JIS Go Live
2020

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experience!

R para Ciencia de Datos

Jornadas de Informática en Salud

Equipo

Julieta Terzano

Fabricio Sobral

Hernán Berinsky

Ernesto Surijon

Alejandro Renato

Fernando Binder

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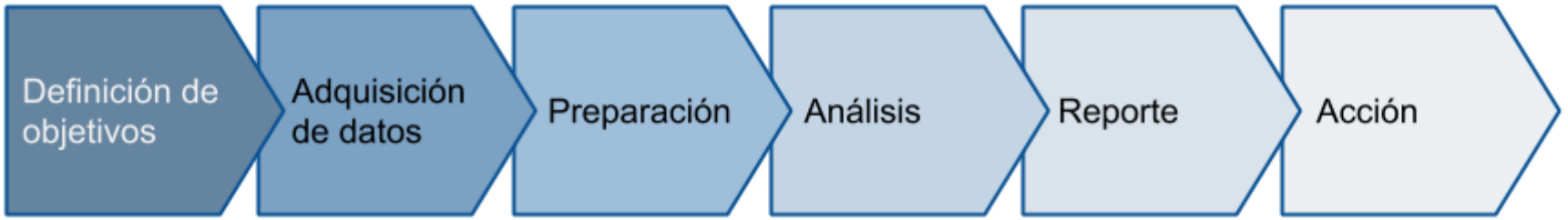
- Software preenvasado y lenguajes de programación
- R y RStudio IDE:
    - Paneles de RStudio
    - Objetos y funciones en R
    - Carga de datos
    - Tablas
    - Tidyverse: librerías para ciencia de datos
    - Gráficos con ggplot2
    - Tests de hipótesis


R Studio®

Proyectos de Ciencia de Datos

Pasos propuestos

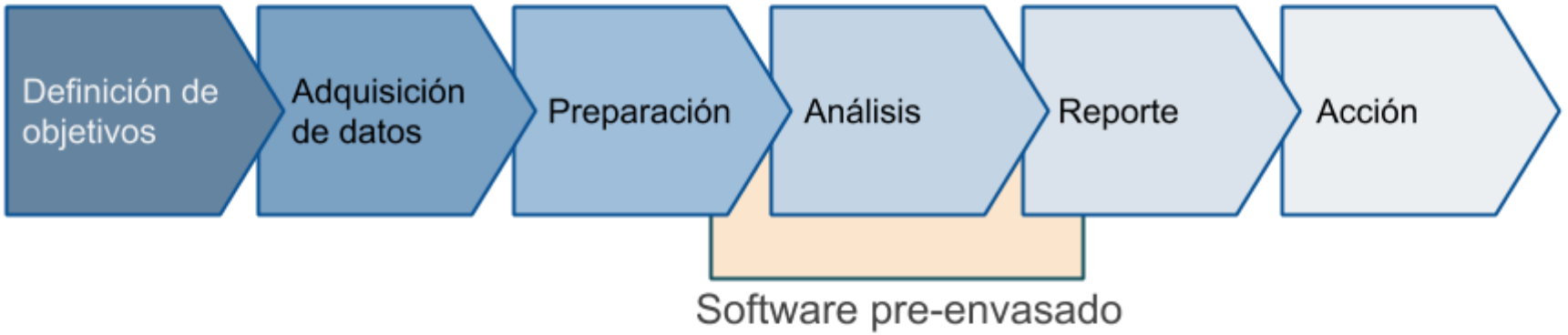
Pasos en un proyecto de ciencia de datos



Las herramientas de software

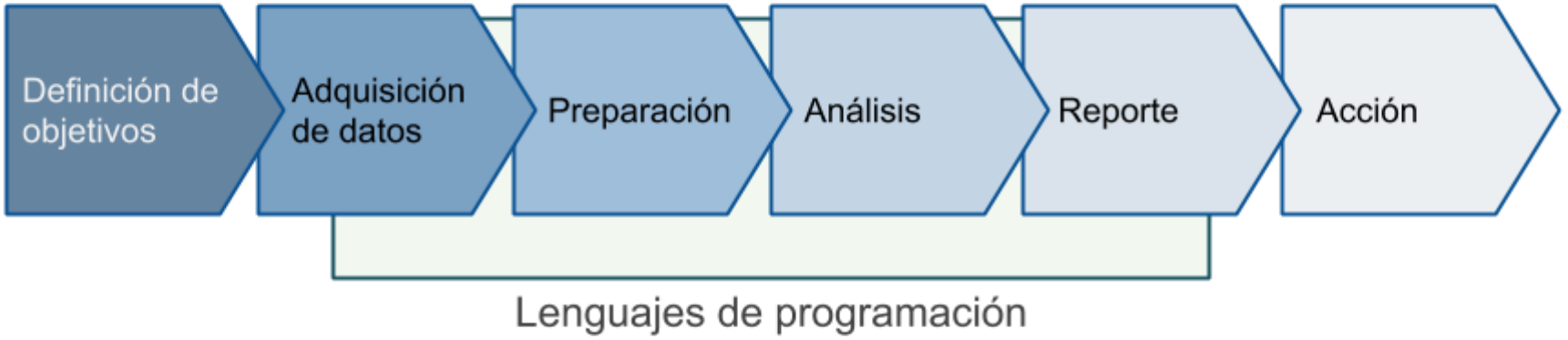
Software pre-envasado y lenguajes de programación

Pasos en un proyecto de ciencia de datos: herramientas



"Usar software pre-envasado es como comprar comida para llevar cada vez que tenés hambre." - *J.P. Onnela*

Pasos en un proyecto de ciencia de datos: herramientas



R para Análisis de Datos

- Lenguaje de programación y entorno de trabajo para análisis estadístico y visualización de gráficos
- Código abierto
- Flexible y extensible
- Comunidad activa

Principal entorno de programación cuantitativa en **estadística académica** y creciente popularidad en **análisis de datos en salud**

R para Análisis de Datos

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- Código abierto
- Flexible y extensible
- Comunidad activa

Instalación de R y R Studio

Instalación de R y R Studio

Paso 1

Instalar **R**

Paso 2

Instalar **RStudio**

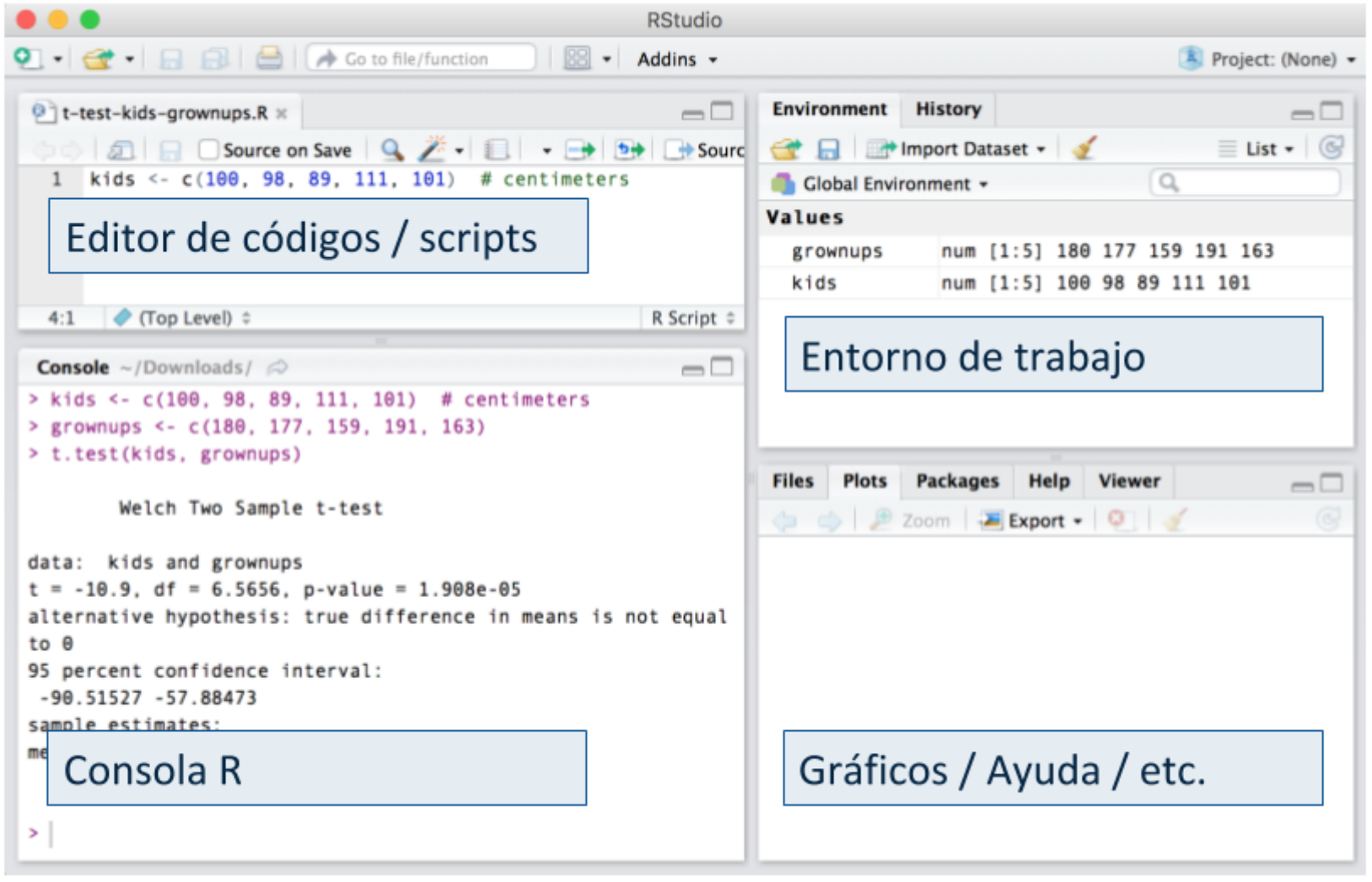
(Entorno de Desarrollo Integrado - IDE)

Alternativa: RStudio Cloud

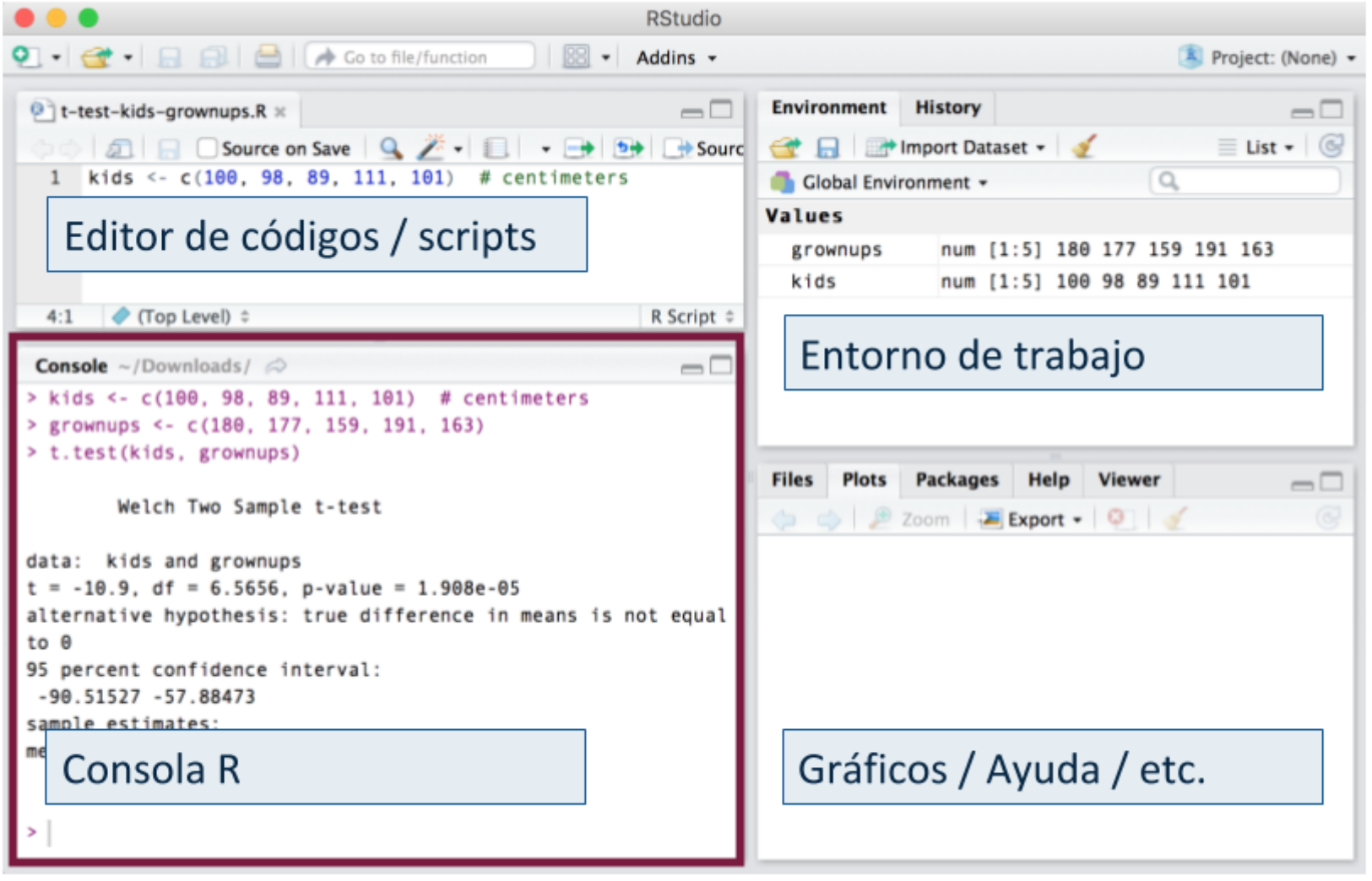
rstudio.cloud

Paneles de RStudio

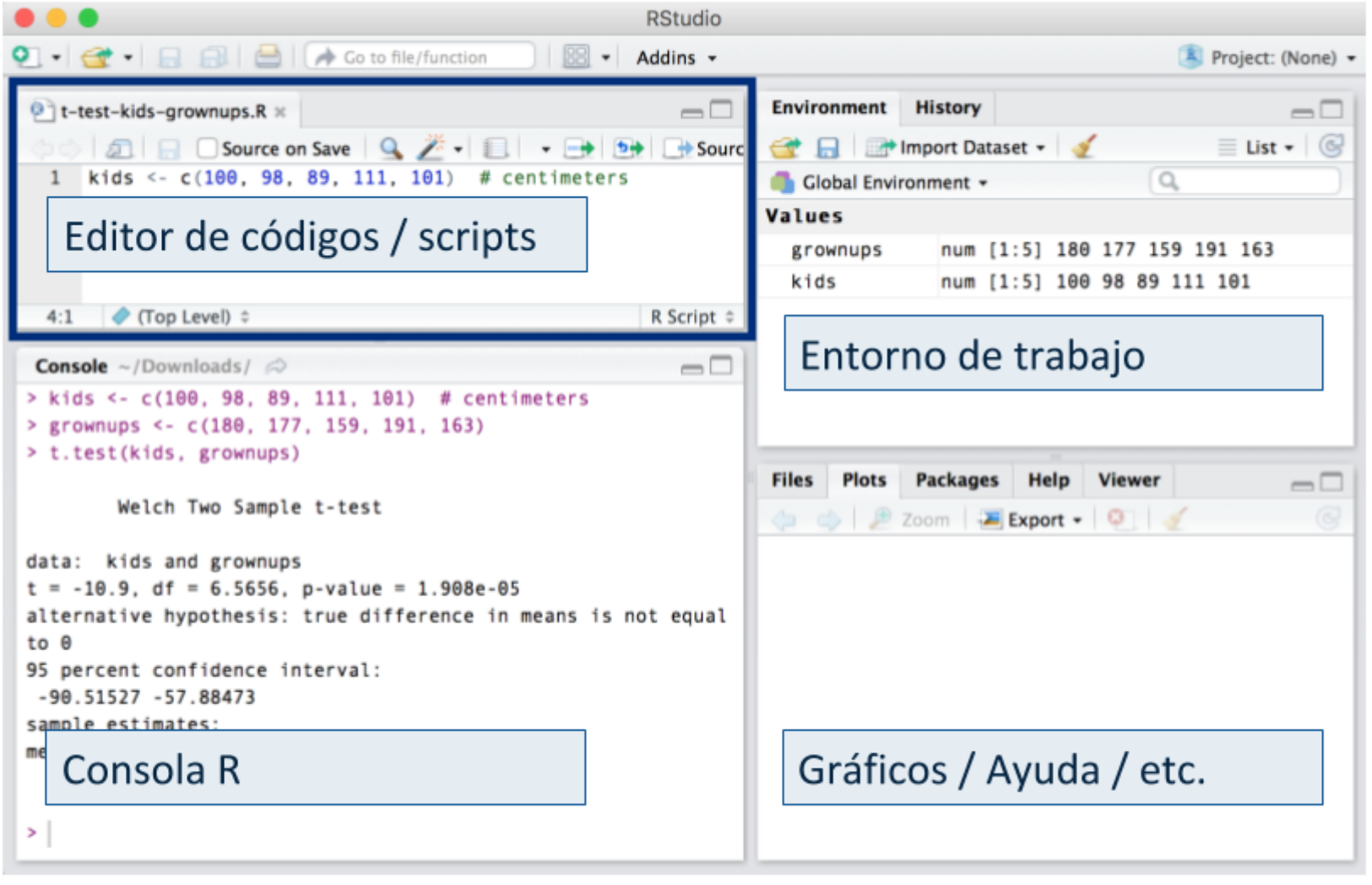
Paneles de RStudio



Paneles de RStudio

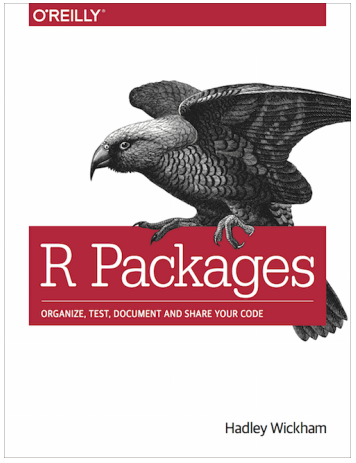


Paneles de RStudio



Librerías / paquetes

Flexibilidad y extensibilidad de R



Conjuntos de:

- Funciones
- Documentación
- Sets de datos de ejemplo

https://r-pkgs.org/

https://cran.r-project.org/web/packages/available_packages_by_name.html

Tidyverse visualization manipulation basics, *G Grolemund 2017*

Librerías / paquetes

Flexibilidad y extensibilidad de R

Instalación

```
install.packages("dplyr")
install.packages("ggplot2")
```

"1 vez por computadora"

Carga de paquetes

```
library(dplyr)
library(ggplot2)
```

"1 vez por sesión"

Tidyverse: Librerías para Ciencia de Datos


```
install.packages("tidyverse")
```

```
library(tidyverse)
```

```
── Attaching packages ─────────────────────
✓ tibble  3.0.1     ✓ purrr   0.3.4
✓ tidyr   1.1.2     ✓ stringr 1.4.0
✓ readr   1.3.1     ✓ forcats 0.5.0

── Conflicts ── tidyverse_conflicts() ──
x dplyr::filter() masks stats::filter()
x dplyr::lag()    masks stats::lag()
```

