R

2023-07-14

Contents

Chapter 1

“ R”.

, . ,
oalieva@hse.ru.

1.1

Chapter 2

R

2.1 R?

R — . 90- .
. , .
, , .
R — . , ,
, . R
, .

—
R .
, R , ,
. , R .

2.2

R – . –
, . 1 2023 . CRAN 19789
. : GitHub, Dracor,
.

, , – ,
, “ ” - .

, R ,
, . , Shiny
- , Leaflet .
Antibarbari HSE.
. R , .

“ ” , . ,
RPerseus, .
“ ”, , “ ” R. , ,
tidyverse, “ ” . .

2.3

. (SPSS, Minitab),
, “ ” , . R,
, .
– (.R)
. , ,
.

2.4

, (,
GitHub) – , . ,
(Python)

```
#
x <- rnorm(1000)
#
y <- sample(x, 100)
```

, , , ( ), .
, , , . “ ”
, , ,
. , .
, ,
( ). ,
, . !
, , .

2.5 ( ) ?

R , . “ ”
( ) : .
, .
(R).
, . -
.

24 :

- R (1-6)
- text-mining (7-13)
- (14-22)

Plotly Leaflet.

, ,
“ : ?” (, 2023 .).
, . , – .

2.6 RStudio

R RStudio, (IDE)
R.

– R R Studio , ;
, .

2.7

1. R

- R Windows: https://cran.r-project.org/bin/windows/
- R Mac: https://cran.r-project.org/bin/macosx/

2. R Studio

- : https://www.rstudio.com/products/rstudio/download/ (
)

MacOS Stylo XQuartz: https://www.xquartz.org/

2.8

RStudio ( ):

, ( ).

, :

```
sessionInfo()
```

`sessionInfo()` – . ,
. (“ - !”). – -
. (, “ ” tidyverse - , .)
.

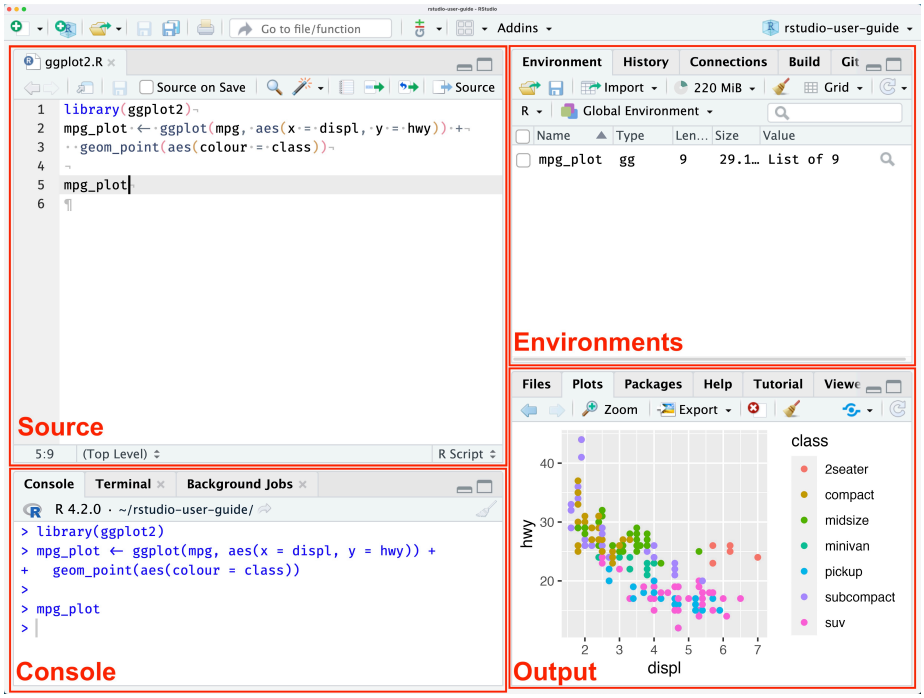


Figure 2.1: RStudio Panes

, , **help**: `?mean()`. ( )
.
(R) `getwd()`
. `setwd()`,
(,). :

```
setwd("/Users/olga/R_Workflow/")
```

R `Session > Set Working Directory`.

, . ,
`Tools > Install Packages`. .
:

```
install.packages("languageR")
```

`library()`, :

```
library(languageR)
```

:

- R [1]
-

2.9 R

. >, **prompt**.

```
sqrt(4) #
```

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

```
2^3 #
```

```
## [1] 8
```

```
log10(100) #
```

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

+, . , .
. `sqrt(2` .

2.10

, -
`<-` (`Alt` + `-` (Windows) `Option` + `-` (Mac)). `=`
, , .

[1] https://intro2r.com/rsprojs.html

```
x <- 2 + 2 #
y <- 0.1 #
x <- y #
x + y
```

```
## [1] 0.2
```

, , , . c() (concatenation) :

```
x <- c(3, 5, 7)
x_mean <- mean(x) #          x.mean    xMean
x_mean
```

```
## [1] 5
```

tidyverse , ; Python, . : R !

, , – , , , , , . – , [. . , 2015, 24]

, ls(). rm(). :

```
rm(list = ls()) #
```

2.11

R ( ). .

```
x <- 2
class(x) #
```

```
## [1] "numeric"
```

```
length(x) #
```

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

```
y <- c() #
y #                    NULL
```

```
## NULL
```

```
length(y) #        0
```

```
## [1] 0
```

NULL , ; NA (not available) – , . mean(c(1, NA, 2)) , mean(c(1, NULL, 2)) .

: `mean(c(1, NA, 2), na.rm=T)`. . [, 2019].

, , :

- (integer)
- (numeric, double,)
- (character)
- (logical)
- , (factor)

```
#
x <- sqrt(2)
typeof(x)
```

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

```
is.integer(x)
```

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

```
is.numeric(x)
```

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

, :

```
x <- c(TRUE, 1, 3, FALSE)
x #
```

```
## [1] 1 1 3 0
```

```
y <- c(1, "a", 2, "     ") #
y #
```

```
## [1] "1"          "a"          "2"          "     "
```

: **R**

(== “ ”, != “ ”, <= “ ”) :

```
x <- c(1:10) #       1   10
y <- x > 5
y #      TRUE             ,
```

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

```
sum(y)
```

```
## [1] 5
```

`all()` `any()` :

```
x <- 10:20
any(x == 15)
```

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

```
all(x > 9)
```

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

:

```
seq(1, 5, 0.5)
```

```
## [1] 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
```

```
rep("foo", 5)
```

```
## [1] "foo" "foo" "foo" "foo" "foo"
```

, - :

```
x <- seq(1, 5, 0.5)
x[4:5] #          1 (      Python)
```

```
## [1] 2.5 3.0
```

, , :
, ,
.

```
x <- 2; y <- c(10, 20, 30); z <- c(5, 6, 7)
y / x
```

```
## [1]  5 10 15
```

```
x + y
```

```
## [1] 12 22 32
```

```
y + z
```

```
## [1] 15 26 37
```

. ,
. (, 1 0), .

```
t <- factor(c("A", "B", "C"), levels = c("A", "B", "C"))
t
```

```
## [1] A B C
## Levels: A B C
```

2.12

, ( ), .

```
list = list(a = c("a", "b", "c"), b = c(1, 2, 3), c = c(T, F, T))
list
```

```
## $a
## [1] "a" "b" "c"
##
## $b
## [1] 1 2 3
##
## $c
## [1]  TRUE FALSE  TRUE
```

, .

```
list$a #
```

```
## [1] "a" "b" "c"
```

```
list[2] #
```

```
## $b
## [1] 1 2 3
```

```
class(list[2])
```

```
## [1] "list"
```

```
list[[2]] #
```

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

```
class(list[[2]])
```

```
## [1] "numeric"
```

```
list$c[1]#
```

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

, list[2] list[[2]] .
XML.

: **R**

, .

2.13

– , : . ,
, , . .

```
M = matrix(c(1, 2, 3, 4), nrow = 2)
M #
```

```
##      [,1] [,2]
## [1,]    1    3
## [2,]    2    4
```

```
M = matrix(c(1, 2, 3, "a"), nrow = 2)
M #               !
```

```
##      [,1] [,2]
## [1,] "1"  "3"
## [2,] "2"  "a"
```

. ( ) . 2 x
2. , , . ,
.

```
M = matrix(c(1, 2, 3, 4), nrow = 2)
M[1, ] #
```

```
## [1] 1 3
```

```
M[,2] #
```

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

```
M[1,1] #
```

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

, .

```
M = matrix(c(1, 2, 3, 4), nrow = 2)
class(M)
```

```
## [1] "matrix" "array"
```

```
dim(M) #
```

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

```
class(M[1, ]) #
```

```
## [1] "numeric"
```

```
dim(M[1, ])
```

```
## NULL
```

NULL, R
, . , ,
. , . .

```
#    -
C = matrix(c(1, 2, 3), nrow = 1)
C
```

```
##      [,1] [,2] [,3]
## [1,]    1    2    3
```

```
#    -
D = matrix(c(1, 2, 3), nrow = 3)
D
```

```
##      [,1]
## [1,]    1
## [2,]    2
## [3,]    3
```

R ; ,
- .

.

```
#
M = matrix(c(1, 2, 3, 4), nrow = 2) #
diag(M)
```

```
## [1] 1 4
```

```
#                ,
t(M)
```

```
##      [,1] [,2]
## [1,]    1    2
## [2,]    3    4
```

```
#                ,              .
M * 3
```

```
##      [,1] [,2]
## [1,]    3    9
## [2,]    6   12
```

```
#
M + M
```

```
##      [,1] [,2]
## [1,]    2    6
## [2,]    4    8
```

. , . ,
, .
: , .
R . [. . , 2015].

