무료 전자 책

배우기

R Language

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#r

1: R

R Docs

.

R .

- R .
- .
- 0 1 .
- R `arrays` ( ) R " " `dim` .
- R (,) . , , , . .
-
-

Examples

R

R RStudio . RStudio R .

Windows :

Visual Studio (2015 3) , IntelliSense R Tools . R .

Windows

1. CRAN Windows R R .
2. .
3. .
4. .

OSX / macOS

1

(0. XQuartz)

1. CRAN R .
2.

.

3. .

R MacGUI . GUI / Applications / Folder R.app . Doc . () R.app R . R /Library/Frameworks/R.Framework/Versions/ . RStudio R GUI R .

2

1. https://brew.sh/ homebrew (macOS) .
2. `brew install R`

Mac R-SIG-Mac .

,

`apt-get` R . CRAN . "" CRAN .

```
sudo apt-get install r-base
```

CRAN CRAN . CRAN . `install.packages()` `install.packages()` . Linux .

```
sudo apt-get install r-base-dev
```

Red Hat Fedora

```
sudo dnf install R
```

Archlinux

R `Extra` .

```
sudo pacman -S r
```

Archlinux R ArchWiki R .

!

```
"Hello World!"
```

, , .

`help()` ? ? R . `help.search()` ?? .

```
#For help on the help function of R
help()

#For help on the paste function
help(paste)    #OR
help("paste")  #OR
?paste         #OR
?"paste"
```

https://www.r-project.org/help.html .

R

R . R .

R

R Windows `RGui` `R` . Linux R .

```
user:~$ R

R version 3.3.2 (2016-10-31) -- "Sincere Pumpkin Patch"
Copyright (C) 2016 The R Foundation for Statistical Computing
Platform: x86_64-pc-linux-gnu (64-bit)

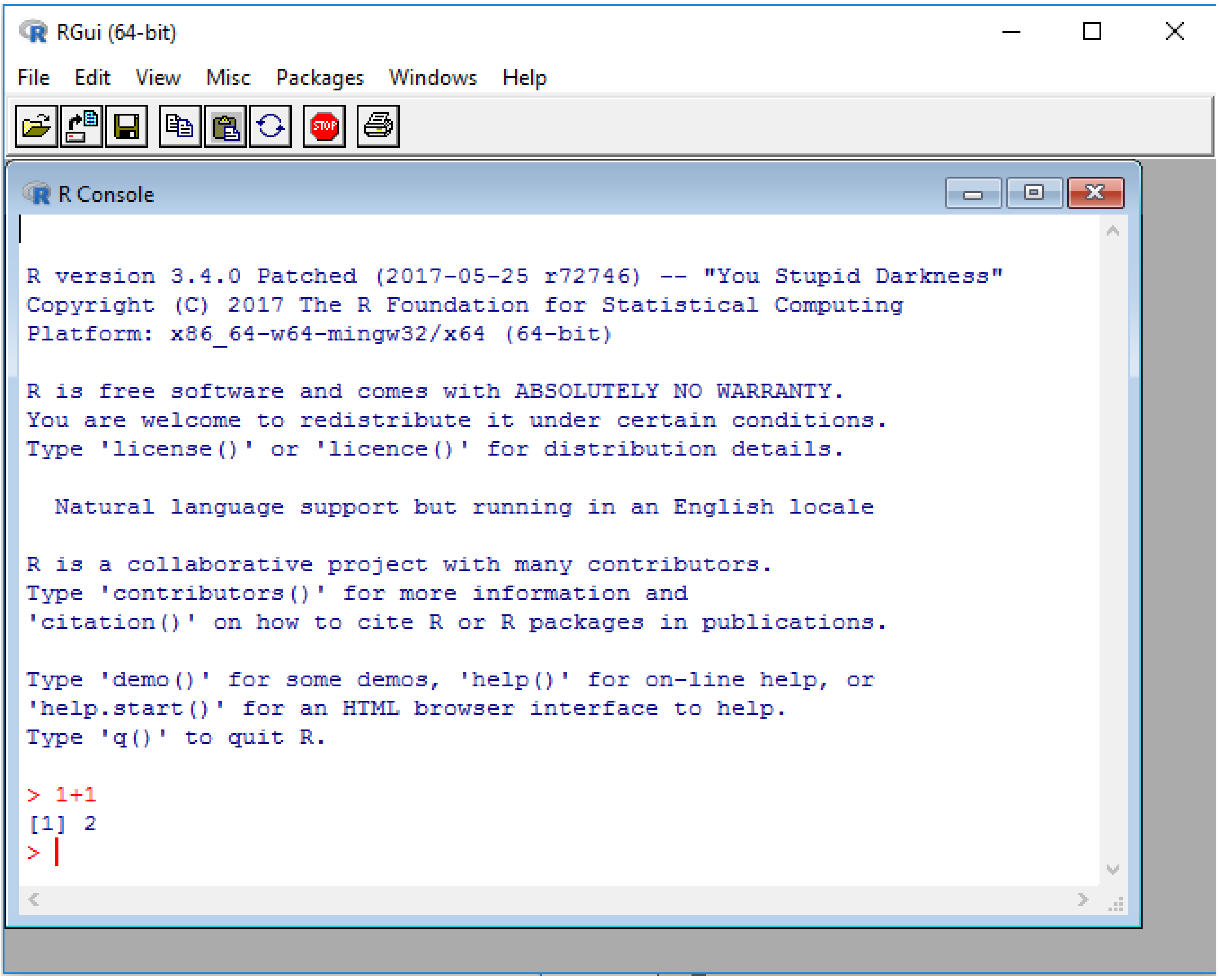
R ist freie Software und kommt OHNE JEGLICHE GARANTIE.
Sie sind eingeladen, es unter bestimmten Bedingungen weiter zu verbreiten.
Tippen Sie 'license()' or 'licence()' für Details dazu.

R ist ein Gemeinschaftsprojekt mit vielen Beitragenden.
Tippen Sie 'contributors()' für mehr Information und 'citation()',
um zu erfahren, wie R oder R packages in Publikationen zitiert werden können.

Tippen Sie 'demo()' für einige Demos, 'help()' für on-line Hilfe, oder
'help.start()' für eine HTML Browserschnittstelle zur Hilfe.
Tippen Sie 'q()', um R zu verlassen.

> 1+1
[1] 2
>
```

RGui Windows RGui.



`>` . R . R .

```
1+1
```

`2` . `[1]` R . (2) .

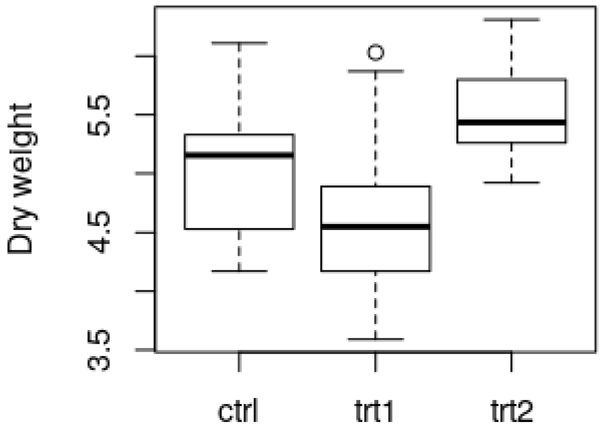
R . `PlantGrowth` . `PlantGrowth` R

`##` R . `##` R .

```
data(PlantGrowth)
str(PlantGrowth)
## 'data.frame':    30 obs. of  2 variables:
## $ weight: num  4.17 5.58 5.18 6.11 4.5 4.61 5.17 4.53 5.33 5.14 ...
## $ group : Factor w/ 3 levels "ctrl","trt1",..: 1 1 1 1 1 1 1 1 1 1 ...
anova(lm(weight ~ group, data = PlantGrowth))
## Analysis of Variance Table
##
## Response: weight
##           Df  Sum Sq Mean Sq F value  Pr(>F)
## group      2  3.7663  1.8832  4.8461 0.01591 *
## Residuals 27 10.4921  0.3886
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
boxplot(weight ~ group, data = PlantGrowth, ylab = "Dry weight")
```

.



`data(PlantGrowth)` `PlantGrowth` . `PlantGrowth` (). `PlantGrowth` `PlantGrowth` . .

.

- (CSV, TSV)
- (Excel, SAS, SPSS, Stata) I / O

`str(PlantGrowth)` . `PlantGrowth` A `data.frame` R . `data.frame` 30 . , . `$` . `weight` (`num` ,) . , `group` . R `factor` . .

`anova(lm( ... ))` . `weight ~ group` " `weight` `group` ". R . `data = ...` .

(Column `Pr(>F)`), `p = 0.01591`) . Tukey 's Test post-hoc .

`boxplot(...)` . . `weight ~ group` : " `group` " `ylab = ...` y :

`q()` `Ctrl` - `D` R .

R

. **R** . R R .

`plants.R` .

```
data(PlantGrowth)

anova(lm(weight ~ group, data = PlantGrowth))

png("plant_boxplot.png", width = 400, height = 300)
boxplot(weight ~ group, data = PlantGrowth, ylab = "Dry weight")
dev.off()
```

(R !).

```
R --no-save <plant.R >plant_result.txt
```

plant_result.txt R . .

png dev.off . . png("FILENAME", width = ..., height = ...) , (png("FILENAME", width = ..., height = ...) PNG . dev.off() . dev.off() .

R : https://riptutorial.com/ko/r/topic/360/r--

2: * ()

*apply for . for *apply .

1. .
2. .
3. .

for , *apply .

for *apply for .

***apply *apply**

*apply *apply .

apply	matrix , data.frame array	( )
sapply	list	( )
lapply	list	list
vapply	`	
mapply	, lists	list

"" .

Examples

apply ( ) .

iris . iris 3 150 . .

```
> head(iris)

  Sepal.Length Sepal.Width Petal.Length Petal.Width Species
1          5.1         3.5          1.4         0.2  setosa
2          4.9         3.0          1.4         0.2  setosa
3          4.7         3.2          1.3         0.2  setosa
4          4.6         3.1          1.5         0.2  setosa
5          5.0         3.6          1.4         0.2  setosa
6          5.4         3.9          1.7         0.4  setosa
```

. for , R apply ( ).

```
> apply(iris[1:4], 2, mean)

Sepal.Length  Sepal.Width Petal.Length  Petal.Width
    5.843333     3.057333     3.758000     1.199333
```

- mean 4 iris .
- 2 (rxC) . 1 .

.

```
# standard deviation
apply(iris[1:4], 2, sd)
# variance
apply(iris[1:4], 2, var)
```

: R colMeans colMeans rowMeans .

. 0.5 . mean .

```
> our.mean.function <- function(x) { mean(x[x > 0.5]) }
> apply(iris[1:4], 2, our.mean.function)

Sepal.Length  Sepal.Width Petal.Length  Petal.Width
    5.843333     3.057333     3.758000     1.665347
```

(Petal.Width .)

? .

```
apply(iris[1:4], 2, function(x) { mean(x[x > 0.5]) })
```

, apply .

: apply . *apply ( ).

.

. .

- paste0()

  ```
  files <- paste0("file_", 1:100, ".rds")
  ```

- list.files() ( ) .

  ```
  files <- list.files("./", pattern = "\\.rds$", full.names = TRUE)
  ```

X .

lapply .

readRDS .rds .

```
my_file_list <- lapply(files, readRDS)
```

for .

. library() :

```
lapply(c("jsonlite","stringr","igraph"),library,character.only=TRUE)
```

`data.frames` (`lapply`,`mapply`)

4 .

```
library(broom)

#* Create the bootstrap data sets
BootData <- lapply(1:4,
                   function(i) mtcars[sample(1:nrow(mtcars),
                                             size = nrow(mtcars),
                                             replace = TRUE), ])

#* Fit the models
Models <- lapply(BootData,
                 function(BD) lm(mpg ~ qsec + wt + factor(am),
                                 data = BD))

#* Tidy the output into a data.frame
Tidied <- lapply(Models,
                 tidy)

#* Give each element in the Tidied list a name
Tidied <- setNames(Tidied, paste0("Boot", seq_along(Tidied)))
```

data.frame .

```
#* Insert the element name into the summary with `lapply`
#* Requires passing the names attribute to `lapply` and referencing `Tidied` within
#* the applied function.
Described_lapply <-
 lapply(names(Tidied),
        function(nm) cbind(nm, Tidied[[nm]]))

Combined_lapply <- do.call("rbind", Described_lapply)

#* Insert the element name into the summary with `mapply`
#* Allows us to pass the names and the elements as separate arguments.
Described_mapply <-
 mapply(
  function(nm, dframe) cbind(nm, dframe),
  names(Tidied),
  Tidied,
  SIMPLIFY = FALSE)

Combined_mapply <- do.call("rbind", Described_mapply)
```

magrittr , ( ).

```
library(magrittr)
library(broom)
Combined <- lapply(1:4,
                   function(i) mtcars[sample(1:nrow(mtcars),
                                              size = nrow(mtcars),
                                              replace = TRUE), ]) %>%
 lapply(function(BD) lm( mpg ~ qsec + wt + factor(am), data = BD)) %>%
 lapply(tidy) %>%
 setNames(paste0("Boot", seq_along(.))) %>%
 mapply(function(nm, dframe) cbind(nm, dframe),
        nm = names(.),
        dframe = .,
        SIMPLIFY = FALSE) %>%
 do.call("rbind", .)
```

: lapply (), sapply () mapply ()

R , . .

- lapply() = .
- sapply() = lapply() .
  - vapply() = sapply() .
- mapply() = mapply() lapply() . sapply() .
  - Map() mapply() SIMPLIFY = FALSE mapply() .

---

lapply ()

lapply() .

- lapply(variable, FUN)
- lapply(seq_along(variable), FUN)

```
# Two ways of finding the mean of x
set.seed(1)
df <- data.frame(x = rnorm(25), y = rnorm(25))
lapply(df, mean)
lapply(seq_along(df), function(x) mean(df[[x]]))
```

---

sapply ()

sapply() .

```
# Two examples to show the different outputs of sapply()
sapply(letters, print)  ## produces a vector
x <- list(a = 1:10, beta = exp(-3:3), logic = c(TRUE,FALSE,FALSE,TRUE))
sapply(x, quantile)  ## produces a matrix
```

---

mapply ()

`mapply()` `lapply()` (m).

```
mapply(sum, 1:5, 10:6, 3) # 3 will be "recycled" by mapply
```

. Hadley Wickham Functionals .

```
randomise <- function(f) f(runif(1e3))

lapply2 <- function(x, f, ...) {
    out <- vector("list", length(x))
    for (i in seq_along(x)) {
        out[[i]] <- f(x[[i]], ...)
    }
    out
}
```

, `randomise` `f` Uniform . `set.seed` .

```
set.seed(123)
randomise(mean)
#[1] 0.4972778

set.seed(123)
mean(runif(1e3))
#[1] 0.4972778


set.seed(123)
randomise(max)
#[1] 0.9994045

set.seed(123)
max(runif(1e3))
#[1] 0.9994045
```

functionals (`x`) (`f`) `base::lapply` `....` `mean` `na.rm` `f` .

```
lapply(list(c(1, 3, 5), c(2, NA, 6)), mean)
# [[1]]
# [1] 3
#
# [[2]]
# [1] NA

lapply2(list(c(1, 3, 5), c(2, NA, 6)), mean)
# [[1]]
# [1] 3
#
# [[2]]
# [1] NA


lapply(list(c(1, 3, 5), c(2, NA, 6)), mean, na.rm = TRUE)
```

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

lapply2(list(c(1, 3, 5), c(2, NA, 6)), mean, na.rm = TRUE)
# [[1]]
# [1] 3
#
# [[2]]
# [1] 4
```

* () : https://riptutorial.com/ko/r/topic/3567/-------

3: .

R .

Examples

.Rprofile -

.Rprofile .Rprofile R R .R Rprofile.site R .Rprofile.site .Rprofile R .

: RStudio RStudio .Rprofile .

.Rprofile .

R

```
# set R_home
Sys.setenv(R_USER="c:/R_home") # just an example directory
# but don't confuse this with the $R_HOME environment variable.
```

```
options(papersize="a4")
options(editor="notepad")
options(pager="internal")
```

.

```
options(help_type="html")
```

```
.Library.site <- file.path(chartr("\\", "/", R.home()), "site-library")
```

```
local({r <- getOption("repos")
    r["CRAN"] <- "http://my.local.cran"
    options(repos=r)})
```

R .

```
# library location
```

```
.libPaths("c:/R_home/Rpackages/win")
```

R . `.Last.value` .

```
makeActiveBinding(".", function(){.Last.value}, .GlobalEnv)
```

.Rprofile R R .

.

`help(Startup)` . `Profile` . , `Rprofile` , , `Profile.site` . R `${RHOME}/etc` . `~/.Renviron` `Renviron` `Renviron.site` .

.profile

```
# Load library setwidth on start - to set the width automatically.
.First <- function() {
  library(setwidth)
  # If 256 color terminal - use library colorout.
  if (Sys.getenv("TERM") %in% c("xterm-256color", "screen-256color")) {
    library("colorout")
  }
}
```

```
# Select default CRAN mirror for package installation.
options(repos=c(CRAN="https://cran.gis-lab.info/"))

# Print maximum 1000 elements.
options(max.print=1000)

# No scientific notation.
options(scipen=10)

# No graphics in menus.
options(menu.graphics=FALSE)

# Auto-completion for package names.
utils::rc.settings(ipck=TRUE)
```

```
# Invisible environment to mask defined functions
.env = new.env()

# Quit R without asking to save.
.env$q <- function (save="no", ...) {
  quit(save=save, ...)
}

# Attach the environment to enable functions.
attach(.env, warn.conflicts=FALSE)
```

. : https://riptutorial.com/ko/r/topic/4166/--

4: ANOVA

Examples

aov ()

(aov) . , .

( ). `aov()` Wilkinson-Rogers `y~f` `lm()` . `y` () `f` ( ) . *f* *aov()* *ANOVA* *.*

`aov()` Type I () Sum of Squares . (Sum of Squares) ( ) . . ( ).

Type I Sum of Squares Type II Type III Sum of Squares . Type II Sum of Squares .
Type II Sum of Squares .

III . Type III Sum of Squares .

II III `Anova()` .

`mtcars` .

```
mtCarsAnovaModel <- aov(wt ~ factor(cyl), data=mtcars)
```

ANOVA :

```
summary(mtCarsAnovaModel)
```

`lm()` .

```
coefficients(mtCarsAnovaModel)
```

Anova ()

/ Type II Type III Sum of Squares . `car` `Anova()` . Type II Sum of Squares . Type III .

`Anova()` `lm()` .

`mtcars` II III .

```
> Anova(lm(wt ~ factor(cyl)*factor(am), data=mtcars), type = 2)
Anova Table (Type II tests)

Response: wt
                       Sum Sq Df F value    Pr(>F)
factor(cyl)            7.2278  2 11.5266 0.0002606 ***
factor(am)             3.2845  1 10.4758 0.0032895 **
```

```
factor(cyl):factor(am) 0.0668  2  0.1065 0.8993714
Residuals              8.1517 26
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

> Anova(lm(wt ~ factor(cyl)*factor(am), data=mtcars), type = 3)
Anova Table (Type III tests)

Response: wt
                        Sum Sq Df F value    Pr(>F)
(Intercept)            25.8427  1 82.4254 1.524e-09 ***
factor(cyl)             4.0124  2  6.3988  0.005498 **
factor(am)              1.7389  1  5.5463  0.026346 *
factor(cyl):factor(am)  0.0668  2  0.1065  0.899371
Residuals               8.1517 26
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

ANOVA : https://riptutorial.com/ko/r/topic/3610/anova

5: data.table

Data.table R . data.table .

- `DT[i, j, by]`
  # DT [where, select | update | do, by]
- `DT[...][...]`
  #
- `################# Shortcuts, special functions and special symbols inside DT[...]`
- . ()
  list () #
- J ()
  # i, list () .
- : =
  # in j,
- .
  # in i,
  # in j,
- .
  # in j, (i)
- .SD
  # in j,
  .SDcols #
- .GRP
  # in j,
- .
  # in j,
- V1, V2, ...
  # j
- `################# Joins inside DT[...]`
- DT1 [DT2, on, j]
  #
- .*
  join DT2 .
- by = .EACHI
  # .
- DT1 [! DT2, on, j]
  # -
- DT1 [DT2, on, roll, j]
  # , on =
- `################# Reshaping, stacking and splitting`
- (DT, id.vars, measure.vars)
  #
  # measure.vars = patterns (...) .
- dcast (DT,)
  #

- rbind (DT1, DT2, ...)
  # stack data.tables
- rbindlist (DT_list, idcol)
  # .
- (DT, by)
  # data.table .
- `################# Some other functions specialized for data.tables`
- #
- #
- #
- fintersect, fsetdiff, funion, fsetequal, , , anyDuplicated
  # set-theory
- N
  #
- rowidv (DT, cols)
  # cols ID (1 ~ N)
- rleidv (DT, cols)
  # cols ID (1 .GRP)
- shift (DT, n, type = c ("lag", "lead"))
  # .
- setorder, setcolorder, setnames, setkey, setindex, setattr
  #

---

data.table .

```
# install from CRAN
install.packages("data.table")

# or install development version
install.packages("data.table", type = "source", repos =
"http://Rdatatable.github.io/data.table")

# and to revert from devel to CRAN, the current version must first be removed
remove.packages("data.table")
install.packages("data.table")
```

. StackOverflow .

---

data.table . , `library(data.table)` , `data.table::fread` `fread` . `help("fread")` `?fread` . `?data.table::fread` .

Examples

data.table

data.table base R data.frame . `class()` vector `"data.table"` `"data.frame"` data.table . data.table

, .

data.table .

```
library(data.table)
```

.

```
DT <- data.table(
  x = letters[1:5],
  y = 1:5,
  z = (1:5) > 3
)
#    x y     z
# 1: a 1 FALSE
# 2: b 2 FALSE
# 3: c 3 FALSE
# 4: d 4  TRUE
# 5: e 5  TRUE
```

data.frame , data.table

```
sapply(DT, class)
#               x            y            z
#     "character"    "integer"    "logical"
```

:

```
dt <- fread("my_file.csv")
```

read.csv fread .

data.frame

data.table data.frame list ( ) data.table .

```
# example data.frame
DF <- data.frame(x = letters[1:5], y = 1:5, z = (1:5) > 3)
# modification
setDT(DF)
```

DF <- . data.frame .

```
sapply(DF, class)
#         x         y         z
#  "factor" "integer" "logical"
```

data.table .

list , **data.frame** , **data.table** , **setDT** A data.table (as.data.table). .

(:) R as.data.table A data.table .

```
mat <- matrix(0, ncol = 10, nrow = 10)

DT <- as.data.table(mat)
# or
DT <- data.table(mat)
```

DT[where, select|update|do, by] data.table .

- "where" i .
- "select | update | do" j .

.

```
mtcars = data.table(mtcars, keep.rownames = TRUE)
```

j := .

```
mtcars[, mpg_sq := mpg^2]
```

NULL :

```
mtcars[, mpg_sq := NULL]
```

:= .

```
mtcars[, `:=`(mpg_sq = mpg^2, wt_sqrt = sqrt(wt))]
# or
mtcars[, c("mpg_sq", "wt_sqrt") := .(mpg^2, sqrt(wt))]
```

.

```
mtcars[, c("mpg_sq", "mpg2_hp") := .(temp1 <- mpg^2, temp1/hp)]
```

.() LHS := RHS .

.

```
vn = "mpg_sq"
mtcars[, (vn) := mpg^2]
```

set

.

```
set(mtcars, j = "hp_over_wt", v = mtcars$hp/mtcars$wt)
```

---

i "" .

```
mtcars[1:3, newvar := "Hello"]
# or
set(mtcars, j = "newvar", i = 1:3, v = "Hello")
```

data.frame . i "" , .

---

levels<- names<- . data.table .

setnames data.table data.frame setattr .

```
# Print a message to the console whenever the data.table is copied
tracemem(mtcars)
mtcars[, cyl2 := factor(cyl)]

# Neither of these statements copy the data.table
setnames(mtcars, old = "cyl2", new = "cyl_fac")
setattr(mtcars$cyl_fac, "levels", c("four", "six", "eight"))

# Each of these statements copies the data.table
names(mtcars)[names(mtcars) == "cyl_fac"] <- "cf"
levels(mtcars$cf) <- c("IV", "VI", "VIII")
```

. .

```
# This function also changes the levels in the global environment
edit_levels <- function(x) setattr(x, "levels", c("low", "med", "high"))
edit_levels(mtcars$cyl_factor)
```

data.table

.SD

.SD data.table by .

.SD lapply A data.table

mtcars .

```
mtcars = data.table(mtcars) # Let's not include rownames to keep things simpler
```

, cyl :

```
mtcars[ , lapply(.SD, mean), by = cyl]

#   cyl      mpg     disp        hp     drat       wt     qsec        vs        am     gear
carb
#1:   6 19.74286 183.3143 122.28571 3.585714 3.117143 17.97714 0.5714286 0.4285714 3.857143
3.428571
#2:   4 26.66364 105.1364  82.63636 4.070909 2.285727 19.13727 0.9090909 0.7272727 4.090909
1.545455
#3:   8 15.10000 353.1000 209.21429 3.229286 3.999214 16.77214 0.0000000 0.1428571 3.285714
3.500000
```

cyl vs , am , gear carb . mean . . .SDcols .

.SDcols

.SDcols data.table .SD .

( ) gear cyl gear cyl :

```
# All the continuous variables in the dataset
cols_chosen <- c("mpg", "disp", "hp", "drat", "wt", "qsec")

mtcars[order(gear, cyl), lapply(.SD, mean), by = .(gear, cyl), .SDcols = cols_chosen]

#   gear cyl    mpg     disp       hp     drat       wt    qsec
#1:    3   4 21.500 120.1000  97.0000 3.700000 2.465000 20.0100
#2:    3   6 19.750 241.5000 107.5000 2.920000 3.337500 19.8300
#3:    3   8 15.050 357.6167 194.1667 3.120833 4.104083 17.1425
#4:    4   4 26.925 102.6250  76.0000 4.110000 2.378125 19.6125
#5:    4   6 19.750 163.8000 116.5000 3.910000 3.093750 17.6700
#6:    5   4 28.200 107.7000 102.0000 4.100000 1.826500 16.8000
#7:    5   6 19.700 145.0000 175.0000 3.620000 2.770000 15.5000
#8:    5   8 15.400 326.0000 299.5000 3.880000 3.370000 14.5500
```

mean .   by .

```
mtcars[ , lapply(.SD, mean), .SDcols = cols_chosen]

#        mpg     disp       hp     drat      wt     qsec
#1: 20.09062 230.7219 146.6875 3.596563 3.21725 17.84875
```

:

- cols_chosen . .SDcols .
- .SDcols .SDcols . mtcars[, lapply(.SD, mean), .SDcols = c(1,3:7)]

.

.N .N .

```
iris[, .(count=.N), by=Species]
```

```
#      Species count
#1:     setosa    50
#2: versicolor    50
#3:  virginica    50
```

data.frame data.table

---

data.table R data.frame , matrix (2D) array . A[rows, cols] .

(A) matrix data.frame data.table :

```
ma <- matrix(rnorm(12), nrow=4, dimnames=list(letters[1:4], c('X', 'Y', 'Z')))
df <- as.data.frame(ma)
dt <- as.data.table(ma)

ma[2:3]  #---> returns the 2nd and 3rd items, as if 'ma' were a vector (because it is!)
df[2:3]  #---> returns the 2nd and 3rd columns
dt[2:3]  #---> returns the 2nd and 3rd rows!
```

.

.

```
ma[2:3, ]  # \
df[2:3, ]  #  }---> returns the 2nd and 3rd rows
dt[2:3, ]  # /
```

. .

```
ma[, 2:3]          #  \
df[, 2:3]          #   \
dt[, 2:3]          #    }---> returns the 2nd and 3rd columns
ma[, c("Y", "Z")]  #   /
df[, c("Y", "Z")]  #  /
dt[, c("Y", "Z")]  # /
```

.

```
mycols <- 2:3
ma[, mycols]                # \
df[, mycols]                #  }---> returns the 2nd and 3rd columns
dt[, mycols, with = FALSE]  # /

dt[, mycols]                # ---> Raises an error
```

mycols . dt mycols .

: data.table data.table . dt . dt[, 2:3] dt[, mycols] 2:3 . mycols .

---

data.frame data.table

data.frame data.table . data.frame . . .

1. .
2. .
3. data.table data.frame (.: print.data.frame).
4. list .
5. data.frame ( ).
6. data.table .

, [,] :

```
A[1:10, ]
A[A$var > 17, ]  # A[var > 17, ] just works for data.table
```

. $ [[ ]] .

```
A$var
colname <- 'var'
A[[colname]]
A[[1]]
```

.

```
B <- `[.data.frame`(A, 2:4)

# We can give it a better name
select <- `[.data.frame`
B <- select(A, 2:4)
C <- select(A, c('foo', 'bar'))
```

". data.frame row.names , data.table key . row.names data.table .

```
B <- A[A$var != 0, ]
# or...
B <- with(A, A[var != 0, ])  # data.table will silently index A by var before subsetting

stuff <- c('a', 'c', 'f')
C <- A[match(stuff, A$name), ]  # really worse than: setkey(A); A[stuff, ]
```

1 . :

```
B <- select(A, 2)    #---> a table with just the second column
C <- unlist(A[1, ])  #---> the first row as a vector (coerced if necessary)
```

data.table

, 1.9.6 .

(1.9.6) `data.table` `data.table` , . [544 2015 9 intro vignette 5 .] 'setkey' 'key =' .

```
library(data.table)
DT <- data.table(
  x = letters[1:5],
  y = 5:1,
  z = (1:5) > 3
)

#> DT
#    x y     z
#1: a 5 FALSE
#2: b 4 FALSE
#3: c 3 FALSE
#4: d 2  TRUE
#5: e 1  TRUE
```

`setkey` . .

```
setkey(DT, y)
```

()

```
tables()

> tables()
     NAME NROW NCOL MB COLS  KEY
[1,] DT      5    3  1 x,y,z y
Total: 1MB
```

.

```
#> DT
#    x y     z
#1: e 1  TRUE
#2: d 2  TRUE
#3: c 3 FALSE
#4: b 4 FALSE
#5: a 5 FALSE
```

.

v1.9.6 , . data.table `"on="` . SO .

2017 1 "on" .

?

key , `setindex(DT, key.col)` `setindexv(DT, "key.col.string")` . DT data.table. `setindex(DT, NULL)` .

`indices(DT)` .

2 ?

"on" . 2 . . .

y DT .

```
DT
# x y     z
# 1: e 1  TRUE
# 2: d 2  TRUE
# 3: c 3 FALSE
# 4: b 4 FALSE
# 5: a 5 FALSE

# Let us set x as index
setindex(DT, x)

# Use indices to see what has been set
indices(DT)
# [1] "x"

# fast subset using index and not keyed column
DT["c", on ="x"]
#x y     z
#1: c 3 FALSE

# old way would have been rekeying DT from y to x, doing subset and
# perhaps keying back to y (now we save two sorts)
# This is a toy example above but would have been more valuable with big data sets
```

data.table : https://riptutorial.com/ko/r/topic/849/data-table

6: data.table

- `melt(DT, id.vars=c(..), variable.name="CategoryLabel", value.name="Value")`
- `dcast(DT, LHS ~ RHS, value.var="Value", fun.aggregate=sum)` `dcast(DT, LHS ~ RHS, value.var="Value", fun.aggregate=sum)`

id.vars	`melt`
variable.name	`melt`
value.name	`melt`
value.var	`dcast` .
	(LHS) (RHS) `dcast`
.	.

`data.table` . `data.table` .

Examples

data.table - I

`data` `USArrests` `datasets` `data USArrests` .

```
data("USArrests")
head(USArrests)

           Murder Assault UrbanPop Rape
Alabama      13.2     236       58 21.2
Alaska       10.0     263       48 44.5
Arizona       8.1     294       80 31.0
Arkansas      8.8     190       50 19.5
California    9.0     276       91 40.6
Colorado      7.9     204       78 38.7
```

`?USArrests` . `data.table` `data.table` . `data.frame` .

```
library(data.table)
DT <- as.data.table(USArrests, keep.rownames=TRUE)
```

. . . . . `USArrests` .

```
            State    Crime  Rate
  1:      Alabama   Murder  13.2
  2:       Alaska   Murder  10.0
  3:      Arizona   Murder   8.1
```

```
  4:      Arkansas   Murder   8.8
  5:    California   Murder   9.0
 ---
196:      Virginia     Rape  20.7
197:    Washington     Rape  26.2
198: West Virginia     Rape   9.3
199:     Wisconsin     Rape  10.8
200:       Wyoming     Rape  15.6
```

`melt` .

```
DTm <- melt(DT)
names(DTm) <- c("State", "Crime", "Rate")
```

`melt` . `USArrests` `UrbanPop` . `Murder` , `Assault` , `Rape` , 10 . `UrbanPop` . `id.vars` `id.vars` .

```
DTmu <- melt(DT, id.vars=c("rn", "UrbanPop" ),
             variable.name='Crime', value.name = "Rate")
names(DTmu)[1] <- "State"
```

(Murder, Assault) `variable.name` `value.name` `value.name` . .

```
             State UrbanPop  Crime Rate
  1:       Alabama       58 Murder 13.2
  2:        Alaska       48 Murder 10.0
  3:       Arizona       80 Murder  8.1
  4:      Arkansas       50 Murder  8.8
  5:    California       91 Murder  9.0
```

split-apply-combine . , ?

```
DTmu[, .(ViolentCrime = sum(Rate)), by=State]
```

:

```
        State ViolentCrime
1:    Alabama        270.4
2:     Alaska        317.5
3:    Arizona        333.1
4:   Arkansas        218.3
5: California        325.6
6:   Colorado        250.6
```

data.table - II

`dcast` `dcast` .

```
DTc <- dcast(DTmu, State + UrbanPop ~ Crime)
```

.

```
             State UrbanPop Murder Assault Rape
 1:        Alabama       58   13.2     236 21.2
 2:         Alaska       48   10.0     263 44.5
 3:        Arizona       80    8.1     294 31.0
 4:       Arkansas       50    8.8     190 19.5
 5:     California       91    9.0     276 40.6
```

(LHS) (RHS) . ? `dcast` . `value.var` .

`dcast` `fun.aggregate` . `.Decile` .

```
DTmu[, Decile := cut(UrbanPop, quantile(UrbanPop, probs = seq(0, 1, by=0.1)))]
levels(DTmu$Decile) <- paste0(1:10, "D")
```

`Decile ~ Crime` . `fun.aggregate` . .

```
dcast(DTmu, Decile ~ Crime, value.var="Rate", fun.aggregate=sum)
```

:

```
dcast(DTmu, Decile ~ Crime, value.var="Rate", fun.aggregate=mean)
```

:

```
             State UrbanPop  Crime Rate Decile
  1:       Alabama       58 Murder 13.2     4D
  2:        Alaska       48 Murder 10.0     2D
  3:       Arizona       80 Murder  8.1     8D
  4:      Arkansas       50 Murder  8.8     2D
  5:    California       91 Murder  9.0    10D
```

. `fun.aggregate` .

```
dcast(DTmu, Decile ~ Crime, value.var="Rate", fun.aggregate=sum)
```

.

```
    Decile Murder Assault  Rape
 1:     1D   39.4     808  62.6
 2:     2D   35.3     815  94.3
 3:     3D   22.6     451  67.7
 4:     4D   54.9     898 106.0
 5:     5D   42.4     758 107.6
```

data.table : https://riptutorial.com/ko/r/topic/6934/data-table----

7: Date

-

- `Date` : `1970-01-01` UNIX . .
- (,).
- .
- `POSIXct` `POSIXlt` `POSIXlt` .
- `sys.Date()` `Date` .

- lubridate `ymd` , `mdy` Date `as.Date` . lubrid .
- data.table IDate Date Date double .

Examples

`Dates` `format(date, format="%Y-%m-%d")` `POSIXct` (`as.POSIXct()`) `POSIXlt` (`as.POSIXlt()`)

```
d = as.Date("2016-07-21") # Current Date Time Stamp

format(d,"%a")            # Abbreviated Weekday
## [1] "Thu"

format(d,"%A")            # Full Weekday
## [1] "Thursday"

format(d,"%b")            # Abbreviated Month
## [1] "Jul"

format(d,"%B")            # Full Month
## [1] "July"

format(d,"%m")            # 00-12 Month Format
## [1] "07"

format(d,"%d")            # 00-31 Day Format
## [1] "21"

format(d,"%e")            # 0-31 Day Format
## [1] "21"

format(d,"%y")            # 00-99 Year
## [1] "16"

format(d,"%Y")            # Year with Century
## [1] "2016"
```

`?strptime` .

`as.Date()`

.

```
> x <- as.Date("2016-8-23")
> x
[1] "2016-08-23"
> class(x)
[1] "Date"
```

`as.Date()` . `%Y-%m-%d` , - - .

```
> as.Date("23-8-2016", format="%d-%m-%Y") # To read in an European-style date
[1] "2016-08-23"
```

. H H . `"dm-yy"` `"dm-YYYY"` `"md-yy"` `"md-YYYY"` `"YYYY-md"` `"YYYY-dm"` . `"-"` `"/"` . 1986 11 6 1986 11 6 1986 11 6 1986 11 6 . **as.Date ()** `"YYYY-md"` .

`"%d-%m-%Y"` `"9-6-1962"` .

```
#
# It tries to interprets the string as YYYY-m-d
#
> as.Date("9-6-1962")
[1] "0009-06-19"       #interprets as "%Y-%m-%d"
>
as.Date("9/6/1962")
[1] "0009-06-19"       #again interprets as "%Y-%m-%d"
>
# It has no problem in understanding, if the date is in form  YYYY-m-d or YYYY/m/d
#
> as.Date("1962-6-9")
[1] "1962-06-09"        # no problem
> as.Date("1962/6/9")
[1] "1962-06-09"        # no problem
>
```

. **as.Date ()** .

`%d`	
`%m`	
`%y`	2
`%Y`	4
`%b`	3
`%B`	

format .

```
> as.Date("9-6-1962",format="%d-%m-%Y")
```

```
[1] "1962-06-09"
>
```

.

```
> as.Date("9-6-1962", "%d-%m-%Y")
[1] "1962-06-09"
>
```

. %b .

```
> as.Date("6Nov1962","%d%b%Y")
[1] "1962-11-06"
>
```

'-' '/' .. . . .

```
> as.Date("6 Nov, 1962","%d %b, %Y")
[1] "1962-11-06"
>
```

.. NA . %B .

```
> as.Date("October 12, 2016", "%B %d, %Y")
[1] "2016-10-12"
>
> as.Date("12 October, 2016", "%d %B, %Y")
[1] "2016-10-12"
>
```

%y . **origin** **tz** ().

R as.Date() Date ISO 8601 YYYY-MM-DD strptime -style .

```
as.Date('2016-08-01')    # in ISO format, so does not require formatting string
## [1] "2016-08-01"

as.Date('05/23/16', format = '%m/%d/%y')
## [1] "2016-05-23"

as.Date('March 23rd, 2016', '%B %drd, %Y')    # add separators and literals to format
## [1] "2016-03-23"

as.Date('  2016-08-01  foo')    # leading whitespace and all trailing characters are ignored
## [1] "2016-08-01"

as.Date(c('2016-01-01', '2016-01-02'))
# [1] "2016-01-01" "2016-01-02"
```

Date : https://riptutorial.com/ko/r/topic/9015/date-

8: devtools

devtools R .

1. R
2. `roxygen2`
3. `devtools`

Examples

R . . .

`./` R .

LaTeX .

`roxygen` .

```
install.packages("devtools")
library("devtools")
install.packages("roxygen2")
library("roxygen2")
```

roxygen . *doxygen* .

roxygen .

```
#' Increment a variable.
#'
#' Note that the behavior of this function
#' is undefined if `x` is not of class `numeric`.
#'
#' @export
#' @author  another guy
#' @name    Increment Function
#' @title   increment
#'
#' @param x   Variable to increment
#' @return    `x` incremented of 1
#'
#' @seealso   `other_function`
#'
#' @examples
#' increment(3)
#' > 4
increment <- function(x) {
  return (x+1)
}
```

.

(*vignettes*) .

./script1.R ./script2.R .

```
package.skeleton(name="MyPackage", code_files=c("script1.R","script2.R"))
```

./MyPackage/man/ . .

```
roxygenize("MyPackage")
```

./ R CMD Rd2pdf MyPackage .

1.

./MyPackage/DESCRIPTION . Package , Version , License , Description , Title , Author Maintainer .

`Depends` *(R version <3.2.0)* `Imports` *(R version> 3.2.0)* .

2.

./MyPackage/ R/ man/ subfolders . , :

- data/ : . .RData data() load() load() .
- tests/ : . .
- src/ : C / C ++ / Fortran (Rcpp ...).
- exec/ : .
- misc/ : .

./MyPackage/Read-and-delete-me .

.

devtools::install("MyPackage") .

./ . R CMD build MyPackage

Github

myPackage `MyPackage/` . .

devutools github :

```
install_package("MyPackage", "your_github_usename")
```

CRAN

CRAN . : ( ). `R CMD check` .

. .

(vignette) . , . (vignette) . .

Vignettes markdown .

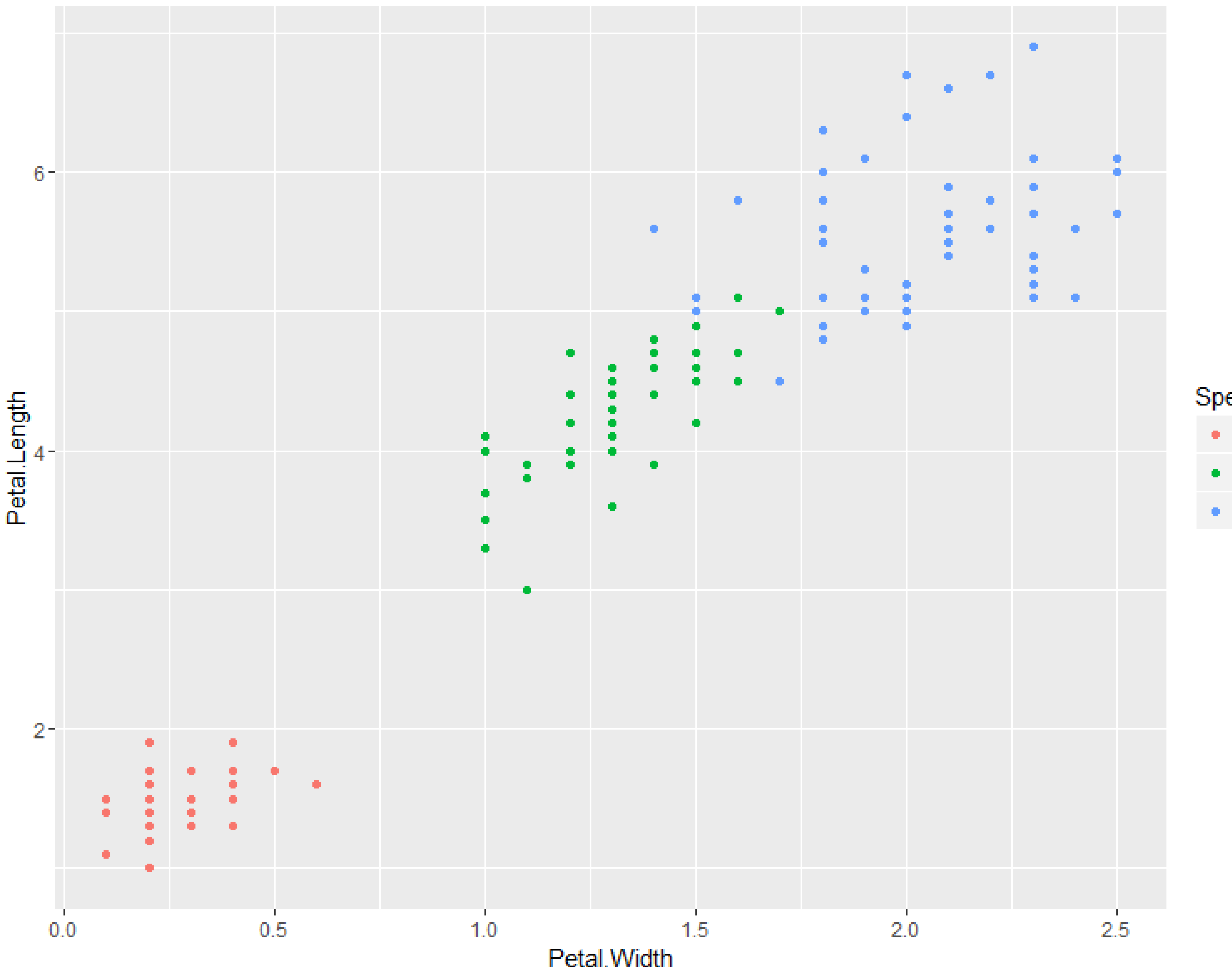
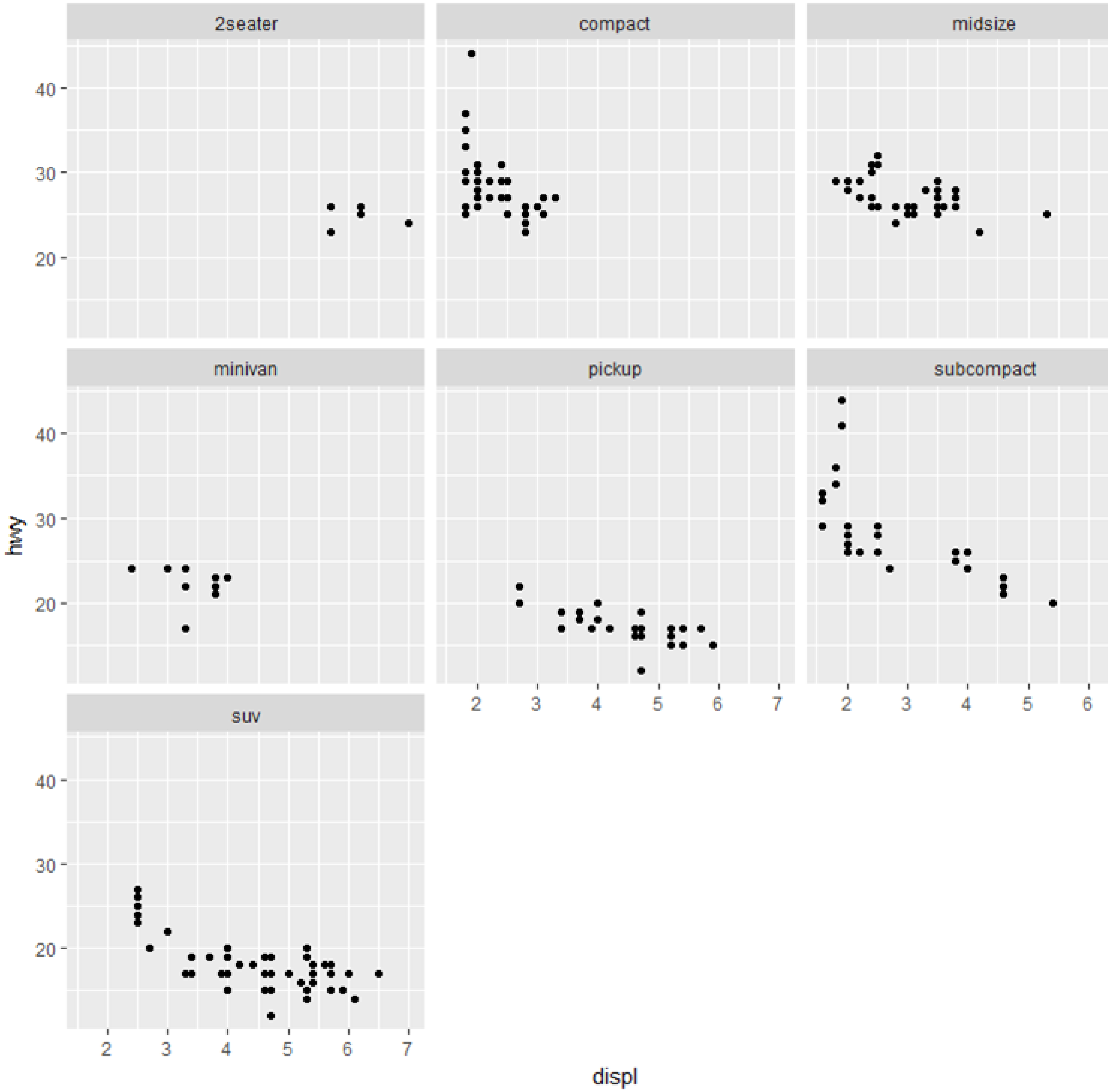
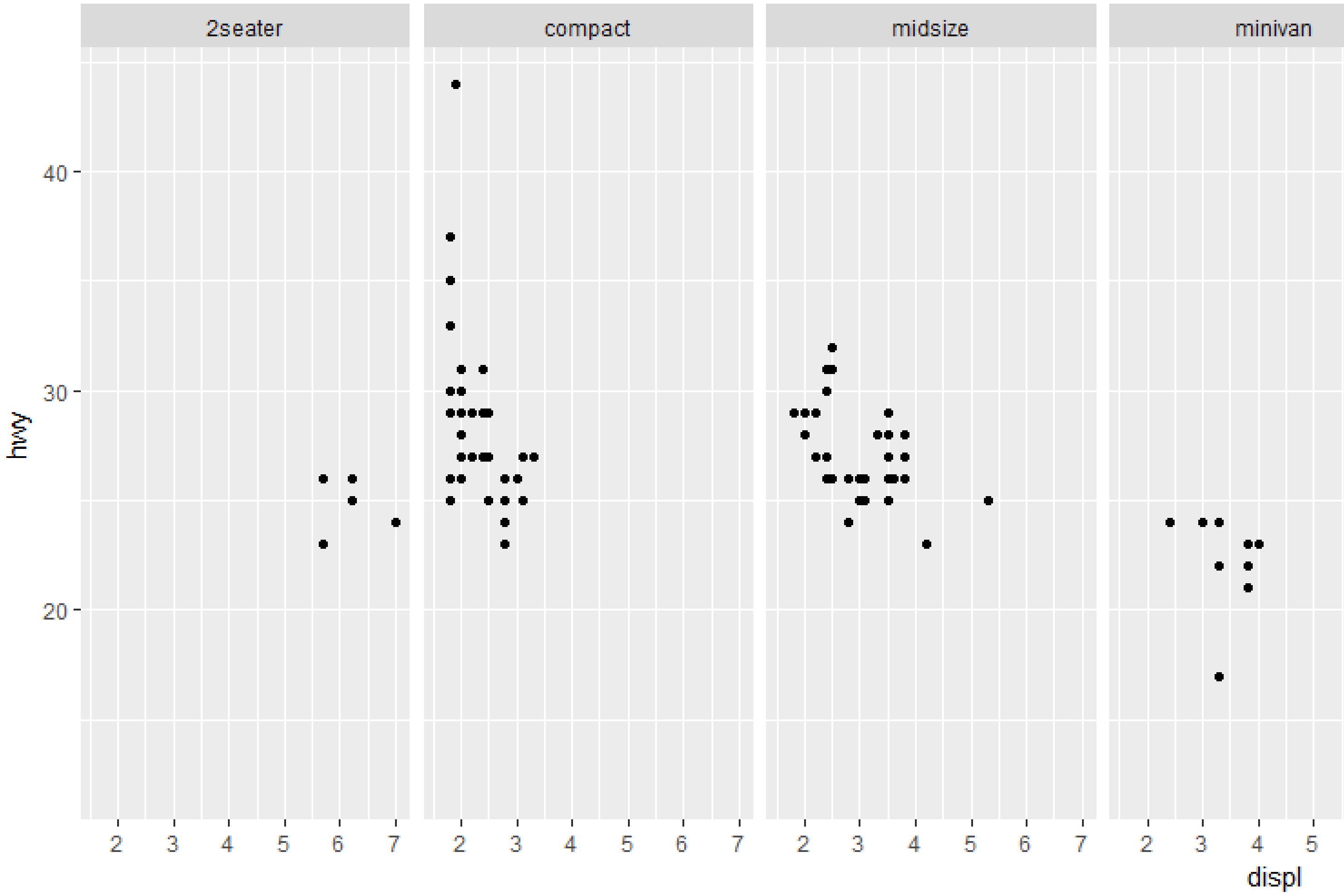
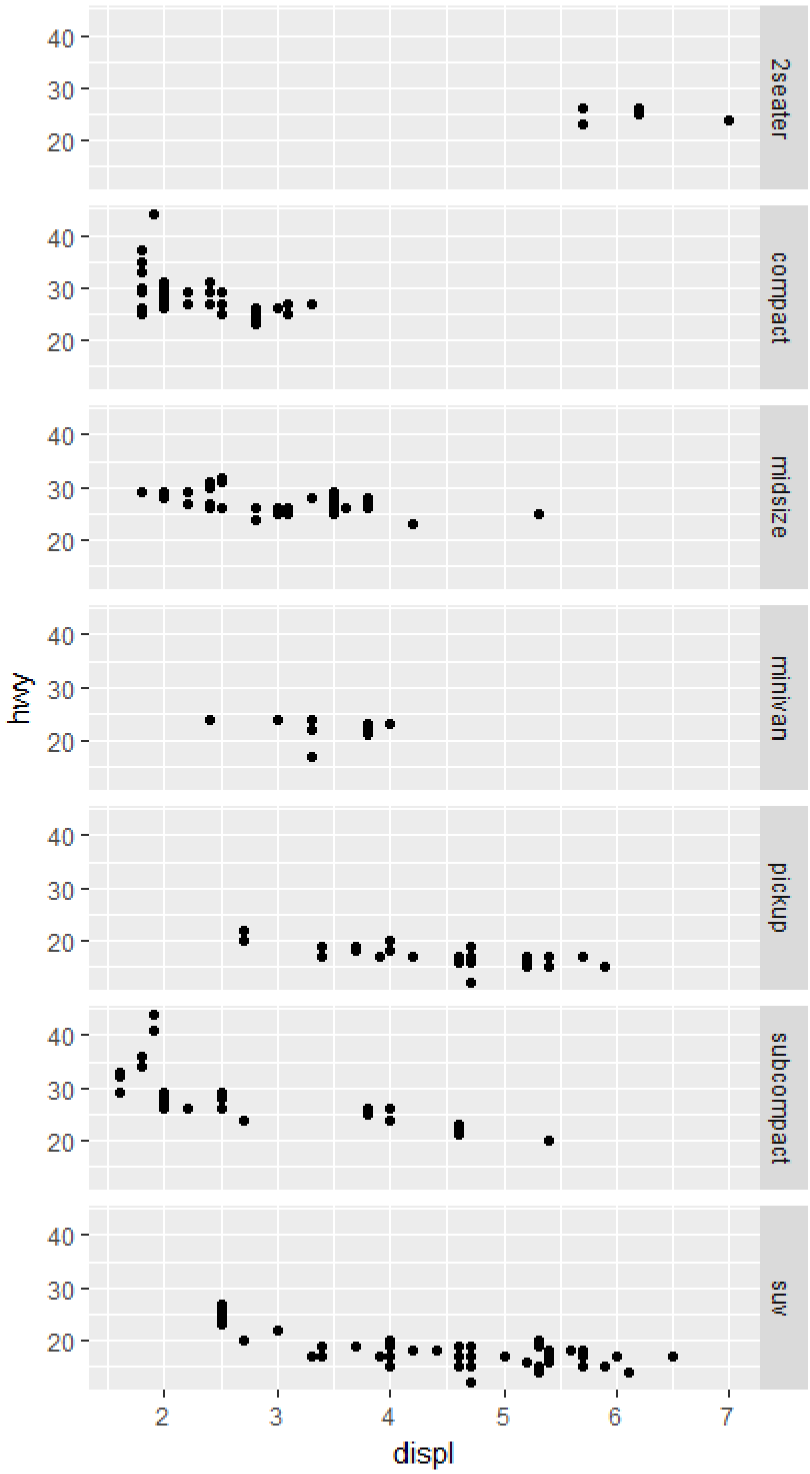
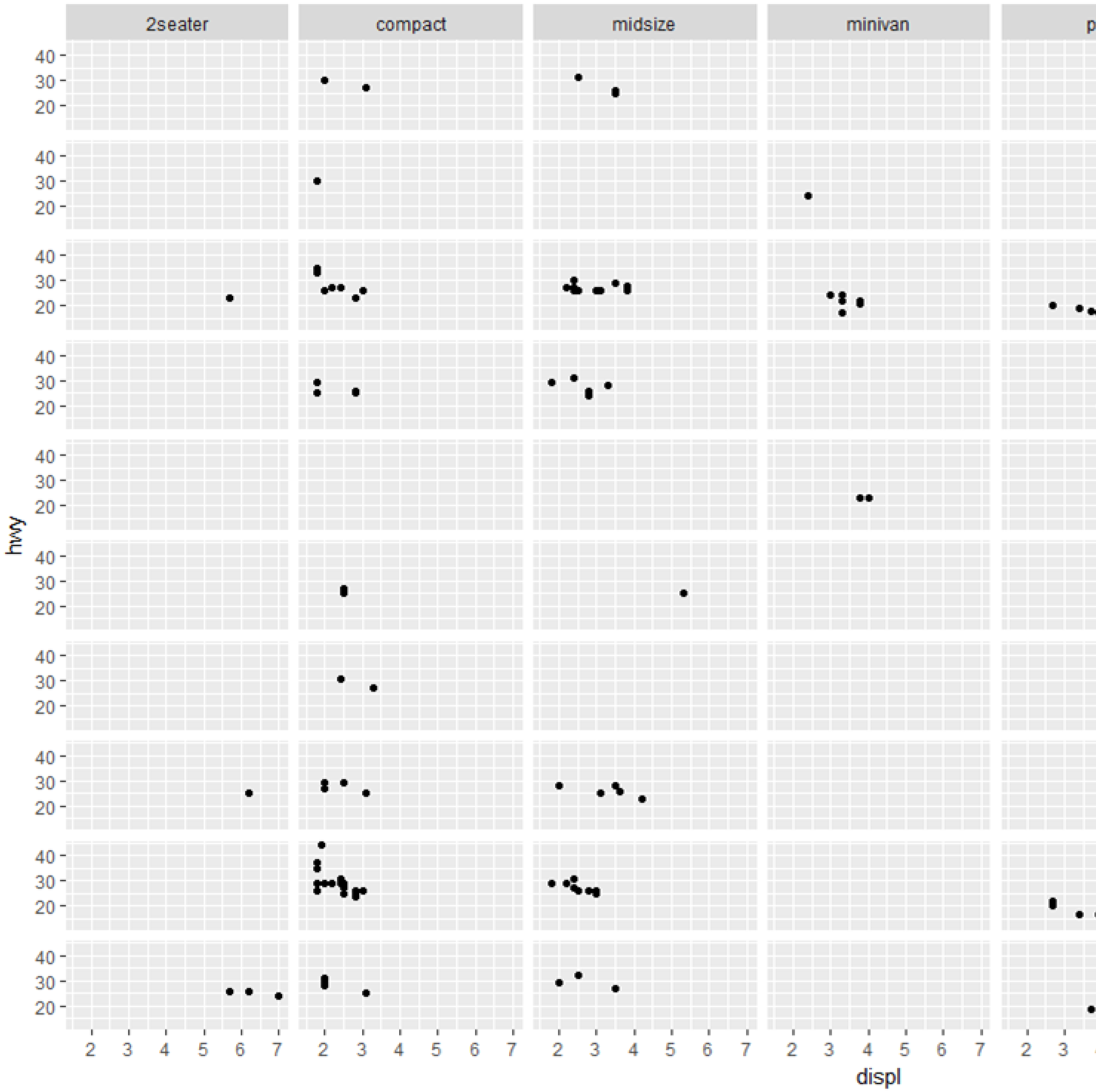
- Rmarkdown : `install.packages("rmarkdown")`
-

```
devtools::use_vignette("MyVignette", "MyPackage")
```

`./vignettes/MyVignette.Rmd` .

Markdown .