Actividad

Actividad

RStudio

Instalar y cargar el paquete Tidyverse

Objetos en R: Variables, vectores y data.frames

Objetos en R

Crear un objeto

Operador 'asignar': <-

```
a <- 4
```

Imprimir el contenido del objeto

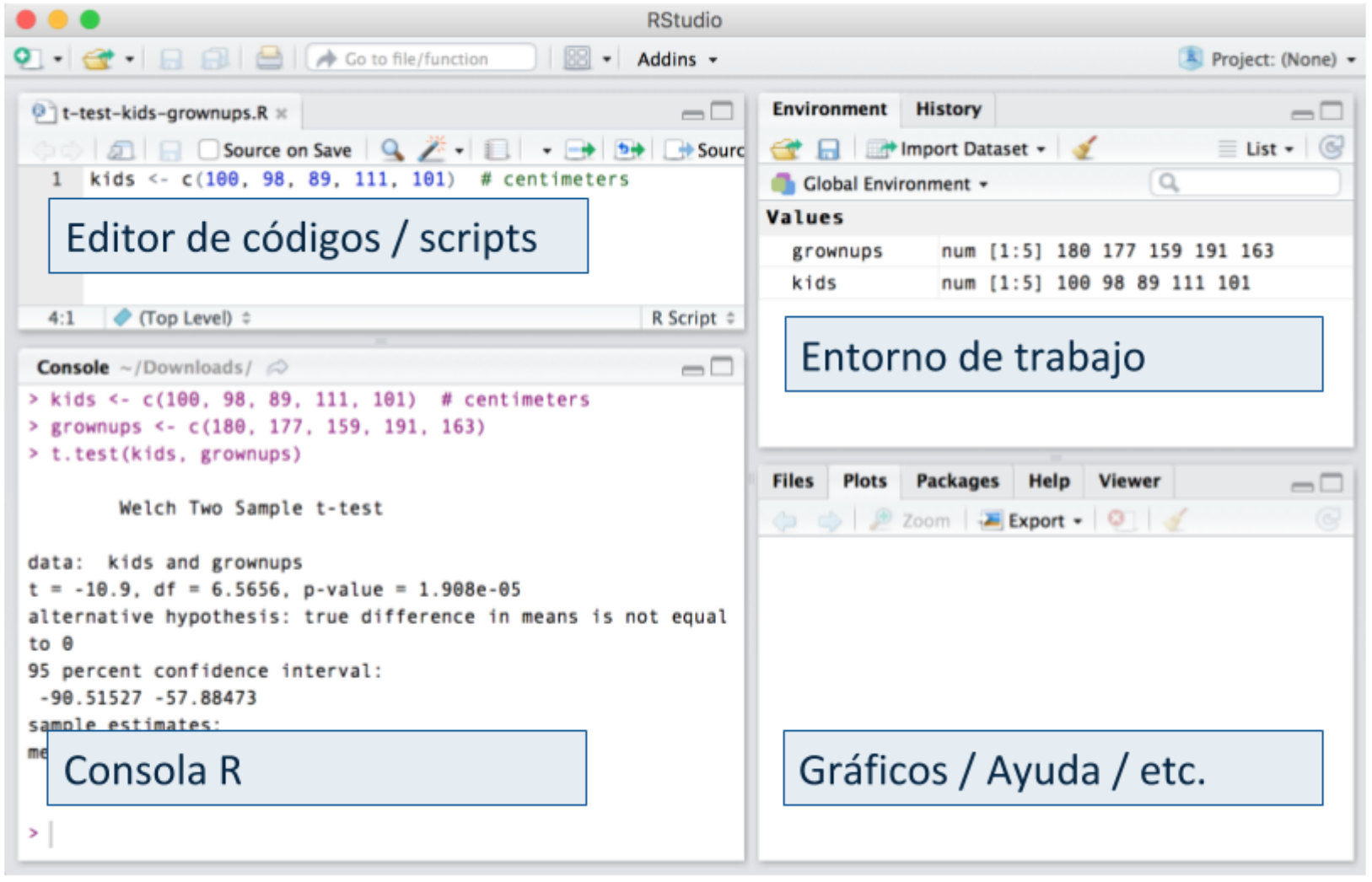
```
print(a)
```

```
[1] 4
```

```
a
```

```
[1] 4
```

Paneles de RStudio



Objetos en R

Crear un objeto

Operador 'asignar': <-

```
a <- 4
```

Imprimir el contenido del objeto

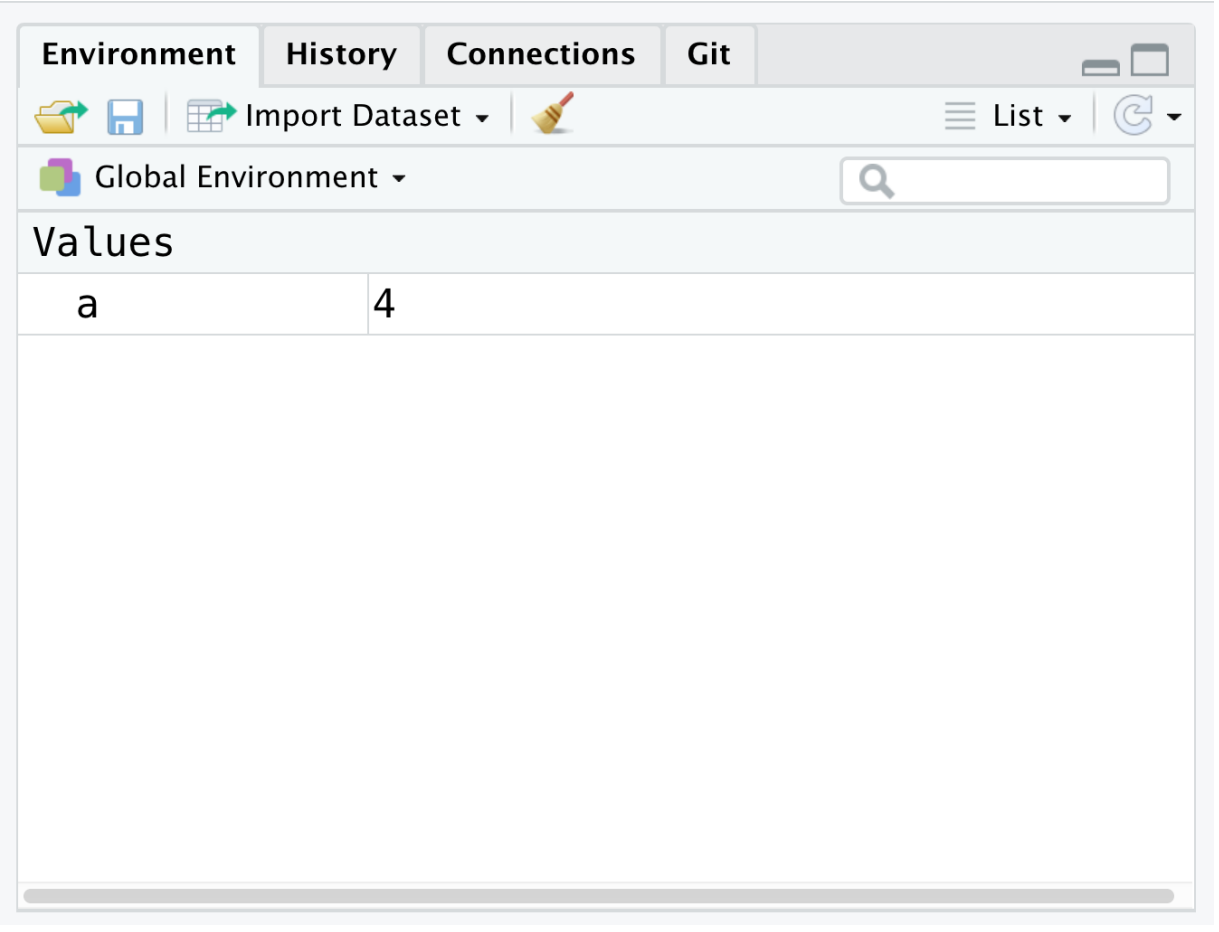
```
print(a)
```

```
[1] 4
```

```
a
```

```
[1] 4
```

Objetos en el Entorno de Trabajo



Tipos de objetos

función `typeof()`

```
a <- 4
typeof(a)
```

```
[1] "double"
```

```
b <- "texto"
typeof(b)
```

```
[1] "character"
```

```
c <- TRUE
typeof(c)
```

```
[1] "logical"
```

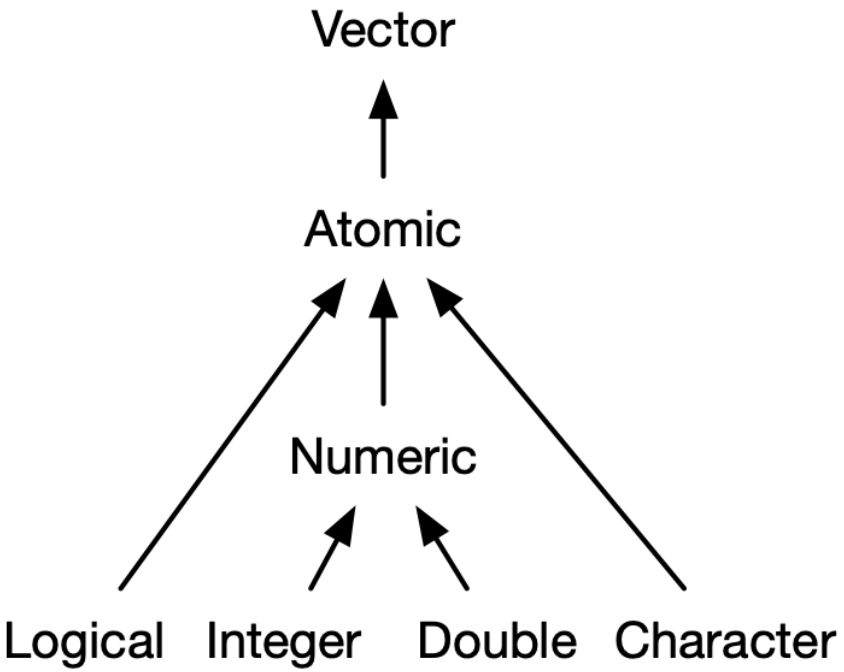
```
d <- 3.1416
typeof(d)
```

```
[1] "double"
```

Clases de Objetos

Clases principales			
numeric		character	logical
integer	double		
1 25	34.6 3.1415	"texto"	TRUE FALSE

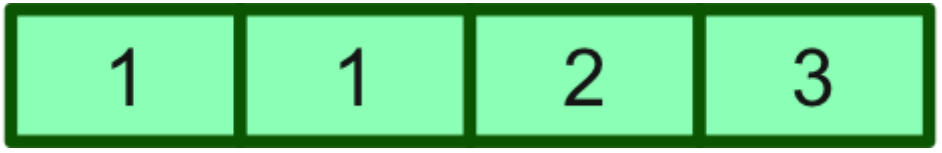
Clases de Objetos



Advanced R. H Wickham. Chapman & Hall/CRC, 2014

Vectores

Objetos lineales. Función `c()`



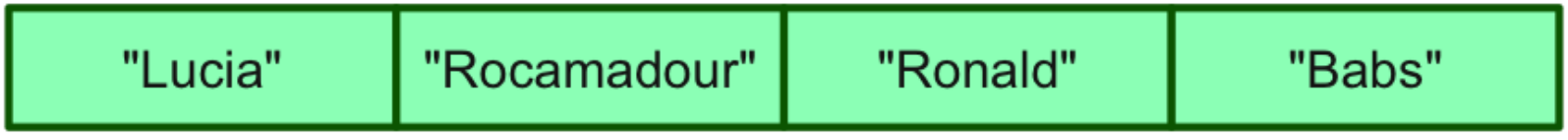

```
vect <- c(1,1,2,3)
```

```
vect
```

```
[1] 1 1 2 3
```

Vectores

Vectores de texto




```
vect <- c("Lucia", "Rocamadour", "Ronald", "Babs")
```

```
vect
```

```
[1] "Lucia"      "Rocamadour" "Ronald"     "Babs"
```

Crear Vectores

Opeardores `c()`, `:` y función `seq()`

```
vect <- c(1,3,5,7)
vect
```

```
[1] 1 3 5 7
```

```
vect <- 1:5
vect
```

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

`seq(from, to, by)`

```
vect <- seq(1, 15, by = 2)
vect
```

```
[1]  1  3  5  7  9 11 13 15
```

Crear Vectores

Función `seq()`

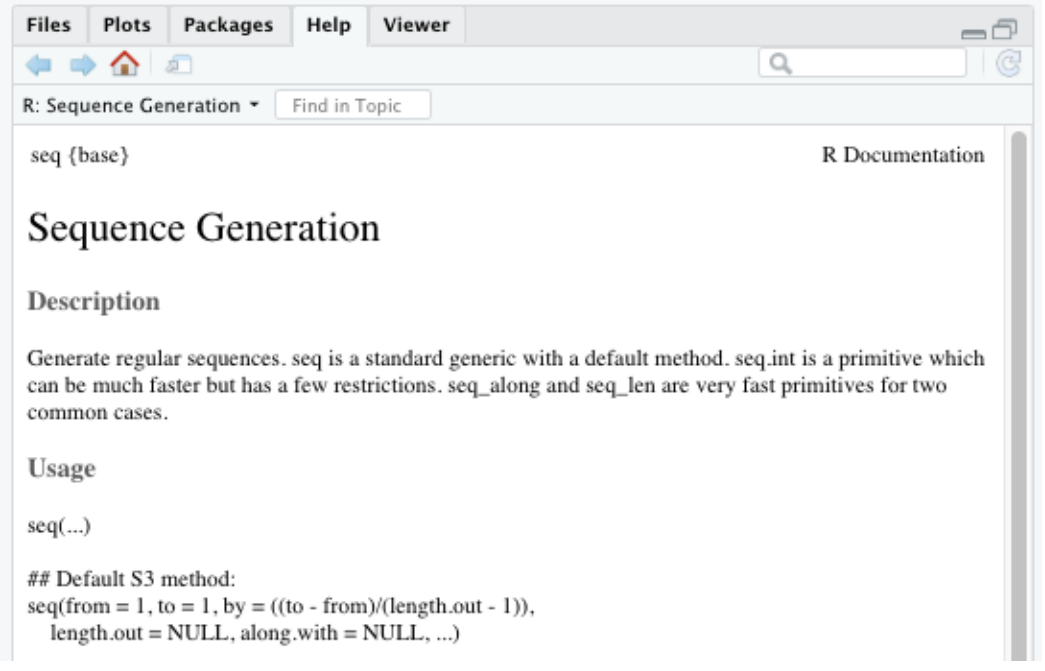
```
funcion(objeto)
```

```
funcion(argumento1, argumento2)
```

Crear Vectores

Función `seq()`

```
?seq()
```



Crear Vectores

Función `seq()`

```
seq(from = 3, to = 21, by = 3)
```

```
[1]  3  6  9 12 15 18 21
```

```
seq(from = 0, to = 2, length.out = 9)
```

```
[1] 0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00
```

Actividad

Crear objetos y vectores atómicos

Usar las funciones:

`c()`

`:`

`seq()`

Crear vectores numéricos:

- los números pares del 2 al 10
- números del 0 al 1 en saltos de 0.01 unidades
- 0, 50, 100, 150, 200… hasta 1000.

Crear vectores numéricos

Los números pares del 2 al 10

```
seq(2, 10, by = 2)
```

```
[1]  2  4  6  8 10
```

```
(1:5) * 2
```

```
[1]  2  4  6  8 10
```

Crear vectores numéricos

Números del 0 al 1 en saltos de 0.01 unidades

```
seq(0, 1, by = 0.01)
```

```
  [1] 0.00 0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10 0.11 0.12 0.1
 [16] 0.15 0.16 0.17 0.18 0.19 0.20 0.21 0.22 0.23 0.24 0.25 0.26 0.27 0.2
 [31] 0.30 0.31 0.32 0.33 0.34 0.35 0.36 0.37 0.38 0.39 0.40 0.41 0.42 0.4
 [46] 0.45 0.46 0.47 0.48 0.49 0.50 0.51 0.52 0.53 0.54 0.55 0.56 0.57 0.5
 [61] 0.60 0.61 0.62 0.63 0.64 0.65 0.66 0.67 0.68 0.69 0.70 0.71 0.72 0.7
 [76] 0.75 0.76 0.77 0.78 0.79 0.80 0.81 0.82 0.83 0.84 0.85 0.86 0.87 0.8
 [91] 0.90 0.91 0.92 0.93 0.94 0.95 0.96 0.97 0.98 0.99 1.00
```

```
(0:100) / 100
```

```
  [1] 0.00 0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10 0.11 0.12 0.1
 [16] 0.15 0.16 0.17 0.18 0.19 0.20 0.21 0.22 0.23 0.24 0.25 0.26 0.27 0.2
 [31] 0.30 0.31 0.32 0.33 0.34 0.35 0.36 0.37 0.38 0.39 0.40 0.41 0.42 0.4
 [46] 0.45 0.46 0.47 0.48 0.49 0.50 0.51 0.52 0.53 0.54 0.55 0.56 0.57 0.5
 [61] 0.60 0.61 0.62 0.63 0.64 0.65 0.66 0.67 0.68 0.69 0.70 0.71 0.72 0.7
```

Crear vectores numéricos

0, 50, 100, 150, 200... hasta 1000

```
seq(0, 1000, by = 50)
```

```
 [1]    0   50  100  150  200  250  300  350  400  450  500  550  600  650
[16]  750  800  850  900  950 1000
```

Acceder a elementos de un vector

`Operador [ ]`

Acceder a elementos de un vector

Operador [ ]


```
vect <- c(3, 3, 4, 5, 9)
vect
```

```
[1] 3 3 4 5 9
```

```
vect[1]
```

```
[1] 3
```

```
vect[3]
```

```
[1] 4
```

Acceder a elementos de un vector

Operador [ ]


```
vect[1:3]
```

```
[1] 3 3 4
```

```
vect[-4]
```

```
[1] 3 3 4 9
```

Acceder a elementos de un vector

`Operador [ ]`

Acceso a elementos usando un vector tipo lógico (`TRUE | FALSE`)

Trae únicamente valores que coinciden con TRUE

```
vect[c(FALSE, FALSE, TRUE, TRUE, FALSE)]
```

```
[1] 4 5
```

Acceder a elementos de un vector

Operador [ ]

Acceso a elementos usando un vector tipo lógico (`TRUE | FALSE`)

```
vect > 3
```

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

```
vect[vect > 3]
```

```
[1] 4 5 9
```

Acceder a elementos de un vector

Operador [ ]

Acceso a elementos usando un vector tipo lógico (`TRUE | FALSE`)

```
vect[vect > 3 & vect < 6]
```

```
[1] 4 5
```

