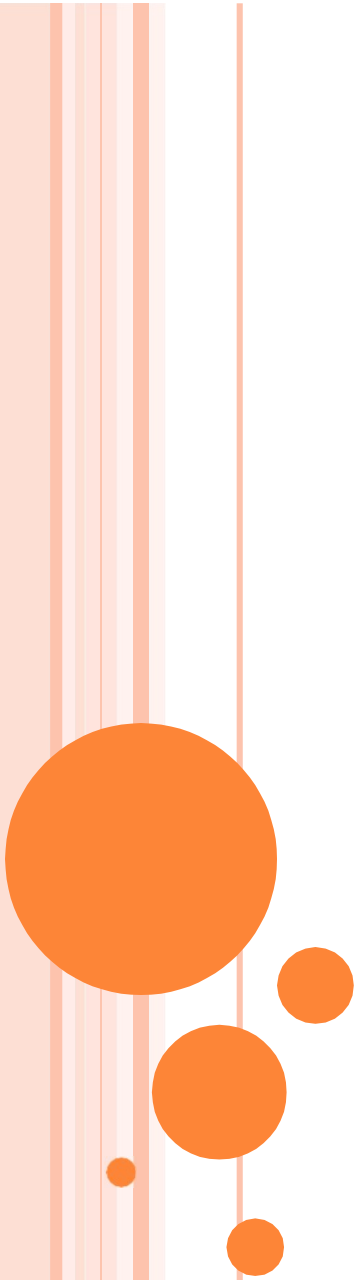


INTRODUCTION

OBJECTIVES OF TUTORIAL

i.	Understand basic statistics and create visualization to solve data analysis problems in various areas.
ii.	Apply statistical methodologies to model practical problems for solutions.
iii.	Apply the fundamental concepts of probability to solve problems related engineering field.
iv.	Apply statistical techniques on large data using R programming.

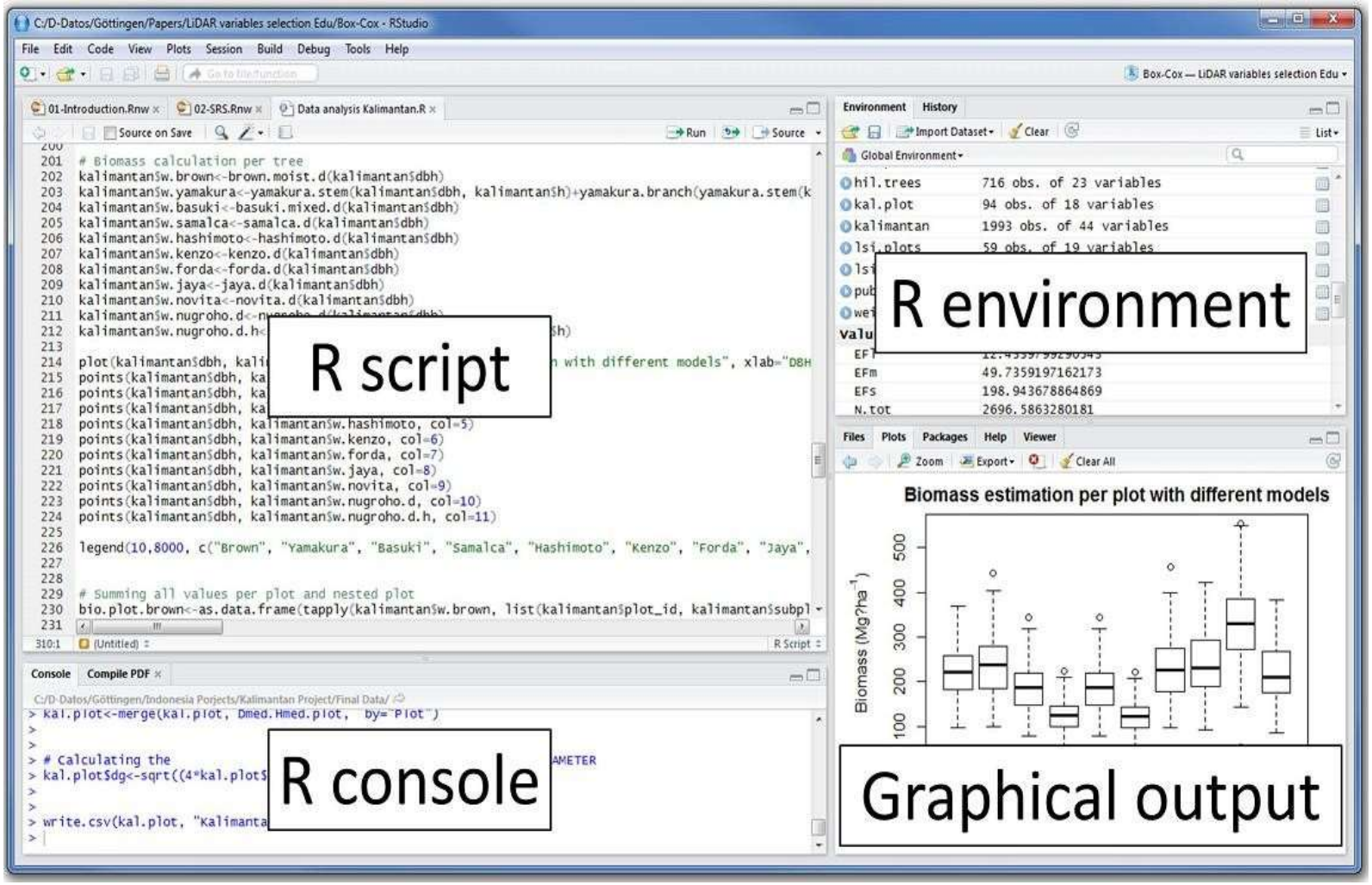
WHAT IS R ?