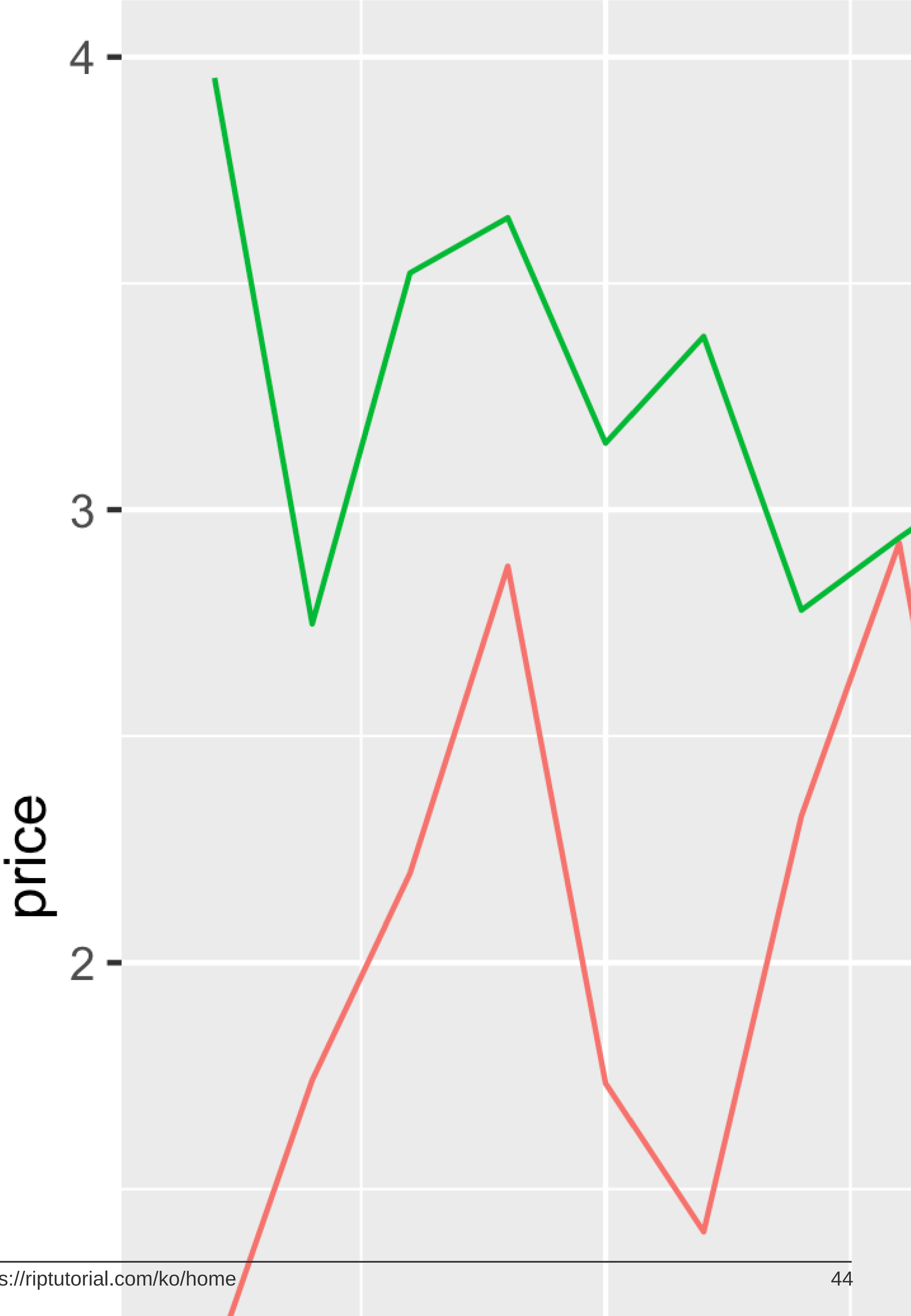
Markdown R Markdown .

```
```{r}
# Add two numbers together
add <- function(a, b) a + b
add(10, 20)
```
```

.

```
# Add two numbers together
add <- function(a, b) a + b
add(10, 20)
## [1] 30
```

, `./DESCRIPTION` .

devtools : https://riptutorial.com/ko/r/topic/10884/devtools--

9: ggplot2

`ggplot2` http://ggplot2.tidyverse.org/ .

(: `data.frame`) .

RStudio "ggplot2 " .

Examples

.

```
library(ggplot2)
ggplot(iris, aes(x = Petal.Width, y = Petal.Length, color = Species)) +
  geom_point()
```

:



facet . . ggplot2 mpg .

( ).

```
ggplot(mpg, aes(x = displ, y = hwy)) +
  geom_point() +
  facet_wrap(~class)
```



.

```
ggplot(mpg, aes(x = displ, y = hwy)) +
  geom_point() +
```

```
  facet_grid(.~class)
```



,   :

```
ggplot(mpg, aes(x = displ, y = hwy)) +
  geom_point() +
  facet_grid(class~.)
```



2 :

```
ggplot(mpg, aes(x = displ, y = hwy)) +
  geom_point() +
  facet_grid(trans~class) #"row" parameter, then "column" parameter
```



ggplot2 . 20 . .

```
set.seed(47)
sweetsWide <- data.frame(date      = 1:20,
                         chocolate = runif(20, min = 2, max = 4),
                         iceCream  = runif(20, min = 0.5, max = 1),
                         candy     = runif(20, min = 1, max = 3))

head(sweetsWide)
##   date chocolate  iceCream    candy
## 1    1  3.953924 0.5890727 1.117311
## 2    2  2.747832 0.7783982 1.740851
## 3    3  3.523004 0.7578975 2.196754
```

```
## 4    4  3.644983 0.5667152 2.875028
## 5    5  3.147089 0.8446417 1.733543
## 6    6  3.382825 0.6900125 1.405674
```

sweetsWide ggplot2 , R reshape2 , data.table tidyr () :

```
# reshape from base R
sweetsLong <- reshape(sweetsWide, idvar = 'date', direction = 'long',
                      varying = list(2:4), new.row.names = NULL, times = names(sweetsWide)[-
1])

# melt from 'reshape2'
library(reshape2)
sweetsLong <- melt(sweetsWide, id.vars = 'date')

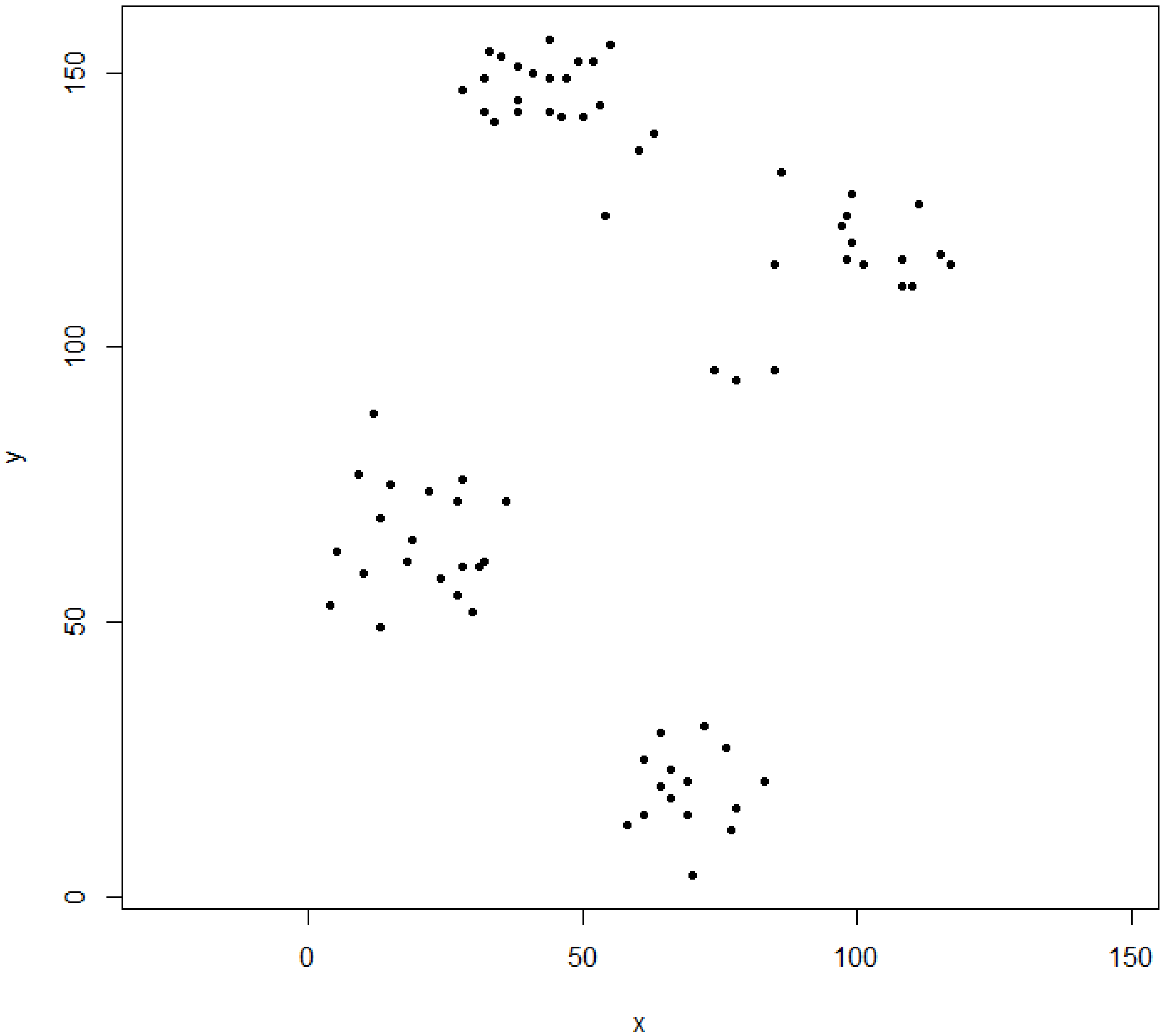
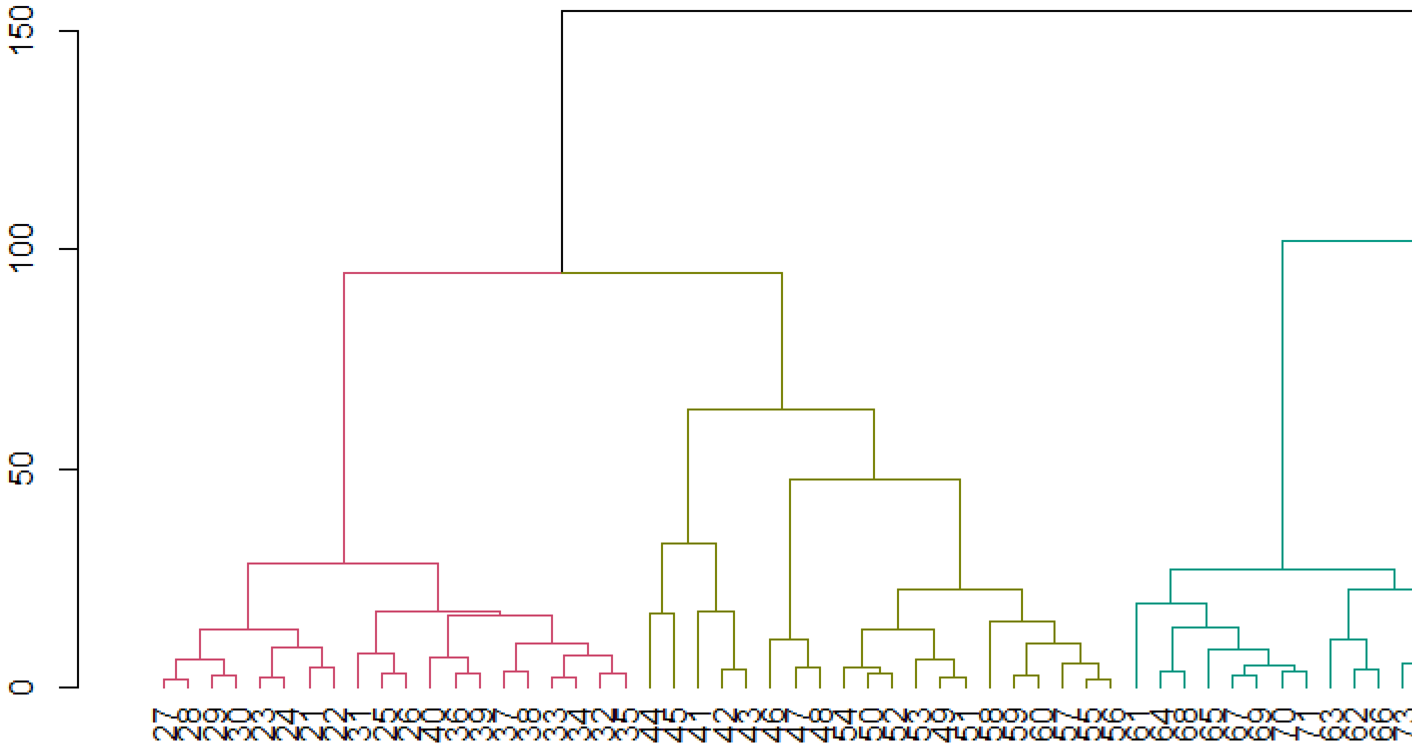
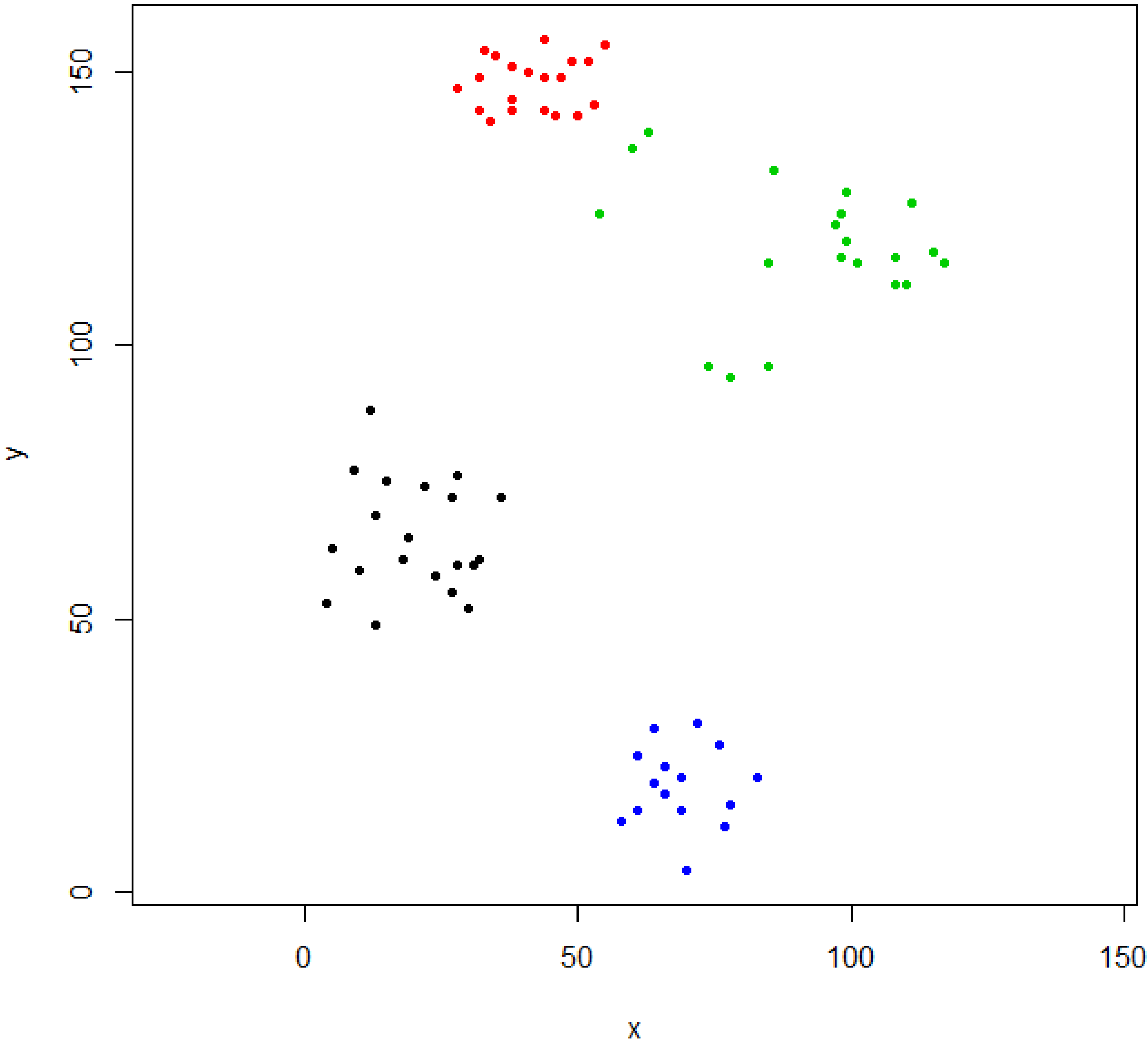
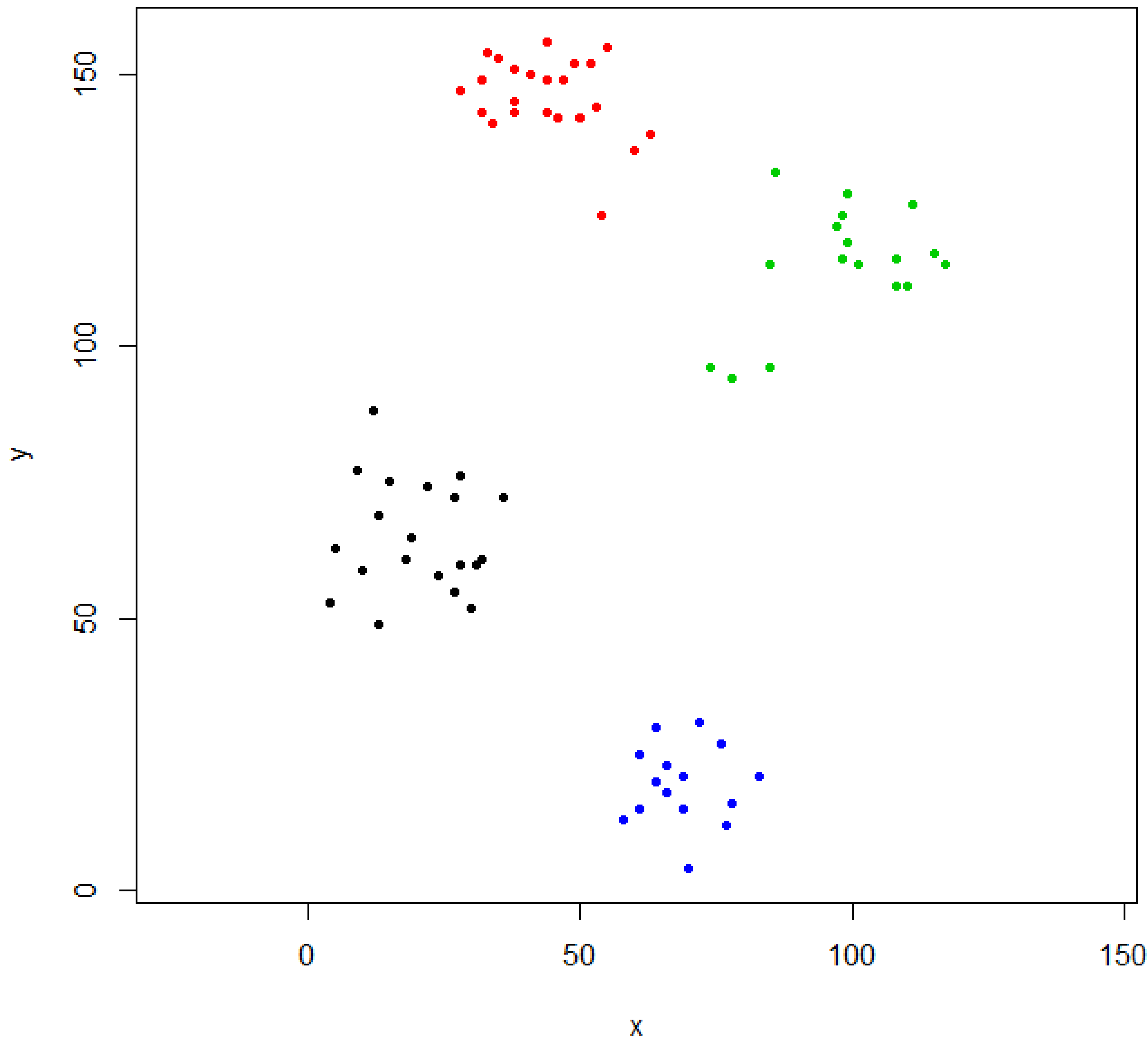
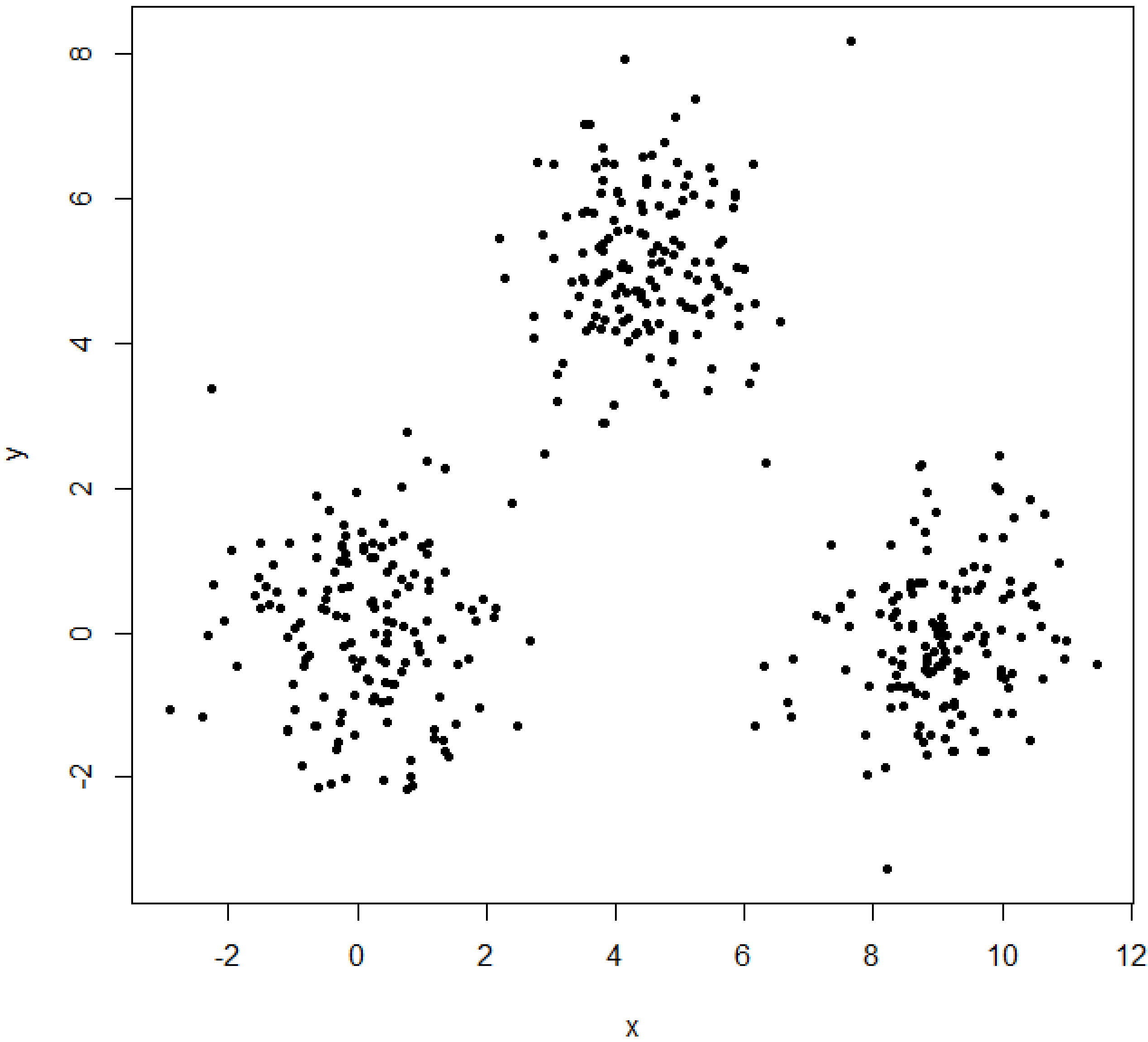
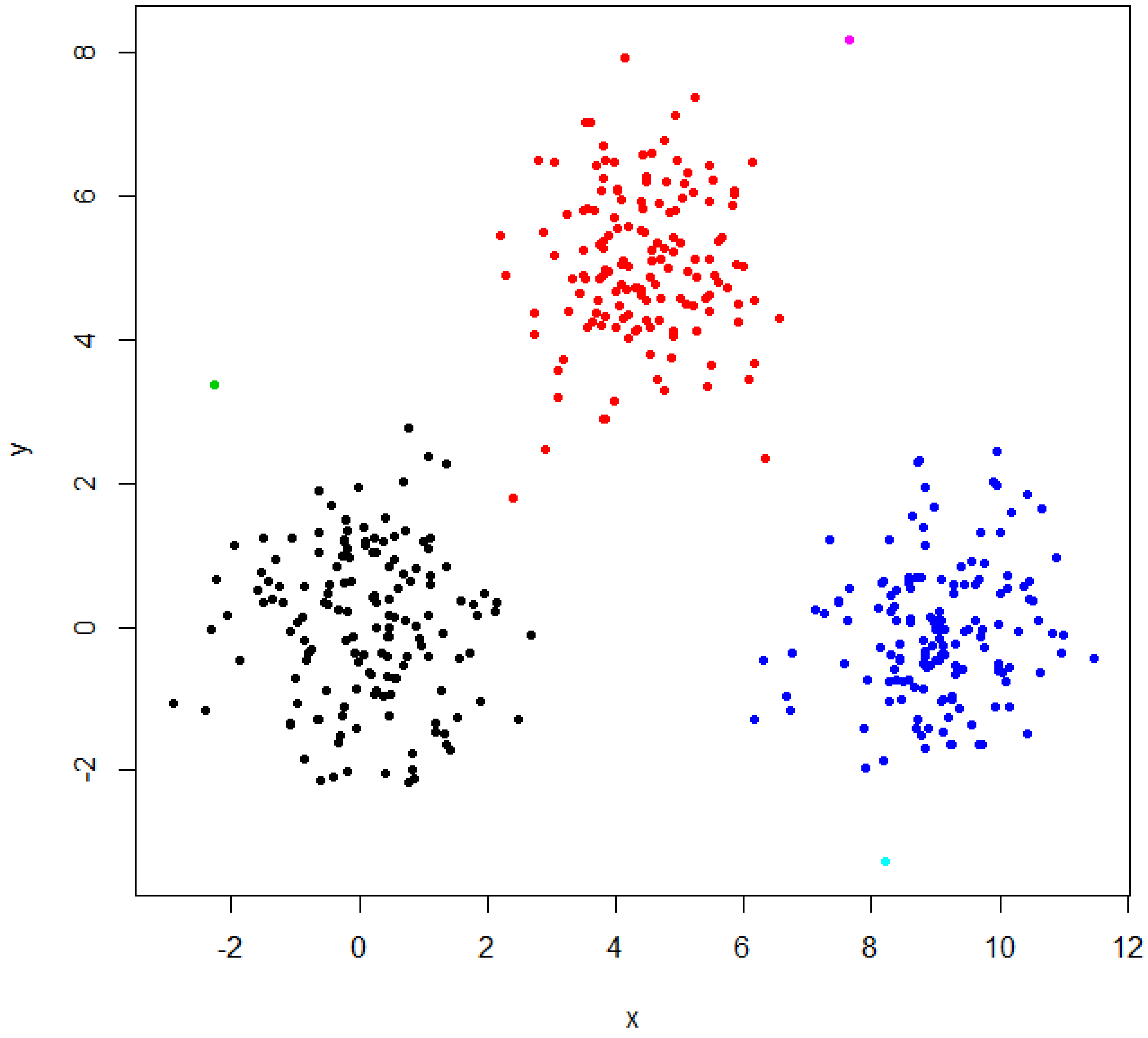
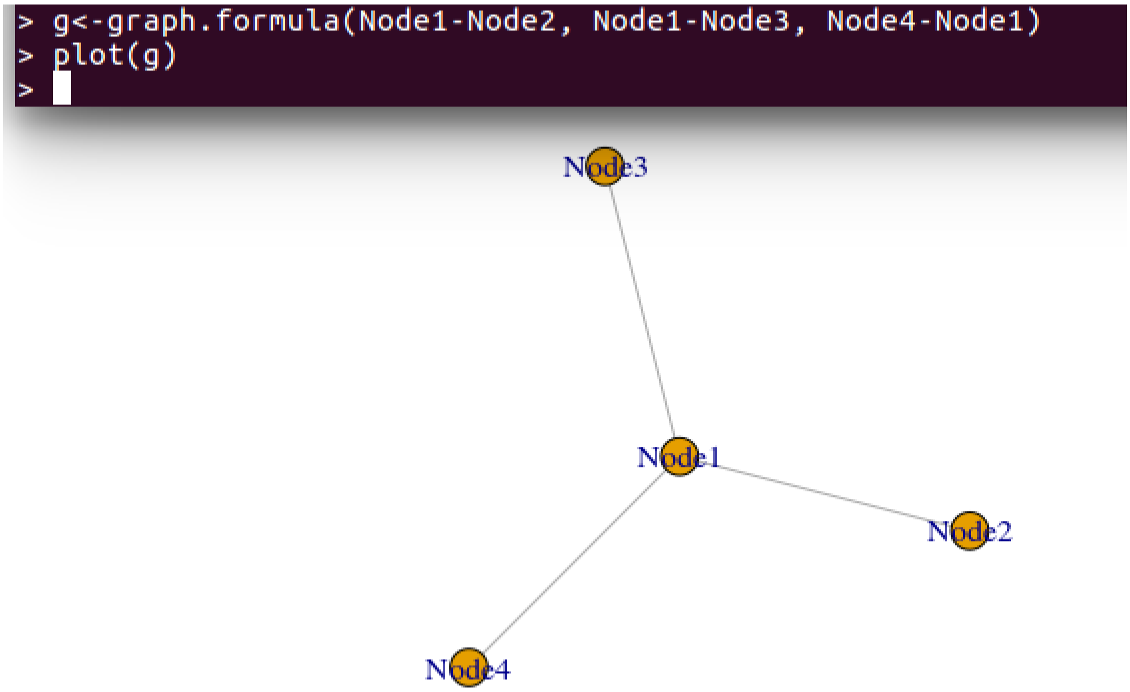
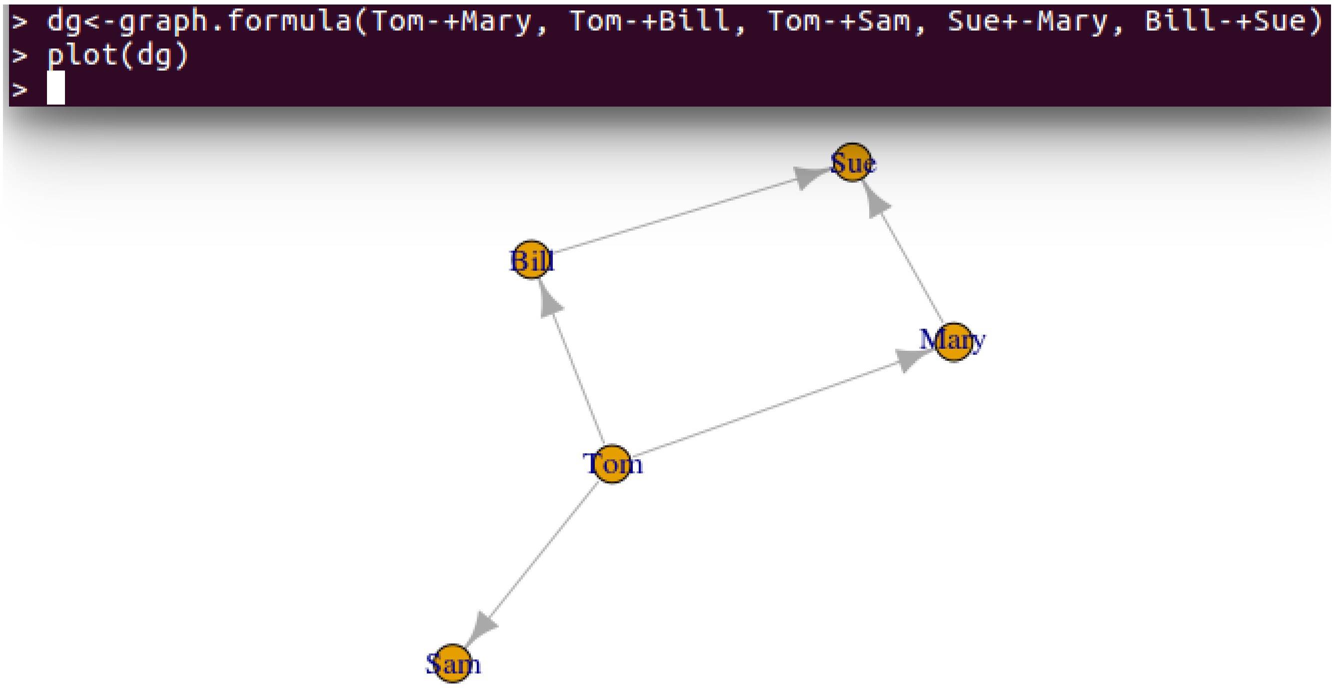
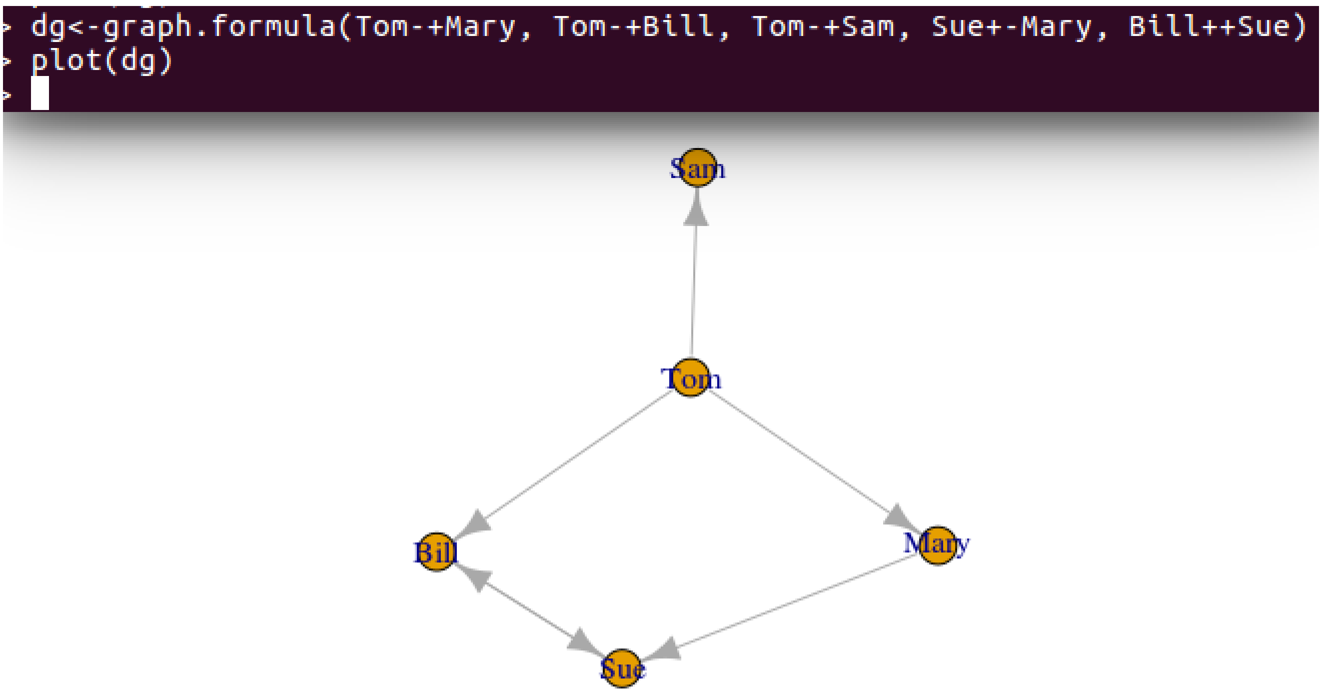
# melt from 'data.table'
# which is an optimized & extended version of 'melt' from 'reshape2'
library(data.table)
sweetsLong <- melt(setDT(sweetsWide), id.vars = 'date')

# gather from 'tidyr'
library(tidyr)
sweetsLong <- gather(sweetsWide, sweet, price, chocolate:candy)
```

.

```
head(sweetsLong)
##   date     sweet    price
## 1    1 chocolate 3.953924
## 2    2 chocolate 2.747832
## 3    3 chocolate 3.523004
## 4    4 chocolate 3.644983
## 5    5 chocolate 3.147089
## 6    6 chocolate 3.382825
```

.

sweetsLong . .

```
library(ggplot2)
ggplot(sweetsLong, aes(x = date, y = price, colour = sweet)) + geom_line()
```


4
3
2
price

10: GPU

GPU " . CUDA OpenCL. NVIDIA CUDA NVIDIA GPU . (: NVIDIA, AMD, Intel) (CPU GPU) SDK ( ) . R GPU .

CUDA Toolkit OpenCL SDK R . R GPU CUDA NVIDIA GPU . .

1. gputools
2.
3. HiPLARM
4.

OpenCL .

1. OpenCL - R OpenCL
2. gpuR -

- GPU .

Examples

gpuR gpuMatrix

```
library(gpuR)

# gpuMatrix objects
X <- gpuMatrix(rnorm(100), 10, 10)
Y <- gpuMatrix(rnorm(100), 10, 10)

# transfer data to GPU when operation called
# automatically copied back to CPU
Z <- X %*% Y
```

gpuR vclMatrix

```
library(gpuR)

# vclMatrix objects
X <- vclMatrix(rnorm(100), 10, 10)
Y <- vclMatrix(rnorm(100), 10, 10)

# data always on GPU
# no data transfer
Z <- X %*% Y
```

GPU : https://riptutorial.com/ko/r/topic/4680/gpu--

11: hclust

`stats` `hclust` .

hclust . CRAN .

Examples

1 - hclust , end ,

ruspini .

```
library(cluster)                ## to get the ruspini data
plot(ruspini, asp=1, pch=20)    ## take a look at the data
```



hclust . . hang .

```
ruspini_hc_defaults <- hclust(dist(ruspini))
dend <- as.dendrogram(ruspini_hc_defaults)
if(!require(dendextend)) install.packages("dendextend"); library(dendextend)
dend <- color_branches(dend, k = 4)
plot(dend)
```



. k .

```
rhc_def_4 = cutree(ruspini_hc_defaults,k=4)
plot(ruspini, pch=20, asp=1, col=rhc_def_4)
```



. .

```
scaled_ruspini_hc_defaults = hclust(dist(scale(ruspini)))
srhc_def_4 = cutree(scaled_ruspini_hc_defaults,4)
plot(ruspini, pch=20, asp=1, col=srhc_def_4)
```



"". method .

```
ruspini_hc_single = hclust(dist(ruspini), method="single")
```

2 - hclust

1 .

3 .

```
set.seed(656)
x = c(rnorm(150, 0, 1), rnorm(150,9,1), rnorm(150,4.5,1))
y = c(rnorm(150, 0, 1), rnorm(150,0,1), rnorm(150,5,1))
XYdf = data.frame(x,y)
plot(XYdf, pch=20)
```



.

```
XY_sing = hclust(dist(XYdf), method="single")
XYs3 = cutree(XY_sing,k=3)
table(XYs3)
XYs3
  1   2   3
448   1   1
```

hclust . "" k .

```
XYs6 = cutree(XY_sing,k=6)
table(XYs6)
XYs6
  1   2   3   4   5   6
148 150   1 149   1   1
```

```
plot(XYdf, pch=20, col=XYs6)
```



StackOverflow .

hclust : https://riptutorial.com/ko/r/topic/8084/hclust----

12: igraph

Examples

R igraph . R v.3.2.3 igraph .

.

```
g<-graph.formula(Node1-Node2, Node1-Node3, Node4-Node1)
plot(g)
```




```
dg<-graph.formula(Tom-+Mary, Tom-+Bill, Tom-+Sam, Sue+-Mary, Bill-+Sue)
plot(dg)
```

.



:

```
dg<-graph.formula(Tom-+Mary, Tom-+Bill, Tom-+Sam, Sue+-Mary, Bill++Sue)
plot(dg)
```



igraph : https://riptutorial.com/ko/r/topic/4851/igraph---

13: JSON

Examples

JSON R /

`jsonlite` JSON . JSON `fromJSON()` `toJSON()` respecitively `vectors` , `matrices` `data.frames` JSON .

JSON ( )

```
library(jsonlite)

## vector to JSON
toJSON(c(1,2,3))
# [1,2,3]

fromJSON('[1,2,3]')
# [1] 1 2 3
```

JSON .

```
toJSON(list(myVec = c(1,2,3)))
# {"myVec":[1,2,3]}

fromJSON('{"myVec":[1,2,3]}')
# $myVec
# [1] 1 2 3
```

```
## list structures
lst <- list(a = c(1,2,3),
            b = list(letters[1:6]))

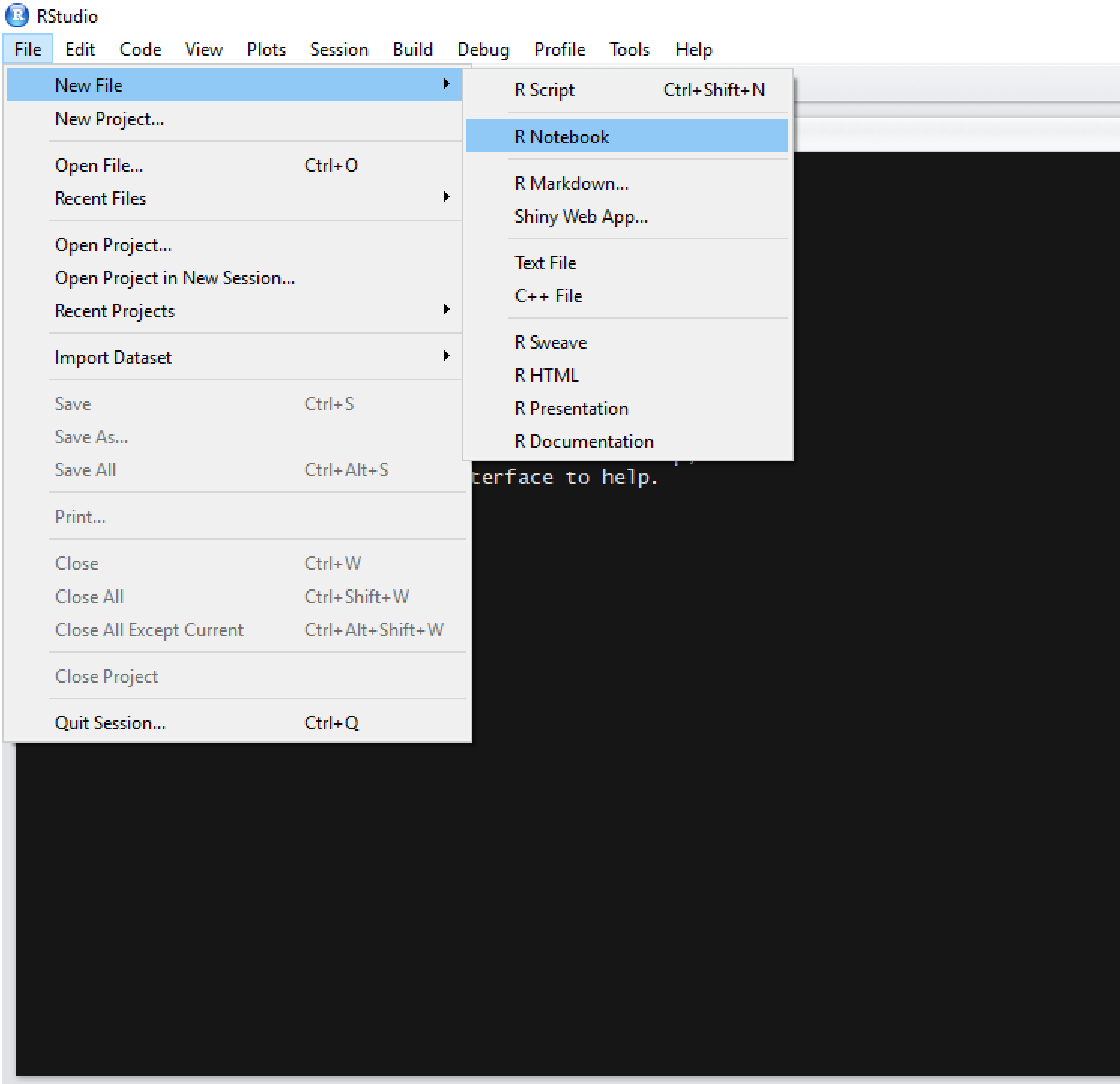
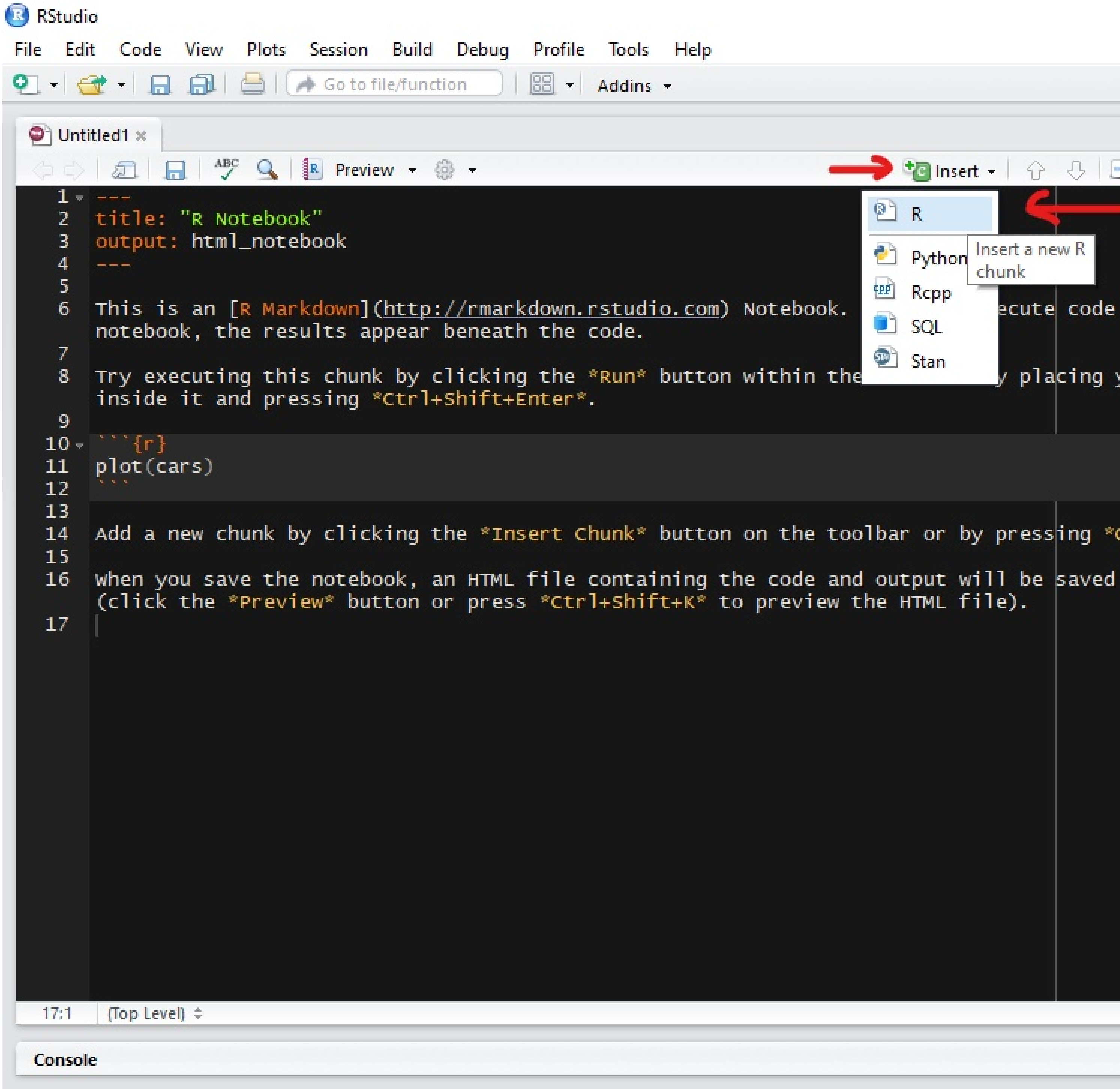
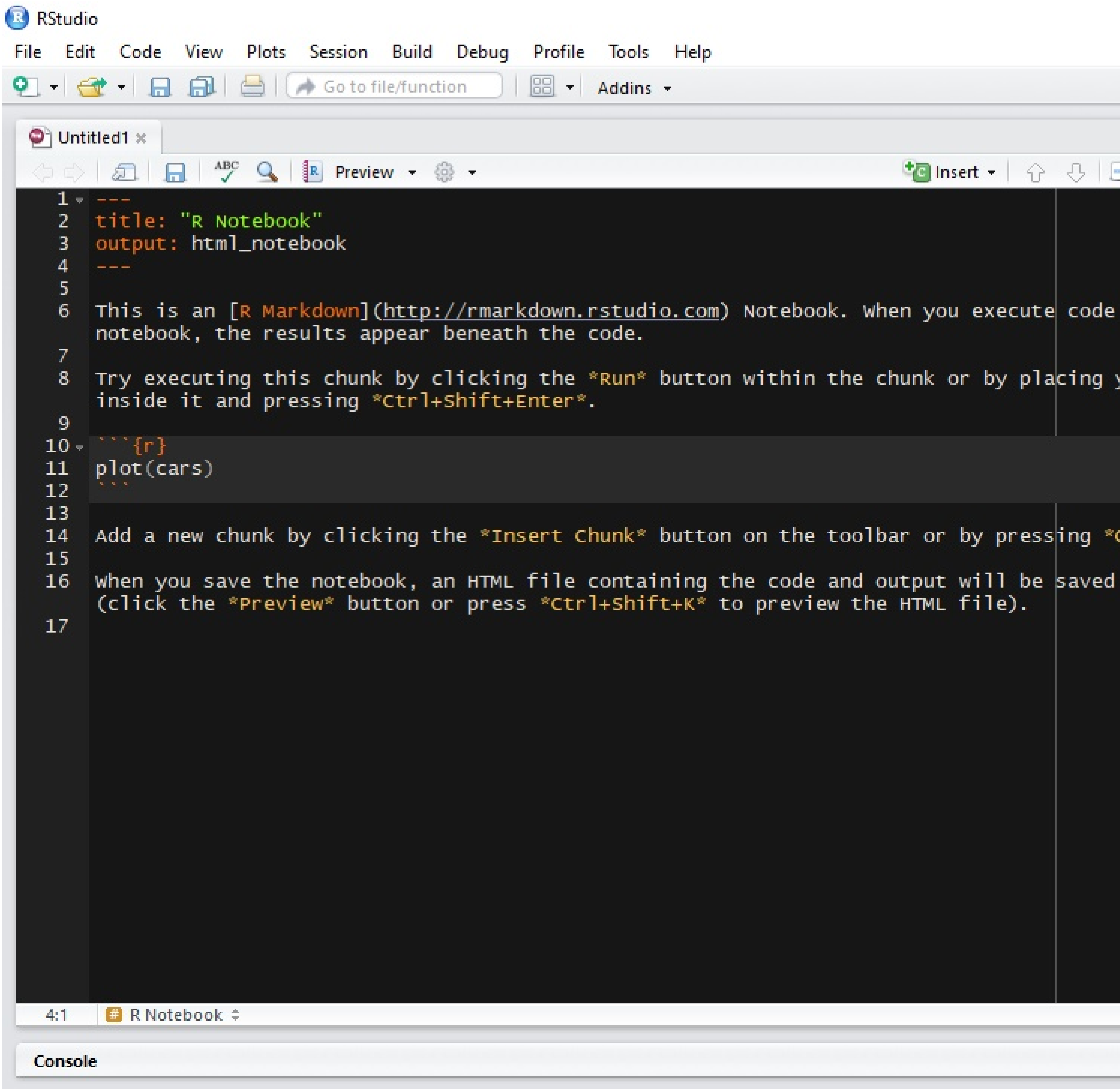
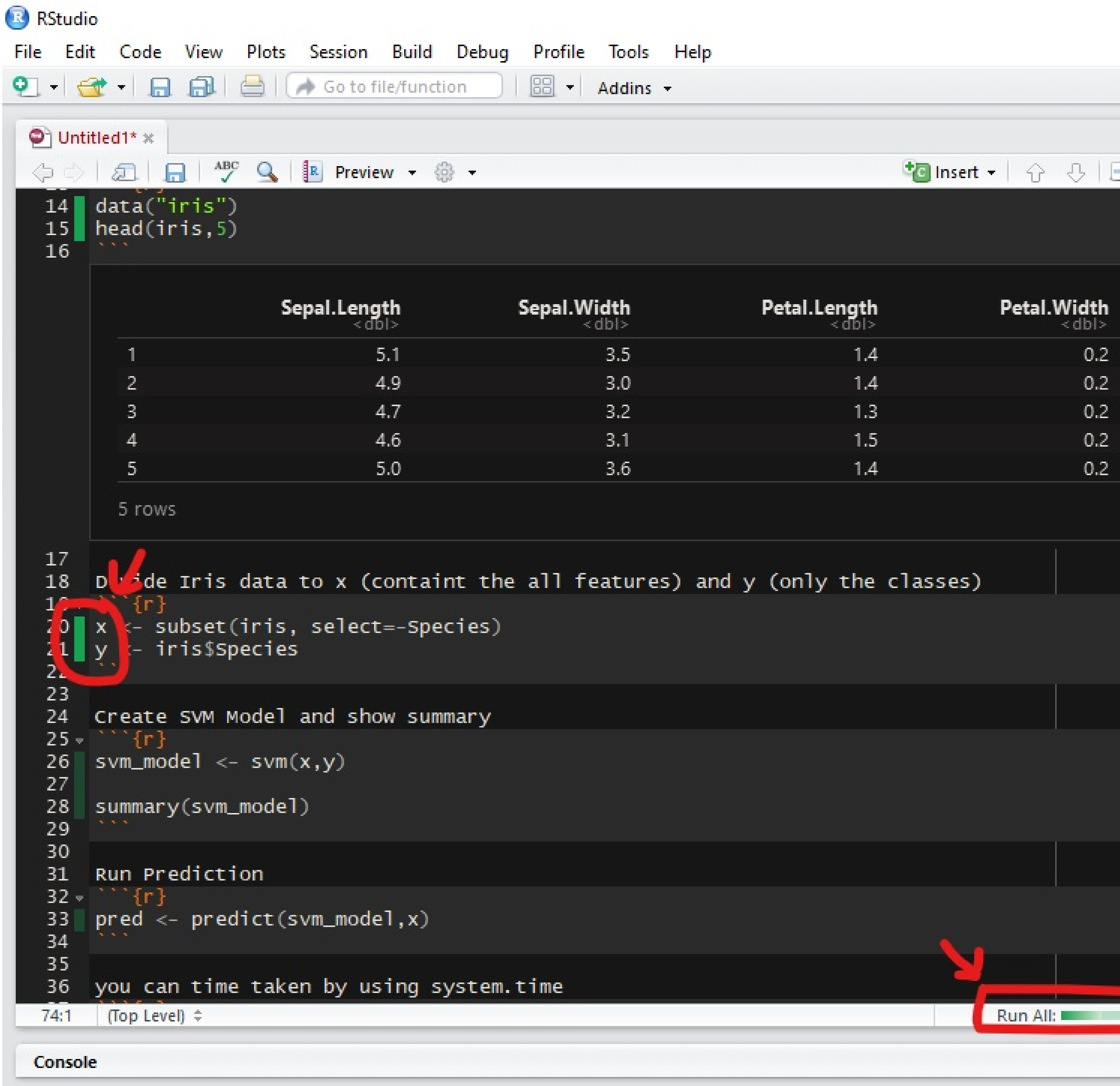
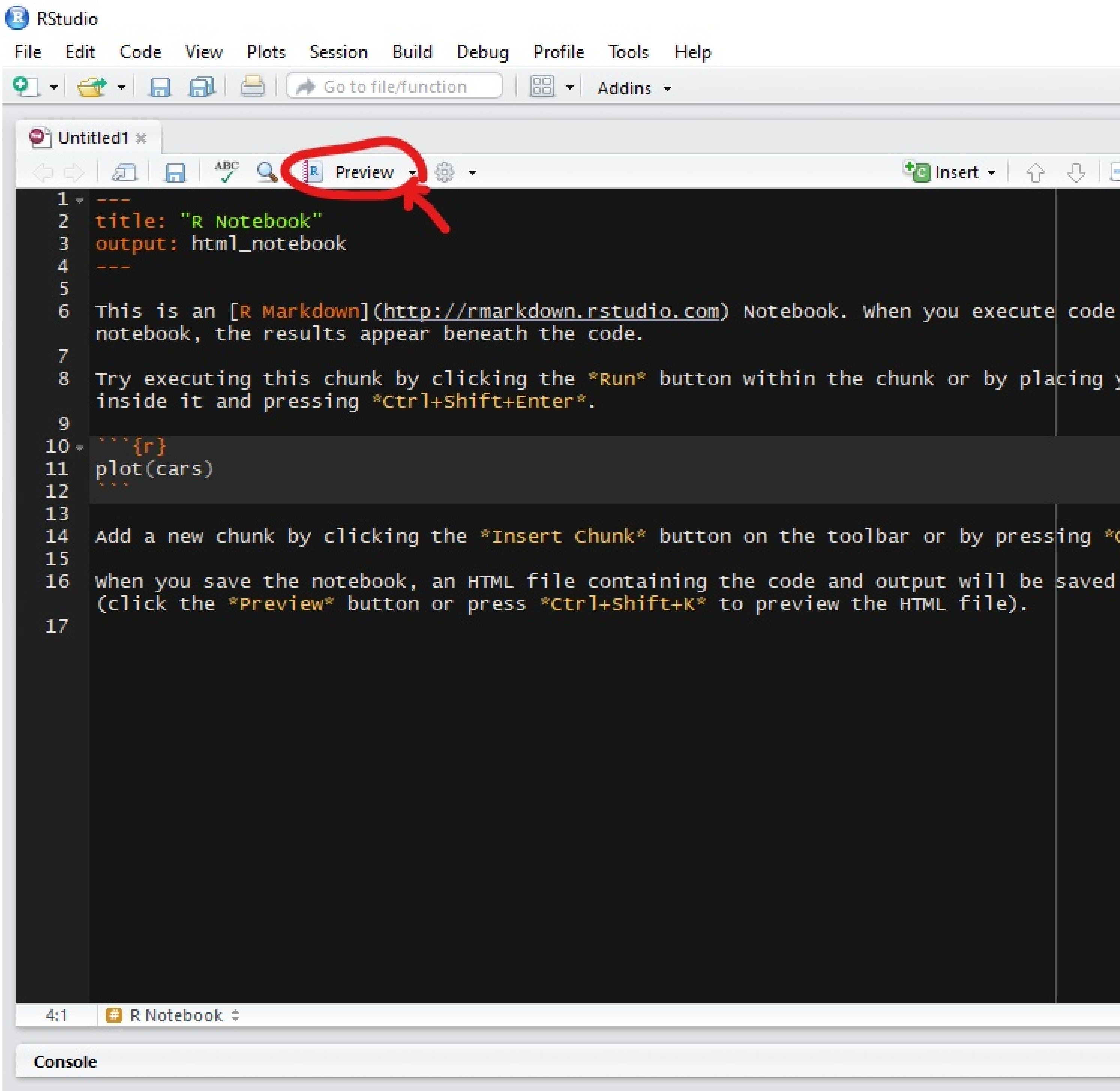
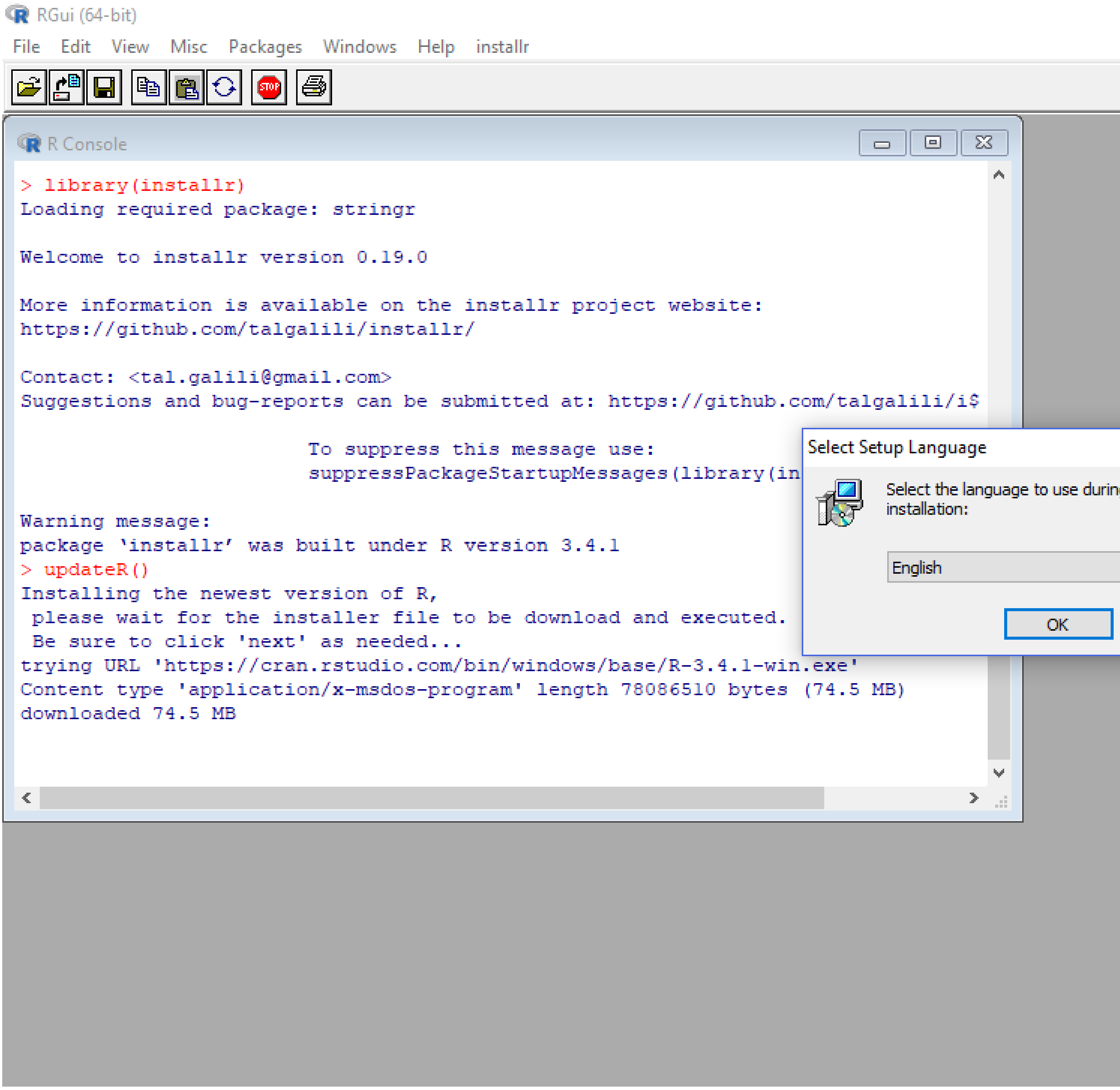
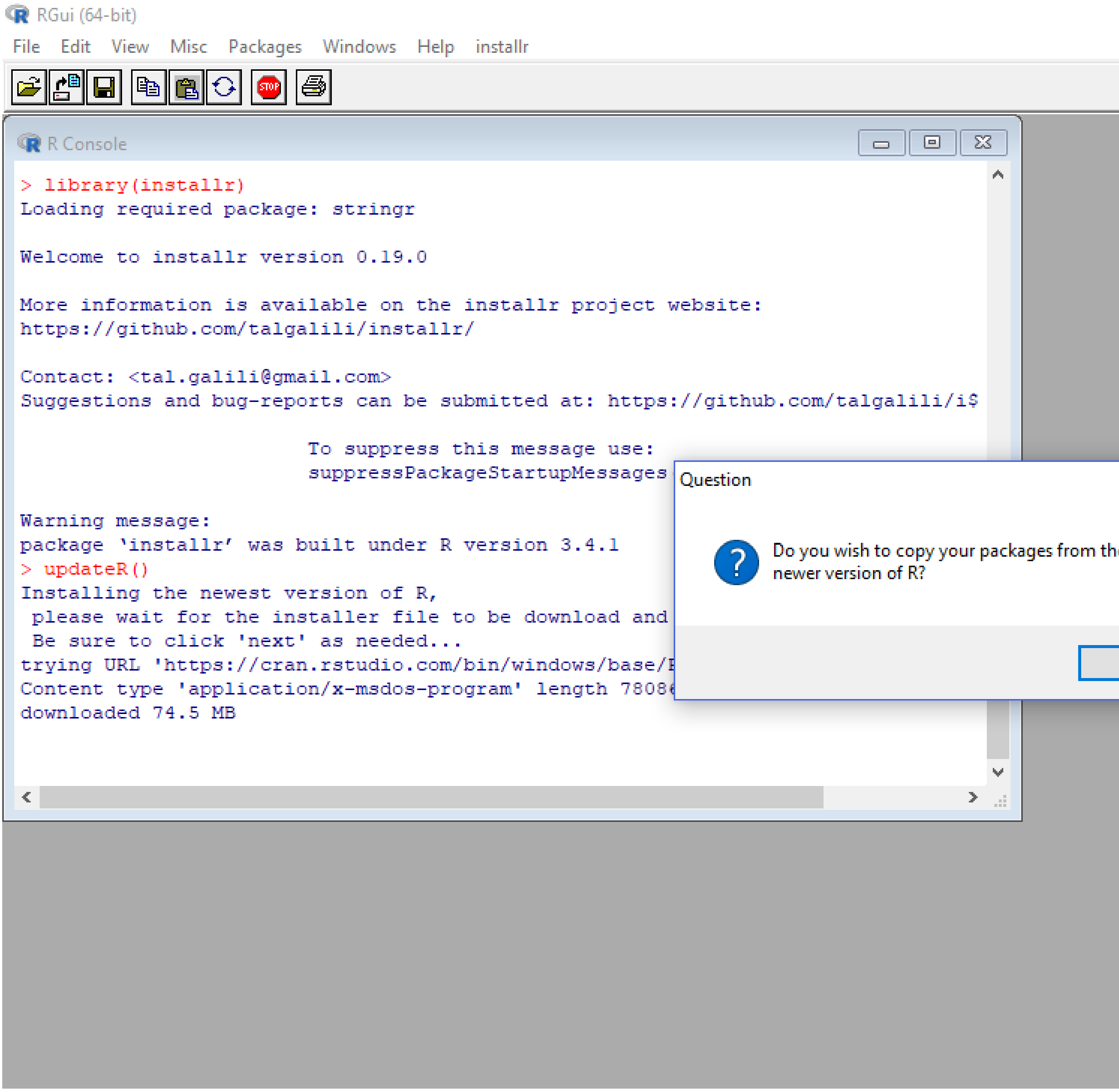
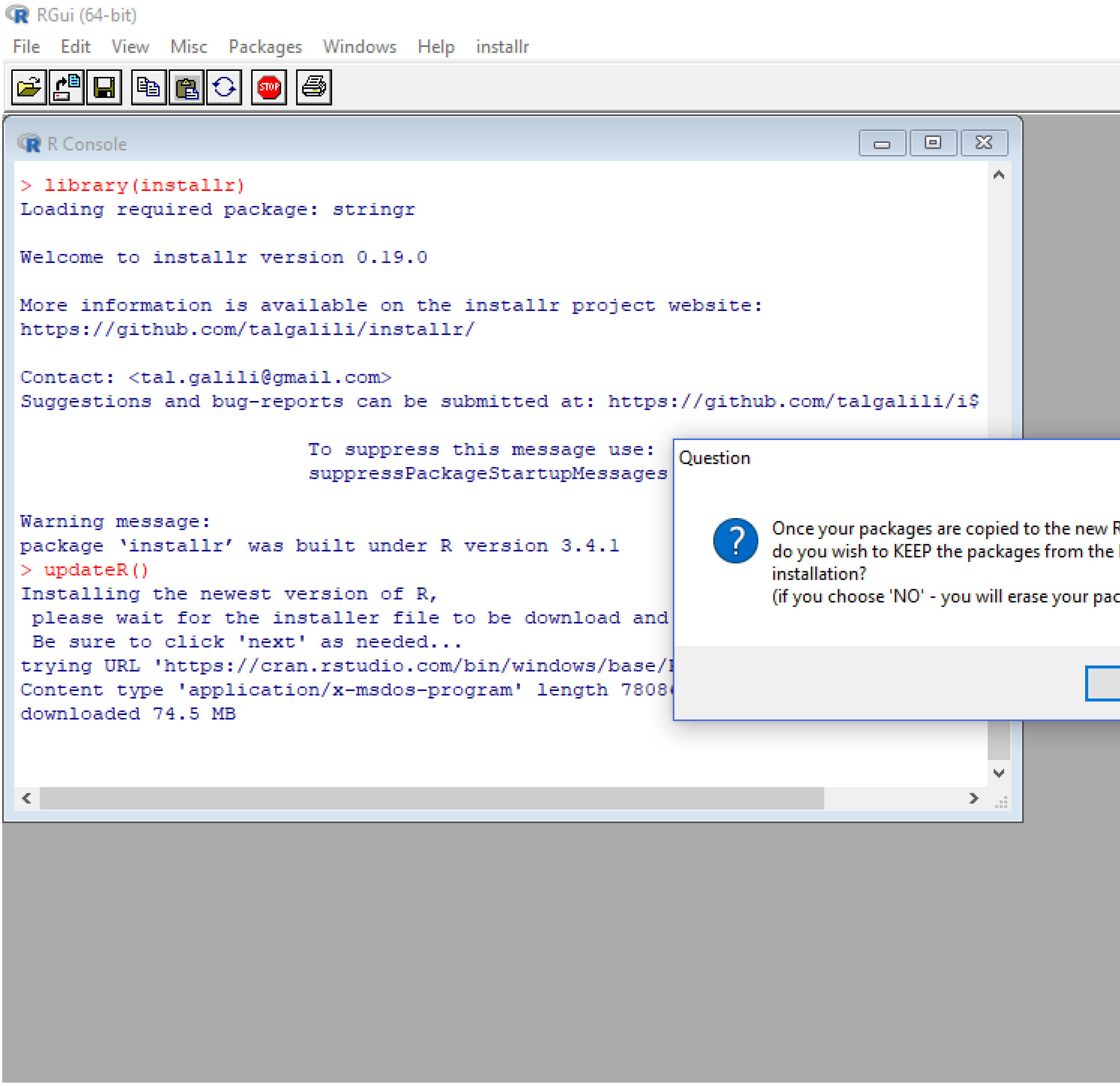
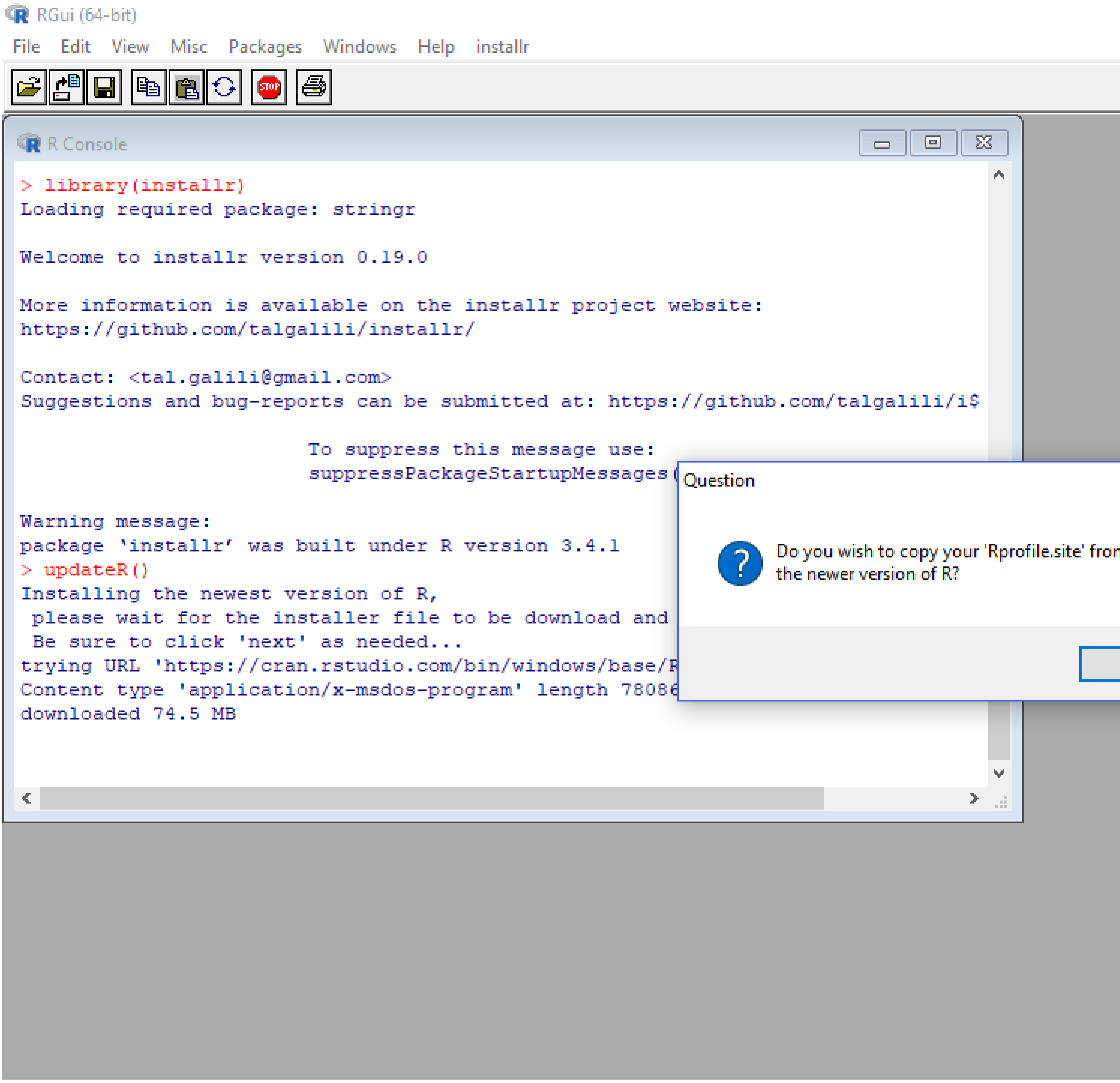
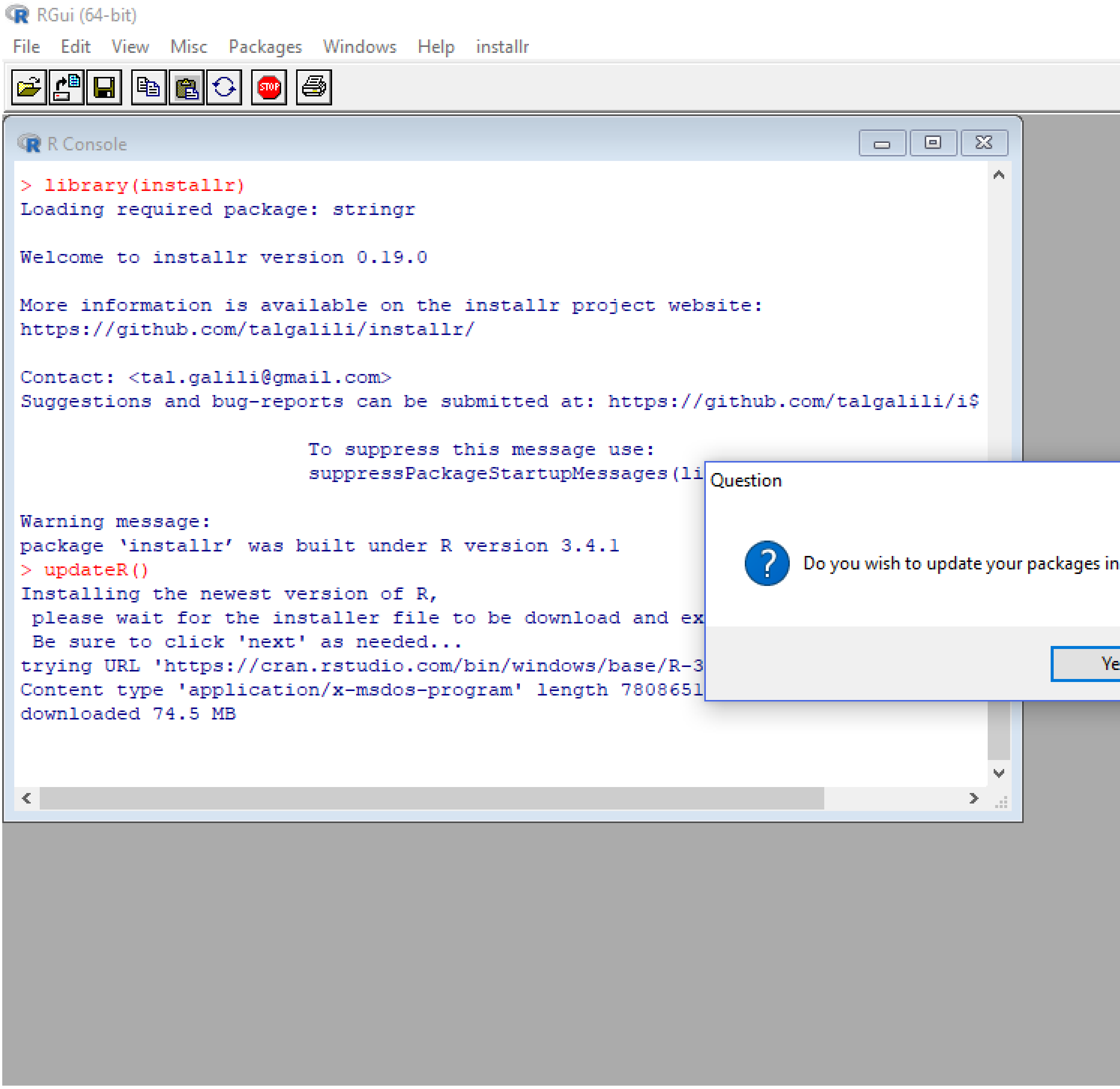
toJSON(lst)
# {"a":[1,2,3],"b":[["a","b","c","d","e","f"]]}


fromJSON('{"a":[1,2,3],"b":[["a","b","c","d","e","f"]]} ')
# $a
# [1] 1 2 3
#
# $b
# [,1] [,2] [,3] [,4] [,5] [,6]
# [1,] "a"  "b"  "c"  "d"  "e"  "f"
```

