

Introduction to R Software

Basics of Calculations

:::

Basics and R as a Calculator

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Basics

- `>` is the prompt sign in R.
- The assignment operators are the left arrow with dash `<-` and equal sign `=`.

`> x <- 20` assigns the value 20 to `x`.

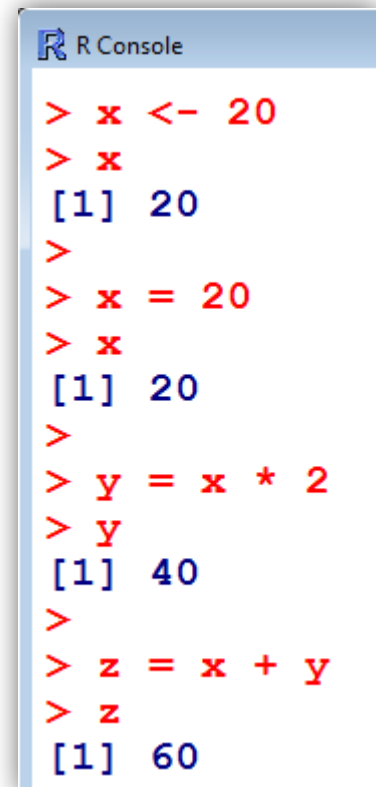
`> x = 20` assigns the value 20 to `x`.

Initially only `<-` was available in R.

- `> x = 20` assigns the value 20 to `x`.

`> y = x * 2` assigns the value `2*x` to `y`.

`> z = x + y` assigns the value `x + y` to `z`.



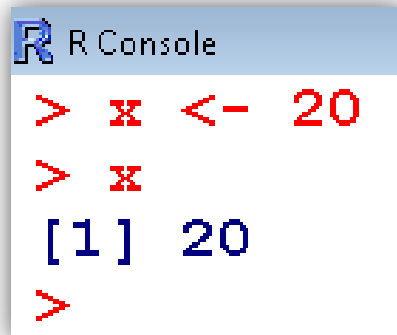
```
R Console
> x <- 20
> x
[1] 20
>
> x = 20
> x
[1] 20
>
> y = x * 2
> y
[1] 40
>
> z = x + y
> z
[1] 60
```

Basics

- **#** : The character **#** marks the beginning of a comment. All characters until the end of the line are ignored.

```
> # mu is the mean
```

```
> # x <- 20 is treated as comment only
```

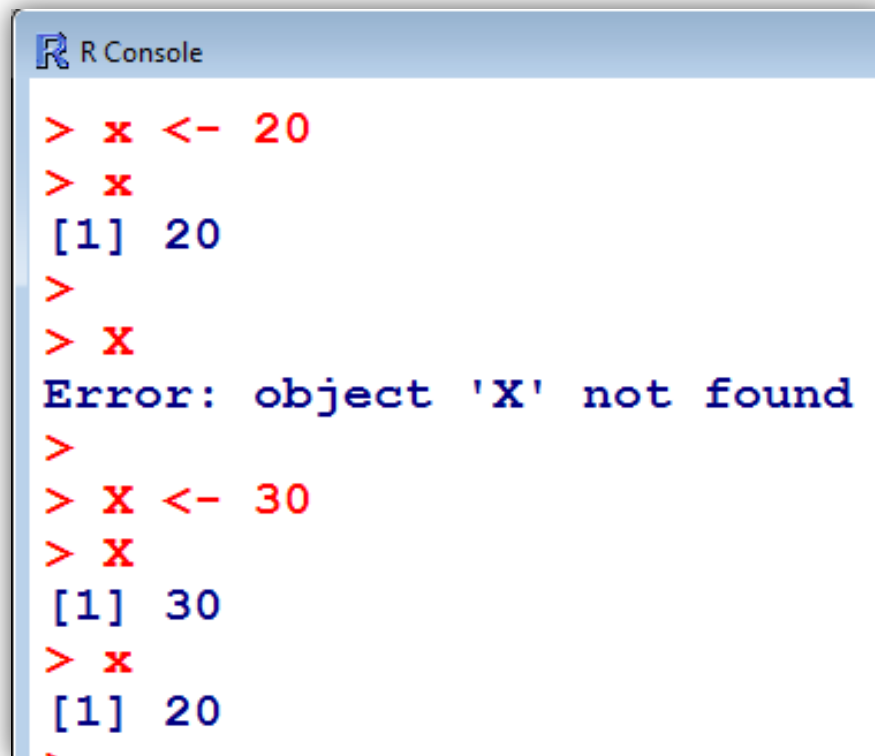
A screenshot of an R console window. The title bar is light blue with the R logo and the text "R Console". The console has a white background with red text for prompts and blue text for output. The code entered is: > x <- 20, followed by > x on the next line. The output is [1] 20 on the line following the second prompt. A third red prompt > is visible on the next line.

```
R Console
> x <- 20
> x
[1] 20
>
```

