

# Introduccion a R y RStudio

## Taller de Introduccion a R y manejo de informacion grillada

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Noviembre, 2018



# ¿Qué es R?

*“R es un lenguaje y entorno de libre acceso para la computación estadística y gráficos que proporciona una amplia variedad de técnicas estadísticas y gráficas: modelado lineal y no lineal, pruebas estadísticas, análisis de series temporales, clasificación, clustering, etc.”*

**- R core group**

# Descargar R y RStudio



<https://cloud.r-project.org/>



<https://www.rstudio.com/products/rstudio/download/>



<https://www.r-project.org/>

```
Rterm (64-bit)

R version 3.5.0 (2018-04-23) -- "Joy in Playing"
Copyright (C) 2018 The R Foundation for Statistical Computing
Platform: x86_64-w64-mingw32/x64 (64-bit)

R es un software libre y viene sin GARANTIA ALGUNA.
Usted puede redistribuirlo bajo ciertas circunstancias.
Escriba 'license()' o 'licence()' para detalles de distribucion.

R es un proyecto colaborativo con muchos contribuyentes.
Escriba 'contributors()' para obtener más información y
'citation()' para saber cómo citar R o paquetes de R en publicaciones.

Escriba 'demo()' para demostraciones, 'help()' para el sistema on-line de ayuda,
o 'help.start()' para abrir el sistema de ayuda HTML con su navegador.
Escriba 'q()' para salir de R.

> -
```



<https://www.r-project.org/>

A screenshot of the RGui (64-bit) window. The title bar says 'RGui (64-bit)'. The menu bar includes 'Archivo', 'Editar', 'Visualizar', 'Misc', 'Paquetes', 'Ventanas', and 'Ayuda'. The toolbar contains icons for file operations and running code. The 'R Console' pane shows the following text:

```
R version 3.5.0 (2018-04-23) -- "Joy in Playing"
Copyright (C) 2018 The R Foundation for Statistical Computing
Platform: x86_64-w64-mingw32/x64 (64-bit)

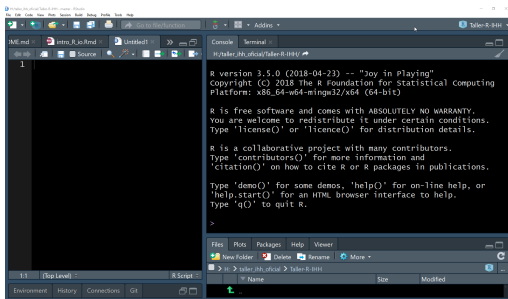
R es un software libre y viene sin GARANTIA ALGUNA.
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Escriba 'demo()' para demostraciones, 'help()' para el sistema on-line de ayuda,
o 'help.start()' para abrir el sistema de ayuda HTML con su navegador.
Escriba 'q()' para salir de R.

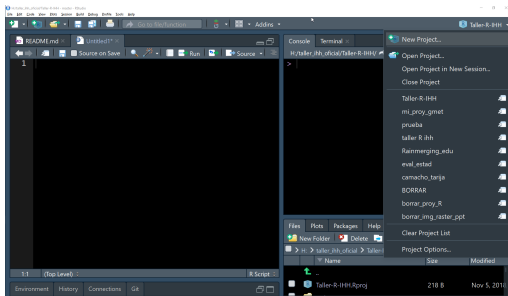
[Previously saved workspace restored]

> |
```



<https://www.rstudio.com/>

# Crear proyecto



- Para poder operar de forma ordenada es recomendable crear un **Proyecto** que contenga la información de entrada, salidas, scripts, etc.
- De esa forma las rutas de acceso se vuelven relativas sin depender de un árbol de carpetas propio de cada usuario.

```
install.packages('beep', repos = 'https://cloud.r-project.org')  
  
## Installing package into 'C:/Users/HP/Documents/R/win-library/3.5'  
## (as 'lib' is unspecified)  
## package 'beep' successfully unpacked and MD5 sums checked  
##  
## The downloaded binary packages are in  
## C:\Users\HP\AppData\Local\Temp\Rtmp0qI8So\downloaded_packages  
library(beep)  
  
## Warning: package 'beep' was built under R version 3.5.1  
beep(sound = 8)
```