2.14

(, data frames) – ( ).
, .
,
.
— [, 2019, 133].

```
#
df <- data.frame(names = c("A", "B"), age = c(10, 11))
df
```

```
##   names age
## 1     A  10
## 2     B  11
```

```
#
df$names #
```

```
## [1] "A" "B"
```

```
df[,"names"] #        ,
```

```
## [1] "A" "B"
```

```
df[1, ] #
```

```
##   names age
## 1     A  10
```

.
– , .
, - .
1867 ., , , “ ”
, , [Campbell, 1867, xxxi].
26 , .
, R.

```
##        dialogue  words hapax ratio group
## 1       Apology   8745    36 0.004     1
## 2     Charmides   8311    31 0.004     1
```

```
## 3      Cratylus  17944   122 0.007     1
## 4       Critias   4950   104 0.021     3
## 5         Crito   4169    19 0.005     1
## 6    Euthydemus  12453    87 0.007     1
## 7     Euthyphro   5181    15 0.003     1
## 8       Gorgias  26337   125 0.005     1
## 9  HippiasMinor   4360    12 0.003     1
## 10          Ion   4024    32 0.008     1
## 11       Laches   7674    27 0.004     1
## 12         Laws 103193   914 0.009     3
## 13        Lysis   6980    49 0.007     1
## 14    Menexenus   4808    43 0.009     1
## 15         Meno   9791    30 0.003     1
## 16   Parmenides  15155    20 0.001     2
## 17       Phaedo  21825   140 0.006     1
## 18     Phaedrus  16645   228 0.014     2
## 19     Philebus  17668    64 0.004     3
## 20   Protagoras  17795   102 0.006     1
## 21     Republic  88878   668 0.008     2
## 22      Sophist  16024   107 0.007     3
## 23    Statesman  16953   180 0.011     3
## 24    Symposium  17461   127 0.007     1
## 25   Theaetetus  22489   162 0.007     2
## 26      Timaeus  23662   370 0.016     3
```

. class() , .

```
## [1] "data.frame"
```

.

```
#
colnames(hapax_plato)
```

```
## [1] "dialogue" "words"    "hapax"    "ratio"    "group"
```

```
#       ()
hapax_plato[hapax_plato$dialogue == "Parmenides", ]
```

```
##      dialogue words hapax ratio group
## 16 Parmenides 15155    20 0.001     2
```

```
#
str(hapax_plato)
```

```
## 'data.frame':    26 obs. of  5 variables:
##  $ dialogue: chr  "Apology" "Charmides" "Cratylus" "Critias" ...
##  $ words   : chr  "8745" "8311" "17944" "4950" ...
##  $ hapax   : chr  "36" "31" "122" "104" ...
```

```
##  $ ratio   : chr  "0.004" "0.004" "0.007" "0.021" ...
##  $ group   : num  1 1 1 3 1 1 1 1 1 1 ...
```

```
#
hapax_plato[hapax_plato$words > 10000, ]
```

```
##        dialogue  words hapax ratio group
## 1       Apology   8745    36 0.004     1
## 2     Charmides   8311    31 0.004     1
## 3      Cratylus  17944   122 0.007     1
## 4       Critias   4950   104 0.021     3
## 5         Crito   4169    19 0.005     1
## 6    Euthydemus  12453    87 0.007     1
## 7     Euthyphro   5181    15 0.003     1
## 8       Gorgias  26337   125 0.005     1
## 9  HippiasMinor   4360    12 0.003     1
## 10          Ion   4024    32 0.008     1
## 11       Laches   7674    27 0.004     1
## 12         Laws 103193   914 0.009     3
## 13        Lysis   6980    49 0.007     1
## 14    Menexenus   4808    43 0.009     1
## 15         Meno   9791    30 0.003     1
## 16   Parmenides  15155    20 0.001     2
## 17       Phaedo  21825   140 0.006     1
## 18     Phaedrus  16645   228 0.014     2
## 19     Philebus  17668    64 0.004     3
## 20   Protagoras  17795   102 0.006     1
## 21     Republic  88878   668 0.008     2
## 22      Sophist  16024   107 0.007     3
## 23    Statesman  16953   180 0.011     3
## 24    Symposium  17461   127 0.007     1
## 25   Theaetetus  22489   162 0.007     2
## 26      Timaeus  23662   370 0.016     3
```

```
#
hapax_plato$group <- as.factor(hapax_plato$group)
hapax_plato[,2:4] <- sapply(hapax_plato[,2:4],as.numeric)
```

summary():

```
summary(hapax_plato)
```

```
##    dialogue             words            hapax            ratio          group
##  Length:26          Min.   :  4024   Min.   : 12.00   Min.   :0.001000   1:16
##  Class :character   1st Qu.:  7154   1st Qu.: 31.25   1st Qu.:0.004000   2: 4
##  Mode  :character   Median : 15590   Median : 94.50   Median :0.007000   3: 6
##                     Mean   : 19364   Mean   :146.69   Mean   :0.007154
##                     3rd Qu.: 17907   3rd Qu.:136.75   3rd Qu.:0.008000
```

```
##                    Max.   :103193   Max.   :914.00   Max.   :0.021000
```

2.15

.

Chapter 3

3.1 R

R , .
R – , [1].

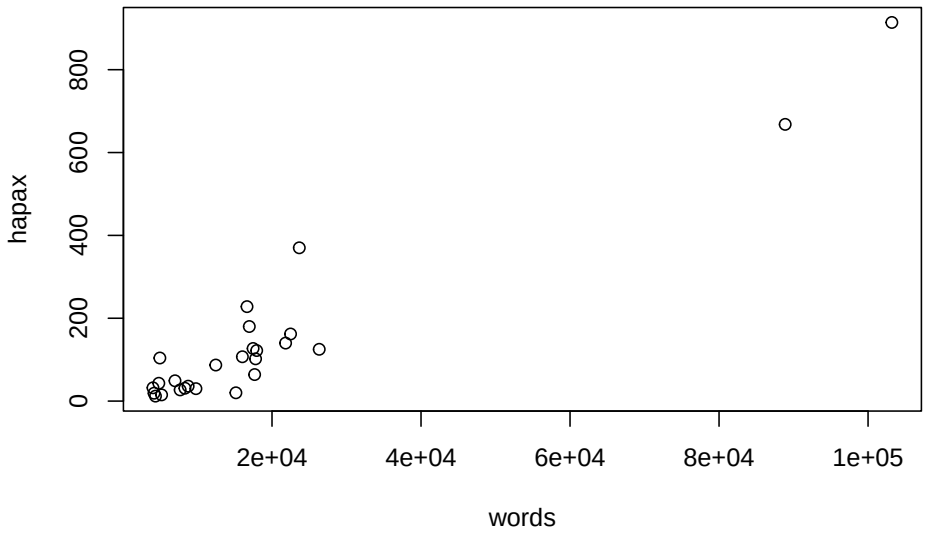
, , - : ,
, , , . .
.

, , , ,
. plot(), , .
, .

(scatter plot), plot()
, x y. : plot(x, y). :
plot(y ~ x). ~ ( ) .

```
attach(hapax_plato)
plot(hapax ~ words)
```

[1] https://youtu.be/a4mvbyNGdBA

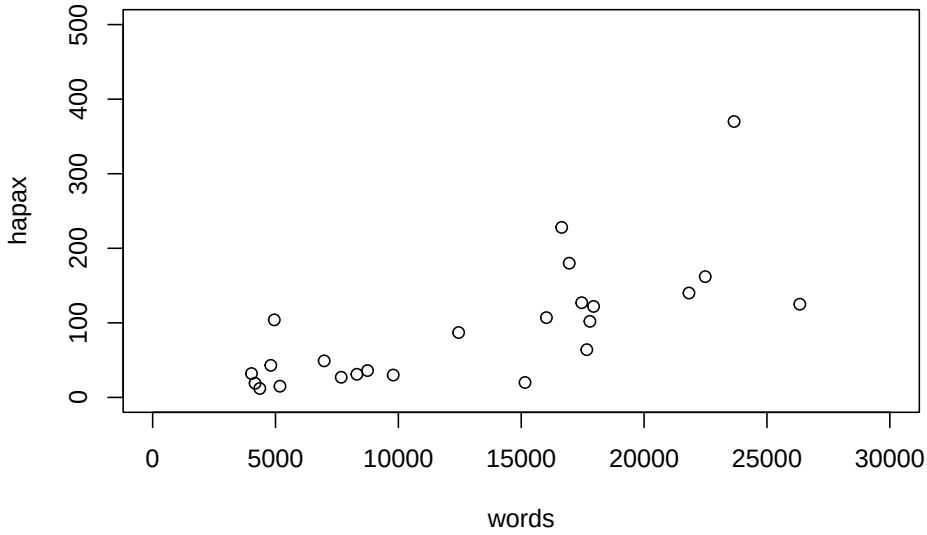


: plot(hapax_plato$hapax ~ hapax_plato$words).

. .

(“ ” “ ”) “ ” , .

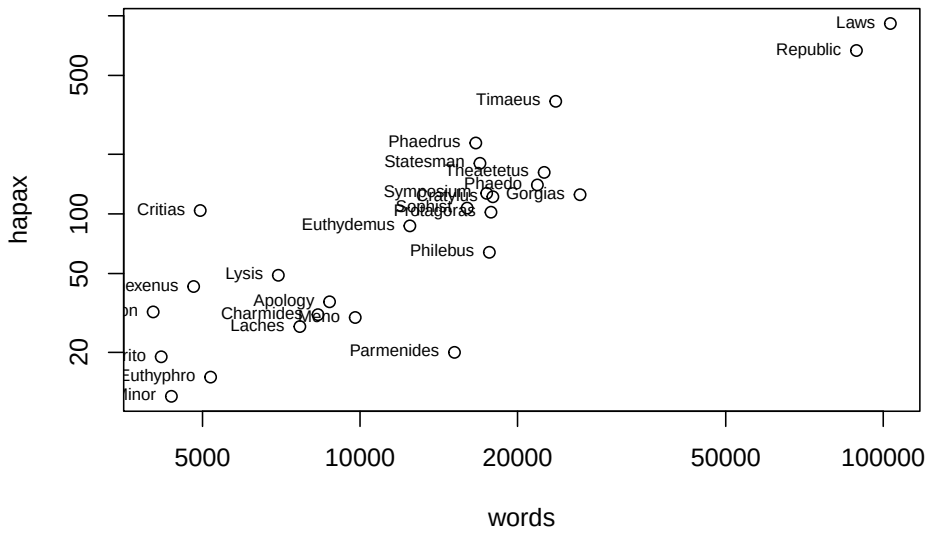
```
attach(hapax_plato)
plot(hapax ~ words, xlim = c(0, 30000), ylim = c(0, 500))
```



- - – ? –

. . , .

```
attach(hapax_plato)
options(scipen=999) #
plot(words, hapax, log = "xy")
#
text(hapax ~ words, labels = dialogue, pos = 2, cex = 0.7)
```



! .

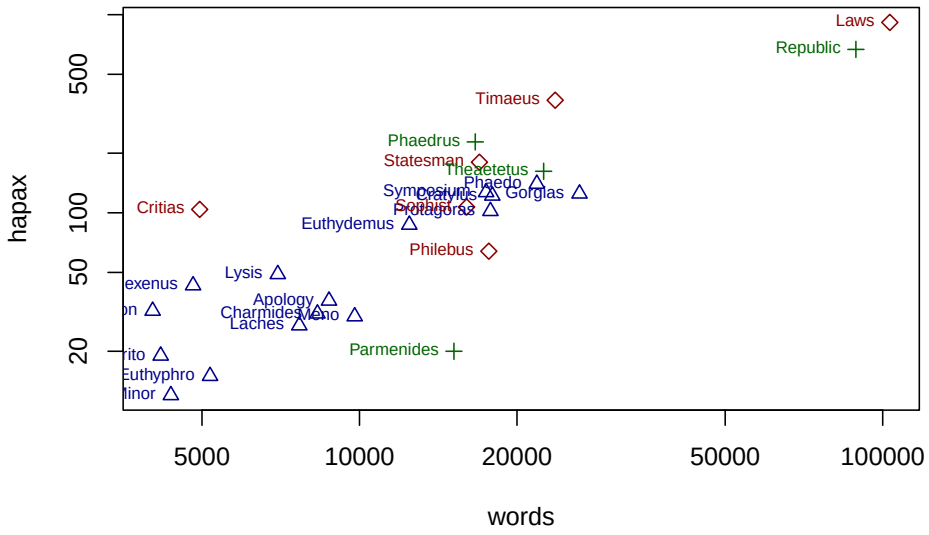
plot() pch. .

2, 3 5.

