

Introduction to R Software

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Lecture 40

More Examples of Programming

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



Example 2

Suppose we want to compute

$$f(x, y) = \frac{\left(\frac{x + \ln y}{\sqrt{y}} \right)^2}{15 + \left(\frac{x + \ln y}{\sqrt{y}} \right)^3} \left[\exp \left(\frac{x + \ln y}{\sqrt{y}} \right) \right]^{\frac{2}{3}}$$

This can be written as

$$f(x, y) = \frac{(g(x, y))^2}{15 + (g(x, y))^3} \left[\exp(g(x, y)) \right]^{\frac{2}{3}}$$

where $g(x, y) = \frac{x + \ln y}{\sqrt{y}}$

Example 2

Input variables : x, y

Output variables: : f

We break this function in two components –

- Compute $g(x,y)$ as a function and then
- compute $f(x,y)$ by calling $g(x,y)$.

Example 2

```
# Remove all data  
rm(list = ls())  
  
# Define input data vectors  
x  
y
```

CONTD...

Example 2

CONTD...

```
# define g(x,y)
g <- function(x,y)
# Start of function
{
  (x+log(y))/sqrt(y)
# End of function
}
```

$$g(x, y) = \frac{x + \ln y}{\sqrt{y}}$$

```
# define f(x,y)
f<-function(x,y)
{
  (((g(x,y))^2)/(15+(g(x,y))^3))*(exp(g(x,y)))^(2/3)
}
```

$$f(x, y) = \frac{(g(x, y))^2}{15 + (g(x, y))^3} \left[\exp(g(x, y)) \right]^{\frac{2}{3}}$$

Example 2: At a glance

```
# define g(x,y)
```

```
g <- function(x,y)
{
  (x+log(y))/sqrt(y)
}
```

```
+++++
```

```
# define f(x,y)
```

```
f<-function(x,y)
{
  (((g(x,y))^2)/(15+(g(x,y))^3))*(exp(g(x,y)))^(2/3)
}
```

```
# g(x,y) must have been defined earlier.
```

Example 2

```
R Console

> # define g(x,y)
>
> g <- function(x,y)
+ {
+   (x+log(y))/sqrt(y)
+ }
>
> # define f(x,y)
>
> f<-function(x,y)
+ {
+   (((g(x,y))^2)/(15+(g(x,y))^3))*exp(g(x,y)))^(2/3)
+ }
> # g(x,y) must have been defined earlier.
> |
```

Example 2

```
R Console

> g
function(x,y)
{
  (x+log(y)) / sqrt(y)
}
>
> f
function(x,y)
{
  (((g(x,y))^2) / (15+(g(x,y))^3)) * (exp(g(x,y)))^(2/3)
}
> |
```

Example 2

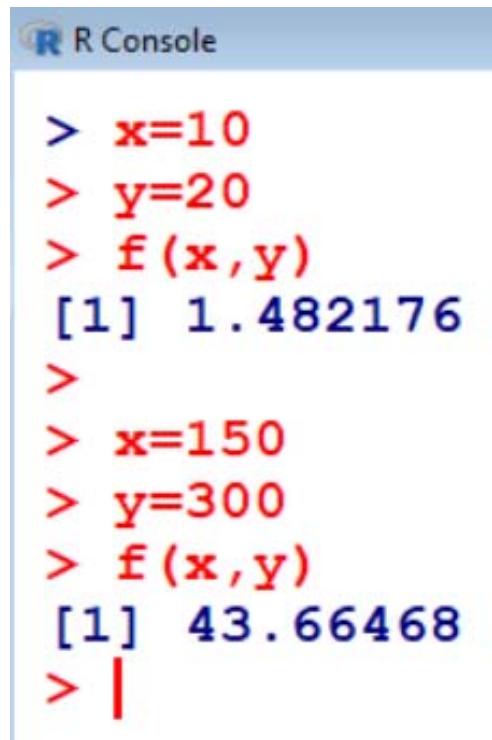
```
> x=10  
> y=20  
> f(x,y)  
[1] 1.482176
```

```
> x=150  
> y=300  
> f(x,y)  
[1] 43.66468
```

There is no need to calculate the value of $g(x,y)$.

Just by changing the values of x and y , one can get different required outcomes.

Example 2

A screenshot of an R console window titled "R Console". The window contains the following R code:

```
> x=10
> y=20
> f(x,y)
[1] 1.482176
>
> x=150
> y=300
> f(x,y)
[1] 43.66468
> |
```

The code defines two variables, x and y, and then calls a function f with them as arguments. The output shows the results for different values of x and y.

Example 3

Suppose we want to compute

$$f(x) = \begin{cases} \exp\left(\frac{x^2 + \ln(1+x^3)}{x^2}\right) & \text{if } x > 0 \\ 20 & \text{if } x = 0 \\ \frac{2x+x^3}{x} & \text{if } x < 0 \end{cases}$$

and plot with line over a values of x as a sequence starting from -5 to 5 and increasing it by 0.2.

Example 3

Input variable : x

Output variable: f

```
# Remove all data  
rm(list = ls())
```

```
# Define input data  
x
```

CONTD...