- R is a language and environment for statistical computing and graphics.
- It compiles and runs on a wide variety of UNIX platforms, Windows and MacOS.
- A well-developed, simple and effective programming language which includes conditionals, loops, user-defined recursive functions and input and output facilities.

R Features

- R provides a wide variety of statistical and graphical techniques.
- R is an integrated suite of software facilities for data manipulation, calculation and graphical display.
- It includes an effective data handling and storage facility.

RSTUDIO SCREEN



R Command Prompt

- Type your first program

#Sample R program

- myString <- "Hello World!“
- print (myString)

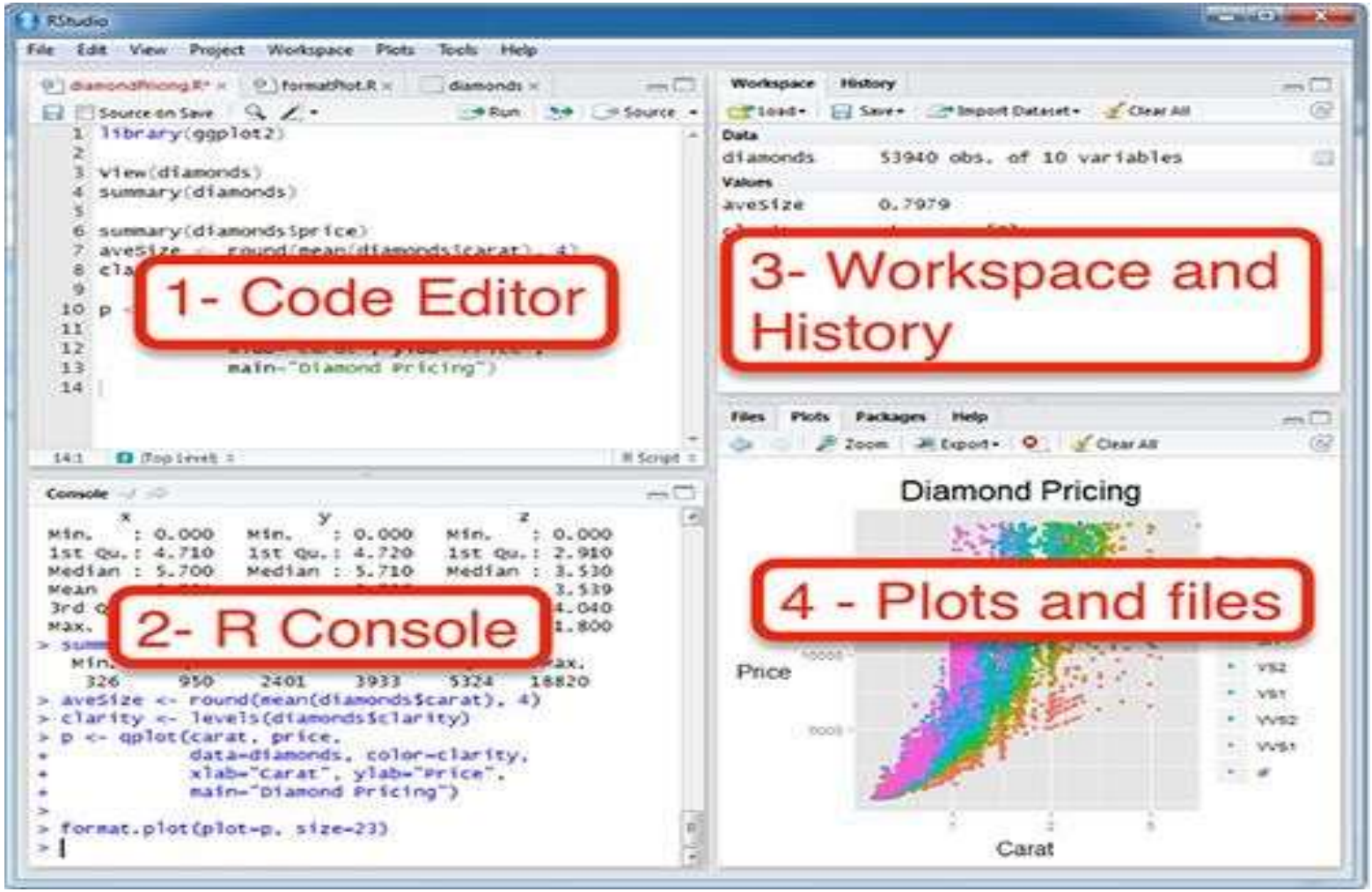
OR

- myString