: **pch**

.

```
attach(hapax_plato)
options(scipen=999) #
plot(words, hapax, log = "xy", col = c("darkblue", "darkgreen", "darkred")[group],
     pch = c(2, 3, 5)[group])
text(hapax ~ words, labels = dialogue,
     pos = 2, cex = 0.7, col = c("darkblue", "darkgreen", "darkred")[group])
```



c , . , ,
(, -).

```
attach(hapax_plato)
options(scipen=999) #
plot(words, hapax, log = "xy", col = c("darkblue", "darkgreen", "darkred")[group], pch
text(hapax ~ words, labels = dialogue,
     pos = 2, cex = 0.7, col = c("darkblue", "darkgreen", "darkred")[group], family = '

#
my_lm <- lm(hapax_plato$hapax ~ hapax_plato$words)
abline(my_lm, lty = "dashed", col = "darkgrey", untf = T)

#
title(main = "                              ")
```

```
## Warning in title(main = "                              "):
## conversion failure on '                              ' in
## 'mbcsToSbcs': dot substituted for <d0>

## Warning in title(main = "                              "):
## conversion failure on '                              ' in
## 'mbcsToSbcs': dot substituted for <a7>

## Warning in title(main = "                              "):
## conversion failure on '                              ' in
## 'mbcsToSbcs': dot substituted for <d0>

## Warning in title(main = "                              "):
## conversion failure on '                              ' in
## 'mbcsToSbcs': dot substituted for <b8>
```

```
## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d1>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <81>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d0>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <bb>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d0>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <be>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d0>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <b3>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d0>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <b0>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d0>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <bf>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d0>
```

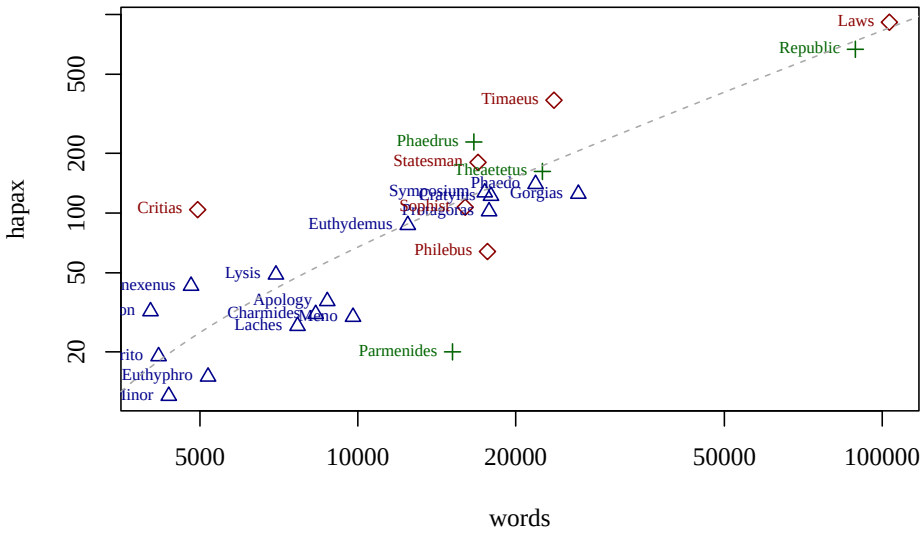
```
## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <b0>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d0>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <ba>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d1>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <81>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d0>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <be>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d0>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <b2>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d0>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <b2>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d0>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <b7>
```

```
## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d0>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <b0>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d0>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <b2>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d0>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <b8>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d1>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <81>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d0>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <b8>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d0>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <bc>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d0>
```

```
## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <be>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d1>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <81>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d1>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <82>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d0>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <b8>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d0>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <be>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d1>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <82>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d0>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <b4>
```

```
## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d0>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <bb>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d0>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <b8>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d0>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <bd>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d1>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <8b>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d0>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <b4>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d0>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <b8>

## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d0>
```

```
## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <b0>


## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d0>


## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <bb>


## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d0>


## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <be>


## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d0>


## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <b3>


## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <d0>


## Warning in title(main = "                          "):
## conversion failure on '                          ' in
## 'mbcsToSbcs': dot substituted for <b0>
```



[2] . .

, .

, R , ,

.

, . , ,

“ ” ? , .

, . ,

.

3.2 Lattice

Lattice (. “ ”) [Sarkar, 2008].

, -

(– –). , ,

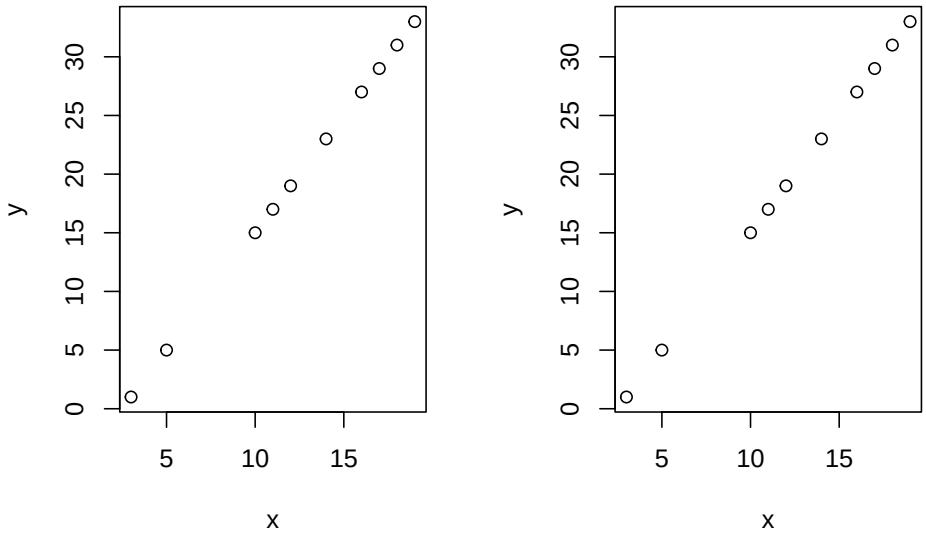
.

R , :

```
x <- sample(1:20, 10)
y <- 2 * x  - 5
par(mfrow = c(1,2)) #
```

[2] https://www.rdocumentation.org/packages/graphics/versions/3.6.2/topics/par

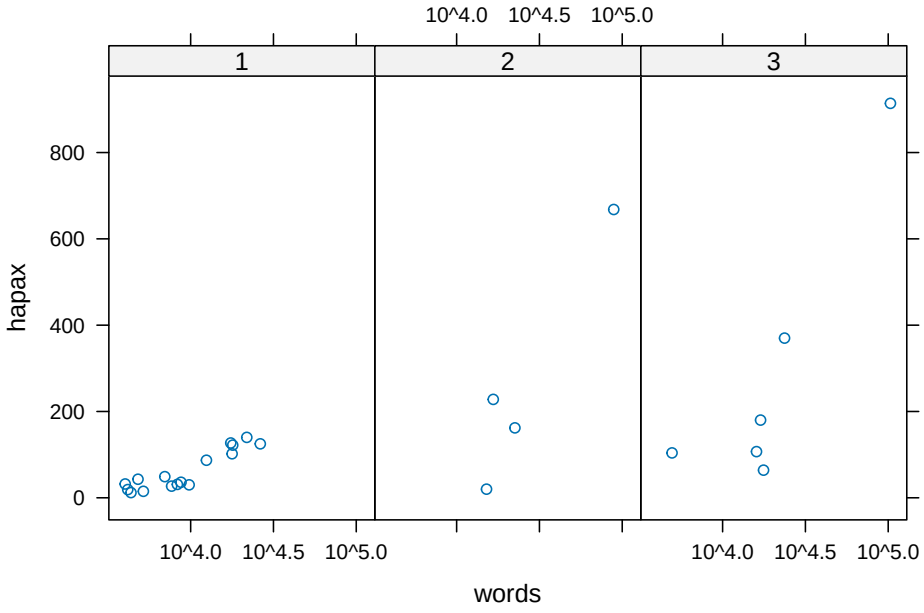
```
plot(x, y)
plot(x, y)
```



, . ,
, . . Lattice.

, .
, .

```
library(lattice)
attach(hapax_plato)

#                          ,                    ;              (      )

xyplot(hapax ~ words | group, data = hapax_plato,
       scales=list(x=list(log=10))) #
```



Lattice, , , ,
. . .

3.3 Ggplot2

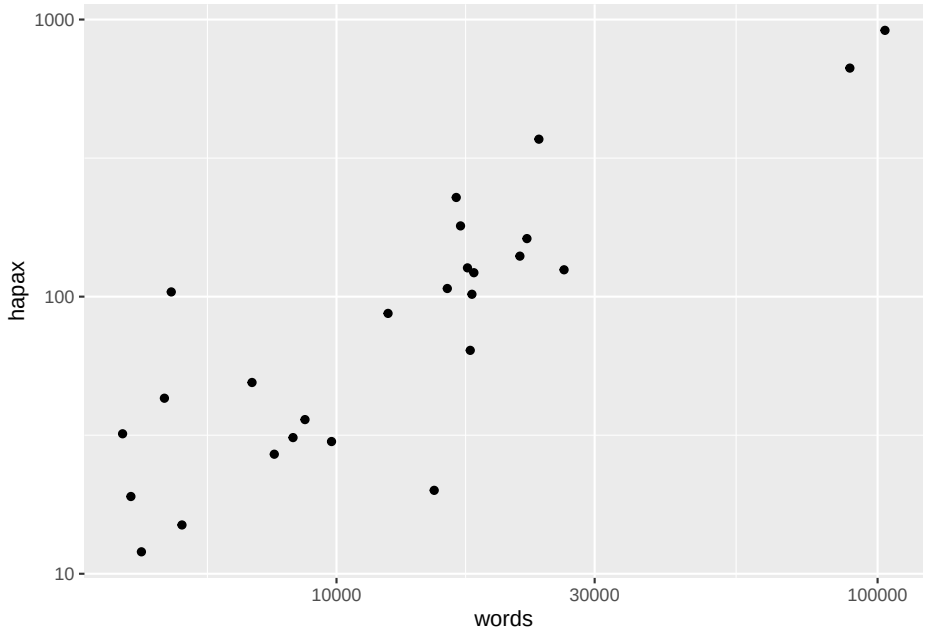
R – ggplot2. “ ”
[, 2017], R Lattice.
, , ; ,
, Lattice.

