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

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

This can be written as

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

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

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)
}
```

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

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

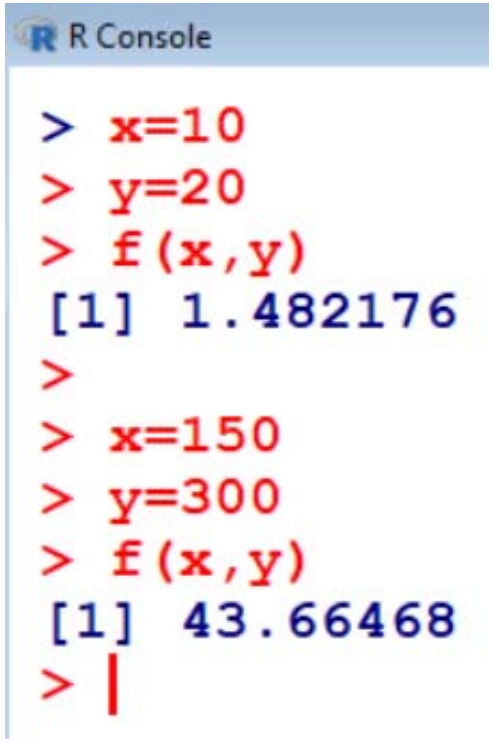
```
> x=10
> y=20
> f(x,y)
[1] 1.482176

> 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



Example 3

Suppose we want to compute

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

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}
}
```

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

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")
}
```

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

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

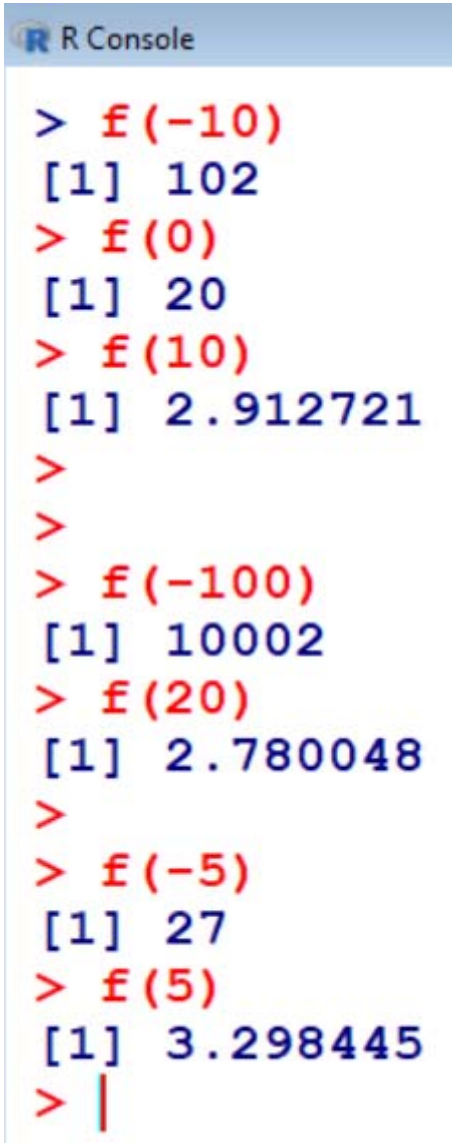
```
> f
function(x)
{
  if(x>0) {exp((x^2+log(1+x^3))/x^2)}
  else if(x==0) {20}
  else {(2*x+x^3)/x}
}
> h
function()
{
x <- seq(-5,5,by=0.2)
y <- 0
for(i in 1:length(x))
{
  y[i] <- f(x[i])
}
plot(x,y,type = "l")
}
```

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
```



Example 3

```
> h( )
```