

❖ Packages in R

In the R programming language, a basic unit of a subscription is a collection of programs. It represents a bundle of code for blocking, data, documentation, and testing , and tracks ideas and experiences in the field of basic science and R functions to form packages that also run on the web.

In addition to the basic features, R provides several packages, which are a collection of functions, symbols, or data in the R programming language, i.e. additional files ready to solve complex problems in R. The downloaded version of R contains a specific set through which data is read and analyzed and statistical tests are performed.

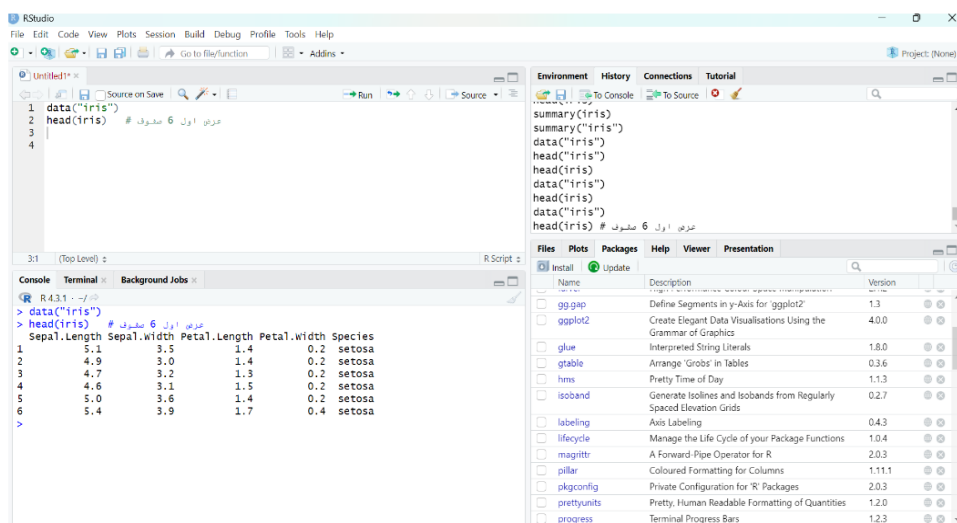
• How to Use Packages

Before using a package, it must be installed, Some packages are essential and are automatically installed when you install R, but there are packages you need to install that are not included in the R installation. There are three important functions involved in installing packages:

- 1- Download the package from within R: `install.packages (package name)`.
- 2- Use the package in R: `library (package name)`.
- 3- Get help with either `? (package name)` , or `help (package name)`

• Loading data packages

Sometimes the packages available in R may be data stored in R. To call them, write the `(data())` command, and the data set appears in the "data sets" package within the R data set, as shown below:



The screenshot shows the RStudio interface. The console displays the following output for the `data()` command:

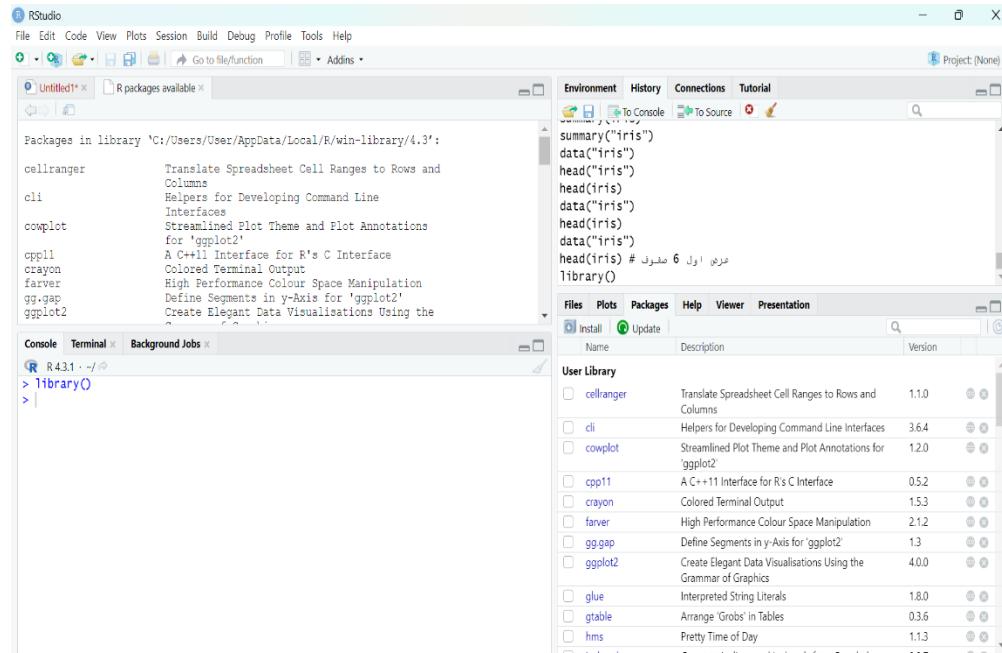
```
> data("iris")
# iris dataset
> head(iris) # عرض اول 6 صفوف
  Sepal.Length Sepal.width Petal.Length Petal.width Species
1          5.1         3.5          1.4         0.2  setosa
2          4.9         3.0          1.4         0.2  setosa
3          4.7         3.2          1.3         0.2  setosa
4          4.6         3.1          1.5         0.2  setosa
5          5.0         3.6          1.4         0.2  setosa
6          5.4         3.9          1.7         0.4  setosa
```