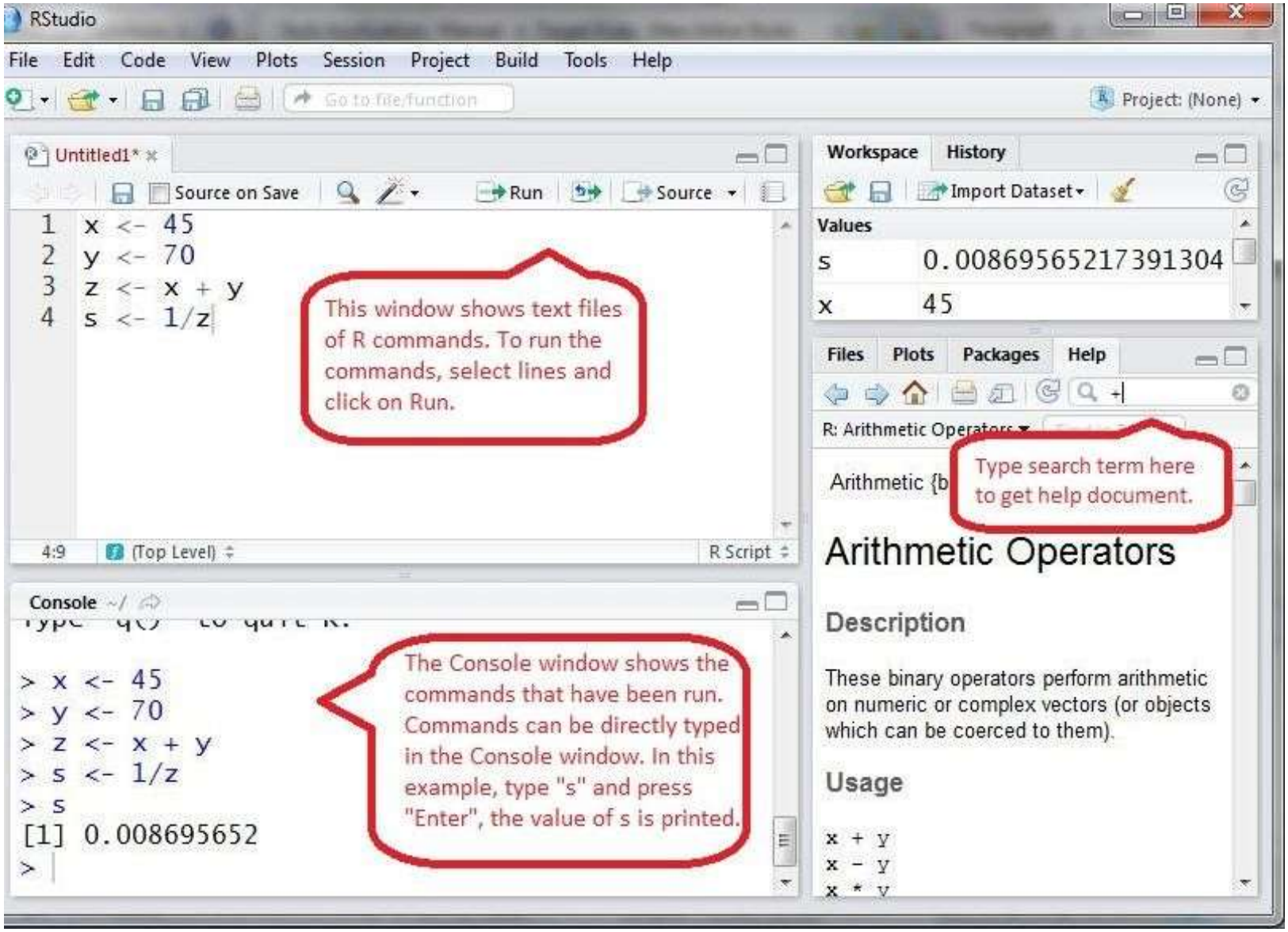
OR

- cat (myString)

RSTUDIO SCREEN



RSTUDIO SCREEN



EXAMPLE

- x = 50
- y = 20
- sum = x + y
- diff = x – y
- product = x * y
- div = x / y
- print (sum)
- print(diff)
- print(product)
- print(div)

DATATYPE OF VARIABLES

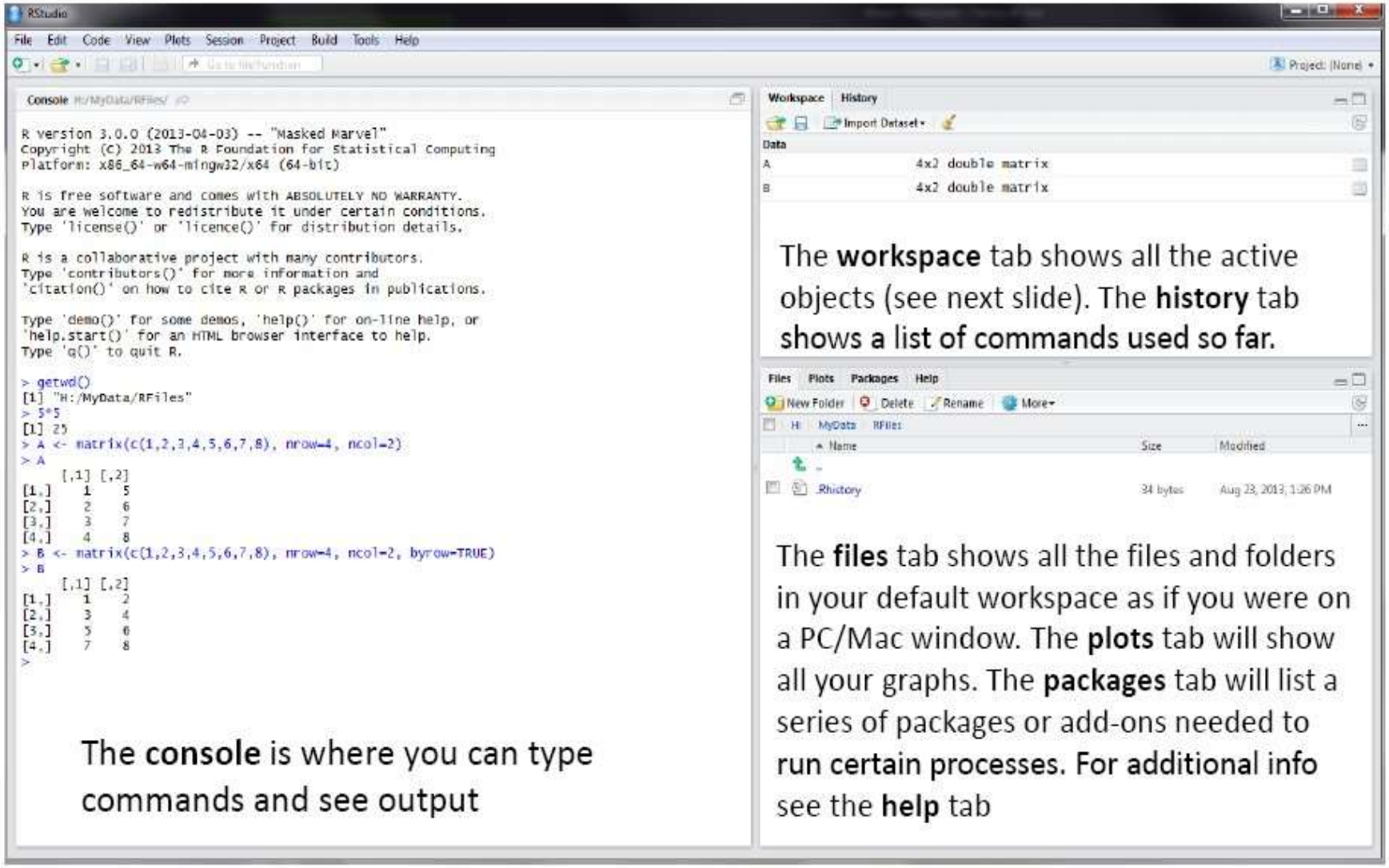
- var_x <- "Hello"
- cat("The class of var_x is ",class(var_x),"\n")

