

# Introduction to R Software

## Swayam Prabha

### Lecture 9

## Functions and Introduction to Matrix

Shalabh

Department of Mathematics and Statistics

Indian Institute of Technology Kanpur

Slides can be downloaded from  
<http://home.iitk.ac.in/~shalab/sp>



# Functions

- **Functions are a bunch of commands grouped together in a sensible unit**
- **Functions take input arguments, do calculations (or make some graphics, call other functions) and produce some output and return a result in a variable. The returned variable can be a complex construct, like a list.**

# Functions

$$Z = f ( X ) \text{ or } Z = f ( X, Y )$$

**$X, Y$  : Input**

**$Z$  : Output, depends on  $X$  and  $Y$ .**

# Functions

## Syntax

```
Name <- function(Argument1, Argument2, ...)  
  {  
    expression  
  }
```

where **expression** is a single command or a group of commands

## Function arguments with description and default values

- Function arguments can be given a meaningful name
- Function arguments can be set to default values
- Functions can have the special argument '...'

# Functions (Single variable)

The sign `<-` is furthermore used for defining functions:

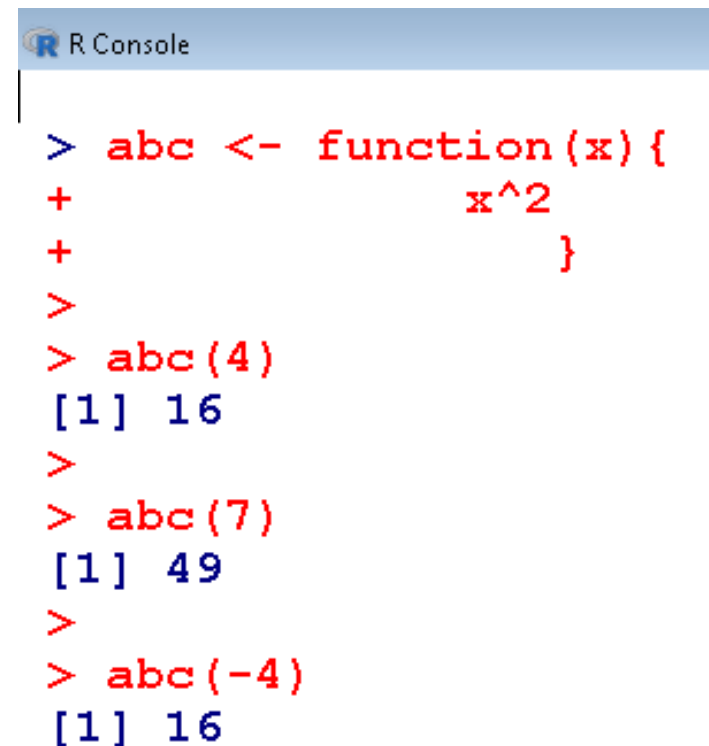
Example:  $f(x) = x^2$

```
> abc <- function(x){  
    x^2  
}
```

```
> abc(4)  
[1] 16
```

```
> abc(7)  
[1] 49
```

```
> abc(-4)  
[1] 4
```



```
R Console  
> abc <- function(x){  
+     x^2  
+ }  
>  
> abc(4)  
[1] 16  
>  
> abc(7)  
[1] 49  
>  
> abc(-4)  
[1] 16
```

# Functions (Two variables)

Example:  $f(x,y) = x^2 + y^2$

```
> abc <- function(x,y) {  
    x^2+y^2  
}
```

```
> abc(4,5)  
[1] 41
```

```
> abc(6,7)  
[1] 85
```

```
> abc(-3,-2)  
[1] 13
```

```
R Console  
> abc <- function(x,y) {  
+     x^2+y^2  
+     }  
> abc(4,5)  
[1] 41  
>  
> abc(6,7)  
[1] 85  
>  
> abc(-3,-2)  
[1] 13
```

# Functions- Another example

Example:  $f(x) = \sin(x)^2 + \cos(x)^2 + x$

```
> abc <- function(x) {  
    sin(x)^2+cos(x)^2 + x  
}
```

```
> abc(9)  
[1] 10
```

```
> abc(988)  
[1] 989
```

```
> abc(-3)  
[1] -2
```

```
R Console  
> abc <- function(x) {  
+     sin(x)^2+cos(x)^2 + x  
+     }  
>  
> abc(9)  
[1] 10  
>  
> abc(988)  
[1] 989  
>  
> abc(-3)  
[1] -2  
>
```



# Functions- Another example

$$f(x) = \sin(x)^3 + \sqrt{\cos(x)} + x^3$$

```
> abc <- function(x){  
  sin(x)^3 + sqrt(cos(x)) + x^3  
}
```

# Matrix

**Matrices are important objects in any calculation.**

**A matrix is a rectangular array with  $p$  rows and  $n$  columns.**

# Matrix

An element in the  $i$ -th row and  $j$ -th column is denoted by  $X_{ij}$  (book version) or  $X[i, j]$  ("program version"),  $i = 1, 2, \dots, n, j = 1, 2, \dots, p$ .

An element of a matrix can also be an object, for example a string. However, in mathematics, we are mostly interested in numerical matrices, whose elements are generally real numbers