## Instalar librerías

```
install.packages('raster')  
install.packages('openxlsx')  
install.packages('ncdf4')  
install.packages('lubridate')
```

# Tipos de objetos en R

## Vector numérico

```
precipitacion <- c(6, 7, 24, 17, 20.5, 20.5, 20, 12, 11, 14, 38,  
                  9.5, 8, 5.5, 7)  
head(precipitacion)  
## [1] 6.0 7.0 24.0 17.0 20.5 20.5
```

## Vector de caracteres

```
fecha <- c('1991-01-01', '1991-01-02', '1991-01-03', '1991-01-04',  
          '1991-01-05', '1991-01-06', '1991-01-07', '1991-01-08',  
          '1991-01-09', '1991-01-10', '1991-01-11', '1991-01-12',  
          '1991-01-13', '1991-01-14', '1991-01-15')  
head(fecha, 4)  
## [1] "1991-01-01" "1991-01-02" "1991-01-03" "1991-01-04"
```

# Tipos de objetos en R

## Factores

```
(valores <- factor(c('b', 'b', 'd', 'c', 'd'),  
                  levels = c('a', 'b', 'c', 'd'))  
  
## [1] b b d c d  
## Levels: a b c d  
table(valores)  
  
## valores  
## a b c d  
## 0 2 1 2
```

## Variables lógicas

```
a <- 2  
b <- 3  
a == b # ¿es a igual a b?  
  
## [1] FALSE
```

# Tipos de objetos en R

## Matrices

```
(A <- matrix(c(-67, -16, -68.5, -17.5), byrow = TRUE, ncol = 2))
```

```
##      [,1] [,2]
## [1,] -67.0 -16.0
## [2,] -68.5 -17.5
```

## Data frames

```
datos <- data.frame(fecha, precipitacion)
```

```
head(datos)
```

```
##      fecha precipitacion
## 1 1991-01-01           6.0
## 2 1991-01-02           7.0
## 3 1991-01-03          24.0
## 4 1991-01-04          17.0
## 5 1991-01-05          20.5
## 6 1991-01-06          20.5
```

# Tipos de objetos en R

## Listas

```
(mi_lista <- list(matriz = A, df = datos))
```

```
## $matriz
```

```
##      [,1] [,2]
```

```
## [1,] -67.0 -16.0
```

```
## [2,] -68.5 -17.5
```

```
##
```

```
## $df
```

```
##      fecha precipitacion
```

```
## 1 1991-01-01          6.0
```

```
## 2 1991-01-02          7.0
```

```
## 3 1991-01-03         24.0
```

```
## 4 1991-01-04         17.0
```

```
## 5 1991-01-05         20.5
```

```
## 6 1991-01-06         20.5
```

```
## 7 1991-01-07         20.0
```

```
## 8 1991-01-08         12.0
```

```
## 9 1991-01-09         11.0
```

```
## 10 1991-01-10        14.0
```

```
## 11 1991-01-11        38.0
```

# Tipos de objetos en R

## Fechas

```
class(fecha)
## [1] "character"
fecha_formato <- as.Date(fecha) # ojo!
head(fecha_formato, 4)
## [1] "1991-01-01" "1991-01-02" "1991-01-03" "1991-01-04"
class(fecha_formato)
## [1] "Date"
```

## Funciones

**Si una tarea se repite mas de dos veces es hora de crear una funcion.**

```
is.leapyear <- function(year){
  condicion_1 <- (year %% 4 == 0)
  condicion_2 <- (year %% 100 != 0)
  condicion_3 <- (year %% 400 == 0)
  return((condicion_1 & condicion_2) | condicion_3)
}
```

# Operaciones lógicas

`==, <, >, <=, >=, %in%`

```
a <- 1 ; b <- c(1, 2, 3)
```

```
a == b
```

```
## [1] TRUE FALSE FALSE
```

```
a <= b
```

```
## [1] TRUE TRUE TRUE
```

```
a %in% b
```

```
## [1] TRUE
```

```
5 %in% b
```

```
## [1] FALSE
```