Basics

- Capital and small letters are different.

> **x** <- 20 and > **X** <- 20 are different



```
R Console
> x <- 20
> x
[1] 20
>
> X
Error: object 'X' not found
>
> X <- 30
> X
[1] 30
> x
[1] 20
```

Basics

- The command `c(1,2,3,4,5)` combines the numbers 1,2,3,4 and 5 to a vector.

R Console

```
> y=1,2,3,4,5
```

```
Error: unexpected ',' in "y=1,"
```

```
>
```

```
> y=(1,2,3,4,5)
```

```
Error: unexpected ',' in "y=(1,"
```

```
>
```

```
> y=c(1,2,3,4,5)
```

```
>
```

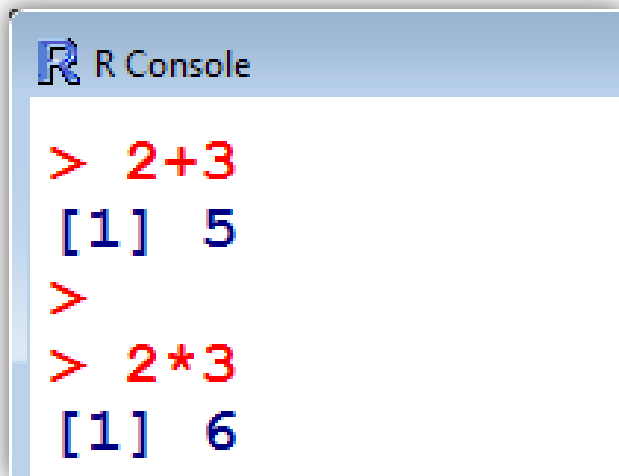
```
> y
```

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

R as a calculator

```
> 2+3          # Command  
[1] 5          # Output
```

```
> 2*3          # Command  
[1] 6          # Output
```



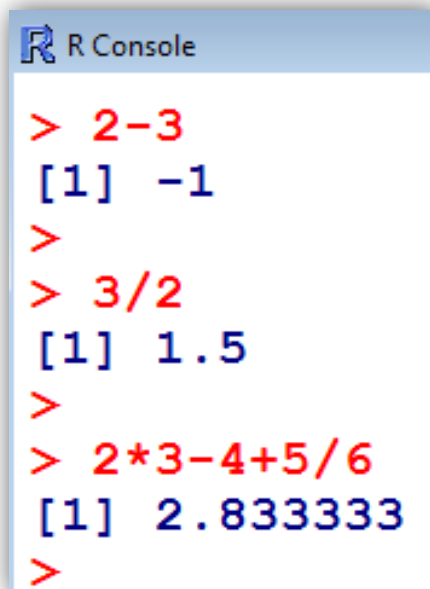
```
R Console  
  
> 2+3  
[1] 5  
  
>  
> 2*3  
[1] 6
```

R as a calculator

```
> 2-3          # Command  
[1] -1         # Output
```

```
> 3/2          # Command  
[1] 1.5         # Output
```

```
> 2*3-4+5/6    # Command  
[1] 2.8333       # Output
```