`data.frame` JSON ( )

```
## converting a data.frame to JSON
df <- data.frame(id = seq_along(1:10),
                 val = letters[1:10])

toJSON(df)
```

```
#
[{"id":1,"val":"a"},{"id":2,"val":"b"},{"id":3,"val":"c"},{"id":4,"val":"d"},{"id":5,"val":"e"},{"id":6


## reading a JSON string
fromJSON('[{"id":1,"val":"a"},{"id":2,"val":"b"},{"id":3,"val":"c"},{"id":4,"val":"d"},{"id":5,"val":"e

#     id val
# 1    1   a
# 2    2   b
# 3    3   c
# 4    4   d
# 5    5   e
# 6    6   f
# 7    7   g
# 8    8   h
# 9    9   i
# 10 10    j
```

JSON .

```
## Reading JSON from URL
googleway_issues <- fromJSON("https://api.github.com/repos/SymbolixAU/googleway/issues")

googleway_issues$url
# [1] "https://api.github.com/repos/SymbolixAU/googleway/issues/20"
"https://api.github.com/repos/SymbolixAU/googleway/issues/19"
# [3] "https://api.github.com/repos/SymbolixAU/googleway/issues/14"
"https://api.github.com/repos/SymbolixAU/googleway/issues/11"
# [5] "https://api.github.com/repos/SymbolixAU/googleway/issues/9"
"https://api.github.com/repos/SymbolixAU/googleway/issues/5"
# [7] "https://api.github.com/repos/SymbolixAU/googleway/issues/2"
```

JSON : https://riptutorial.com/ko/r/topic/2460/json

14: R Markdown (RStudio)

R Notebook R Markdown , . R / R Markdown . : R RStudio RStudio 1.0 .

Examples

-> -> R RStudio
R Notebook RStudio . RStudio .



. (R) **Ctrl + Alt + I (OS X : Cmd + Option + I) .**



( ) . **Ctrl + Shift + Enter (OS X : Cmd + Shift + Enter)** .

.

.

Ctrl + Alt + I (OS X : Cmd + Option + I) .



. R . R .

Run . . **Ctrl + Alt + R (OS X : Cmd + Option + R).**

R **Restart R** ( ) .

.



. .

"pdf_document" "html_notebook" .



`.Rmd` `.nb.html` . ( ) .Rmd HTML .

RStudio .

R Markdown (RStudio) : https://riptutorial.com/ko/r/topic/10728/r-markdown---rstudio--

15: R

Examples

Windows

R Windows ( ) R .

, R .

R R . (`c:\stats\R`). , R . () (`tm`). :

- .
- `miniCRAN` .

`packageStatus` .

```
pkgs <- packageStatus()  # choose mirror
upgrade(pkgs)
```

`installr` . GUI . gui Rgui RStudio . .

```
install.packages("installr") # install
setInternet2(TRUE) # only for R versions older than 3.3.0
installr::updateR() # updating R.
```

https://www.r-statistics.com/tag/installr/ Windows . https://www.r-statistics.com/2015/06/ - - - Windows on /

. R .

R : https://riptutorial.com/ko/r/topic/4088/r----

16: R

. R . R .

Examples

R

https://cran.r-project.org/ . . .

installr R

installr R R .

R (RStudio RStudio). .

```
install.packages("installr")
library("installr")
updateR()
```


RGui (64-bit)
File Edit View Misc Packages Windows Help installr
R Console
> library(installr)
Loading required package: stringr
Welcome to installr version 0.19.0
More information is available on the installr project website:
https://github.com/talgalili/installr/
Contact: <tal.galili@gmail.com>
Suggestions and bug-reports can be submitted at: https://github.com/talgalili/i$
To suppress this message use:
suppressPackageStartupMessages(library(in
Warning message:
package 'installr' was built under R version 3.4.1
> updateR()
Installing the newest version of R,
please wait for the installer file to be download and executed.
Be sure to click 'next' as needed...
trying URL 'https://cran.rstudio.com/bin/windows/base/R-3.4.1-win.exe'
Content type 'application/x-msdos-program' length 78086510 bytes (74.5 MB)
downloaded 74.5 MB
Select Setup Language
Select the language to use durin
installation:
English
OK

.

R . R .


RGui (64-bit)
File Edit View Misc Packages Windows Help installr
R Console
> library(installr)
Loading required package: stringr
Welcome to installr version 0.19.0
More information is available on the installr project website:
https://github.com/talgalili/installr/
Contact: <tal.galili@gmail.com>
Suggestions and bug-reports can be submitted at: https://github.com/talgalili/i$
To suppress this message use:
suppressPackageStartupMessages
Warning message:
package 'installr' was built under R version 3.4.1
> updateR()
Installing the newest version of R,
please wait for the installer file to be download and
Be sure to click 'next' as needed...
trying URL 'https://cran.rstudio.com/bin/windows/base/R
Content type 'application/x-msdos-program' length 7808
downloaded 74.5 MB
Question
Do you wish to copy your packages from the
newer version of R?

.



Rprofile.site .


RGui (64-bit)
File Edit View Misc Packages Windows Help installr
R Console
> library(installr)
Loading required package: stringr
Welcome to installr version 0.19.0
More information is available on the installr project website:
https://github.com/talgalili/installr/
Contact: <tal.galili@gmail.com>
Suggestions and bug-reports can be submitted at: https://github.com/talgalili/i$
To suppress this message use:
suppressPackageStartupMessages(
Warning message:
package 'installr' was built under R version 3.4.1
> updateR()
Installing the newest version of R,
please wait for the installer file to be download and
Be sure to click 'next' as needed...
trying URL 'https://cran.rstudio.com/bin/windows/base/R
Content type 'application/x-msdos-program' length 78086
downloaded 74.5 MB
Question
Do you wish to copy your 'Rprofile.site' fron
the newer version of R?

R .



R .

R

R .

```
version
```

R : https://riptutorial.com/ko/r/topic/10729/r---

17: R

Examples

R R " " .

, " " .

- ?
- R ?
- ?
- `apply` ? , R ?

, `apply` , R .

/ .

```
apply(mtcars, 1, mean)
          Mazda RX4       Mazda RX4 Wag          Datsun 710      Hornet 4 Drive   Hornet
Sportabout             Valiant          Duster 360
           29.90727            29.98136            23.59818            38.73955
53.66455            35.04909            59.72000
          Merc 240D            Merc 230            Merc 280           Merc 280C           Merc
450SE          Merc 450SL         Merc 450SLC
           24.63455            27.23364            31.86000            31.78727
46.43091            46.50000            46.35000
 Cadillac Fleetwood Lincoln Continental   Chrysler Imperial            Fiat 128          Honda
Civic      Toyota Corolla       Toyota Corona
           66.23273            66.05855            65.97227            19.44091
17.74227            18.81409            24.88864
   Dodge Challenger         AMC Javelin          Camaro Z28    Pontiac Firebird           Fiat
X1-9       Porsche 914-2        Lotus Europa
           47.24091            46.00773            58.75273            57.37955
18.92864            24.77909            24.88027
     Ford Pantera L        Ferrari Dino       Maserati Bora          Volvo 142E
           60.97182            34.50818            63.15545            26.26273
```

? .

1. `data.frame` `matrix` . (`apply` .) . `matrix` . `apply(iris, 2, class)` `str(iris)` `sapply(iris, class)` `apply(iris, 2, class)` .
2. , . , R `nrow(mtcars)` . `mean` R ? ? :
3. R , ?

:

```
rowMeans(mtcars)
          Mazda RX4       Mazda RX4 Wag          Datsun 710      Hornet 4 Drive   Hornet
Sportabout             Valiant          Duster 360
           29.90727            29.98136            23.59818            38.73955
53.66455            35.04909            59.72000
          Merc 240D            Merc 230            Merc 280           Merc 280C           Merc
```

```
450SE          Merc 450SL         Merc 450SLC
           24.63455            27.23364            31.86000            31.78727
46.43091            46.50000            46.35000
 Cadillac Fleetwood Lincoln Continental   Chrysler Imperial            Fiat 128          Honda
Civic      Toyota Corolla       Toyota Corona
           66.23273            66.05855            65.97227            19.44091
17.74227            18.81409            24.88864
   Dodge Challenger         AMC Javelin          Camaro Z28    Pontiac Firebird            Fiat
X1-9       Porsche 914-2        Lotus Europa
           47.24091            46.00773            58.75273            57.37955
18.92864            24.77909            24.88027
     Ford Pantera L        Ferrari Dino       Maserati Bora          Volvo 142E
           60.97182            34.50818            63.15545            26.26273
```

R . data.frame matrix . rowMeans .

```
rowMeans(iris)
Error in rowMeans(iris) : 'x' must be numeric
```

? , mtcars (A data.frame list list A vector).

```
Reduce(`+`, mtcars)/ncol(mtcars)
 [1] 29.90727 29.98136 23.59818 38.73955 53.66455 35.04909 59.72000 24.63455 27.23364 31.86000
31.78727 46.43091 46.50000 46.35000 66.23273 66.05855
[17] 65.97227 19.44091 17.74227 18.81409 24.88864 47.24091 46.00773 58.75273 57.37955 18.92864
24.77909 24.88027 60.97182 34.50818 63.15545 26.26273
```

(NA) .

R .

```
aggregate(. ~ cyl, mtcars, mean)
cyl      mpg     disp         hp     drat        wt     qsec        vs        am     gear
carb
1   4 26.66364 105.1364  82.63636 4.070909 2.285727 19.13727 0.9090909 0.7272727 4.090909
1.545455
2   6 19.74286 183.3143 122.28571 3.585714 3.117143 17.97714 0.5714286 0.4285714 3.857143
3.428571
3   8 15.10000 353.1000 209.21429 3.229286 3.999214 16.77214 0.0000000 0.1428571 3.285714
3.500000
```

R C (C R).

? R rowsum rowsum , .

```
rowsum(mtcars[-2], mtcars$cyl)/table(mtcars$cyl)
mpg     disp         hp     drat        wt     qsec        vs        am     gear     carb
4 26.66364 105.1364  82.63636 4.070909 2.285727 19.13727 0.9090909 0.7272727 4.090909 1.545455
6 19.74286 183.3143 122.28571 3.585714 3.117143 17.97714 0.5714286 0.4285714 3.857143 3.428571
8 15.10000 353.1000 209.21429 3.229286 3.999214 16.77214 0.0000000 0.1428571 3.285714 3.500000
```

.

. data.frame ? matrix ?

( ). .

m .

```
set.seed(100)
m <- matrix(sample(1e2), 10)
m
      [,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8] [,9] [,10]
 [1,]    8   33   39   86   71  100   81   68   89    84
 [2,]   12   16   57   80   32   82   69   11   41    92
 [3,]   62   91   53   13   42   31   60   70   98    79
 [4,]   66   94   29   67   45   59   20   96   64     1
 [5,]   36   63   76    6   10   48   85   75   99     2
 [6,]   18    4   27   19   44   56   37   95   26    40
 [7,]    3   24   21   25   52   51   83   28   49    17
 [8,]   46    5   22   43   47   74   35   97   77    65
 [9,]   55   54   78   34   50   90   30   61   14    58
[10,]   88   73   38   15    9   72    7   93   23    87
```

:

```
apply(m, 1, var)
[1]  871.6556  957.5111  699.2111  941.4333 1237.3333  641.8222  539.7889  759.4333  500.4889
1255.6111
```

, .

```
RowVar <- function(x) {
  rowSums((x - rowMeans(x))^2)/(dim(x)[2] - 1)
}
RowVar(m)
[1]  871.6556  957.5111  699.2111  941.4333 1237.3333  641.8222  539.7889  759.4333  500.4889
1255.6111
```

R : https://riptutorial.com/ko/r/topic/3327/r----

18: Rcpp

Examples

Rcpp R : `cppFunction()` `evalCpp()` . `sourceCpp()` C ++ `cppFunction()` .

R C ++ . "" .

```
# Note - This is R code.
# cppFunction in Rcpp allows for rapid testing.
require(Rcpp)

# Creates a function that multiples each element in a vector
# Returns the modified vector.
cppFunction("
NumericVector exfun(NumericVector x, int i){
x = x*i;
return x;
}")

# Calling function in R
exfun(1:5, 3)
```

C ++ .

```
# Use evalCpp to evaluate C++ expressions
evalCpp("std::numeric_limits<double>::max()")
## [1] 1.797693e+308
```

Rcpp

Rcpp R C ++ . .

```
// [[Rcpp::attribute]]
```

.

```
// [[Rcpp::export]]
```

`sourceCpp()` C ++ .

C ++ .

```
// Add code below into C++ file Rcpp_example.cpp

#include <Rcpp.h>
using namespace Rcpp;

// Place the export tag right above function declaration.
// [[Rcpp::export]]
```

```
double muRcpp(NumericVector x){

    int n = x.size(); // Size of vector
    double sum = 0; // Sum value

    // For loop, note cpp index shift to 0
    for(int i = 0; i < n; i++){
        // Shorthand for sum = sum + x[i]
        sum += x[i];
    }

    return sum/n; // Obtain and return the Mean
}

// Place dependent functions above call or
// declare the function definition with:
double muRcpp(NumericVector x);

// [[Rcpp::export]]
double varRcpp(NumericVector x, bool bias = true){

    // Calculate the mean using C++ function
    double mean = muRcpp(x);
    double sum = 0;

    int n = x.size();

    for(int i = 0; i < n; i++){
        sum += pow(x[i] - mean, 2.0); // Square
    }

    return sum/(n-bias); // Return variance
}
```

R *C* ++ .

```
require(Rcpp)

# Compile File
sourceCpp("path/to/file/Rcpp_example.cpp")

# Make some sample data
x = 1:5

all.equal(muRcpp(x), mean(x))
## TRUE

all.equal(varRcpp(x), var(x))
## TRUE
```

Rcpp

C ++ .

```
// [[Rcpp::plugins(name)]]
```

:

```
// built-in C++11 plugin
// [[Rcpp::plugins(cpp11)]]

// built-in C++11 plugin for older g++ compiler
// [[Rcpp::plugins(cpp0x)]]

// built-in C++14 plugin for C++14 standard
// [[Rcpp::plugins(cpp14)]]

// built-in C++1y plugin for C++14 and C++17 standard under development
// [[Rcpp::plugins(cpp1y)]]

// built-in OpenMP++11 plugin
// [[Rcpp::plugins(openmp)]]
```

Rcpp `Rcpp.h` `Rcpp<PACKAGE>.h` (: RcppArmadillo) .

```
// [[Rcpp::depends(Rcpp<PACKAGE>)]]
```

:

```
// Use the RcppArmadillo package
// Requires different header file from Rcpp.h
#include <RcppArmadillo.h>
// [[Rcpp::depends(RcppArmadillo)]]

// Use the RcppEigen package
// Requires different header file from Rcpp.h
#include <RcppEigen.h>
// [[Rcpp::depends(RcppEigen)]]
```

Rcpp : https://riptutorial.com/ko/r/topic/1404/rcpp

19: RESTful R

OpenCPU R , .

Examples

opencpu

. https://www.opencpu.org/apps.html

R .

```
library(opencpu)
opencpu$start(port = 5936)
```

URL R . XML, html, JSON .

, R cURL .

```
#curl uses http post method for -X POST or -d "arg=value"
curl http://localhost:5936/ocpu/library/MASS/scripts/ch01.R -X POST
curl http://localhost:5936/ocpu/library/stats/R/rnorm -d "n=10&mean=5"
```

. R ( ).

`/ocpu/tmp/` .

:

```
curl https://public.opencpu.org/ocpu/library/stats/R/rnorm -d n=5
/ocpu/tmp/x009f9e7630/R/.val
/ocpu/tmp/x009f9e7630/stdout
/ocpu/tmp/x009f9e7630/source
/ocpu/tmp/x009f9e7630/console
/ocpu/tmp/x009f9e7630/info
```

`x009f9e7630` .

`/ocpu/tmp/x009f9e7630/R/.val` `/ocpu/tmp/x009f9e7630/R/.val` `rnorm(5)` `/ocpu/tmp/x009f9e7630/R/console` `rnorm(5)` .

RESTful R : https://riptutorial.com/ko/r/topic/8323/restful-r-

20: RMarkdown knitr

- :
    - YAML , .

: " `r format(Sys.time(), '%d %B, %Y')` "	
: 10 . html `html_output` . PDF , `pdf_document` , ..	

:

		HTML	pdf		ODT	RTF	MD				
citation_package	, natbib, biblatex none LaTeX										
	R "none", "hide" "show" .										
CSS	CSS										
dev	(: "png")										
	()										
fig_caption	?										
fig_height, fig_width	()										
	: "tango", "pygments", "kate", "zenburn", "textmate"										
	(in_header, before_body, after_body)										
	( )?										
keep_md	knitr .md										
keep_tex	knitr .tex .										

		HTML	pdf		ODT	RTF	MD				
latex_engine	""pdflatex ","xelatex ", lualatex"										
lib_dir	(, MathJax)										
mathjax	URL MathJax / URL .										
md_extensions	R Markdown Markdown										
number_sections											
pandoc_args	Pandoc										
preserve_yaml	YAML ?										
reference_docx	docx docx										
self_contained											
slide_level											
	?										
	, em , ...										
	Pandoc										
	Bootswatch Beamer										
toc											
toc_depth											
toc_float	.										

Examples

Rstudio

.Rmd , .R r .

Rstudio `render` .

```
---
title: "Rstudio exemple of a rmd file"
author: 'stack user'
date: "22 July 2016"
```

````
output: html_document
---

The header is used to define the general parameters and the metadata.

## R Markdown

This is an R Markdown document.
It is a script written in markdown with the possibility to insert chunk of R code in it.
To insert R code, it needs to be encapsulated into inverted quote.

Like that for a long piece of code:

```{r cars}
summary(cars)
```

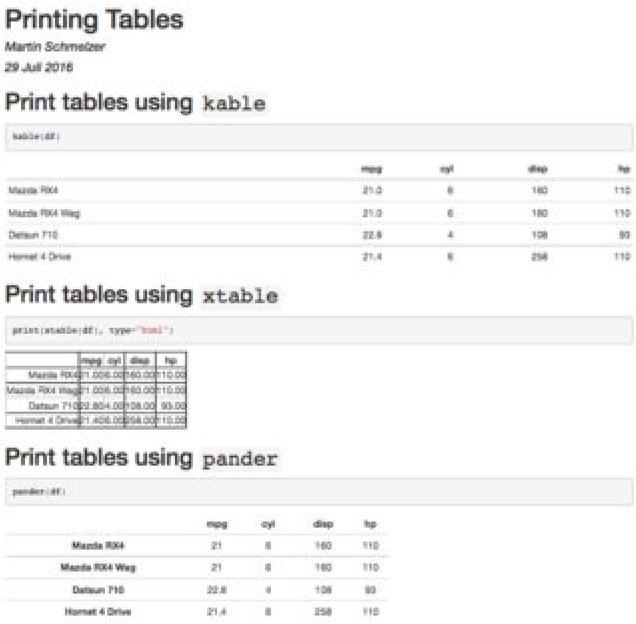
And like ``r cat("that")`` for small piece of code.

## Including Plots

You can also embed plots, for example:

```{r echo=FALSE}
plot(pressure)
```
````

ioslides

. jQuery CSS knitr ioslides . jQuery . .

```
<script src="https://ajax.googleapis.com/ajax/libs/jquery/1.12.2/jquery.min.js"></script>
```

jQuery DOM ( ) . , HTML . (`$(document).ready(function() { ... })`), `.backdrop` `.title-slide` , `.backdrop` `.segue` " `<footer></footer>` (: `</slide>`). `label` .

CSS .

`<footer>` (`footer::after`) `footer::after` :

- `label` .
- 12
- (20 , 60)

.

````
---
title: "Adding a footer to presentaion slides"
author: "Martin Schmelzer"
date: "26 Juli 2016"
output: ioslides_presentation
---

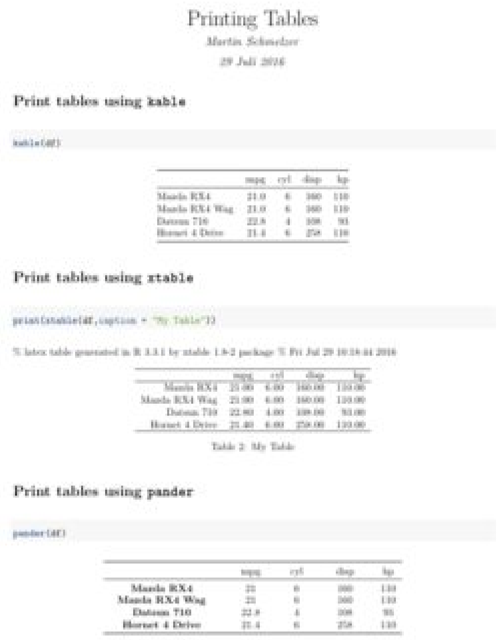
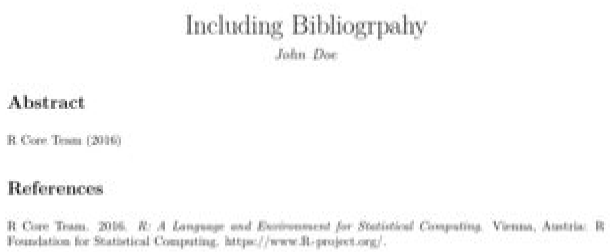
```{r setup, include=FALSE}
knitr::opts_chunk$set(echo = FALSE)
````
````

````
```

<script src="https://ajax.googleapis.com/ajax/libs/jquery/1.12.2/jquery.min.js"></script>

<script>
    $(document).ready(function() {
      $('slide:not(.title-slide, .backdrop, .segue)').append('<footer label=\"My amazing
footer!\"></footer>');
    })
</script>

<style>
  footer:after {
    content: attr(label);
    font-size: 12pt;
    position: absolute;
    bottom: 20px;
    left: 60px;
    line-height: 1.9;
  }
</style>


## Slide 1

This is slide 1.

## Slide 2

This is slide 2

# Test

## Slide 3

And slide 3.
````

.
````

RMarkdown knitr : https://riptutorial.com/ko/r/topic/2999/rmarkdown--knitr-

21: RMarkdown

Examples

HTML LaTeX . .

.

-
- xtable
-

HTML

```
---
title: "Printing Tables"
author: "Martin Schmelzer"
date: "29 Juli 2016"
output: html_document
---

```{r setup, include=FALSE}
knitr::opts_chunk$set(echo = TRUE)
library(knitr)
library(xtable)
library(pander)
df <- mtcars[1:4,1:4]
```

Print tables using `kable`
```{r, 'kable'}
kable(df)
```

Print tables using `xtable`
```{r, 'xtable', results='asis'}
print(xtable(df), type="html")
```

Print tables using `pander`
```{r, 'pander'}
pander(df)
```
```



Printing Tables

Martin Schmelzer

29 Juli 2016

Print tables using `kable`

```
kable(df)
```

	mpg	cyl	disp	hp
Mazda RX4	21.0	6	160	110
Mazda RX4 Wag	21.0	6	160	110
Datsun 710	22.8	4	108	93
Hornet 4 Drive	21.4	6	258	110

Print tables using `xtable`

```
print(xtable(df), type="html")
```

	mpg	cyl	disp	hp
Mazda RX4	21.00	6.00	160.00	110.00
Mazda RX4 Wag	21.00	6.00	160.00	110.00
Datsun 710	22.80	4.00	108.00	93.00
Hornet 4 Drive	21.40	6.00	258.00	110.00

Print tables using `pander`

```
pander(df)
```

	mpg	cyl	disp	hp
Mazda RX4	21	6	160	110
Mazda RX4 Wag	21	6	160	110
Datsun 710	22.8	4	108	93
Hornet 4 Drive	21.4	6	258	110

PDF

````
---
title: "Printing Tables"
author: "Martin Schmelzer"
date: "29 Juli 2016"
output: pdf_document
---

```{r setup, include=FALSE}
knitr::opts_chunk$set(echo = TRUE)
library(knitr)
library(xtable)
library(pander)
df <- mtcars[1:4,1:4]
```

# Print tables using `kable`
```{r, 'kable'}
kable(df)
```

# Print tables using `xtable`
```{r, 'xtable', results='asis'}
print(xtable(df, caption="My Table"))
```

# Print tables using `pander`
```{r, 'pander'}
pander(df)
```
````



Printing Tables

Martin Schweizer

29 Juli 2016

Print tables using kable

```
kable(df)
```

	mpg	cyl	disp	hp
Mazda RX4	21.0	6	160	110
Mazda RX4 Wag	21.0	6	160	110
Datsun 710	22.8	4	108	93
Hornet 4 Drive	21.4	6	258	110

Print tables using xtable

```
print(xtable(df,caption = "My Table"))
```

% latex table generated in R 3.3.1 by xtable 1.8-2 package % Fri Jul 29 10:18:44 2016

	mpg	cyl	disp	hp
Mazda RX4	21.00	6.00	160.00	110.00
Mazda RX4 Wag	21.00	6.00	160.00	110.00
Datsun 710	22.80	4.00	108.00	93.00
Hornet 4 Drive	21.40	6.00	258.00	110.00

Table 2: My Table

Print tables using pander

```
pander(df)
```

	mpg	cyl	disp	hp
Mazda RX4	21	6	160	110
Mazda RX4 Wag	21	6	160	110
Datsun 710	22.8	4	108	93
Hornet 4 Drive	21.4	6	258	110

xtable ?

```
options(xtable.comment = FALSE)
```

LaTeX preample

LaTeX (: `\usepackage`) RMarkdown .

1. YAML `header-includes` :

```
---
title: "Including LaTeX Preample Commands in RMarkdown"
header-includes:
   - \renewcommand{\familydefault}{cmss}
   - \usepackage[cm, slantedGreek]{sfmath}
   - \usepackage[T1]{fontenc}
output: pdf_document
---

```{r setup, include=FALSE}
knitr::opts_chunk$set(echo = TRUE, external=T)
```

Section 1

As you can see, this text uses the Computer Moden Font!
```

Including LaTeX Preample Commands in RMarkdown

Section 1

As you can see, this text uses the Computer Moden Font!

2. `includes` , `in_header` `includes`

```
---
title: "Including LaTeX Preample Commands in RMarkdown"
output:
  pdf_document:
    includes:
      in_header: includes.tex
---

```{r setup, include=FALSE}
knitr::opts_chunk$set(echo = TRUE, external=T)
```

Section 1

As you can see, this text uses the Computer Modern Font!
```

include.tex `header-includes` .

`template` . .

```
---
title: "My Template"
author: "Martin Schmelzer"
output:
  pdf_document:
    template: myTemplate.tex
---
```

bibtex cna YAML `bibliography:` . `biblio-style:` . .

```
---
title: "Including Bibliography"
author: "John Doe"
output: pdf_document
bibliography: references.bib
---

# Abstract

@R_Core_Team_2016

# References
```


Including Bibliogrpahy
John Doe

Abstract

R Core Team (2016)

References

R Core Team. 2016. *R: A Language and Environment for Statistical Computing*. Vienna, Austria: R Foundation for Statistical Computing. https://www.R-project.org/.

R-markdown

R-

R-markdown R . R .

.

```
`r 2*2`
```

.

.

```
```{r name, echo=TRUE, include=TRUE, ...}

2*2

````
```

. ( ).

- **echo** (boolean) .
- ()
- **fig.width** (numeric) .
- **fig.height** () .
- **fig.cap** (character) .

`tag=value` .

R-markdown

R-markdown . R-markdown R .

```
# Title #

This is **plain markdown** text.

```{r code, include=FALSE, echo=FALSE}

# Just declare variables

income <- 1000
taxes  <- 125

```

My income is: `r income ` dollars and I payed `r taxes ` dollars in taxes.

Below is the sum of money I will have left:

```{r gain, include=TRUE, echo=FALSE}

gain <- income-taxes
```
```

```
gain

```

```{r plotOutput, include=TRUE, echo=FALSE, fig.width=6, fig.height=6}

pie(c(income,taxes), label=c("income", "taxes"))

```
```

## R-markdown

R `knitr` R-markdown R markdown .

R-markdown pdf / html .

1. `knitr` R-markdown markdown .
2. markdown *pandoc* pdf / html .

`knitr` `knit2html()` `knit2pdf()` . `knit2pdf()` `knit2pdf()` .

`income.Rmd` R `pdf` .

```
library(knitr)
knit2pdf("income.Rmd", "income.pdf")
```

.
```

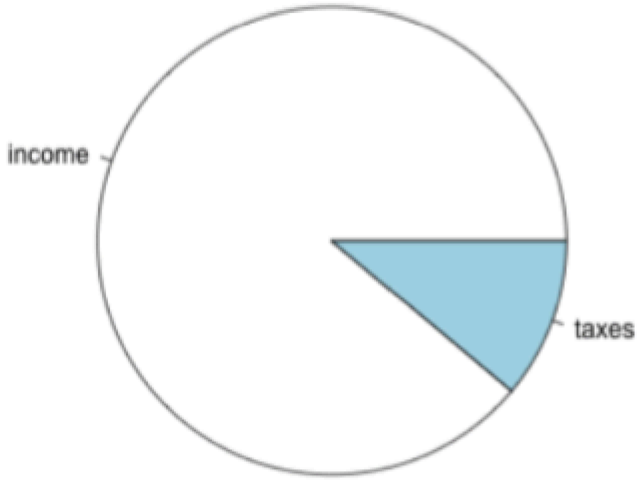
Title

This is **plain markdown** text.

My income is: 1000 dollars and I payed 125 dollars in taxes.

Below is the sum of money I will have left:

```
## [1] 875
```



RMarkdown   : https://riptutorial.com/ko/r/topic/4572/rmarkdown---

22: RMD

YAML	
`toc`	
`number_sections`	
`bibliography`	
`csl`	

- RMD .
- `install.packages("rmarkdown")` R `rmarkdown` .
- Rmarkdown . YAML . `link-citations: true`
- .

MODS	.mods
BibLaTeX	.
BibTeX	.bibtex
RIS	
EndNote	.enl
EndNote XML	.xml
ISI	.wos
MEDLINE	.medline
	.coop
JSON citeproc	.json

Examples

RMD YAML . PDF , (toc) .

```
---
title: "Writing an academic paper in R"
author: "Author"
date: "Date"
```

```
output:
  pdf_document:
    number_sections: yes
toc: yes
bibliography: bibliography.bib
---
```

`bibliography.bib` :

```
@ARTICLE{Meyer2000,
  AUTHOR="Bernd Meyer",
  TITLE="A constraint-based framework for diagrammatic reasoning",
  JOURNAL="Applied Artificial Intelligence",
  VOLUME= "14",
  ISSUE = "4",
  PAGES= "327--344",
  YEAR=2000
}
```

.bib `@` bibkey (: `Meyer2000` .

```
# Introduction

`@Meyer2000` results in @Meyer2000.

`@Meyer2000 [p. 328]` results in @Meyer2000 [p. 328]

`[@Meyer2000]` results in [@Meyer2000]

`[-@Meyer2000]` results in [-@Meyer2000]

# Summary

# References
```

RStudio (Ctrl + Shift + K) `rmarkdown::render("<path-to-your-RMD-file">)` RMD `rmarkdown::render("<path-to-your-RMD-file">)` .

Writing an academic paper in

Author

Date

Contents

1 Introduction

`@Meyer2000` results in Meyer (2000).

`@Meyer2000 [p. 328]` results in Meyer (2000, 328)

`[@Meyer2000]` results in (Meyer 2000)

`[-@Meyer2000]` results in (2000)

2 Summary

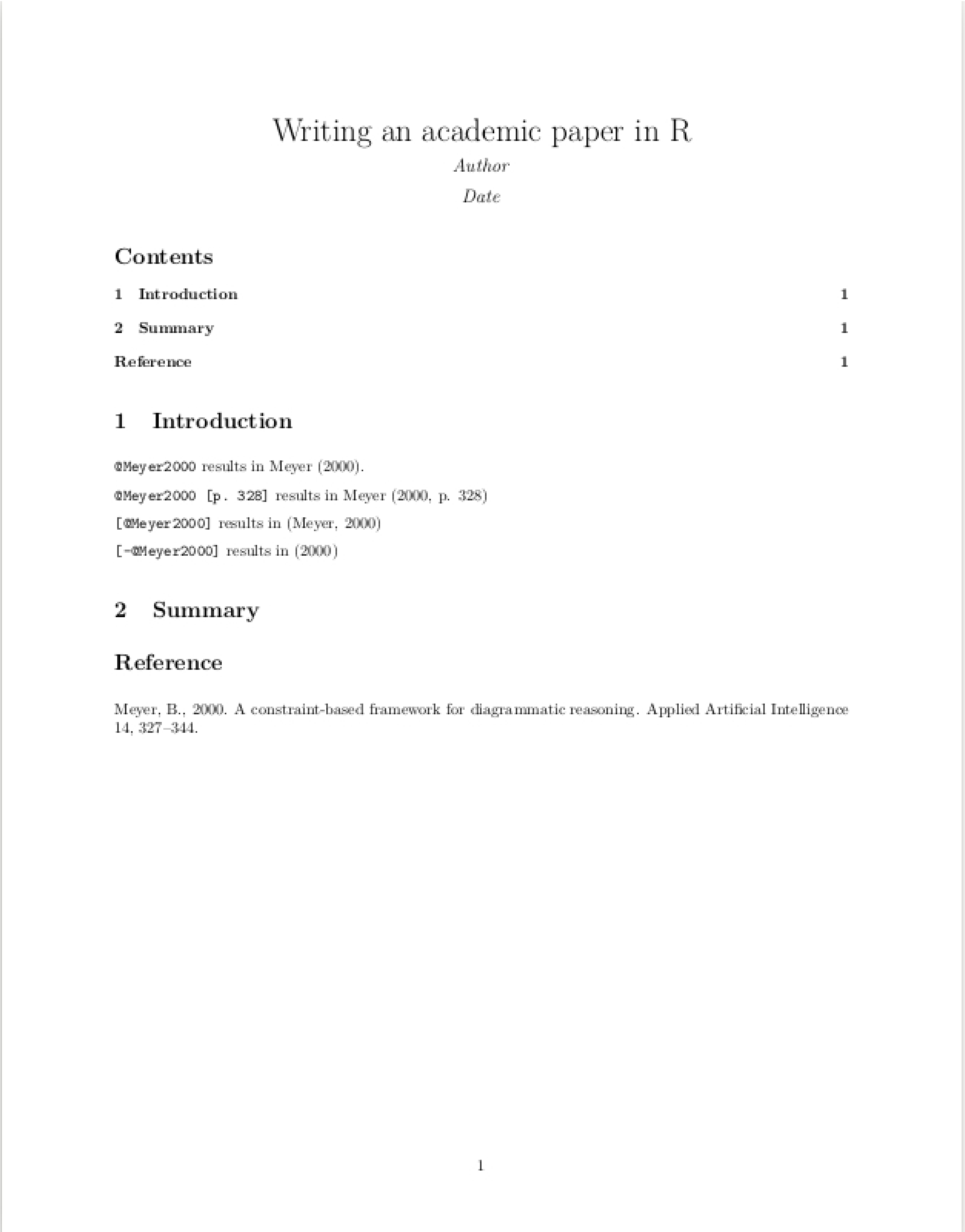
References

Meyer, Bernd. 2000. "A Constraint-Based Framework for Diagrammatic Rea
Intelligence 14 (4): 327–44.

RMD .

.

```
---
title: "Writing an academic paper in R"
author: "Author"
date: "Date"
output:
  pdf_document:
    number_sections: yes
toc: yes
bibliography: bibliography.bib
csl: elsevier-harvard.csl
---

# Introduction

`@Meyer2000` results in @Meyer2000.

`@Meyer2000 [p. 328]` results in @Meyer2000 [p. 328]

`[@Meyer2000]` results in [@Meyer2000]

`[-@Meyer2000]` results in [-@Meyer2000]

# Summary

# Reference
```



Writing an academic paper in R

Author

Date

Contents

1 Introduction

`@Meyer2000` results in Meyer (2000).

`@Meyer2000 [p. 328]` results in Meyer (2000, p. 328)

`[@Meyer2000]` results in (Meyer, 2000)

`[-@Meyer2000]` results in (2000)

2 Summary

Reference

Meyer, B., 2000. A constraint-based framework for diagrammatic reasoning. Applied Artificial Intelligence 14, 327–344.

1

"   " .

RMD   : https://riptutorial.com/ko/r/topic/7606/rmd--

23: RODBC

Examples

RODBC Excel

`RODBC` R RDMS Windows Excel SQL Excel .

```
require(RODBC)
con = odbcConnectExcel("myfile.xlsx") # open a connection to the Excel file
sqlTables(con)$TABLE_NAME # show all sheets
df = sqlFetch(con, "Sheet1") # read a sheet
df = sqlQuery(con, "select * from [Sheet1 $]") # read a sheet (alternative SQL syntax)
close(con) # close the connection to the file
```

SQL Server

RODBC SQL Server . 'Driver', SQL Server, "Atilla" `sqlQuery` .

```
library(RODBC)
cn  <- odbcDriverConnect(connection="Driver={SQL
Server};server=localhost;database=Atilla;trusted_connection=yes;")
tbl <- sqlQuery(cn, 'select top 10 * from table_1')
```

```
library(RODBC)
con <- odbcDriverConnect("driver={Sql Server};server=servername;trusted connection=true")
dat <- sqlQuery(con, "select * from table");
close(con)
```

SQL Server . connectionstrings.com .

databasename.schema.objectname .

RODBC : https://riptutorial.com/ko/r/topic/2471/rodbc

24: R

Examples

R PDF PMF

PMF BINOMIAL

10 . 2 6 ?

dbinom .

```
> dbinom(2, 10, 1/6)
[1] 0.29071
```

POISSON PMF

20 . 18 ?

dpois .

```
> dpois(18, 20)
[1] 0.08439355
```

PDF

5 2 x = 2.5 pdf .

```
> dnorm(2.5, mean=5, sd=2)
[1] 0.09132454
```

R : https://riptutorial.com/ko/r/topic/4333/r--

25: R

Examples

R , , Base . . .

. . :

```
one <- function() { 1 }
one()
[1] 1

two <- function() { 1 + 1 }
two()
[1] 2
```

(`{ }` . , .

. (`vec`) (6) .

```
vec <- 4:9
subtract.length <- function(x) { x - length(x) }
subtract.length(vec)
[1] -2 -1  0  1  2  3
```

`length()` (, *Base*) . .

```
vec2 <- (4:7)/2

msdf <- function(x, multiplier=4) {
    mult <- x * multiplier
    subl <- subtract.length(x)
    data.frame(mult, subl)
}

msdf(vec2, 5)
  mult subl
1 10.0 -2.0
2 12.5 -1.5
3 15.0 -1.0
4 17.5 -0.5
```

`multiplier=4` `multiplier` `4` . `4` .

, (`one` , `two` , `subtract.length`)

. . `*apply` Base .

`data.frame` .

```
df <- data.frame(first=5:9, second=(0:4)^2, third=-1:3)
```

```
apply(df, 2, function(x) { sqrt(sum(x^2)) })
    first    second     third
15.968719 18.814888  3.872983
```

.

```
x <- sample(1:6, 12, replace=TRUE)
mat <- matrix(x, nrow=3)

apply(mat, 1, function(x) { seq(min(x), max(x)) })
```

.

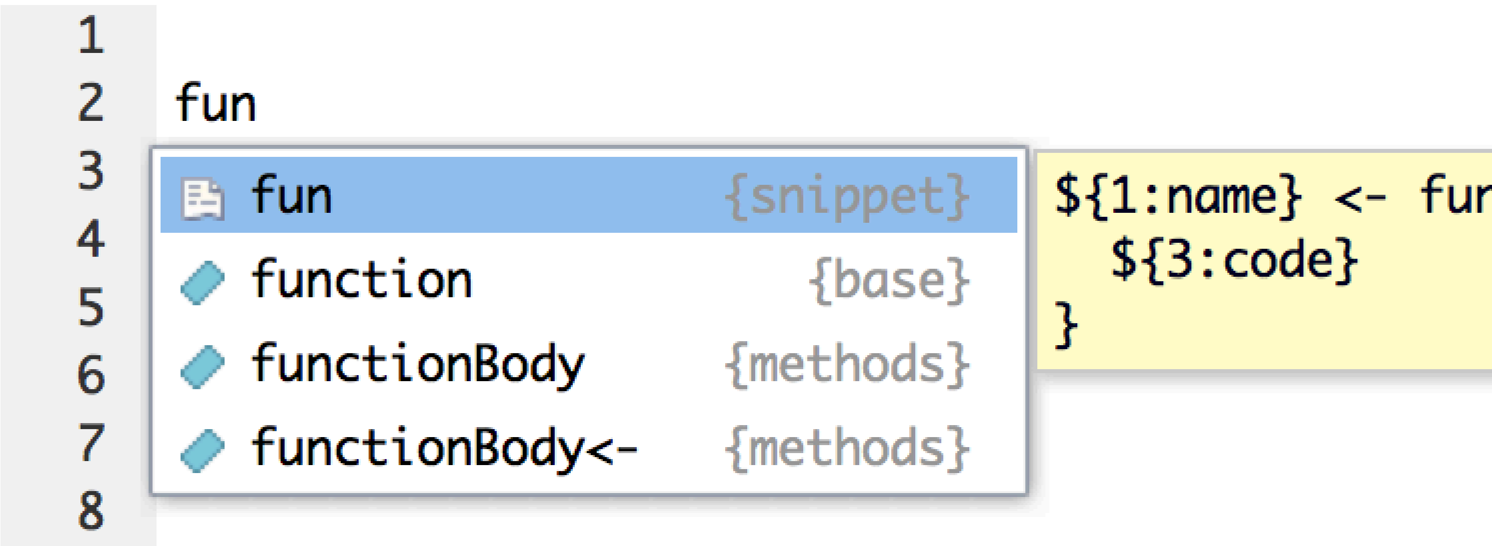
```
(function() { 1 })()
[1] 1
```

~ .

```
f <- function() { 1 })
f()
[1] 1
```

RStudio

.
""RStudio IDE Tab .