The Environment pane on the right shows the loaded data set:

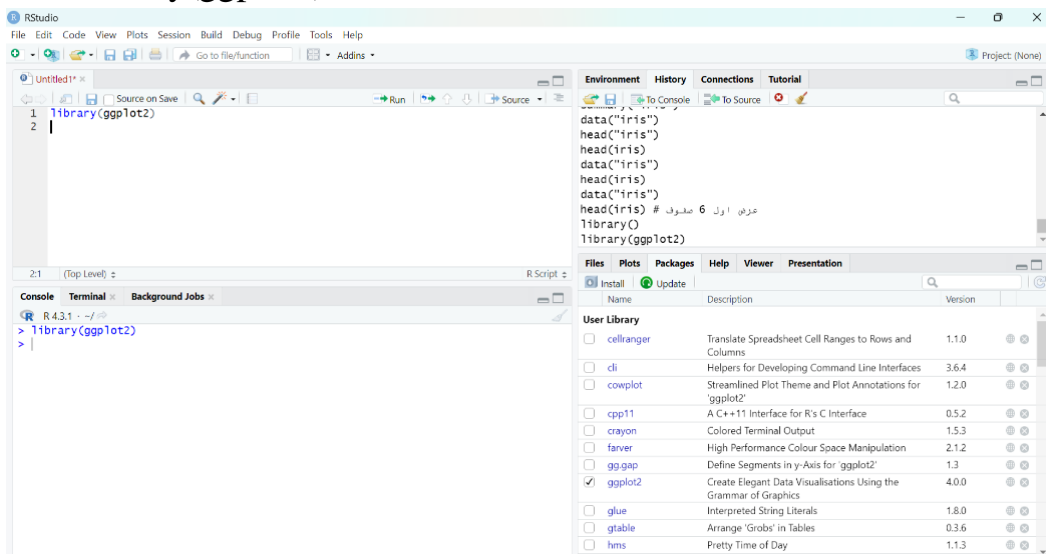
Name	Description	Version
gggplot	Define Segments in y-Axis for ggpplot2	1.3
ggplot2	Create Elegant Data Visualisations Using the Grammar of Graphics	4.0.0
glue	Interpreted String Literals	1.8.0
gttable	Arrange 'Grobs' in Tables	0.3.6
hms	Pretty Time of Day	1.1.3
isoband	Generate Isolines and Isobands from Regularly Spaced Elevation Grids	0.2.7
labeling	Axis Labeling	0.4.3
lifecycle	Manage the Life Cycle of your Package Functions	1.0.4
magrittr	A Forward-Pipe Operator for R	2.0.3
pillar	Coloured Formatting for Columns	1.11.1
pkgconfig	Private Configuration for 'R' Packages	2.0.3
prettyunits	Pretty, Human Readable Formatting of Quantities	1.2.0
progress	Terminal Progress Bars	1.2.3

- **Downloading program packages**

The R program includes additional programs that provide broader solution capabilities. To obtain a list of all packages installed in R, type the command "**library()**" and the window shown below will appear:



To load any package listed in the window above, say (`ggplot2`), we use the command "`library(ggplot2)`".