3.3.1 : qplot()

; .

```
library(ggplot2) #              tidyverse
options(scipen = 999)
qplot(words, hapax, data = hapax_plato, log = "xy")
```

```
## Warning: `qplot()` was deprecated in ggplot2 3.4.0.
## This warning is displayed once every 8 hours.
## Call `lifecycle::last_lifecycle_warnings()` to see where this warning was
## generated.
```



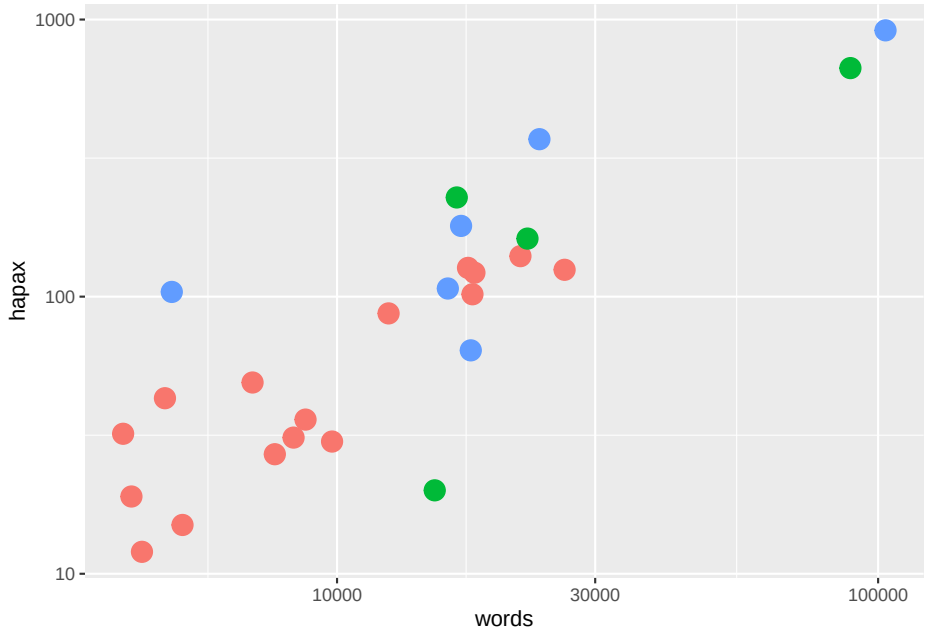
`qplot()` – .

ggplot `qplot()` (deprecated), `ggplot()` .

, .

, , . .

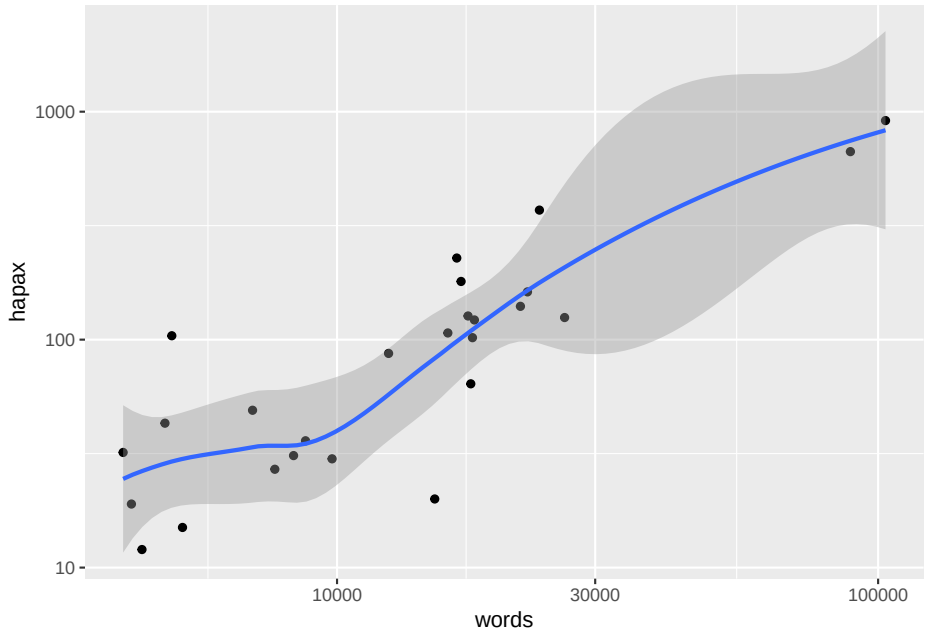
```
qplot(words, hapax, data = hapax_plato, log = "xy", col = group, size = 1.5) + theme(le
```



( ) :

```
qplot(words, hapax, data = hapax_plato, log = "xy", geom = c("point", "smooth"))
```

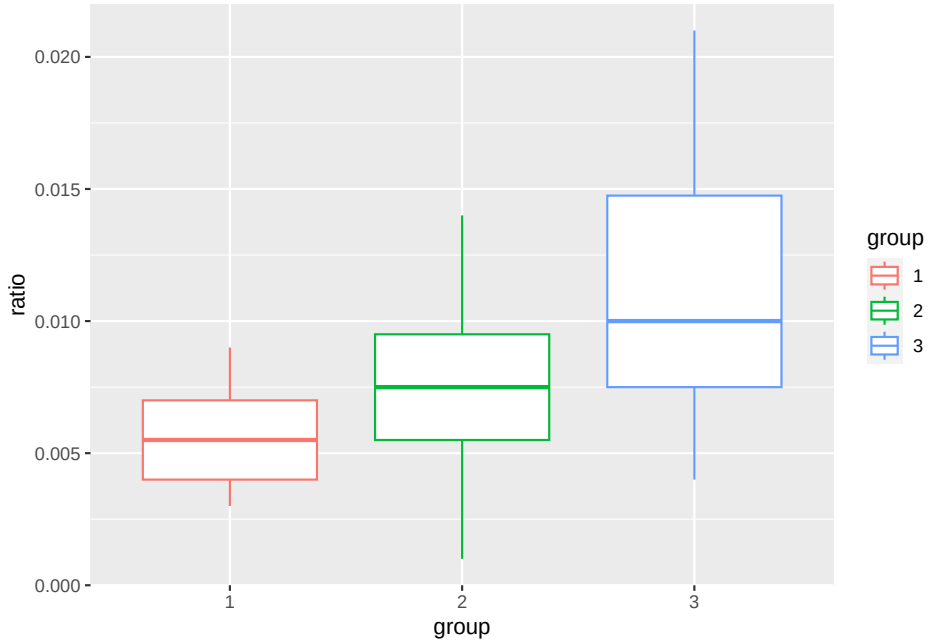
```
## `geom_smooth()` using method = 'loess' and formula = 'y ~ x'
```



( ) ,

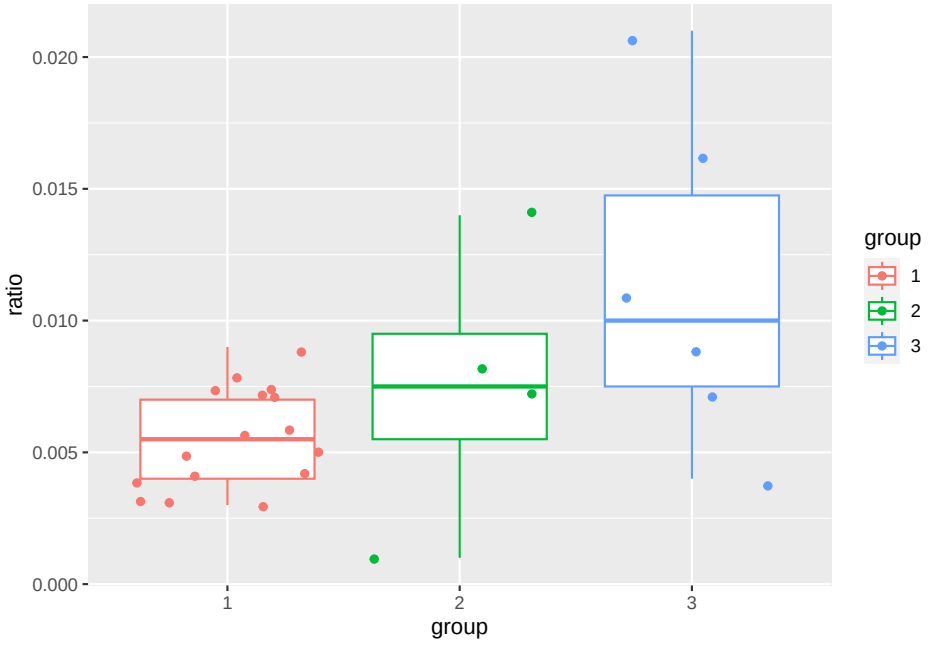
.

```
attach(hapax_plato)
qplot(group, ratio, data = hapax_plato, geom = "boxplot", color = group)
```



.

```
qplot(group, ratio, data = hapax_plato, geom = c("boxplot", "jitter"), color = group)
```



3.3.2 : ggplot()

ggplot(),

: data aes(. *aesthetics*);

.

[Wickham and Grolemund, 2017].

, , , .

,

. diorisis_meta,

, Diorisis[3].

```
load("./datasets/DiorisisMeta.Rdata")
diorisis_meta
```

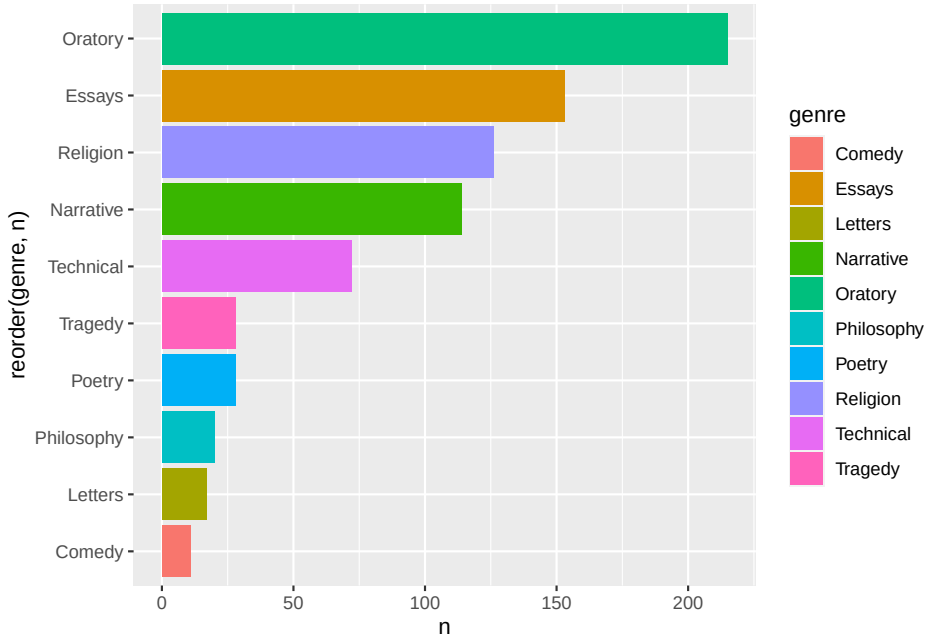
```
## # A tibble: 784 x 5
##    name            title                    date genre     subgenre
##    <chr>           <chr>                   <dbl> <chr>     <chr>
##  1 Achilles Tatius Leucippe and Clitophon    120 Narrative Novel
##  2 Aelian          De Natura Animalium       230 Technical Natural History
##  3 Aelian          Epistulae Rusticae        230 Letters   Letters
##  4 Aelian          Varia Historia            200 Essays    Miscellanea
##  5 Aeneas Tacticus Poliorcetica             -350 Technical Military
##  6 Aeschines       Against Ctesiphon        -330 Oratory   Oratory
##  7 Aeschines       Against Timarchus        -347 Oratory   Oratory
```

[3] https://figshare.com/articles/dataset/The_Diorisis_Ancient_Greek_Corpus/6187256

```
##  8 Aeschines       The Speech on the Embassy  -336 Oratory   Oratory
##  9 Aeschylus       Agamemnon                  -458 Tragedy   Tragedy
## 10 Aeschylus       Eumenides                  -458 Tragedy   Tragedy
## # i 774 more rows
```