.

```
name <- function(variables) {

}
```

.

```
name <- function(df, x, y) {
        require(tidyverse)
        out <-
        return(out)
}
```

`Global Options -> Code Edit Snippets` .

. [[. R .

```
basic.stats <- function(dset, vars){
    for(i in 1:length(vars)){
        print(vars[i])
        print(summary(dset[[vars[i]]]))
    }
}

basic.stats(iris, c("Sepal.Length", "Petal.Width"))
```

, (, 1 , , , 3) R . `dset[[vars[i]]]` `vars` i `dset` . , `iris[["Sepal.Length"]]` `iris` `Sepal.Length` .

R : https://riptutorial.com/ko/r/topic/7937/r--

26: R ODE

- ode (y, times, func, parms, method, ...)

	( ) : ODE ()
	; .
	ODE
	( ) : func
	: lsoda

. "The Lorenz model" "Lorenz"

```
return(list(c(dX, dY, dZ)))
```

.

```
yini <- c(X = 1, Y = 1, Z = 1)
```

Examples

Lorenz X, Y Z . .

$$\frac{dX}{dt} = a \cdot X + Y \cdot Z$$

$$\frac{dY}{dt} = b \cdot (Y - Z)$$

$$\frac{dZ}{dT} = -X \cdot Y + c \cdot Y - Z$$

.

$$X(0) = Y(0) = Z(0) = 1$$

a, b c

$$a = -8/3$$

$$b = -10$$

$$c = 28$$

```
library(deSolve)
```

```r
## -----------------------------------------------------------------------------
## Define R-function
## ----------------------------------------------------------------------------

Lorenz <- function (t, y, parms) {
  with(as.list(c(y, parms)), {
    dX <- a * X + Y * Z
    dY <- b * (Y - Z)
    dZ <- -X * Y + c * Y - Z

    return(list(c(dX, dY, dZ)))
  })
}

## -----------------------------------------------------------------------------
## Define parameters and variables
## -----------------------------------------------------------------------------

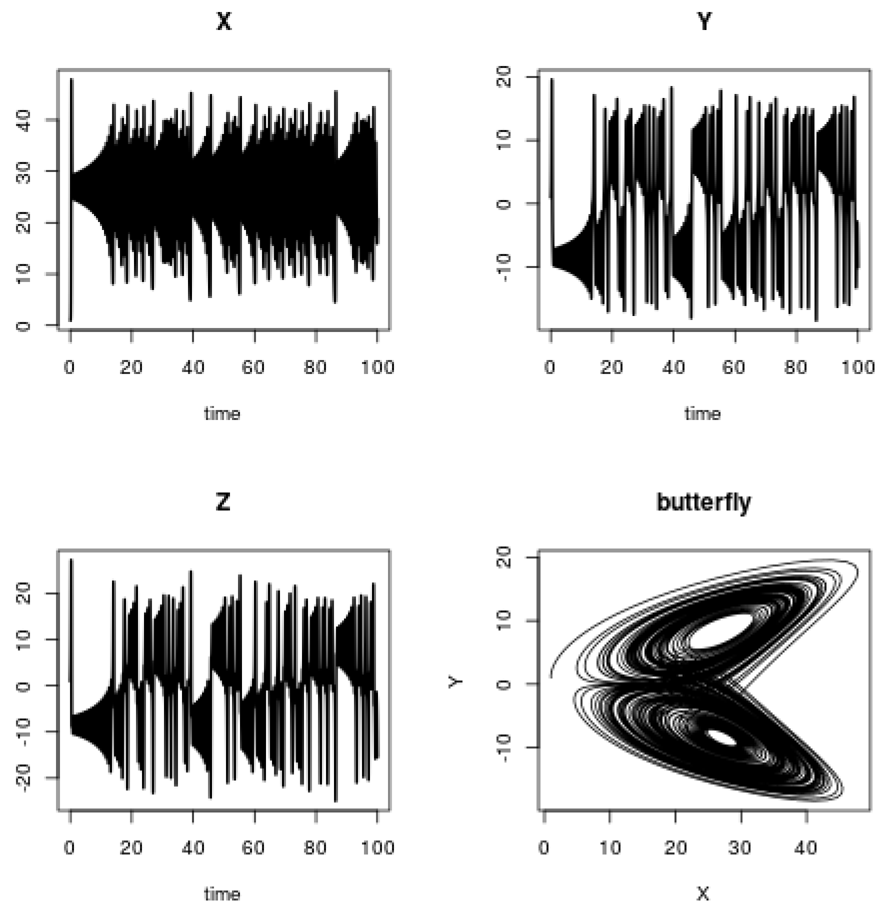
parms <- c(a = -8/3, b = -10, c = 28)
yini <- c(X = 1, Y = 1, Z = 1)
times <- seq(from = 0, to = 100, by = 0.01)


## -----------------------------------------------------------------------------
## Solve the ODEs
## -----------------------------------------------------------------------------

out <- ode(y = yini, times = times, func = Lorenz, parms = parms)

## -----------------------------------------------------------------------------
## Plot the results
## -----------------------------------------------------------------------------

plot(out, lwd = 2)
plot(out[,"X"], out[,"Y"],
     type = "l", xlab = "X",
     ylab = "Y", main = "butterfly")
```



Lotka-Volterra :

```
library(deSolve)

## -----------------------------------------------------------------------------
## Define R-function
## -----------------------------------------------------------------------------

LV <- function(t, y, parms) {
    with(as.list(c(y, parms)), {

        dP <- rG * P * (1 - P/K) - rI * P * C
        dC <- rI * P * C * AE - rM * C

        return(list(c(dP, dC), sum = C+P))
    })
}

## -----------------------------------------------------------------------------
## Define parameters and variables
## -----------------------------------------------------------------------------

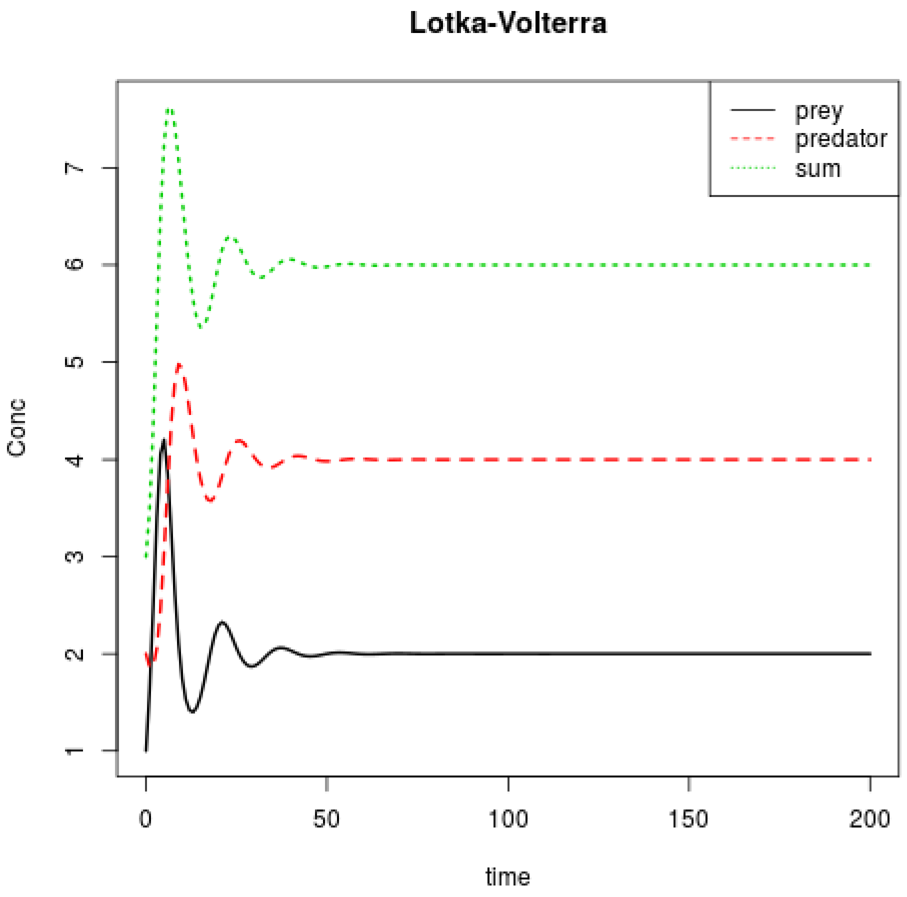
parms <- c(rI = 0.2, rG = 1.0, rM = 0.2, AE = 0.5, K = 10)
yini <- c(P = 1, C = 2)
times <- seq(from = 0, to = 200, by = 1)

## -----------------------------------------------------------------------------
## Solve the ODEs
## -----------------------------------------------------------------------------
```

```
out <- ode(y = yini, times = times, func = LV, parms = parms)

## -----------------------------------------------------------------------------
## Plot the results
## -----------------------------------------------------------------------------

matplot(out[ ,1], out[ ,2:4], type = "l", xlab = "time", ylab = "Conc",
        main = "Lotka-Volterra", lwd = 2)
legend("topright", c("prey", "predator", "sum"), col = 1:3, lty = 1:3)
```



ODE - R

```
library(deSolve)

## -----------------------------------------------------------------------------
## Define parameters and variables
## -----------------------------------------------------------------------------

eps <- 0.01;
M <- 10
k <- M * eps^2/2
L <- 1
L0 <- 0.5
r <- 0.1
w <- 10
g <- 1
```

```
parameter <- c(eps = eps, M = M, k = k, L = L, L0 = L0, r = r, w = w, g = g)

yini <- c(xl = 0, yl = L0, xr = L, yr = L0,
          ul = -L0/L, vl = 0,
          ur = -L0/L, vr = 0,
          lam1 = 0, lam2 = 0)


times <- seq(from = 0, to = 3, by = 0.01)

## -------------------------------------------------------------------------------
## Define R-function
## -------------------------------------------------------------------------------

caraxis_R <- function(t, y, parms) {
  with(as.list(c(y, parms)), {

    yb <- r * sin(w * t)
    xb <- sqrt(L * L - yb * yb)
    Ll <- sqrt(xl^2 + yl^2)
    Lr <- sqrt((xr - xb)^2 + (yr - yb)^2)

    dxl <- ul; dyl <- vl; dxr <- ur; dyr <- vr

    dul  <- (L0-Ll) * xl/Ll      + 2 * lam2 * (xl-xr) + lam1*xb
    dvl  <- (L0-Ll) * yl/Ll      + 2 * lam2 * (yl-yr) + lam1*yb - k * g

    dur  <- (L0-Lr) * (xr-xb)/Lr - 2 * lam2 * (xl-xr)
    dvr  <- (L0-Lr) * (yr-yb)/Lr - 2 * lam2 * (yl-yr) - k * g

    c1   <- xb * xl + yb * yl
    c2   <- (xl - xr)^2 + (yl - yr)^2 - L * L

    return(list(c(dxl, dyl, dxr, dyr, dul, dvl, dur, dvr, c1, c2)))
  })
}
```

ODE - C

```
sink("caraxis_C.c")
cat("
/* suitable names for parameters and state variables */

#include <R.h>
#include <math.h>
static double parms[8];

#define eps parms[0]
#define m   parms[1]
#define k   parms[2]
#define L   parms[3]
#define L0  parms[4]
#define r   parms[5]
#define w   parms[6]
#define g   parms[7]

/*----------------------------------------------------------------------
 initialising the parameter common block
----------------------------------------------------------------------
```

```
*/
void init_C(void (* daeparms)(int *, double *)) {
  int N = 8;
  daeparms(&N, parms);
    }
/* Compartments */

#define xl y[0]
#define yl y[1]
#define xr y[2]
#define yr y[3]
#define lam1 y[8]
#define lam2 y[9]

/*----------------------------------------------------------------------
 the residual function
----------------------------------------------------------------------
*/
void caraxis_C (int *neq, double *t, double *y, double *ydot,
              double *yout, int* ip)
{
  double yb, xb, Lr, Ll;

  yb  = r * sin(w * *t) ;
  xb  = sqrt(L * L - yb * yb);
  Ll  = sqrt(xl * xl + yl * yl) ;
  Lr  = sqrt((xr-xb)*(xr-xb) + (yr-yb)*(yr-yb));

  ydot[0] = y[4];
  ydot[1] = y[5];
  ydot[2] = y[6];
  ydot[3] = y[7];

  ydot[4] = (L0-Ll) * xl/Ll + lam1*xb + 2*lam2*(xl-xr)    ;
  ydot[5] = (L0-Ll) * yl/Ll + lam1*yb + 2*lam2*(yl-yr) - k*g;
  ydot[6] = (L0-Lr) * (xr-xb)/Lr      - 2*lam2*(xl-xr)       ;
  ydot[7] = (L0-Lr) * (yr-yb)/Lr      - 2*lam2*(yl-yr) - k*g   ;

  ydot[8]  = xb * xl + yb * yl;
  ydot[9]  = (xl-xr) * (xl-xr) + (yl-yr) * (yl-yr) - L*L;

}
", fill = TRUE)
sink()
system("R CMD SHLIB caraxis_C.c")
dyn.load(paste("caraxis_C", .Platform$dynlib.ext, sep = ""))
dllname_C <- dyn.load(paste("caraxis_C", .Platform$dynlib.ext, sep = ""))[[1]]
```

ODE - Fortran

```
sink("caraxis_fortran.f")
cat("
c----------------------------------------------------------------
c Initialiser for parameter common block
c----------------------------------------------------------------
       subroutine init_fortran(daeparms)

        external daeparms
        integer, parameter :: N = 8
```

```
        double precision parms(N)
        common /myparms/parms

        call daeparms(N, parms)
        return
        end

c----------------------------------------------------------------
c rate of change
c----------------------------------------------------------------
        subroutine caraxis_fortran(neq, t, y, ydot, out, ip)
        implicit none
        integer          neq, IP(*)
        double precision t, y(neq), ydot(neq), out(*)
        double precision eps, M, k, L, L0, r, w, g
        common /myparms/ eps, M, k, L, L0, r, w, g

        double precision xl, yl, xr, yr, ul, vl, ur, vr, lam1, lam2
        double precision yb, xb, Ll, Lr, dxl, dyl, dxr, dyr
        double precision dul, dvl, dur, dvr, c1, c2

c expand state variables
         xl = y(1)
         yl = y(2)
         xr = y(3)
         yr = y(4)
         ul = y(5)
         vl = y(6)
         ur = y(7)
         vr = y(8)
         lam1 = y(9)
         lam2 = y(10)

         yb = r * sin(w * t)
         xb = sqrt(L * L - yb * yb)
         Ll = sqrt(xl**2 + yl**2)
         Lr = sqrt((xr - xb)**2 + (yr - yb)**2)

         dxl = ul
         dyl = vl
         dxr = ur
         dyr = vr

         dul = (L0-Ll) * xl/Ll      + 2 * lam2 * (xl-xr) + lam1*xb
         dvl = (L0-Ll) * yl/Ll      + 2 * lam2 * (yl-yr) + lam1*yb - k*g
         dur = (L0-Lr) * (xr-xb)/Lr - 2 * lam2 * (xl-xr)
         dvr = (L0-Lr) * (yr-yb)/Lr - 2 * lam2 * (yl-yr) - k*g

         c1  = xb * xl + yb * yl
         c2  = (xl - xr)**2 + (yl - yr)**2 - L * L

c function values in ydot
         ydot(1)  = dxl
         ydot(2)  = dyl
         ydot(3)  = dxr
         ydot(4)  = dyr
         ydot(5)  = dul
         ydot(6)  = dvl
         ydot(7)  = dur
         ydot(8)  = dvr
         ydot(9)  = c1
```

```
        ydot(10) = c2
       return
       end
", fill = TRUE)

sink()
system("R CMD SHLIB caraxis_fortran.f")
dyn.load(paste("caraxis_fortran", .Platform$dynlib.ext, sep = ""))
dllname_fortran <- dyn.load(paste("caraxis_fortran", .Platform$dynlib.ext, sep = ""))[[1]]
```

ODE -

ODE - R ,   ODE -   C ODE - Fortran -   .

```
library(microbenchmark)

R <- function(){
  out <- ode(y = yini, times = times, func = caraxis_R,
             parms = parameter)
}


C <- function(){
  out <- ode(y = yini, times = times, func = "caraxis_C",
             initfunc = "init_C", parms = parameter,
             dllname = dllname_C)
}

fortran <- function(){
  out <- ode(y = yini, times = times, func = "caraxis_fortran",
             initfunc = "init_fortran", parms = parameter,
             dllname = dllname_fortran)
}
```

.

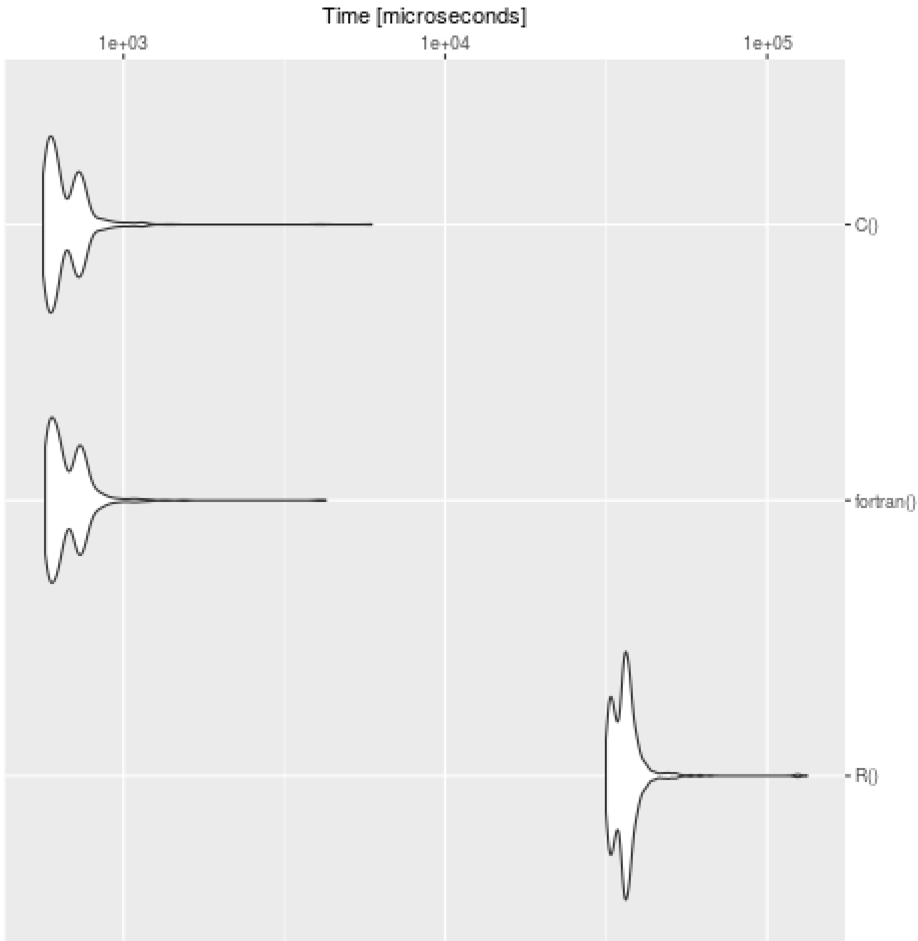
```
all.equal(tail(R()), tail(fortran()))
all.equal(R()[,2], fortran()[,2])
all.equal(R()[,2], C()[,2])
```

(:   ) :

```
bench <- microbenchmark::microbenchmark(
  R(),
  fortran(),
  C(),
  times = 1000
)

summary(bench)

     expr        min        lq       mean     median         uq        max neval cld
      R()  31508.928 33651.541 36747.8733 36062.2475 37546.8025 132996.564  1000   b
fortran()    570.674   596.700   686.1084   637.4605   730.1775   4256.555  1000  a
      C()    562.163   590.377   673.6124   625.0700   723.8460   5914.347  1000  a
```



C R . . `c0de` ODE R C .

R ODE : https://riptutorial.com/ko/r/topic/7448/r-ode--

27: R

R 4 . .

S3, S4, Reference Classes S6.

Examples

S3

S3 R OO .

S3 . `class` get (got?) .

```
> class(3)
[1] "numeric"
```

`class` .

```
> bicycle <- 2
> class(bicycle) <- 'vehicle'
> class(bicycle)
[1] "vehicle"
```

`attr` .

```
> velocipede <- 2
> attr(velocipede, 'class') <- 'vehicle'
> class(velocipede)
[1] "vehicle"
```

.

```
> class(x = bicycle) <- c('human-powered vehicle', class(x = bicycle))
> class(x = bicycle)
[1] "human-powered vehicle" "vehicle"
```

R .

:

```
> summary.vehicle <- function(object, ...) {
+   message('this is a vehicle')
+ }
> summary(object = my_bike)
this is a vehicle
```

`summary.bicycle` .

```
> summary.bicycle <- function(object, ...) {
+   message('this is a bicycle')
+ }
> summary(object = my_bike)
this is a bicycle
```

R : https://riptutorial.com/ko/r/topic/9723/r---

28: R -

Examples

0 0

0 .

.

```
data("GermanCredit")
variances<-apply(GermanCredit, 2, var)
variances[which(variances<=0.0025)]
```

. .

"nearZeroVar (,) . ... "

```
library(caret)
names(GermanCredit)[nearZeroVar(GermanCredit)]
```

NA

.

```
library(VIM)
data(sleep)
colMeans(is.na(sleep))

   BodyWgt    BrainWgt        NonD       Dream       Sleep        Span        Gest
0.00000000 0.00000000 0.22580645 0.19354839 0.06451613 0.06451613 0.06451613
      Pred         Exp      Danger
0.00000000 0.00000000 0.00000000
```

NonD Dream . 20 % ( )

. . :

```
library(purrr) # in order to use keep()

# select correlatable vars
toCorrelate<-mtcars %>% keep(is.numeric)

# calculate correlation matrix
correlationMatrix <- cor(toCorrelate)

# pick only one out of each highly correlated pair's mirror image
correlationMatrix[upper.tri(correlationMatrix)]<-0

# and I don't remove the highly-correlated-with-itself group
```

```
diag(correlationMatrix)<-0

# find features that are highly correlated with another feature at the +- 0.85 level
apply(correlationMatrix,2, function(x) any(abs(x)>=0.85))

  mpg   cyl  disp    hp  drat    wt  qsec    vs    am  gear  carb
 TRUE  TRUE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE
```

MPG , . cyl disp . .

R - : https://riptutorial.com/ko/r/topic/7561/r-------

29: R I / O

Examples

Rds RData (Rda)

`.rds` `.Rdata` (`.rda`) R R . (: `write.table` .

- R .
- R (: ,) .

`saveRDS` / `readRDS` R . .

, .rds `iris` :

```
saveRDS(object = iris, file = "my_data_frame.rds")
```

:

```
iris2 <- readRDS(file = "my_data_frame.rds")
```

`save()` `save()` `.Rdata` .

: 2 :

```
save(iris, cars, file = "myIrisAndCarsData.Rdata")
```

:

```
load("myIrisAndCarsData.Rdata")
```

`save` `load` :

```
save(iris, cars, file = "myIrisAndCarsData.Rdata", envir = foo  <- new.env())
load("myIrisAndCarsData.Rdata", envir = foo)
foo$cars

save(iris, cars, file = "myIrisAndCarsData.Rdata", envir = foo  <- new.env())
load("myIrisAndCarsData.Rdata", envir = foo)
foo$cars
```

R I / O : https://riptutorial.com/ko/r/topic/5540/r----i---o

30: R

Examples

RCurl

imdb   .

```
R> library(RCurl)
R> library(XML)
R> url <- "http://www.imdb.com/chart/top"
R> top <- getURL(url)
R> parsed_top <- htmlParse(top, encoding = "UTF-8")
R> top_table <- readHTMLTable(parsed_top)[[1]]
R> head(top_table[1:10, 1:3])


Rank & Title IMDb Rating
1 1. The Shawshank Redemption (1994) 9.2
2 2. The Godfather (1972) 9.2
3 3. The Godfather: Part II (1974) 9.0
4 4. The Dark Knight (2008) 8.9
5 5. Pulp Fiction (1994) 8.9
6 6. The Good, the Bad and the Ugly (1966) 8.9
7 7. Schindler's List (1993) 8.9
8 8. 12 Angry Men (1957) 8.9
9 9. The Lord of the Rings: The Return of the King (2003) 8.9
10 10. Fight Club (1999) 8.8
```

R   : https://riptutorial.com/ko/r/topic/4336/r--

31: R

R . R `?regex` . ICU .

Examples

`grep`

```
# General syntax:
# grep(<pattern>, <character vector>)

mystring <- c('The number 5',
              'The number 8',
              '1 is the loneliest number',
              'Company, 3 is',
              'Git SSH tag is git@github.com',
              'My personal site is www.personal.org',
              'path/to/my/file')

grep('5', mystring)
# [1] 1
grep('@', mystring)
# [1] 5
grep('number', mystring)
# [1] 1 2 3
```

`x|y` "x" "y" .

```
grep('5|8', mystring)
# [1] 1 2
grep('com|org', mystring)
# [1] 5 6
```

`.` Regex . " "

```
grep('The number .', mystring)
# [1] 1 2
```

!

```
tricky <- c('www.personal.org', 'My friend is a cyborg')
grep('.org', tricky)
# [1] 1 2
```

(`\`) . R ( ).

```
grep('\.org', tricky)
# Error: '\.' is an unrecognized escape in character string starting "'\."
grep('\\.org', tricky)
# [1] 1
```

(`[]`) .

```
grep('[13]', mystring)
# [1] 3 4
grep('[@/]', mystring)
# [1] 5 7
```

. `[0-4]` 0, 1, 2, 3 4 `[AZ]` `[Az]` `[A-z0-9]` ( )

```
grep('[0-4]', mystring)
# [1] 3 4
grep('[A-Z]', mystring)
# [1] 1 2 4 5 6
```

R . `[:lower:]` `az` , `[:upper:]` `AZ` , `[:alpha:]` `Az` , `[:digit:]` `0-9` , `[:alnum:]` `A-z0-9` . . `[[:digit:]]` ( ). `[@[:digit:]/]` `@` , `/` `0-9` .

```
grep('[[:digit:]]', mystring)
# [1] 1 2 3 4
grep('[@[:digit:]/]', mystring)
# [1] 1 2 3 4 5 7
```

(`^`) . , `[^5]` "5" .

```
grep('The number [^5]', mystring)
# [1] 2
```

R : https://riptutorial.com/ko/r/topic/9743/r---

32: S4

GOF Java (OOP) (" ").

R , S4 Object System .

Examples

R S4 Class State Machine .

(`";"`) . : `Name;[Address;]Phone` . , . .

```
GREGORY BROWN; 25 NE 25TH; +1-786-987-6543
DAVID SMITH;786-123-4567
ALAN PEREZ; 25 SE 50TH; +1-786-987-5553
```

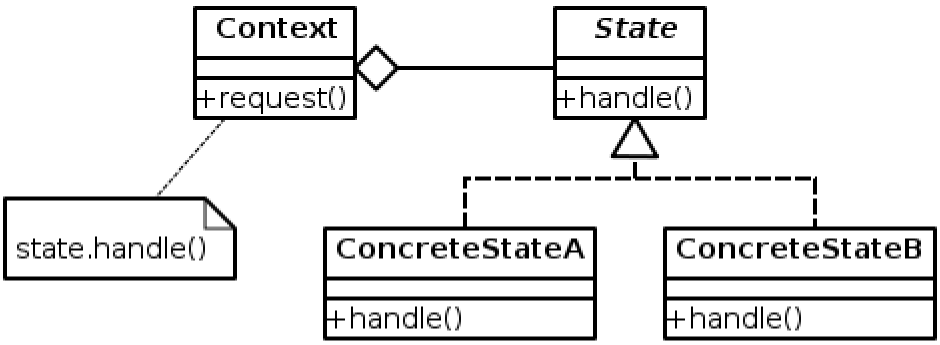
. , . . . :

- : `"^([AZ]'?\\s+)* *[AZ]+(\\s+[AZ]{1,2}\\.?,? +)*[AZ]+((-|\\s+)[AZ]+)*$"` . : `RAFAEL REAL, DAVID R. SMITH, ERNESTO PEREZ GONZALEZ, O' CONNOR BROWN, LUIS PEREZ-MENA`
- : `"^\\s[0-9]{1,4}(\\s+[AZ]{1,2}[0-9]{1,2}[AZ]{1,2}|[AZ\\s0-9]+)$"` . : `11020 LE JEUNE ROAD` , `87 SW 27TH` . , , .
- : `"^\\s*(\\+1(-|\\s+))*[0-9]{3}(-|\\s+)[0-9]{3}(-|\\s+)[0-9]{4}$"` . : `305-123-4567, 305 123 4567, +1-786-123-4567` .

:

- , .
- R `"\"` .
- regex101.com . .

. State () (State Pattern).



.

- `Context` : , . (`handle()`), (`handle()` `State`) . . `Context` .
  - : `state`
  - : `handle()` , ...

- `State` : . . .
  - : `name, pattern`
  - : `doAction()` , `isState` (`pattern`), ...
- `Concrete States` ( ) : `Context` `State` . `InitState` , `NameState` , `AddressState` , `PhoneState` .
  . .

: action, `handle()` , `doAction()` `goNext()` . `doAction()` `Context` `handle()` (`State` `Context`) .

S4 Person .

```
setClass(Class = "Person",
    slots = c(name = "character", address = "character", phone = "character")
)
```

. `setClass` `prototype, representation` `"initialize"` .

```
setMethod("initialize", "Person",
  definition = function(.Object, name = NA_character_,
    address = NA_character_, phone = NA_character_) {
        .Object@name <- name
        .Object@address <- address
        .Object@phone <- phone
        .Object
    }
)
```

initialize `methods` . R .

```
> initialize
```

. .

```
function (.Object, ...) {...}
```

`setMethod` *exaclty* (`.Object`) .

`show` , Java `toString()` .

```
setMethod("show", signature = "Person",
  definition = function(object) {
      info <- sprintf("%s@[name='%s', address='%s', phone='%s']",
        class(object), object@name, object@address, object@phone)
      cat(info)
      invisible(NULL)
  }
)
```

: `toString()` Java .

(`Person`) R (:). ( ).

```
setGeneric(name = "as.list", signature = c('x'),
    def = function(x) standardGeneric("as.list"))

# Suggestion taken from here:
# http://stackoverflow.com/questions/30386009/how-to-extend-as-list-in-a-canonical-way-to-s4-objects
setMethod("as.list", signature = "Person",
    definition = function(x) {
        mapply(function(y) {
        #apply as.list if the slot is again an user-defined object
        #therefore, as.list gets applied recursively
        if (inherits(slot(x,y),"Person")) {
          as.list(slot(x,y))
        } else {
          #otherwise just return the slot
          slot(x,y)
        }
      },
        slotNames(class(x)),
        SIMPLIFY=FALSE)
    }
)
```

R OO . Statisticians . 1) (`setGeneric`) 2) (`setMethod`) . .

S4 , `State` .

```
setClass(Class = "State", slots = c(name = "character", pattern = "character"))

setMethod("initialize", "State",
  definition = function(.Object, name = NA_character_, pattern = NA_character_) {
      .Object@name <- name
      .Object@pattern <- pattern
      .Object
  }
)

setMethod("show", signature = "State",
  definition = function(object) {
      info <- sprintf("%s@[name='%s', pattern='%s']", class(object),
          object@name, object@pattern)
      cat(info)
      invisible(NULL)
  }
)

setGeneric(name = "isState", signature = c('obj', 'input'),
    def = function(obj, input) standardGeneric("isState"))

setGeneric(name = "doAction", signature = c('obj', 'input', 'context'),
    def = function(obj, input, context) standardGeneric("doAction"))
```

`State` `name` `pattern` (`isState()`) (`doAction()` `doAction()`).

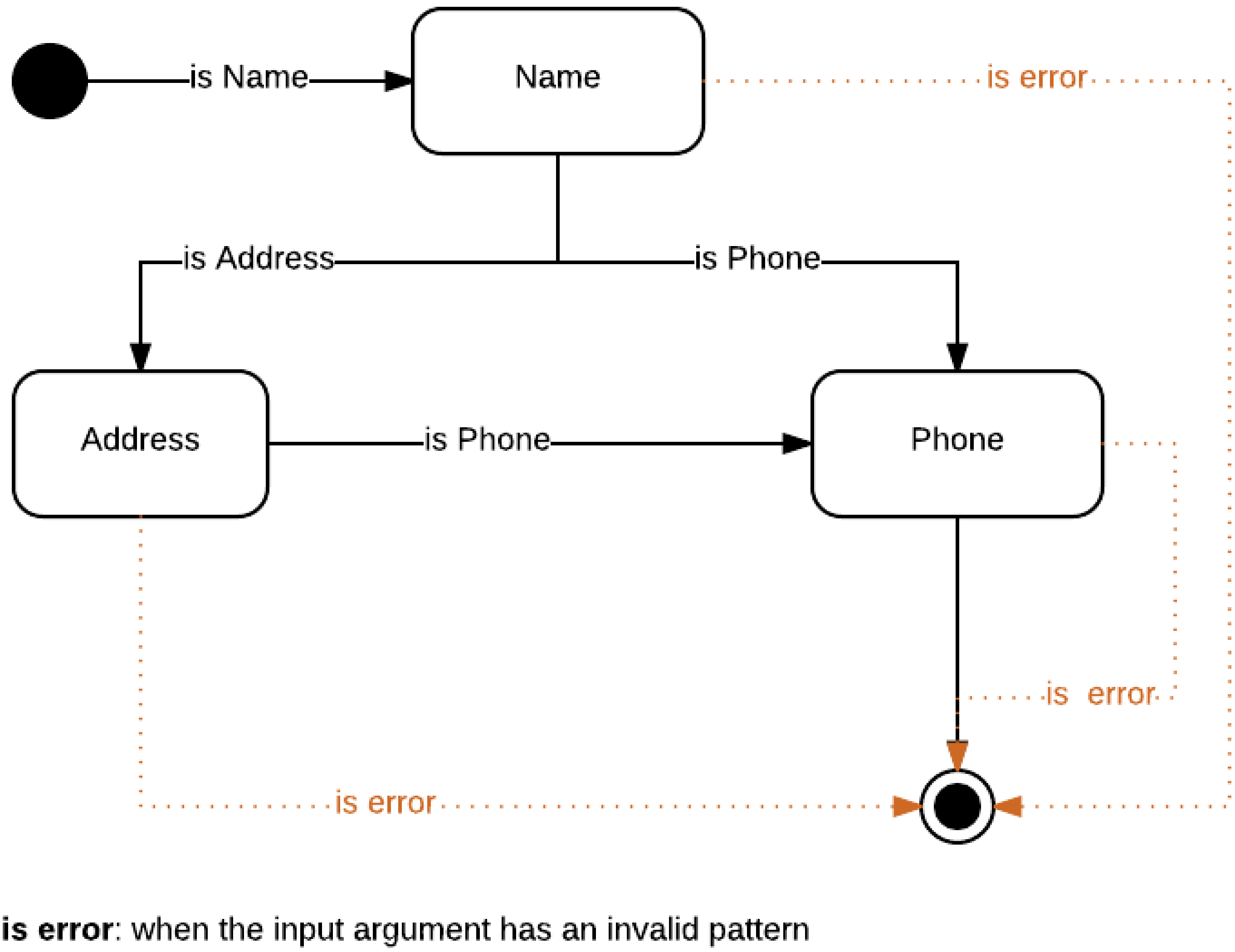
.

/

/				

: [row, col]=[i,j] i j .

Name ( ) . UML State Machine .



State

:

.

```
setClass("InitState", contains = "State")

setMethod("initialize", "InitState",
  definition = function(.Object, name = "init", pattern = NA_character_) {
      .Object@name <- name
      .Object@pattern <- pattern
      .Object
```

```
    }
)

setMethod("show", signature = "InitState",
  definition = function(object) {
      callNextMethod()
  }
)
```

R `contains` .

`show` `callNextMethod()`).

. `NA` .

`State` .

```
setMethod(f = "isState", signature = "InitState",
  definition = function(obj, input) {
      nameState <- new("NameState")
      result <- isState(nameState, input)
      return(result)
  }
)
```

(`pattern`), `name` , .

```
setMethod(f = "doAction", signature = "InitState",
    definition = function(obj, input, context) {
        nameState <- new("NameState")
        if (isState(nameState, input)) {
            person <- context@person
            person@name <- trimws(input)
            context@person <- person
            context@state <- nameState
        } else {
            msg <- sprintf("The input argument: '%s' cannot be identified", input)
            stop(msg)
        }
        return(context)
    }
)
```

`doAction` . `@-operator` . `get/set` `get/set` (OO :), `get-set` .

`doAction` .

.

```
setClass ("NameState", contains = "State")

setMethod("initialize","NameState",
  definition=function(.Object, name="name",
        pattern = "^([A-Z]'?\\s+)* *[A-Z]+(\\s+[A-Z]{1,2}\\.?,? +)*[A-Z]+((-|\\s+)[A-Z]+)*$")
{
        .Object@pattern <- pattern
```

```
        .Object@name <- name
        .Object
  }
)

setMethod("show", signature = "NameState",
  definition = function(object) {
      callNextMethod()
  }
)
```

`grepl` .

```
setMethod(f="isState", signature="NameState",
  definition=function(obj, input) {
      result <- grepl(obj@pattern, input, perl=TRUE)
      return(result)
  }
)
```

.

```
setMethod(f = "doAction", signature = "NameState",
  definition=function(obj, input, context) {
      addressState <- new("AddressState")
      phoneState <- new("PhoneState")
      person <- context@person
      if (isState(addressState, input)) {
          person@address <- trimws(input)
          context@person <- person
          context@state <- addressState
      } else if (isState(phoneState, input)) {
          person@phone <- trimws(input)
          context@person <- person
          context@state <- phoneState
      } else {
          msg <- sprintf("The input argument: '%s' cannot be identified", input)
          stop(msg)
      }
      return(context)
  }
)
```

. . .

- `person` : `address` `phone` .
- `state`

`isState()` . (`addressState, phoneState`) .

( ) .

```
setClass("AddressState", contains = "State")

setMethod("initialize", "AddressState",
  definition = function(.Object, name="address",
```

```
    pattern = "^\\s[0-9]{1,4}(\\s+[A-Z]{1,2}[0-9]{1,2}[A-Z]{1,2}|[A-Z\\s0-9]+)$") {
        .Object@pattern <- pattern
        .Object@name <- name
        .Object
    }
)

setMethod("show", signature = "AddressState",
  definition = function(object) {
      callNextMethod()
  }
)

setMethod(f="isState", signature="AddressState",
    definition=function(obj, input) {
        result <- grepl(obj@pattern, input, perl=TRUE)
        return(result)
    }
)

setMethod(f = "doAction", "AddressState",
    definition=function(obj, input, context) {
        phoneState <- new("PhoneState")
        if (isState(phoneState, input)) {
            person <- context@person
            person@phone <- trimws(input)
            context@person <- person
            context@state <- phoneState
        } else {
            msg <- sprintf("The input argument: '%s' cannot be identified", input)
            stop(msg)
        }
        return(context)
    }
)
```

```
setClass("PhoneState", contains = "State")

setMethod("initialize", "PhoneState",
  definition = function(.Object, name = "phone",
    pattern = "^\\s*(\\+1(-|\\s+))*[0-9]{3}(-|\\s+)[0-9]{3}(-|\\s+)[0-9]{4}$") {
        .Object@pattern <- pattern
        .Object@name <- name
        .Object
    }
)

setMethod("show", signature = "PhoneState",
  definition = function(object) {
      callNextMethod()
  }
)

setMethod(f = "isState", signature = "PhoneState",
    definition = function(obj, input) {
        result <- grepl(obj@pattern, input, perl = TRUE)
        return(result)
    }
)
```

context persons .

```
setMethod(f = "doAction", "PhoneState",
    definition = function(obj, input, context) {
        context <- addPerson(context, context@person)
        context@state <- new("InitState")
        return(context)
    }
)
```

Context . .

```
setClass(Class = "Context",
     slots = c(state = "State", persons = "list", person = "Person")
)
```

- state :
- person : .
- persons : .

: name name .

```
setMethod(f="initialize", signature="Context",
  definition = function(.Object) {
        .Object@state <- new("InitState")
        .Object@persons <- list()
        .Object@person <- new("Person")
        return(.Object)
    }
)

setMethod("show", signature = "Context",
  definition = function(object) {
      cat("An object of class ", class(object), "\n", sep = "")
      info <- sprintf("[state='%s', persons='%s', person='%s']", object@state,
          toString(object@persons), object@person)
      cat(info)
      invisible(NULL)
  }
)

setGeneric(name = "handle", signature = c('obj', 'input', 'context'),
    def = function(obj, input, context) standardGeneric("handle"))

setGeneric(name = "addPerson", signature = c('obj', 'person'),
    def = function(obj, person) standardGeneric("addPerson"))

setGeneric(name = "parseLine", signature = c('obj', 's'),
    def = function(obj, s) standardGeneric("parseLine"))

setGeneric(name = "parseLines", signature = c('obj', 's'),
    def = function(obj, s) standardGeneric("parseLines"))

setGeneric(name = "as.df", signature = c('obj'),
    def = function(obj) standardGeneric("as.df"))
```

.

- handle() : state doAction() .
- addPerson : persons person .
- parseLine() : .
- parseLines() : ()
- as.df() : persons .

.

handle() context state doAction() .

```
setMethod(f = "handle", signature = "Context",
    definition = function(obj, input) {
        obj <- doAction(obj@state, input, obj)
        return(obj)
    }
)

setMethod(f = "addPerson", signature = "Context",
  definition = function(obj, person) {
      obj@persons <- c(obj@persons, person)
      return(obj)
  }
)
```

, R- strsplit() . handle() (state , person , persons) context .

```
setMethod(f = "parseLine", signature = "Context",
  definition = function(obj, s) {
      elements <- strsplit(s, ";")[[1]]
      # Adding an empty field for considering the end state.
      elements <- c(elements, "")
      n <- length(elements)
      input <- NULL
      for (i in (1:n)) {
        input <- elements[i]
        obj <- handle(obj, input)
      }
      return(obj@person)
  }
)
```

R , (obj) :

```
setMethod(f = "parseLines", signature = "Context",
  definition = function(obj, s) {
      n <- length(s)
      listOfPersons <- list()
      for (i in (1:n)) {
          ipersons <- parseLine(obj, s[i])
          listOfPersons[[i]] <- ipersons
      }
      obj@persons <- listOfPersons
      return(obj)
  }
```

```
)
```

persons S4 Person . R . as.list Person . persons , lapply() . lappy() , data.frame persons.list . rbind() ( )

```
# Sugestion taken from this post:
# http://stackoverflow.com/questions/4227223/r-list-to-data-frame
setMethod(f = "as.df", signature = "Context",
  definition = function(obj) {
    persons <- obj@persons
    persons.list <- lapply(persons, as.list)
    persons.ds <- do.call(rbind, lapply(persons.list, data.frame, stringsAsFactors = FALSE))
    return(persons.ds)
  }
)
```

. .

```
s <- c(
    "GREGORY BROWN; 25 NE 25TH; +1-786-987-6543",
    "DAVID SMITH;786-123-4567",
     "ALAN PEREZ; 25 SE 50TH; +1-786-987-5553"
)
```

context .

```
context <- new("Context")
context <- parseLines(context, s)
```

.

```
df <- as.df(context)
> df
           name    address           phone
1 GREGORY BROWN 25 NE 25TH +1-786-987-6543
2   DAVID SMITH       <NA>    786-123-4567
3    ALAN PEREZ 25 SE 50TH +1-786-987-5553
```

show .

```
> show(context@persons[[1]])
Person@[name='GREGORY BROWN', address='25 NE 25TH', phone='+1-786-987-6543']
```

:

```
>show(new("PhoneState"))
PhoneState@[name='phone', pattern='^\s*(\+1(-|\s+))*[0-9]{3}(-|\s+)[0-9]{3}(-|\s+)[0-9]{4}$']
```

as.list() .

```
> as.list(context@persons[[1]])
$name
```

```
[1] "GREGORY BROWN"

$address
[1] "25 NE 25TH"

$phone
[1] "+1-786-987-6543"

>
```

OO R State . R OO OOP . . . : `object.setID("A1")` Java / C # R `setID(object, "A1")` . . `this` `"."` . (`"Person"` , `"isState"`) .

S4 Java / C # . , State Pattern . . `if-else` , `State` `if-else` .

: .

.

S4 : https://riptutorial.com/ko/r/topic/9126/s4------

33: sqldf

Examples

`sqldf()` `sqldf` R. SQL SQLite .

`ggplot2` "diamonds" 10 .

```
data("diamonds")
head(diamonds)
```

```
# A tibble: 6 x 10
  carat       cut color clarity depth table price     x     y     z
  <dbl>     <ord> <ord>   <ord> <dbl> <dbl> <int> <dbl> <dbl> <dbl>
1  0.23     Ideal     E     SI2  61.5    55   326  3.95  3.98  2.43
2  0.21   Premium     E     SI1  59.8    61   326  3.89  3.84  2.31
3  0.23      Good     E     VS1  56.9    65   327  4.05  4.07  2.31
4  0.29   Premium     I     VS2  62.4    58   334  4.20  4.23  2.63
5  0.31      Good     J     SI2  63.3    58   335  4.34  4.35  2.75
6  0.24 Very Good     J    VVS2  62.8    57   336  3.94  3.96  2.48
```

```
require(sqldf)
sqldf("select * from diamonds limit 10")
```

```
   carat       cut color clarity depth table price    x    y    z
1   0.23     Ideal     E     SI2  61.5    55   326 3.95 3.98 2.43
2   0.21   Premium     E     SI1  59.8    61   326 3.89 3.84 2.31
3   0.23      Good     E     VS1  56.9    65   327 4.05 4.07 2.31
4   0.29   Premium     I     VS2  62.4    58   334 4.20 4.23 2.63
5   0.31      Good     J     SI2  63.3    58   335 4.34 4.35 2.75
6   0.24 Very Good     J    VVS2  62.8    57   336 3.94 3.96 2.48
7   0.24 Very Good     I    VVS1  62.3    57   336 3.95 3.98 2.47
8   0.26 Very Good     H     SI1  61.9    55   337 4.07 4.11 2.53
9   0.22      Fair     E     VS2  65.1    61   337 3.87 3.78 2.49
10  0.23 Very Good     H     VS1  59.4    61   338 4.00 4.05 2.39
```

"E" 10 .

```
sqldf("select * from diamonds where color = 'E' limit 10")
```

```
   carat       cut color clarity depth table price    x    y    z
1   0.23     Ideal     E     SI2  61.5    55   326 3.95 3.98 2.43
2   0.21   Premium     E     SI1  59.8    61   326 3.89 3.84 2.31
3   0.23      Good     E     VS1  56.9    65   327 4.05 4.07 2.31
4   0.22      Fair     E     VS2  65.1    61   337 3.87 3.78 2.49
5   0.20   Premium     E     SI2  60.2    62   345 3.79 3.75 2.27
6   0.32   Premium     E      I1  60.9    58   345 4.38 4.42 2.68
7   0.23 Very Good     E     VS2  63.8    55   352 3.85 3.92 2.48
8   0.23 Very Good     E     VS1  60.7    59   402 3.97 4.01 2.42
9   0.23 Very Good     E     VS1  59.5    58   402 4.01 4.06 2.40
10  0.23      Good     E     VS1  64.1    59   402 3.83 3.85 2.46
```

SQL "" " ( ).

1 .

```
sqldf("select count(*) from diamonds where carat > 1 and color = 'E'")
```

```
  count(*)
1     1892
```

.

```
sqldf("select *, count(*) as cnt_big_E_colored_stones from diamonds where carat > 1 and color
= 'E' group by clarity")
```

```
  carat       cut color clarity depth table price    x    y    z
cnt_big_E_colored_stones
1  1.30      Fair     E      I1  66.5    58  2571 6.79 6.75 4.50
65
2  1.28     Ideal     E      IF  60.7    57 18700 7.09 6.99 4.27
28
3  2.02 Very Good     E     SI1  59.8    59 18731 8.11 8.20 4.88
499
4  2.03   Premium     E     SI2  61.5    59 18477 8.24 8.16 5.04
666
5  1.51     Ideal     E     VS1  61.5    57 18729 7.34 7.40 4.53
158
6  1.72 Very Good     E     VS2  63.4    56 18557 7.65 7.55 4.82
318
7  1.20     Ideal     E    VVS1  61.8    56 16256 6.78 6.87 4.22
52
8  1.55     Ideal     E    VVS2  62.5    55 18188 7.38 7.40 4.62
106
```

, `cut` `price` ?

```
sqldf("select cut,  max(price) from diamonds group by cut")

        cut max(price)
1      Fair      18574
2      Good      18788
3     Ideal      18806
4   Premium      18823
5 Very Good      18818
```

sqldf : https://riptutorial.com/ko/r/topic/2100/sqldf

34: stringi

.

```
install.packages("stringi")
```

:

```
require("stringi")
```

Examples

```
stri_count_fixed("babab", "b")
# [1] 3
stri_count_fixed("babab", "ba")
# [1] 2
stri_count_fixed("babab", "bab")
# [1] 1
```

:

```
length(gregexpr("b","babab")[[1]])
# [1] 3
length(gregexpr("ba","babab")[[1]])
# [1] 2
length(gregexpr("bab","babab")[[1]])
# [1] 1
```

.

```
stri_count_fixed("babab", c("b","ba"))
# [1] 3 2
stri_count_fixed(c("babab","bbb","bca","abc"), c("b","ba"))
# [1] 3 0 1 0
```

R :

```
sapply(c("b","ba"),function(x)length(gregexpr(x,"babab")[[1]]))
# b ba
# 3  2
```

- `a`

- `a`

```
stri_count_regex("a1 b2 a3 b4 aa", "a.")
# [1] 3
stri_count_regex("a1 b2 a3 b4 aa", "a\\d")
# [1] 2
```

```
stri_dup("abc",3)
# [1] "abcabcabc"
```

R .

```
paste0(rep("abc",3),collapse = "")
# [1] "abcabcabc"
```

```
stri_paste(LETTERS,"-", 1:13)
# [1] "A-1"  "B-2"  "C-3"  "D-4"  "E-5"  "F-6"  "G-7"  "H-8"  "I-9"  "J-10" "K-11" "L-12" "M-
13"
# [14] "N-1"  "O-2"  "P-3"  "Q-4"  "R-5"  "S-6"  "T-7"  "U-8"  "V-9"  "W-10" "X-11" "Y-12" "Z-
13"
```

R .

```
> paste(LETTERS,1:13,sep="-")
 #[1] "A-1"  "B-2"  "C-3"  "D-4"  "E-5"  "F-6"  "G-7"  "H-8"  "I-9"  "J-10" "K-11" "L-12" "M-
13"
 #[14] "N-1"  "O-2" "P-3"  "Q-4"  "R-5"  "S-6"  "T-7"  "U-8"  "V-9"  "W-10" "X-11" "Y-12" "Z-
13"
```

.

```
stri_split_fixed(c("To be or not to be.", "This is very short sentence.")," ")
# [[1]]
# [1] "To"  "be"  "or"  "not" "to"  "be."
#
# [[2]]
# [1] "This"      "is"        "very"      "short"     "sentence."
```

.

```
stri_split_fixed("Apples, oranges and pineaplles.",c(" ", ",", "s"))
# [[1]]
# [1] "Apples,"     "oranges"     "and"         "pineaplles."
#
# [[2]]
# [1] "Apples"                   " oranges and pineaplles."
#
# [[3]]
# [1] "Apple"          ", orange"       " and pineaplle" "."
```

stringi : https://riptutorial.com/ko/r/topic/1670/stringi---

35: strsplit

- strsplit (
-
-
- =
- perl = FALSE
- useBytes = FALSE)

Examples

`strsplit` . R data.frame .

`strsplit` : :

```
temp <- c("this,that,other", "hat,scarf,food", "woman,man,child")
# get a list split by commas
myList <- strsplit(temp, split=",")
# print myList
myList
[[1]]
[1] "this"  "that"  "other"

[[2]]
[1] "hat"   "scarf" "food"

[[3]]
[1] "woman" "man"   "child"
```

split . , temp2 temp . .

```
temp2 <- c("this, that, other", "hat,scarf ,food", "woman; man ; child")
myList2 <- strsplit(temp2, split=" ?[,;] ?")
myList2
[[1]]
[1] "this"  "that"  "other"

[[2]]
[1] "hat"   "scarf" "food"

[[3]]
[1] "woman" "man"   "child"
```

:

1. .
2. . R , R .

strsplit : https://riptutorial.com/ko/r/topic/2762/strsplit-

36: texreg   .

texreg ( )   . HTML .doc (MS Office Word)   .

-

Examples

```
# models
fit1 <- lm(mpg ~ wt, data = mtcars)
fit2 <- lm(mpg ~ wt+hp, data = mtcars)
fit3 <- lm(mpg ~ wt+hp+cyl, data = mtcars)

# export to html
texreg::htmlreg(list(fit1,fit2,fit3),file='models.html')


# export to doc
texreg::htmlreg(list(fit1,fit2,fit3),file='models.doc')
```

.

	Model 1	Model 2	Model 3
(Intercept)	37.29***	37.23***	38.75***
	(1.88)	(1.60)	(1.79)
wt	-5.34***	-3.88***	-3.17***
	(0.56)	(0.63)	(0.74)
hp		-0.03**	-0.02
		(0.01)	(0.01)
cyl			-0.94
			(0.55)
R^2	0.75	0.83	0.84
Adj. R^2	0.74	0.81	0.83
Num. obs.	32	32	32
RMSE	3.05	2.59	2.51

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Statistical models

`texreg::htmlreg()`   .   .

```
# export to html
texreg::htmlreg(list(fit1,fit2,fit3),file='models.html',
                single.row = T,
                custom.model.names = LETTERS[1:3],
                leading.zero = F,
                digits = 3)
```

.

	A	B	C
(Intercept)	37.285 (1.878)***	37.227 (1.599)***	38.752 (1.787)***
wt	-5.344 (0.559)***	-3.878 (0.633)***	-3.167 (0.741)***
hp		-0.032 (0.009)**	-0.018 (0.012)
cyl			-0.942 (0.551)
R^2	0.753	0.827	0.843
Adj. R^2	0.745	0.815	0.826
Num. obs.	32	32	32
RMSE	3.046	2.593	2.512

***p < 0.001, **p < 0.01, *p < 0.05

Statistical models

texreg . : https://riptutorial.com/ko/r/topic/9037/texreg-------

37: tidyr

: tidyr `gather` ( ) `spread` ().

.

Examples

spread ()

```
library(tidyr)

## example data
set.seed(123)
df <- data.frame(
  name = rep(c("firstName", "secondName"), each=4),
  numbers = rep(1:4, 2),
  value = rnorm(8)
)
df
#         name numbers       value
# 1  firstName       1 -0.56047565
# 2  firstName       2 -0.23017749
# 3  firstName       3  1.55870831
# 4  firstName       4  0.07050839
# 5 secondName       1  0.12928774
# 6 secondName       2  1.71506499
# 7 secondName       3  0.46091621
# 8 secondName       4 -1.26506123
```

" "" .

```
spread(data = df,
       key = numbers,
       value = value)
#      name          1          2         3           4
# 1  firstName -0.5604756 -0.2301775 1.5587083  0.07050839
# 2 secondName  0.1292877  1.7150650 0.4609162 -1.26506123
```

" .

```
spread(data = df,
       key = name,
       value = value)
#   numbers   firstName secondName
# 1       1 -0.56047565  0.1292877
# 2       2 -0.23017749  1.7150650
# 3       3  1.55870831  0.4609162
# 4       4  0.07050839 -1.2650612
```

gather ()

```
library(tidyr)

## example data
df <- read.table(text ="  numbers  firstName secondName
1       1  1.5862639  0.4087477
2       2  0.1499581  0.9963923
3       3  0.4117353  0.3740009
4       4 -0.4926862  0.4437916", header = T)
df
#   numbers  firstName secondName
# 1       1  1.5862639  0.4087477
# 2       2  0.1499581  0.9963923
# 3       3  0.4117353  0.3740009
# 4       4 -0.4926862  0.4437916
```

'numbers' .

```
gather(data = df,
       key = numbers,
       value = myValue)
#   numbers    numbers    myValue
# 1       1  firstName  1.5862639
# 2       2  firstName  0.1499581
# 3       3  firstName  0.4117353
# 4       4  firstName -0.4926862
# 5       1 secondName  0.4087477
# 6       2 secondName  0.9963923
# 7       3 secondName  0.3740009
# 8       4 secondName  0.4437916
```

tidyr : https://riptutorial.com/ko/r/topic/9195/tidyr--

38: xgboost

Examples

xgboost

```
library(caret) # for dummyVars
library(RCurl) # download https data
library(Metrics) # calculate errors
library(xgboost) # model

###############################################################################
# Load data from UCI Machine Learning Repository (http://archive.ics.uci.edu/ml/datasets.html)
urlfile <- 'https://archive.ics.uci.edu/ml/machine-learning-databases/adult/adult.data'
x <- getURL(urlfile, ssl.verifypeer = FALSE)
adults <- read.csv(textConnection(x), header=F)

# adults <-read.csv('https://archive.ics.uci.edu/ml/machine-learning-
databases/adult/adult.data', header=F)
names(adults)=c('age','workclass','fnlwgt','education','educationNum',
                'maritalStatus','occupation','relationship','race',
                'sex','capitalGain','capitalLoss','hoursWeek',
                'nativeCountry','income')
# clean up data
adults$income <- ifelse(adults$income==' <=50K',0,1)
# binarize all factors
library(caret)
dmy <- dummyVars(" ~ .", data = adults)
adultsTrsf <- data.frame(predict(dmy, newdata = adults))
###############################################################################

# what we're trying to predict adults that make more than 50k
outcomeName <- c('income')
# list of features
predictors <- names(adultsTrsf)[!names(adultsTrsf) %in% outcomeName]

# play around with settings of xgboost - eXtreme Gradient Boosting (Tree) library
# https://github.com/tqchen/xgboost/wiki/Parameters
# max.depth - maximum depth of the tree
# nrounds - the max number of iterations

# take first 10% of the data only!
trainPortion <- floor(nrow(adultsTrsf)*0.1)

trainSet <- adultsTrsf[ 1:floor(trainPortion/2),]
testSet <- adultsTrsf[(floor(trainPortion/2)+1):trainPortion,]

smallestError <- 100
for (depth in seq(1,10,1)) {
        for (rounds in seq(1,20,1)) {

                # train
                bst <- xgboost(data = as.matrix(trainSet[,predictors]),
                               label = trainSet[,outcomeName],
                               max.depth=depth, nround=rounds,
                               objective = "reg:linear", verbose=0)
                gc()
```

```
                # predict
                predictions <- predict(bst, as.matrix(testSet[,predictors]),
outputmargin=TRUE)
                err <- rmse(as.numeric(testSet[,outcomeName]), as.numeric(predictions))

                if (err < smallestError) {
                        smallestError = err
                        print(paste(depth,rounds,err))
                }
        }
}

cv <- 30
trainSet <- adultsTrsf[1:trainPortion,]
cvDivider <- floor(nrow(trainSet) / (cv+1))

smallestError <- 100
for (depth in seq(1,10,1)) {
        for (rounds in seq(1,20,1)) {
                totalError <- c()
                indexCount <- 1
                for (cv in seq(1:cv)) {
                        # assign chunk to data test
                        dataTestIndex <- c((cv * cvDivider):(cv * cvDivider + cvDivider))
                        dataTest <- trainSet[dataTestIndex,]
                        # everything else to train
                        dataTrain <- trainSet[-dataTestIndex,]

                        bst <- xgboost(data = as.matrix(dataTrain[,predictors]),
                                       label = dataTrain[,outcomeName],
                                       max.depth=depth, nround=rounds,
                                       objective = "reg:linear", verbose=0)
                        gc()
                        predictions <- predict(bst, as.matrix(dataTest[,predictors]),
outputmargin=TRUE)

                        err <- rmse(as.numeric(dataTest[,outcomeName]),
as.numeric(predictions))
                        totalError <- c(totalError, err)
                }
                if (mean(totalError) < smallestError) {
                        smallestError = mean(totalError)
                        print(paste(depth,rounds,smallestError))
                }
        }
}

###########################################################################
# Test both models out on full data set

trainSet <- adultsTrsf[ 1:trainPortion,]

# assign everything else to test
testSet <- adultsTrsf[(trainPortion+1):nrow(adultsTrsf),]

bst <- xgboost(data = as.matrix(trainSet[,predictors]),
               label = trainSet[,outcomeName],
               max.depth=4, nround=19, objective = "reg:linear", verbose=0)
pred <- predict(bst, as.matrix(testSet[,predictors]), outputmargin=TRUE)
rmse(as.numeric(testSet[,outcomeName]), as.numeric(pred))
```

```
bst <- xgboost(data = as.matrix(trainSet[,predictors]),
               label = trainSet[,outcomeName],
               max.depth=3, nround=20, objective = "reg:linear", verbose=0)
pred <- predict(bst, as.matrix(testSet[,predictors]), outputmargin=TRUE)
rmse(as.numeric(testSet[,outcomeName]), as.numeric(pred))
```

xgboost : https://riptutorial.com/ko/r/topic/3239/xgboost

39:

(: as.numeric, as.data.frame) R .