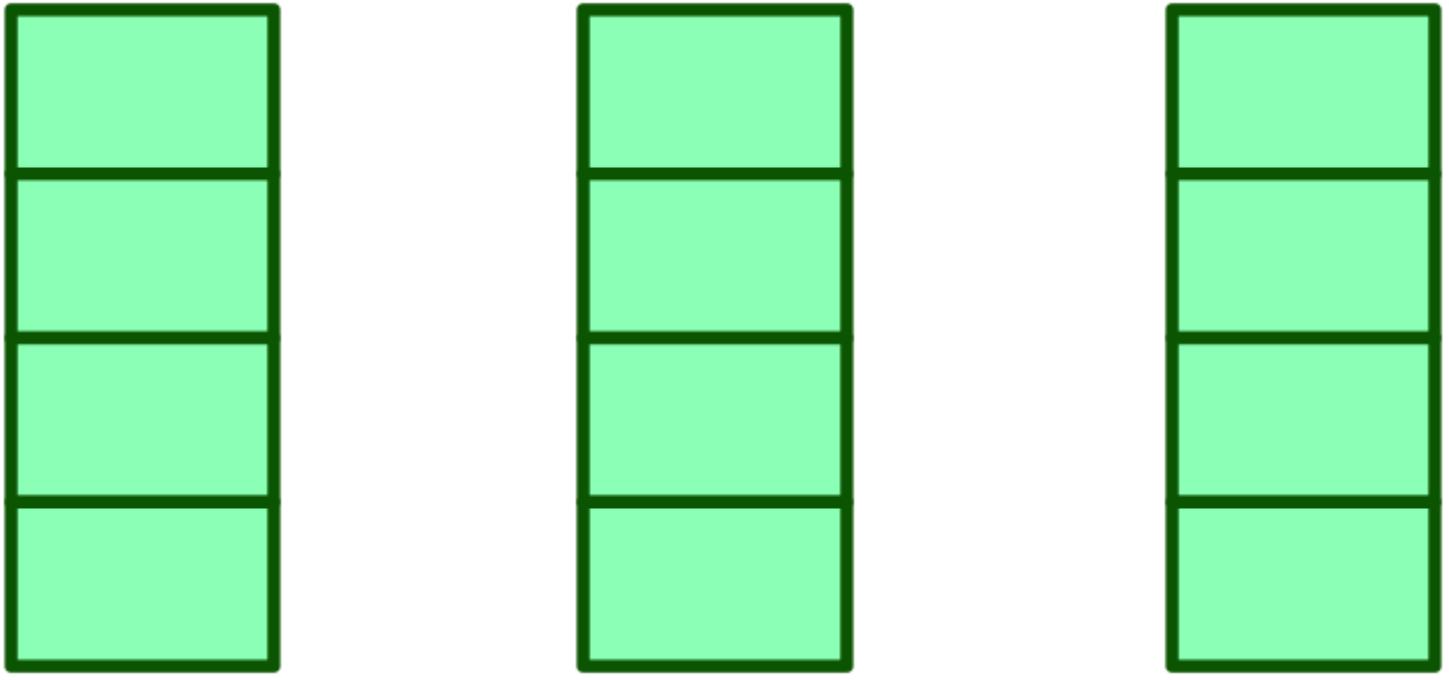
```
vect[vect < 4 | vect > 6]
```

```
[1] 3 3 9
```

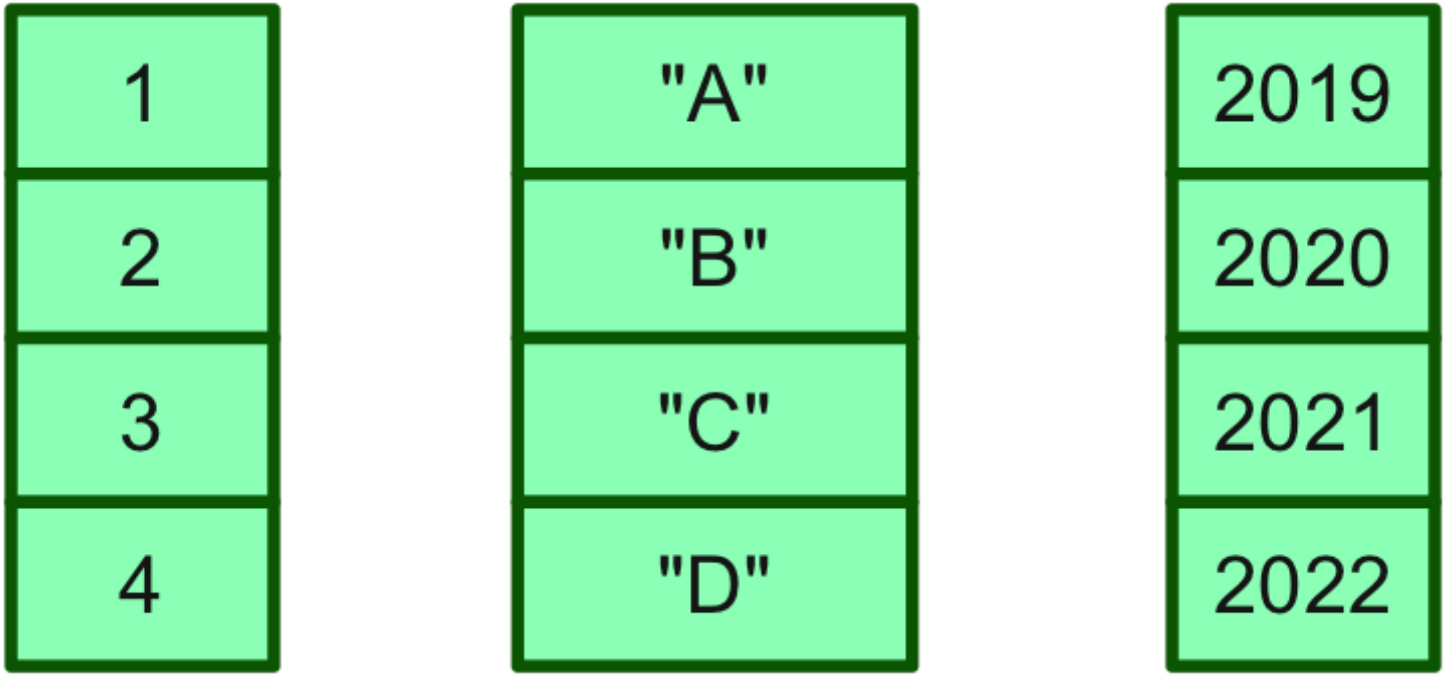
Tablas

Data.frames y tibbles

Tablas como vectores columnares



Tablas como vectores columnares



Data.frame

Código para crear objeto

```
data.frame()
```

```
data.frame(col1, col2, col3)
```

Data.frame

Código para crear objeto

```
data.frame(columna1 = c(1, 2, 3, 4),
           columna2 = c("A", "B", "C", "D"),
           columna3 = 2019:2022)
```

Data.frame

Código para crear objeto

```
data.frame(columna1 = c(1, 2, 3, 4),
           columna2 = c("A", "B", "C", "D"),
           columna3 = 2019:2022)
```

```
  columna1 columna2 columna3
1        1        A     2019
2        2        B     2020
3        3        C     2021
4        4        D     2022
```

Data.frame

Código para crear objeto: asignar <-

```
base <- data.frame(columna1 = c(1, 2, 3, 4),
                   columna2 = c("A", "B", "C", "D"),
                   columna3 = 2019:2022)
```

```
base
```

```
  columna1 columna2 columna3
1        1        A     2019
2        2        B     2020
3        3        C     2021
4        4        D     2022
```

Actividad

Crear data.frame

```
base <- data.frame(columna1 = c(1, 2, 3, 4),
                   columna2 = c("A", "B", "C", "D"),
                        columna3 = 2019:2022)
```

Exploración de datos

Test con datos: gapminder

```
install.packages("dslabs")
```

DSLabs package - *Rafael A. Irizarry, Amy Gill*

Exploración de datos

Crear base 'mundo'

```
mundo <- dslabs::gapminder
```

DSLabs package - *Rafael A. Irizarry, Amy Gill*

Exploración inicial mínima

Exploración inicial mínima

```
dim()

names()

str()

head()
```

Exploración inicial

Dimensiones Nombres Estructura Cabecera

Dimensiones

```
dim(mundo)
```

```
[1] 10545     9
```

Nombres

```
names(mundo)
```

```
[1] "country"          "year"             "infant_mortality" "life_expectar
[5] "fertility"        "population"       "gdp"              "continent"
[9] "region"
```

Exploración inicial

Dimensiones Nombres **Estructura** Cabecera

Estructura

```
str(mundo)
```

```
'data.frame':    10545 obs. of  9 variables:
 $ country         : Factor w/ 185 levels "Albania","Algeria",..: 1 2 3 4 5
 $ year            : int  1960 1960 1960 1960 1960 1960 1960 1960 1960 1960
 $ infant_mortality: num  115.4 148.2 208 NA 59.9 ...
 $ life_expectancy : num  62.9 47.5 36 63 65.4 ...
 $ fertility       : num  6.19 7.65 7.32 4.43 3.11 4.55 4.82 3.45 2.7 5.57
 $ population      : num  1636054 11124892 5270844 54681 20619075 ...
 $ gdp             : num  NA 1.38e+10 NA NA 1.08e+11 ...
 $ continent       : Factor w/ 5 levels "Africa","Americas",..: 4 1 1 2 2 3
 $ region          : Factor w/ 22 levels "Australia and New Zealand",..: 19
```

Exploración inicial

Dimensiones Nombres **Estructura** Cabecera

Estructura (2): `tibble::glimpse`

```
glimpse(mundo)
```

```
Rows: 10,545
Columns: 9
$ country          <fct> Albania, Algeria, Angola, Antigua and Barbuda, Arg
$ year             <int> 1960, 1960, 1960, 1960, 1960, 1960, 1960, 1960, 19
$ infant_mortality <dbl> 115.40, 148.20, 208.00, NA, 59.87, NA, NA, 20.30,
$ life_expectancy  <dbl> 62.87, 47.50, 35.98, 62.97, 65.39, 66.86, 65.66, 7
$ fertility        <dbl> 6.19, 7.65, 7.32, 4.43, 3.11, 4.55, 4.82, 3.45, 2
$ population       <dbl> 1636054, 11124892, 5270844, 54681, 20619075, 18673
$ gdp              <dbl> NA, 13828152297, NA, NA, 108322326649, NA, NA, 960
$ continent        <fct> Europe, Africa, Africa, Americas, Americas, Asia,
$ region           <fct> Southern Europe, Northern Africa, Middle Africa, C
```

Exploración inicial

Dimensiones Nombres Estructura **Cabecera**

Cabecera

```
head(mundo)
```

```
              country year infant_mortality life_expectancy fertility
1             Albania 1960           115.40           62.87      6.19
2             Algeria 1960           148.20           47.50      7.65
3              Angola 1960           208.00           35.98      7.32
4 Antigua and Barbuda 1960               NA           62.97      4.43
5           Argentina 1960            59.87           65.39      3.11
6             Armenia 1960               NA           66.86      4.55
  population          gdp continent          region
1    1636054           NA    Europe Southern Europe
2   11124892  13828152297    Africa Northern Africa
3    5270844           NA    Africa   Middle Africa
4      54681           NA  Americas       Caribbean
5   20619075 108322326649  Americas   South America
```

Exploración inicial

Dimensiones Nombres Estructura Cabecera

`View()`

```
View(mundo)
```

r_intro_2020_presentacion.Rmd* | mundo | Untitled2* | xaringan_theme_jis2020.css

Filter

	country	year	infant_mortality	life_expectancy	fertility	population	gd
1	Albania	1960	115.40	62.87	6.19	1636054	
2	Algeria	1960	148.20	47.50	7.65	11124892	
3	Angola	1960	208.00	35.98	7.32	5270844	
4	Antigua and Barbuda	1960	*NA*	62.97	4.43	54681	
5	Argentina	1960	59.87	65.39	3.11	20619075	
6	Armenia	1960	*NA*	66.86	4.55	1867396	
7	Aruba	1960	*NA*	65.66	4.82	54208	
8	Australia	1960	20.30	70.87	3.45	10292328	
9	Austria	1960	37.30	68.75	2.70	7065525	
10	Azerbaijan	1960	*NA*	61.33	5.57	3897889	
11	Bahamas	1960	51.00	62.00	4.50	109526	

Showing 1 to 12 of 10,545 entries, 9 total columns

Actividad

Importar set de datos gapminder

Obener sus dimensiones, nombres y tipos de variables

Exploración de set de datos gapminder

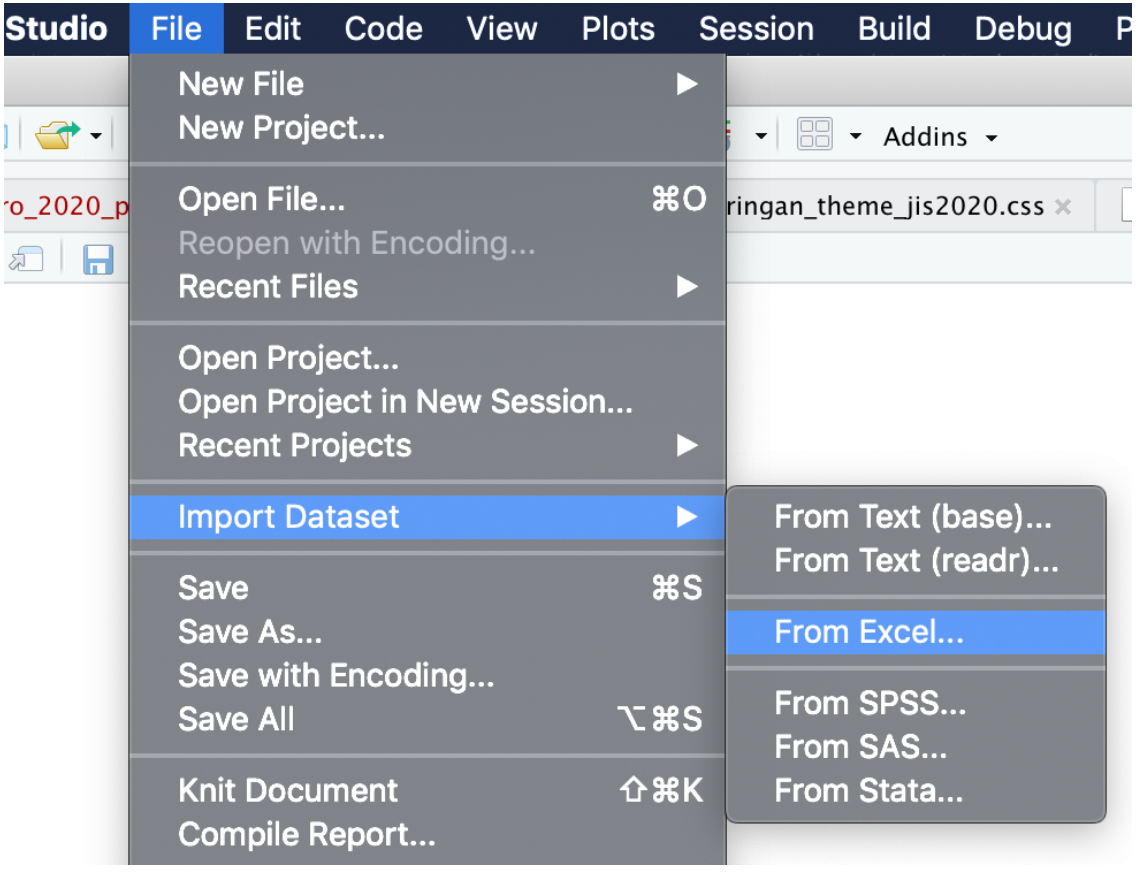
```
mundo <- dslabs::gapminder

dim(mundo)
names(mundo)
str(mundo)
head(mundo)
```

Carga de datos

Carga de datos

Desde el menú de RStudio



Carga de datos

Con código

```
nombre_objeto <- funcion.lectura("camino/a/archivo")
```

Carga de base de datos

```
consultas <- read_csv("datos/consultas.csv")
```

Carga de datos

Con código

```
nombre_objeto <- funcion.lectura("camino/a/archivo")
```

```
consultas <- read_csv("consultas.csv") # requiere tidyverse
consultas <- read_csv("~/projectos/taller_r_jis/consultas.csv")
```

Carga de datos

Con código

```
nombre_objeto <- funcion.lectura("camino/a/archivo")
```

```
consultas <- read_csv("consultas.csv") # requiere tidyverse
consultas <-
  read_csv("https://raw.githubusercontent.com/f-binder/datos_intro
```

Carga de datos

Directorio de trabajo

```
getwd()
```

```
[1] "/Usuario/proyectos/intro_r_jis2020"
```

Actividad

RStudio

Carga de datos:

`consultas.csv`

Carga de datos: Consultas

```
consultas <- read_csv("datos/consultas.csv") # read_csv requiere t
```

Consultas: exploración inicial

```
dim(consultas)
```

```
[1] 670  14
```

Consultas: exploración inicial

```
names(consultas)
```

```
id
edad
edad35
embarazos
glucemia
presion_art
bmi
turno
dia_semana
hora_presente
hora_atencion
mins_espera
uso_portal
urgencias
```

Consultas: exploración inicial

```
glimpse(consultas)
```

```
Rows: 670
Columns: 14
$ id             <dbl> 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 1
$ edad           <dbl> 50, 31, 32, 21, 33, 30, 26, 53, 30, 59, 51, 31, 31, 
$ edad35         <dbl> 1, 0, 0, 0, 0, 0, 0, 1, 0, 1, 1, 0, 0, 0, 0, 0, 1, 1
$ embarazos      <dbl> 3, 0, 4, 0, 0, 2, 2, 1, 2, 0, 2, 0, 4, 0, 0, 2, 4, 4
$ glucemia       <dbl> 148, 85, 183, 89, 137, 116, 78, 197, 110, 189, 166, 
$ presion_art    <dbl> 72, 66, 64, 66, 40, 74, 50, 70, 92, 60, 72, 84, 74, 
$ bmi            <dbl> 33.6, 26.6, 23.3, 28.1, 43.1, 25.6, 31.0, 30.5, 37.6
$ turno          <chr> "am", "am", "pm", "am", "am", "pm", "pm", "am", "am"
$ dia_semana     <chr> "Vie", "Lun", "Lun", "Vie", "Mar", "Mar", "Vie", "Lu
$ hora_presente  <dttm> 2019-11-08 11:03:00, 2019-10-07 09:35:00, 2019-11-0
$ hora_atencion  <dttm> 2019-11-08 11:13:00, 2019-10-07 10:11:00, 2019-11-0
$ mins_espera    <dbl> 12, 39, 40, 16, 8, 39, 25, 12, 25, 31, 29, 21, 13, 3
$ uso_portal     <dbl> 0, 1, 0, 0, 0, 1, 1, 1, 1, 0, 1, 1, 1, 0, 0, 0, 1, 0
$ urgencias      <dbl> 0, 0, 0, 1, 0, 0, 0, 1, 0, 0, 1, 1, 0, 1, 0, 0, 1, 1
```