# Indexacion

## Vector []

```
fecha_formato[2]  
## [1] "1991-01-02"
```

## Matriz y data frame []

```
datos[1,2]  
## [1] 6  
head(datos[,2], 11)  
## [1] 6.0 7.0 24.0 17.0 20.5 20.5 20.0 12.0 11.0 14.0 38.0
```

## Data frame \$

```
datos_precip <- datos$precipitacion  
head(datos_precip, 11)  
## [1] 6.0 7.0 24.0 17.0 20.5 20.5 20.0 12.0 11.0 14.0 38.0
```



## Listas [], [[]], \$

```
mi_lista[1]
```

```
## $matriz
```

```
##      [,1] [,2]
```

```
## [1,] -67.0 -16.0
```

```
## [2,] -68.5 -17.5
```

```
mi_lista[[1]]
```

```
##      [,1] [,2]
```

```
## [1,] -67.0 -16.0
```

```
## [2,] -68.5 -17.5
```

```
mi_lista$matriz
```

```
##      [,1] [,2]
```

```
## [1,] -67.0 -16.0
```

```
## [2,] -68.5 -17.5
```

# Información de objetos

## Propiedades de los datos

```
str(datos) # data frame
```

```
## 'data.frame':    15 obs. of  2 variables:  
## $ fecha          : Factor w/ 15 levels "1991-01-01","1991-01-02",...: 1 2  
## $ precipitacion: num  6 7 24 17 20.5 20.5 20 12 11 14 ...
```

```
str(mi_lista) # lista
```

```
## List of 2  
## $ matriz: num [1:2, 1:2] -67 -68.5 -16 -17.5  
## $ df      : 'data.frame': 15 obs. of  2 variables:  
## ..$ fecha          : Factor w/ 15 levels "1991-01-01","1991-01-02",...: 1  
## ..$ precipitacion: num [1:15] 6 7 24 17 20.5 20.5 20 12 11 14 ...
```

## Algunos estadísticos

```
summary(datos$precipitacion)
```

|    |      |         |        |       |         |       |
|----|------|---------|--------|-------|---------|-------|
| ## | Min. | 1st Qu. | Median | Mean  | 3rd Qu. | Max.  |
| ## | 5.50 | 7.50    | 12.00  | 14.67 | 20.25   | 38.00 |

# Bucles vs Vectorización

## Bucles

```
salida <- vector()
for (i in 1:3) { salida[i] <- paste('indice', i, sep = '=') }
salida
## [1] "indice=1" "indice=2" "indice=3"
```