Example 3

CONTD...

```
f<-function(x)
{
  if(x>0) {exp( (x^2+log(1+x^3))/x^2)}
  else if(x==0) {20}
  else {(2*x+x^3)/x}
}
```

$$f(x) = \begin{cases} \exp\left(\frac{x^2 + \ln(1 + x^3)}{x^2}\right) & \text{if } x > 0 \\ 20 & \text{if } x = 0 \\ \frac{2x + x^3}{x} & \text{if } x < 0 \end{cases}$$

CONTD...

Example 3

CONTD...

```
h <- function( )  
  
# Start of function  
  
{  
  
# Generation of data on x  
  
x<-seq(-5,5,by=0.2)  
  
# Initialization of y to store values of f(x)  
  
y<-0
```

CONTD...

Example 3

CONTD...

```
# Generation of f(x) values corresponding to x  
  
for(i in 1:length(x))  
{  
  y[i]<-f(x[i])  
}  
  
# length(x) and length(y) must be same to plot  
# y=f(x) with respect to x  
  
plot(x,y,type = "l")  
}
```

Example 3: At a glance

```
f<-function(x)
{
  if(x>0) {exp( (x^2+log(1+x^3))/x^2)}
  else if(x==0) {20}
  else {(2*x+x^3)/x}
}
```

```
h <- function()
{
x <- seq(-5,5,by=0.2)
y <- 0

for(i in 1:length(x))
{
  y[i] <- f(x[i])
}
plot(x,y,type = "l")
}
```

$$f(x) = \begin{cases} \exp\left(\frac{x^2 + \ln(1+x^3)}{x^2}\right) & \text{if } x > 0 \\ 20 & \text{if } x = 0 \\ \frac{2x+x^3}{x} & \text{if } x < 0 \end{cases}$$

Example 3

```
R Console
> f<-function(x)
+ {
+   if(x>0) {exp((x^2+log(1+x^3))/x^2)}
+   else if(x==0) {20}
+   else {(2*x+x^3)/x}
+ }
>
> h <- function()
+ {
+   x <- seq(-5,5,by=0.2)
+   y <- 0
+   for(i in 1:length(x))
+   {
+     y[i] <- f(x[i])
+   }
+   plot(x,y,type = "l")
+ }
> |
```

Example 3

```
R Console

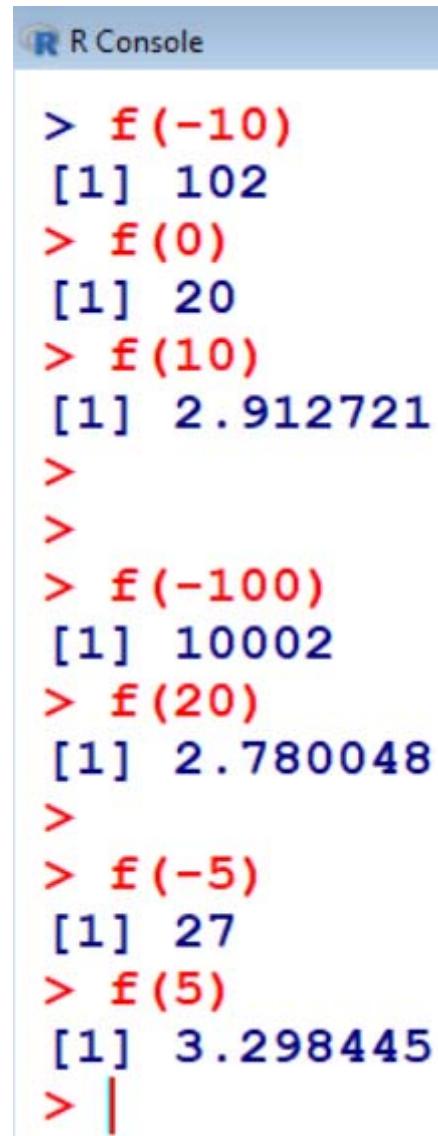
> f
function(x)
{
  if(x>0) {exp((x^2+log(1+x^3))/x^2)}
  else if(x==0) {20}
  else {(2*x+x^3)/x}
}
> h
function()
{
  x <- seq(-5,5,by=0.2)
  y <- 0
  for(i in 1:length(x))
  {
    y[i] <- f(x[i])
  }
  plot(x,y,type = "l")
}
```

Example 3

```
> f(-10)
[1] 102
> f(0)
[1] 20
> f(10)
[1] 2.912721

> f(-100)
[1] 10002
> f(20)
[1] 2.780048

> f(-5)
[1] 27
> f(5)
[1] 3.298445
```



A screenshot of an R console window titled "R Console". The window shows several lines of R code and their corresponding outputs. The code consists of function calls to "f" with various arguments, and the results are printed in blue. The console interface includes a menu bar at the top and a scroll bar on the right side.

```
> f(-10)
[1] 102
> f(0)
[1] 20
> f(10)
[1] 2.912721
>
>
> f(-100)
[1] 10002
> f(20)
[1] 2.780048
>
> f(-5)
[1] 27
> f(5)
[1] 3.298445
> |
```

Example 3

> h()