Consultas: exploración inicial

```
head(consultas)
```

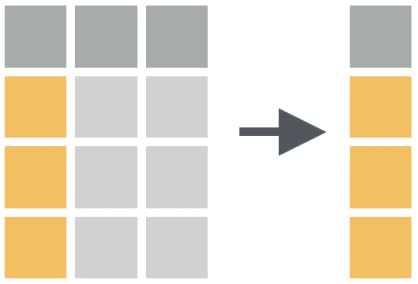
```
# A tibble: 6 x 14
     id  edad edad35 embarazos glucemia presion_art   bmi turno dia_semana
  <dbl> <dbl>  <dbl>     <dbl>    <dbl>       <dbl> <dbl> <chr> <chr>
1     1    50      1         3      148          72  33.6 am    Vie
2     2    31      0         0       85          66  26.6 am    Lun
3     3    32      0         4      183          64  23.3 pm    Lun
4     4    21      0         0       89          66  28.1 am    Vie
5     5    33      0         0      137          40  43.1 am    Mar
6     6    30      0         2      116          74  25.6 pm    Mar
# … with 5 more variables: hora_presente <dttm>, hora_atencion <dttm>,
#   mins_espera <dbl>, uso_portal <dbl>, urgencias <dbl>
```

Tidyverse: Librerías para Ciencia de Datos

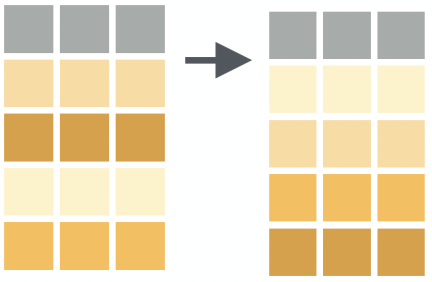
Conjunto de paquetes para ciencia de datos

Funciones de dplyr

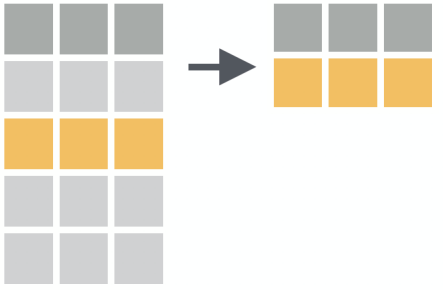
`select()`



`arrange()`

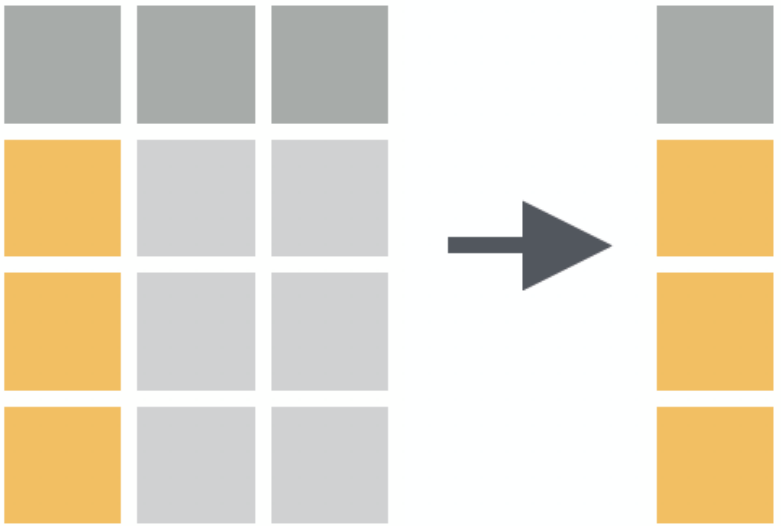


`filter()`



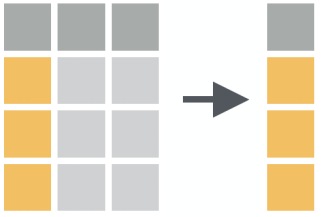
Dplyr Cheat Sheet - https://github.com/rstudio/cheatsheets/blob/master/data-transformation.pdf

select()



Dplyr Cheat Sheet - https://github.com/rstudio/cheatsheets/blob/master/data-transformation.pdf

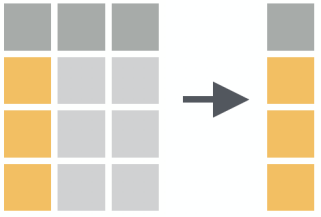
select()



```
select(consultas, id, edad, mins_espera)
```

```
# A tibble: 670 x 3
      id  edad mins_espera
   <dbl> <dbl>       <dbl>
 1     1    50          12
 2     2    31          39
 3     3    32          40
 4     4    21          16
 5     5    33           8
 6     6    30          39
 7     7    26          25
 8     8    53          12
 9     9    30          25
10    10    59          31
```

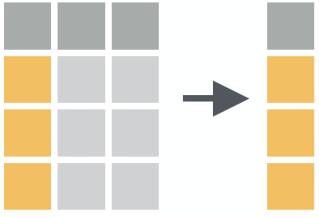
select()



```
consultas %>% select(id, edad, mins_espera)
```

```
# A tibble: 670 x 3
      id  edad mins_espera
   <dbl> <dbl>       <dbl>
 1     1    50          12
 2     2    31          39
 3     3    32          40
 4     4    21          16
 5     5    33           8
 6     6    30          39
 7     7    26          25
 8     8    53          12
 9     9    30          25
10    10    59          31
```

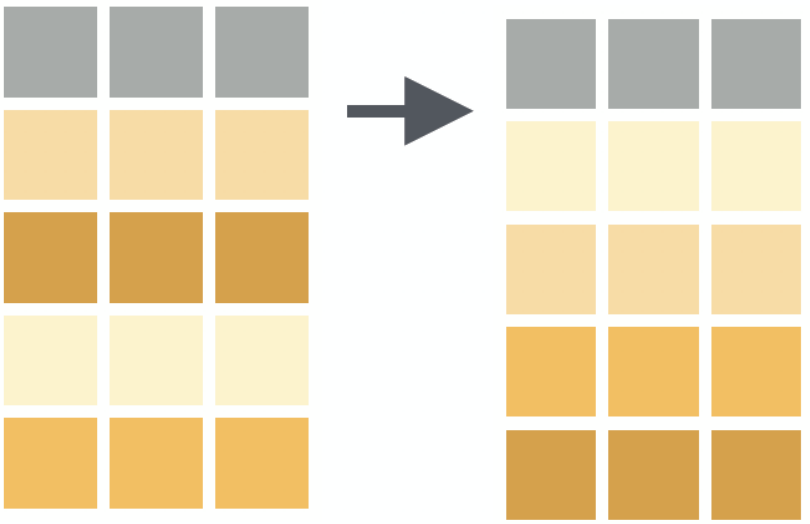
select()



```
consultas %>%
  select(edad, edad35, everything())
```

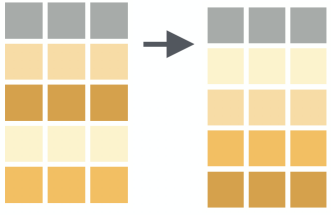
```
# A tibble: 670 x 14
    edad edad35    id embarazos glucemia presion_art   bmi turno dia_semana
   <dbl>  <dbl> <dbl>     <dbl>    <dbl>       <dbl> <dbl> <chr> <chr>
 1    50      1     1         3      148          72  33.6 am    Vie
 2    31      0     2         0       85          66  26.6 am    Lun
 3    32      0     3         4      183          64  23.3 pm    Lun
 4    21      0     4         0       89          66  28.1 am    Vie
 5    33      0     5         0      137          40  43.1 am    Mar
 6    30      0     6         2      116          74  25.6 pm    Mar
 7    26      0     7         2       78          50  31   pm    Vie
 8    53      1     8         1      197          70  30.5 am    Lun
 9    30      0     9         2      110          92  37.6 am    Mie
```

arrange()



Dplyr Cheat Sheet - https://github.com/rstudio/cheatsheets/blob/master/data-transformation.pdf

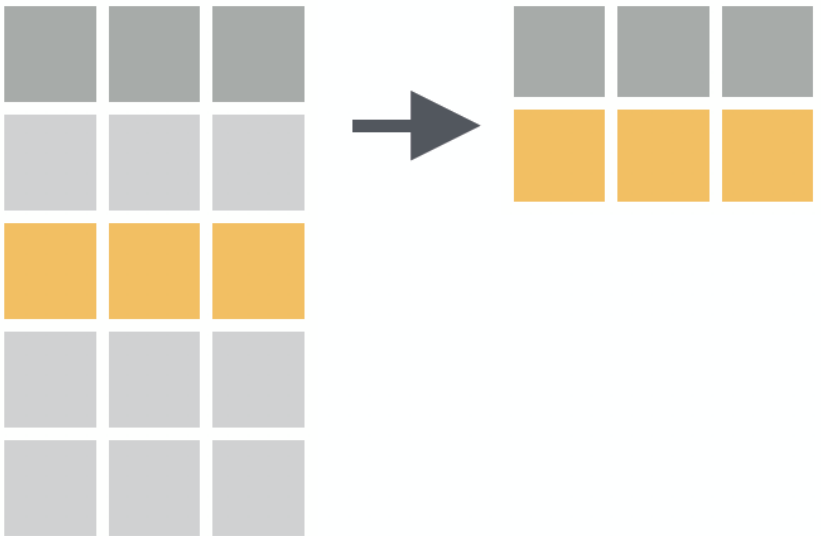
arrange()



```
arrange(consultas, mins_espera)
```

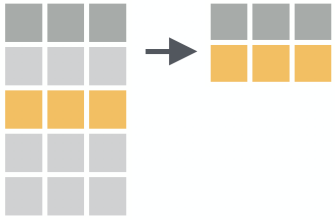
```
# A tibble: 670 x 14
      id mins_espera  edad edad35 embarazos glucemia presion_art   bmi tur
   <dbl>       <dbl> <dbl>  <dbl>     <dbl>    <dbl>        <dbl> <dbl> <ch
 1   125           1    22      0         1      108           52  32.5 am
 2   212           1    23      0         0      179           90  44.1 pm
 3   240           1    40      1         2      122           78  23   pm
 4   353           1    35      1         2      136           84  35   am
 5   408           1    21      0         0      124           56  21.8 pm
 6   447           1    64      1         4      120           78  25   am
 7   590           1    53      1         4      156           86  24.8 am
 8    52           2    24      0         1      141           58  25.4 am
 9   142           2    27      0         0      114           80  44.2 am
10   102           4    21      0         2       99           76  23.2 am
# … with 660 more rows, and 5 more variables: dia_semana <chr>,
```

filter()



Dplyr Cheat Sheet - https://github.com/rstudio/cheatsheets/blob/master/data-transformation.pdf

filter()



```
filter(consultas, mins_espera < 10)
```

```
# A tibble: 74 x 14
      id  edad mins_espera edad35 embarazos glucemia presion_art   bmi turn
   <dbl> <dbl>       <dbl>  <dbl>     <dbl>    <dbl>        <dbl> <dbl> <ch
 1     5    33           8      0         0      137           40  43.1 am
 2    22    38           9      1         2      117           92  34.1 pm
 3    31    26           9      0         2      180           64  34   am
 4    46    41           8      1         4      187           68  37.7 pm
 5    52    24           2      0         1      141           58  25.4 am
 6    56    54           9      1         1      109           92  42.7 am
 7    75    42           5      1         4       81           78  46.7 pm
 8    84    22           8      0         0      151           60  26.1 am
 9   102    21           4      0         2       99           76  23.2 am
10   110    23           5      0         0      118           58  33.3 am
# … with 64 more rows, and 5 more variables: dia_semana <chr>,
```

Actividad

Seleccionar columnas y filtrar registros

Funciones de `dplyr`

Operador 'pipe': `%>%`

```
fx2(fx1(objeto))
```

```
fx1(objeto) %>% fx2()
```

Ejemplo de uso de pipes

Selecionar columnas y filtrar observaciones

```
consultas %>%
  select(edad, bmi, mins_espera, glucemia) %>%
  filter(bmi < 20 & edad > 50)
```

```
# A tibble: 1 x 4
   edad   bmi mins_espera glucemia
  <dbl> <dbl>       <dbl>    <dbl>
1    60  19.6          11      129
```

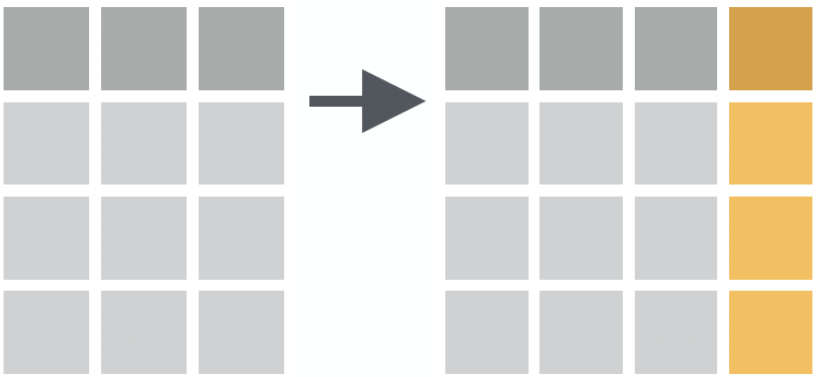
Ejemplo de uso de pipes

Selecionar columnas y filtrar observaciones

```
consultas %>%
  select(edad, glucemia, dia_semana) %>%
  filter(dia_semana %in% c("Mie", "Jue")) %>%
  arrange(desc(glucemia))
```

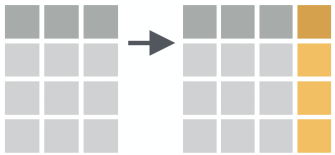
```
# A tibble: 267 x 3
    edad glucemia dia_semana
   <dbl>    <dbl> <chr>
 1    28      198 Mie
 2    39      197 Mie
 3    62      197 Mie
 4    41      196 Jue
 5    57      196 Mie
 6    29      196 Mie
 7    55      195 Mie
 8    31      195 Jue
 9    41      194 Mie
```

mutate()



Dplyr Cheat Sheet - https://github.com/rstudio/cheatsheets/blob/master/data-transformation.pdf

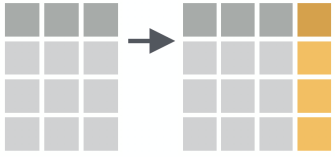
mutate()



```
mutate(consultas, horas_espera = mins_espera/60)
```

```
# A tibble: 670 x 15
      id  edad edad35 embarazos glucemia presion_art   bmi turno dia_semana
   <dbl> <dbl>  <dbl>     <dbl>    <dbl>       <dbl> <dbl> <chr> <chr>
 1     1    50      1         3      148          72  33.6 am    Vie
 2     2    31      0         0       85          66  26.6 am    Lun
 3     3    32      0         4      183          64  23.3 pm    Lun
 4     4    21      0         0       89          66  28.1 am    Vie
 5     5    33      0         0      137          40  43.1 am    Mar
 6     6    30      0         2      116          74  25.6 pm    Mar
 7     7    26      0         2       78          50  31   pm    Vie
 8     8    53      1         1      197          70  30.5 am    Lun
 9     9    30      0         2      110          92  37.6 am    Mie
10    10    59      1         0      189          60  30.1 pm    Vie
# … with 660 more rows, and 6 more variables: hora_presente <dttm>,
#   hora_atencion <dttm>, mins_espera <dbl>, uso_portal <dbl>, urgencias <d
```

mutate()



```
mutate(consultas, horas_espera = mins_espera/60) %>%
  select(mins_espera, horas_espera, everything())
```

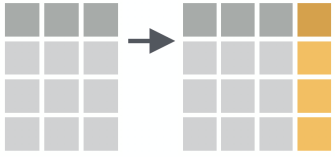
```
# A tibble: 670 x 15
   mins_espera horas_espera    id  edad edad35 embarazos glucemia presion_a
         <dbl>        <dbl> <dbl> <dbl>  <dbl>     <dbl>    <dbl>       <dl
 1          12        0.2       1    50      1         3      148
 2          39        0.65      2    31      0         0       85
 3          40        0.667     3    32      0         4      183
 4          16        0.267     4    21      0         0       89
 5           8        0.133     5    33      0         0      137
 6          39        0.65      6    30      0         2      116
 7          25        0.417     7    26      0         2       78
 8          12        0.2       8    53      1         1      197
 9          25        0.417     9    30      0         2      110
10          31        0.517    10    59      1         0      189
# … with 660 more rows, and 7 more variables: bmi <dbl>, turno <chr>,
```

Función `ifelse()`

3 argumentos

```
ifelse(condición, si_verdadero,
si_falso)
```

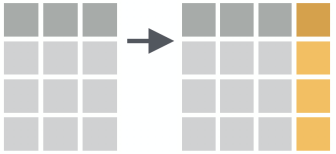
mutate()



```
consultas %>%
  mutate(partos_dicot = ifelse(embarazos > 0,
                               "atc_embarazos",
                               "nuligesta")) %>%
  select(embarazos, partos_dicot, everything())
```

```
# A tibble: 670 x 15
   embarazos partos_dicot    id  edad edad35 glucemia presion_art   bmi tu
       <dbl> <chr>        <dbl> <dbl>  <dbl>    <dbl>       <dbl> <dbl> <c
 1         3 atc_embaraz…     1    50      1      148          72  33.6 am
 2         0 nuligesta        2    31      0       85          66  26.6 am
 3         4 atc_embaraz…     3    32      0      183          64  23.3 pm
 4         0 nuligesta        4    21      0       89          66  28.1 am
 5         0 nuligesta        5    33      0      137          40  43.1 am
 6         2 atc_embaraz…     6    30      0      116          74  25.6 pm
 7         2 atc_embaraz…     7    26      0       78          50  31   pm
 8         1 atc_embaraz…     8    53      1      197          70  30.5 am
```

mutate()



```
consultas %>%
  mutate(partos_dicot = ifelse(embarazos > 0,
                               "atc_embarazos",
                               "nuligesta")) %>%
  distinct(embarazos, partos_dicot) %>% arrange(embarazos)
```

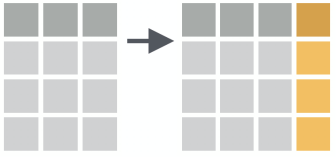
```
# A tibble: 5 x 2
  embarazos partos_dicot
      <dbl> <chr>
1         0 nuligesta
2         1 atc_embarazos
3         2 atc_embarazos
4         3 atc_embarazos
5         4 atc_embarazos
```

Función

`case_when()`

```
case_when(condicion1 ~ resultado1,
          condicion2 ~ resultado2,
          condición3 ~ resultado3,
          ...)
```

mutate()



```
consultas %>%
  mutate(seguimiento =
           case_when(glucemia > 126 ~ "consulta endocr.",
                     glucemia >= 110 ~ "estrecho",
                     glucemia >= 100 | edad >= 65 ~ "intermedio",
                     TRUE ~ "bajo"))
```

```
# A tibble: 8 x 3
   edad glucemia seguimiento
  <dbl>    <dbl> <chr>
1    31       85 bajo
2    21       89 bajo
3    50      148 consulta endocr.
4    32      183 consulta endocr.
5    30      116 estrecho
6    30      110 estrecho
7    31      107 intermedio
```