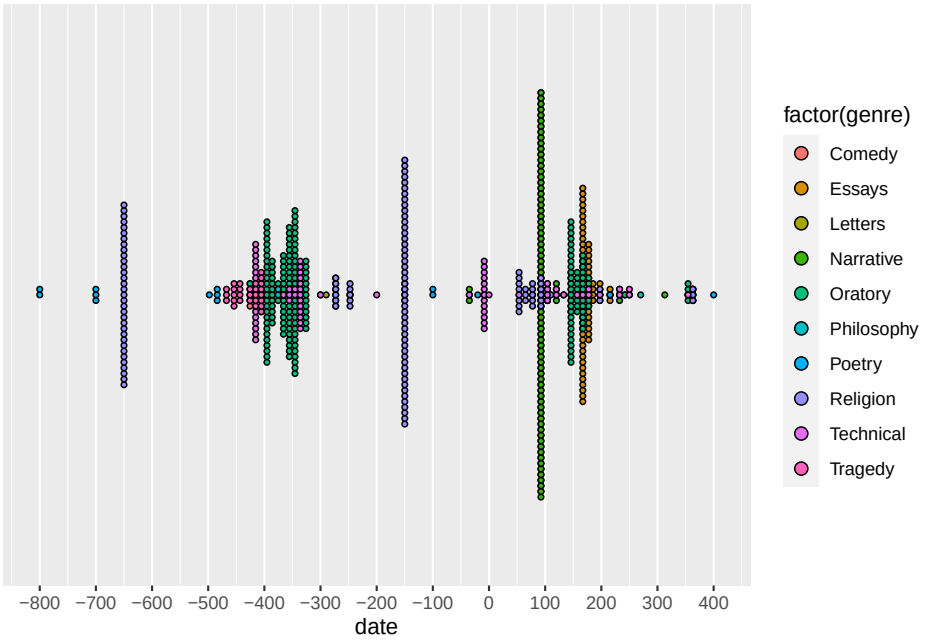
, .

```
library(tidyverse)
diorisis_meta %>%
  group_by(genre) %>%
  count() %>%
  ggplot(aes(reorder(genre, n), n, fill = genre)) +
  geom_bar(stat = "identity") +
  coord_flip()
```



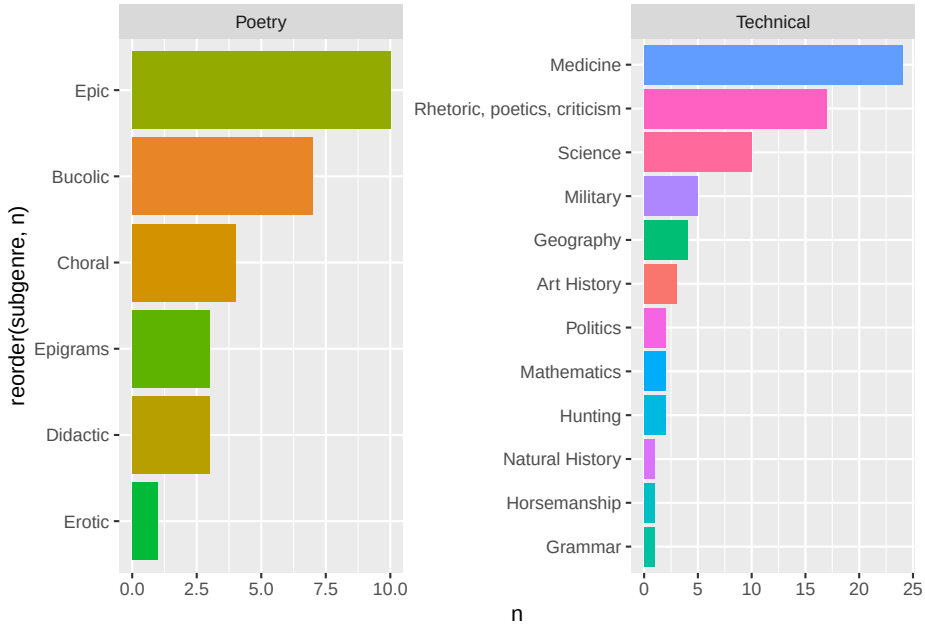
, dotplot, ,
, . , .
(,) ( ).

```
diorisis_meta %>% ggplot(aes(date, fill = factor(genre))) +
  geom_dotplot(binwidth = 10, stackdir = "centerwhole", binpositions = "all") +
  scale_y_continuous(NULL, breaks = NULL) +
  scale_x_continuous(breaks = scales::pretty_breaks(n = 10))
```



. : ? ’ –

```
diorisis_meta %>%
  group_by(genre, subgenre) %>%
  count %>%
  filter(genre %in% c("Poetry", "Technical")) %>%
  ggplot(aes(reorder(subgenre, n), n, fill = subgenre)) +
  geom_col(show.legend = F) +
  facet_wrap(~genre, scales = "free") + #
  coord_flip()
```



.

3.4 R

:

- R ;
- ggsave()
- RStudio.

```
#          pdf
pdf(file = "Diorisis.pdf")
diorisis_meta %>%
  group_by(genre, subgenre) %>%
  count %>%
  filter(genre %in% c("Poetry", "Technical")) %>%
  ggplot(aes(reorder(subgenre, n), n, fill = subgenre)) +
  geom_col(show.legend = F) +
  facet_wrap(~genre, scales = "free") +
  coord_flip()
dev.off()

#
ggsave(
  filename = "Diorisis.png",
  plot = last_plot(),
```

```
  device = "png",
  scale = 1,
  width = NA,
  height = 500,
  units = "px",
  dpi = 300
)
```

Chapter 4

> Tidy datasets are all alike, but every messy dataset is messy in its own way.
>
> — Hadley Wickham

4.1 tidyverse

“ ” R,
R, tidyverse [Winter, 2020]. Tidyverse –
( ), ., `dplyr`, `ggplot2`
.

```
#
library(tidyverse)
```

4.1.1 Tibble

tidyverse – tibble, [1]. ,
, : [2].
, , , , .

:

- , ;[3]
- `print()`, `head()`;
- ;
- “ ” ;

[1] https://r4ds.had.co.nz/tibbles.html
[2] https://tibble.tidyverse.org/
[3] , : https://simplystatistics.org/posts/2015-07-24-stringsasfactors-an-unauthorized-biography/

- .

```
load("./datasets/DiorisisMeta.Rdata")

#                  10    ,                       ,
as_tibble(diorisis_meta)
```

```
## # A tibble: 784 x 5
##    name            title                       date genre     subgenre
##    <chr>           <chr>                      <dbl> <chr>     <chr>
##  1 Achilles Tatius Leucippe and Clitophon       120 Narrative Novel
##  2 Aelian          De Natura Animalium          230 Technical Natural History
##  3 Aelian          Epistulae Rusticae           230 Letters   Letters
##  4 Aelian          Varia Historia               200 Essays    Miscellanea
##  5 Aeneas Tacticus Poliorcetica                -350 Technical Military
##  6 Aeschines       Against Ctesiphon           -330 Oratory   Oratory
##  7 Aeschines       Against Timarchus           -347 Oratory   Oratory
##  8 Aeschines       The Speech on the Embassy   -336 Oratory   Oratory
##  9 Aeschylus       Agamemnon                   -458 Tragedy   Tragedy
## 10 Aeschylus       Eumenides                   -458 Tragedy   Tragedy
## # i 774 more rows
```

```
#
head(as.data.frame(diorisis_meta)[, 1])  #
```

```
## [1] "Achilles Tatius" "Aelian"          "Aelian"          "Aelian"
## [5] "Aeneas Tacticus" "Aeschines"
```

```
as_tibble(diorisis_meta)[,1] #
```

```
## # A tibble: 784 x 1
##    name
##    <chr>
##  1 Achilles Tatius
##  2 Aelian
##  3 Aelian
##  4 Aelian
##  5 Aeneas Tacticus
##  6 Aeschines
##  7 Aeschines
##  8 Aeschines
##  9 Aeschylus
## 10 Aeschylus
## # i 774 more rows
```

```
#
df <- data.frame('var 1' = 1:2, two = 3:4)
df
```

```
##   var.1 two
## 1     1   3
## 2     2   4
```

```
tbl <- tibble('var 1' = 1:2, two = 3:4)
tbl
```

```
## # A tibble: 2 x 2
##   `var 1`   two
##     <int> <int>
## 1       1     3
## 2       2     4
```

4.1.2 Dplyr

, tibble “ ”, dplyr[4].

,

:

- mutate() , ;
- select() ;
- filter() ;
- summarise() ;
- arrange() .

group_by(),

“ ”, **pipe %>%** magrittr.

, .

```
diorisis_meta %>%
  select(-subgenre) %>%
  filter(genre == "Narrative") %>%  #          !
  group_by(name) %>%
  count() %>%
  arrange(-n)
```

```
## # A tibble: 20 x 2
## # Groups:   name [20]
##    name                          n
##    <chr>                     <int>
##  1 Plutarch                     71
##  2 Appian                       14
##  3 Flavius Josephus              4
##  4 Xenophon                      4
##  5 Arrian                        3
##  6 Diodorus Siculus              3
```

[4] https://dplyr.tidyverse.org/

```
##  7 Philostratus the Athenian      2
##  8 Achilles Tatius                1
##  9 Cassius Dio                    1
## 10 Chariton                       1
## 11 Diogenes Laertius              1
## 12 Dionysius of Halicarnassus     1
## 13 Eusebius of Caesarea           1
## 14 Herodotus                      1
## 15 Longus                         1
## 16 Lucian                         1
## 17 Polybius                       1
## 18 Pseudo Apollodorus             1
## 19 Thucydides                     1
## 20 Xenophon of Ephesus            1
```

R :

```
diorisis_df <- as.data.frame(diorisis_meta)
diorisis_select <- diorisis_df[,-5] # remove column
diorisis_filter <- diorisis_select[diorisis_select$genre == "Narrative", ]
diorisis_names <- diorisis_filter$name
diorisis_count <- as.data.frame(table(diorisis_names))
diorisis_sort <- diorisis_count[order(diorisis_count$Freq, decreasing =T),]
diorisis_sort
```

```
##                diorisis_names Freq
## 15                   Plutarch   71
## 2                      Appian   14
## 10           Flavius Josephus    4
## 19                   Xenophon    4
## 3                      Arrian    3
## 6            Diodorus Siculus    3
## 14  Philostratus the Athenian    2
## 1              Achilles Tatius    1
## 4                  Cassius Dio    1
## 5                     Chariton    1
## 7           Diogenes Laertius    1
## 8  Dionysius of Halicarnassus    1
## 9        Eusebius of Caesarea    1
## 11                   Herodotus    1
## 12                      Longus    1
## 13                      Lucian    1
## 16                    Polybius    1
## 17         Pseudo Apollodorus    1
## 18                   Thucydides    1
## 20        Xenophon of Ephesus    1
```

- .

4.2

tidyverse – , “ ”. “ ” ,
, , “ ” [5].

:

- ;
- ;
- ;
- – .