Examples

R . ,

```
x = 1:3
x
[1] 1 2 3
typeof(x)
#[1] "integer"

x[2] = "hi"
x
#[1] "1"  "hi" "3"
typeof(x)
#[1] "character"
```

`x` `integer` `integer` . `x[2] = "hi"` , R `x` `character` .

: https://riptutorial.com/ko/r/topic/9793/

40:

Examples

: / . ! @DataTx " " . (:-)) .

R ("" " ") `nlme` ( ) `lme4` ( ). .

```
library(nlme)
library(lme4)
m1.nlme <- lme(Reaction~Days,random=~Days|Subject,data=sleepstudy,method="REML")
m1.lme4 <- lmer(Reaction~Days+(Days|Subject),data=sleepstudy,REML=TRUE)
all.equal(fixef(m1.nlme),fixef(m1.lme4))
## [1] TRUE
```

:

- .
- `nlme` *S-PLUS* Pinheiro Bates 2000 *Mixed-effects* (`vignette("lmer",package="lme4")` 2015 *Journal of Statistical Software* / `vignette("lmer",package="lme4")` `lme4`)
- `lme4` .
- `nlme` (P) - `lme4` `lmerTest` `afex`
- `nlme` (/ /) .

GLMM FAQ (GLMM) .

: https://riptutorial.com/ko/r/topic/3460/---

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Examples

XY

R ,   .

XY   . XY   f} .

rgdal sp   . R Spatial*DataFrame (* Points , Lines Polygons) .

OpenGeocode   .

CSV   . rgdal .

```
setwd("D:/GeocodeExample/")
library(rgdal)
```

CSV data.frame R.

```
xy <- read.csv("worldcities.csv", stringsAsFactors = FALSE)
```

(: ,)   .

```
head(xy)
str(xy)
```

"-33.532"   .   SpatialPointsDataFrame()   numeric .   .

```
xy$latitude <- as.numeric(xy$latitude)
xy$longitude <- as.numeric(xy$longitude)
```

NA . .

```
xy <- xy[!is.na(xy$longitude),]
```

XY   .   (CRS) .

```
xySPoints <- SpatialPointsDataFrame(coords = c(xy[,c("longitude", "latitude")]),
proj4string = CRS("+proj=longlat +ellps=WGS84 +datum=WGS84 +no_defs"),
data = xy
)
```

.

```
plot(xySPoints, pch = ".")
```

(.shp)

rgdal

ESRI shape `rgdal` `rgdal` `readOGR()` R .

```
library(rgdal)
shp <- readORG(dsn = "/path/to/your/file", layer = "filename")
```

`dsn` / `layer` (: `.shp`) .

shapefile `raster` `shapefile` .

```
library(raster)
shp <- shapefile("path/to/your/file.shp")
```

rgdal import .

`tmap` `rgdal::readORG` .

```
library(tmap)
sph <- read_shape("path/to/your/file.shp")
```

: https://riptutorial.com/ko/r/topic/2093/-

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Examples

R Wilkinson-Rogers [1] .

Linear Regressions `lm` `formula` . `formula` .

```
my_formula1 <- formula(mpg ~ wt)
class(my_formula1)
# gives "formula"

mod1 <- lm(my_formula1, data = mtcars)
coef(mod1)
# gives (Intercept)          wt
#         37.285126   -5.344472
```

~ (LHS) (RHS) . `formula` `formula` .

```
form <- mpg ~ wt
class(form)
#[1] "formula"
```

`formula` ~ .

```
form_mt <- formula(mpg ~ wt, env = mtcars)
```

`wt` () . `0` `-1` `formula` .

```
coef(lm(mpg ~ 0 + wt, data = mtcars))
coef(lm(mpg ~ wt -1, data = mtcars))
```

`a` `b` `a:b` `formula` :

```
 coef(lm(mpg ~ wt:vs, data = mtcars))
```

`formula` `a + b + a:b` . `a*b` . `*` .

```
coef(lm(mpg ~ wt*vs, data = mtcars))
```

`*` .

```
coef(lm(mpg ~ wt*vs*hp, data = mtcars))
```

7 . 3 , , .

3 . - .

```
coef(lm(mpg ~ wt*vs*hp - wt:vs:hp, data = mtcars))
```

^ .

```
coef(lm(mpg ~ (wt + vs + hp) ^ 2, data = mtcars))
```

.

. . `data` (LHS) . :

```
coef(lm(mpg ~ ., data = mtcars))
```

10 . . . (`?update.formula` `?update.formula`).

1. GN Wilkinson CE Rogers. . *C ( )* Vol. 22, No.3 (1973), pp. 392-399

, 2 2

y ~ . . y . . `y ~ var1 + var2 + var3+...+var15`

y ~ . ^ 2 ( ) 2 . `y ~ var1 + var2 + ...+var15 + var1:var2 + var1:var3 + var1:var4...and so on`

y ~ var1 + var2 + ...+var15 + I(var1^2) + I(var2^2) + I(var3^2)...+I(var15^2) : `I(var^2)` 2 .

y ~ poly(var1, degree = 2) + poly(var2, degree = 2)+...poly(var15, degree = 2)

y ~ poly(var1, var2, var3, ...var15, degree = 2) .

`poly(var1, degree = 2)` `var1 + I(var1^2)` .

3 `poly()` `degree = 3` .

`poly` `I(var, 2)` . `I(var, 2)` `poly()` `poly()` .

, 2 2 .

y ~ .^2 + I(var1^2) + I(var2^2)+...I(var15^2)

4 :

```
old <- reformulate( 'y ~ x1+x2+x3+x4' )
new <- reformulate( " y ~ .^2 + I(x1^2) + I(x2^2) + I(x3^2) + I(x4^2) ")
tmp <- .Call(stats:::C_updateform, old, new)
terms.formula(tmp, simplify = TRUE )

# ~y ~ x1 + x2 + x3 + x4 + I(x1^2) + I(x2^2) + I(x3^2) + I(x4^2) +
#   x1:x2 + x1:x3 + x1:x4 + x2:x3 + x2:x4 + x3:x4
# attr(,"variables")
# list(~y, x1, x2, x3, x4, I(x1^2), I(x2^2), I(x3^2), I(x4^2))
# attr(,"factors")
#         x1 x2 x3 x4 I(x1^2) I(x2^2) I(x3^2) I(x4^2) x1:x2 x1:x3 x1:x4 x2:x3 x2:x4 x3:x4
# ~y       0  0  0  0       0       0       0       0     0     0     0     0     0     0
```

```
# x1        1  0  0  0        0        0        0        0      1      1      1      0      0      0
# x2        0  1  0  0        0        0        0        0      1      0      0      1      1      0
# x3        0  0  1  0        0        0        0        0      0      1      0      1      0      1
# x4        0  0  0  1        0        0        0        0      0      0      1      0      1      1
# I(x1^2)   0  0  0  0        1        0        0        0      0      0      0      0      0      0
# I(x2^2)   0  0  0  0        0        1        0        0      0      0      0      0      0      0
# I(x3^2)   0  0  0  0        0        0        1        0      0      0      0      0      0      0
# I(x4^2)   0  0  0  0        0        0        0        1      0      0      0      0      0      0
# attr(,"term.labels")
# [1] "x1"      "x2"      "x3"      "x4"      "I(x1^2)" "I(x2^2)" "I(x3^2)" "I(x4^2)"
# [9] "x1:x2"   "x1:x3"   "x1:x4"   "x2:x3"   "x2:x4"   "x3:x4"
# attr(,"order")
# [1] 1 1 1 1 1 1 1 1 2 2 2 2 2 2
# attr(,"intercept")
# [1] 1
# attr(,"response")
# [1] 1
# attr(,".Environment")
# <environment: R_GlobalEnv>
```

: https://riptutorial.com/ko/r/topic/1061/

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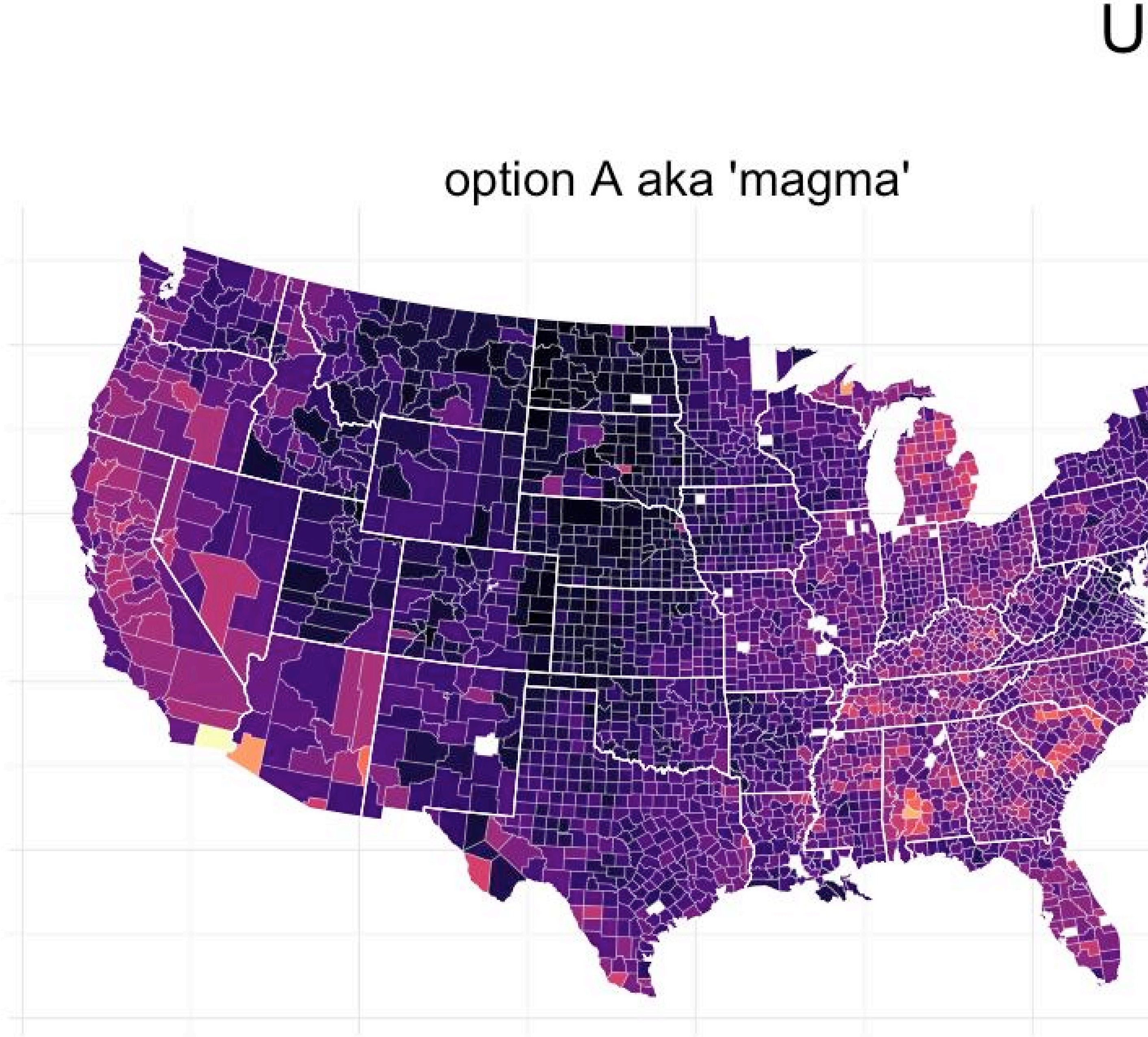
Examples

viridis -

Viridis (chromis viridis fish) Python `matplotlib` ( ). `R` .

`magma` , `plasma` , `inferno` `viridis` 4 (). `option` `A` , `B` , `C` `D` . 4 .


U
option A aka 'magma'


option C aka 'plasma'

(souce)

CRAN github .

---

viridis .

---

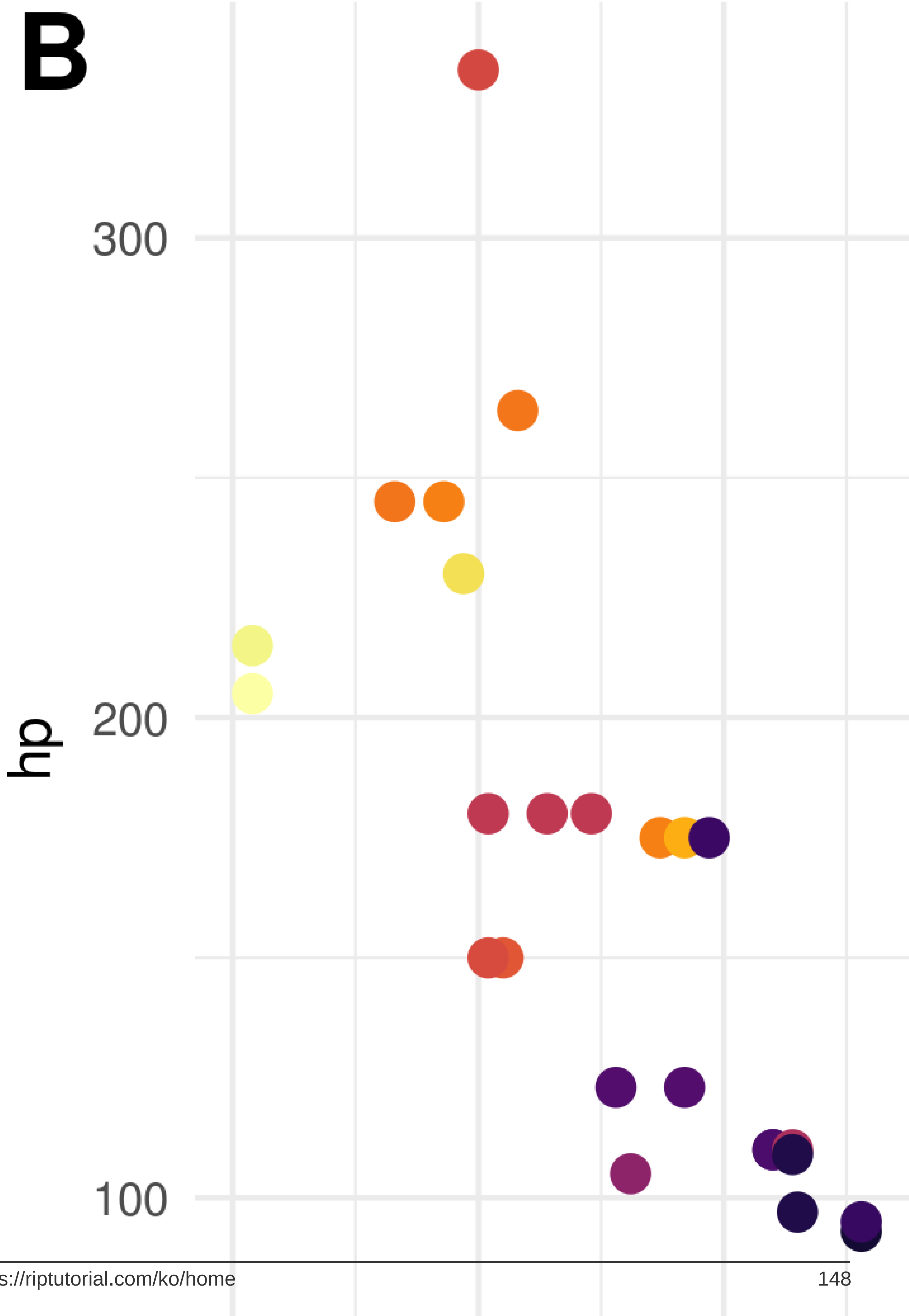
viridis ggplot2 . ggplot2 scale_color_viridis() scale_fill_viridis() . .

```
library(viridis)
library(ggplot2)

gg1 <- ggplot(mtcars)+
    geom_point(aes(x = mpg, y = hp, color = disp), size = 3)+
    scale_color_viridis(option = "B")+
    theme_minimal()+
    theme(legend.position = c(.8,.8))

gg2 <- ggplot(mtcars)+
        geom_violin(aes(x = factor(cyl), y = hp, fill = factor(cyl)))+
        scale_fill_viridis(discrete = T)+
        theme_minimal()+
        theme(legend.position = 'none')

library(cowplot)
output <- plot_grid(gg1,gg2, labels = c('B','D'),label_size = 20)
print(output)
```


B
300
200
100
hp

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Examples

Random Forest (Breiman, L. (2001), Random Forests, *Machine Learning 45 (5)* , 5-32).
`randomForest` Breiman Fortran R .

`iris` `factor` R . .

```
library(randomForest)

rf <- randomForest(x = iris[, 1:4],
                   y = iris$Species,
                   ntree = 500,
                   do.trace = 100)

rf

# Call:
#   randomForest(x = iris[, 1:4], y = iris$Species, ntree = 500,      do.trace = 100)
# Type of random forest: classification
# Number of trees: 500
# No. of variables tried at each split: 2
#
# OOB estimate of  error rate: 4%
# Confusion matrix:
#   setosa versicolor virginica class.error
# setosa         50          0         0        0.00
# versicolor      0         47         3        0.06
# virginica       0          3        47        0.06
```

	. `factor` .
ntree	CART
do.trace	,

: https://riptutorial.com/ko/r/topic/8326/-

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Examples

R `Map` , `Reduce` , `Filter` , `Find` , `Position` , `Negate` .

`Map` .

```
words <- list("this", "is", "an", "example")
Map(toupper, words)
```

`Reduce` 2 .

```
Reduce(`*`, 1:10)
```

`Filter` TRUE .

```
Filter(is.character, list(1,"a",2,"b",3,"c"))
```

`Find` TRUE .

```
Find(is.character, list(1,"a",2,"b",3,"c"))
```

`Position` TRUE .

```
Position(is.character, list(1,"a",2,"b",3,"c"))
```

`Negate` TRUE FALSE TRUE .

```
is.noncharacter <- Negate(is.character)
is.noncharacter("a")
is.noncharacter(mean)
```

: https://riptutorial.com/ko/r/topic/5050/-

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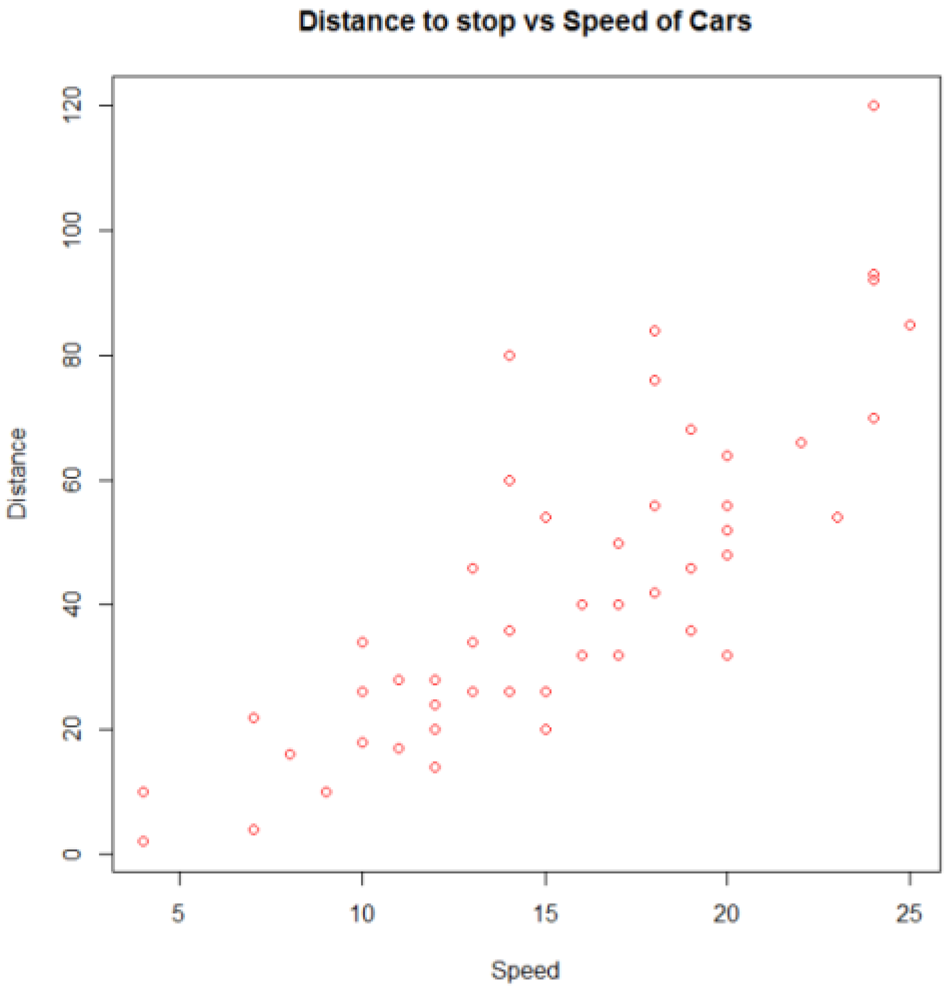
x	X . data$variablex data[,x]
y	y . data$variabley data[,y]
main	
sub	
xlab	X
ylab	y
pch	
col	
type	. "p" , "l" , "b" , "c" "b" , "o" 'overplotted' "h" ' histogram' (") , "s" , "S" , "n"

" " par . par . .

Examples

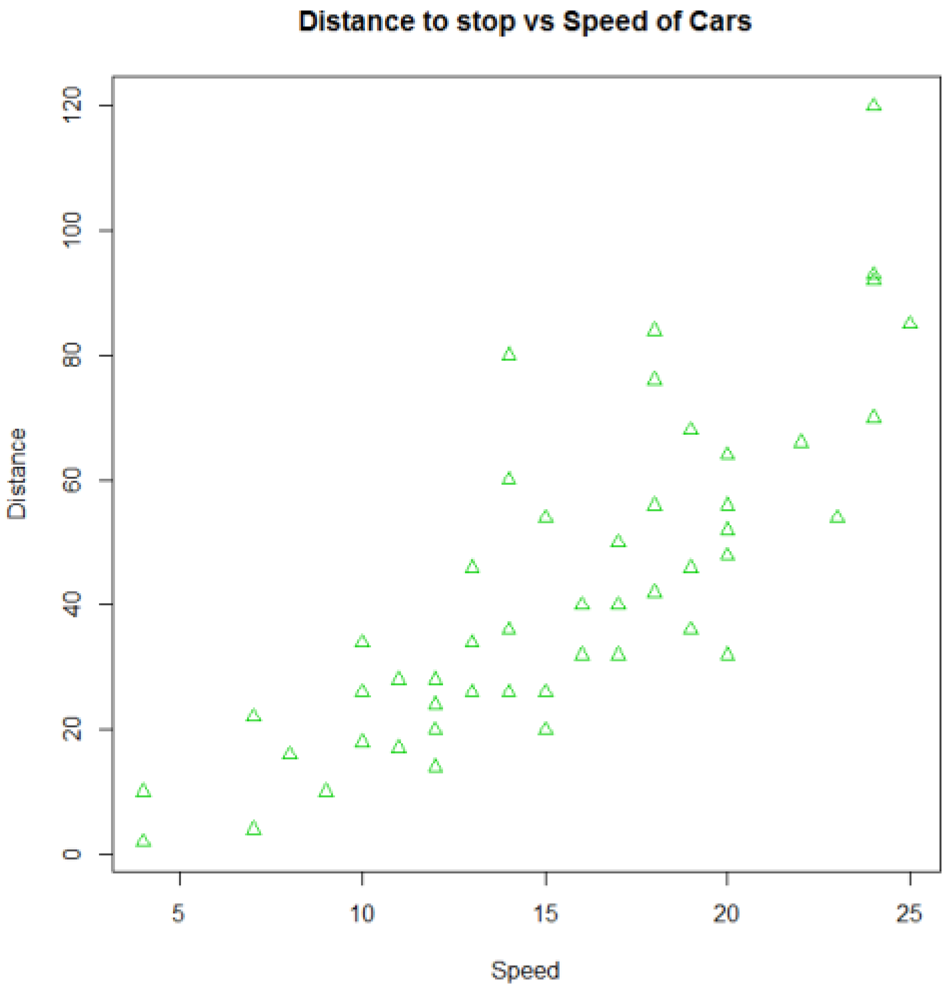
plot() . cars 1920 cars . (()).

```
plot(x = cars$speed, y = cars$dist, pch = 1, col = 1,
     main = "Distance vs Speed of Cars",
     xlab = "Speed", ylab = "Distance")
```



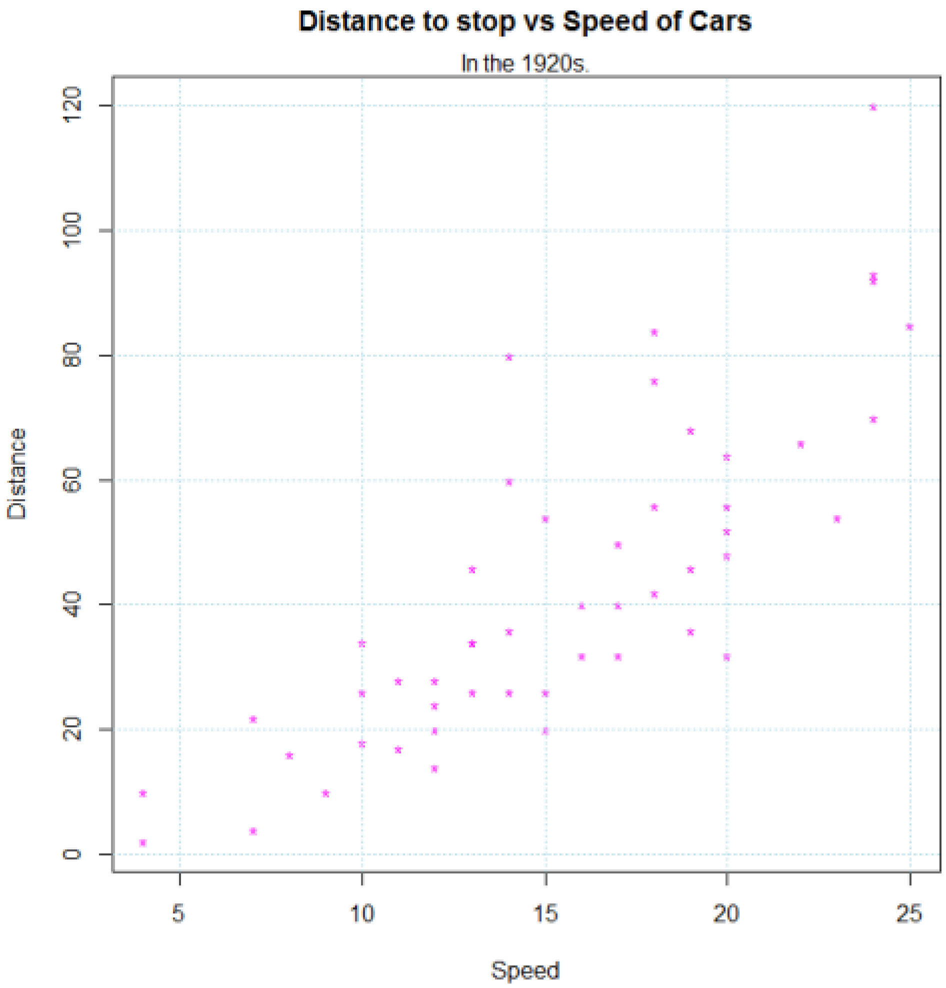
.   .

```
with(cars, plot(dist~speed, pch = 2, col = 3,
     main = "Distance to stop vs Speed of Cars",
     xlab = "Speed", ylab = "Distance"))
```



points() , text() , mtext() , lines() , grid() .

```
plot(dist~speed, pch = "*", col = "magenta", data=cars,
     main = "Distance to stop vs Speed of Cars",
     xlab = "Speed", ylab = "Distance")
mtext("In the 1920s.")
grid(,col="lightblue")
```



Matplot

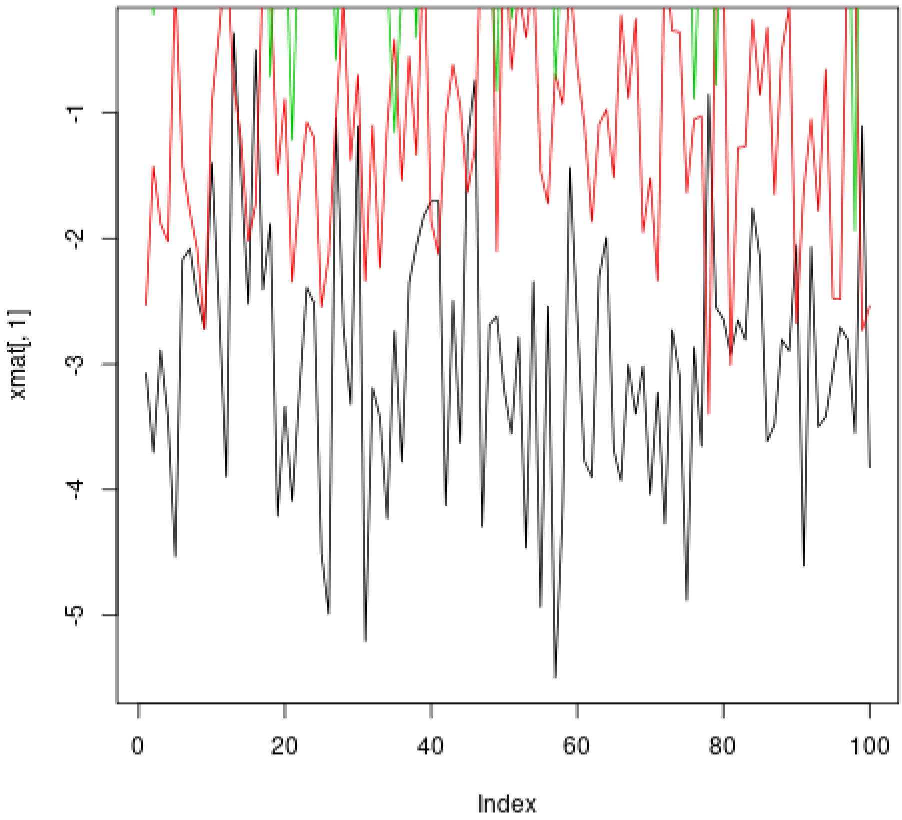
`matplot` ( ) .

. .

```
xmat <- cbind(rnorm(100, -3), rnorm(100, -1), rnorm(100, 1), rnorm(100, 3))
head(xmat)
#           [,1]        [,2]       [,3]     [,4]
# [1,] -3.072793 -2.53111494  0.6168063 3.780465
# [2,] -3.702545 -1.42789347 -0.2197196 2.478416
# [3,] -2.890698 -1.88476126  1.9586467 5.268474
# [4,] -3.431133 -2.02626870  1.1153643 3.170689
# [5,] -4.532925  0.02164187  0.9783948 3.162121
# [6,] -2.169391 -1.42699116  0.3214854 4.480305
```

`plot` `points` `lines` .

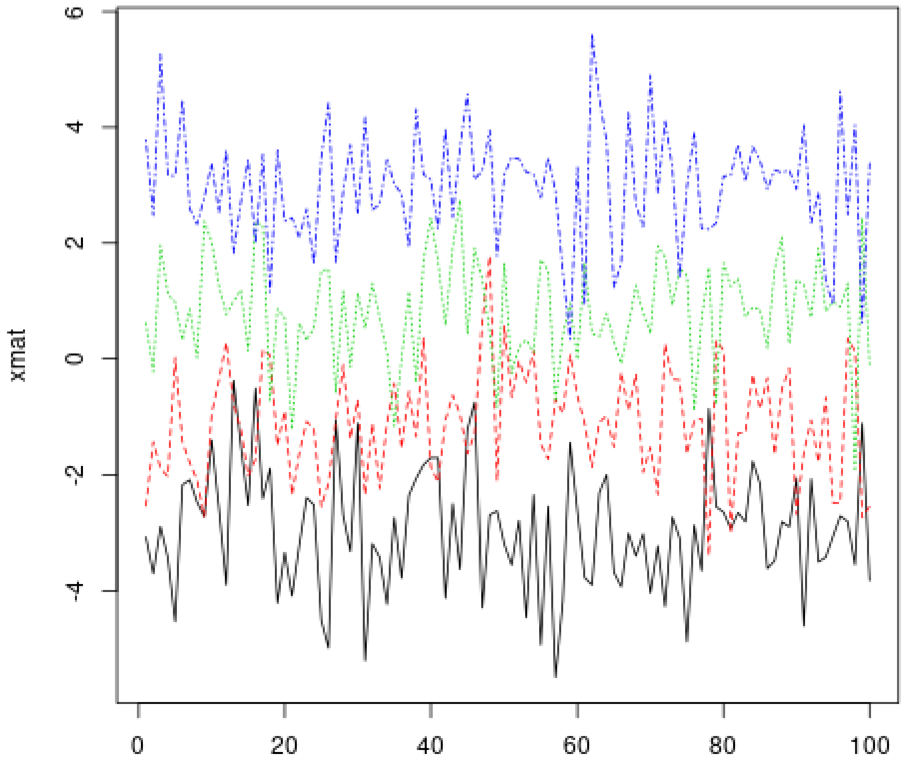
```
plot(xmat[,1], type = 'l')
lines(xmat[,2], col = 'red')
lines(xmat[,3], col = 'green')
lines(xmat[,4], col = 'blue')
```



. plot .

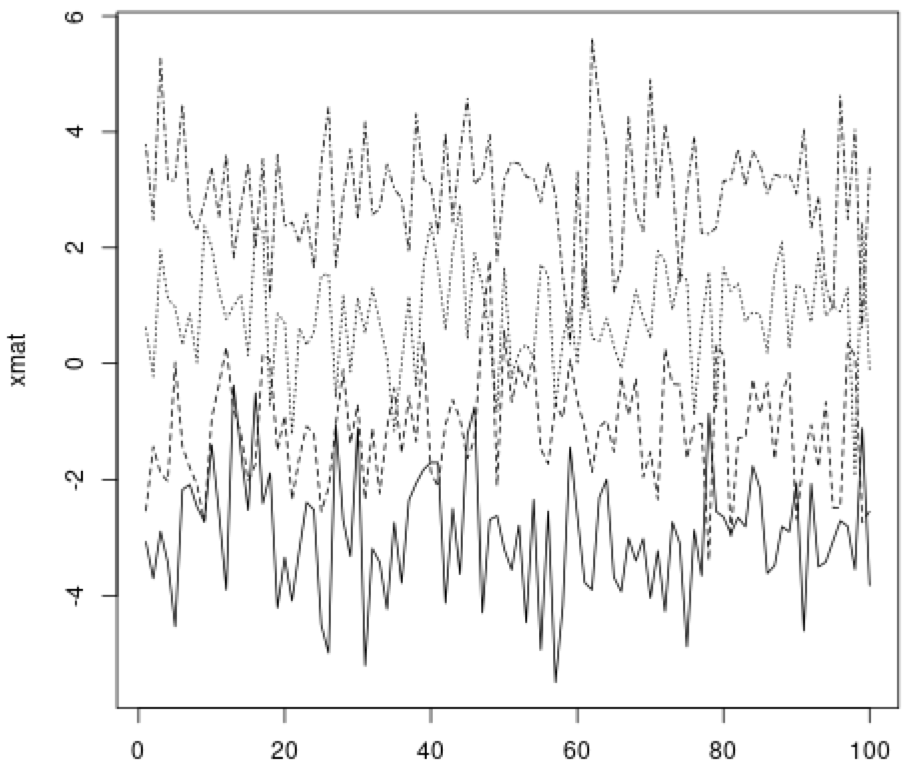
matplot .

```
matplot(xmat, type = 'l')
```



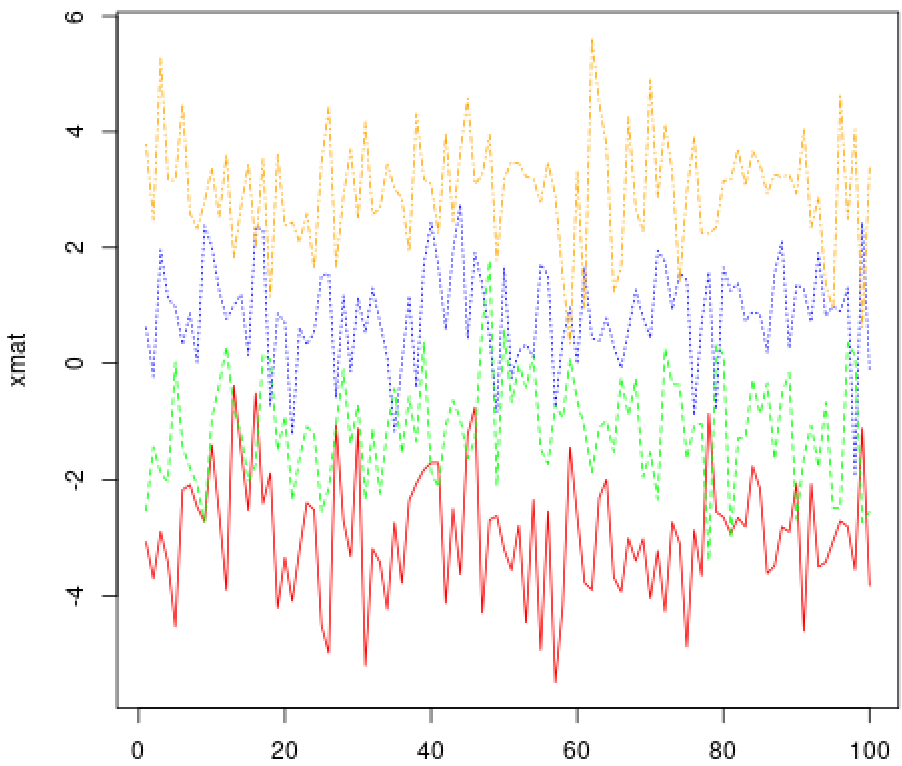
`matplot` (`col`) (`lty`) ., ( ) ...

```
matplot(xmat, type = 'l', col = 'black')
```



...   (R   ).

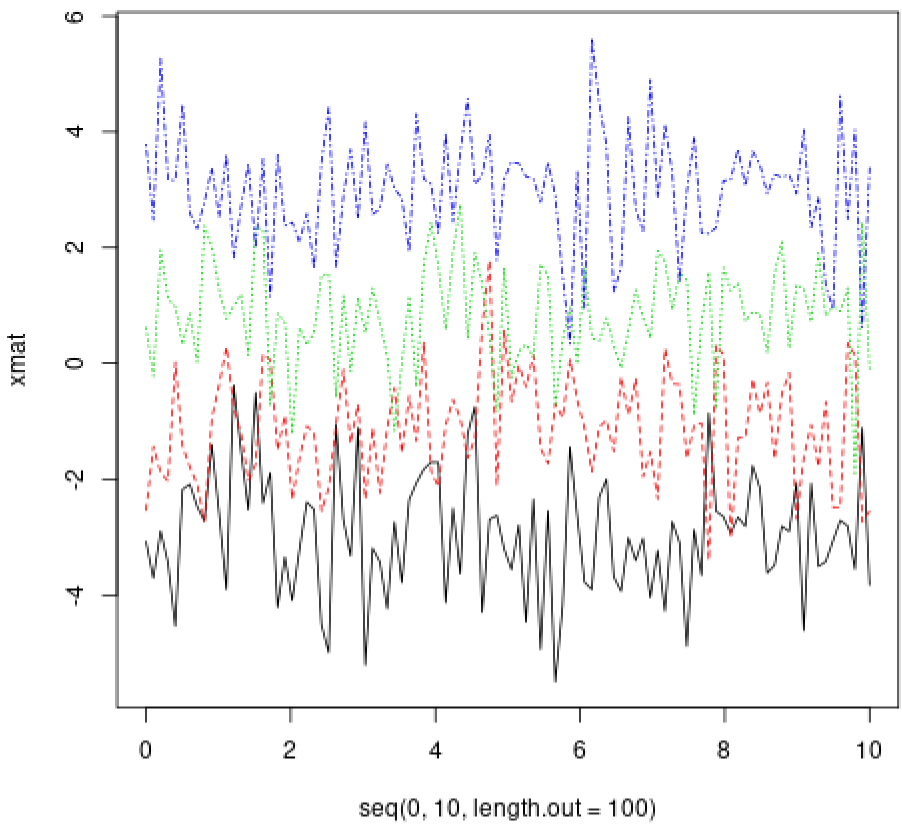
```
matplot(xmat, type = 'l', col = c('red', 'green', 'blue', 'orange'))
```



main , xlab , xmin plot . ?par .

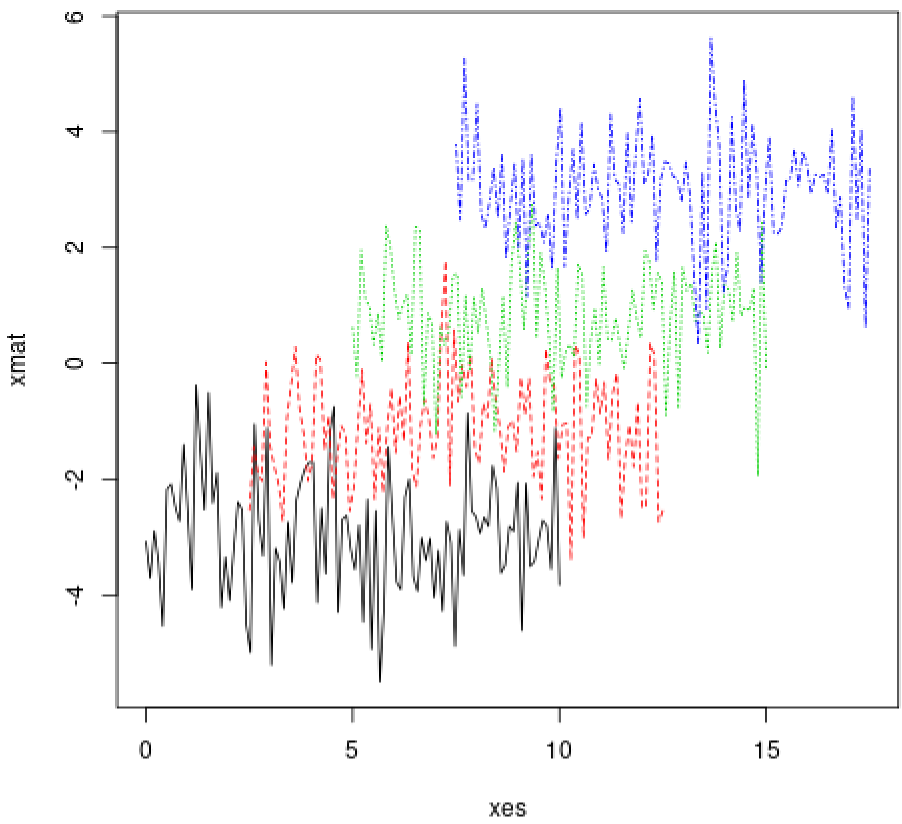
plot , , matplot y x . x y .

```
matplot(x = seq(0, 10, length.out = 100), y = xmat, type='l')
```



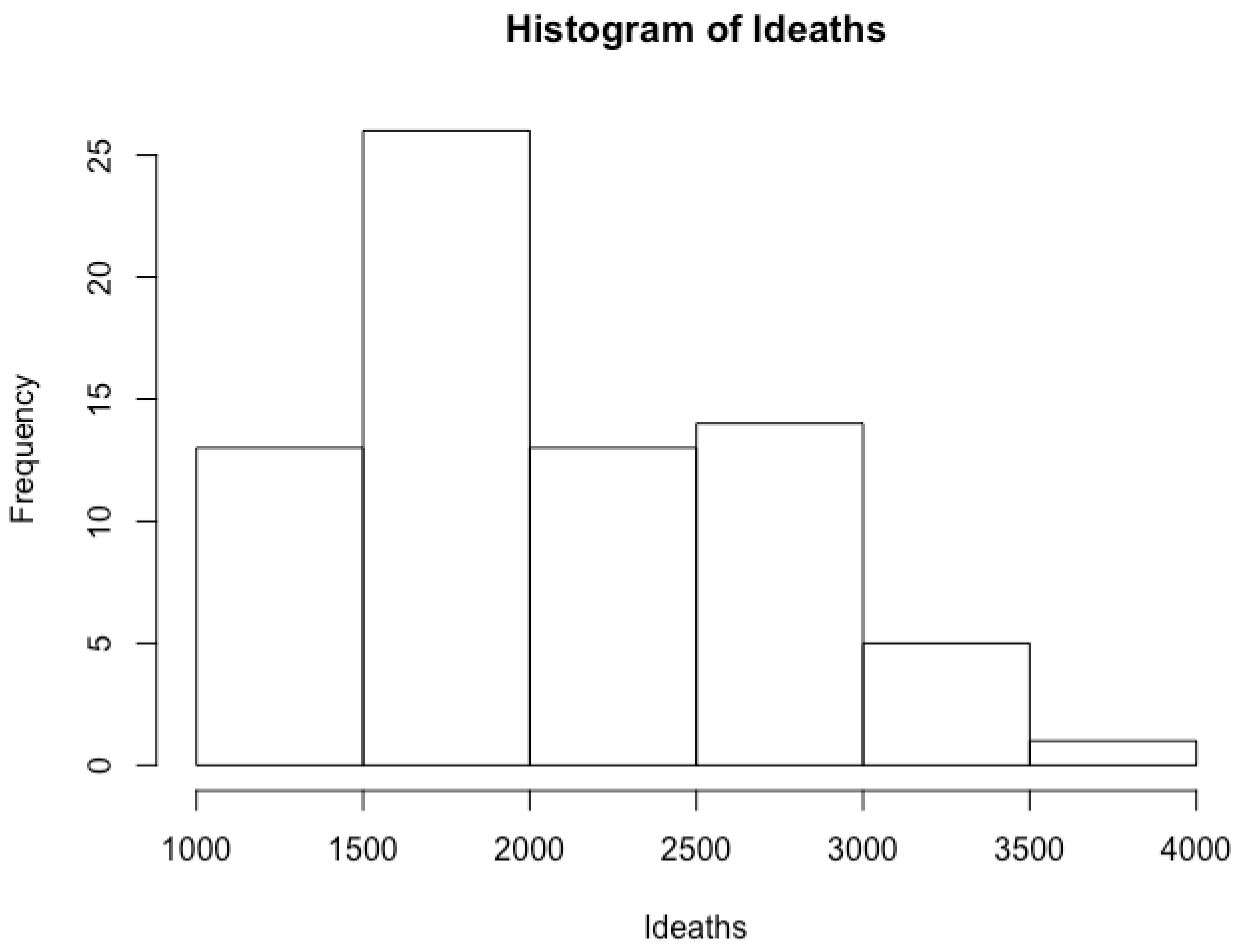
, x y .

```
xes <- cbind(seq(0, 10, length.out = 100),
             seq(2.5, 12.5, length.out = 100),
             seq(5, 15, length.out = 100),
             seq(7.5, 17.5, length.out = 100))
matplot(x = xes, y = xmat, type = 'l')
```

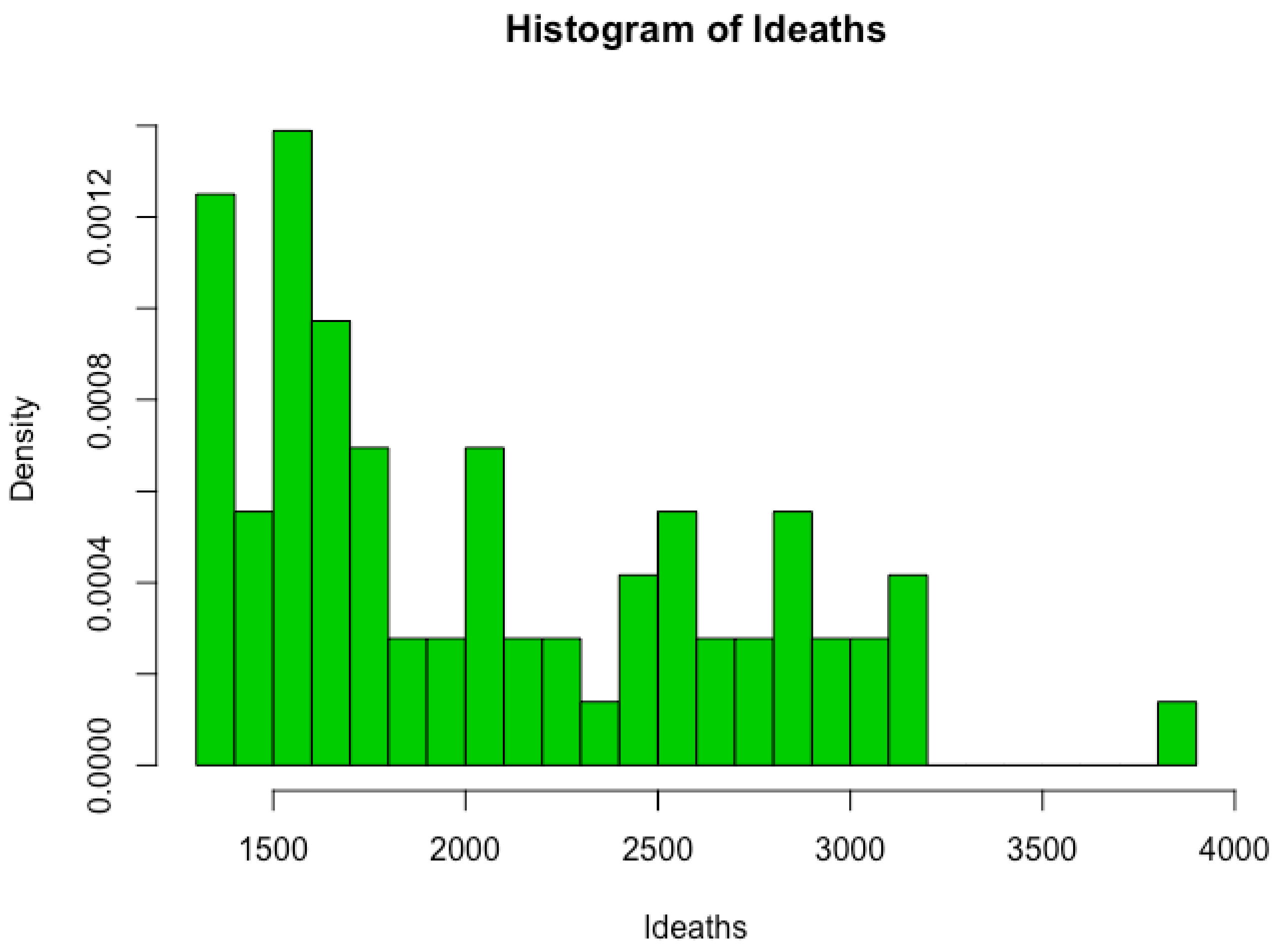


.

```
hist(ldeaths)
```




```
hist(ldeaths, breaks = 20, freq = F, col = 3)
```

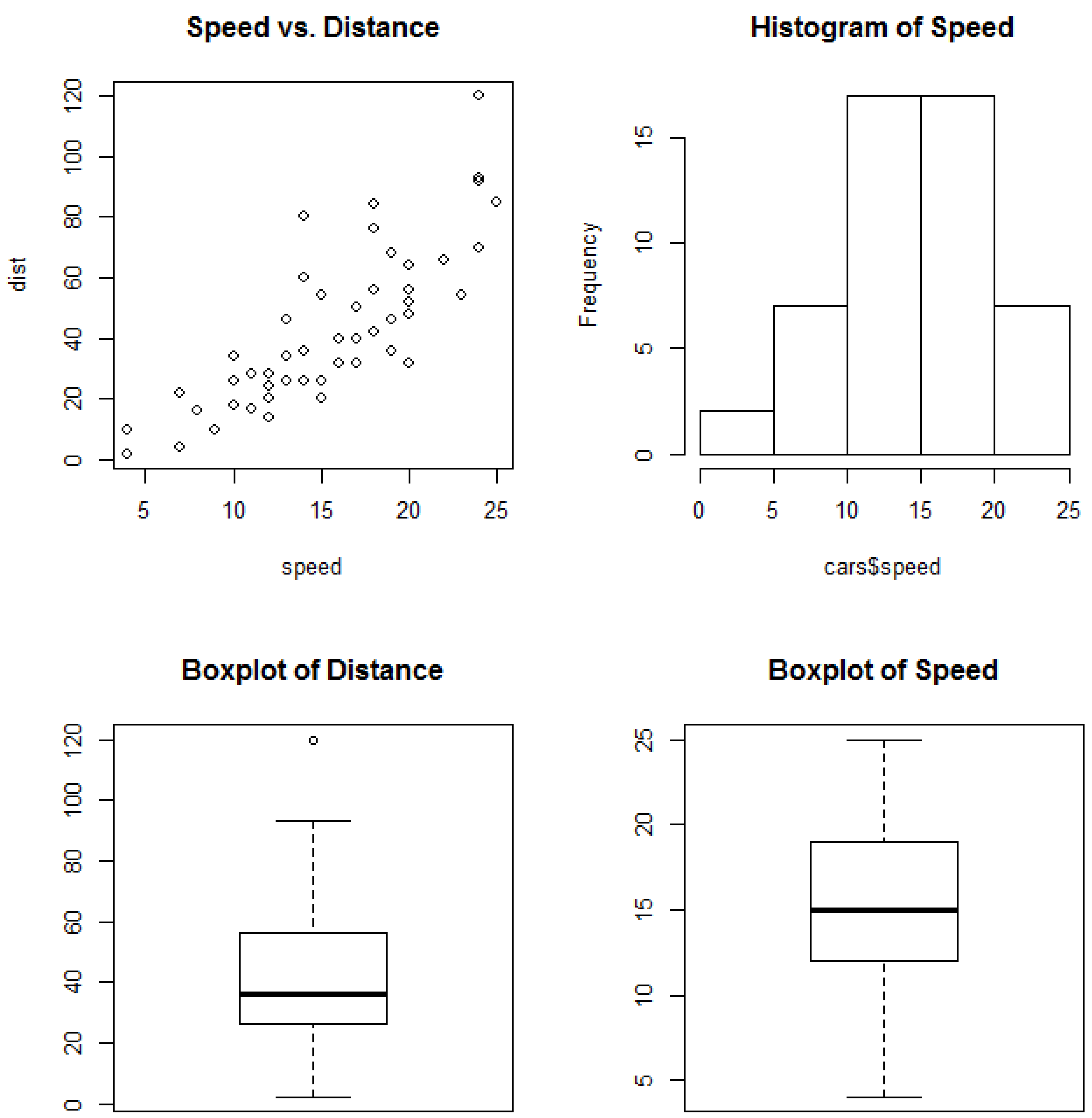


(: Scatterplot Barplot)   . R `par()` `layout()`   .

`par()`

`par` `mfrow` `mfcol`   nrows ncols `c(nrows, ncols)` .   .

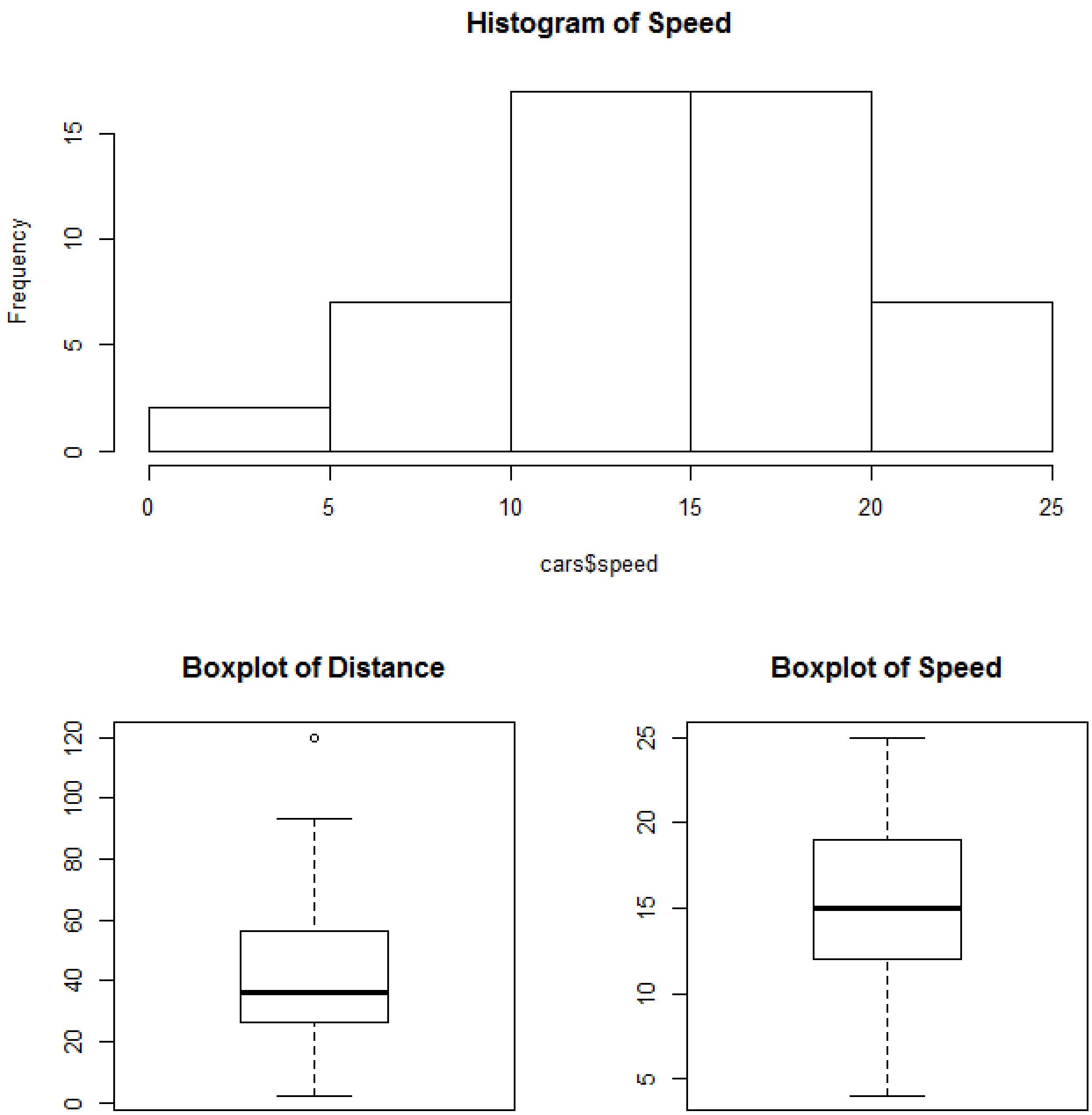
```
par(mfrow=c(2,2))
plot(cars, main="Speed vs. Distance")
hist(cars$speed, main="Histogram of Speed")
boxplot(cars$dist, main="Boxplot of Distance")
boxplot(cars$speed, main="Boxplot of Speed")
```



layout()

layout()   .   .