Crear variable con case_when()

```
# A tibble: 8 x 3
   edad glucemia seguimiento
  <dbl>    <dbl> <chr>
1    31       85 bajo
2    21       89 bajo
3    50      148 consulta endocr.
4    32      183 consulta endocr.
5    30      116 estrecho
6    30      110 estrecho
7    31      107 intermedio
8    33      103 intermedio
```

Tidyverse: función `summarise()`

Medidas de resumen

Medidas de resumen generales

Sintaxis de `summarise()`

```
datos %>%
  summarise(nombre_resultado1 = formula1,
            nombre_resultado2 = formula2,
            ...)
```

Ejemplo de `summarise()`

Medidas de resumen global

```
consultas %>%
  summarise(promedio_espera = mean(mins_espera))
```

```
# A tibble: 1 x 1
  promedio_espera
            <dbl>
1            24.6
```

Ejemplo de `summarise()`

Medidas de resumen global

```
consultas %>%
  summarise(n = n(),
            promedio_espera = mean(mins_espera),
            maxima_espera = max(mins_espera))
```

```
# A tibble: 1 x 3
      n promedio_espera maxima_espera
  <int>           <dbl>          <dbl>
1   670            24.6             58
```

Ejemplo de `summarise()`

Medidas de resumen por grupos:

```
consultas %>%
  group_by(dia_semana) %>%
  summarise(n = n(),
            espera_media = mean(mins_espera),
            espera_max = max(mins_espera))
```

Ejemplo de `summarise()`

Medidas de resumen por grupos:

```
consultas %>%
  group_by(dia_semana) %>%
  summarise(n = n(),
            espera_media = mean(mins_espera),
            espera_max = max(mins_espera))
```

```
# A tibble: 5 x 4
  dia_semana     n espera_media espera_max
  <chr>      <int>        <dbl>      <dbl>
1 Jue          128         24.1         56
2 Lun          151         25.8         58
3 Mar          116         24.5         54
4 Mie          139         20.6         50
5 Vie          136         27.6         56
```

Combinaciones!

```
consultas %>%
  mutate(gestas = ifelse(embarazos > 0,
                         "atc_gestas",
                         "nuligesta")) %>%
  group_by(gestas) %>%
  summarise(n = n(),
            gluc_media = mean(glucemia),
            gluc_min = min(glucemia))
```

Combinaciones!

```
consultas %>%
  mutate(gestas = ifelse(embarazos > 0,
                         "atc_gestas",
                         "nuligesta")) %>%
  group_by(gestas) %>%
  summarise(n = n(),
            gluc_media = mean(glucemia),
            gluc_min = min(glucemia))
```

```
# A tibble: 2 x 4
  gestas          n gluc_media gluc_min
  <chr>       <int>      <dbl>    <dbl>
1 atc_gestas    440       124.       44
2 nuligesta     230       118.       57
```

Gráficos con Ggplot2

Ggplot2: gramática de gráficos

Componentes de un gráfico:

- Datos

- 'Geoms' o 'capas'

- 'Mappings' vínculo entre datos y geoms

Ggplot2: gramática de gráficos

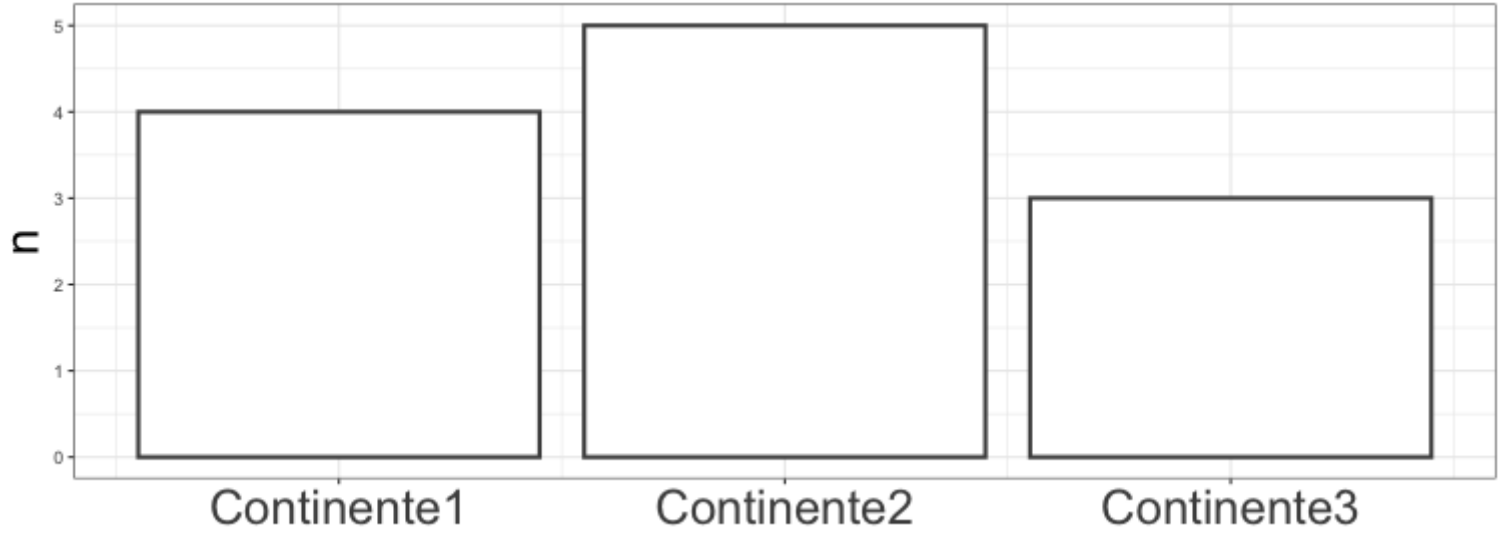
Crear base 'mundo'

```
mundo <- dslabs::gapminder
```

DSLabs package - *Rafael A. Irizarry, Amy Gill*

Ggplot2: sintaxis

Gráfico de barras



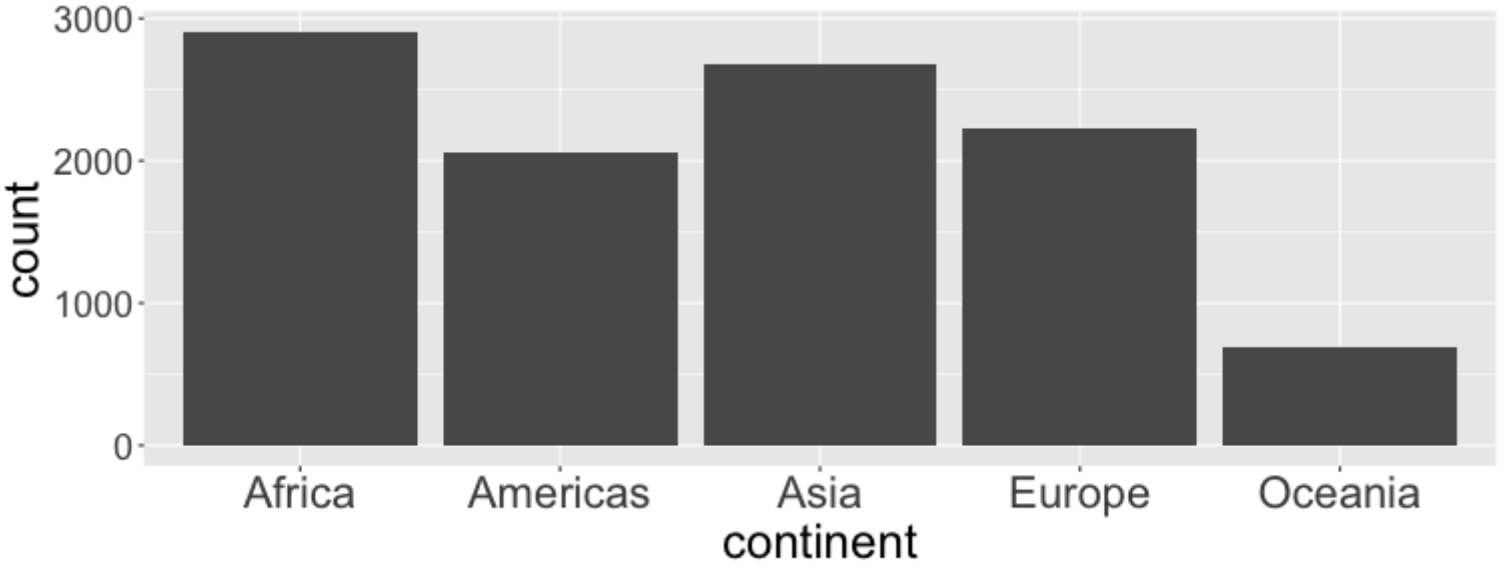
Ggplot2: sintaxis

Gráfico de barras

Parámetro	valor
Data	mundo
Geom	bar
Mapping (aes)	x = continent

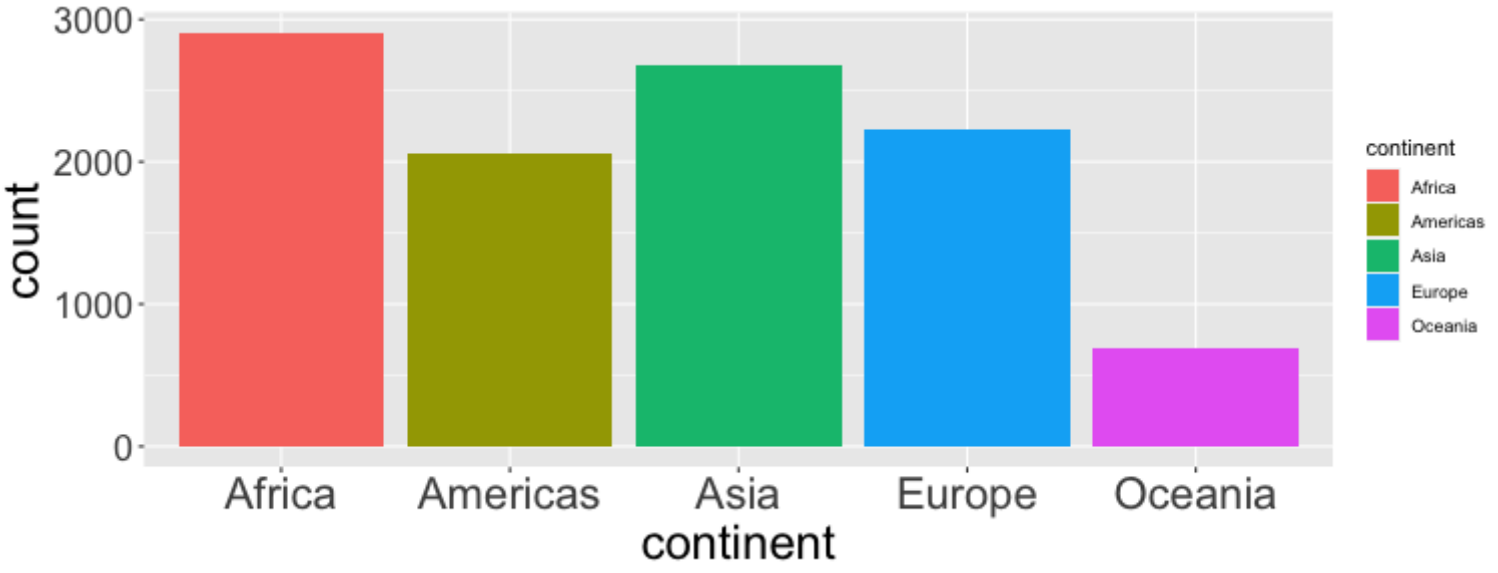
Ggplot2: gramática de gráficos

```
ggplot(data = mundo, aes(x = continent)) +
  geom_bar()
```



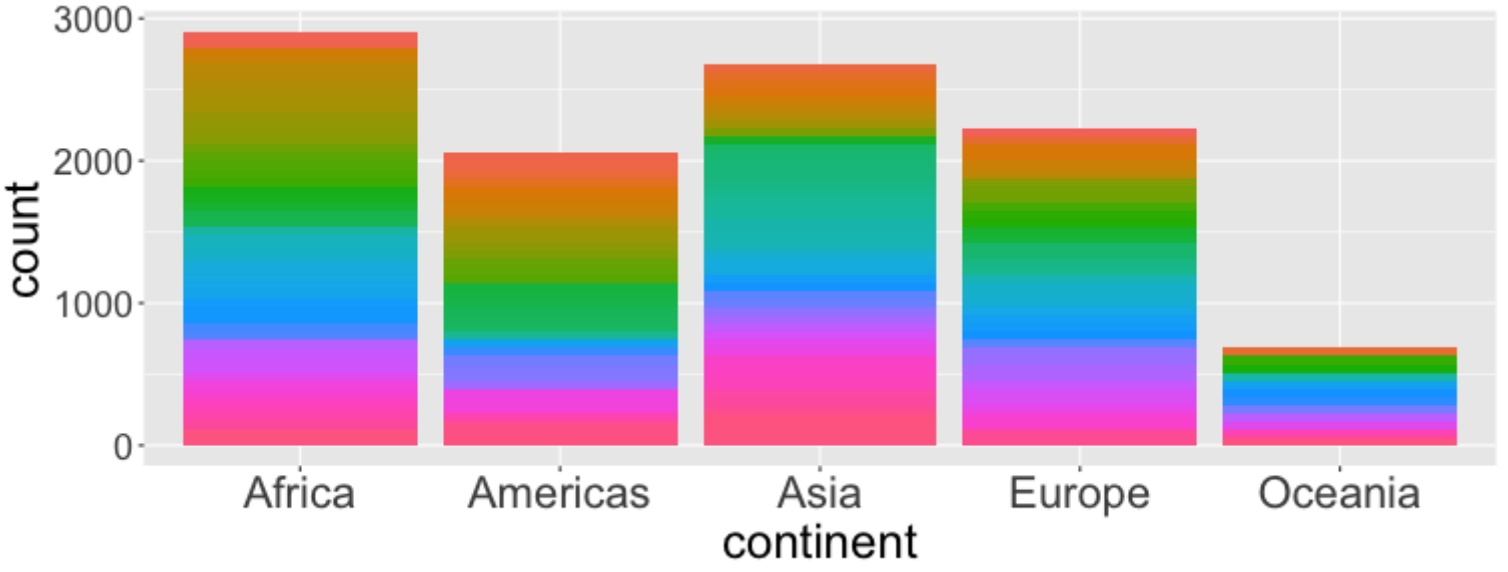
Ggplot2: gramática de gráficos

```
ggplot(data = mundo, aes(x = continent)) +
  geom_bar(aes(fill = continent))
```



Ggplot2: gramática de gráficos

```
ggplot(data = mundo, aes(x = continent)) +
  geom_bar(aes(fill = country))
```



Ggplot y pipes

%>%

¿Seleccionar variables y filtrar observaciones antes de graficar?

Ggplot y pipes

```
ggplot(data, aes(x, y))
```

```
data %>% ggplot(., aes(x, y))
```

```
data %>% ggplot(aes(x, y))
```

Ggplot y pipes

```
mundo %>% dim()
```

```
[1] 10545     9
```

```
mundo %>%
  filter(continent == "Oceania") %>%
  dim()
```

```
[1] 684   9
```

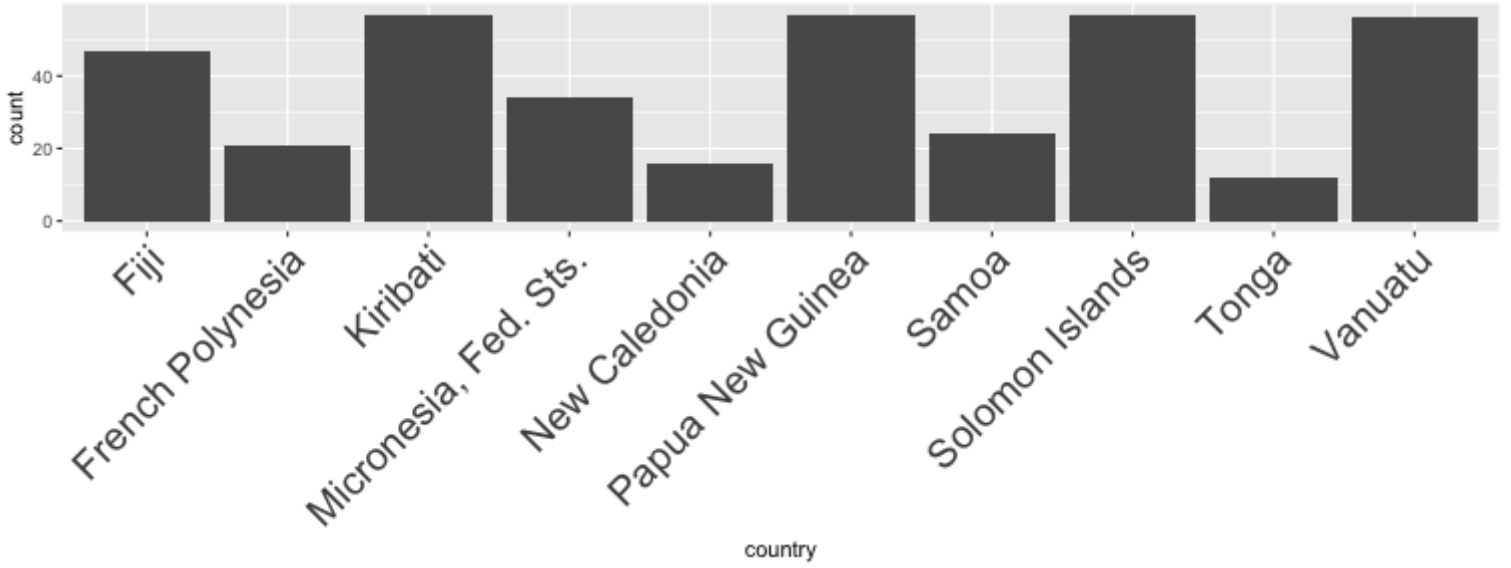
Ggplot y pipes

```
mundo %>%
  filter(continent == "Oceania" & life_expectancy < 65) %>%
  dim()
```

```
[1] 381   9
```

Ggplot y pipes

```
mundo %>%
  filter(continent == "Oceania" & life_expectancy < 65) %>%
  ggplot(aes(x = country)) +
  geom_bar()
```