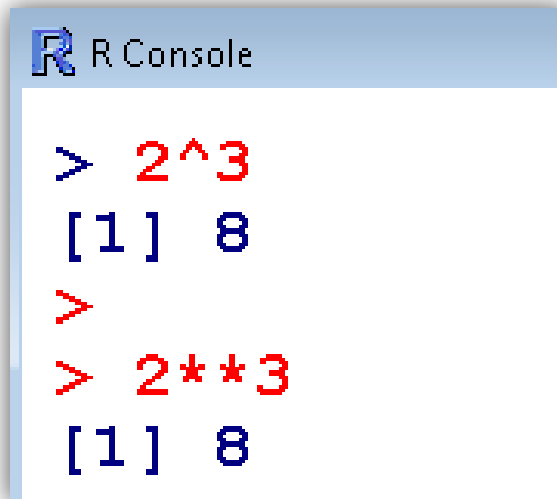
The screenshot shows the R Console window with the following text:

```
R Console  
> 2-3  
[1] -1  
>  
> 3/2  
[1] 1.5  
>  
> 2*3-4+5/6  
[1] 2.833333  
>
```

R as a calculator

```
> 2^3          # Command  
[1] 8          # Output
```

```
> 2**3         # Command  
[1] 8          # Output
```



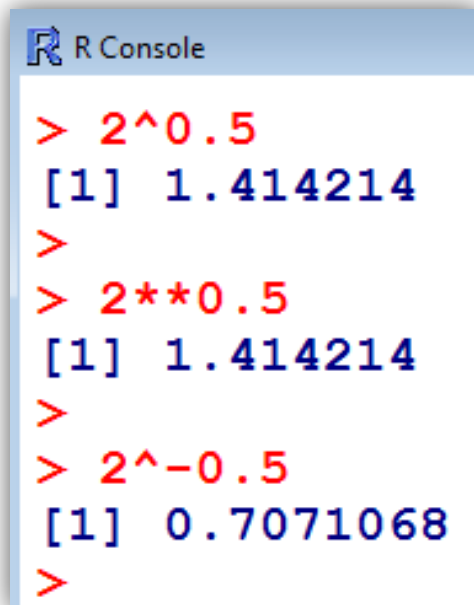
```
R Console  
  
> 2^3  
[1] 8  
  
>  
> 2**3  
[1] 8
```


R as a calculator

```
> 2^0.5      # Command  
[1] 1.414214  # Output
```

```
> 2**0.5     # Command  
[1] 1.414214  # Output
```

```
> 2^-0.5     # Command  
[1] 0.7071068 # Output
```

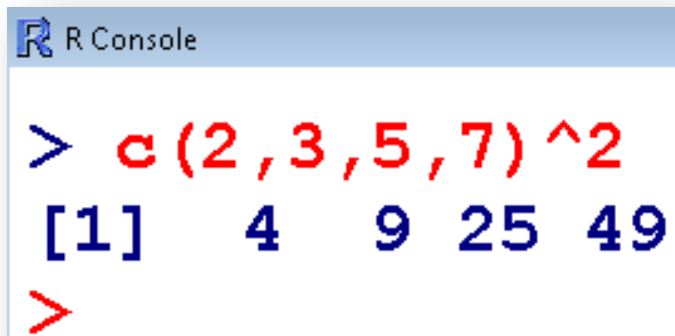


```
R Console  
> 2^0.5  
[1] 1.414214  
>  
> 2**0.5  
[1] 1.414214  
>  
> 2^-0.5  
[1] 0.7071068  
>
```

R as a calculator

```
> c(2,3,5,7)^2      # command: application to a  
                      vector  
[1] 4 9 25 49        # output
```

$2^2, 3^2, 5^2, 7^2$



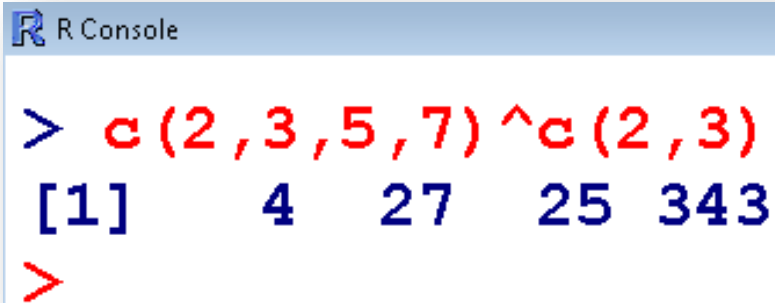
R Console

```
> c(2,3,5,7)^2  
[1] 4 9 25 49  
>
```

R as a calculator

```
> c(2,3,5,7)^c(2,3)    # !!ATTENTION! Observe the  
                        # operation  
[1]  4 27 25 343        # output
```