- var_y <- 34.5
- cat(" Now the class of var_y is",class(var_y),"\n")

#Finding Variables

- print(ls())

RSTUDIO SCREEN



DATA TYPES

- The variables are assigned with R-Objects and the data type of the R-object becomes the data type of the variable.

- There are many types of R-objects.

- **Vectors**
- **Lists**
- **Matrices**
- **Arrays**
- **Factors**
- **Data Frames**

VECTORS

- When you want to create vector with more than one element, you should use **c()** function which means to combine the elements into a vector.

```
# Create a vector.
color <- c('red','green',"yellow")
print(color)

# Get the class of the vector.
print(class(color))
```

VARIABLES USAGE

- # Assignment using equal operator.
- var.1 = c(0,1,2,3)

- # Assignment using leftward operator.
- var.2 <- c("learn","R")

- # Assignment using rightward operator.
- c(TRUE,1) -> var.3 print(var.1)

- cat ("var.1 is ", var.1 ,"\n")
- cat ("var.2 is ", var.2 ,"\n")
- cat ("var.3 is ", var.3 ,"\n")

EXAMPLES ON VECTORS

- a=c(1,2,3,4)
- b= a+5
- print(b)

- **sqrt**(a)

- a <- **c**(1,2,3)
- b <- **c**(10,11,12,13)
- a+b

- a = **c**(2,4,6,3,1,5)
- b = **sort**(a)
- **c** = **sort**(a,decreasing =**TRUE**)

LISTS

- A list is a R-object which can contain many different types of elements inside it like vectors, functions.

```
# Create a list.
list1 <- list(c(2,5,3),21.3,"sin")

# Print the list.
 print(list1)
```

MATRICES

- A matrix is a two-dimensional rectangular data set. It can be created using a vector input to the matrix function.

```
# Create a matrix.
M=matrix(c('a','a','b','c','b','a'),
nrow=2,ncol=3,byrow = TRUE)
print(M)

N=matrix(c(‘23','’12','’45,‘67','’90’,‘55'),
nrow=3,ncol=2)
print(M)
```

ARRAYS

- While matrices are confined to two dimensions, arrays can be of any number ofdimensions.
- The array function takes a dim attribute which creates the required number ofdimension.
- Example below we create an array with two elements which are 3x3 matrices each.

```
# Create an array.
a <- array(c('green','yellow'),dim=c(3,3,2))
print(a)
```

FACTORS

- Factors are the r-objects which are created using a vector. It stores the vector along with the distinct values of the elements in the vector as labels.
- The labels are always character irrespective of whether it is numeric or character or boolean etc. in the input vector. They are useful in statistical modeling.
- Factors are created using the **factor()** function.
- The **nlevels** functions gives the count of levels.

EXAMPLE ON FACTORS

```
# Create a vector.
apple_colors <-
  c('green','green','yellow','red','red','red','green')

 # Create a factor object.
 factor_apple <- factor(apple_colors)

# Print the factor.
print(factor_apple)
print(nlevels(factor_apple))
```

DATA FRAMES

- Data frames are tabular data objects. Unlike a matrix in data frame ,each column can contain different modes of data.
- The first column can be numeric while the second column can be character and third column can be logical. It is a list of vectors of equal length.