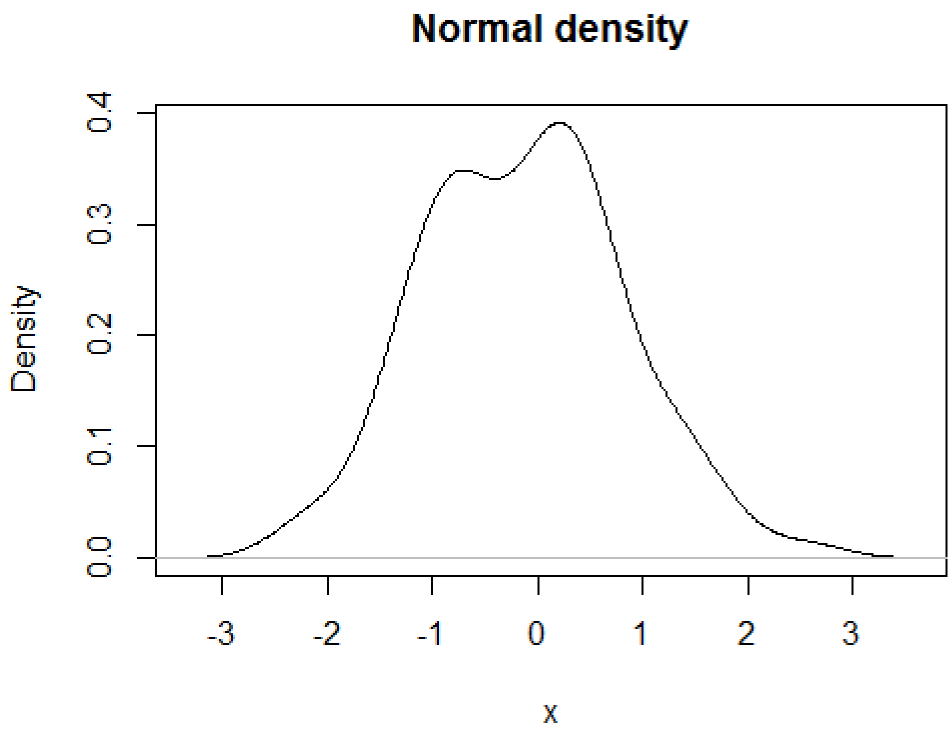
```
layout(matrix(c(1,1,2,3), 2,2, byrow=T))
hist(cars$speed, main="Histogram of Speed")
boxplot(cars$dist, main="Boxplot of Distance")
boxplot(cars$speed, main="Boxplot of Speed")
```



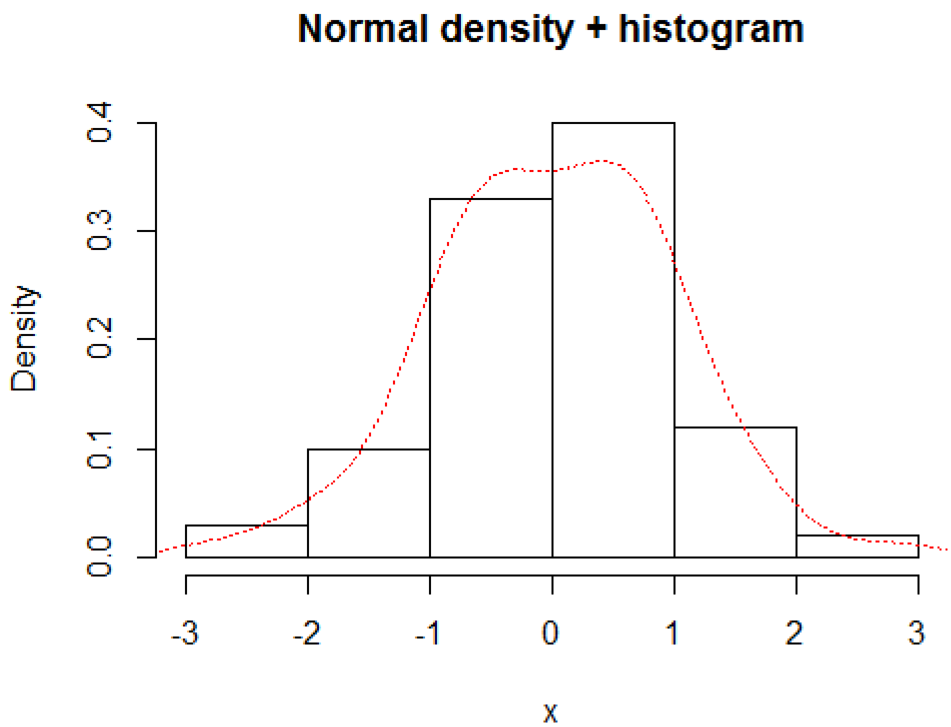
.

```
plot(density(rnorm(100)),main="Normal density",xlab="x")
```

~ .



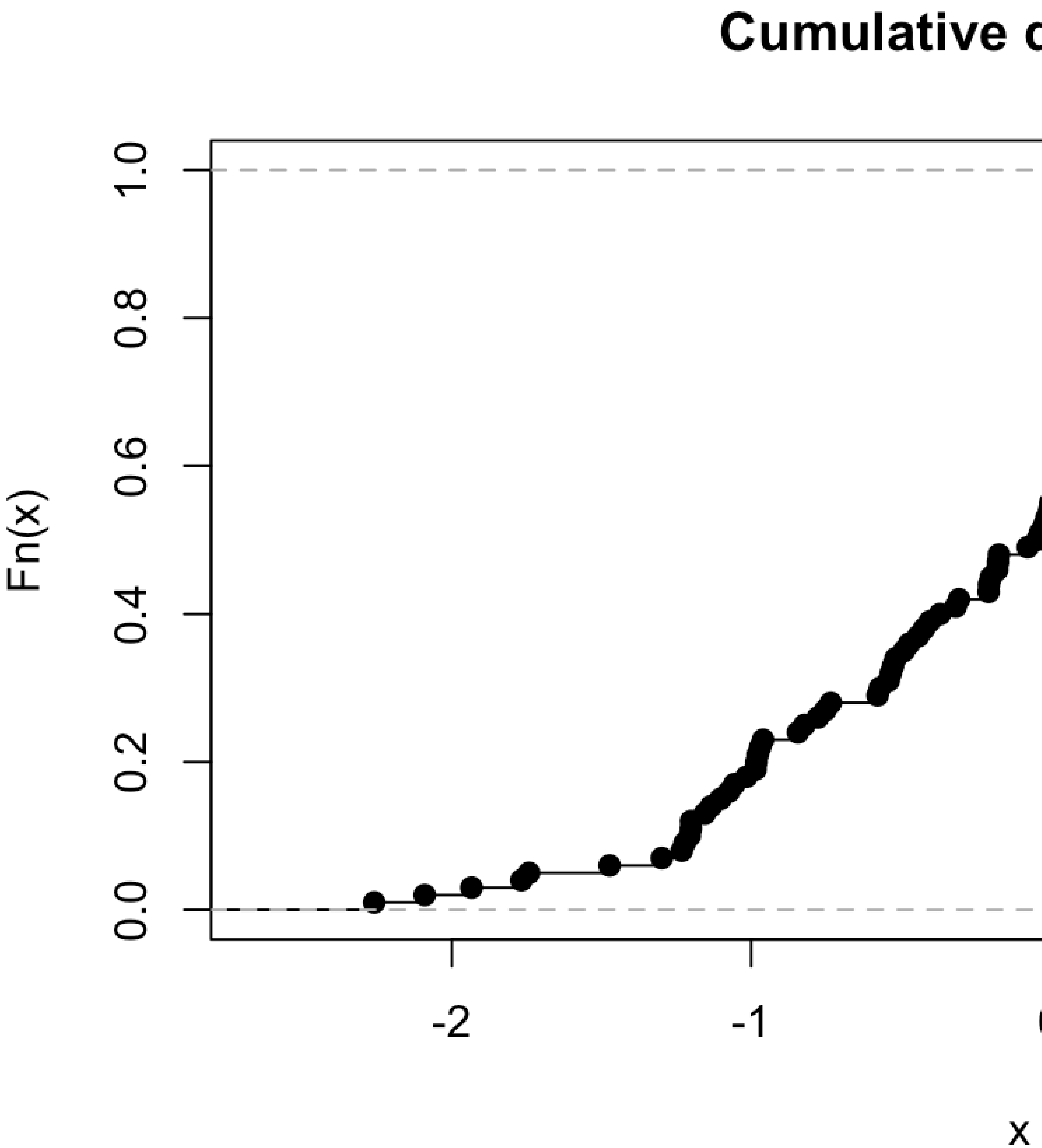

```
x=rnorm(100)
hist(x,prob=TRUE,main="Normal density + histogram")
lines(density(x),lty="dotted",col="red")
```



. `ecdf()` .

```
plot(ecdf(rnorm(100)),main="Cumulative distribution",xlab="x")
```

~ .



R_Plots

-

.

```
x_values <- rnorm(n = 20 , mean = 5 , sd = 8) #20 values generated from Normal(5,8)
y_values <- rbeta(n = 20 , shape1 = 500 , shape2 = 10) #20 values generated from Beta(500,10)
```

`x_values` `y_values` .

```
plot(x = x_values, y = y_values, type = "p") #standard scatter-plot
plot(x = x_values, y = y_values, type = "l") # plot with lines
plot(x = x_values, y = y_values, type = "n") # empty plot
```

`?plot()` .

-

.

```
#boxplot is an easy way to see if we have some outliers in the data.

z<- rbeta(20 , 500 , 10) #generating values from beta distribution
z[c(19 , 20)] <- c(0.97 , 1.05) # replace the two last values with outliers
boxplot(z) # the two points are the outliers of variable z.
```

-

```
hist(x = x_values) # Histogram for x vector
hist(x = x_values, breaks = 3) #use breaks to set the numbers of bars you want
```

- **Pie_charts**

.

. .

```
P <- c(rep('A' , 3) , rep('B' , 10) , rep('C' , 7) )
t <- table(P) # this is a frequency matrix of variable P
pie(t) # And this is a visual version of the matrix above
```

: https://riptutorial.com/ko/r/topic/1377/-

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Examples

. : , .   (   ).

.

```
exampleList1 <- list('a', 'b')
exampleList2 <- list(1, 2)
exampleList3 <- list('a', 1, 2)
```

str   .

```
str(exampleList1)
str(exampleList2)
str(exampleList3)
```

, ,   ,   . [.

```
# Returns List
exampleList3[1]
exampleList3[1:2]
```

[[.

```
# Returns Character
exampleList3[[1]]
```

.

```
exampleList4 <- list(
    num = 1:3,
    numeric = 0.5,
    char = c('a', 'b')
)
```

.

```
exampleList4[['char']]
```

$.

```
exampleList4$num
```

. $.

```
exampleList5 <- exampleList4[2:3]

exampleList4$num
# c(1, 2, 3)

exampleList5$num
# 0.5

exampleList5[['num']]
# NULL
```

.

```
## Numeric vector
exampleVector1 <- c(12, 13, 14)
## Character vector
exampleVector2 <- c("a", "b", "c", "d", "e", "f")
## Matrix
exampleMatrix1 <- matrix(rnorm(4), ncol = 2, nrow = 2)
## List
exampleList3 <- list('a', 1, 2)

exampleList6 <- list(
    num = exampleVector1,
    char = exampleVector2,
    mat = exampleMatrix1,
    list = exampleList3
)
exampleList6
#$num
#[1] 12 13 14
#
#$char
#[1] "a" "b" "c" "d" "e" "f"
#
#$mat
#           [,1]        [,2]
#[1,] 0.5013050 -1.88801542
#[2,] 0.4295266  0.09751379
#
#$list
#$list[[1]]
#[1] "a"
#
#$list[[2]]
#[1] 1
#
#$list[[3]]
#[1] 2
```

(:) . `list` `list` .

```
l1 <- list(c(1, 2, 3), c("a", "b", "c"))
l1
## [[1]]
## [1] 1 2 3
##
## [[2]]
```

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

. . . names .

```
names(l1)
## NULL
names(l1) <- c("vector1", "vector2")
l1
## $vector1
## [1] 1 2 3
##
## $vector2
## [1] "a" "b" "c"
```

.

```
l2 <- list(vec = c(1, 3, 5, 7, 9),
       mat = matrix(data = c(1, 2, 3), nrow = 3))
l2
## $vec
## [1] 1 3 5 7 9
##
## $mat
##      [,1]
## [1,]    1
## [2,]    2
## [3,]    3
names(l2)
## [1] "vec" "mat"
```

"vec" "mat" .

R . . ( )

.

```
# Function example which returns a single element numeric vector
exampleFunction1 <- function(num1, num2){
    result <- num1 + num2
    return(result)
}

# Using example function 1
exampleFunction1(1, 2)

# Function example which returns a simple numeric vector
exampleFunction2 <- function(num1, num2, multiplier){
    tempResult1 <- num1 + num2
    tempResult2 <- tempResult1 * multiplier
    result <- c(tempResult1, tempResult2)
    return(result)
}

# Using example function 2
exampleFunction2(1, 2, 4)
```

. .

R 1 ( ). ( ) ( ) .

```
# We will be using mtcars dataset here
# Function which returns a result that is supposed to contain multiple type of results
# This can be solved by putting the results into a list
exampleFunction3 <- function(dataframe, removeColumn, sumColumn){
    resultDataFrame <- dataframe[, -removeColumn]
    resultSum <- sum(dataframe[, sumColumn])
    resultList <- list(resultDataFrame, resultSum)
    return(resultList)
}

# Using example function 3
exampleResult <- exampleFunction3(mtcars, 2, 4)
exampleResult[[1]]
exampleResult[[2]]
```

vector data.frame , .

. (: n mxn , data.frame data.table) . .

```
res <- list(character(0), c("Luzhuang", "Laisu", "Peihui"), character(0),
    c("Anjiangping", "Xinzhai", "Yongfeng"), character(0), character(0),
    c("Puji", "Gaotun", "Banjingcun"), character(0), character(0),
    character(0))
res
```

```
[[1]]
character(0)

[[2]]
[1] "Luzhuang" "Laisu"    "Peihui"

[[3]]
character(0)

[[4]]
[1] "Anjiangping" "Xinzhai"     "Yongfeng"

[[5]]
character(0)

[[6]]
character(0)

[[7]]
[1] "Puji"       "Gaotun"     "Banjingcun"

[[8]]
character(0)

[[9]]
character(0)

[[10]]
```

```
character(0)
```

```
res <- sapply(res, function(s) if (length(s) == 0) NA_character_ else paste(s, collapse = "
"))
res
```

```
 [1] NA                              "Luzhuang Laisu Peihui"        NA
"Anjiangping Xinzhai Yongfeng" NA

 [6] NA                              "Puji Gaotun Banjingcun"       NA
NA                             NA
```

:

. , Azure ML R . .

```
> df
       name height        team fun_index title age         desc Y
1    Andrea    195       Lazio        97     6  33   eccellente 1
2      Paja    165  Fiorentina        87     6  31       deciso 1
3      Roro    190       Lazio        65     6  28       strano 0
4    Gioele     70       Lazio       100     0   2    simpatico 1
5     Cacio    170    Juventus        81     3  33         duro 0
6     Edola    171       Lazio        72     5  32     svampito 1
7    Salami    175       Inter        75     3  30  doppiopasso 1
8    Braugo    180       Inter        79     5  32          gjn 0
9     Benna    158    Juventus        80     6  28     esaurito 0
10   Riggio    182       Lazio        92     5  31     certezza 1
11 Giordano    185        Roma        79     5  29        buono 1

> number <- "42"
```

.

```
> paste(df$name[4],"is a",df3$team[4], "supporter." )
[1] "Gioele is a  Lazio supporter."
> paste("The answer to THE question is", number )
[1] "The answer to THE question is 42"
```

. .

```
l <- list(df,number)
dataframe_container <- data.frame(out2 = as.integer(serialize(l, connection=NULL)))
```

.

```
#----- unserialize ----------------------------------------+
unser_obj <- unserialize(as.raw(dataframe_container$out2))
#----- taking back the elements----------------------------+
df_mod        <- unser_obj[1][[1]]
number_mod    <- unser_obj[2][[1]]
```

.

```
> paste(df_mod$name[4],"is a",df_mod$team[4], "supporter." )
[1] "Gioele is a  Lazio supporter."
> paste("The answer to THE question is", number_mod )
[1] "The answer to THE question is 42"
```

: https://riptutorial.com/ko/r/topic/1365/

48:

R . f} .

- data.table ,
- tidyr
-

Examples

`reshape` R `reshape` . `?reshape` .

```
# create unbalanced longitudinal (panel) data set
set.seed(1234)
df <- data.frame(identifier=rep(1:5, each=3),
                 location=rep(c("up", "down", "left", "up", "center"), each=3),
                 period=rep(1:3, 5), counts=sample(35, 15, replace=TRUE),
                 values=runif(15, 5, 10))[-c(4,8,11),]
df

   identifier location period counts   values
1           1       up      1      4 9.186478
2           1       up      2     22 6.431116
3           1       up      3     22 6.334104
5           2     down      2     31 6.161130
6           2     down      3     23 6.583062
7           3     left      1      1 6.513467
9           3     left      3     24 5.199980
10          4       up      1     18 6.093998
12          4       up      3     20 7.628488
13          5   center      1     10 9.573291
14          5   center      2     33 9.156725
15          5   center      3     11 5.228851
```

data.frame . , 2 , 3 4 . : , .

data.frame ,

```
# reshape wide on time variable
df.wide <- reshape(df, idvar="identifier", timevar="period",
                   v.names=c("values", "counts"), direction="wide")
df.wide
   identifier location values.1 counts.1 values.2 counts.2 values.3 counts.3
1           1       up 9.186478        4 6.431116       22 6.334104       22
5           2     down       NA       NA 6.161130       31 6.583062       23
7           3     left 6.513467        1       NA       NA 5.199980       24
10          4       up 6.093998       18       NA       NA 7.628488       20
13          5   center 9.573291       10 9.156725       33 5.228851       11
```

NAs .

"v.names" . "drop" . data.frame non-varying / non-id v.names .

```
reshape(df, idvar="identifier", timevar="period", direction="wide",
        drop="location")
```

df.wide .

```
reshape(df.wide, direction="long")
```

.

```
# remove "." separator in df.wide names for counts and values
names(df.wide)[grep("\\.", names(df.wide))] <-
              gsub("\\.", "", names(df.wide)[grep("\\.", names(df.wide))])
```

.

`reshape` long `reshape` "varying" . .

```
reshape(df.wide, idvar="identifier",
        varying=list(c(3,5,7), c(4,6,8)), direction="long")
```

long reshaping "v.names" .

"9" "" `reshape` time .

. . .

	[cm]	[yr]
	178	20
	174	45
	182	31

.

	[cm]	178
	[cm]	174
	[cm]	182
	[yr]	20
	[yr]	45

	[yr]	31

Base R . mtcars . . .

```
mtcars # shows the dataset
data <- data.frame(observation=row.names(mtcars),mtcars)
```

R

R long : stack() unstack() .

```
long <- stack(data)
long # this shows the long format
wide <- unstack(long)
wide # this shows the wide format
```

. .

tidyr

gather() wide long spread() long wide .

```
library(tidyr)
long <- gather(data, variable, value, 2:12) # where variable is the name of the
# variable column, value indicates the name of the value column and 2:12 refers to
# the columns to be converted.
long # shows the long result
wide <- spread(long,variable,value)
wide # shows the wide result (~data)
```

data.table

data.table reshape2 melt() , dcast() .

```
library(data.table)
long <- melt(data,'observation',2:12,'variable', 'value')
long # shows the long result
wide <- dcast(long, observation ~ variable)
wide # shows the wide result (~data)
```

: https://riptutorial.com/ko/r/topic/2904/-----

49:

Examples

tbl_df

tbl_df (*tibble diff*) . tibble .

`as_data_frame` tbl_df .

```
library(tibble)
mtcars_tbl <- as_data_frame(mtcars)
```

data.frames tbl_dfs .

```
# A tibble: 32 x 11
     mpg   cyl  disp    hp  drat    wt  qsec    vs    am  gear  carb
*  <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
1   21.0     6 160.0   110  3.90 2.620 16.46     0     1     4     4
2   21.0     6 160.0   110  3.90 2.875 17.02     0     1     4     4
3   22.8     4 108.0    93  3.85 2.320 18.61     1     1     4     1
4   21.4     6 258.0   110  3.08 3.215 19.44     1     0     3     1
5   18.7     8 360.0   175  3.15 3.440 17.02     0     0     3     2
6   18.1     6 225.0   105  2.76 3.460 20.22     1     0     3     1
7   14.3     8 360.0   245  3.21 3.570 15.84     0     0     3     4
8   24.4     4 146.7    62  3.69 3.190 20.00     1     0     4     2
9   22.8     4 140.8    95  3.92 3.150 22.90     1     0     4     2
10  19.2     6 167.6   123  3.92 3.440 18.30     1     0     4     4
# ... with 22 more rows
```

- (`32 x 11`)
- (`dbl`)
- . (`options(tibble.print_max = [number])` `options(tibble.print_max = [number])`).

dplyr `group_by()` tbl_dfs .

:

`tidyverse` ?

`tidyverse` R Hadley / Rstudio . `tidyverse` . .

tidyverse API . tidyverse .

tidyverse R for Data Science. tidyverse tidyverse .

( ))

?

R .

```
install.package("tidyverse")
library("tidyverse")
```

/ . / .

?

:

- ggplot2 : SO_doc
- dplyr : (Rcpp) SO_doc
- tidyr : SO_doc
- readr : .
- purrr : JS underscore.js, lodash lazy.js R .
- tibble : .
- magrittr : SO_doc

:

- hms :
- stringr : .
- lubridate : / SO_doc
- forcats : .

:

- DBI : R (DBMS) .
- : SPSS, SAS Stata . SO_doc
- httr : httr API .
- jsonlite : JSON
- readxl : read.xls .xlsx SO_doc
- rvest : rvest SO_doc .
- xml2 : XML

:

- modelr : .
- : .

tidyverse .

- knitr : API . SO_docs : 1 , 2

- rmarkdown :   Rstudio . SO_docs : 1 , 2 , 3 , 4

: https://riptutorial.com/ko/r/topic/1395/

50:

Examples

5 ,

```
sample(5)
# [1] 4 5 3 1 2
```

:

```
sample(10:15)
# [1] 11 15 12 10 14 13
```

`pracma` .

```
randperm(a, k)
# Generates one random permutation of k of the elements a, if a is a vector,
# or of 1:a if a is a single integer.
# a: integer or numeric vector of some length n.
# k: integer, smaller as a or length(a).

# Examples
library(pracma)
randperm(1:10, 3)
[1] 3 7 9

randperm(10, 10)
[1]  4  5 10  8  2  7  6  9  3  1

randperm(seq(2, 10, by=2))
[1]  6  4 10  2  8
```

R `set.seed()` . , ( ).

```
> sample(1:10,5)
[1]  6  9  2  7 10
> sample(1:10,5)
[1]  7  6  1  2 10
```

.

```
> rnorm(5)
[1]  0.4874291  0.7383247  0.5757814 -0.3053884  1.5117812
> rnorm(5)
[1]  0.38984324 -0.62124058 -2.21469989  1.12493092 -0.04493361
```

(1) .

```
> set.seed(1)
```

```
> sample(letters,2)
[1] "g" "j"
> set.seed(1)
> sample(letters,2)
[1] "g" "j"
```

`rexp()` :

```
> set.seed(1)
> rexp(5)
[1] 0.7551818 1.1816428 0.1457067 0.1397953 0.4360686
> set.seed(1)
> rexp(5)
[1] 0.7551818 1.1816428 0.1457067 0.1397953 0.4360686
```

5 .

0 10

```
runif(5, min=0, max=10)
[1] 2.1724399 8.9209930 6.1969249 9.3303321 2.4054102
```

0 1

```
rnorm(5, mean=0, sd=1)
[1] -0.97414402 -0.85722281 -0.08555494 -0.37444299  1.20032409
```

10 0.5

```
rbinom(5, size=10, prob=0.5)
[1] 4 3 5 2 3
```

0.2

```
rgeom(5, prob=0.2)
[1] 14  8 11  1  3
```

3 , 10 5

```
rhyper(5, m=3, n=10, k=5)
[1] 2 0 1 1 1
```

10 0.8

```
rnbinom(5, size=10, prob=0.8)
```

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

() 2

```
rpois(5, lambda=2)
[1] 2 1 2 3 4
```

1.5

```
rexp(5, rate=1.5)
[1] 1.8993303 0.4799358 0.5578280 1.5630711 0.6228000
```

0 1

```
rlogis(5, location=0, scale=1)
[1]  0.9498992 -1.0287433 -0.4192311  0.7028510 -1.2095458
```

15

```
rchisq(5, df=15)
[1] 14.89209 19.36947 10.27745 19.48376 23.32898
```

a = 1 b = 0.5

```
rbeta(5, shape1=1, shape2=0.5)
[1] 0.1670306 0.5321586 0.9869520 0.9548993 0.9999737
```

3 = 0.5

```
rgamma(5, shape=3, scale=0.5)
[1] 2.2445984 0.7934152 3.2366673 2.2897537 0.8573059
```

0 1

```
rcauchy(5, location=0, scale=1)
[1] -0.01285116 -0.38918446  8.71016696 10.60293284 -0.68017185
```

0 1 ( )

```
rlnorm(5, meanlog=0, sdlog=1)
[1] 0.8725009 2.9433779 0.3329107 2.5976206 2.8171894
```

0.5 1

```
rweibull(5, shape=0.5, scale=1)
[1] 0.337599112 1.307774557 7.233985075 5.840429942 0.005751181
```

Wilcoxon   10 ,   20 .

```
rwilcox(5, 10, 20)
[1] 111  88  93 100 124
```

5   3

```
rmultinom(5, size=5, prob=c(0.1,0.1,0.8))
     [,1] [,2] [,3] [,4] [,5]
[1,]    0    0    1    1    0
[2,]    2    0    1    1    0
[3,]    3    5    3    3    5
```

: https://riptutorial.com/ko/r/topic/1578/-

51: - (POSIXct POSIXlt)

R - POSIXct POSIXlt (`?DateTimeClasses`).

POSIXct .

•

•

Examples

```
# test date-time object
options(digits.secs = 3)
d = as.POSIXct("2016-08-30 14:18:30.58", tz = "UTC")

format(d,"%S")  # 00-61 Second as integer
## [1] "30"

format(d,"%OS") # 00-60.99… Second as fractional
## [1] "30.579"

format(d,"%M")  # 00-59 Minute
## [1] "18"

format(d,"%H")  # 00-23 Hours
## [1] "14"

format(d,"%I")  # 01-12 Hours
## [1] "02"

format(d,"%p")  # AM/PM Indicator
## [1] "PM"

format(d,"%z")  # Signed offset
## [1] "+0000"

format(d,"%Z")  # Time Zone Abbreviation
## [1] "UTC"
```

`?strptime` .

/

POSIXct POSIXlt - . " " .

```
as.POSIXct("11:38",                        # time string
           format = "%H:%M")               # formatting string
```

```
## [1] "2016-07-21 11:38:00 CDT"
strptime("11:38",                          # identical, but makes a POSIXlt object
         format = "%H:%M")
## [1] "2016-07-21 11:38:00 CDT"

as.POSIXct("11 AM",
           format = "%I %p")
## [1] "2016-07-21 11:00:00 CDT"
```

.

```
as.POSIXct("11:38:22",                  # time string without timezone
           format = "%H:%M:%S",
           tz = "America/New_York")     # set time zone
## [1] "2016-07-21 11:38:22 EDT"

as.POSIXct("2016-07-21 00:00:00",
           format = "%F %T")            # shortcut tokens for "%Y-%m-%d" and "%H:%M:%S"
```

`?strptime` .

- .
- time , . 0.
- string `tz` .

- `tz` .
  - CST "CST6CDT" "America/Chicago" .
- .
  - R : `OlsonNames()`
  - R : `system("cat $R_HOME/share/zoneinfo/zone.tab")`
- IANA (Internet Assigned Numbers Authority)
  - tz (Wikipedia)
  - IANA TZ (2016e)

-

POSIXct . POSIXct .

```
## adding/subtracting times - 60 seconds
as.POSIXct("2016-01-01") + 60
# [1] "2016-01-01 00:01:00 AEDT"

## adding 3 hours, 14 minutes, 15 seconds
as.POSIXct("2016-01-01") + ( (3 * 60 * 60) + (14 * 60) + 15)
# [1] "2016-01-01 03:14:15 AEDT"
```

, `as.difftime` datetime . :

```
as.POSIXct("2016-01-01")         +
```

```
  as.difftime(3,  units="hours") +
  as.difftime(14, units="mins")  +
  as.difftime(15, units="secs")
# [1] "2016-01-01 03:14:15 AEDT"
```

/ `difftime()` , , , .

```
# using POSIXct objects
difftime(
  as.POSIXct("2016-01-01 12:00:00"),
  as.POSIXct("2016-01-01 11:59:59"),
  unit = "secs")
# Time difference of 1 secs
```

- `seq.POSIXt()` `seq` .

- (POSIXct POSIXlt) : https://riptutorial.com/ko/r/topic/9027/------posixct--posixlt-

52:

R ,   . ?Dates " , " ?DateTimeClasses " , " ?difftime "   "" . : - .

- POSIXct

  date-time POSIXct 1970-01-01 00:00:00 UTC UNIX epoch   . Sys.Time()   Sys.Time() .

- POSIXlt

  , , , ,, ,   . strptime   .

- Date   .

/

POSIXct tidyverse UNIX . POSIXlt .

```
origin = as.POSIXct("1970-01-01 00:00:00", format ="%Y-%m-%d %H:%M:%S", tz = "UTC")

origin
## [1] "1970-01-01 UTC"

origin + 47
## [1] "1970-01-01 00:00:47 UTC"

as.numeric(origin)     # At epoch
## 0

as.numeric(Sys.time()) # Right now (output as of July 21, 2016 at 11:47:37 EDT)
## 1469116057

posixlt = as.POSIXlt(Sys.time(), format ="%Y-%m-%d %H:%M:%S", tz = "America/Chicago")

# Conversion to POISXct
posixct = as.POSIXct(posixlt)
posixct

# Accessing components
posixlt$sec   # Seconds 0-61
posixlt$min   # Minutes 0-59
posixlt$hour  # Hour 0-23
posixlt$mday  # Day of the Month 1-31
posixlt$mon   # Months after the first of the year 0-11
posixlt$year  # Years since 1900.

ct = as.POSIXct("2015-05-25")
lt = as.POSIXlt("2015-05-25")

object.size(ct)
# 520 bytes
object.size(lt)
```

```
# 1816 bytes
```

-
- data.table IDate ITime
-
-
-

Examples

R , .

```
Sys.Date()             # Returns date as a Date object

## [1] "2016-07-21"

Sys.time()             # Returns date & time at current locale as a POSIXct object

## [1] "2016-07-21 10:04:39 CDT"

as.numeric(Sys.time()) # Seconds from UNIX Epoch (1970-01-01 00:00:00 UTC)

## [1] 1469113479

Sys.timezone()         # Time zone at current location

## [1] "Australia/Melbourne"
```

`OlsonNames()` Olson / IANA .

```
str(OlsonNames())
## chr [1:589] "Africa/Abidjan" "Africa/Accra" "Africa/Addis_Ababa" "Africa/Algiers"
"Africa/Asmara" "Africa/Asmera" "Africa/Bamako" ...
```

.

. .

```
eom <- function(x, p=as.POSIXlt(x)) as.Date(modifyList(p, list(mon=p$mon + 1, mday=0)))
```

:

```
x <- seq(as.POSIXct("2000-12-10"),as.POSIXct("2001-05-10"),by="months")
> data.frame(before=x,after=eom(x))
      before      after
1 2000-12-10 2000-12-31
2 2001-01-10 2001-01-31
3 2001-02-10 2001-02-28
4 2001-03-10 2001-03-31
5 2001-04-10 2001-04-30
6 2001-05-10 2001-05-31
```

```
>
```

:

```
> eom('2000-01-01')
[1] "2000-01-31"
```

.

```
date <- as.Date("2017-01-20")

> as.POSIXlt(cut(date, "month"))
[1] "2017-01-01 EST"
```

num . mondate .

```
moveNumOfMonths <- function(date, num) {
    as.Date(mondate(date) + num)
}
```

.

:

1 :

```
> moveNumOfMonths("2017-10-30",-1)
[1] "2017-09-30"
```

2 :

```
> moveNumOfMonths("2017-10-30",-2)
[1] "2017-08-30"
```

2 :

```
> moveNumOfMonths("2017-02-28", 2)
[1] "2017-04-30"
```

2 2 , 4 .

.

```
> moveNumOfMonths("2016-11-30", 2)
[1] "2017-01-31"
> moveNumOfMonths("2017-01-31", -2)
[1] "2016-11-30"
```

11 30 .

```
> moveNumOfMonths("2017-01-30", -2)
[1] "2016-11-30"
> moveNumOfMonths("2016-11-30", 2)
[1] "2017-01-31"
```

1 31 11 2 1 .

: https://riptutorial.com/ko/r/topic/1157/-

53: /

expr	"try part" tryCatch . (,) readLines . explicilty return " " ( ) insided
/ /	. AFAIU, (simpleCondition) tryCatch).
	"try part" . . finally = <expression> ("try part") .

tryCatch

tryCatch expr . . , (, return(NA) () warning error ?tryCatch). tryCatch ( ).

"try part" NA y NA . NULL lapply NULL " / " y 3 2 NULL . return , NULL (,).

" "

urls , (readLines) :

```
Warning message:
    In file(con, "r") : cannot open file 'I'm no URL': No such file or directory
```

"" . readLines warn = FALSE , .

```
suppressWarnings(readLines(con = url))
```

```
readLines(con = url, warn = FALSE)
```

Examples

tryCatch ()

URL HTML . () () . .

tryCatch

```
readUrl <- function(url) {
    out <- tryCatch(

        ########################################################
        # Try part: define the expression(s) you want to "try" #
        ########################################################

        {
            # Just to highlight:
            # If you want to use more than one R expression in the "try part"
```

```
            # then you'll have to use curly brackets.
            # Otherwise, just write the single expression you want to try and

            message("This is the 'try' part")
            readLines(con = url, warn = FALSE)
        },

        ########################################################################
        # Condition handler part: define how you want conditions to be handled #
        ########################################################################

        # Handler when a warning occurs:
        warning = function(cond) {
            message(paste("Reading the URL caused a warning:", url))
            message("Here's the original warning message:")
            message(cond)

            # Choose a return value when such a type of condition occurs
            return(NULL)
        },

        # Handler when an error occurs:
        error = function(cond) {
            message(paste("This seems to be an invalid URL:", url))
            message("Here's the original error message:")
            message(cond)

            # Choose a return value when such a type of condition occurs
            return(NA)
        },

        ###############################################
        # Final part: define what should happen AFTER #
        # everything has been tried and/or handled    #
        ###############################################

        finally = {
            message(paste("Processed URL:", url))
            message("Some message at the end\n")
        }
    )
    return(out)
}
```

URL URL

```
urls <- c(
    "http://stat.ethz.ch/R-manual/R-devel/library/base/html/connections.html",
    "http://en.wikipedia.org/wiki/Xz",
    "I'm no URL"
)
```

.

```
y <- lapply(urls, readUrl)
# Processed URL: http://stat.ethz.ch/R-manual/R-devel/library/base/html/connections.html
# Some message at the end
#
```

```
# Processed URL: http://en.wikipedia.org/wiki/Xz
# Some message at the end
#
# URL does not seem to exist: I'm no URL
# Here's the original error message:
# cannot open the connection
# Processed URL: I'm no URL
# Some message at the end
#
# Warning message:
# In file(con, "r") : cannot open file 'I'm no URL': No such file or directory
```

```
length(y)
# [1] 3

head(y[[1]])
# [1] "<!DOCTYPE html PUBLIC \"-//W3C//DTD HTML 4.01 Transitional//EN\">"
# [2] "<html><head><title>R: Functions to Manipulate Connections</title>"
# [3] "<meta http-equiv=\"Content-Type\" content=\"text/html; charset=utf-8\">"
# [4] "<link rel=\"stylesheet\" type=\"text/css\" href=\"R.css\">"
# [5] "</head><body>"
# [6] ""

y[[3]]
# [1] NA
```

/ : https://riptutorial.com/ko/r/topic/4060/----

54:

Examples

R . . .

a .

```
a <- matrix(1:9, 3, 3)
```

? .

```
> class(a)
[1] "matrix"
```

:

```
> a %*% t(a)
      [,1] [,2] [,3]
[1,]   66   78   90
[2,]   78   93  108
[3,]   90  108  126
```

a ?

```
> dim(a)
[1] 3 3
> nrow(a)
[1] 3
> ncol(a)
[2] 3
```

head , tail str .

```
> head(a, 1)
     [,1] [,2] [,3]
[1,]    1    4    7
> tail(a, 1)
     [,1] [,2] [,3]
[3,]    3    6    9
> str(a)
int [1:3, 1:3] 1 2 3 4 5 6 7 8 9
```

(:) . str . : a

```
a <- c(a)
```

?

```
> class(a)
[1] "integer"
```

, a . .

```
> dim(a)
NULL
```

, :

```
> length(a)
[1] 9
```

:

```
> class(a * 1.0)
[1] "numeric"
```

data.frames .

```
a <- as.data.frame(a)
names(a) <- c("var1", "var2", "var3")
```

:

```
> names(a)
[1] "var1" "var2" "var3"
```

R .

: https://riptutorial.com/ko/r/topic/3565/

55:

( ).

TRUE , FALSE NA . . T F R TRUE FALSE T F .

Examples

. (: ! , | , & , xor()) (&& , ||) . if cond .

!		!
&	( )	x y
&&	( )	x && y
|	( )	x |
||	( )	x ||
xor	( ) OR	xor (x, y)

|| TRUE . . && FALSE FALSE .

```
> x <- 5
> x > 6 || stop("X is too small")
Error: X is too small
> x > 3 || stop("X is too small")
[1] TRUE
```

is.logical() .

as.logical() .

```
> x <- 2
> z <- x > 4
> z
[1] FALSE
> class(x)
[1] "numeric"
> as.logical(2)
[1] TRUE
```

as.numeric() double . NA NA NA .

NAs

.

```
> TRUE & NA
[1] NA
> FALSE & NA
[1] FALSE
> TRUE || NA
[1] TRUE
> FALSE || NA
[1] NA
```

: https://riptutorial.com/ko/r/topic/9016/-

56:

NA .

NA (NA). (: sqrt(-1)) NaN ().

Examples

anyNA . is.na .

```
vec <- c(1, 2, 3, NA, 5)

anyNA(vec)
# [1] TRUE
is.na(vec)
# [1] FALSE FALSE FALSE  TRUE FALSE
```

is.na (FALSE = 0, TRUE = 1). .

```
sum(is.na(vec))
# [1] 1
```

colSums colSums colSums is.na .

```
colSums(is.na(airquality))
#   Ozone Solar.R    Wind    Temp   Month     Day
#      37       7       0       0       0       0
```

naniar (github CRAN) .

NA

read.* read.* R "NA" . NA . (.), (-) (: empty) NA . read.* na.strings R / NA na.strings .

```
read.csv("name_of_csv_file.csv", na.strings = "-")
```

NA .

```
read.csv('missing.csv', na.strings = c('.','-'))
```

NA write.csv na . .

NAs

NA logical .

```
class(NA)
#[1] "logical"
```

NA .

```
x <- c(1, NA, 1)
class(x[2])
#[1] "numeric"
```

NA NA_character_ , NA_integer_ , NA_real_ NA_complex_ . NA_integer_ NA_integer_ . Date :

```
class(Sys.Date()[NA_integer_])
# [1] "Date"
```

TRUE / FALSE / NA

NA NA NA . , NA OR TRUE TRUE TRUE NA OR FALSE NA NA TRUE FALSE

```
NA | TRUE
# [1] TRUE
# TRUE | TRUE is TRUE and FALSE | TRUE is also TRUE.

NA | FALSE
# [1] NA
# TRUE | FALSE is TRUE but FALSE | FALSE is FALSE.

NA & TRUE
# [1] NA
# TRUE & TRUE is TRUE but FALSE & TRUE is FALSE.

NA & FALSE
# [1] FALSE
# TRUE & FALSE is FALSE and FALSE & FALSE is also FALSE.
```

NA .

```
df <- data.frame(v1=0:9,
                 v2=c(rep(1:2, each=4), NA, NA),
                 v3=c(NA, letters[2:10]))

df[df$v2 == 1 & !is.na(df$v2), ]
#  v1 v2   v3
#1  0  1 <NA>
#2  1  1    b
#3  2  1    c
#4  3  1    d

df[df$v2 == 1, ]
     v1 v2   v3
#1     0  1 <NA>
#2     1  1    b
#3     2  1    c
#4     3  1    d
#NA   NA NA <NA>
#NA.1 NA NA <NA>
```

NA . SPSS 99 .

```
num.vec <- c(1, 2, 3, 99, 5)
num.vec
## [1]  1  2  3 99  5
```

NA .

```
num.vec[num.vec == 99] <- NA
```

is.na<- . (?is.na) .

is.na<- . .

```
is.na(num.vec) <- num.vec == 99
```

```
num.vec
## [1]  1  2  3 NA  5
```

.

```
num.vec[!is.na(num.vec)]
num.vec[complete.cases(num.vec)]
na.omit(num.vec)
## [1] 1 2 3 5
```

.

```
mean(num.vec) # returns: [1] NA
```

na.rm NA .

```
mean(num.vec, na.rm = TRUE) # returns: [1] 2.75

# an alternative to using 'na.rm = TRUE':
mean(num.vec[!is.na(num.vec)]) # returns: [1] 2.75
```

lm R na.action . na.omit options(na.action = 'na.exclude') R .

na.action na.action . :

```
 lm(y2 ~ y1, data = anscombe, na.action = 'na.exclude')
```

: https://riptutorial.com/ko/r/topic/3388/-

57:

`sub` `gsub` . .

Examples

`pattern` . `replacement` .

", forename" "forename surname" .

```
library(randomNames)
set.seed(1)

strings <- randomNames(5)
strings
# [1] "Sigg, Zachary"        "Holt, Jake"           "Ortega, Sandra"       "De La Torre,
Nichole"
# [5] "Perkins, Donovon"

sub("^(.+),\\s(.+)$", "\\2 \\1", strings)
# [1] "Zachary Sigg"        "Jake Holt"           "Sandra Ortega"       "Nichole De La Torre"
# [5] "Donovon Perkins"
```

.

```
sub("^(.+),\\s(.+)", "\\1", strings)
# [1] "Sigg"        "Holt"        "Ortega"      "De La Torre" "Perkins"
```

( ). :

```
2,14,14,14,19
```

:

```
2,14,19
```

`gsub` .

```
gsub("(\\d+)(,\\1)+","\\1", "2,14,14,14,19")
[1] "2,14,19"
```

, .

```
 > gsub("(\\d+)(,\\1)+", "\\1", "2,14,14,14,19,19,20,21")
[1] "2,14,19,20,21"
```

.

1. `(\\d+)` : (1) ( ) 1. (`\"` `\'`) (`\\`) . `\d\` `[0-9]` .

2. , : : , (   )
3. \\1 : 1 , .   .

.   .

```
one,two,two,three,four,four,five,six
```

\d \w . \w ,   . [a-zA-Z0-9_] .

```
> gsub("(\\w+)(,\\1)+", "\\1", "one,two,two,three,four,four,five,six")
[1] "one,two,three,four,five,six"
>
```

,   .

: https://riptutorial.com/ko/r/topic/9219/---

58:

R . , . . .- - -

Examples

Vector1 .

```
set.seed(123)
Vector1 <- rnorm(20)
```

.

```
set.seed(123)
Vector1[sample(1:length(Vector1), 5)] <- NA
```

is.na Vector .

```
Vector1 <- Vector1[!is.na(Vector1)]
```

Vector1 NA .

NA . *complete.cases* .

6 NAs

```
x <- head(airquality)
```

Solar.R NAs 2 .

```
x_no_NA <- x[complete.cases(x),]
```

x_no_NA NAs

: https://riptutorial.com/ko/r/topic/8165/-

59:

R . R . R .

Examples

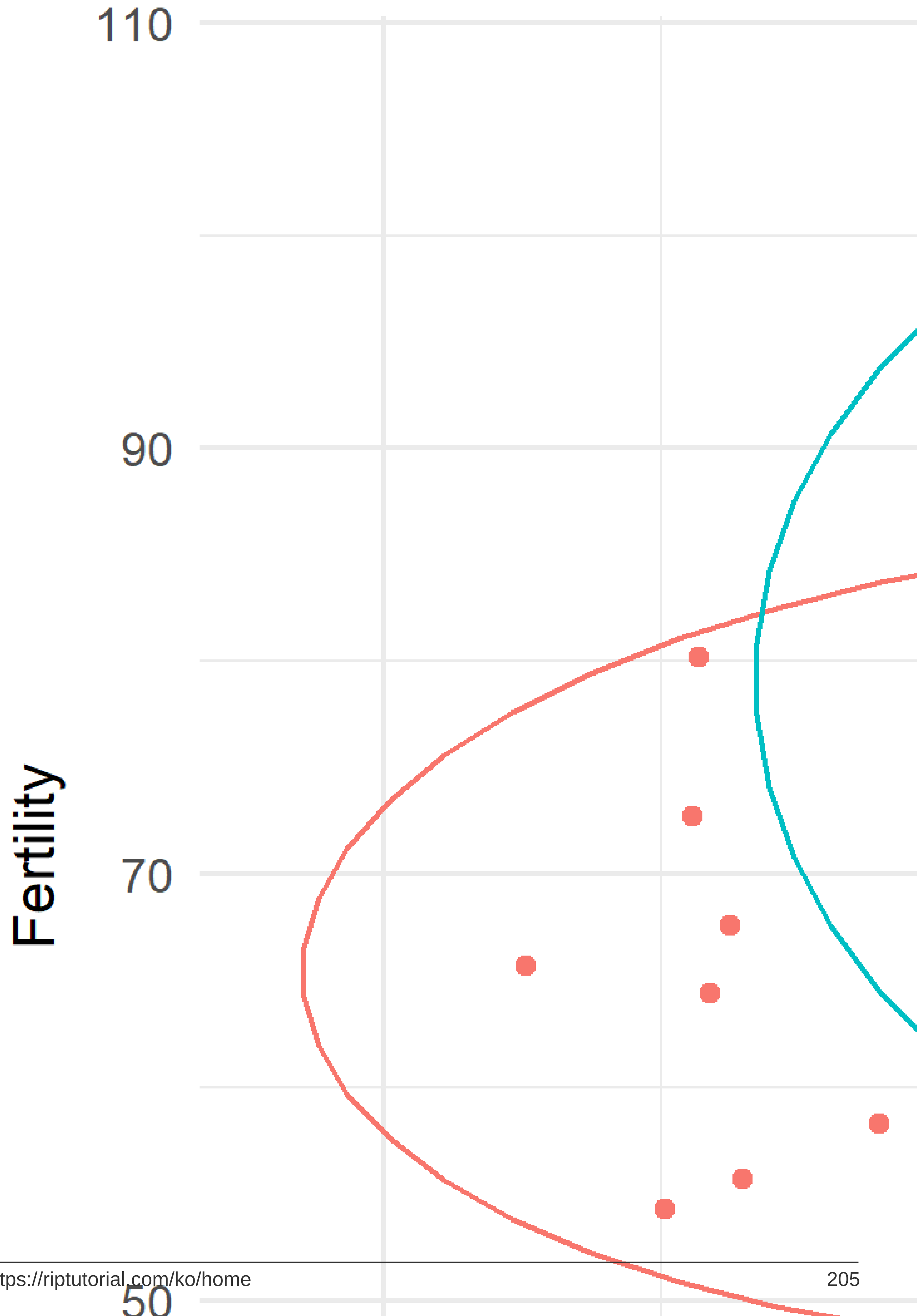
R . . .

https://vincentarelbundock.github.io/Rdatasets/datasets.html

(1888) . .

```
library(tidyverse)

swiss %>%
        ggplot(aes(x = Agriculture, y = Fertility,
                   color = Catholic > 50))+
        geom_point()+
        stat_ellipse()
```


110
90
70
50
Fertility

60:

- data.frame (..., row.names = NULL, check.rows = FALSE, check.names = TRUE, stringsAsFactors = default.stringsAsFactors ())
- as.data.frame (x, row.names = NULL, = FALSE, ...) #
- as.data.frame (x, ..., stringsAsFactors = default.stringsAsFactors ()) " # S3
- as.data.frame (x, row.names = NULL, = FALSE, ..., stringsAsFactors = default.stringsAsFactors ()) "
- is.data.frame (x)

Examples

data.frame

data.frame : . () " " . ( ).

data.frame .

```
> structure(list(character()), class = "data.frame")
NULL
<0 rows> (or 0-length row.names)
```

. data.frame . 3 2 data.frame (`a` `b`).

```
> structure(list(a = 1:3, b = letters[1:3]), class = "data.frame")
[1] a b
<0 rows> (or 0-length row.names)
```

data.frame . 1 : 3 .

```
> structure(list(a = 1:3, b = letters[1:3]), class = "data.frame", row.names = 1:3)
  a b
1 1 a
2 2 b
3 3 c
```

3 2 data.frame . `nrow()` , `ncol()` `dim()` .

```
> x <- structure(list(a = numeric(3), b = character(3)), class = "data.frame", row.names =
1:3)
> nrow(x)
[1] 3
> ncol(x)
[1] 2
> dim(x)
```

```
[1] 3 2
```

R data.frame (`structure()`). `data.frame()` . ., `data.frame()` .

```
> str(data.frame("a a a" = numeric(3), "b-b-b" = character(3)))
'data.frame':   3 obs. of  2 variables:
 $ a.a.a: num  0 0 0
 $ b.b.b: Factor w/ 1 level "": 1 1 1
```

`as.data.frame()` . data.frame `data.frame()` data.frame . , .

```
> m <- matrix(letters[1:9], nrow = 3)
> m
     [,1] [,2] [,3]
[1,] "a"  "d"  "g"
[2,] "b"  "e"  "h"
[3,] "c"  "f"  "i"
```

:

```
> as.data.frame(m)
  V1 V2 V3
1  a  d  g
2  b  e  h
3  c  f  i
> str(as.data.frame(m))
'data.frame':   3 obs. of  3 variables:
 $ V1: Factor w/ 3 levels "a","b","c": 1 2 3
 $ V2: Factor w/ 3 levels "d","e","f": 1 2 3
 $ V3: Factor w/ 3 levels "g","h","i": 1 2 3
```

: `[` , `[[` , `$`

.

- `data[rows, columns]` `matrix`
  -
  - ( )
- `list` :
  - `data[columns]`
  - `data[[one_column]]`
- `$` `data$column_name`

`mtcars` .

: `data[rows, columns]`

`mtcars` `[]` . .

```
# get the first row
```

```
mtcars[1, ]
# get the first five rows
mtcars[1:5, ]
```

:

```
# get the first column
mtcars[, 1]
# get the first, third and fifth columns:
mtcars[, c(1, 3, 5)]
```

. mtcars[1,] .

( )

. data.frame . numeric character .

```
# get the mpg column
mtcars[, "mpg"]
# get the mpg, cyl, and disp columns
mtcars[, c("mpg", "cyl", "disp")]
```

.

```
mtcars["Mazda Rx4", ]
```

.

```
# first four rows of the mpg column
mtcars[1:4, "mpg"]

# 2nd and 5th row of the mpg, cyl, and disp columns
mtcars[c(2, 5), c("mpg", "cyl", "disp")]
```

:

. .

```
## multiple columns returns a data frame
class(mtcars[, c("mpg", "cyl")])
# [1] "data.frame"
## single column returns a vector
class(mtcars[, "mpg"])
# [1] "numeric"
```

. ( ) , drop = FALSE . R " ".

```
class(mtcars[, "mpg", drop = FALSE])
# [1] "data.frame"
```

. , drop = FALSE .

list . , ( ). [ ] [[[[.

data[columns]

.

```
mtcars["mpg"]
mtcars[c("mpg", "cyl", "disp")]
my_columns <- c("mpg", "cyl", "hp")
mtcars[my_columns]
```

data[columns] data[, columns] data.frame list *data.frame* . matrix data.frame data.frame .

```
## When selecting a single column
## like a list will return a data frame
class(mtcars["mpg"])
# [1] "data.frame"
## like a matrix will return a vector
class(mtcars[, "mpg"])
# [1] "numeric"
```

data[[one_column]]

data.frame list [[. .

```
# extract a single column by name as a vector
mtcars[["mpg"]]

# extract a single column by name as a data frame (as above)
mtcars["mpg"]
```

$

$.

```
# get the column "mpg"
mtcars$mpg
```

$.

$

$. (: RStudio) . $ . . , .

```
my_column <- "mpg"
# the below will not work
mtcars$my_column
# but these will work
```

```
mtcars[, my_column]  # vector
mtcars[my_column]    # one-column data frame
mtcars[[my_column]]  # vector
```

R $. (:) $.

( ) $

```
# give you the values of "mpg" column
# as "mtcars" has only one column having name starting with "m"
mtcars$m
# will give you "NULL"
# as "mtcars" has more than one columns having name starting with "d"
mtcars$d
```

:

() .

.

```
mtcars[1, ]   # first row
mtcars[ -1, ] # everything but the first row
mtcars[-(1:10), ] # everything except the first 10 rows
```

.

< .

```
# logical vector indicating TRUE when a row has mpg less than 15
# FALSE when a row has mpg >= 15
test <- mtcars$mpg < 15

# extract these rows from the data frame
mtcars[test, ]
```

.

```
# extract all columns for rows where the value of cyl is 4.
mtcars[mtcars$cyl == 4, ]
# extract the cyl, mpg, and hp columns where the value of cyl is 4
mtcars[mtcars$cyl == 4, c("cyl", "mpg", "hp")]
```

data.frames

`data.frames` `subset()` , `transform()` , `with()` `within()` .

`subset()` `data.frame` ( ).

```
subset(mtcars, subset = cyl == 6, select = c("mpg", "hp"))
                mpg  hp
Mazda RX4      21.0 110
Mazda RX4 Wag  21.0 110
Hornet 4 Drive 21.4 110
Valiant        18.1 105
Merc 280       19.2 123
Merc 280C      17.8 123
Ferrari Dino   19.7 175
```

cyl == 6 mpg hp . [] .

```
mtcars[mtcars$cyl == 6, c("mpg", "hp")]
```

transform() data.frame . mpg2 mpg^2 mtcars data.frame :

```
mtcars <- transform(mtcars, mpg2 = mpg^2)
```

~

with() within() data.frame $ [] .

, / airquality data.frame :

```
aq <- within(airquality, {
    lOzone <- log(Ozone) # creates new column
    Month <- factor(month.abb[Month]) # changes Month Column
    cTemp <- round((Temp - 32) * 5/9, 1) # creates new column
    S.cT <- Solar.R / cTemp  # creates new column
    rm(Day, Temp) # removes columns
})
```

. .data.frame . .: 1 3 .

```
df1 <- data.frame(x = 1:3, y = c("a", "b", "c"))
df1
##   x y
## 1 1 a
## 2 2 b
## 3 3 c
class(df1)
## [1] "data.frame"
```

.

```
df2 <- data.frame(x = c("1", "2", "3"), y = c("a", "b", "c"))
df2
##   x y
## 1 1 a
## 2 2 b
## 3 3 c
```

"X" df1 df2 . str .

```
str(df1)
## 'data.frame':    3 obs. of  2 variables:
##  $ x: int  1 2 3
##  $ y: Factor w/ 3 levels "a","b","c": 1 2 3
str(df2)
## 'data.frame':    3 obs. of  2 variables:
##  $ x: Factor w/ 3 levels "1","2","3": 1 2 3
##  $ y: Factor w/ 3 levels "a","b","c": 1 2 3
```

df1 data.frame "x" "y" 3 . "x" ( ) "y" ( ) . . stringsAsFactors .

```
df3 <- data.frame(x = 1:3, y = c("a", "b", "c"), stringsAsFactors = FALSE)
str(df3)
## 'data.frame':    3 obs. of  2 variables:
##  $ x: int  1 2 3
##  $ y: chr  "a" "b" "c"
```

"y" . "" . data.frame . (data.frame(x = 1:3, y = 1:4) .)

, R . :

```
mydataframe <- iris
str(mydataframe)
```

do.call .

do.call . .

```
dataList  <- list(1:3,4:6,7:9)
dataList
# [[1]]
# [1] 1 2 3
#
# [[2]]
# [1] 4 5 6
#
# [[3]]
# [1] 7 8 9

dataframe <- data.frame(do.call(rbind, dataList))
dataframe
#   X1 X2 X3
# 1  1  2  3
# 2  4  5  6
# 3  7  8  9
```

.

```
dataframeList  <- list(data.frame(a = 1:2, b = 1:2, c = 1:2),
                       data.frame(a = 3:4, b = 3:4, c = 3:4))
dataframeList
# [[1]]
```

```
#   a b c
# 1 1 1 1
# 2 2 2 2

# [[2]]
#   a b c
# 1 3 3 3
# 2 4 4 4

dataframe      <- do.call(rbind, dataframeList)
dataframe
#   a b c
# 1 1 1 1
# 2 2 2 2
# 3 3 3 3
# 4 4 4 4
```

data.frame

. RDBMS data.frame . . .

. FALSE stringsAsFactors .

.

```
bob <- data.frame(jobs = c("scientist", "analyst"),
                  pay  = c(160000, 100000), age = c(30, 25))
str(bob)
```

```
'data.frame':    2 obs. of  3 variables:
 $ jobs: Factor w/ 2 levels "analyst","scientist": 2 1
 $ pay : num  160000 100000
 $ age : num  30 25
```

```
# Convert *all columns* to character
bob[] <- lapply(bob, as.character)
str(bob)
```

```
    'data.frame':    2 obs. of  3 variables:
 $ jobs: chr  "scientist" "analyst"
 $ pay : chr  "160000" "1e+05"
 $ age : chr  "30" "25"
```

```
# Convert only factor columns to character
bob[] <- lapply(bob, function(x) {
    if is.factor(x) x <- as.character(x)
    return(x)
})
```

columns rows .

```
df <- data.frame(item = c(1:10),
                 price_Elasticity = c(-0.57667, 0.03205, -0.04904, 0.10342, 0.04029,
```

```
                                       0.0742, 0.1669, 0.0313, 0.22204, 0.06158),
                   total_Margin = c(-145062, 98671, 20576, -56382, 207623, 43463, 1235,
                                    34521, 146553, -74516))
```

price_Elasticity > 0 rows .

df[df$price_Elasticity > 0,]

```
   item price_Elasticity total_Margin
2     2          0.03205        98671
4     4          0.10342       -56382
5     5          0.04029       207623
6     6          0.07420        43463
7     7          0.16690         1235
8     8          0.03130        34521
9     9          0.22204       146553
10   10          0.06158       -74516
```

price_Elasticity > 0 total_Margin > 0 :

df[df$price_Elasticity > 0 & df$total_Margin > 0,]

```
  item price_Elasticity total_Margin
2    2          0.03205        98671
5    5          0.04029       207623
6    6          0.07420        43463
7    7          0.16690         1235
8    8          0.03130        34521
9    9          0.22204       146553
```

: https://riptutorial.com/ko/r/topic/438/-

61:

R . R . .

Examples

R

aggregate .

```
aggregate(formula,function,data)
```

.