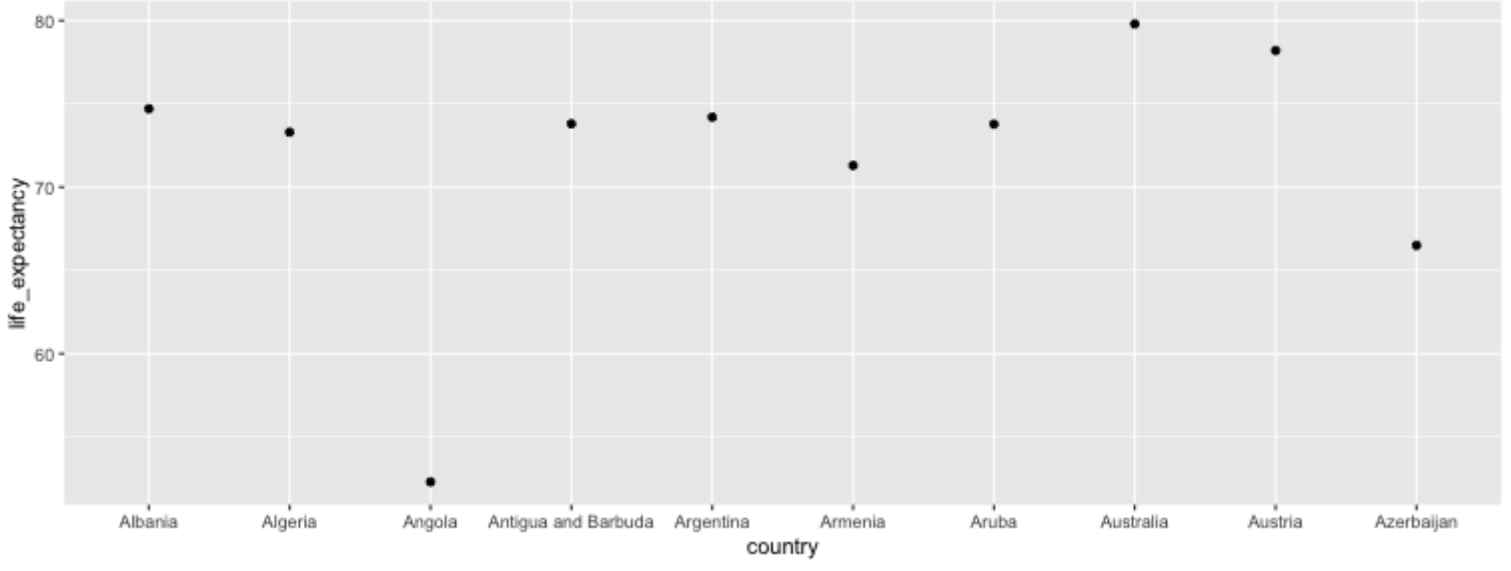


Ggplot y pipes

```
mundo %>%
filter(str_detect(country, "^A") &
         year == 2000) %>%
  ggplot(aes(x = country,
             y = life_expectancy)) +
  geom_point()
```

Ggplot y pipes

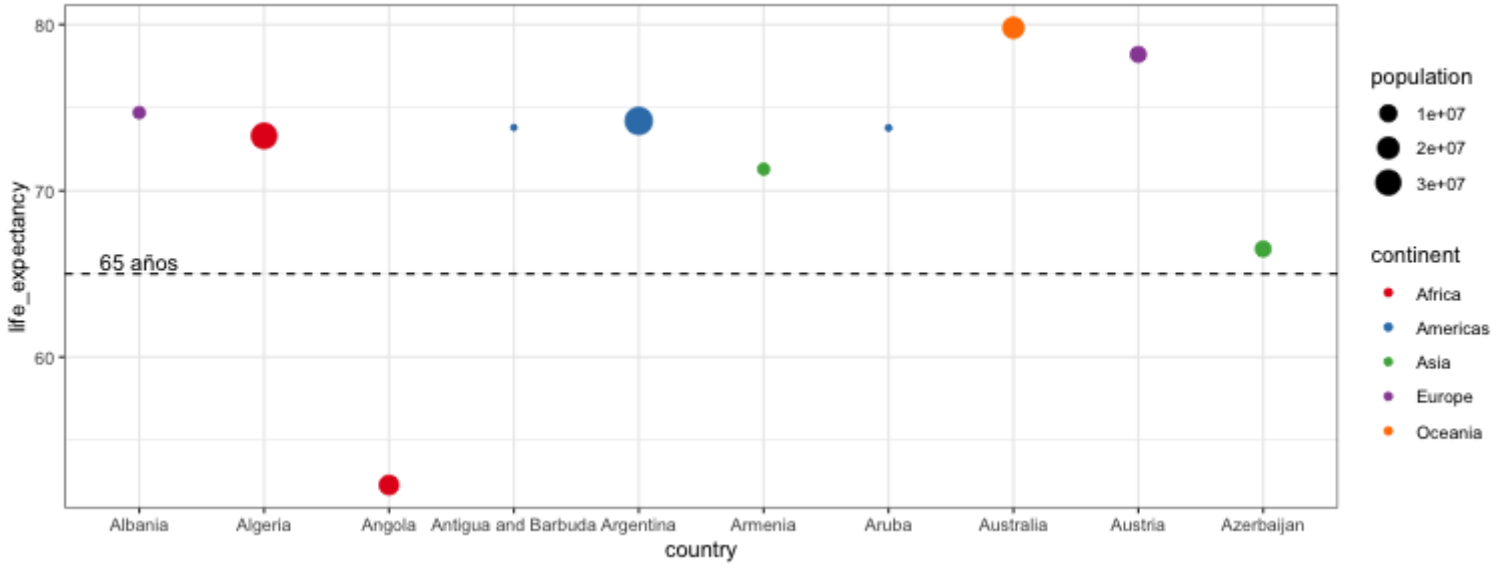
```
mundo %>%
filter(str_detect(country, "^A") &
         year == 2000) %>%
  ggplot(aes(x = country,
             y = life_expectancy)) +
  geom_point()
```



Ggplot y pipes

```
mundo %>%
filter(str_detect(country, "^A") &
         year == 2000) %>%
  ggplot(aes(x = country,
             y = life_expectancy)) +
  geom_point(aes(size = population, color = continent)) +
  geom_hline(yintercept = 65, lty = "dashed") +
  annotate("text", y = 65, x = 1, vjust = -0.3,
           label = "65 años") +
  theme_bw()
```

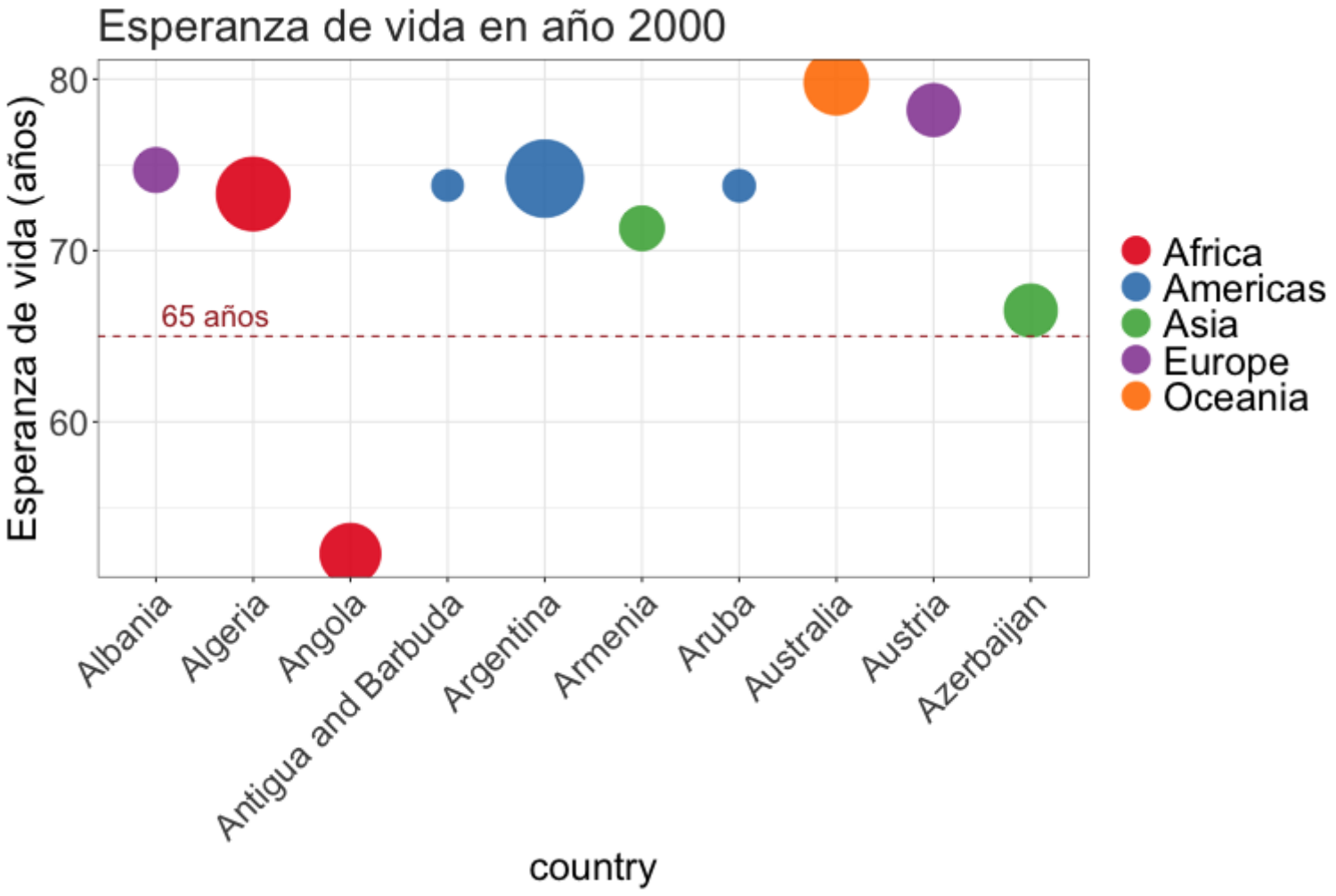
Ggplot y pipes



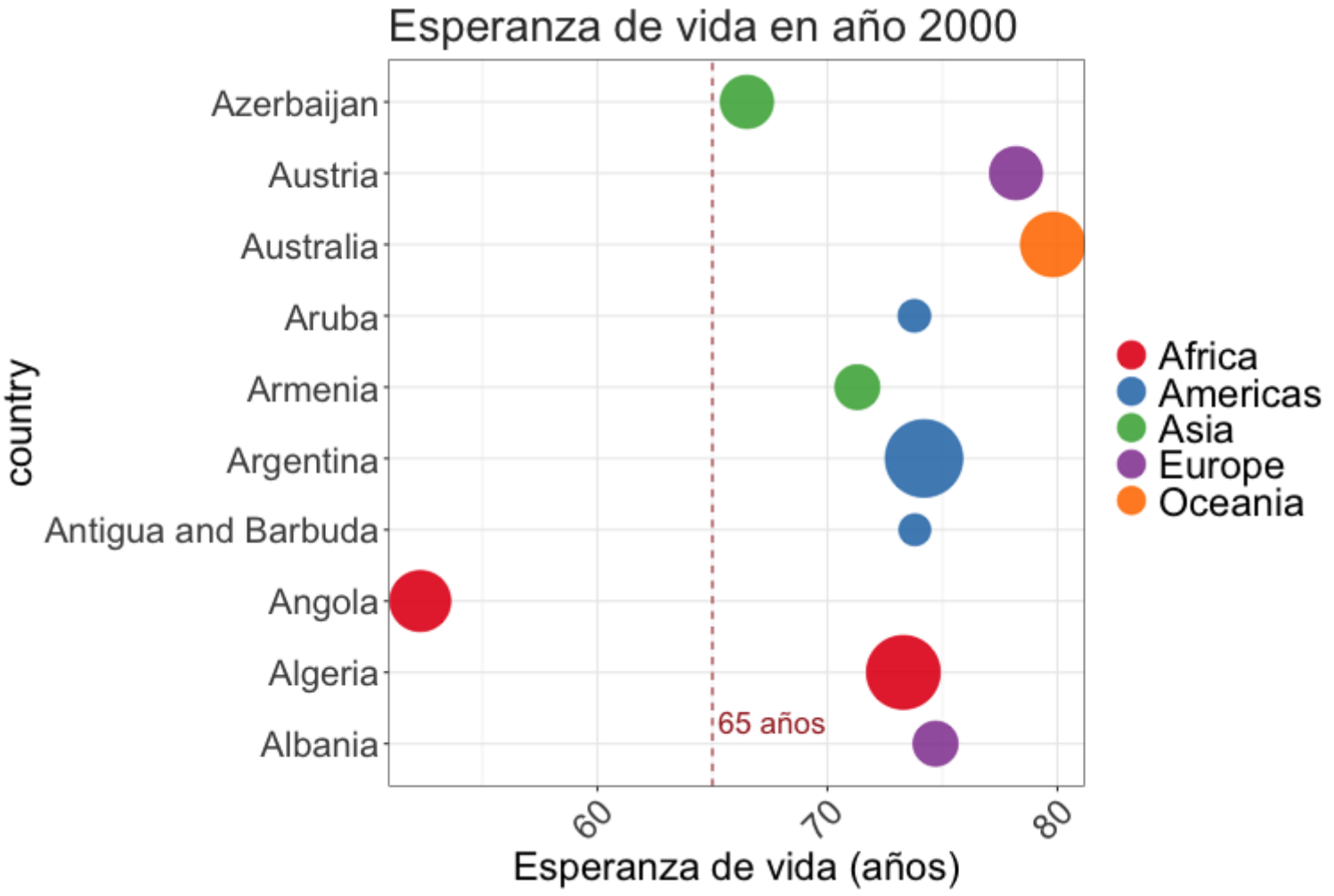
Ggplot y pipes

```
mundo %>%
filter(str_detect(country, "^A") &
         year == 2000) %>%
  ggplot(aes(x = country,
             y = life_expectancy)) +
  geom_point(aes(size = population, color = continent)) +
  geom_hline(yintercept = 65, lty = "dashed") +
  annotate("text", y = 65, x = 1, vjust = -0.3,
           label = "Esperanza de vida = 65 años") +
  labs(title = "Esperanza de vida en año 2000") +
  theme_bw() +
  theme(axis.text.x =
          element_text(angle = 45, hjust = 1, size = 14),
        axis.title = element_text(size = 15),
        legend.position = "bottom")
```

Ggplot y pipes



Ggplot y pipes

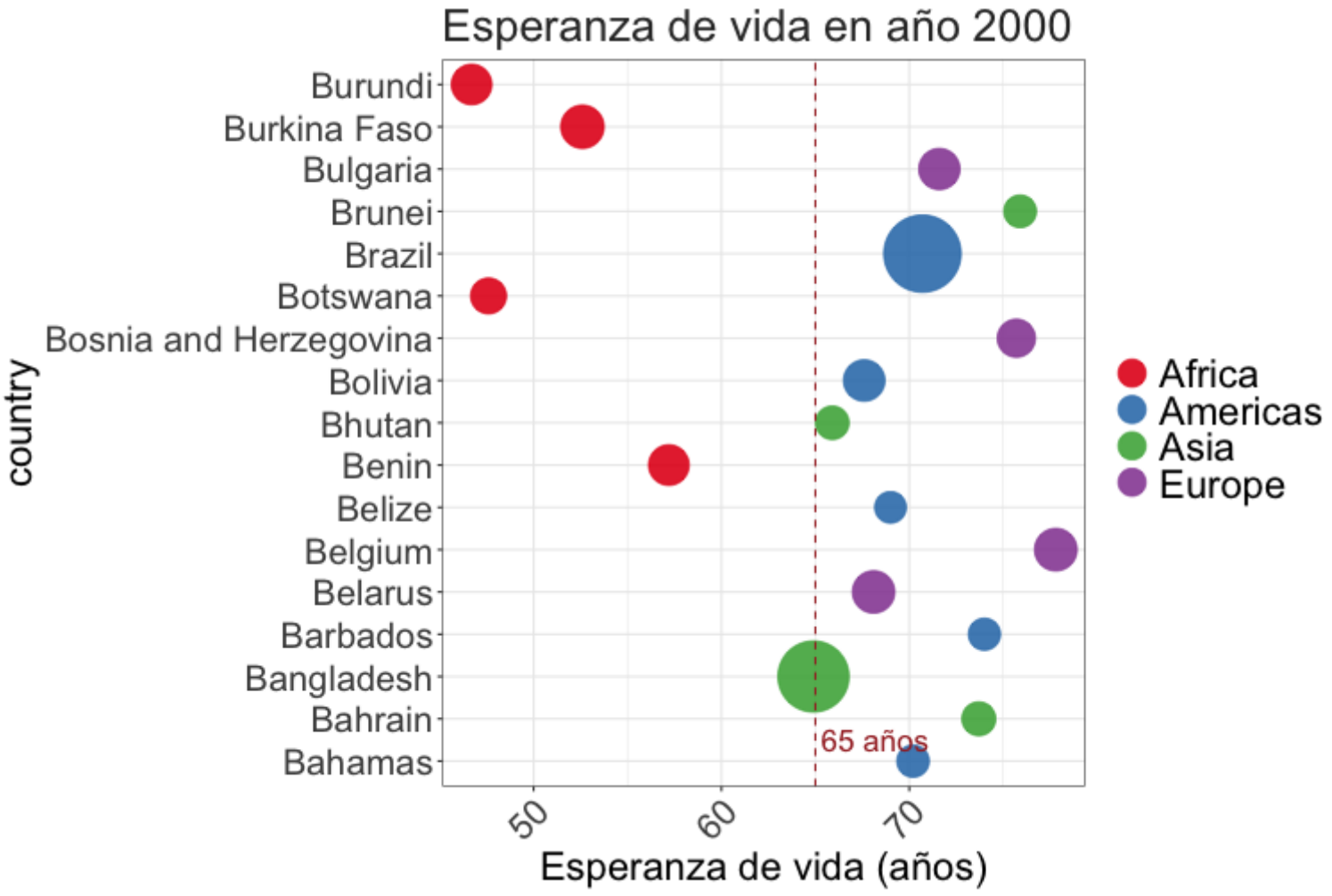


Filtrar B

```
mundo %>%
  filter(str_detect(country, "^A") &
           year == 2000) %>%
  ggplot(aes(x = country,
             y = life_expectancy)) + (...)
```

```
mundo %>%
  filter(str_detect(country, "^B") &
           year == 2000) %>%
  ggplot(aes(x = country,
             y = life_expectancy)) + (...)
```

Filtrar B


Esperanza de vida en año 2000
Burundi
Burkina Faso
Bulgaria
Brunei
Brazil
Botswana
Bosnia and Herzegovina
Bolivia
Bhutan
Benin
Belize
Belgium
Belarus
Barbados
Bangladesh
Bahrain
Bahamas
country
65 años
50
60
70
Esperanza de vida (años)
Africa
Americas
Asia
Europe

Tests de hipótesis

Tests de hipótesis

Pregunta

¿Es diferente el tiempo de espera los lunes y viernes vs mitad de semana?