$2^2, 3^3, 5^2, 7^3$

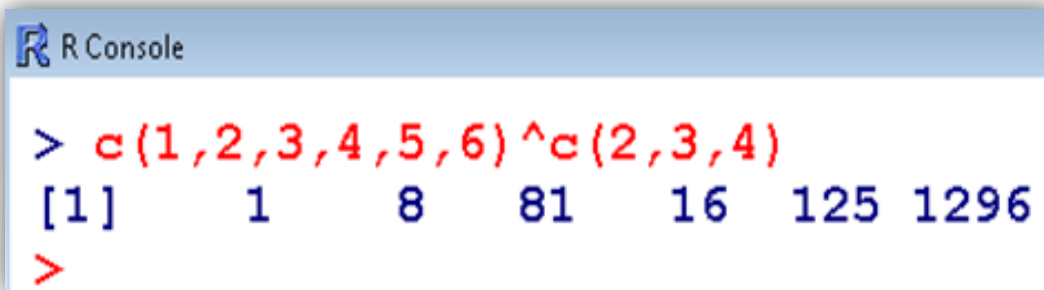


```
R Console  
> c(2,3,5,7)^c(2,3)  
[1]  4 27 25 343  
>
```

R as a calculator

```
> c(1,2,3,4,5,6)^c(2,3,4) # command: application  
                             to a vector with vector  
[1]  1  8 81 16 125 1296 # output
```

$1^2, 2^3, 3^4, 4^2, 5^3, 6^4$



R Console

```
> c(1,2,3,4,5,6)^c(2,3,4)  
[1]  1  8 81 16 125 1296  
>
```

R as a calculator

```
> c(2,3,5,7)^c(2,3,4)
```

#error message

```
[1] 4 27 625 49
```

output

Warning message:

longer object length is not a multiple of

shorter object length in: c(2,3,5,7)^c(2,3,4)

$$2^2, 3^3, 5^4, 7^2$$

R Console

```
> c(2,3,5,7)^c(2,3,4)
```

```
[1] 4 27 625 49
```

Warning message:

In c(2, 3, 5, 7)^c(2, 3, 4) :

longer object length is not a multiple of shorter object length

```
>
```

Multiplication and Division $x * y$, x/y :

```
> c(2,3,5,7) * 3  
[1] 6 9 15 21
```

2×3 , 3×3 , 5×3 , 7×3

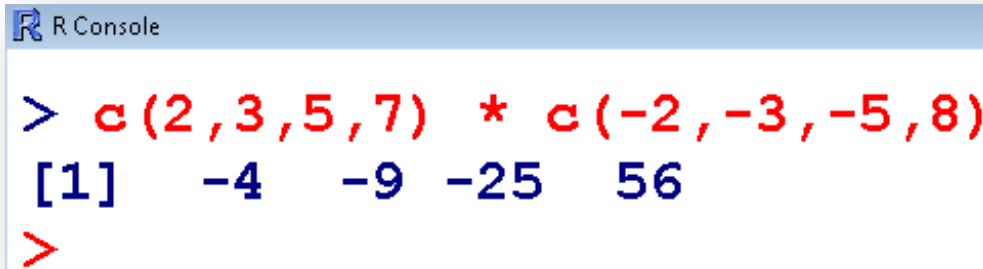
 R Console

```
> c(2,3,5,7) * 3  
[1] 6 9 15 21  
>
```

Multiplication and Division $x * y$, x/y :

```
> c(2,3,5,7) * c(-2,-3,-5,8)
[1] -4 -9 -25 56
```

$2 \times (-2)$, $3 \times (-3)$, $5 \times (-5)$, 7×8

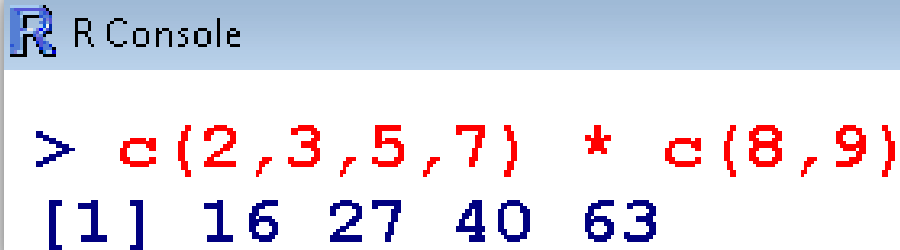


```
R Console
> c(2,3,5,7) * c(-2,-3,-5,8)
[1] -4 -9 -25 56
>
```