: .

tidyr , .

```
data("table2")
table2
```

```
## # A tibble: 12 x 4
##    country      year type            count
##    <chr>       <dbl> <chr>           <dbl>
##  1 Afghanistan  1999 cases             745
##  2 Afghanistan  1999 population   19987071
##  3 Afghanistan  2000 cases            2666
##  4 Afghanistan  2000 population   20595360
##  5 Brazil       1999 cases           37737
##  6 Brazil       1999 population  172006362
##  7 Brazil       2000 cases           80488
##  8 Brazil       2000 population  174504898
##  9 China        1999 cases          212258
## 10 China        1999 population 1272915272
## 11 China        2000 cases          213766
## 12 China        2000 population 1280428583
```

```
data("table3")
table3
```

```
## # A tibble: 6 x 3
##   country      year rate
##   <chr>       <dbl> <chr>
## 1 Afghanistan  1999 745/19987071
## 2 Afghanistan  2000 2666/20595360
## 3 Brazil       1999 37737/172006362
## 4 Brazil       2000 80488/174504898
```

[5] https://r4ds.had.co.nz/tidy-data.html

```
## 5 China        1999 212258/1272915272
## 6 China        2000 213766/1280428583
```

```
data("table4a")
table4a
```

```
## # A tibble: 3 x 3
##   country     `1999` `2000`
##   <chr>        <dbl>  <dbl>
## 1 Afghanistan    745   2666
## 2 Brazil       37737  80488
## 3 China       212258 213766
```

```
data("table4b")
table4b
```

```
## # A tibble: 3 x 3
##   country         `1999`     `2000`
##   <chr>            <dbl>      <dbl>
## 1 Afghanistan   19987071   20595360
## 2 Brazil       172006362  174504898
## 3 China       1272915272 1280428583
```

tidyr:[6]

- separate() ;
- unite() ;
- pivot_longer() ;
- pivot_wider() ;
- drop_na() replace_na() , NA .

distinct() dplyr, unique() .

, dplyr _join, .[7]

.

4.3 :

4.3.1

. Book-Crossing – 250 .

.

```
load("./datasets/BooksBX.Rdata")
load("./datasets/RatingsBX.Rdata")
```

[6] https://tidyr.tidyverse.org/reference/index.html
[7] https://r4ds.had.co.nz/relational-data.html

```
load("./datasets/UsersBX.Rdata")

ratings
```

```
## # A tibble: 493,813 x 3
##    `User-ID` ISBN       `Book-Rating`
##        <dbl> <chr>              <dbl>
##  1    276725 034545104X             0
##  2    276726 0155061224             5
##  3    276727 0446520802             0
##  4    276729 052165615X             3
##  5    276729 0521795028             6
##  6    276733 2080674722             0
##  7    276736 3257224281             8
##  8    276737 0600570967             6
##  9    276744 038550120X             7
## 10    276745 342310538             10
## # i 493,803 more rows
```

```
users
```

```
## # A tibble: 246,666 x 3
##    `User-ID` Location                           Age
##        <dbl> <chr>                              <chr>
##  1         1 nyc, new york, usa                 NULL
##  2         2 stockton, california, usa          18
##  3         3 moscow, yukon territory, russia    NULL
##  4         4 porto, v.n.gaia, portugal          17
##  5         5 farnborough, hants, united kingdom NULL
##  6         6 santa monica, california, usa      61
##  7         7 washington, dc, usa                NULL
##  8         8 timmins, ontario, canada           NULL
##  9         9 germantown, tennessee, usa         NULL
## 10        10 albacete, wisconsin, spain         26
## # i 246,656 more rows
```

```
books
```

```
## # A tibble: 270,760 x 8
##    ISBN       `Book-Title`         `Book-Author` `Year-Of-Publication` Publisher
##    <chr>      <chr>                <chr>                         <dbl> <chr>
##  1 0195153448 Classical Mythology  Mark P. O. M~                  2002 Oxford U~
##  2 0002005018 Clara Callan         Richard Bruc~                  2001 HarperFl~
##  3 0060973129 Decision in Normandy Carlo D'Este                   1991 HarperPe~
##  4 0374157065 Flu: The Story of t~ Gina Bari Ko~                  1999 Farrar S~
##  5 0393045218 The Mummies of Urum~ E. J. W. Bar~                  1999 W. W. No~
##  6 0399135782 The Kitchen God's W~ Amy Tan                        1991 Putnam P~
```

```
##  7 0425176428 What If?: The World~ Robert Cowley                2000 Berkley ~
##  8 0671870432 PLEADING GUILTY      Scott Turow                  1993 Audiowor~
##  9 0679425608 Under the Black Fla~ David Cordin~                1996 Random H~
## 10 074322678X Where You'll Find M~ Ann Beattie                  2002 Scribner
## # i 270,750 more rows
## # i 3 more variables: `Image-URL-S` <chr>, `Image-URL-M` <chr>,
## #   `Image-URL-L` <chr>
```

?

- users Location
-
- https://www.bookcrossing.com/ ;
, . . moscow, yukon territory, russia (–
).
- Age .
- , , , .
: - 30 ? -
? - , ? -
? - ? . .
- , .

: ratings books isbn, ratings users
User-ID.

4.3.2

.

```
users_separated <- users %>%
  mutate(Age = as.numeric(Age)) %>%
  filter(!is.na(Age))  %>% # drop_na(Age)
  separate(Location, into = c(NA, NA, "country"), sep = ",")

users_separated #                ,
```

```
## # A tibble: 148,869 x 3
##    `User-ID` country        Age
##        <dbl> <chr>        <dbl>
##  1         2 " usa"          18
##  2         4 " portugal"     17
##  3         6 " usa"          61
##  4        10 " spain"        26
##  5        11 " australia"    14
##  6        13 " spain"        26
##  7        18 " brazil"       25
```

```
##  8        19 ""              14
##  9        20 " usa"          19
## 10        21 " spain"        46
## # i 148,859 more rows
```

, .

```
users_separated %>%
  group_by(country) %>%
  count() %>%
  arrange(-n)
```

```
## # A tibble: 543 x 2
## # Groups:   country [543]
##    country               n
##    <chr>             <int>
##  1 " usa"            67138
##  2 " united kingdom" 10935
##  3 " canada"          9877
##  4 " spain"           9505
##  5 " germany"         8016
##  6 " australia"       7824
##  7  <NA>              5914
##  8 " italy"           4754
##  9 " france"          2395
## 10 " portugal"        2175
## # i 533 more rows
```

:

```
users_separated %>%
  group_by(country) %>%
  count() %>%
  arrange(n)
```

```
## # A tibble: 543 x 2
## # Groups:   country [543]
##    country                   n
##    <chr>                 <int>
##  1 "  pasig city."            1
##  2 " &#20013;&#22269;"        1
##  3 " &#32654;&#22269;"        1
##  4 " 5057chadwick ct."        1
##  5 " 600 083"                 1
##  6 " \\n/a\\\""               1
##  7 " a new year is ahead"     1
##  8 " aberdeenshire"           1
##  9 " agusan del sur"          1
```

```
## 10 " alabama"                 1
## # i 533 more rows
```

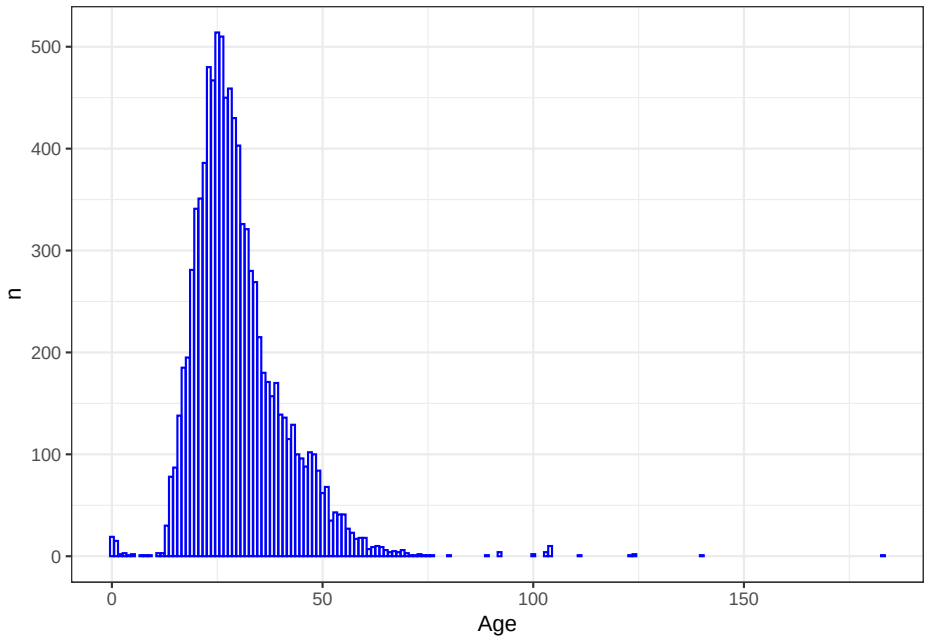
. (
) - . , .
, . ,
separate() , . (
) mutate().

```
spain_data <- users_separated %>%
  mutate(country = str_replace_all(country, pattern = "\\s+", "")) %>% #        ,
  filter(country == "spain") %>%
  group_by(Age) %>%
  count() %>%
  arrange(-n)

spain_data
```

```
## # A tibble: 86 x 2
## # Groups:   Age [86]
##      Age     n
##    <dbl> <int>
##  1    25   514
##  2    26   510
##  3    23   480
##  4    24   467
##  5    28   459
##  6    27   450
##  7    29   430
##  8    30   403
##  9    22   386
## 10    21   351
## # i 76 more rows
```

:

```
spain_data %>%
  ggplot(aes(Age, n)) +
  geom_bar(stat = "identity", col = "blue", fill = "white") +
  theme_bw()
```



! 0 183

, , :

```
spain_id <- users_separated %>%
  mutate(country = str_replace_all(country, pattern = "\\s+", "")) %>%
  filter(country == "spain") #                                    ,          ,
```

4.3.3

, ratings users User-ID, ratings
id, (, . .).
_join[8].