Tests de hipótesis: Scripts para Investigación

```r
## Cargar librerías ------

## Cargar datos ----------
datos <- readxl::read_xlsx()

# Exploración inicial ----

# Crear variables --------
datos %>% mutate()

# Analisis descriptivo ---
datos %>% count(var)

# Comparacion - test 1 ---
t.test(var1 ~ grupo)
```

Tests de hipótesis: Scripts para Investigación

```
## Cargar librerías ------

## Cargar datos ----------
datos <- readxl::read_xlsx()

# Exploración inicial ----

# Crear variables --------
datos %>% mutate()

# Analisis descriptivo ---
datos %>% count(var)

# Comparacion - test 1 ---
t.test(var1 ~ grupo)
```

Test de hipótesis: Exploración de datos

Repasar base de datos

```
dim(consultas)
```

```
[1] 670  14
```

Test de hipótesis: Exploración de datos

Repasar base de datos

```
consultas %>%
  select(mins_espera, dia_semana, hora_presente, hora_atencion) %>%
  head(10)
```

```
# A tibble: 10 x 4
   mins_espera dia_semana hora_presente       hora_atencion
         <dbl> <chr>      <dttm>              <dttm>
 1          12 Vie        2019-11-08 11:03:00 2019-11-08 11:13:00
 2          39 Lun        2019-10-07 09:35:00 2019-10-07 10:11:00
 3          40 Lun        2019-11-04 15:01:00 2019-11-04 15:42:00
 4          16 Vie        2019-10-25 10:29:00 2019-10-25 10:42:00
 5           8 Mar        2019-11-05 10:09:00 2019-11-05 10:20:00
 6          39 Mar        2019-10-15 14:38:00 2019-10-15 15:18:00
 7          25 Vie        2019-10-18 14:37:00 2019-10-18 14:58:00
 8          12 Lun        2019-10-14 09:46:00 2019-10-14 09:54:00
 9          25 Mie        2019-10-16 09:23:00 2019-10-16 09:51:00
```

Test de hipótesis: Exploración de datos

¿Es diferente el tiempo de espera los lunes y viernes vs mitad de semana?

Test de hipótesis: Exploración de datos

¿Es diferente el tiempo de espera los lunes y viernes vs mitad de semana?

Variables de interés: dia_semana y mins_espera

Días Semana

Tiempo de Espera

Test de hipótesis: Exploración de datos

¿Es diferente el tiempo de espera los lunes y viernes vs mitad de semana?

Variables de interés: dia_semana y mins_espera

Días Semana

Tiempo de Espera

Test de hipótesis: Exploración de datos

Verificar días de la semana disponibles y valores vacíos de ambos

```
consultas %>%
  distinct(dia_semana)
```

```
# A tibble: 5 x 1
  dia_semana
  <chr>
1 Vie
2 Lun
3 Mar
4 Mie
5 Jue
```

Test de hipótesis: Exploración de datos

Verificar días de la semana disponibles y valores vacíos de ambos

```
consultas %>%
  summarise(n_vacios_dias = sum(is.na(dia_semana)),
            n_vacios_espera = sum(is.na(mins_espera)))
```

```
# A tibble: 1 x 2
  n_vacios_dias n_vacios_espera
          <int>           <int>
1             0               0
```

```
sum(is.na(consultas$mins_espera))
```

```
[1] 0
```

Test de hipótesis: Exploración de datos

```
consultas %>%
  count(dia_semana)
```

```
# A tibble: 5 x 2
  dia_semana     n
  <chr>      <int>
1 Jue          128
2 Lun          151
3 Mar          116
4 Mie          139
5 Vie          136
```

Test de hipótesis: Exploración de datos

```
consultas %>%
  count(dia_semana) %>%
  mutate(perc = 100*n/sum(n))
```

```
# A tibble: 5 x 3
  dia_semana     n  perc
  <chr>      <int> <dbl>
1 Jue          128  19.1
2 Lun          151  22.5
3 Mar          116  17.3
4 Mie          139  20.7
5 Vie          136  20.3
```

Test de hipótesis: Exploración de datos

¿Es diferente el tiempo de espera los lunes y viernes vs mitad de semana?

Variables de interés: dia_semana y mins_espera

Días Semana

Tiempo de Espera

Test de hipótesis: Exploración de datos

summary()

```
summary(consultas$mins_espera)
```

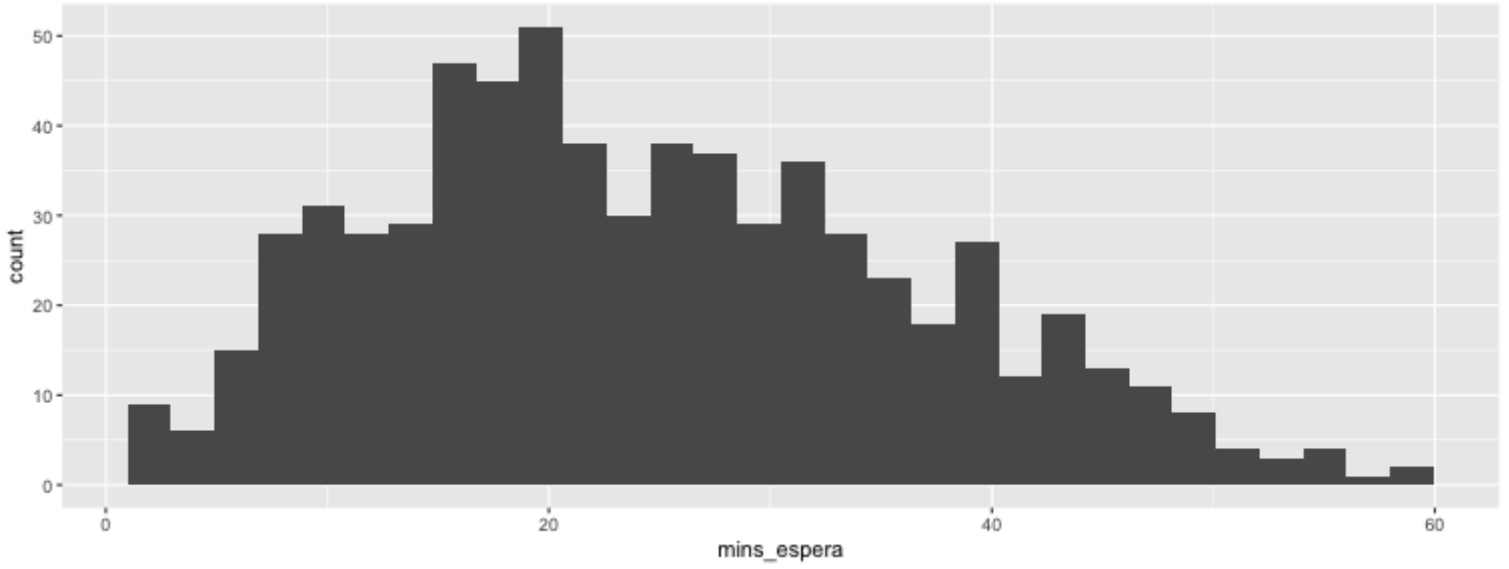
```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max. 
   1.00   16.00   23.00   24.55   33.00   58.00 
```

Test de hipótesis: Exploración de datos

```
consultas %>%
  ggplot(aes(x = mins_espera)) +
  geom_histogram()
```

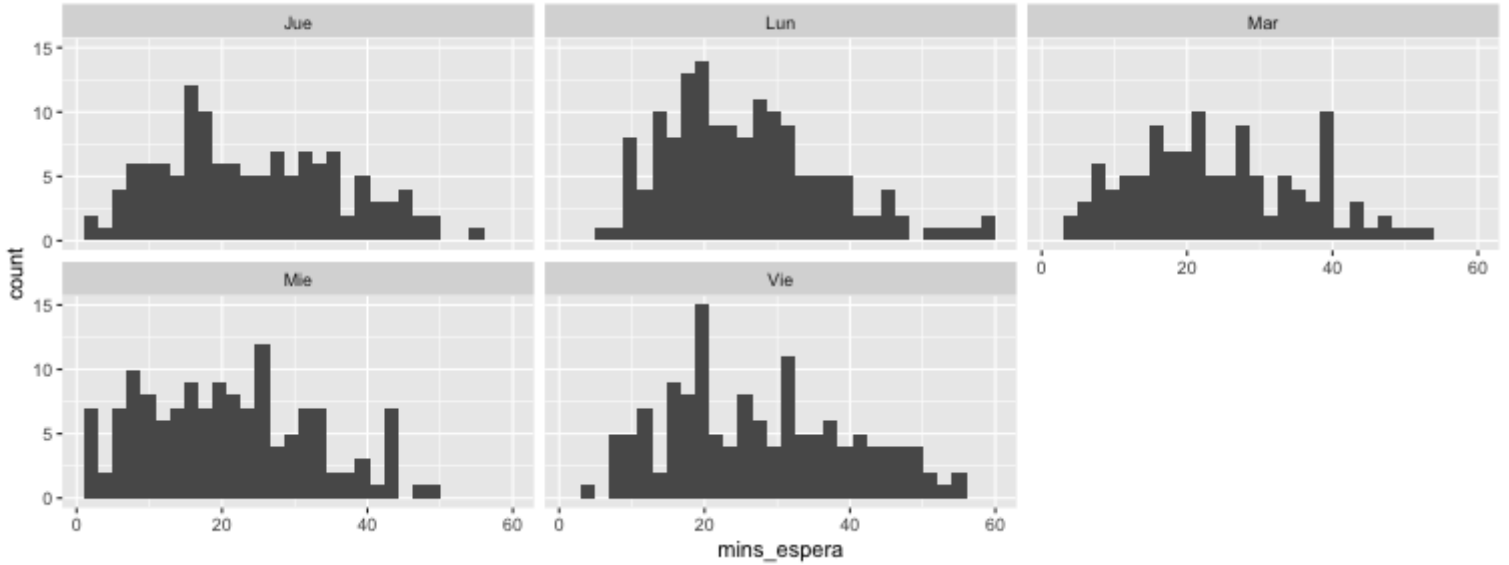
Test de hipótesis: Exploración de datos

```
consultas %>%
  ggplot(aes(x = mins_espera)) +
  geom_histogram()
```



Test de hipótesis: Exploración de datos

```
consultas %>%
  ggplot(aes(x = mins_espera)) +
  geom_histogram() +
  facet_wrap(~dia_semana)
```



Tests de hipótesis: Scripts para Investigación

```
## Cargar librerías ------

## Cargar datos ----------
datos <- readxl::read_xlsx()

# Exploración inicial ----

# Crear variables --------
datos %>% mutate()

# Analisis descriptivo ---
datos %>% count(var)

# Comparacion - test 1 ---
t.test(var1 ~ grupo)
```

Test de hipótesis: Crear grupos

```
consultas %>%
  mutate(extr_semana =
           ifelse(dia_semana %in% c("Lun", "Vie"),
                  "extremo",
                  "centro"))
```

```
# A tibble: 5 x 2
  dia_semana extr_semana
  <chr>      <chr>
1 Vie        extremo
2 Lun        extremo
3 Mar        centro
4 Mie        centro
5 Jue        centro
```

Test de hipótesis: Crear grupos

```
consultas <- consultas %>%
  mutate(extr_semana =
           ifelse(dia_semana %in% c("Lun", "Vie"),
                  "extremo",
                  "centro"))
```

```
dim(consultas)
```

```
[1] 670  15
```

Tests de hipótesis: Scripts para Investigación

```
## Cargar librerías ------

## Cargar datos ----------
datos <- readxl::read_xlsx()

# Exploración inicial ----

# Crear variables --------
datos %>% mutate()

# Analisis descriptivo ---
datos %>% count(var)

# Comparacion - test 1 ---
t.test(var1 ~ grupo)
```

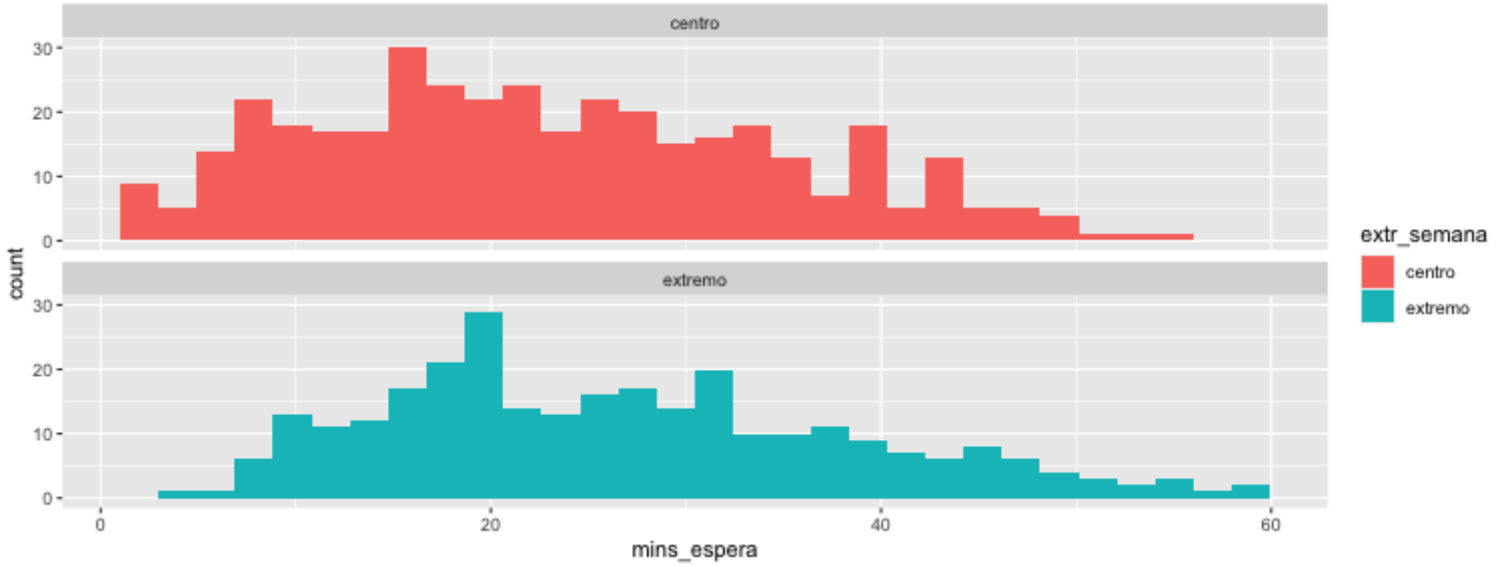
Test de hipótesis: Análisis descriptivo

```
consultas %>%
  group_by(extr_semana) %>%
  summarise(promedio_espera = mean(mins_espera),
            maxima_espera = max(mins_espera))
```

```
# A tibble: 2 x 3
  extr_semana promedio_espera maxima_espera
  <chr>                 <dbl>          <dbl>
1 centro                 23.0             56
2 extremo                26.7             58
```

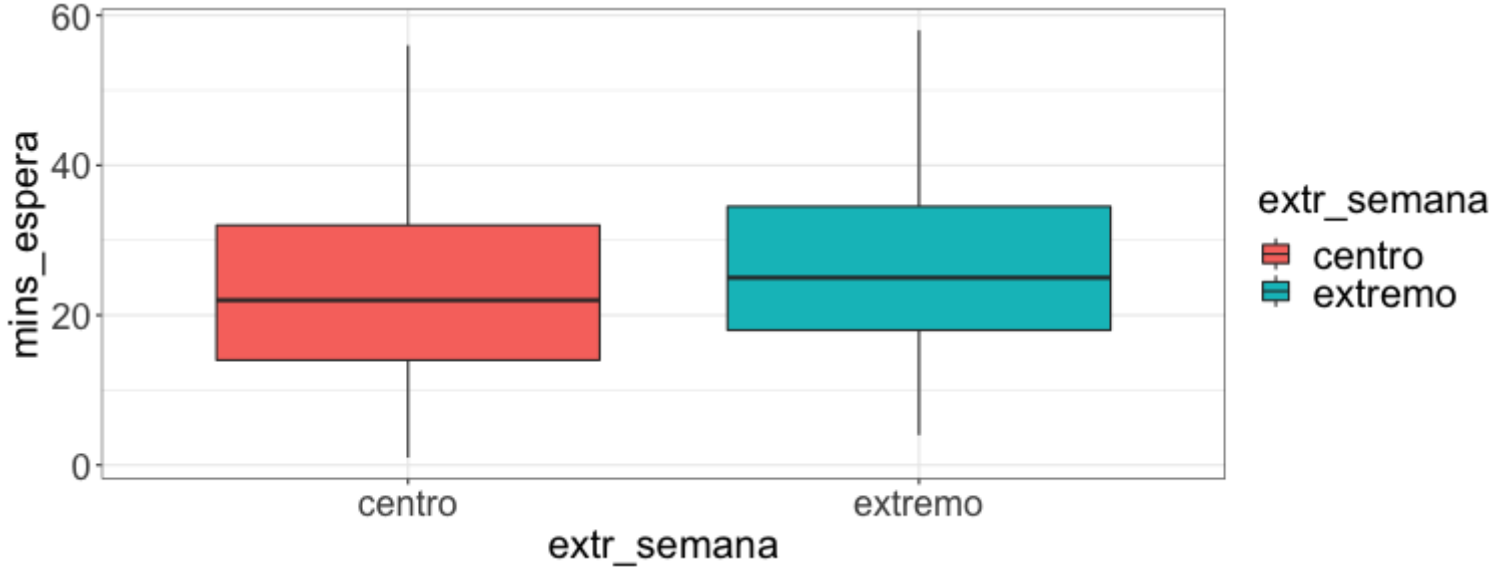
Test de hipótesis: Análisis descriptivo

```
consultas %>%
  ggplot(aes(x = mins_espera)) +
  geom_histogram(aes(fill = extr_semana)) +
  facet_wrap(~extr_semana, ncol = 1)
```



Test de hipótesis: Análisis descriptivo

```
consultas %>%
  ggplot(aes(x = extr_semana,
             y = mins_espera)) +
  geom_boxplot(aes(fill = extr_semana))
```



Tests de hipótesis: Scripts para Investigación

```r
## Cargar librerías ------

## Cargar datos ----------
datos <- readxl::read_xlsx()

# Exploración inicial ----

# Crear variables --------
datos %>% mutate()

# Analisis descriptivo ---
datos %>% count(var)

# Comparacion - test 1 ---
t.test(var1 ~ grupo)
```

Test de hipótesis: Test

```
t.test(consultas$mins_espera ~ consultas$extr_semana)
```

```
    Welch Two Sample t-test

data:  consultas$mins_espera by consultas$extr_semana
t = -3.9455, df = 619.32, p-value = 8.875e-05
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -5.596872 -1.876914
sample estimates:
 mean in group centro mean in group extremo
              22.9530                26.6899
```

Test de hipótesis: Resultados

```
t.test(consultas$mins_espera ~
         consultas$extr_semana)["p.value"]
```

```
$p.value
[1] 8.875334e-05
```

```
resultado <-
  t.test(consultas$mins_espera ~ consultas$extr_semana)

sprintf("%1.5f",
        as.numeric(resultado$p.value))
```

```
[1] "0.00009"
```

Extras

RMarkdown

R y Big Data

Extras 1: RMarkdown

- Interfaz de Notebooks
- Tejido de `código` y **Texto**
- Múltiples lenguajes (R, SQL, Python...)
- Output estático o dinámico: HTML, .pdf, Word, Shiny

https://rmarkdown.rstudio.com/

~/Documents/rmarkdown - gh-pages - RStudio

Go to file/function | Addins | rmarkdown

1-example.Rmd

Knit | Run

```
---
title: "Viridis Demo"
output: html_document
---

```{r include = FALSE}
library(viridis)
```

The code below demonstrates two color palettes in the [viridis](https://github.com/sjmgarnier/viridis) package. Each plot displays a contour map of the Maunga Whau volcano in Auckland, New Zealand.

Viridis colors

```{r}
image(volcano, col = viridis(200))
```

Magma colors

```{r}
image(volcano, col = viridis(200, option = "A"))
```
```

1:1 | Viridis Demo | R Markdown

Console

Environment | History | Build | Git

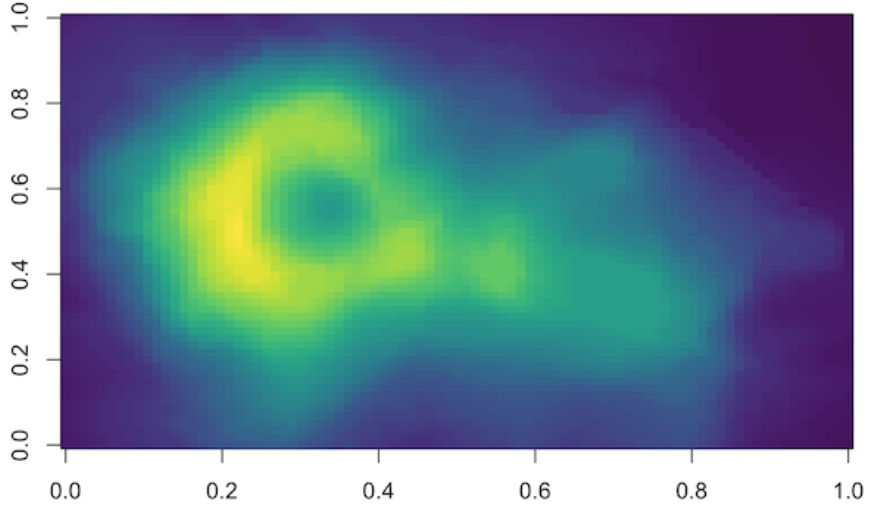
Files | Plots | Packages | Help | Viewer

Viridis Demo

The code below demonstrates two color palettes in the viridis package. Each plot displays a contour map of the Maunga Whau volcano in Auckland, New Zealand.