## Vectorización

```
sapply(1:3, function(i) paste('indice', i, sep = '='))
## [1] "indice=1" "indice=2" "indice=3"
```

# Ejemplo: Manipulacion de informacion tabular

|    | A                                    | B     | C           | D    | E    | F   | G    | H   | I               | J    | K           | L    | M    | N     |
|----|--------------------------------------|-------|-------------|------|------|-----|------|-----|-----------------|------|-------------|------|------|-------|
| 1  | Estación:                            |       | San Calixto |      |      |     |      |     | Latitud Sud:    |      | 16° 29' 43" |      |      |       |
| 2  | Departamento:                        |       | La Paz      |      |      |     |      |     | Longitud Oeste: |      | 68° 7' 57"  |      |      |       |
| 3  | Provincia:                           |       | Murillo     |      |      |     |      |     | Altitud m/s/nm: |      | 3658        |      |      |       |
| 4  | DATOS DE : PRECIPITACION DIARIA (mm) |       |             |      |      |     |      |     |                 |      |             |      |      |       |
| 5  | 1981                                 |       |             |      |      |     |      |     |                 |      |             |      |      |       |
| 6  | DIA                                  | ENE   | FEB         | MAR  | ABR  | MAY | JUN  | JUL | AGO             | SEP  | OCT         | NOV  | DIC  | TOTAL |
| 7  | 1                                    | 8.0   | 0.3         | 8.4  | 0.0  | 0.0 | 0.0  | 0.0 | 0.0             | 0.0  | 0.0         | 0.0  | 2.5  | 19.2  |
| 8  | 2                                    | 0.8   | 4.5         | 1.6  | 1.0  | 0.0 | 0.0  | 0.0 | 0.0             | 0.0  | 0.0         | 0.0  | 0.0  | 7.9   |
| 9  | 3                                    | 11.9  | 0.0         | 3.0  | 0.0  | 0.0 | 0.0  | 0.0 | 0.0             | 1.4  | 0.0         | 0.0  | 4.7  | 21.0  |
| 10 | 4                                    | 22.4  | 0.0         | 0.3  | 0.0  | 0.0 | 0.0  | 0.0 | 0.0             | 22.8 | 0.0         | 0.0  | 0.2  | 45.7  |
| 11 | 5                                    | 8.1   | 0.0         | 2.1  | 0.0  | 0.0 | 0.0  | 0.0 | 3.7             | 0.0  | 9.4         | 3.2  | 0.0  | 26.5  |
| 12 | 6                                    | 1.0   | 18.2        | 2.3  | 0.7  | 0.0 | 0.0  | 0.0 | 9.4             | 0.0  | 0.7         | 1.5  | 0.0  | 33.8  |
| 13 | 7                                    | 0.0   | 29.1        | 13.1 | 3.8  | 0.0 | 0.0  | 0.0 | 1.4             | 0.0  | 5.0         | 0.0  | 0.0  | 52.4  |
| 14 | 8                                    | 3.6   | 3.5         | 12.1 | 0.0  | 0.0 | 0.0  | 0.0 | 0.3             | 0.0  | 8.5         | 6.6  | 0.0  | 34.6  |
| 15 | 9                                    | 1.1   | 7.4         | 17.8 | 10.2 | 0.0 | 0.0  | 0.0 | 0.8             | 0.0  | 0.0         | 0.0  | 0.0  | 37.3  |
| 16 | 10                                   | 7.8   | 6.3         | 0.5  | 11.3 | 0.0 | 0.0  | 0.0 | 9.1             | 0.0  | 0.0         | 0.0  | 0.0  | 35.0  |
| 17 | 11                                   | 3.8   | 0.0         | 0.0  | 20.5 | 2.2 | 0.0  | 0.0 | 0.0             | 0.6  | 0.0         | 0.0  | 2.0  | 29.1  |
| 18 | 12                                   | 3.7   | 0.0         | 6.8  | 0.0  | 0.7 | 0.0  | 0.0 | 0.4             | 0.1  | 0.0         | 0.0  | 0.0  | 11.7  |
| 19 | 13                                   | 5.7   | 19.0        | 0.3  | 1.3  | 0.0 | 0.0  | 0.0 | 0.0             | 0.0  | 0.0         | 1.6  | 0.0  | 27.9  |
| 20 | 14                                   | 5.3   | 2.6         | 0.0  | 0.0  | 0.0 | 0.0  | 0.0 | 1.4             | 0.0  | 0.0         | 0.0  | 0.0  | 9.3   |
| 21 | 15                                   | 1.9   | 3.1         | 0.0  | 0.0  | 0.0 | 0.0  | 0.0 | 0.9             | 0.0  | 0.0         | 0.0  | 2.2  | 8.1   |
| 22 | 16                                   | 22.8  | 0.0         | 0.2  | 0.0  | 0.0 | 0.0  | 0.0 | 0.0             | 0.0  | 0.0         | 0.8  | 0.6  | 24.4  |
| 23 | 17                                   | 0.0   | 0.0         | 0.0  | 0.0  | 0.0 | 0.0  | 0.0 | 0.0             | 0.0  | 0.7         | 0.0  | 0.0  | 0.7   |
| 24 | 18                                   | 9.4   | 0.0         | 1.6  | 0.0  | 0.0 | 0.0  | 0.0 | 0.0             | 0.0  | 0.0         | 0.0  | 0.2  | 11.2  |
| 25 | 19                                   | 7.8   | 0.5         | 3.4  | 0.0  | 0.0 | 0.0  | 0.0 | 0.0             | 2.0  | 0.0         | 3.3  | 1.7  | 18.7  |