.

```
spain_ratings <- spain_id %>%
  left_join(ratings) %>%
  filter(!is.na(ISBN)) %>%
  filter(`Book-Rating` > 7) %>% #                  ,          "`"
  group_by(ISBN) %>%
  count() %>%
  arrange(-n)
```

```
## Joining with `by = join_by(`User-ID`)`
```

[8]https://r4ds.had.co.nz/relational-data.html

```
spain_ratings
```

```
## # A tibble: 1,281 x 2
## # Groups:   ISBN [1,281]
##    ISBN           n
##    <chr>      <int>
##  1 8432206407     4
##  2 8433969978     4
##  3 846630679X     4
##  4 8472236552     4
##  5 8495501198     4
##  6 840149186X     3
##  7 8401499585     3
##  8 8423310353     3
##  9 8423662152     3
## 10 8432215007     3
## # i 1,271 more rows
```

, . spain_ratings books.

```
spain_books <- spain_ratings %>%
  filter(n > 2) %>%
  left_join(books) %>%
  filter(!is.na(`Book-Title`), !is.na(`Book-Author`)) %>%
  ungroup()
```

```
## Joining with `by = join_by(ISBN)`
```

```
spain_books
```

```
## # A tibble: 15 x 9
##    ISBN           n `Book-Title`   `Book-Author` `Year-Of-Publication` Publisher
##    <chr>      <int> <chr>          <chr>                          <dbl> <chr>
##  1 8432206407     4 Sin Noticias ~ Eduardo Mend~                   1995 Planeta ~
##  2 8433969978     4 El Libro de L~ Paul Auster                     2003 Anagrama
##  3 846630679X     4 La caverna = ~ Jose Saramago                   2002 Punto de~
##  4 8472236552     4 UN Viejo Que ~ Luis Sepulve~                   1993 Tusquets~
##  5 8495501198     4 Memorias de u~ Arthur Golden                   2001 Suma de ~
##  6 840149186X     3 El Club de Lo~ N. H. Kleinb~                   1995 Plaza &a~
##  7 8401499585     3 Los Pilares d~ Ken Follett                     1995 Plaza &a~
##  8 8423310353     3 El Camino (Co~ Miguel Delib~                   1991 Continen~
##  9 8432215007     3 El perfume     Patrick Susk~                   1997 Editoria~
## 10 8445071408     3 El Senor De L~ J. R. R. Tol~                   2001 Minotauro
## 11 8445071416     3 El Hobbit      J. R. R. Tol~                   1991 Minotauro
## 12 8477204055     3 El caballero ~ Robert Fisher                   2000 Obelisco
## 13 8478884459     3 Harry Potter ~ J. K. Rowling                   1999 Lectorum~
## 14 8484602508     3 Diario de Un ~ Antonio Salas                   2003 Temas de~
```

```
## 15 8495501112     3 Son De Mar     Manuel Vicent                  2002 Suma de ~
## # i 3 more variables: `Image-URL-S` <chr>, `Image-URL-M` <chr>,
## #   `Image-URL-L` <chr>
```

, ! (. ,
ISBN, ISBN, ?)

(, ,).
, :

```
spain_books %>%
  select(3:5) %>%
  rename(title = `Book-Title`, author = `Book-Author`)
```

```
## # A tibble: 15 x 3
##    title                                          author `Year-Of-Publication`
##    <chr>                                          <chr>                  <dbl>
##  1 Sin Noticias De Gurb (Biblioteca breve)        Eduar~                  1995
##  2 El Libro de Las Ilusiones                      Paul ~                  2003
##  3 La caverna = A caverna                         Jose ~                  2002
##  4 UN Viejo Que Leia Novelas De Amor/the Old Men W~ Luis ~                1993
##  5 Memorias de una geisha                         Arthu~                  2001
##  6 El Club de Los Poetas Muertos                  N. H.~                  1995
##  7 Los Pilares de La Tierra                       Ken F~                  1995
##  8 El Camino (Coleccion Destinolibro)             Migue~                  1991
##  9 El perfume                                     Patri~                  1997
## 10 El Senor De Los Anillos: LA Comunidad Del Anill~ J. R.~                2001
## 11 El Hobbit                                      J. R.~                  1991
## 12 El caballero de la armadura oxidada            Rober~                  2000
## 13 Harry Potter y la piedra filosofal             J. K.~                  1999
## 14 Diario de Un Skin: Un Topo En El Movimiento Neo~ Anton~                2003
## 15 Son De Mar                                     Manue~                  2002
```

select() - [9], :

- starts_with()
- ends_with()
- contains()
- matches()
- num_range()

```
spain_books %>%
  select(-contains("URL"), -matches("Publisher")) %>% #
  rename(title = `Book-Title`,
         author = `Book-Author`,
         published = `Year-Of-Publication`) #
```

```
## # A tibble: 15 x 5
```

[9] https://r4ds.had.co.nz/transform.html

```
##    ISBN           n title                                    author published
##    <chr>      <int> <chr>                                    <chr>      <dbl>
##  1 8432206407     4 Sin Noticias De Gurb (Biblioteca breve)  Eduar~      1995
##  2 8433969978     4 El Libro de Las Ilusiones                Paul ~      2003
##  3 846630679X     4 La caverna = A caverna                   Jose ~      2002
##  4 8472236552     4 UN Viejo Que Leia Novelas De Amor/the Old ~ Luis ~      1993
##  5 8495501198     4 Memorias de una geisha                   Arthu~      2001
##  6 840149186X     3 El Club de Los Poetas Muertos            N. H.~      1995
##  7 8401499585     3 Los Pilares de La Tierra                 Ken F~      1995
##  8 8423310353     3 El Camino (Coleccion Destinolibro)       Migue~      1991
##  9 8432215007     3 El perfume                               Patri~      1997
## 10 8445071408     3 El Senor De Los Anillos: LA Comunidad Del ~ J. R.~      2001
## 11 8445071416     3 El Hobbit                                J. R.~      1991
## 12 8477204055     3 El caballero de la armadura oxidada      Rober~      2000
## 13 8478884459     3 Harry Potter y la piedra filosofal       J. K.~      1999
## 14 8484602508     3 Diario de Un Skin: Un Topo En El Movimient~ Anton~      2003
## 15 8495501112     3 Son De Mar                               Manue~      2002
```

, - .

Chapter 5

5.1

R . ,
, [, 2019].

, , , , .
. return(); ,
(. ,).

, , :

```
center <- function(x){
  n = x - mean(x)
  return(n)
}

x <- c(5, 10, 15)
center(x) #              ,
```

```
## [1] -5  0  5
```

scale() (scale = F;
,).

n, . .
– . , . :
.

. :

```
center <- function(x, na.rm = F){
  if(na.rm) { x <- x[!is.na(x)]} #
  x - mean(x) #           return()
```

```
}

x <- c(5, 10, NA)
center(x)
```

```
## [1] NA NA NA
```

? ?

```
center(x, na.rm = T)
```

```
## [1] -2.5  2.5
```

R , , . ,
, .

```
center <- function(x, na.rm = F, what_is_your_name){
  if(na.rm) { x <- x[!is.na(x)]} #
  x - mean(x) #           return()
}

center(x, na.rm = T)
```

```
## [1] -2.5  2.5
```

```
center(x, na.rm = T, what_is_your_name = "Locusclassicus")
```

```
## [1] -2.5  2.5
```

, , , , .
(f() –). R !

, .

```
center <- function(x){
  if (length(x) == 1) {stop("            ")}
  x - mean(x) #           return()
}

x <- 10
center(x) #
```

, R . :

```
x <- c(5, 10, 15)
x - mean(x)
```

```
## [1] -5  0  5
```

5.2

f(), x,
f() x. . .

R , [, 2019].

R, . x + 4
+(x, 4):

```
x <- c(1.2, 2.51, 3.8)

#
round(x)
```

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

```
#
`+`(x, 4)
```

```
## [1] 5.20 6.51 7.80
```

, : ,
.

```
is_article <- function(x){
  x == c("a", "the")
}

x <- "the"
is_article(x) #              ,
```

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

, .

```
x <- c("just", "the")
is_article(x)
```

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

```
x <- c("the", "just")
is_article(x) #
```

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

?

, !

, . , :

```
is_article <- function(x) {
  articles <- c("a", "the")
```

```
  x %in% articles
}

x <- c(rep("the", 5), rep("if", 5))
is_article(x)
```

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

```
sum(is_article(x))
```

```
## [1] 5
```

5.3 ?

:

- , ;
- , ;
- (, ,)

: , !

> Writing good functions is a lifetime journey.
>
> — Hadley Wickham

. , . , ,
.

```
#
x <- c("  ", "   ", "   ")
y <- c(" ", "   ", "  ", " ", "    ", "   ", "    ", "  ")
idx <- which(x %in% y)
x[idx]
```

```
## [1] "   "
```

```
#
common_words <- function(x, y){
  idx <- which(x %in% y)
  x[idx]
}

#
x <- c("  ", "   ", "  ", "      ", "    ", "  ")
y <- c("    ", "  ", "  ", " ", "    ", "   ", "    ")
common_words(x, y)
```

```
## [1] "  "     "    " " "
```

, !

, ( ). ,
. Stylo;
Delta . , .

```
library(stylo)
dist.delta
```

```
## function (x, scale = TRUE)
## {
##     if (is.matrix(x) == FALSE & is.data.frame(x) == FALSE) {
##         stop("cannot apply a distance measure: wrong data format!")
##     }
##     if (length(x[1, ]) < 2 | length(x[, 1]) < 2) {
##         stop("at least 2 cols and 2 rows are needed to compute a distance!")
##     }
##     if (scale == TRUE) {
##         x = scale(x)
##     }
##     y = dist(x, method = "manhattan")/length(x[1, ])
##     return(y)
## }
## <bytecode: 0x13af68428>
## <environment: namespace:stylo>
```

5.4

5.4.1

R, , –
.

R ,
, , .

—

: for while. for,
while .

5.4.1.1 for

.

```
y <- c(" ", "   ", "  ", " ", "    ", "   ", "     ", "  ")

result <- c()
for(i in y) {
  n <- nchar(i)
```

```
  result <- c(result, n)
}

result
```

```
## [1] 1 5 3 2 7 6 9 4
```

, - ; ,
nchar() .

```
nchar(y)
```

```
## [1] 1 5 3 2 7 6 9 4
```

for . , (
,). . ,
.

```
rownames(hapax_plato) <- hapax_plato$dialogue
hapax_plato <- hapax_plato %>% select(-ratio, -group, -dialogue) #      pipe          d
str(hapax_plato)
```

```
## 'data.frame':    26 obs. of  2 variables:
##  $ words: chr  "8745" "8311" "17944" "4950" ...
##  $ hapax: chr  "36" "31" "122" "104" ...
```

chr, , .

```
for (i in seq_along(hapax_plato)) {  # seq_along   1:length(x)
  hapax_plato[,i] <- as.numeric(hapax_plato[,i])
}

str(hapax_plato) #      ,
```

```
## 'data.frame':    26 obs. of  2 variables:
##  $ words: num  8745 8311 17944 4950 4169 ...
##  $ hapax: num  36 31 122 104 19 87 15 125 12 32 ...
```

, . ,
: colSums() (, , rowSums()).
, .

```
medians <- c()
for (i in seq_along(hapax_plato)) {
  m <- median(hapax_plato[,i])
  medians <- c(medians, m)
}

medians
```

```
## [1] 15589.5    94.5
```

, , .
, [1]. –
.

```
medians <- vector("double", ncol(hapax_plato))
for (i in seq_along(hapax_plato)) {
  medians[i] <- median(hapax_plato[,i])
}

medians
```

```
## [1] 15589.5    94.5
```

tictoc.

```
library(tictoc)

#
tic()
medians <- c()
for (i in seq_along(hapax_plato)) {
  m <- median(hapax_plato[,i])
  medians <- c(medians, m)
}
toc()
```

```
## 0.004 sec elapsed
```

```
#
tic()
medians <- vector("double", ncol(hapax_plato))
for (i in seq_along(hapax_plato)) {
  medians[i] <- median(hapax_plato[,i])
}
toc()
```

```
## 0.003 sec elapsed
```

, ( ).
, i. !