:

```
df = data.frame(group=c("Group 1","Group 1","Group 2","Group 2","Group 2"), subgroup =
c("A","A","A","A","B"),value = c(2,2.5,1,2,1.5))

# sum, grouping by one column
aggregate(value~group, FUN=sum, data=df)

# mean, grouping by one column
aggregate(value~group, FUN=mean, data=df)

# sum, grouping by multiple columns
aggregate(value~group+subgroup,FUN=sum,data=df)

# custom function, grouping by one column
# in this example we want the sum of all values larger than 2 per group.
aggregate(value~group, FUN=function(x) sum(x[x>2]), data=df)
```

:

```
> df = data.frame(group=c("Group 1","Group 1","Group 2","Group 2","Group 2"), subgroup =
c("A","A","A","A","B"),value = c(2,2.5,1,2,1.5))
> print(df)
    group subgroup value
1 Group 1        A   2.0
2 Group 1        A   2.5
3 Group 2        A   1.0
4 Group 2        A   2.0
5 Group 2        B   1.5
>
> # sum, grouping by one column
> aggregate(value~group, FUN=sum, data=df)
    group value
1 Group 1   4.5
2 Group 2   4.5
>
> # mean, grouping by one column
> aggregate(value~group, FUN=mean, data=df)
    group value
```

```
1 Group 1  2.25
2 Group 2  1.50
>
> # sum, grouping by multiple columns
> aggregate(value~group+subgroup,FUN=sum,data=df)
    group subgroup value
1 Group 1        A   4.5
2 Group 2        A   3.0
3 Group 2        B   1.5
>
> # custom function, grouping by one column
> # in this example we want the sum of all values larger than 2 per group.
> aggregate(value~group, FUN=function(x) sum(x[x>2]), data=df)
    group value
1 Group 1   2.5
2 Group 2   0.0
```

dplyr

dplyr ! group_by () summarize () . .

:

```
# Aggregating with dplyr
library(dplyr)

df = data.frame(group=c("Group 1","Group 1","Group 2","Group 2","Group 2"), subgroup =
c("A","A","A","A","B"),value = c(2,2.5,1,2,1.5))
print(df)

# sum, grouping by one column
df %>% group_by(group) %>% summarize(value = sum(value)) %>% as.data.frame()

# mean, grouping by one column
df %>% group_by(group) %>% summarize(value = mean(value)) %>% as.data.frame()

# sum, grouping by multiple columns
df %>% group_by(group,subgroup) %>% summarize(value = sum(value)) %>% as.data.frame()

# custom function, grouping by one column
# in this example we want the sum of all values larger than 2 per group.
df %>% group_by(group) %>% summarize(value = sum(value[value>2])) %>% as.data.frame()
```

:

```
> library(dplyr)
>
> df = data.frame(group=c("Group 1","Group 1","Group 2","Group 2","Group 2"), subgroup =
c("A","A","A","A","B"),value = c(2,2.5,1,2,1.5))
> print(df)
    group subgroup value
1 Group 1        A   2.0
2 Group 1        A   2.5
3 Group 2        A   1.0
4 Group 2        A   2.0
5 Group 2        B   1.5
>
```

```
> # sum, grouping by one column
> df %>% group_by(group) %>% summarize(value = sum(value)) %>% as.data.frame()
    group value
1 Group 1   4.5
2 Group 2   4.5
>
> # mean, grouping by one column
> df %>% group_by(group) %>% summarize(value = mean(value)) %>% as.data.frame()
    group value
1 Group 1  2.25
2 Group 2  1.50
>
> # sum, grouping by multiple columns
> df %>% group_by(group,subgroup) %>% summarize(value = sum(value)) %>% as.data.frame()
    group subgroup value
1 Group 1        A   4.5
2 Group 2        A   3.0
3 Group 2        B   1.5
>
> # custom function, grouping by one column
> # in this example we want the sum of all values larger than 2 per group.
> df %>% group_by(group) %>% summarize(value = sum(value[value>2])) %>% as.data.frame()
    group value
1 Group 1   2.5
2 Group 2   0.0
```

data.table

data.table `dt[i, j, by]` . " *dt* *i* *j* . "dt , . `list()` `.()` . `.()` `.()` .

:

```
# Aggregating with data.table
library(data.table)

dt = data.table(group=c("Group 1","Group 1","Group 2","Group 2","Group 2"), subgroup =
c("A","A","A","A","B"),value = c(2,2.5,1,2,1.5))
print(dt)

# sum, grouping by one column
dt[,.(value=sum(value)),group]

# mean, grouping by one column
dt[,.(value=mean(value)),group]

# sum, grouping by multiple columns
dt[,.(value=sum(value)),.(group,subgroup)]

# custom function, grouping by one column
# in this example we want the sum of all values larger than 2 per group.
dt[,.(value=sum(value[value>2])),group]
```

:

```
> # Aggregating with data.table
> library(data.table)
>
```

```
> dt = data.table(group=c("Group 1","Group 1","Group 2","Group 2","Group 2"), subgroup =
c("A","A","A","A","B"),value = c(2,2.5,1,2,1.5))
> print(dt)
     group subgroup value
1: Group 1        A   2.0
2: Group 1        A   2.5
3: Group 2        A   1.0
4: Group 2        A   2.0
5: Group 2        B   1.5
>
> # sum, grouping by one column
> dt[,.(value=sum(value)),group]
     group value
1: Group 1   4.5
2: Group 2   4.5
>
> # mean, grouping by one column
> dt[,.(value=mean(value)),group]
     group value
1: Group 1  2.25
2: Group 2  1.50
>
> # sum, grouping by multiple columns
> dt[,.(value=sum(value)),.(group,subgroup)]
     group subgroup value
1: Group 1        A   4.5
2: Group 2        A   3.0
3: Group 2        B   1.5
>
> # custom function, grouping by one column
> # in this example we want the sum of all values larger than 2 per group.
> dt[,.(value=sum(value[value>2])),group]
     group value
1: Group 1   2.5
2: Group 2   0.0
```

: https://riptutorial.com/ko/r/topic/10792/--

62: I / O

- RMySQL
- RODBC

Examples

MySQL

RMySQL MariaDB MySQL R .

```
library(RMySQL)

mydb <- dbConnect(MySQL(), user='user', password='password', dbname='dbname',host='127.0.0.1')

queryString <- "SELECT * FROM table1 t1 JOIN table2 t2 on t1.id=t2.id"
query <- dbSendQuery(mydb, queryString)
data <- fetch(query, n=-1) # n=-1 to return all results
```

100,000 . SQL . . :

```
queryString <- "SELECT * FROM table1 limit 100000"
```

MongoDB

MongoDB R MongoLite .

```
# Use MongoLite library:
#install.packages("mongolite")
library(jsonlite)
library(mongolite)

# Connect to the database and the desired collection as root:
db <- mongo(collection = "Tweets", db = "TweetCollector", url =
"mongodb://USERNAME:PASSWORD@HOSTNAME")

# Read the desired documents i.e. Tweets inside one dataframe:
documents <- db$find(limit = 100000, skip = 0, fields = '{ "_id" : false, "Text" : true }')
```

`HOSTNAME` `PASSWORD` `USERNAME` `TweetCollector` `Tweets` . , `Text` .

. `Text` (: `documents$Text` .

I / O : https://riptutorial.com/ko/r/topic/5537/---i---o

63: R

R R . R `source(.)` R .

/ `file("stdin")` ( ), `stdout()` ( ) `stderr()` ( ). `stdin()` R `stdin()` .

Examples

R

R

R `R` (Windows `R.exe` `R` `Rscript` (`Rscript.exe`) .

R **Shebang** . `#!/usr/bin/env Rscript` . Windows .

R "hist.png" .

```
#!/usr/bin/env Rscript

# User message (\n = end the line)
cat("Input numbers, separated by space:\n")
# Read user input as one string (n=1 -> Read only one line)
input <- readLines(file('stdin'), n=1)
# Split the string at each space (\\s == any space)
input <- strsplit(input, "\\s")[[1]]
# convert the obtained vector of strings to numbers
input <- as.numeric(input)

# Open the output picture file
png("hist.png",width=400, height=300)
# Draw the histogram
hist(input)
# Close the output file
dev.off()
```

R . Shebang . `cat("....\n")` . `file("stdin")` " `file("stdin")` . (`scan` , `read.table` , `read.csv` , ...) . . . `png(.)` `dev.off()` . (`jpeg(.)` `pdf(.)`) . `dev.off()` . .

R

Linux / Mac

. "" "" " " .

```
chmod +x PATH/TO/SCRIPT/SCRIPTNAME.R
```

.

Windows

.

```
"C:\Program Files\R-XXXXXXX\bin\Rscript.exe" "%~dp0\XXXXXXX.R" %*
```

`*.txt` `*.bat` `*.bat` . `notepad` (`Word`) `"FILENAME.bat"` . `""` .

`XXX...` :

- R
- .

: `"C:\...\Rscript.exe"` Windows `Rscript.exe` . `"%~dp0\XXX.R"` `Rscript` R . `%~dp0` . `%*` R .

R . R .

littler R

littler (*r*) (cran) littler `r` R (Linux MacOS).

littler

R :

```
install.packages("littler")
```

`r` .

```
You could link to the 'r' binary installed in
'/home/*USER*/R/x86_64-pc-linux-gnu-library/3.4/littler/bin/r'
from '/usr/local/bin' in order to use 'r' for scripting.
```

`r` , symlink :

```
ln -s /home/*USER*/R/x86_64-pc-linux-gnu-library/3.4/littler/bin/r /usr/local/bin/r
```

apt-get (Debian, Ubuntu) :

```
sudo apt-get install littler
```

.r littler

`littler r` R . :

```
# User message (\n = end the line)
cat("Input numbers, separated by space:\n")
# Read user input as one string (n=1 -> Read only one line)
input <- readLines(file('stdin'), n=1)
# Split the string at each space (\\s == any space)
input <- strsplit(input, "\\s")[[1]]
# convert the obtained vector of strings to numbers
input <- as.numeric(input)

# Open the output picture file
png("hist.png",width=400, height=300)
# Draw the histogram
hist(input)
# Close the output file
dev.off()
```

shebang . `hist.r` .

```
r hist.r
```

littler

shebang littler R

```
#!/usr/bin/env r
```

R `chmod +X /path/to/script.r` .

R : https://riptutorial.com/ko/r/topic/9937/-r----

64:

dplyr R "" plyr . dplyr CRAN .

```
install.package("dplyr")
```

dplyr tbl. dplyr (0.5.0) .

-
-
- SQLite
- PostgreSQL / Redshift
- MySQL / MariaDB
-
- MonetDB
- ( )

Examples

dplyr

dplyr R . : data.frame , data.table , database . dplyr dplyr .

dplyr . (filter , arrange , select , mutate summarise) . group_by .

.

- .
- (: $).
- . , . .

mtcars dplyr . mtcars tbl_df ( ), rownames rownames_to_column tibble .

```
library(dplyr) # This documentation was written using version 0.5.0

mtcars_tbl <- as_data_frame(tibble::rownames_to_column(mtcars, "cars"))

# examine the structure of data
head(mtcars_tbl)

# A tibble: 6 x 12
#                 cars   mpg   cyl  disp    hp  drat    wt  qsec    vs    am  gear  carb
#                <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
#1         Mazda RX4  21.0     6   160   110  3.90 2.620 16.46     0     1     4     4
#2     Mazda RX4 Wag  21.0     6   160   110  3.90 2.875 17.02     0     1     4     4
#3        Datsun 710  22.8     4   108    93  3.85 2.320 18.61     1     1     4     1
#4    Hornet 4 Drive  21.4     6   258   110  3.08 3.215 19.44     1     0     3     1
#5 Hornet Sportabout  18.7     8   360   175  3.15 3.440 17.02     0     0     3     2
#6           Valiant  18.1     6   225   105  2.76 3.460 20.22     1     0     3     1
```

filter . data.frame ( ) (TRUE FALSE)

4 - cyl :

```
filter(mtcars_tbl, cyl == 4)

# A tibble: 11 x 12
#              cars   mpg   cyl  disp    hp  drat    wt  qsec    vs    am  gear  carb
#             <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
#1      Datsun 710  22.8     4 108.0    93  3.85 2.320 18.61     1     1     4     1
#2       Merc 240D  24.4     4 146.7    62  3.69 3.190 20.00     1     0     4     2
#3        Merc 230  22.8     4 140.8    95  3.92 3.150 22.90     1     0     4     2
#4        Fiat 128  32.4     4  78.7    66  4.08 2.200 19.47     1     1     4     1
#5     Honda Civic  30.4     4  75.7    52  4.93 1.615 18.52     1     1     4     2
# ... with 6 more rows
```

. 4 6 - cyl 5 - gear :

```
filter(mtcars_tbl, cyl == 4 | cyl == 6, gear == 5)

# A tibble: 3 x 12
#            cars   mpg   cyl  disp    hp  drat    wt  qsec    vs    am  gear  carb
#           <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
#1 Porsche 914-2  26.0     4 120.3    91  4.43 2.140  16.7     0     1     5     2
#2  Lotus Europa  30.4     4  95.1   113  3.77 1.513  16.9     1     1     5     2
#3  Ferrari Dino  19.7     6 145.0   175  3.62 2.770  15.5     0     1     5     6
```

filter slice . slice . data.frame .

6 ~ 9 .

```
slice(mtcars_tbl, 6:9)

# A tibble: 4 x 12
#         cars   mpg   cyl  disp    hp  drat    wt  qsec    vs    am  gear  carb
#        <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
#1    Valiant  18.1     6 225.0   105  2.76  3.46 20.22     1     0     3     1
#2 Duster 360  14.3     8 360.0   245  3.21  3.57 15.84     0     0     3     4
#3  Merc 240D  24.4     4 146.7    62  3.69  3.19 20.00     1     0     4     2
#4   Merc 230  22.8     4 140.8    95  3.92  3.15 22.90     1     0     4     2
```

:

```
slice(mtcars_tbl, -c(1:5, 10:n()))
```

slice(mtcars_tbl, 6:9) slice(mtcars_tbl, 6:9)

n() .

arrange () . (dplyr), data.frame , . .

- hp

```
arrange(mtcars_tbl, hp)

# A tibble: 32 x 12
#             cars   mpg   cyl  disp    hp  drat    wt  qsec    vs    am  gear  carb
#            <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
#1     Honda Civic  30.4     4  75.7    52  4.93 1.615 18.52     1     1     4     2
#2       Merc 240D  24.4     4 146.7    62  3.69 3.190 20.00     1     0     4     2
#3  Toyota Corolla  33.9     4  71.1    65  4.22 1.835 19.90     1     1     4     1
#4        Fiat 128  32.4     4  78.7    66  4.08 2.200 19.47     1     1     4     1
#5       Fiat X1-9  27.3     4  79.0    66  4.08 1.935 18.90     1     1     4     1
#6   Porsche 914-2  26.0     4 120.3    91  4.43 2.140 16.70     0     1     5     2
# ... with 26 more rows
```

arrange - mpg - cyl :

```
arrange(mtcars_tbl, desc(mpg), cyl)

# A tibble: 32 x 12
#             cars   mpg   cyl  disp    hp  drat    wt  qsec    vs    am  gear  carb
#            <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
#1  Toyota Corolla  33.9     4  71.1    65  4.22 1.835 19.90     1     1     4     1
#2        Fiat 128  32.4     4  78.7    66  4.08 2.200 19.47     1     1     4     1
#3     Honda Civic  30.4     4  75.7    52  4.93 1.615 18.52     1     1     4     2
#4    Lotus Europa  30.4     4  95.1   113  3.77 1.513 16.90     1     1     5     2
#5       Fiat X1-9  27.3     4  79.0    66  4.08 1.935 18.90     1     1     4     1
#6   Porsche 914-2  26.0     4 120.3    91  4.43 2.140 16.70     0     1     5     2
# ... with 26 more rows
```

select . mpg , disp , wt , qsec vs mtcars_tbl :

```
select(mtcars_tbl, mpg, disp, wt, qsec, vs)

# A tibble: 32 x 5
#     mpg  disp    wt  qsec    vs
#   <dbl> <dbl> <dbl> <dbl> <dbl>
#1   21.0 160.0 2.620 16.46     0
#2   21.0 160.0 2.875 17.02     0
#3   22.8 108.0 2.320 18.61     1
#4   21.4 258.0 3.215 19.44     1
#5   18.7 360.0 3.440 17.02     0
#6   18.1 225.0 3.460 20.22     1
# ... with 26 more rows
```

: . cars disp vs carb :

```
select(mtcars_tbl, cars:disp, vs:carb)

# A tibble: 32 x 8
#                cars   mpg   cyl  disp    vs    am  gear  carb
#               <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
#1          Mazda RX4  21.0     6 160.0     0     1     4     4
#2      Mazda RX4 Wag  21.0     6 160.0     0     1     4     4
#3         Datsun 710  22.8     4 108.0     1     1     4     1
#4     Hornet 4 Drive  21.4     6 258.0     1     0     3     1
#5  Hornet Sportabout  18.7     8 360.0     0     0     3     2
#6            Valiant  18.1     6 225.0     1     0     3     1
```

```
# ... with 26 more rows
```

select(mtcars_tbl, -(hp:qsec))

. ,(starts_with() , ends_with() , contains() , matches() , num_range() , one_of() , everything()) select . ?select_helpers ?select ?select .

: select() .

.

```
select(mtcars_tbl, cylinders = cyl, displacement = disp)

# A tibble: 32 x 2
#   cylinders displacement
#       <dbl>        <dbl>
#1          6        160.0
#2          6        160.0
#3          4        108.0
#4          6        258.0
#5          8        360.0
#6          6        225.0
# ... with 26 more rows
```

.

rename :

```
rename(mtcars_tbl, cylinders = cyl, displacement = disp)

# A tibble: 32 x 12
#                cars   mpg cylinders displacement    hp  drat    wt  qsec    vs
#               <chr> <dbl>     <dbl>        <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
#1          Mazda RX4  21.0         6        160.0   110  3.90 2.620 16.46     0
#2      Mazda RX4 Wag  21.0         6        160.0   110  3.90 2.875 17.02     0
#3         Datsun 710  22.8         4        108.0    93  3.85 2.320 18.61     1
#4     Hornet 4 Drive  21.4         6        258.0   110  3.08 3.215 19.44     1
#5  Hornet Sportabout  18.7         8        360.0   175  3.15 3.440 17.02     0
#6            Valiant  18.1         6        225.0   105  2.76 3.460 20.22     1
# ... with 26 more rows, and 3 more variables: am <dbl>, gear <dbl>, carb <dbl>
```

mutate . dplyr **mutate** . data.frame .

```
mutate(mtcars_tbl, weight_ton = wt/2, weight_pounds = weight_ton * 2000)

# A tibble: 32 x 14
#                cars   mpg   cyl  disp    hp  drat    wt  qsec    vs    am  gear  carb
weight_ton weight_pounds
#               <chr> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
<dbl>         <dbl>
#1          Mazda RX4  21.0     6 160.0   110  3.90 2.620 16.46     0     1     4     4
1.3100          2620
#2      Mazda RX4 Wag  21.0     6 160.0   110  3.90 2.875 17.02     0     1     4     4
1.4375          2875
```

```
#3          Datsun 710  22.8     4 108.0    93  3.85 2.320 18.61     1     1     4     1
1.1600          2320
#4      Hornet 4 Drive  21.4     6 258.0   110  3.08 3.215 19.44     1     0     3     1
1.6075          3215
#5   Hornet Sportabout  18.7     8 360.0   175  3.15 3.440 17.02     0     0     3     2
1.7200          3440
#6             Valiant  18.1     6 225.0   105  2.76 3.460 20.22     1     0     3     1
1.7300          3460
# ... with 26 more rows
```

weight_ton weight_pounds . R mutate   .

mutate transmute .

```
transmute(mtcars_tbl, weight_ton = wt/2, weight_pounds = weight_ton * 2000)

# A tibble: 32 x 2
#   weight_ton weight_pounds
#        <dbl>         <dbl>
#1      1.3100          2620
#2      1.4375          2875
#3      1.1600          2320
#4      1.6075          3215
#5      1.7200          3440
#6      1.7300          3460
# ... with 26 more rows
```

summarise   .   .

mpg disp   .

```
summarise(mtcars_tbl, mean_mpg = mean(mpg), sd_mpg = sd(mpg),
          mean_disp = mean(disp), sd_disp = sd(disp))

# A tibble: 1 x 4
#   mean_mpg   sd_mpg mean_disp  sd_disp
#      <dbl>    <dbl>     <dbl>    <dbl>
#1 20.09062 6.026948  230.7219 123.9387
```

group_by

group_by   .   .

cyl mpg mean sd :

```
by_cyl <- group_by(mtcars_tbl, cyl)
summarise(by_cyl, mean_mpg = mean(mpg), sd_mpg = sd(mpg))


# A tibble: 3 x 3
#     cyl mean_mpg   sd_mpg
#   <dbl>    <dbl>    <dbl>
```

```
#1     4 26.66364 4.509828
#2     6 19.74286 1.453567
#3     8 15.10000 2.560048
```

togther

`cars` `hp` `gear` , `cyl` `mpg` , `gear` , `mpg` > 20 `hp` > (75)

```
selected <- select(mtcars_tbl, cars:hp, gear)
ordered <- arrange(selected, cyl, desc(mpg))
by_cyl <- group_by(ordered, gear)
filter(by_cyl, mpg > 20, hp > 75)

Source: local data frame [9 x 6]
Groups: gear [3]

#             cars   mpg   cyl  disp    hp  gear
#            <chr> <dbl> <dbl> <dbl> <dbl> <dbl>
#1   Lotus Europa  30.4     4  95.1   113     5
#2  Porsche 914-2  26.0     4 120.3    91     5
#3     Datsun 710  22.8     4 108.0    93     4
#4       Merc 230  22.8     4 140.8    95     4
#5  Toyota Corona  21.5     4 120.1    97     3
# ... with 4 more rows
```

.

```
filter(
    group_by(
        arrange(
            select(
                mtcars_tbl, cars:hp
            ), cyl, desc(mpg)
        ), cyl
    ),mpg > 20, hp > 75
)
```

. `dplyr` pipe `%>%` . .

```
mtcars_tbl %>%
    select(cars:hp) %>%
    arrange(cyl, desc(mpg)) %>%
    group_by(cyl) %>%
    filter(mpg > 20, hp > 75)
```

.

`dplyr` ( ) `summarise_all()` .

.

```
mtcars_tbl %>%
    summarise_all(n_distinct)

# A tibble: 1 x 12
#   cars   mpg   cyl  disp    hp  drat    wt  qsec    vs    am  gear  carb
#  <int> <int> <int> <int> <int> <int> <int> <int> <int> <int> <int> <int>
#1    32    25     3    27    22    22    29    30     2     2     3     6
```

cyl .

```
mtcars_tbl %>%
    group_by(cyl) %>%
    summarise_all(n_distinct)

# A tibble: 3 x 12
#    cyl  cars   mpg  disp    hp  drat    wt  qsec    vs    am  gear  carb
#  <dbl> <int> <int> <int> <int> <int> <int> <int> <int> <int> <int> <int>
#1     4    11     9    11    10    10    11    11     2     2     3     2
#2     6     7     6     5     4     5     6     7     2     2     3     3
#3     8    14    12    11     9    11    13    14     1     2     2     4
```

group_by . 3 . cyl .

summarise summarise_at

```
mtcars_tbl %>%
    group_by(cyl) %>%
    summarise_at(c("mpg", "disp", "hp"), mean)

# A tibble: 3 x 4
#    cyl      mpg     disp        hp
#  <dbl>    <dbl>    <dbl>     <dbl>
#1     4 26.66364 105.1364  82.63636
#2     6 19.74286 183.3143 122.28571
#3     8 15.10000 353.1000 209.21429
```

helper (?select_helpers)

.

```
mtcars_tbl %>%
    group_by(cyl) %>%
    summarise_at(c("mpg", "disp", "hp"),
                 c("mean", "sd"))
```

funs funs .

```
mtcars_tbl %>%
    group_by(cyl) %>%
    summarise_at(c("mpg", "disp", "hp"),
                 funs(mean, sd))

# A tibble: 3 x 7
#    cyl mpg_mean disp_mean   hp_mean   mpg_sd  disp_sd    hp_sd
#  <dbl>    <dbl>     <dbl>     <dbl>    <dbl>    <dbl>    <dbl>
```

```
#1     4 26.66364  105.1364  82.63636 4.509828 26.87159 20.93453
#2     6 19.74286  183.3143 122.28571 1.453567 41.56246 24.26049
#3     8 15.10000  353.1000 209.21429 2.560048 67.77132 50.97689
```

.   .

```
mtcars_tbl %>%
    group_by(cyl) %>%
    summarise_at(c("mpg", "disp", "hp"),
                 c(Mean = "mean", SD = "sd"))

mtcars_tbl %>%
    group_by(cyl) %>%
    summarise_at(c("mpg", "disp", "hp"),
                 funs(Mean = mean, SD = sd))


# A tibble: 3 x 7
#    cyl mpg_Mean disp_Mean   hp_Mean   mpg_SD  disp_SD    hp_SD
#  <dbl>    <dbl>     <dbl>     <dbl>    <dbl>    <dbl>    <dbl>
#1     4 26.66364  105.1364  82.63636 4.509828 26.87159 20.93453
#2     6 19.74286  183.3143 122.28571 1.453567 41.56246 24.26049
#3     8 15.10000  353.1000 209.21429 2.560048 67.77132 50.97689
```

summarise_if summarise_if .

cyl numeric mean .

```
mtcars_tbl %>%
    group_by(cyl) %>%
    summarise_if(is.numeric, mean)

# A tibble: 3 x 11
#    cyl      mpg     disp        hp     drat       wt     qsec
#  <dbl>    <dbl>    <dbl>     <dbl>    <dbl>    <dbl>    <dbl>
#1     4 26.66364 105.1364  82.63636 4.070909 2.285727 19.13727
#2     6 19.74286 183.3143 122.28571 3.585714 3.117143 17.97714
#3     8 15.10000 353.1000 209.21429 3.229286 3.999214 16.77214
# ... with 4 more variables: vs <dbl>, am <dbl>, gear <dbl>,
#   carb <dbl>
```

mean mean .

cyl mean :

```
mtcars_tbl %>%
    group_by(cyl) %>%
    summarise_if(function(x) is.numeric(x) & n_distinct(x) > 6, mean)

# A tibble: 3 x 7
#    cyl      mpg     disp        hp     drat       wt     qsec
#  <dbl>    <dbl>    <dbl>     <dbl>    <dbl>    <dbl>    <dbl>
#1     4 26.66364 105.1364  82.63636 4.070909 2.285727 19.13727
#2     6 19.74286 183.3143 122.28571 3.585714 3.117143 17.97714
#3     8 15.10000 353.1000 209.21429 3.229286 3.999214 16.77214
```

()

dplyr::filter() - .

```
dplyr::filter(iris,Sepal.Length>7)
#       Sepal.Length Sepal.Width Petal.Length Petal.Width   Species
#    1           7.1         3.0          5.9         2.1 virginica
#    2           7.6         3.0          6.6         2.1 virginica
#    3           7.3         2.9          6.3         1.8 virginica
#    4           7.2         3.6          6.1         2.5 virginica
#    5           7.7         3.8          6.7         2.2 virginica
#    6           7.7         2.6          6.9         2.3 virginica
#    7           7.7         2.8          6.7         2.0 virginica
#    8           7.2         3.2          6.0         1.8 virginica
#    9           7.2         3.0          5.8         1.6 virginica
#    10          7.4         2.8          6.1         1.9 virginica
#    11          7.9         3.8          6.4         2.0 virginica
#    12          7.7         3.0          6.1         2.3 virginica
```

dplyr::distinct() - :

```
distinct(iris, Sepal.Length, .keep_all = TRUE)
#       Sepal.Length Sepal.Width Petal.Length Petal.Width    Species
#    1           5.1         3.5          1.4         0.2     setosa
#    2           4.9         3.0          1.4         0.2     setosa
#    3           4.7         3.2          1.3         0.2     setosa
#    4           4.6         3.1          1.5         0.2     setosa
#    5           5.0         3.6          1.4         0.2     setosa
#    6           5.4         3.9          1.7         0.4     setosa
#    7           4.4         2.9          1.4         0.2     setosa
#    8           4.8         3.4          1.6         0.2     setosa
#    9           4.3         3.0          1.1         0.1     setosa
#   10          5.8         4.0          1.2         0.2     setosa
#   11          5.7         4.4          1.5         0.4     setosa
#   12          5.2         3.5          1.5         0.2     setosa
#   13          5.5         4.2          1.4         0.2     setosa
#   14          4.5         2.3          1.3         0.3     setosa
#   15          5.3         3.7          1.5         0.2     setosa
#   16          7.0         3.2          4.7         1.4 versicolor
#   17          6.4         3.2          4.5         1.5 versicolor
#   18          6.9         3.1          4.9         1.5 versicolor
#   19          6.5         2.8          4.6         1.5 versicolor
#   20          6.3         3.3          4.7         1.6 versicolor
#   21          6.6         2.9          4.6         1.3 versicolor
#   22          5.9         3.0          4.2         1.5 versicolor
#   23          6.0         2.2          4.0         1.0 versicolor
#   24          6.1         2.9          4.7         1.4 versicolor
#   25          5.6         2.9          3.6         1.3 versicolor
#   26          6.7         3.1          4.4         1.4 versicolor
#   27          6.2         2.2          4.5         1.5 versicolor
#   28          6.8         2.8          4.8         1.4 versicolor
#   29          7.1         3.0          5.9         2.1  virginica
#   30          7.6         3.0          6.6         2.1  virginica
#   31          7.3         2.9          6.3         1.8  virginica
#   32          7.2         3.6          6.1         2.5  virginica
#   33          7.7         3.8          6.7         2.2  virginica
```

```
#   34          7.4         2.8          6.1          1.9  virginica
#   35          7.9         3.8          6.4          2.0  virginica
```

%> % ()

(%> %) `dplyr` . `mtcars` (`help("mtcars")`) .

```
library(dplyr)
library(magrittr)
df <- mtcars
df$cars <- rownames(df) #just add the cars names to the df
df <- df[,c(ncol(df),1:(ncol(df)-1))] # and place the names in the first column
```

1.

`summarize` . `n()` .

```
 df %>%
  summarize(count=n(),mean_mpg = mean(mpg, na.rm = TRUE),
            min_weight = min(wt),max_weight = max(wt))

#  count mean_mpg min_weight max_weight
#1    32 20.09062      1.513      5.424
```

2.

.

```
df %>%
  group_by(cyl, gear) %>%
  summarize(count=n(),mean_mpg = mean(mpg, na.rm = TRUE),
            min_weight = min(wt),max_weight = max(wt))

# Source: local data frame [8 x 6]
# Groups: cyl [?]
#
#    cyl  gear count mean_mpg min_weight max_weight
#  <dbl> <dbl> <int>    <dbl>      <dbl>      <dbl>
#1     4     3     1   21.500      2.465      2.465
#2     4     4     8   26.925      1.615      3.190
#3     4     5     2   28.200      1.513      2.140
#4     6     3     2   19.750      3.215      3.460
#5     6     4     4   19.750      2.620      3.440
#6     6     5     1   19.700      2.770      2.770
#7     8     3    12   15.050      3.435      5.424
#8     8     5     2   15.400      3.170      3.570
```

dplyr NSE

`dplyr` NSE (Non-Standard Evaluation) . . Shiny . `select` `select_` .

```
variable1 <- "Sepal.Length"
variable2 <- "Sepal.Width"
```

```
iris %>%
select_(variable1, variable2) %>%
head(n=5)
#   Sepal.Length Sepal.Width
#   1          5.1         3.5
#   2          4.9         3.0
#   3          4.7         3.2
#   4          4.6         3.1
#   5          5.0         3.6
```

lazyeval interp lazyeval .

```
variable1 <- "Sepal.Length"
variable2 <- "Sepal.Width"
variable3 <- "Species"
iris %>%
select_(variable1, variable2, variable3) %>%
group_by_(variable3) %>%
summarize_(mean1 = lazyeval::interp(~mean(var), var = as.name(variable1)), mean2 =
lazyeval::interp(~mean(var), var = as.name(variable2)))
#       Species mean1 mean2
#        <fctr> <dbl> <dbl>
# 1      setosa 5.006 3.428
# 2 versicolor 5.936 2.770
# 3  virginica 6.588 2.974
```

: https://riptutorial.com/ko/r/topic/4250/-

65:

Examples

`browser` . . R .

`browser()` `browser()` . R .

	.
	\
	(,)
	(,)
	" " .
	.

,

```
toDebug <- function() {
    a = 1
    b = 2

    browser()

    for(i in 1:100) {
        a = a * b
    }
}

toDebug()
```

.

```
Called from: toDebug
Browser[1]>
```

.

```
Called from: toDebug
Browser[1]> a
[1] 1
Browser[1]> b
[1] 2
Browse[1]> n
```

```
debug at #7: for (i in 1:100) {
    a = a * b
}
Browse[2]> n
debug at #8: a = a * b
Browse[2]> a
[1] 1
Browse[2]> n
debug at #8: a = a * b
Browse[2]> a
[1] 2
Browse[2]> Q
```

browser() .

```
mtcars %>% group_by(cyl) %>% {browser()}
```

debug debug .

```
debug(mean)
mean(1:3)
```

. undebug .

```
undebug(mean)
mean(1:3)
```

debugonce .

```
debugonce(mean)
mean(1:3)
mean(1:3)
```

: https://riptutorial.com/ko/r/topic/1695/

66: R with knitr

1. << - , ... >> =
   # R
   @
2. \ Sexpr { #R }
3. << read-external-R-file >> =
   read_chunk ('r-file.R')
   @
   << - , ... >> =
   @

	(TRUE / FALSE) - R
	(TRUE / FALSE) - R
	(TRUE / FALSE) - R
	(TRUE / FALSE) - R
	(TRUE / FALSE) - R
fig.width	() - R
.	() - R

Knitr (LaTeX) (R) . . knitr LaTeX (.tex) R (.R) R noweb (.Rnw) . .Rnw LaTeX R .

Knitr PDF .

.Rnw PDF . , R LaTeX ('kniting'). knitr . knitr .

```
Rscript -e "library(knitr); knit('r-noweb-file.Rnw')
```

.tex (r-noweb.tex) PDF .

```
pdflatex r-noweb-file.tex
```

Examples

R :

Knitr LaTeX R R . . R R / . . .

```
# r-noweb-file.Rnw
\documentclass{article}

 <<echo=FALSE,cache=FALSE>>=
 knitr::opts_chunk$set(echo=FALSE,  cache=TRUE)
 knitr::read_chunk('r-file.R')
 @

\begin{document}
This is an Rnw file (R noweb).  It contains a combination of LateX and R.

One we have called the read\_chunk command above we can reference sections of code in the r-
file.R script.

<<Chunk1>>=
@
\end{document}
```

R .

```
## r-file.R
## note the specific comment style of a single pound sign followed by four dashes

# ---- Chunk1 ----

print("This is R Code in an external file")

x <- seq(1:10)
y <- rev(seq(1:10))
plot(x,y)
```

R Knitr

Knitr LaTeX R R . . apporach .

```
# r-noweb-file.Rnw
\documentclass{article}
\begin{document}
This is an Rnw file (R noweb).  It contains a combination of LateX and R.

<<my-label>>=
print("This is an R Code Chunk")
x <- seq(1:10)
@

Above is an internal code chunk.
We can access data created in any code chunk inline with our LaTeX code like this.
The length of array x is \Sexpr{length(x)}.

\end{document}
```

Knitr LaTex R

Knitr LaTeX R R . . apporach .

```
# r-noweb-file.Rnw
\documentclass{article}
\begin{document}
This is an Rnw file (R noweb).  It contains a combination of LateX and R.

<<code-chunk-label>>=
print("This is an R Code Chunk")
x <- seq(1:10)
y <- seq(1:10)
plot(x,y)  # Brownian motion
@

\end{document}
```

R with knitr : https://riptutorial.com/ko/r/topic/4334/-r-with-knitr

67:

I / O

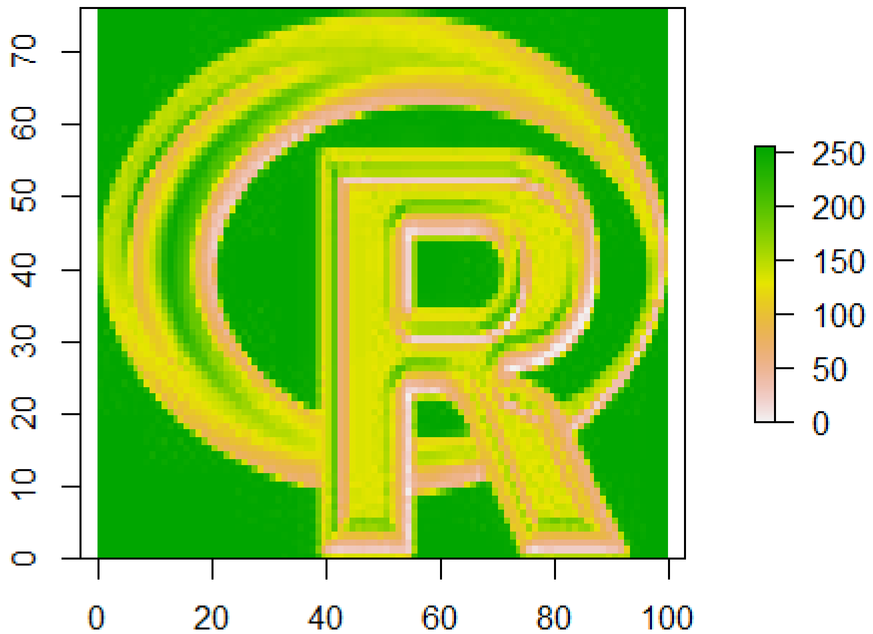
Examples

GLCM

Gray Level Co-Occurrence Matrix (Haralick et al., 1973) . glcm R RasterLayer RasterLayer
.

```
library(glcm)
library(raster)

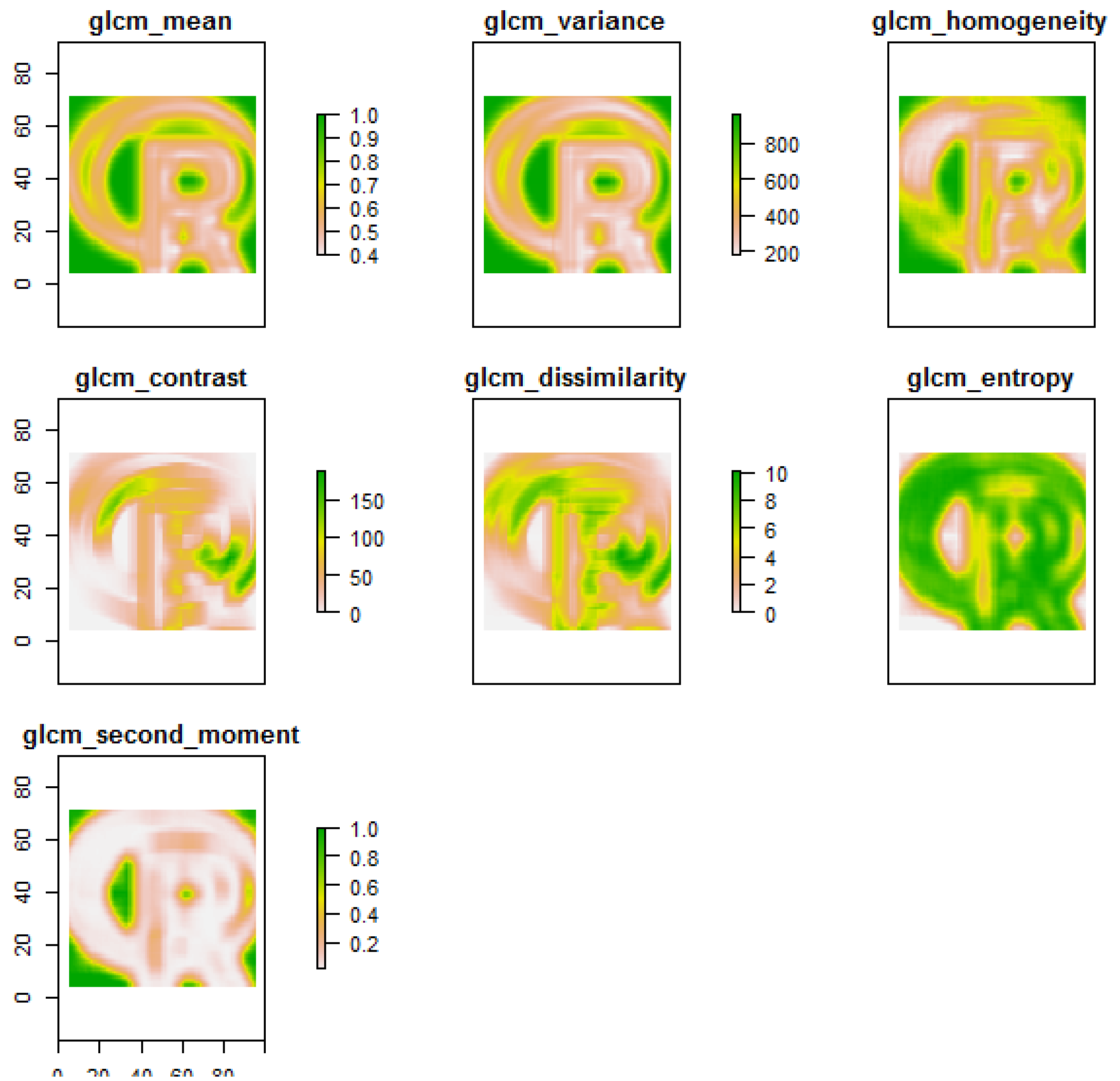
r <- raster("C:/Program Files/R/R-3.2.3/doc/html/logo.jpg")
plot(r)
```



GLCM

```
rglcm <- glcm(r,
              window = c(9,9),
              shift = c(1,1),
              statistics = c("mean", "variance", "homogeneity", "contrast",
                             "dissimilarity", "entropy", "second_moment")
              )

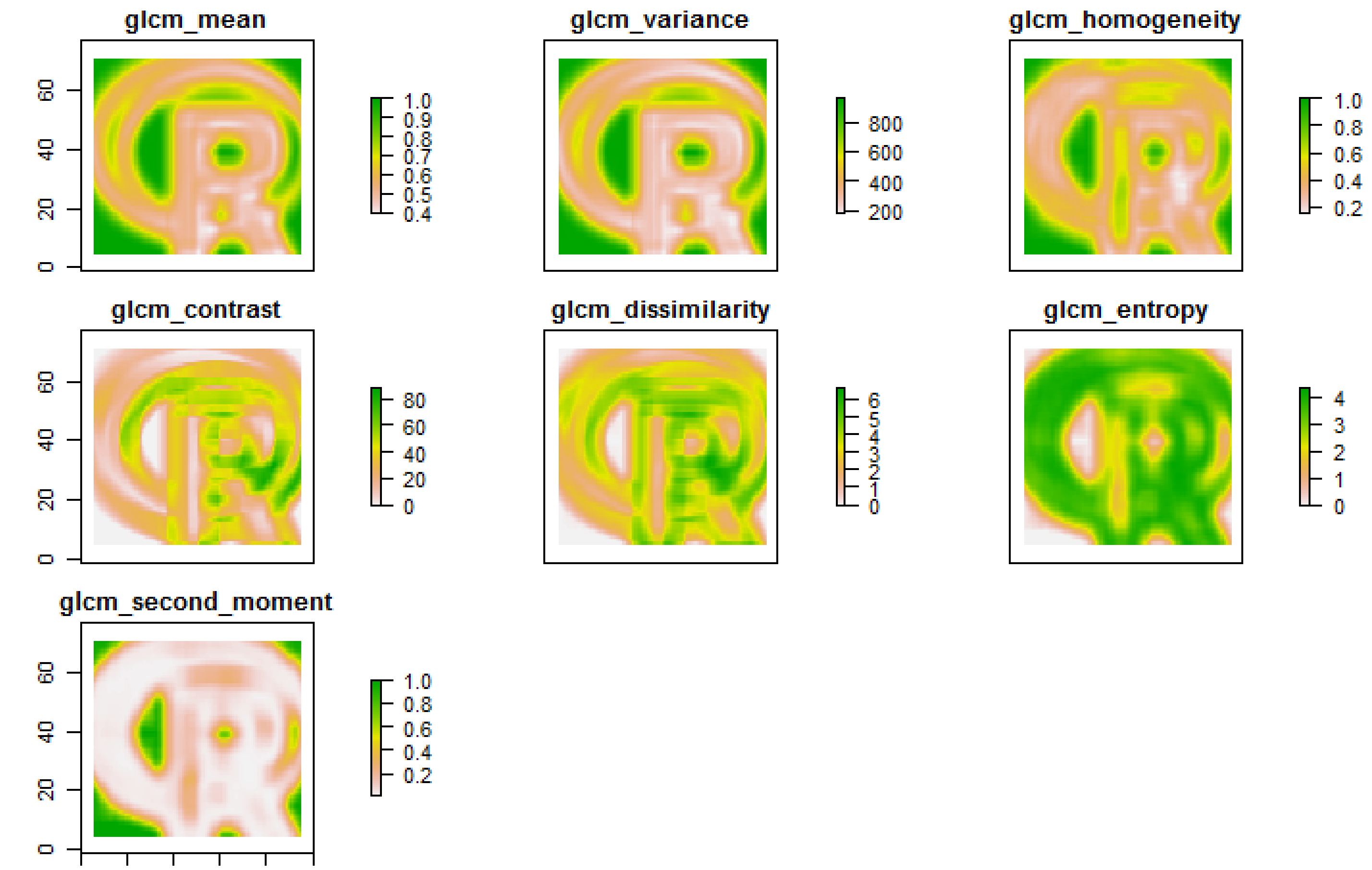
plot(rglcm)
```



4 (0 °, 45 °, 90 °, 135 °) . `shift` .

```
rglcm1 <- glcm(r,
              window = c(9,9),
              shift=list(c(0,1), c(1,1), c(1,0), c(1,-1)),
              statistics = c("mean", "variance", "homogeneity", "contrast",
                             "dissimilarity", "entropy", "second_moment")
              )

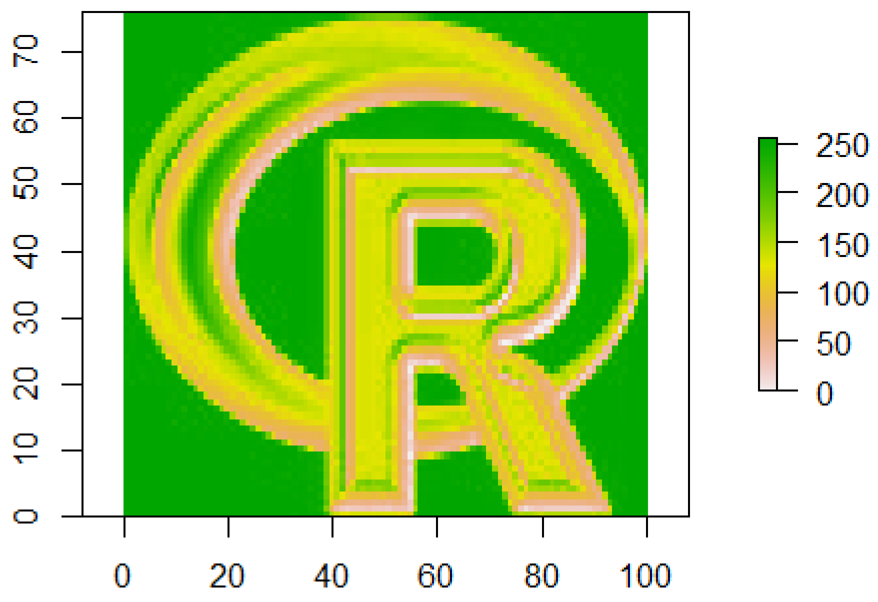
plot(rglcm1)
```



`mmand` n Morphologies . .

```
library(raster)
library(mmand)

r <- raster("C:/Program Files/R/R-3.2.3/doc/html/logo.jpg")
plot(r)
```



( ) (: 9x9) (: `disc` , `box` `diamond`) .

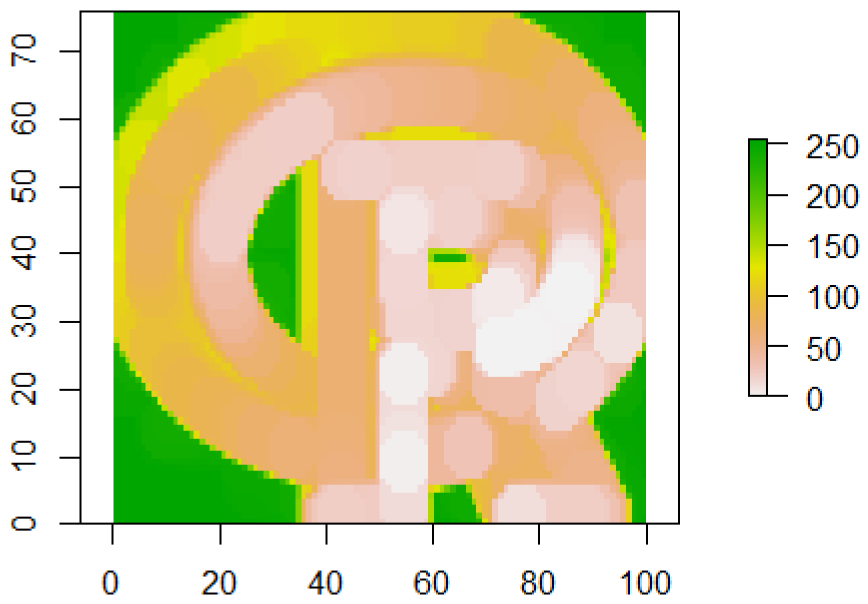
```
sk <- shapeKernel(c(9,9), type="disc")
```

, erode() .

```
rArr <- as.array(r, transpose = TRUE)
rErode <- erode(rArr, sk)
rErode <- setValues(r, as.vector(aperm(rErode)))
```

erode() dilate() , opening() closing() .

```
plot(rErode)
```



: https://riptutorial.com/ko/r/topic/3726/---

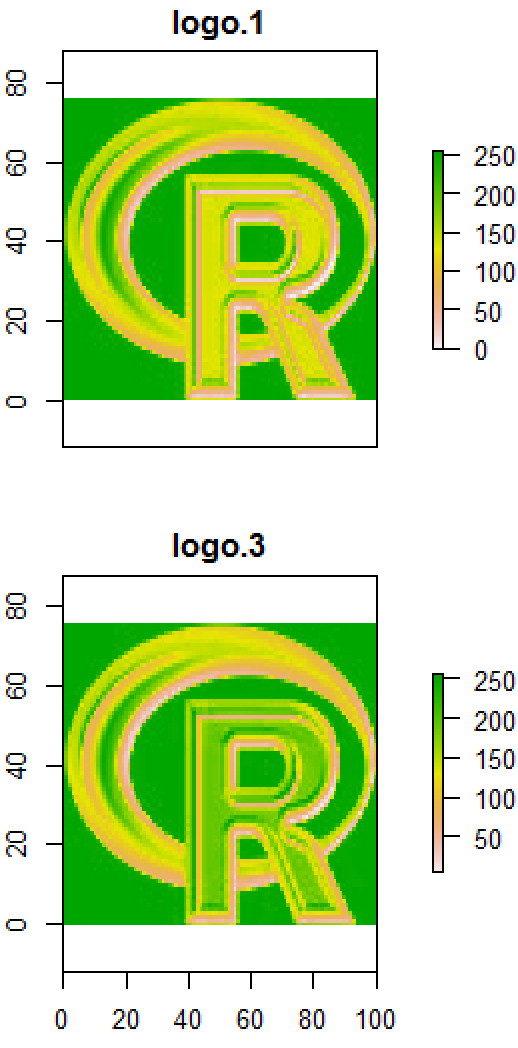
68: I / O

.

Examples

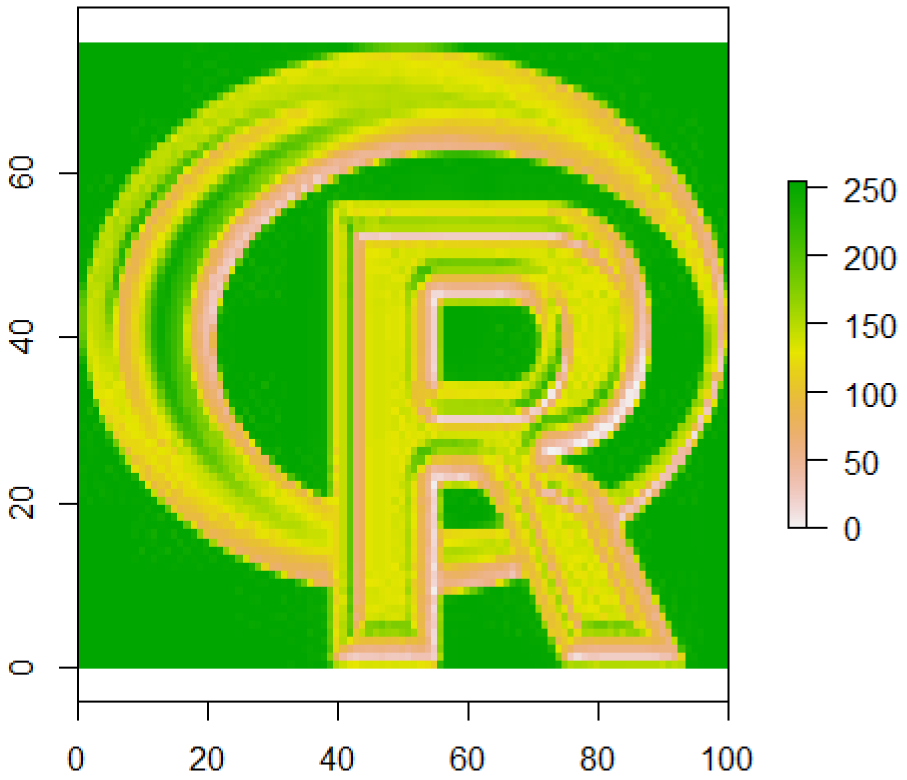
R (, ,).

```
library(raster)
r <- stack("C:/Program Files/R/R-3.2.3/doc/html/logo.jpg")
plot(r)
```



`RasterStack` `[[` .

```
plot(r[[1]])
```



I / O : https://riptutorial.com/ko/r/topic/5539/---i---o

69: -

. , R "run-length encoding" . :

```
dat <- c(1, 2, 2, 2, 3, 1, 4, 4, 1, 1)
```

1 1 ; 2 3 ; 3 - 1 ; . R .

. R , `rleid` data.table ( ) .

Examples

`rle ' -

. .

```
dat <- c(1, 2, 2, 2, 3, 1, 4, 4, 1, 1)
```

`rle` .

```
r <- rle(dat)
r
# Run Length Encoding
#   lengths: int [1:6] 1 3 1 1 2 2
#   values : num [1:6] 1 2 3 1 4 1
```

`r$values` `r$values` .

```
r$values
# [1] 1 2 3 1 4 1
```

1 2 3 1 .

`r$lengths` .

```
r$lengths
# [1] 1 3 1 1 2 2
```

1 1, 2 3.

R

. .

```
(dat <- data.frame(x = c(1, 1, 2, 2, 2, 1), y = 1:6))
```

```
#   x y
# 1 1 1
# 2 1 2
# 3 2 3
# 4 2 4
# 5 2 5
# 6 1 6
```

x 2 1 3 2 1 1. y . x (1.5, 4 6).

base R, rle x run-length .

```
(r <- rle(dat$x))
# Run Length Encoding
#   lengths: int [1:3] 2 3 1
#   values : num [1:3] 1 2 1
```

. length(r$lengths) r$lengths rep .

```
(run.id <- rep(seq_along(r$lengths), r$lengths))
# [1] 1 1 2 2 2 3
```

tapply ID y .

```
data.frame(x=r$values, meanY=tapply(dat$y, run.id, mean))
#   x meanY
# 1 1   1.5
# 2 2   4.0
# 3 1   6.0
```

data.table run

data.table . .

```
library(data.table)
(DT <- data.table(x = c(1, 1, 2, 2, 2, 1), y = 1:6))
#    x y
# 1: 1 1
# 2: 1 2
# 3: 2 3
# 4: 2 4
# 5: 2 5
# 6: 1 6
```

x 2 1 3 2 1 1. y . x (1.5, 4 6).

data.table rleid ID ID .

```
rleid(DT$x)
# [1] 1 1 2 2 2 3
```

ID y .

```
DT[,mean(y),by=.(x, rleid(x))]
#    x rleid  V1
# 1: 1     1 1.5
# 2: 2     2 4.0
# 3: 1     3 6.0
```

long run run-length encoding (run) . , 1 0 1,000 :

```
set.seed(144)
dat <- sample(rep(0:1, c(1, 1e5)), 1e7, replace=TRUE)
table(dat)
#       0       1
#     103 9999897
```

1 .

```
rle.df <- with(rle(dat), data.frame(values, lengths))
dim(rle.df)
# [1] 207   2
head(rle.df)
#   values lengths
# 1      1   52818
# 2      0       1
# 3      1  219329
# 4      0       1
# 5      1  318306
# 6      0       1
```

- 52,818 1, 0, 219,329 1, 0 . run-length 207 1000 414 . `rle.df` `write.csv` .

- . `rep` run-length `values` run-length `lengths` .

```
decompressed <- rep(rle.df$values, rle.df$lengths)
```

.

```
identical(decompressed, dat)
# [1] TRUE
```

R `inverse.rle` `rle` :

```
rle.obj <- rle(dat)                            # create a rle object here
class(rle.obj)
# [1] "rle"

dat.inv <- inverse.rle(rle.obj)              # apply the inverse.rle on the rle object
```

`dat` :

```
identical(dat.inv, dat)
# [1] TRUE
```

- : https://riptutorial.com/ko/r/topic/1133/----

70:

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

Examples

barplot ()

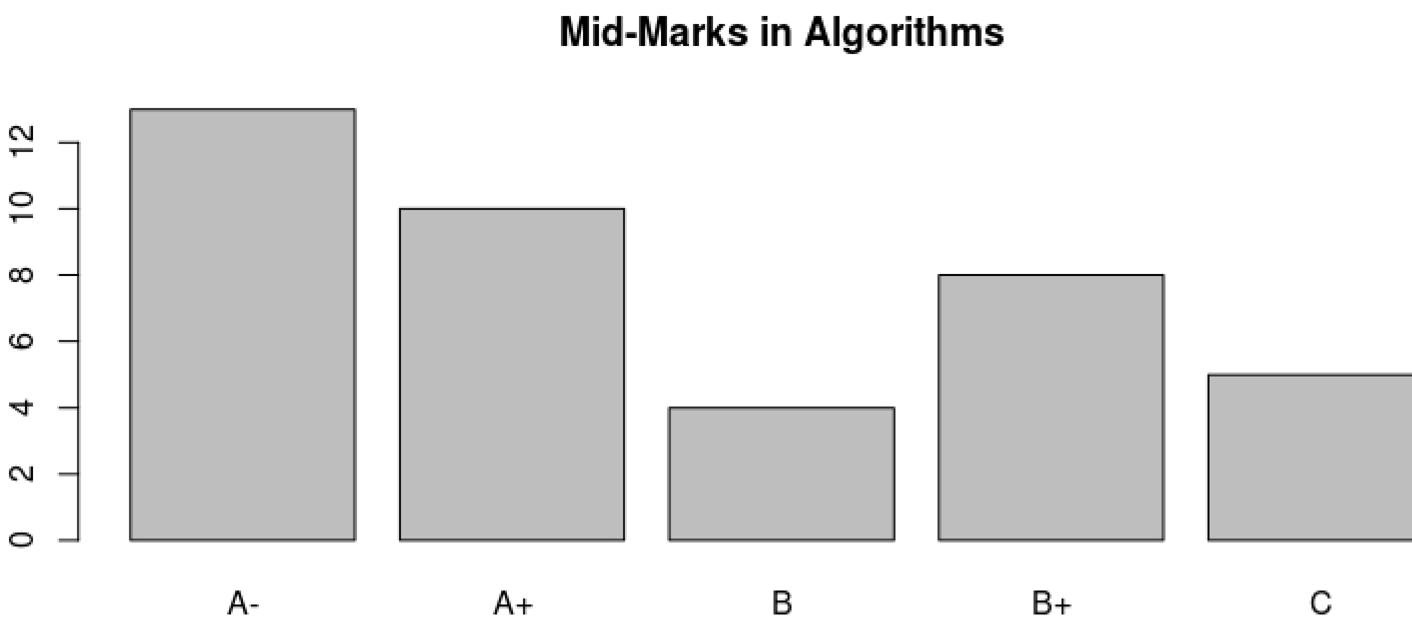
x   ( ) y .   ( )   .

`barplot()` R . `barplot()` . R `heights` . .

`barplot()` .