Multiplication and Division $x * y$, x/y :

```
> c(2,3,5,7) * c(8,9) # !!! ATTENTION  
[1] 16 27 40 63
```

2×8 , 3×9 , 5×8 , 7×9



R Console

```
> c(2,3,5,7) * c(8,9)  
[1] 16 27 40 63
```


Multiplication and Division $x * y$, x/y :

```
> c(2,3,5,7) * c(8,9,10) # error message
```

```
[1] 16 27 50 56
```

Warning message:

longer object length

is not a multiple of shorter object length

in: c(2, 3, 5, 7) * c(8, 9, 10)

2×8 , 3×9 , 5×10 , 7×8

```
R Console
> c(2,3,5,7) * c(8,9,10)
[1] 16 27 50 56
Warning message:
In c(2, 3, 5, 7) * c(8, 9, 10) :
  longer object length is not a multiple of shorter object length
> |
```

Addition and Subtraction $x + y$, $x - y$

```
> c(2,3,5,7) + 10  
[1] 12 13 15 17
```

2+10, 3+10, 5+10, 7+10



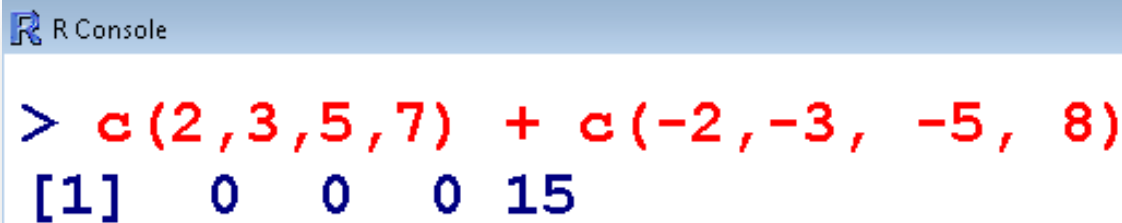
R Console

```
> c(2,3,5,7) + 10  
[1] 12 13 15 17
```

Addition and Subtraction $x + y$, $x - y$

```
> c(2,3,5,7) + c(-2,-3,-5,8)
[1] 0 0 0 15
```

$2 + (-2)$, $3 + (-3)$, $5 + (-5)$, $7 + 8$

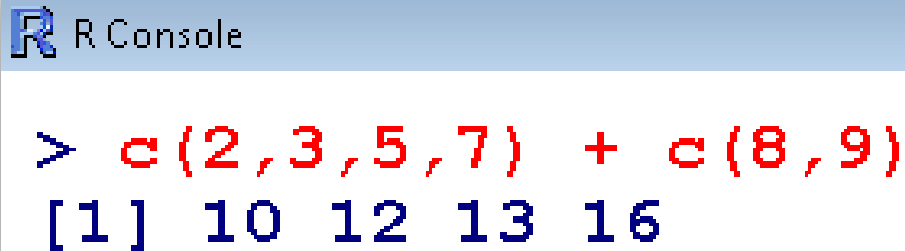


```
R Console
> c(2,3,5,7) + c(-2,-3,-5,8)
[1] 0 0 0 15
```

Addition and Subtraction $x + y$, $x - y$

```
> c(2,3,5,7) + c(8,9) # !!! ATTENTION!  
[1] 10 12 13 16
```

$2+8$, $3+9$, $5+2$, $7+9$



```
R Console  
> c(2,3,5,7) + c(8,9)  
[1] 10 12 13 16
```

Addition and Subtraction $x + y$, $x - y$

```
> c(2,3,5,7) + c(8,9,10) # error message
```

```
[1] 10 12 15 15
```

Warning message:

longer object length

is not a multiple of shorter object length

in: c(2, 3, 5, 7) + c(8, 9, 10)

2+8, 3+9, 5+10, 7+8

```
R Console
> c(2,3,5,7) + c(8,9,10)
[1] 10 12 15 15
Warning message:
In c(2, 3, 5, 7) + c(8, 9, 10) :
  longer object length is not a multiple of shorter object length
>
```