❖ Statistical Applications in R

The R language implements statistical variations in addition to other functions used in statistics, with modern, dynamic commands that are easy and straightforward in terms of writing or imposing restrictions on specific and detailed results. The following are the most important statistical functions with entities:

First – Measures of Central Tendency

1- Mean

The mean is calculated by finding the sum of the values and dividing by the number of values in a data series. The general formula is as follows:

Mean(x) , $x = \text{متجه المدخلات}$

Example :

```
> x=c(2,4,6,8,10)
```

```
> mean(x)
```

```
[1] 6
```

```
> median(x)
```

```
[1] 6
```

Example :

```
> x=c(12,5,9,34,-3,-7,-14,28)
```

```
> z=mean(x)
```

```
> z
```

```
[1] 8
```

2- Median:

The median is the value that lies in the middle of a set of data after it has been sorted in ascending or descending order, as shown in the example below:

Example :

```
> x=c(12,5,9,34,-3,-7,-14,28)
```

```
> V=median(x)
```

```
> V
```

```
[1] 7
```

Second- Measures of dispersion

مقاييس التشتت

المدى الربيعي $IQR(x)$, $max(x)$, $min(x)$, اصغر واكبر قيمة $range(x)$, $sd(x)$, $Var(x)$

Example :

```
> var(c(2,4,6,8))
[1] 6.666667
> sd(c(2,4,6,8))
[1] 2.581989
> range(c(2,4,6,8))
[1] 2 8
> min(c(2,4,6,8))
[1] 2
> max(c(2,4,6,8))
[1] 8
> IQR(c(2,4,6,8))
[1] 3
```

Third- Addition and counting functions

$rang(x)$, $sort(x)$, عدد العناصر $Length(x)$, حاصل ضرب القيم $prod(x)$, $Sum(x)$

Example :

```
sum(c(1,2,3,4))
[1] 10
> prod(c(1,2,3,4))
[1] 24
> length(c(1,2,3,4))
[1] 4
> sort(c(2,1,6,8,0,15,9))
[1] 0 1 2 6 8 9 15
> range(c(2,1,6,8,0,15,9))
[1] 0 15
```

Fourth- Full statistical description functions

دوال الوصف الاحصائي الكاملة

Summary(x) , quantile(x) الكمية

Example :

```
> x=c(10,20,30,40,50,60)
```

```
> summary(x)
```

Min. 1st Qu. Median Mean 3rd Qu. Max.

10.0 22.5 35.0 35.0 47.5 60.0

```
> quantile(x)
```

0% 25% 50% 75% 100%

10.0 22.5 35.0 47.5 60.0

❖ Differential Equations المعادلات الخطية

To solve a system of linear equations in R, we use the (Solve) function. The following example illustrates the application of the function:

Example :

$$3x_1 + 2x_2 - x_3 = 1$$

$$2x_1 - 2x_2 + 4x_3 = -2$$

$$-x_1 + 0.5x_2 - x_3 = 0$$

$$\begin{bmatrix} 3 & 2 & -1 \\ 2 & -2 & 4 \\ -1 & 0.5 & -1 \end{bmatrix} = \begin{bmatrix} 1 \\ -2 \\ 0 \end{bmatrix}, \quad A * x = b, \quad A^{-1} * b = x$$

```
> A=array(c(3,2,-1,2,-2,0.5,-1,4,-1),c(3,3))
```

```
> b=c(1,-2,0)
```

```
> solve(A,b)
```

```
[1] 1 -2 -2
```

❖ Linear Regression

Regression analysis is a statistical tool widely used to create a model of the relationship between two variables. One variable is called the dependent variable, and the other is called the independent variable. These two variables are related through the regression equation, as shown in the equation below:

$$y = b + ax$$

y : Represents the dependent variable

x : Represents the independent variable

a,b : These are constants called coefficients

The instruction for the regression equation is `lm(y~x)`

Example :

Use the regression equation to predict a person's weight when their height is known:

```
> x=c(151,174,138,186,128,136,179,163,152,131)#    الطول
> y=c(63,81,56,91,47,57,76,72,62,48)#    الوزن
> lm(y~x) # معادلة الانحدار
```

```
Call:
lm(formula = y ~ x)
```

```
Coefficients:
(Intercept)          x
-38.4551          0.6746
```

```
> summary(lm(y~x)) # ملخص العلاقة
plot(x,y) # To plot the regression function:
```

```
Call:
lm(formula = y ~ x)
```

```
Residuals:
    Min     1Q   Median     3Q    Max
-6.3002 -1.6629  0.0412  1.8944  3.9775
```

```
Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept) -38.45509     8.04901  -4.778  0.00139 **
x             0.67461     0.05191  12.997 1.16e-06 ***
```

```
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```