| 26 | 20                                   | 0.5   | 11.5        | 0.0  | 0.0  | 1.3 | 0.0  | 0.0 | 0.0             | 0.7  | 0.0         | 0.0  | 1.1  | 15.1  |
| 27 | 21                                   | 4.7   | 0.1         | 0.0  | 0.0  | 0.0 | 0.0  | 0.0 | 0.0             | 8.3  | 0.8         | 0.5  | 7.0  | 21.4  |
| 28 | 22                                   | 0.0   | 5.0         | 0.6  | 0.0  | 0.0 | 0.0  | 0.0 | 0.0             | 0.9  | 3.5         | 0.0  | 0.0  | 10.0  |
| 29 | 23                                   | 0.0   | 0.3         | 1.0  | 0.0  | 0.0 | 0.0  | 0.0 | 0.0             | 0.1  | 0.0         | 1.5  | 2.0  | 4.9   |
| 30 | 24                                   | 0.0   | 13.8        | 0.0  | 0.0  | 0.0 | 0.0  | 0.0 | 0.0             | 8.7  | 6.0         | 0.3  | 2.7  | 31.5  |
| 31 | 25                                   | 0.0   | 4.3         | 0.0  | 0.0  | 0.0 | 0.0  | 0.0 | 0.0             | 0.0  | 3.5         | 7.7  | 0.0  | 15.5  |
| 32 | 26                                   | 7.1   | 3.2         | 0.3  | 0.0  | 0.0 | 0.0  | 0.0 | 0.0             | 5.5  | 6.6         | 0.0  | 2.0  | 24.7  |
| 33 | 27                                   | 19.0  | 0.7         | 0.0  | 0.0  | 0.0 | 0.0  | 0.0 | 0.0             | 0.0  | 14.2        | 0.0  | 3.5  | 37.4  |
| 34 | 28                                   | 2.6   | 4.3         | 0.0  | 0.0  | 0.0 | 0.0  | 0.0 | 0.0             | 0.0  | 4.3         | 0.2  | 0.0  | 11.4  |
| 35 | 29                                   | 0.0   | ****        | 0.0  | 0.0  | 0.0 | 0.0  | 0.0 | 0.0             | 0.0  | 0.0         | 0.8  | 4.1  | 4.9   |
| 36 | 30                                   | 0.0   | ****        | 0.0  | 0.0  | 0.0 | 0.0  | 0.0 | 0.0             | 0.0  | 0.3         | 0.0  | 6.0  | 6.3   |
| 37 | 31                                   | 0.0   | ****        | 0.0  | **** | 0.0 | **** | 0.0 | ****            | 0.0  | 6.8         | **** | 0.4  | 7.2   |
| 38 | SUM                                  | 159.0 | 137.7       | 75.4 | 48.8 | 4.2 | 0.0  | 0.0 | 27.4            | 51.1 | 70.3        | 28.0 | 42.9 | 644.8 |
| 39 | MED                                  | 7.2   | 6.9         | 4.2  | 7.0  | 1.4 | 0.0  | 0.0 | 3.0             | 4.6  | 5.0         | 2.3  | 2.5  | 4.4   |
| 40 | MAX                                  | 22.8  | 29.1        | 17.8 | 20.5 | 2.2 | 0.0  | 0.0 | 9.4             | 22.8 | 14.2        | 7.7  | 7.0  | 29.1  |
| 41 | MIN                                  | 0.0   | 0.0         | 0.0  | 0.0  | 0.0 | 0.0  | 0.0 | 0.0             | 0.0  | 0.0         | 0.0  | 0.0  | 0.0   |
| 42 | N                                    | 22.0  | 20.0        | 18.0 | 7.0  | 3.0 | 0.0  | 0.0 | 9.0             | 11.0 | 14.0        | 12.0 | 17.0 | 133.0 |
| 43 | AÑO: 1982                            |       |             |      |      |     |      |     |                 |      |             |      |      |       |
| 44 | DIA                                  | ENE   | FEB         | MAR  | ABR  | MAY | JUN  | JUL | AGO             | SEP  | OCT         | NOV  | DIC  | TOTAL |
| 45 | 1                                    | 1.0   | 0.0         | 11.7 | 0.0  | 0.0 | 0.0  | 1.0 | 0.0             | 0.0  | 0.0         | 0.5  | 0.0  | 14.2  |
| 46 | 2                                    | 0.4   | 0.0         | 0.1  | 0.0  | 0.0 | 0.0  | 0.0 | 0.0             | 0.0  | 0.0         | 1.6  | 0.0  | 2.1   |
| 47 | 3                                    | 12.6  | 0.0         | 0.0  | 0.0  | 0.0 | 0.0  | 0.0 | 0.0             | 0.0  | 0.0         | 0.0  | 0.0  | 12.6  |
| 48 | 4                                    | 6.4   | 0.0         | 24.2 | 0.0  | 0.0 | 0.0  | 0.0 | 0.0             | 0.0  | 0.3         | 0.0  | 0.6  | 31.5  |
| 49 | 5                                    | 5.6   | 0.0         | 3.7  | 3.8  | 0.0 | 0.0  | 0.0 | 0.0             | 2.7  | 0.3         | 0.0  | 11.5 | 27.6  |
| 50 | 6                                    | 2.4   | 0.0         | 0.0  | 11.9 | 0.0 | 0.0  | 0.0 | 0.0             | 0.5  | 0.0         | 0.0  | 0.5  | 15.3  |
| 51 | 7                                    | 9.0   | 0.1         | 0.0  | 0.0  | 0.0 | 0.0  | 0.0 | 0.0             | 0.0  | 0.0         | 0.0  | 3.5  | 12.6  |
| 52 | 8                                    | 6.7   | 1.7         | 0.0  | 0.5  | 0.0 | 0.0  | 0.0 | 0.0             | 0.0  | 1.0         | 0.0  | 0.6  | 10.5  |
| 53 | 9                                    | 6.7   | 1.7         | 0.0  | 0.5  | 0.0 | 0.0  | 0.0 | 0.0             | 0.0  | 1.0         | 0.0  | 0.6  | 10.5  |