Viridis colors

```
image(volcano, col = viridis(200))
```



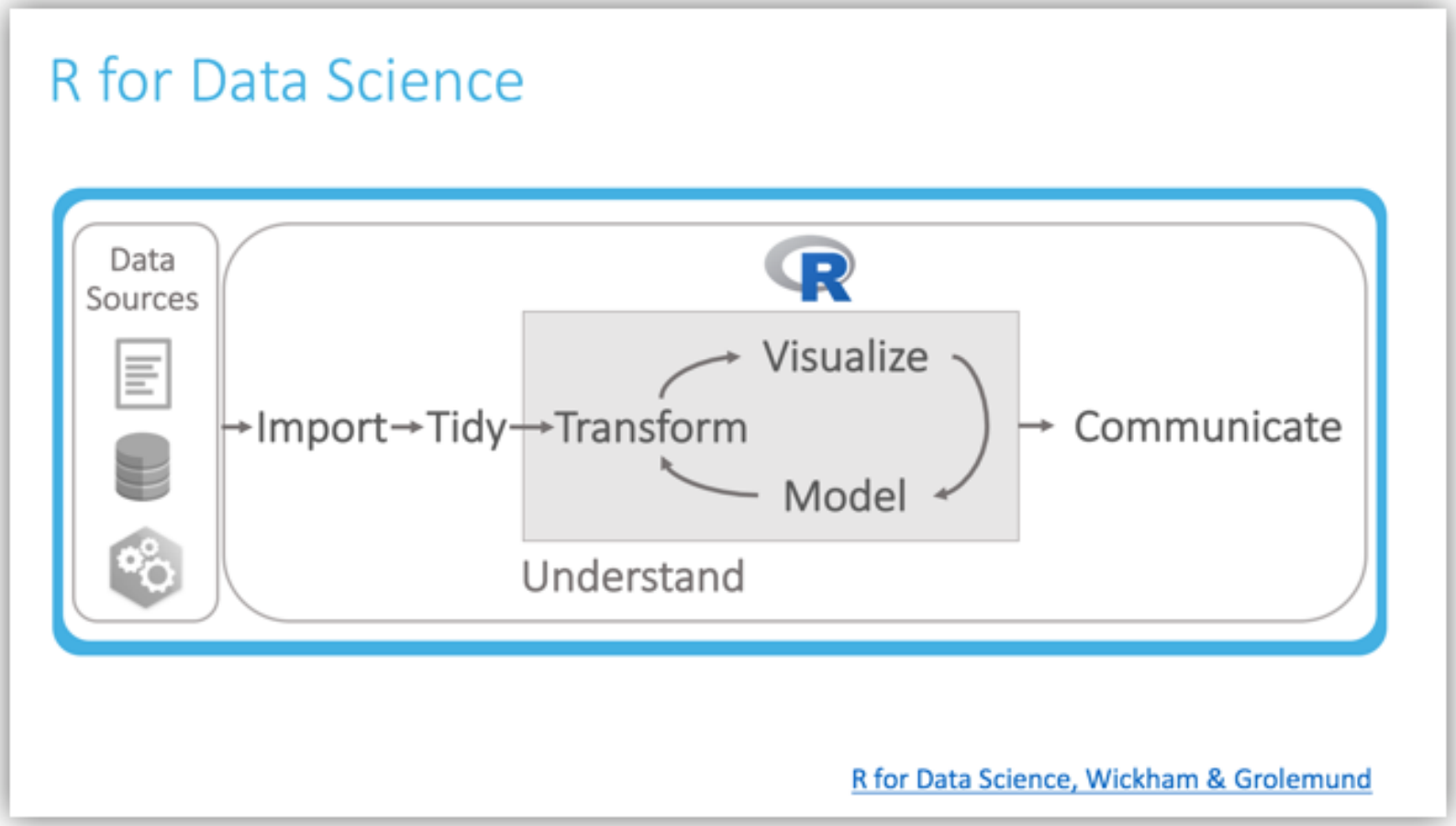
Magma colors

Extras 2: R y Big Data

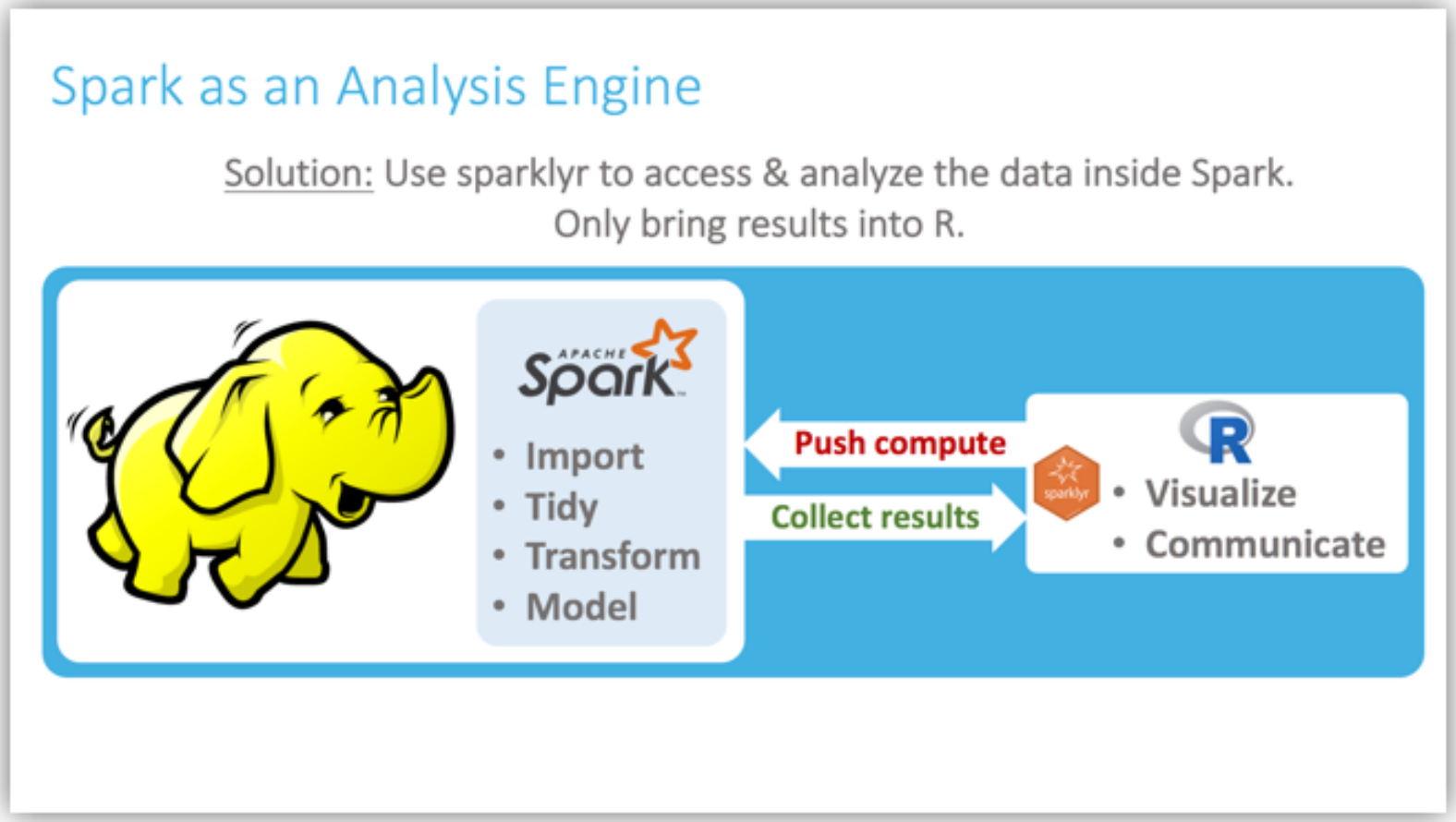
¿Qué tamaño es Big Data?

Manejo de memoria en R.

R y Big Data: manejo local

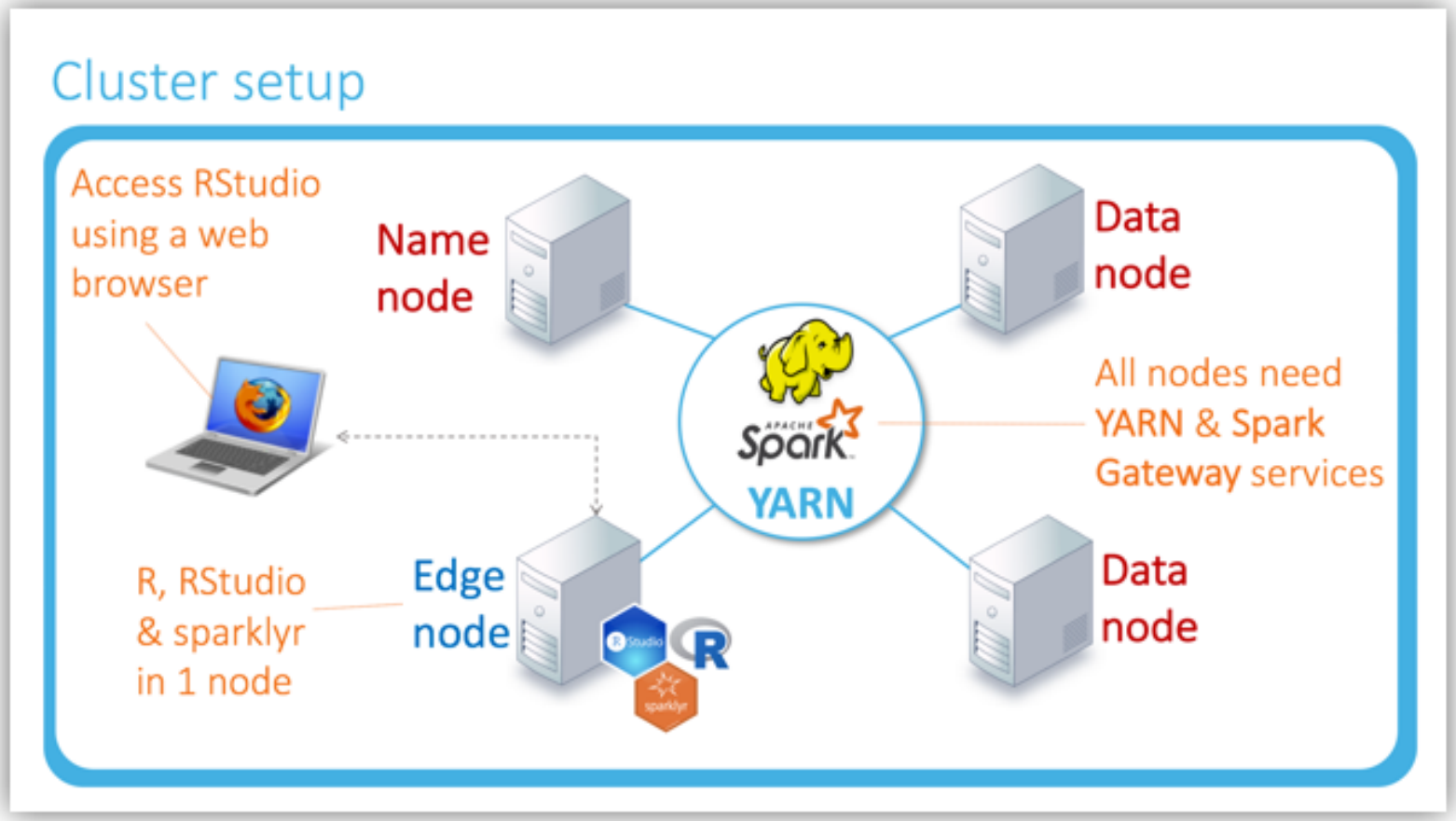


R y Big Data



https://spark.rstudio.com/guides/data-lakes/

R y Big Data



https://spark.rstudio.com/guides/data-lakes/

Recursos Educativos

Recursos online

- Cursos online
- R Cheat Sheets
- Libros/e-books
- Comunidades de usuarios

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Cursos online

EdX, Coursera, Udemy...

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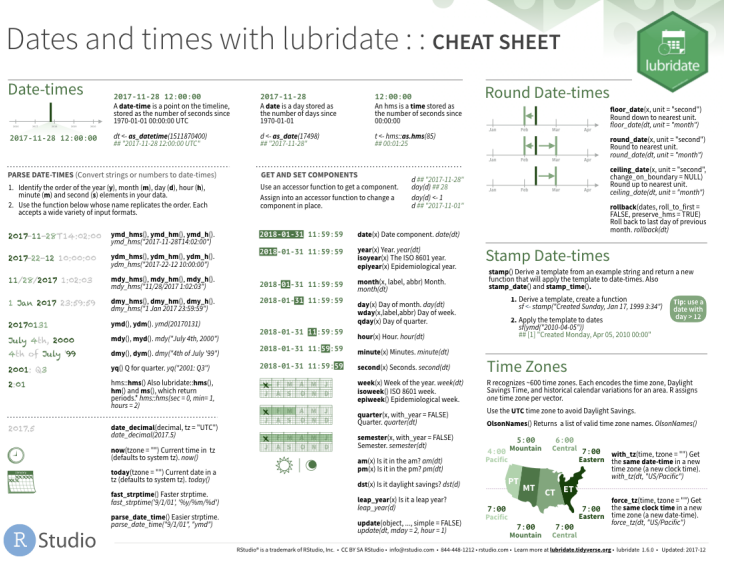
Cheat Sheets

https://rstudio.com/resources/cheatsheets/



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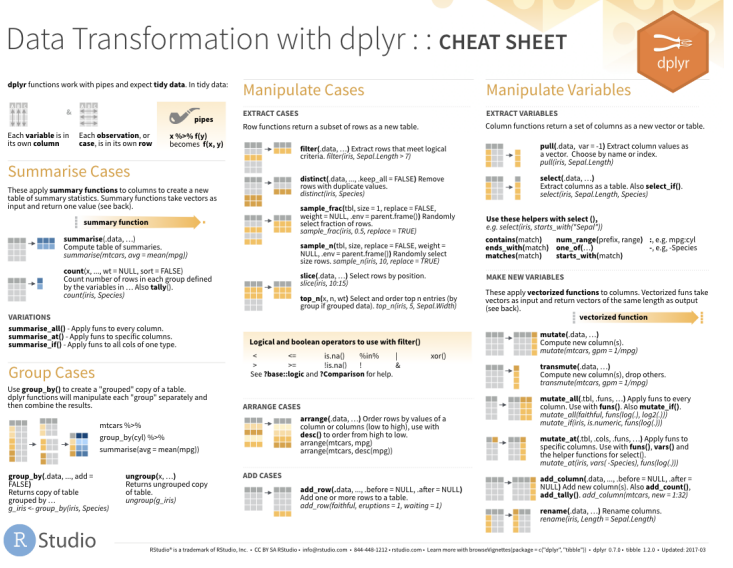

Recursos online

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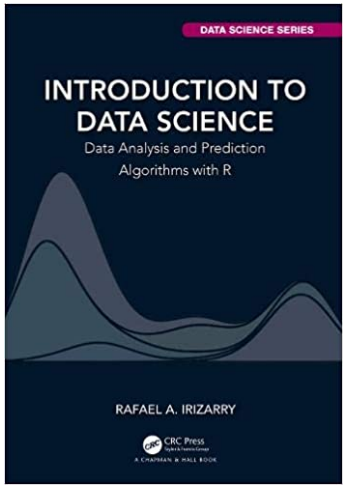
e-books(1)

Introduction to Data Science: Data Analysis and Prediction Algorithms with R - *Rafael Irizarry*



https://rafalab.github.io/dsbook/

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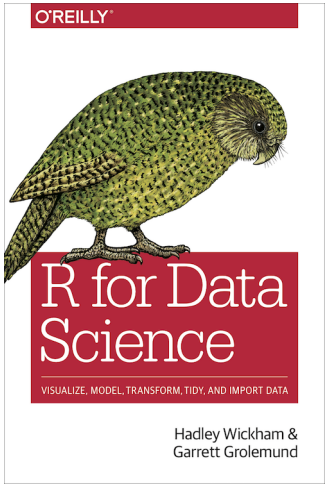
e-books(2)

R for Data Science - *Hadley Wickham & Garrett Grolemund*



https://r4ds.hadley.nz/

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e-books(2)

R para Ciencia de Datos - *Hadley Wickham*

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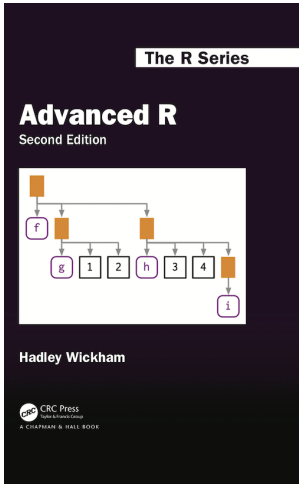
- Comunidades de usuarios

e-books(3)

Advanced R - *Hadley Wickham*



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- https://stackoverflow.com/
- community.rstudio.com

Ejemplos reproducibles: Reprex

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5 answers

Increase the **size** of **line** in geom_line - Stack Overflow	1 answer	Nov 7, 2017
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¡Muchas Gracias!

Diapositivas creadas con el paquete de R **xaringan**. https://github.com/yihui/xaringan