
a<=b
```

```
[1] TRUE
```

```
a<b | a>b
```

```
[1] TRUE
```

```
a<b & a>b
```

```
[1] FALSE
```

```
a<b | a>=b # ?
```

```
[1] TRUE
```

```
a<b & a>=b # ?
```

```
[1] FALSE
```



```
# | (pipe) ==>
```

```
#####  
### help #####  
?log  
help(log)  
example(log)
```

```
log> log(exp(3))  
[1] 3
```

```
log> log10(1e7) # = 7  
[1] 7
```

```
log> x <- 10~-(1+2*1:9)
```

```
log> cbind(deparse.level=2, # to get nice column names  
log+      x, log(1+x), log1p(x), exp(x)-1, expm1(x))  
      x    log(1 + x)    log1p(x)    exp(x) - 1    expm1(x)  
[1,] 1e-03 9.995003e-04 9.995003e-04 1.000500e-03 1.000500e-03  
[2,] 1e-05 9.999950e-06 9.999950e-06 1.000005e-05 1.000005e-05  
[3,] 1e-07 1.000000e-07 1.000000e-07 1.000000e-07 1.000000e-07  
[4,] 1e-09 1.000000e-09 1.000000e-09 1.000000e-09 1.000000e-09  
[5,] 1e-11 1.000000e-11 1.000000e-11 1.000000e-11 1.000000e-11  
[6,] 1e-13 9.992007e-14 1.000000e-13 9.992007e-14 1.000000e-13  
[7,] 1e-15 1.110223e-15 1.000000e-15 1.110223e-15 1.000000e-15  
[8,] 1e-17 0.000000e+00 1.000000e-17 0.000000e+00 1.000000e-17  
[9,] 1e-19 0.000000e+00 1.000000e-19 0.000000e+00 1.000000e-19
```

```
?sd
```

```
#####
```

```
# create your first vector
```

```
x=c(1,2,3,4,5)  
y=c(3,6,9,12,15)  
y
```

```
[1] 3 6 9 12 15
```

```
x
```

```
[1] 1 2 3 4 5
```

```
length(x)
```

```
[1] 5
```

```
length(y)
```

```
[1] 5
```

```
mode(x)
```

```
[1] "numeric"
```

```
is(x)
```

```
[1] "numeric" "vector"
```

```
mode(y)
```

```
[1] "numeric"
```

```
is(y)
```

```
[1] "numeric" "vector"
```

```
x= c(1, 2, 3, 4, 5, 6, 7, 8, 9) # c="concatenate"  
# x is a vector  
x
```

```
[1] 1 2 3 4 5 6 7 8 9
```

```
mode(x)      # mode of x
```

```
[1] "numeric"
```

```
is(x)        # type of x
```

```
[1] "numeric" "vector"
```

```
length(x)    #length of x
```

```
[1] 9
```

```
DNA=c("A", "T", "G", "C")  
DNA
```

```
[1] "A" "T" "G" "C"
```

```
mode(DNA)
```

```
[1] "character"
```

```
is(DNA)
```

```
[1] "character"          "vector"          "data.frameRowLabels"  
[4] "SuperClassMethod"
```

```
length(DNA)
```

```
[1] 4
```

```
#Task: character vector of 1, 3, 5, 7
```

```
char=c("1", "3", "5", "7")  
char
```

```
[1] "1" "3" "5" "7"
```

```
DNA2=c("ATGTGTCA", "GTCA", "GTCATC")  
#Task: mode, is function, length
```

```
mode(DNA2)
```

```
[1] "character"
```

```
is(DNA2)
```

```
[1] "character"          "vector"              "data.frameRowLabels"  
[4] "SuperClassMethod"
```

```
length(DNA2)
```

```
[1] 3
```

```
logicals=c(TRUE, TRUE, FALSE, TRUE, FALSE)  
logicals
```

```
[1] TRUE TRUE FALSE TRUE FALSE
```

```
mode(logicals)
```

```
[1] "logical"
```

```
length(logicals)
```

```
[1] 5
```

```
is(logicals)
```

```
[1] "logical" "vector"
```

```
y= c("1", "2", "3", "4")
```

```
mode(y)
```

```
[1] "character"
```

```
dec=c(10,20,30,60,80,90,100,50,40)  
dec
```

```
[1] 10 20 30 60 80 90 100 50 40
```

```
dec[2]
```

```
[1] 20
```

```
dec[7]
```

```
[1] 100
```

```
dec[3]
```

```
[1] 30
```

```
DNA2=c("ATGTGTCA", "GTCA", "GTCATC")  
DNA2[2]
```

```
[1] "GTCA"
```

```
DNA2[3]
```

```
[1] "GTCATC"
```

```
yz=c(3, 4, 7, 9, 10, 5)  
yz
```

```
[1] 3 4 7 9 10 5
```

```

#Task: 3rd, 4th, and 2nd element from yz

yz[3]

[1] 7

yz[4]

[1] 9

yz[2]

[1] 4

s= c("AATTGCCC", "ATGCATT", "AACCGTTG")
s[1]

[1] "AATTGCCC"

# Task: find the others with indexing
s[2]

[1] "ATGCATT"

s[3]

[1] "AACCGTTG"

#####
##### vector operations #####
# Most standard mathematical functions work with vectors.
x= c(1, 2, 3, 4, 5, 6, 7, 8, 9, 10)

x+x #goes index-wise

[1]  2  4  6  8 10 12 14 16 18 20

```

```
mode(x)
```

```
[1] "numeric"
```

```
is(x)
```

```
[1] "numeric" "vector"
```

```
y= c(5, 10 ,15, 20, 25, 30, 35, 40, 45, 50)
```

```
y/x
```

```
[1] 5 5 5 5 5 5 5 5 5 5
```

```
y * x
```

```
[1] 5 20 45 80 125 180 245 320 405 500
```

```
log2(x)
```

```
[1] 0.000000 1.000000 1.584963 2.000000 2.321928 2.584963 2.807355 3.000000  
[9] 3.169925 3.321928
```

```
#Round the values
```

```
x= c(1, 2, 3, 4, 5, 6, 7, 8, 9, 10)
```

```
log2(x)
```

```
[1] 0.000000 1.000000 1.584963 2.000000 2.321928 2.584963 2.807355 3.000000  
[9] 3.169925 3.321928
```

```
round(log2(x))
```

```
[1] 0 1 2 2 2 3 3 3 3 3
```

```
####Task: Round the value for 1, 3 digits after decimal
```

```
round(log2(x), 1)
```

```
[1] 0.0 1.0 1.6 2.0 2.3 2.6 2.8 3.0 3.2 3.3
```

```
round(log2(x), 3)
```

```
[1] 0.000 1.000 1.585 2.000 2.322 2.585 2.807 3.000 3.170 3.322
```

```
##### Exercise 1
```

```
# Compute the difference between 2020
```

```
# and the year you started at the university and
```

```
# divide this by the difference between 2020 and the year you were born.
```

```
# Multiply this with 100 to get the percentage of your life
```

```
# you have spent at the university.
```

0.2 Basic plotting

```
a <- 1:10  
b <- -10:1  
plot(a, b)
```