|    | A          | B           |
|----|------------|-------------|
| 1  | fecha      | San_Calixto |
| 2  | 01/01/1981 | 8           |
| 3  | 02/01/1981 | 0.8         |
| 4  | 03/01/1981 | 11.9        |
| 5  | 04/01/1981 | 22.4        |
| 6  | 05/01/1981 | 8.1         |
| 7  | 06/01/1981 | 1           |
| 8  | 07/01/1981 | 0           |
| 9  | 08/01/1981 | 3.6         |
| 10 | 09/01/1981 | 1.1         |
| 11 | 10/01/1981 | 7.8         |
| 12 | 11/01/1981 | 3.8         |
| 13 | 12/01/1981 | 3.7         |
| 14 | 13/01/1981 | 5.7         |
| 15 | 14/01/1981 | 5.3         |
| 16 | 15/01/1981 | 1.9         |
| 17 | 16/01/1981 | 22.8        |
| 18 | 17/01/1981 | 0           |
| 19 | 18/01/1981 | 9.4         |
| 20 | 19/01/1981 | 7.8         |
| 21 | 20/01/1981 | 0.5         |
| 22 | 21/01/1981 | 4.7         |
| 23 | 22/01/1981 | 0           |
| 24 | 23/01/1981 | 0           |
| 25 | 24/01/1981 | 0           |
| 26 | 25/01/1981 | 0           |
| 27 | 26/01/1981 | 7.1         |
| 28 | 27/01/1981 | 19          |
| 29 | 28/01/1981 | 2.6         |
| 30 | 29/01/1981 | 0           |
| 31 | 30/01/1981 | 0           |
| 32 | 31/01/1981 | 0           |
| 33 | 01/02/1981 | 0.3         |
| 34 | 02/02/1981 | 4.5         |
| 35 | 03/02/1981 | 0           |
| 36 | 04/02/1981 | 0           |
| 37 | 05/02/1981 | 0           |
| 38 | 06/02/1981 | 18.2        |
| 39 | 07/02/1981 | 29.1        |
| 40 | 08/02/1981 | 3.5         |
| 41 | 09/02/1981 | 7.4         |
| 42 | 10/02/1981 | 6.3         |