- Data Frames are created using the **data.frame()** function.

```
# Create the data frame.

BMI <- data.frame( gender = c("Male", "Male","Female"), height =
   c(152, 171.5, 165), weight = c(81,93, 78), Age =c(42,38,26) )
print(BMI)


dat <- data.frame(id = letters[1:10], x = 1:10, y = 11:20)
 dat
```

OPERATORS

- An operator is a symbol that tells the compiler to perform specific mathematical or logical manipulations. R language is rich in built-in operators and provides following types of operators.

- **Types of Operators**
- Arithmetic Operators
- Relational Operators
- Logical Operators
- Assignment Operators
- Miscellaneous Operators

ARITHMETIC OPERATORS

Operator	Description	Example
+	Adds two vectors	v <- c(2,5.5,6) t <- c(8, 3, 4) print(v+t) It produces following result: [1] 10.0 8.5 10.0
%%	Give the remainder of the first vector with the second	v <- c(2,5.5,6) t <- c(8, 3, 4) print(v%%t) it produces following result: [1] 2.0 2.5 2.0
%/%	The result of division of first vector with second (quotient)	v <- c(2,5.5,6) t <- c(8, 3, 4) print(v%/%t) it produces following result: [1] 0 1 1
^	The first vector raised to the exponent of second vector	v <- c(2,5.5,6) t <- c(8, 3, 4) print(v^t) it produces following result: [1] 256.000 166.375 1296.000

Relational Operators

Operator	Description	Example
>	Checks if each element of the first vector is greater than the corresponding element of the second vector.	v <- c(2,5.5,6,9) t <- c(8,2.5,14,9) print(v>t) It produces following result: [1] FALSE TRUE FALSE FALSE
==	Checks if each element of the first vector is equal to the corresponding element of the second vector.	v <- c(2,5.5,6,9) t <- c(8,2.5,14,9) print(v==t) it produces following result: [1] FALSE FALSE FALSE TRUE
!=	Checks if each element of the first vector is unequal to the corresponding element of the second vector.	v <- c(2,5.5,6,9) t <- c(8,2.5,14,9) print(v!=t) it produces following result: [1] TRUE TRUE TRUE FALSE

Logical Operators

Operator	Description	Example
&	It is called Element-wise Logical AND operator. It combines each element of the first vector with the corresponding element of the second vector and gives a output TRUE if both the elements are TRUE.	v <- c(3,1,TRUE,2+3i) t <- c(4,1,FALSE,2+3i) print(v&t) it produces following result: [1] TRUE TRUE FALSE TRUE
!	It is called Logical NOT operator. Takes each element of the vector and gives the opposite logical value.	v <- c(3,0,TRUE,2+2i) print(!v) it produces following result: [1] FALSE TRUE FALSE FALSE
&&	Called Logical AND operator. Takes first element of both the vectors and gives the TRUE only if both are TRUE.	v <- c(3,0,TRUE,2+2i) t <- c(1,3,TRUE,2+3i) print(v&&t) it produces following result: [1] TRUE

Assignment Operators

Operator	Description	Example
<- or = or <<-	Called Left Assignment	v1 <- c(3,1,TRUE,2+3i) v2 <<- c(3,1,TRUE,2+3i) v3 = c(3,1,TRUE,2+3i) print(v1) print(v2) print(v3) it produces following result: [1] 3+0i 1+0i 1+0i 2+3i [1] 3+0i 1+0i 1+0i 2+3i [1] 3+0i 1+0i 1+0i 2+3i
-> or ->>	Called Right Assignment	c(3,1,TRUE,2+3i) -> v1 c(3,1,TRUE,2+3i) ->> v2 print(v1) print(v2) it produces following result: [1] 3+0i 1+0i 1+0i 2+3i [1] 3+0i 1+0i 1+0i 2+3i

MISCELLANEOUS OPERATORS

Operator	Description	Example
%in%	This operator is used to identify if an element belongs to a vector.	v1 <- 8 v2 <- 12 t <- 1:10 print(v1 %in% t) print(v2 %in% t) it produces following result: [1] TRUE [1] FALSE
%*%	This operator is used to multiply a matrix with its transpose.	M = matrix(c(2,6,5,1,10,4), nrow=2,ncol=3,byrow = TRUE) t = M %*% t(M) print(t) it produces following result: [,1] [,2] [1,] 65 82 [2,] 82 117

- https://www.coursera.org/learn/decision-making/lecture/K57sl/the-role-of-r
- https://www.rstudio.com/products/rstudio/