5.4.1.2 while

, while . , , ,
, 6 . ?

```
k <- 0
n <- 0
```

[1] https://r4ds.had.co.nz/iteration.html

```
while (n != 6) {
  k <- k + 1
  n <- nchar(y[k])
}

y[k]
```

```
## [1] "    "
```

. , NA.

```
y[nchar(y) == 6][1]
```

```
## [1] "    "
```

5.4.2

, .

```
if(any(nchar(y) > 6)) print("     ")
```

```
## [1] "     "
```

| (“ ”) & (“ ”), :

```
y
```

```
## [1] " "          "   "     "  "       " "         "    "    "    "
## [7] "     " "   "
```

```
nchar(y) > 6 | nchar(y) < 2
```

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

|| (“ ”) && (“ ”), , .

```
nchar(y) > 6 || nchar(y) < 2
```

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

:

```
if (sum(nchar(y)) > 10) {
  print("      ")
} else if (sum(nchar(y)) < 5) {
  print("     ")
} else {
  print("     ")
}
```

```
## [1] "      "
```

:

```
ifelse((sum(nchar(y)) > 10), "      ", "      ")
```

```
## [1] "      "
```

5.5 _apply R

, , R _apply.

5.5.1 tapply()

, ( ) . , .

```
load("./datasets/HapaxPlato.Rdata")
```

```
my_fct <- as.factor(hapax_plato$group)
my_vct <- as.numeric(hapax_plato$ratio)
tapply(my_vct, my_fct, mean)
```

```
##          1          2          3
## 0.00550000 0.00750000 0.01133333
```

tidyverse :

```
hapax_plato %>%
  mutate(ratio = as.numeric(ratio)) %>%
  group_by(group) %>%
  summarise(mean = mean(ratio))
```

```
## # A tibble: 3 x 2
##   group   mean
##   <dbl>  <dbl>
## 1     1 0.0055
## 2     2 0.0075
## 3     3 0.0113
```

5.5.2 apply()

.

```
#
rownames(hapax_plato) <- hapax_plato$dialogue
hapax_plato <- subset(hapax_plato, select = -c(dialogue, group)) #

#
str(hapax_plato)
```

```
## 'data.frame':    26 obs. of  3 variables:
##  $ words: chr  "8745" "8311" "17944" "4950" ...
```

```
##  $ hapax: chr  "36" "31" "122" "104" ...
##  $ ratio: chr  "0.004" "0.004" "0.007" "0.021" ...
```

```
#
hapax_plato<- apply(hapax_plato, 2, as.numeric)

#
round((apply(hapax_plato, 2, sd)), 3)
```

```
##     words     hapax     ratio
## 23640.597   208.856     0.004
```

apply() sd() stats, ( ).

```
hapax_centered <- apply(hapax_plato, 2, function(x) x - mean(x))
head(hapax_centered)
```

```
##           words      hapax         ratio
## [1,] -10619.423 -110.69231 -0.0031538462
## [2,] -11053.423 -115.69231 -0.0031538462
## [3,]  -1420.423  -24.69231 -0.0001538462
## [4,] -14414.423  -42.69231  0.0138461538
## [5,] -15195.423 -127.69231 -0.0021538462
## [6,]  -6911.423  -59.69231 -0.0001538462
```

- , ( ) dplyr:

```
as_tibble(hapax_plato) %>%
  mutate(words = words - mean(words),
         hapax = hapax - mean(hapax),
         ratio = ratio - mean(ratio))
```

! , ! , [2]:

```
as_tibble(hapax_plato) %>%
  mutate_all(function(x) x - mean(x))
```

[3]:

```
fn <- function(x) x - mean(x)
as_tibble(hapax_plato) %>%
  mutate(across(1:3, fn))
```

, , .

[2] https://dplyr.tidyverse.org/reference/mutate_all.html
[3] https://dplyr.tidyverse.org/articles/colwise.html

5.5.3 lapply() sapply()

lapply() sapply() . , ,
.

, , – stylo.corpus,
stylo[4].

.

```
load("./datasets/PlatoStylo.Rdata")
class(corpus)
```

```
## [1] "stylo.corpus"
```

RStudio, , corpus , (,
,):

, – 26 ( ), – .
, , :

```
class(corpus[[1]])
```

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

, 1000 , sample()
. lapply() (l = list) :

```
samples <- lapply(corpus, sample, 1000, replace = T)
```

samples ,
.

sapply() , (s = simplify).

```
s_sample <- sapply(corpus[1:2], sample, 5, replace = F)
s_sample
```

```
##      Apology    Charmides
## [1,] "   "     "   "
## [2,] "     " "   "
## [3,] "   "     "    "
## [4,] "  "       "   "
## [5,] "    "   "  "
```

, dplyr , stylo :

```
corpus_df <- stack(corpus)
head(corpus_df)
```

```
##     values     ind
```

[4] https://rdrr.io/cran/stylo/

```
## 1        Apology
## 2         Apology
## 3          Apology
## 4           Apology
## 5         Apology
## 6       Apology
```

:

```
corpus_tbl <- corpus_df %>%
  as_tibble() %>%
  relocate(ind, .before = values) %>%
  rename(title = ind,
         word = values)

corpus_tbl
```

```
## # A tibble: 503,475 x 2
##    title   word
##    <fct>   <chr>
##  1 Apology
##  2 Apology
##  3 Apology
##  4 Apology
##  5 Apology
##  6 Apology
##  7 Apology
##  8 Apology
##  9 Apology
## 10 Apology
## # i 503,465 more rows
```

:

```
samples <- corpus_tbl %>%
  group_by(title) %>%
  sample_n(size = 1000, replace = T)

dim(samples) #    ,                        1000
```

```
## [1] 26000     2
```

!

5.6 Purrr

– purrr tidyverse[5]. .

[5] https://purrr.tidyverse.org/

> You should never feel bad about using a loop instead of a map function. The map functions are a step up a tower of abstraction, and it can take a long time to get your head around how they work.
>
> — Hadley Wickham & Garrett Grolemund

– `map()` – 23 [6]. `map` – , :
[Wickham and Grolemund, 2017].

:

- `map(.x, .f, ..., .progress = FALSE)`
- `map_lgl(.x, .f, ..., .progress = FALSE)`
- `map_int(.x, .f, ..., .progress = FALSE)`
- `map_dbl(.x, .f, ..., .progress = FALSE)`
- `map_chr(.x, .f, ..., .progress = FALSE)`

:

- `map_if()`
- `imap()`
- `lmap()`
- `map2()`
- `map_if()`
- `modify()`

. purrr – [7], .

5.6.1 map_df() map_dbl()

, map .

```
hapax_plato <- as_tibble(hapax_plato)
map_df(hapax_plato, center)
```

```
## # A tibble: 26 x 3
##      words  hapax     ratio
##      <dbl>  <dbl>     <dbl>
##  1 -10619. -111.  -0.00315
##  2 -11053. -116.  -0.00315
##  3  -1420.  -24.7 -0.000154
##  4 -14414.  -42.7  0.0138
##  5 -15195. -128.  -0.00215
##  6  -6911.  -59.7 -0.000154
##  7 -14183. -132.  -0.00415
##  8   6973.  -21.7 -0.00215
##  9 -15004. -135.  -0.00415
## 10 -15340. -115.   0.000846
```

[6] https://adv-r.hadley.nz/functionals.html
[7] ., : https://www.emilhvitfeldt.com/post/2018-01-08-purrr-tips-and-tricks/

```
## # i 16 more rows
```

map – pipeable, :

```
hapax_plato %>% map_df(center)
```

. , , dbl:

```
round(map_dbl(hapax_plato, mean), 3)
```

```
##     words     hapax     ratio
## 19364.423   146.692     0.007
```

5.6.2 map2()

map2()
,
[8].

```
mean = list(1, 10, 100)
sd = list(0.5, 5, 50)
map2(mean, sd, rnorm, n = 3)
```

```
## [[1]]
## [1] 0.9897045 0.6571986 1.0210709
##
## [[2]]
## [1]  7.411873 10.106023  8.358997
##
## [[3]]
## [1]  69.68189 203.96908  94.06450
```

, , ; , , – .

2

, pnorm().

map2() : [9].

```
library(slider)
windows <- slide(corpus_tbl[1:36,], ~.x, .after = 6)
out <- map2(.x = windows, .y = 1:length(windows), ~ mutate(.x, window_id = .y)) # out
out[2]
```

```
## [[1]]
## # A tibble: 7 x 3
##   title   word     window_id
##   <fct>   <chr>        <int>
```

[8] https://adv-r.hadley.nz/functionals.html
[9] https://smltar.com/embeddings.html#understand-word-embeddings-by-finding-themyourself

```
## 1 Apology                2
## 2 Apology                 2
## 3 Apology                  2
## 4 Apology                2
## 5 Apology               2
## 6 Apology                2
## 7 Apology                 2
```

5.7 Furrr

, .

Chapter 6

Blocks

6.1 Equations

Here is an equation.

$$f(k) = \binom{n}{k} p^k (1-p)^{n-k} \tag{6.1}$$

You may refer to using `\@ref(eq:binom)`, like see Equation (6.1).

6.2 Theorems and proofs

Labeled theorems can be referenced in text using `\@ref(thm:tri)`, for example, check out this smart theorem 6.1.

Theorem 6.1. *For a right triangle, if c denotes the* length *of the hypotenuse and a and b denote the lengths of the* ***other*** *two sides, we have*

$$a^2 + b^2 = c^2$$

Read more here https://bookdown.org/yihui/bookdown/markdown-extensions-by-bookdown.html.

6.3 Callout blocks

The R Markdown Cookbook provides more help on how to use custom blocks to design your own callouts: https://bookdown.org/yihui/rmarkdown-cookbook/custom-blocks.html

Chapter 7

Sharing your book

7.1 Publishing

HTML books can be published online, see: https://bookdown.org/yihui/bookdown/publishing.html

7.2 404 pages

By default, users will be directed to a 404 page if they try to access a webpage that cannot be found. If you'd like to customize your 404 page instead of using the default, you may add either a `_404.Rmd` or `_404.md` file to your project root and use code and/or Markdown syntax.

7.3 Metadata for sharing

Bookdown HTML books will provide HTML metadata for social sharing on platforms like Twitter, Facebook, and LinkedIn, using information you provide in the `index.Rmd` YAML. To setup, set the `url` for your book and the path to your `cover-image` file. Your book's `title` and `description` are also used.

This `gitbook` uses the same social sharing data across all chapters in your book- all links shared will look the same.

Specify your book's source repository on GitHub using the `edit` key under the configuration options in the `_output.yml` file, which allows users to suggest an edit by linking to a chapter's source file.

Read more about the features of this output format here:

https://pkgs.rstudio.com/bookdown/reference/gitbook.html

Or use:

```
?bookdown::gitbook
```

Bibliography

Lewis Campbell. *The Sophistes and Politicus of Plato with a Revised Text and English Notes*. Clarendon Press, 1867.

Deepayan Sarkar. *Lattice: Multivariate Data Visualization with R*. Springer, 2008.

Hadley Wickham and Garrett Grolemund. *R for Data Science*. O'Reilly, 2017. URL https://r4ds.had.co.nz/index.html.

Bodo Winter. *Statistics for Linguists: An Introduction Using R*. Routledge, 2020.

. . . *R:* , 2015.

. *ggplot2*. , 2017.

. *R*. , 2019.

. . . *R*. , 2015.