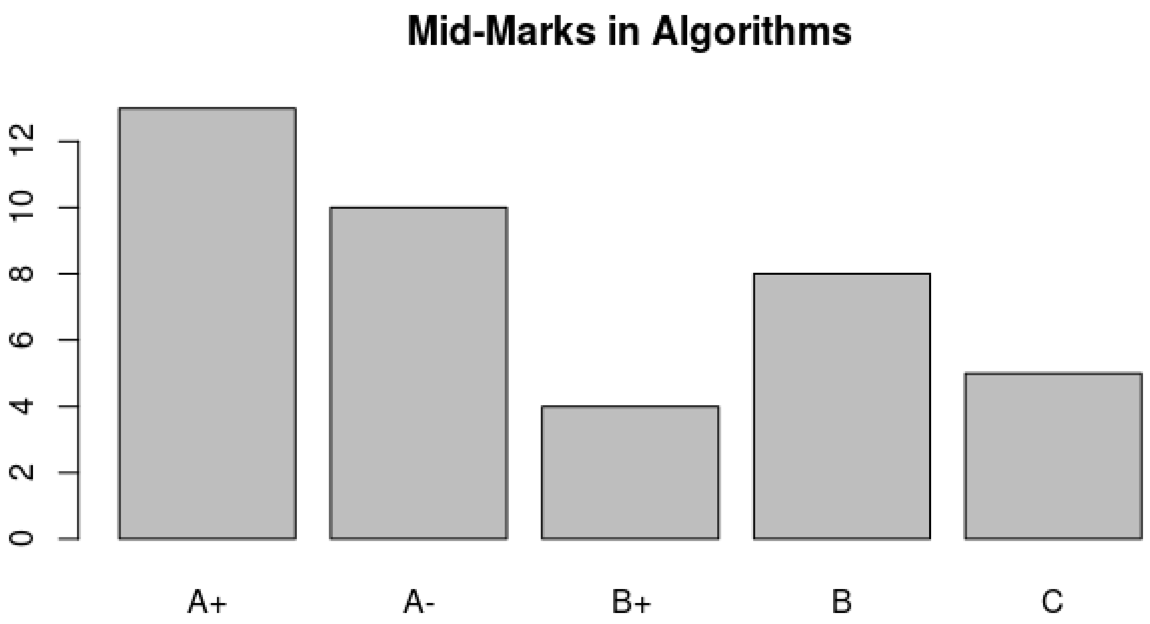
```
> grades<-c("A+","A-","B+","B","C")
> Marks<-sample(grades,40,replace=T,prob=c(.2,.3,.25,.15,.1))
> Marks
[1] "A+" "A-" "B+" "A-" "A+" "B"  "A+" "B+" "A-" "B"  "A+" "A-"
[13] "A-" "B+" "A-" "A-" "A-" "A-" "A+" "A-" "A+" "A+" "C"  "C"
[25] "B"  "C"  "B+" "C"  "B+" "B+" "B+" "A+" "B+" "A-" "A+" "A-"
[37] "A-" "B"  "C"  "A+"
>
```

```
> barplot(table(Marks),main="Mid-Marks in Algorithms")
```



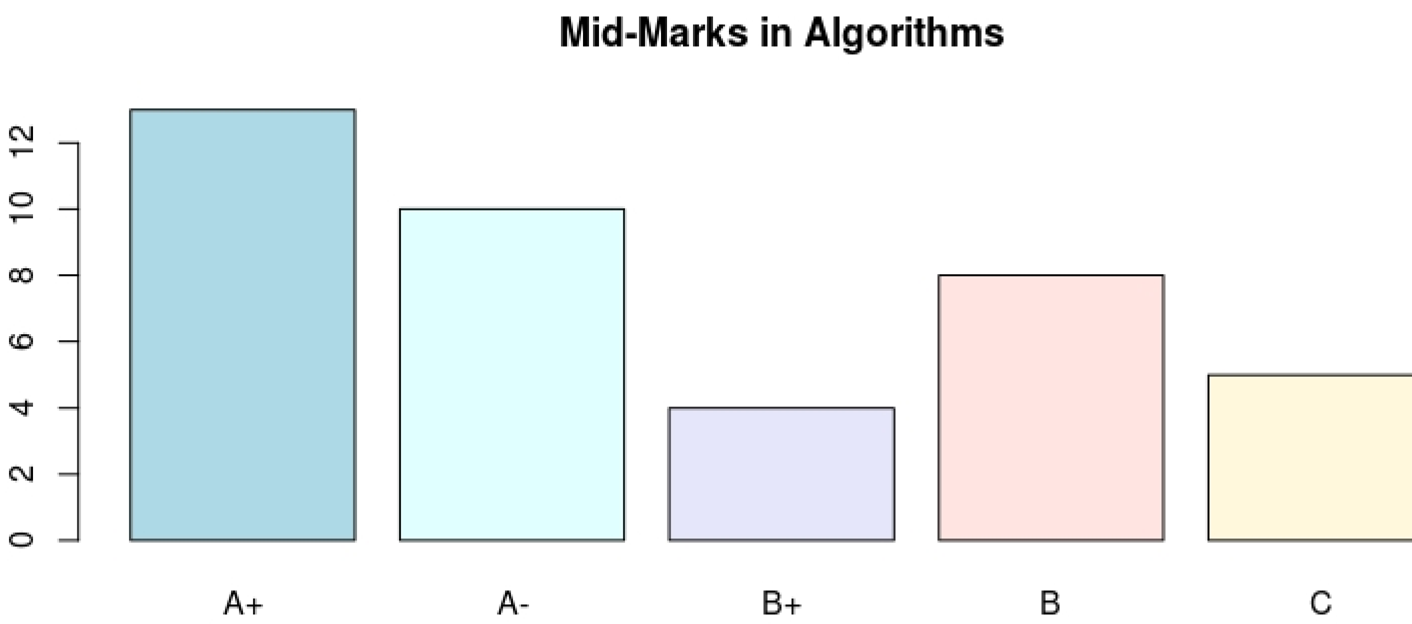
barplot () factor x `lexicographical order` . `names.arg` , .

```
# plot to the desired horizontal axis labels
> barplot(table(Marks),names.arg=grades ,main="Mid-Marks in Algorithms")
```



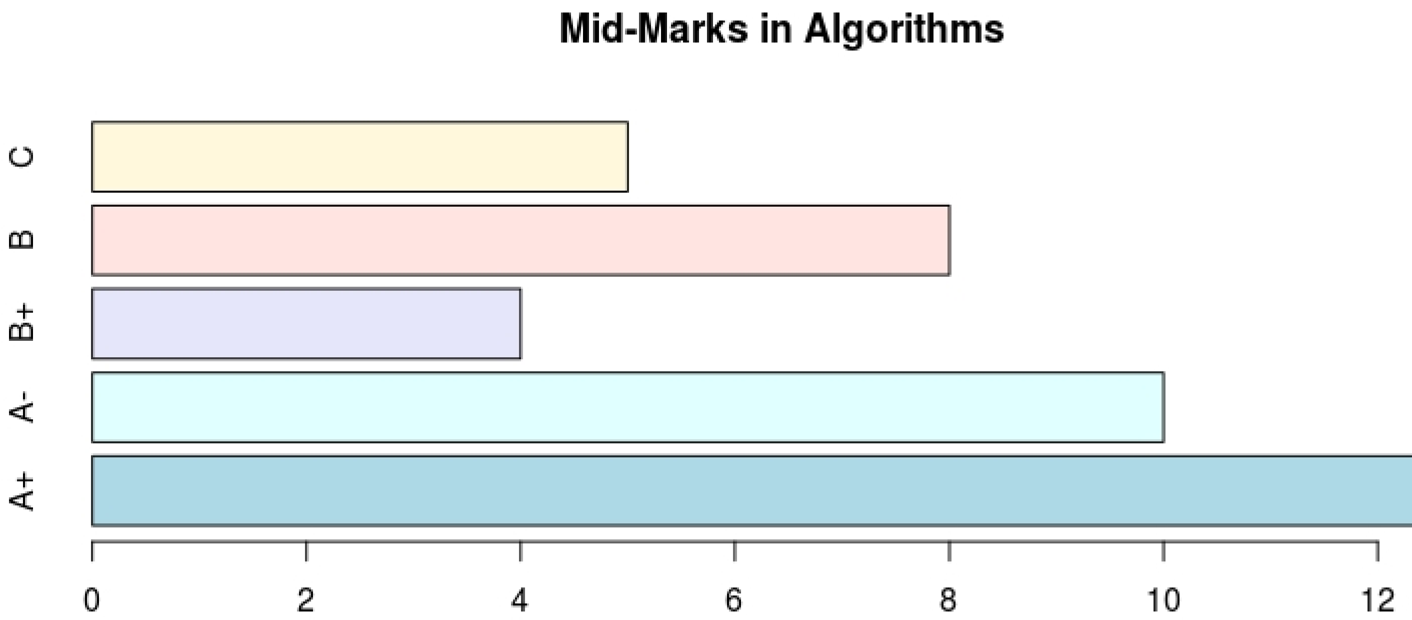
col= .

```
> barplot(table(Marks),names.arg=grades,col = c("lightblue",
        "lightcyan", "lavender", "mistyrose",  "cornsilk"),
         main="Mid-Marks in Algorithms")
```



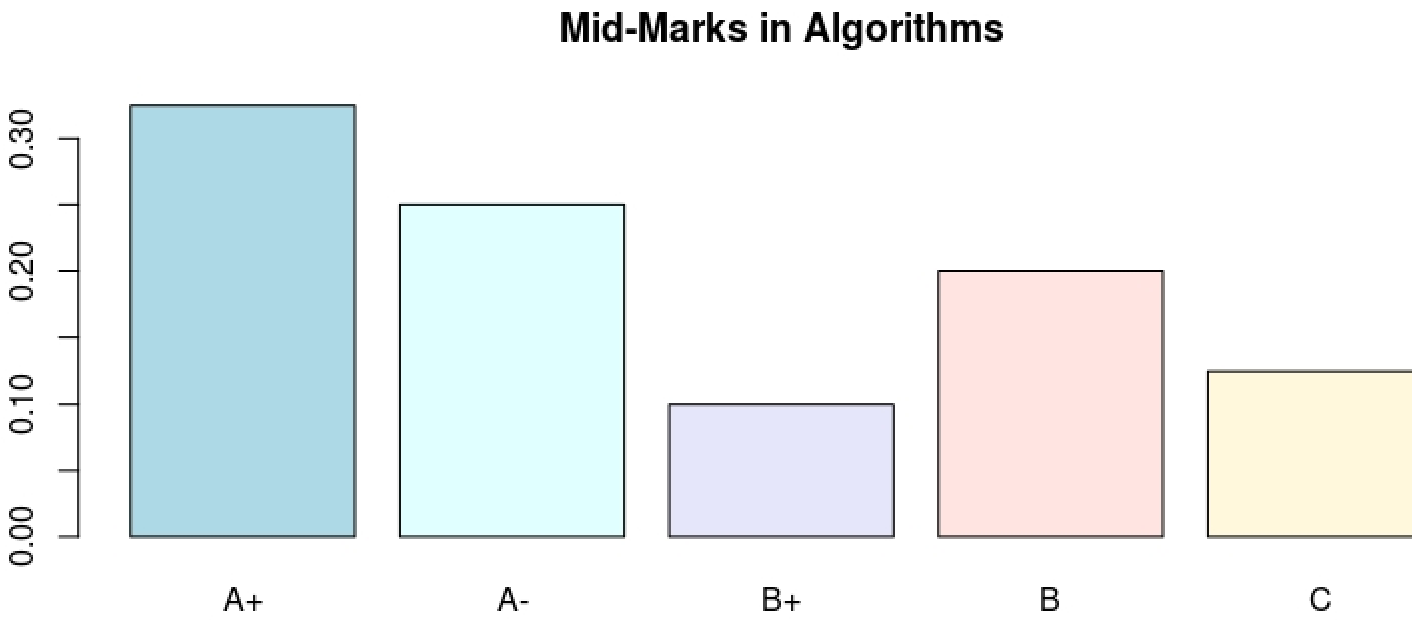
.

```
> barplot(table(Marks),names.arg=grades,horiz=TRUE,col = c("lightblue",
          "lightcyan", "lavender", "mistyrose",  "cornsilk"),
           main="Mid-Marks in Algorithms")
```



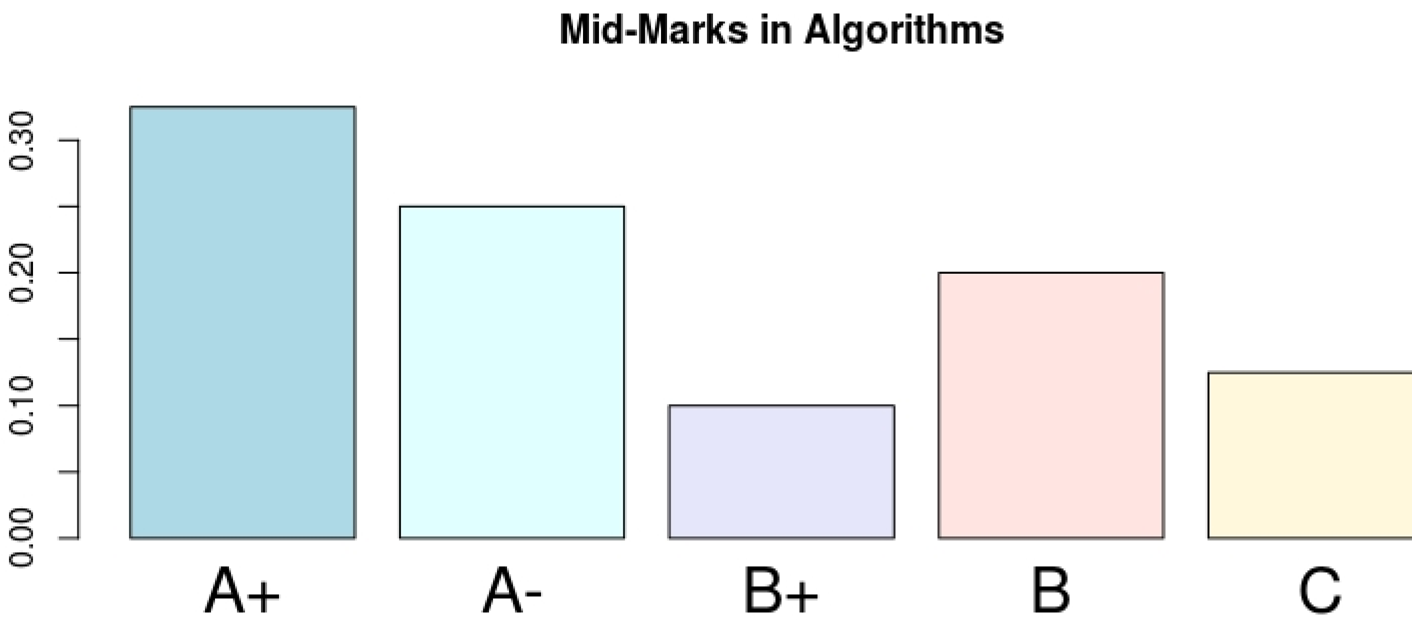
y .

```
> barplot(prop.table(table(Marks)),names.arg=grades,col = c("lightblue",
           "lightcyan", "lavender", "mistyrose",  "cornsilk"),
            main="Mid-Marks in Algorithms")
```



x cex.names .

```
> barplot(prop.table(table(Marks)),names.arg=grades,col = c("lightblue",
          "lightcyan", "lavender", "mistyrose",  "cornsilk"),
           main="Mid-Marks in Algorithms",cex.names=2)
```

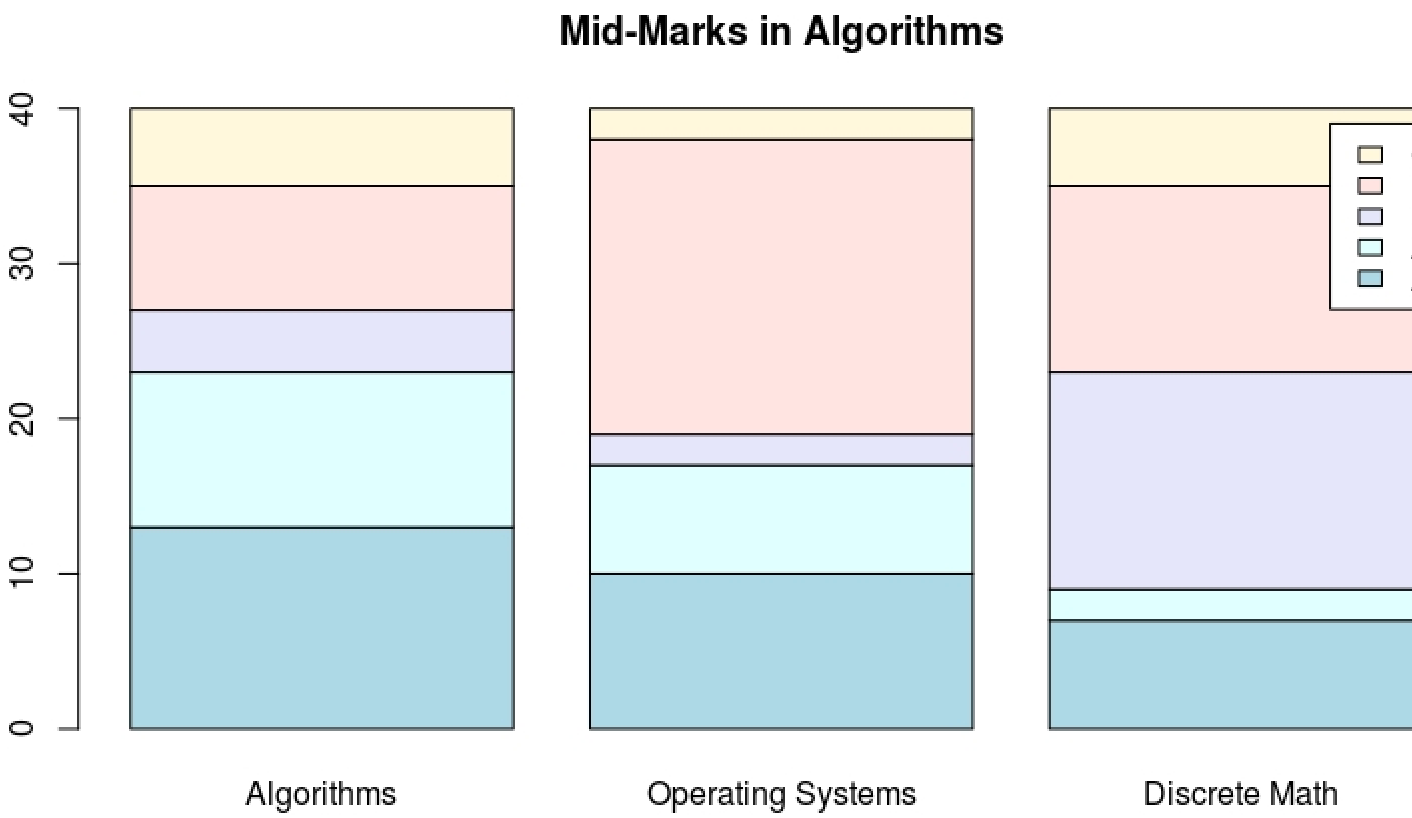


barplot() heights . , , . .

```
> gradTab
    Algorithms Operating Systems Discrete Math
  A-        13                10             7
  A+        10                 7             2
  B          4                 2            14
  B+         8                19            12
  C          5                 2             5
```

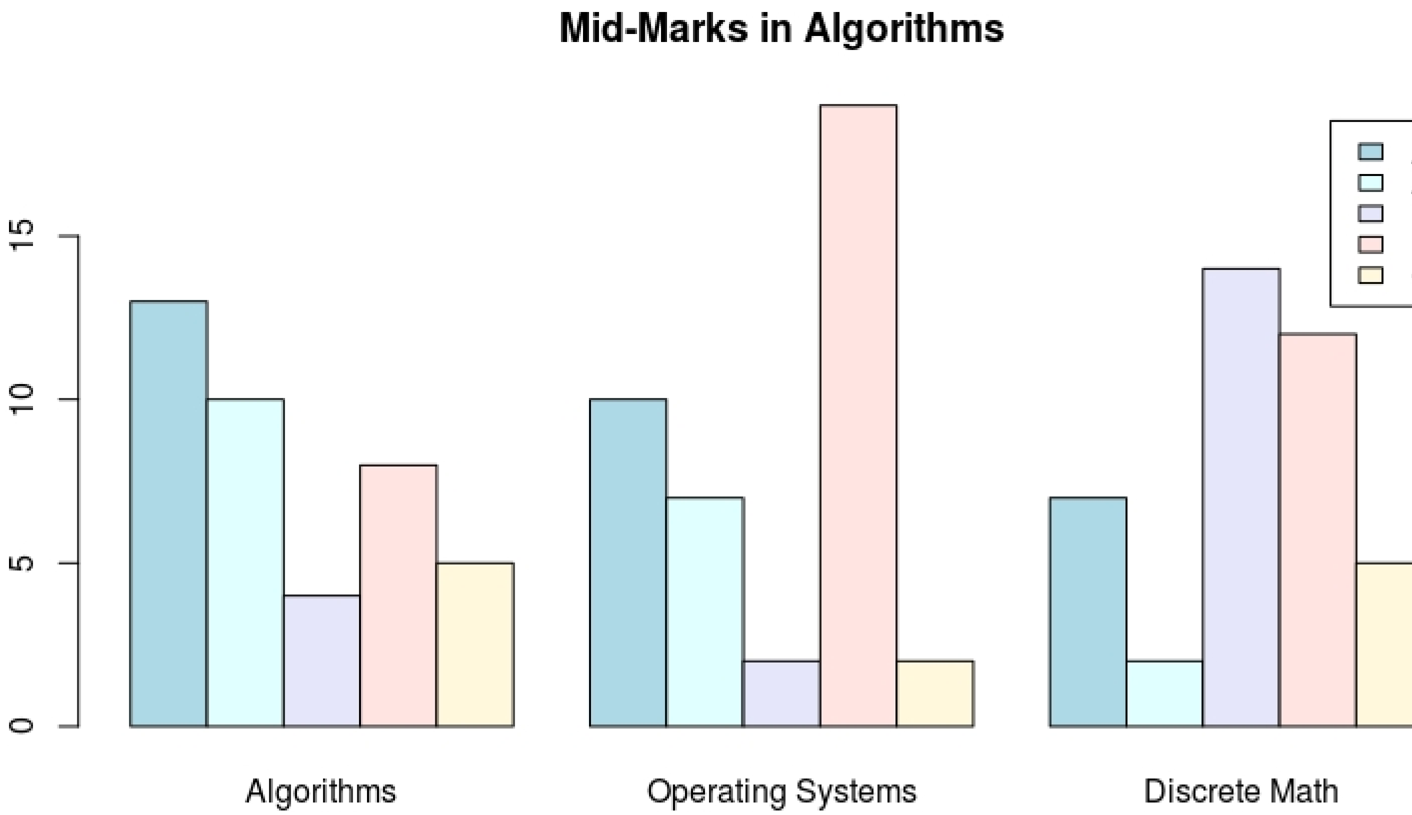
.

```
> barplot(gradTab,col = c("lightblue","lightcyan",
     "lavender", "mistyrose",  "cornsilk"),legend.text = grades,
      main="Mid-Marks in Algorithms")
```



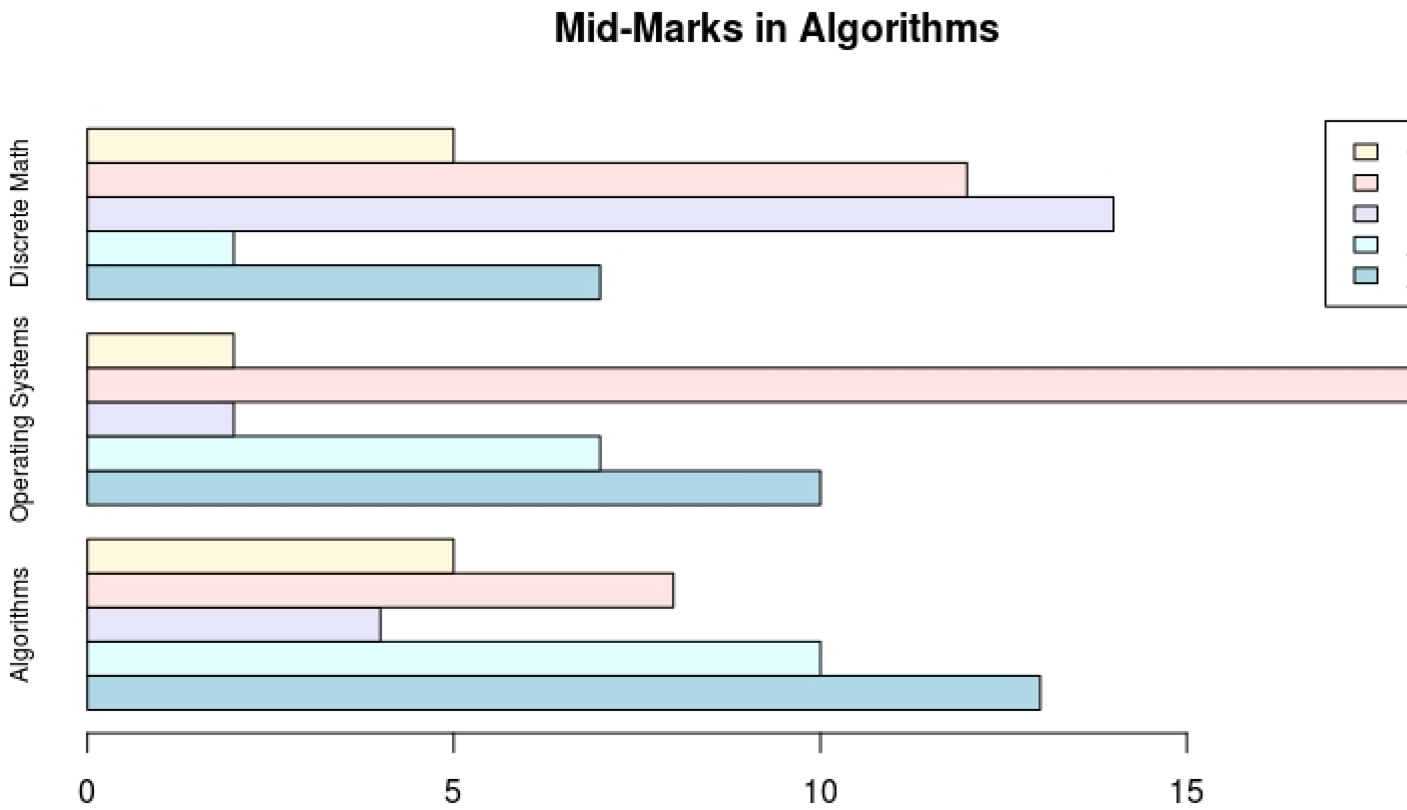
besides .

```
 > barplot(gradTab,beside = T,col = c("lightblue","lightcyan",
     "lavender", "mistyrose",  "cornsilk"),legend.text = grades,
      main="Mid-Marks in Algorithms")
```



horiz=T .

```
> barplot(gradTab,beside = T,horiz=T,col = c("lightblue","lightcyan",
       "lavender", "mistyrose",  "cornsilk"),legend.text = grades,
        cex.names=.75,main="Mid-Marks in Algorithms")
```



: https://riptutorial.com/ko/r/topic/8091/-

71: :

R R .

Examples

Q & A .

- . .
- . .
- . .

  ```
  library(help = "datasets")
  ```

.

- `?data.frame` . SO Docs . R .
- Remarks .

`R>` , `>` `+` . . .

. .

- ( ).
- `#` `##` .
- `[1]` .
- .

`=` `<-` R . , `x<-1` (`x <- 1` `x < -1`)

. . . .

H1 .

: : https://riptutorial.com/ko/r/topic/5410/-----

72:

R . . .

rand . r* ( ). " " runif . "" R .

Examples

sample .

set.seed set.seed . sample set.seed .

sample . .

```
set.seed(1251)
sample(x = 10)

[1]  7  1  4  8  6  3 10  5  2  9
```

sample 1 x . . .

```
library(datasets)
set.seed(1171)
iris_rand <- iris[sample(x = 1:nrow(iris)),]

> head(iris)
  Sepal.Length Sepal.Width Petal.Length Petal.Width Species
1          5.1         3.5          1.4         0.2  setosa
2          4.9         3.0          1.4         0.2  setosa
3          4.7         3.2          1.3         0.2  setosa
4          4.6         3.1          1.5         0.2  setosa
5          5.0         3.6          1.4         0.2  setosa
6          5.4         3.9          1.7         0.4  setosa

> head(iris_rand)
    Sepal.Length Sepal.Width Petal.Length Petal.Width    Species
145          6.7         3.3          5.7         2.5  virginica
5            5.0         3.6          1.4         0.2     setosa
85           5.4         3.0          4.5         1.5 versicolor
137          6.3         3.4          5.6         2.4  virginica
128          6.1         3.0          4.9         1.8  virginica
105          6.5         3.0          5.8         2.2  virginica
```

.

sample . () . .

```
set.seed(7043)
```

```
sample(x = LETTERS,size = 7)

[1] "S" "P" "J" "F" "Z" "G" "R"
```

size x . x .

```
set.seed(7305)
sample(x = letters,size = 26)

[1] "x" "z" "y" "i" "k" "f" "d" "s" "g" "v" "j" "o" "e" "c" "m" "n" "h" "u" "a" "b" "l" "r"
"w" "t" "q" "p"

sample(x = letters,size = 30)
Error in sample.int(length(x), size, replace, prob) :
  cannot take a sample larger than the population when 'replace = FALSE'
```

.

---

sample replace . replace FALSE . TRUE .

```
set.seed(5062)
sample(x = c("A","B","C","D"),size = 8,replace = TRUE)

[1] "D" "C" "D" "B" "A" "A" "A" "A"
```

---

sample . "" . 20 . , , 1/3.

```
set.seed(6472)
sample(x = c("Red","Blue","Green"),
       size = 20,
       replace = TRUE)
```

urn 2 , 1 , 1 . x Red . sample prob sample .

prob . 1/2 1/4.

```
set.seed(28432)
sample(x = c("Red","Blue","Green"),
       size = 20,
       replace = TRUE,
       prob = c(0.50,0.25,0.25))
```

, prob 1 . R 1 . 2 Red, 1 Blue 1 Green . .

```
set.seed(28432)
frac_prob_example <- sample(x = c("Red","Blue","Green"),
                            size = 200,
                            replace = TRUE,
```

```
                            prob = c(0.50,0.25,0.25))

set.seed(28432)
numeric_prob_example <- sample(x = c("Red","Blue","Green"),
                               size = 200,
                               replace = TRUE,
                               prob = c(2,1,1))

> identical(frac_prob_example,numeric_prob_example)
[1] TRUE
```

0 0 .

`replace` `FALSE` `prob` . , `prob` . , `size` 0 . :

```
set.seed(21741)
sample(x = c("Red","Blue","Green"),
       size = 2,
       replace = FALSE,
       prob = c(0.8,0.19,0.01))
```

Red ( ) . 80 %, 19 %, 1 %.

Red . 20 % (19 %, 1 %). (19/20) 95 %, (1/20) 5 % .

`set.seed` randomization random seed . R `set.seed` .

```
set.seed(1643)
samp1 <- sample(x = 1:5,size = 200,replace = TRUE)

set.seed(1643)
samp2 <- sample(x = 1:5,size = 200,replace = TRUE)

> identical(x = samp1,y = samp2)
[1] TRUE
```

.

: https://riptutorial.com/ko/r/topic/9574/

73:

RandomForest . Wikipedia Random Forests . R randomForest . CRAN .

Examples

-

```
######  Used for both Classification and Regression examples
library(randomForest)
library(car)            ## For the Soils data
data(Soils)

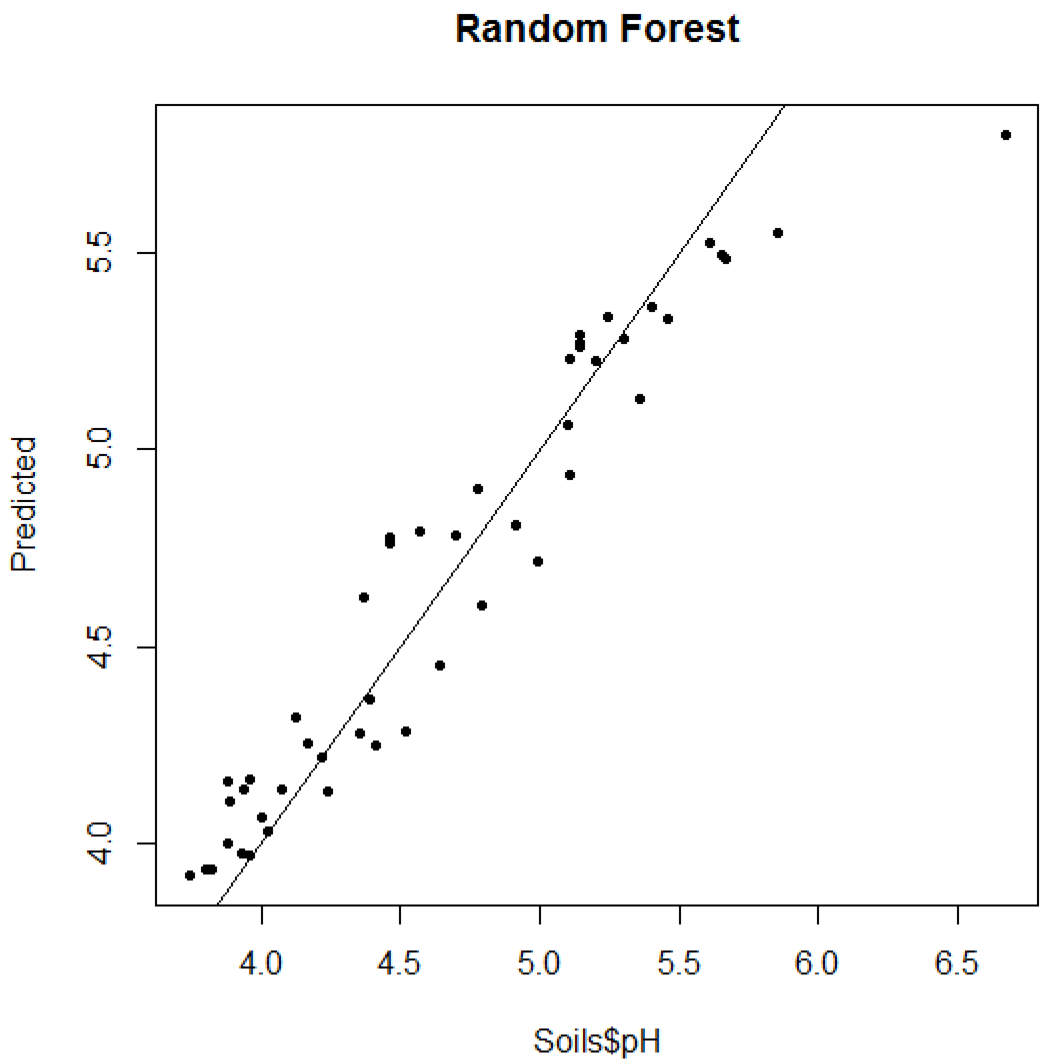
######################################################
##    RF Classification Example
set.seed(656)            ## for reproducibility
S_RF_Class = randomForest(Gp ~ ., data=Soils[,c(4,6:14)])
Gp_RF = predict(S_RF_Class, Soils[,6:14])
length(which(Gp_RF != Soils$Gp))            ## No Errors

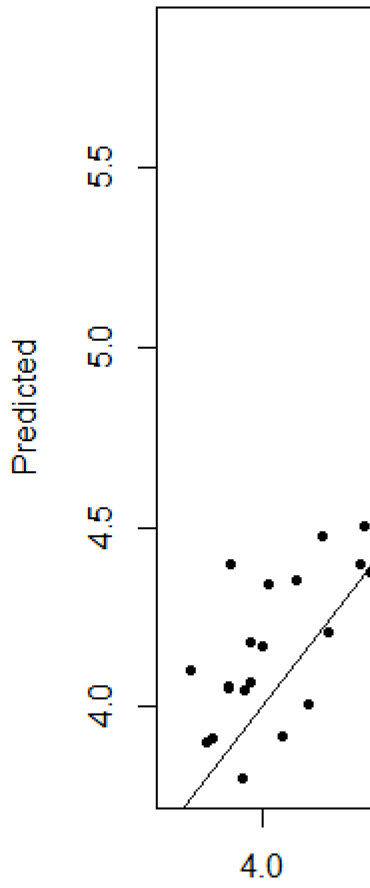
## Naive Bayes for comparison
library(e1071)
S_NB  = naiveBayes(Soils[,6:14], Soils[,4])
Gp_NB = predict(S_NB, Soils[,6:14], type="class")
length(which(Gp_NB != Soils$Gp))            ## 6 Errors
```

RF .

```
######################################################
##    RF Regression Example
set.seed(656)            ## for reproducibility
S_RF_Reg = randomForest(pH ~ ., data=Soils[,6:14])
pH_RF = predict(S_RF_Reg, Soils[,6:14])

## Compare Predictions with Actual values for RF and Linear Model
S_LM = lm(pH ~ ., data=Soils[,6:14])
pH_LM = predict(S_LM, Soils[,6:14])
par(mfrow=c(1,2))
plot(Soils$pH, pH_RF, pch=20, ylab="Predicted", main="Random Forest")
abline(0,1)
plot(Soils$pH, pH_LM, pch=20, ylab="Predicted", main="Linear Model")
abline(0,1)
```





: https://riptutorial.com/ko/r/topic/8088/--

74:

' ' .

- ()
-
- strsplit

-

Examples

`is.character()` . `as.character()` .

```
x <- "The quick brown fox jumps over the lazy dog"
class(x)
[1] "character"
is.character(x)
[1] TRUE
```

NA .

```
as.numeric("2")
[1] 2
as.numeric("fox")
[1] NA
Warning message:
NAs introduced by coercion
```

: https://riptutorial.com/ko/r/topic/9017/-

75:

:

-

Examples

R print cat . R R .

```
print("Hello World")
#[1] "Hello World"
cat("Hello World\n")
#Hello World
```

. (: x <- "Hello World" x print .)

cat . 1 ().

```
cat(c("hello", "world", "\n"))
#hello world
```

(\n) .

```
cat("Hello World")
#Hello World>
```

. (RStudio 's .)

print "" . "Hello World" cat . [1] ( ).

```
print("Hello World")
#[1] "Hello World"
```

R . s print(s) print("Hello World") :

```
s <- "Hello World"
s
#[1] "Hello World"
```

.

```
"Hello World"
#[1] "Hello World"
```

(c() oncatenate **C**), print() cat :

```
print(c("Hello World", "Here I am."))
```

```
#[1] "Hello World" "Here I am."
```

c() . (paste .) R . , [1] , R .

```
c("Hello World", "Here I am!", "This next string is really long.")
#[1] "Hello World"                      "Here I am!"
#[3] "This next string is really long."
```

print .

"" "" print .

```
print(1)
#[1] 1
print(TRUE)
#[1] TRUE
```

Factor SO . cat print . print() foo print(foo) invisible invisible . R REPL, "read-eval-print-loop" . cat (:) . (print()) , **cat()** . message() warning() . cat , . .

```
message("hello world")
#hello world
suppressMessages(message("hello world"))
```

. R map-reduce . . . .

file() ("r").

```
conn <- file("/path/example.data", "r") #when file is in local system
conn1 <- file("stdin", "r") #when just standard input/output for files are available
```

.

```
line <- readLines(conn, n=1, warn=FALSE)
```

conn n=1 . (10 20) n (: 10, 20) . n=-1 .

; writeLines(),cat() . . file() .

```
conn2 <- file("/path/result.data", "w") #when file is in local system
conn3 <- file("stdout", "w") #when just standard input/output for files are available
```

.

```
writeLines("text",conn2, sep = "\n")
```

Base R . .

```
system("top -a -b -n 1", intern = TRUE)
system2("top", "-a -b -n 1", stdout = TRUE)
```

.

```
 [1] "top - 08:52:03 up 70 days, 15:09,  0 users,  load average: 0.00, 0.00, 0.00"
 [2] "Tasks: 125 total,   1 running, 124 sleeping,   0 stopped,   0 zombie"
 [3] "Cpu(s):  0.9%us,  0.3%sy,  0.0%ni, 98.7%id,  0.1%wa,  0.0%hi,  0.0%si,  0.0%st"
 [4] "Mem:  12194312k total,  3613292k used,  8581020k free,   216940k buffers"
 [5] "Swap: 12582908k total,  2334156k used, 10248752k free,  1682340k cached"
 [6] ""
 [7] "  PID USER      PR  NI  VIRT  RES  SHR S %CPU %MEM    TIME+  COMMAND            "
 [8] "11300 root      20   0 1278m 375m 3696 S  0.0  3.2 124:40.92 trala              "
 [9] " 6093 user1     20   0 1817m 269m 1888 S  0.0  2.3  12:17.96 R                  "
[10] " 4949 user2     20   0 1917m 214m 1888 S  0.0  1.8  11:16.73 R                  "
```

, UNIX `top -a -b -n 1` . OS .

`devtools` . .

```
devtools::system_output("top", "-a -b -n 1")
```

`data.table` `fread` `read.table` `read.table` . `data.table` `data.frame` .

```
fread("top -a -b -n 1", check.names = TRUE)
       PID     USER PR NI  VIRT  RES  SHR S X.CPU X.MEM     TIME.         COMMAND
  1: 11300     root 20  0 1278m 375m 3696 S     0   3.2 124:40.92           trala
  2:  6093    user1 20  0 1817m 269m 1888 S     0   2.3  12:18.56               R
  3:  4949    user2 20  0 1917m 214m 1888 S     0   1.8  11:17.33               R
  4:  7922    user3 20  0 3094m 131m 1892 S     0   1.1  21:04.95               R
```

`fread` 6 .

`check.names = TRUE` `%CPU` , `%MEN` `TIME+` .

: https://riptutorial.com/ko/r/topic/5541/---

76:

- boxplot (x, ...) #
- boxplot (, = NULL, ..., , na.action = NULL) ## "S3
- boxplot (x, ..., range = 1.5, width = NULL, varwidth = FALSE, notch = FALSE, outline = TRUE, , = TRUE, = ("fg"), col = NULL, log = " ", = S3 (= false), == ==

	(R)
	y ~ grp . y grp ( ) .
	data.frame ( ).
	.
na.action	NA . .
	. .
	TRUE () boxplot . .
	col null , . .

Examples

boxplot () {graphics} box-and-whisker

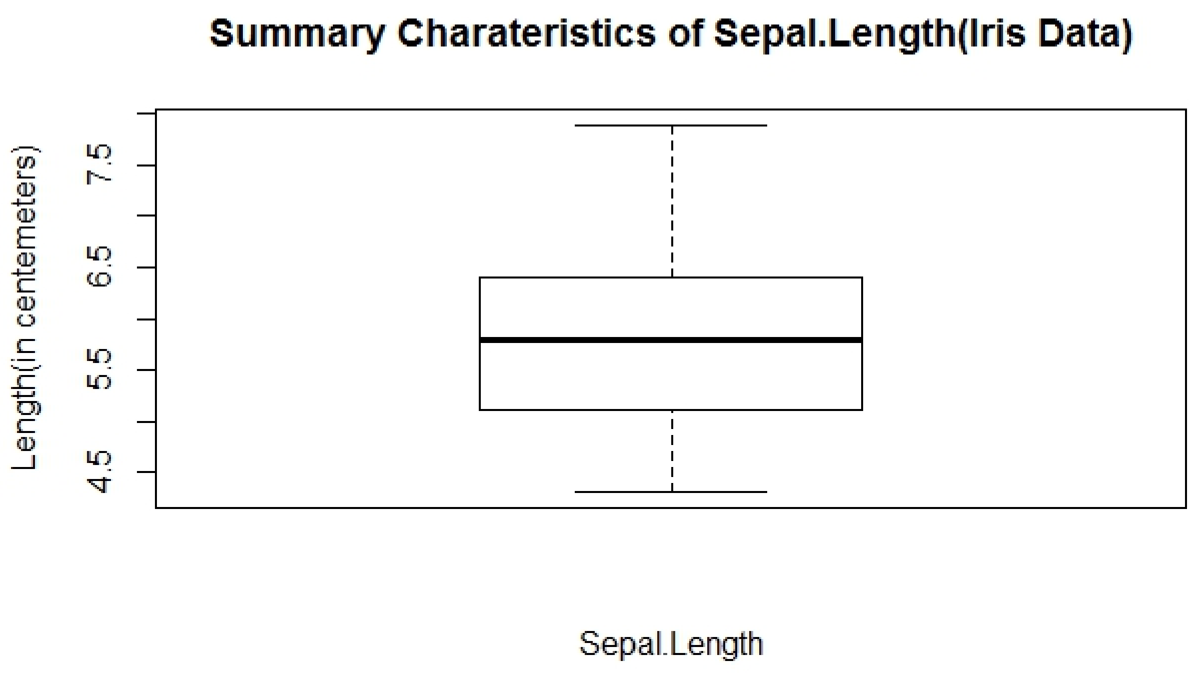
`boxplot()  iris  .`

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

boxplot (Sepal.Length)

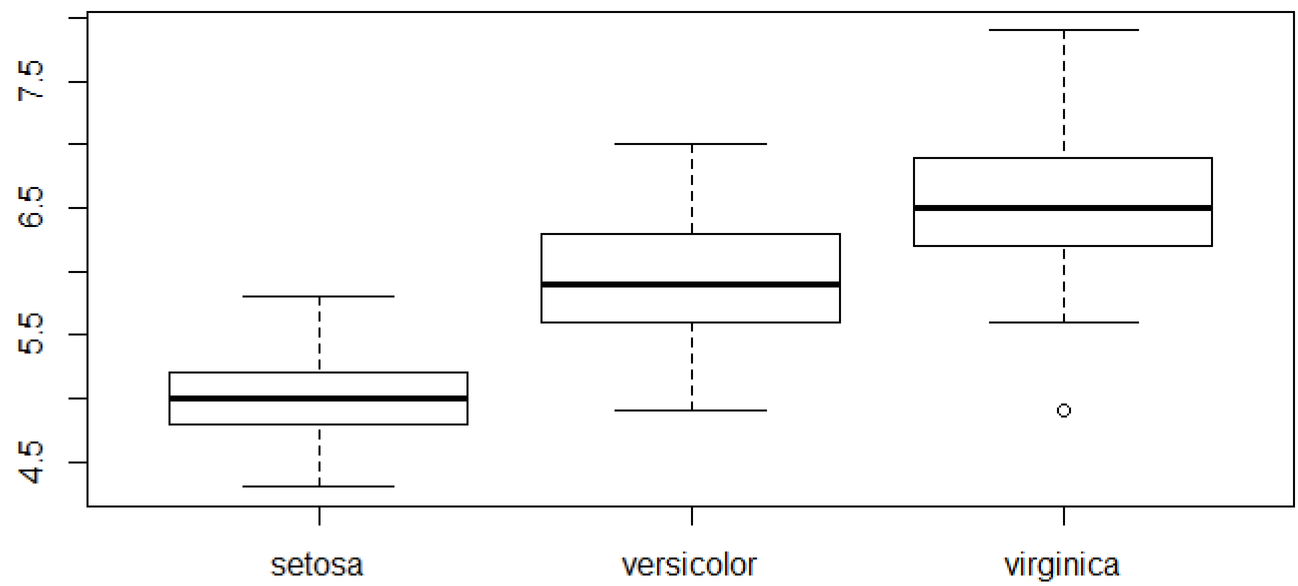
.

```
boxplot(iris[,1],xlab="Sepal.Length",ylab="Length(in centemeters)",
           main="Summary Charateristics of Sepal.Length(Iris Data)")
```



(species)

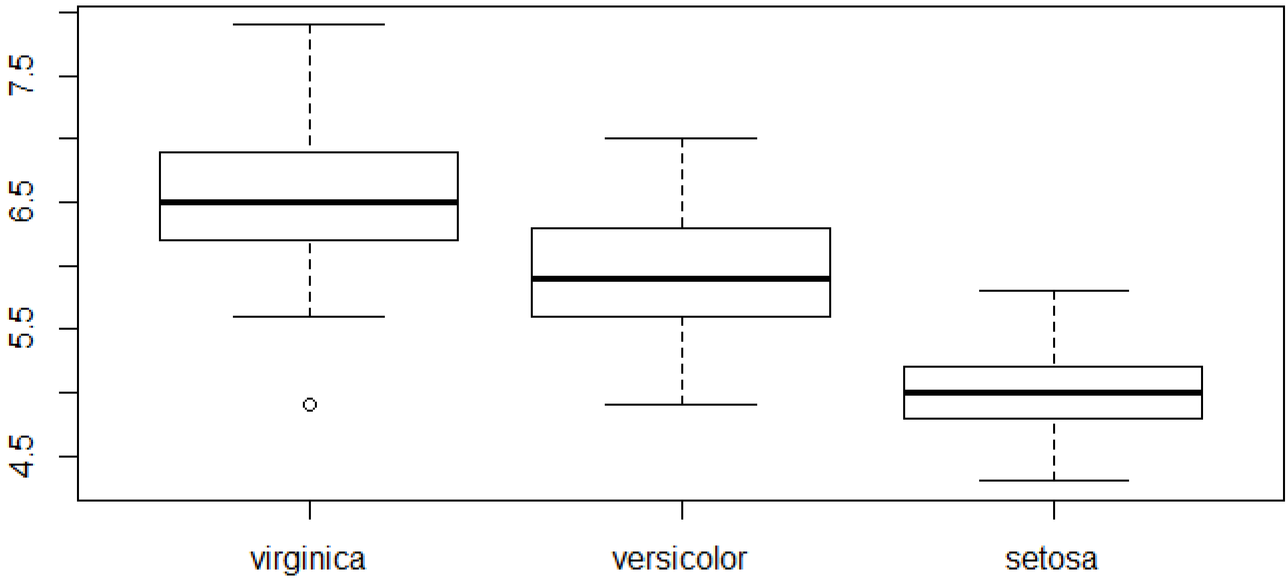
```
boxplot(Sepal.Length~Species,data = iris)
```



.

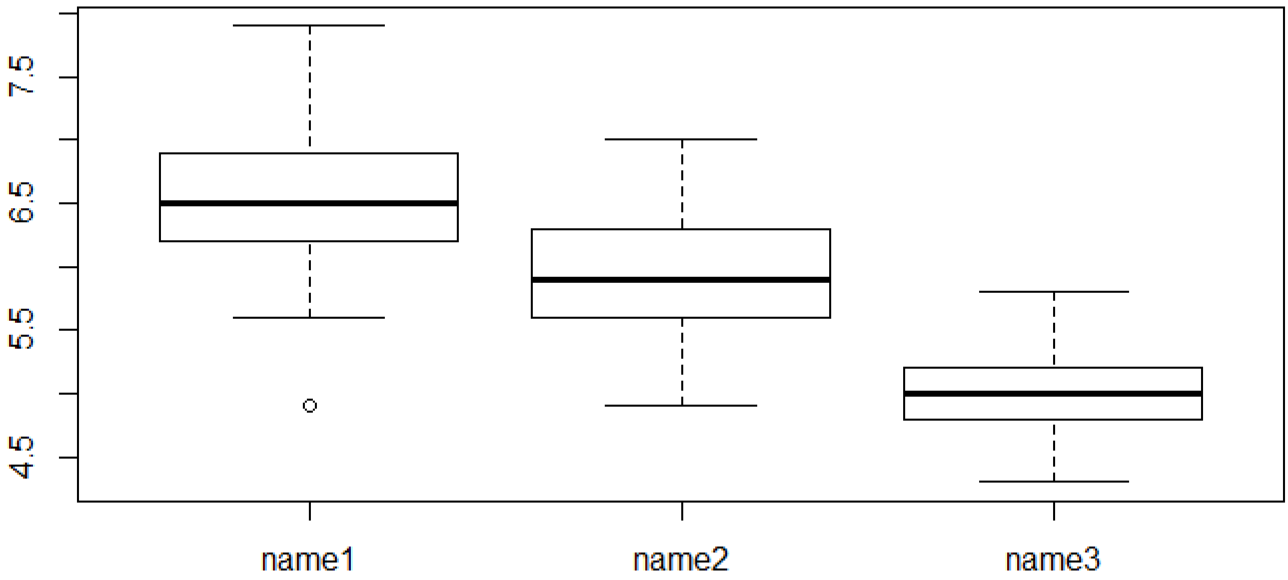
virginica - versicolor - setosa

```
newSpeciesOrder <- factor(iris$Species, levels=c("virginica","versicolor","setosa"))
boxplot(Sepal.Length~newSpeciesOrder,data = iris)
```



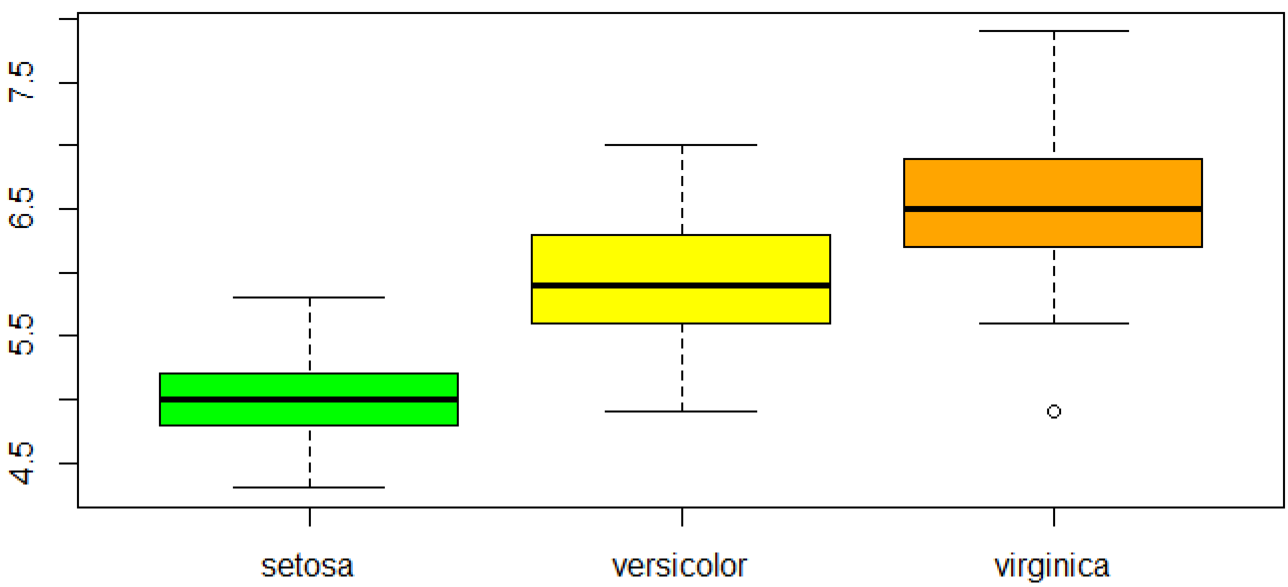
Names . .

```
boxplot(Sepal.Length~newSpeciesOrder,data = iris,names= c("name1","name2","name3"))
```



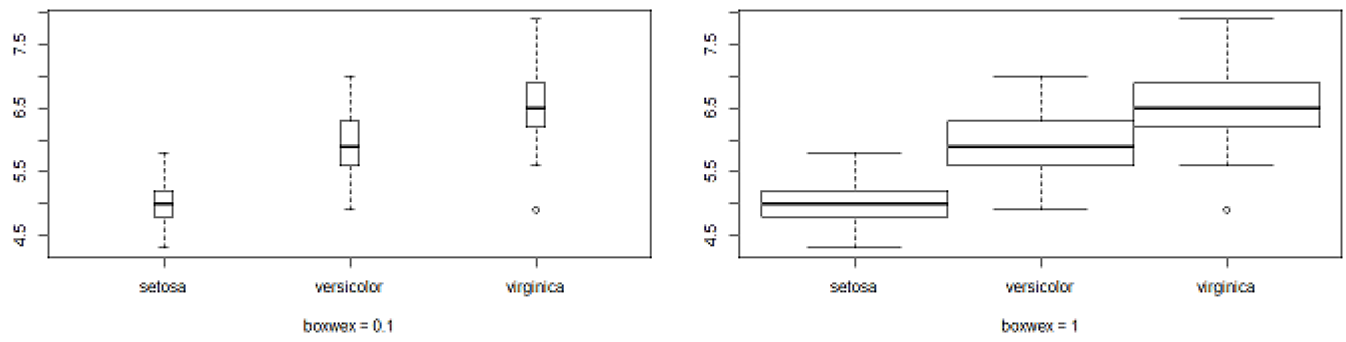
col : .

```
boxplot(Sepal.Length~Species,data = iris,col=c("green","yellow","orange"))
```



boxwex : .

```
boxplot(Sepal.Length~Species,data = iris,boxwex = 0.1)
boxplot(Sepal.Length~Species,data = iris,boxwex = 1)
```



boxplots `plot=FALSE`

plot FALSE FALSE .

.

```
> boxplot(Sepal.Length~newSpeciesOrder,data = iris,plot=FALSE)
$stats #summary of the numerical variable for the 3 groups
     [,1] [,2] [,3]
[1,]  5.6  4.9  4.3 # extreme value
[2,]  6.2  5.6  4.8 # first quartile limit
[3,]  6.5  5.9  5.0 # median limit
[4,]  6.9  6.3  5.2 # third quartile limit
[5,]  7.9  7.0  5.8 # extreme value

$n #number of observations in each groups
[1] 50 50 50

$conf #extreme value of the notchs
         [,1]     [,2]     [,3]
[1,] 6.343588 5.743588 4.910622
[2,] 6.656412 6.056412 5.089378

$out #extreme value
[1] 4.9

$group #group in which are the extreme value
[1] 1

$names #groups names
[1] "virginica"  "versicolor" "setosa"
```

boxplot .

- boxlty -
- boxlwd -
- boxcol -

- boxfill -

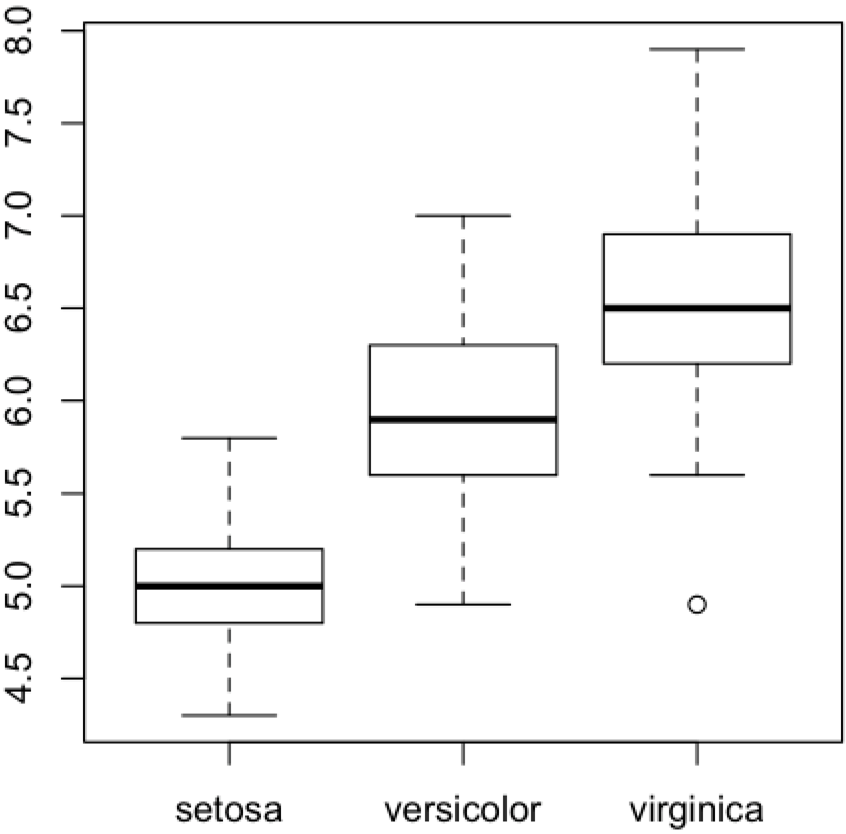
- medlty - ("blank")
- -
- medcol -
- medpch - (NA)
- medcex -
- medbg -

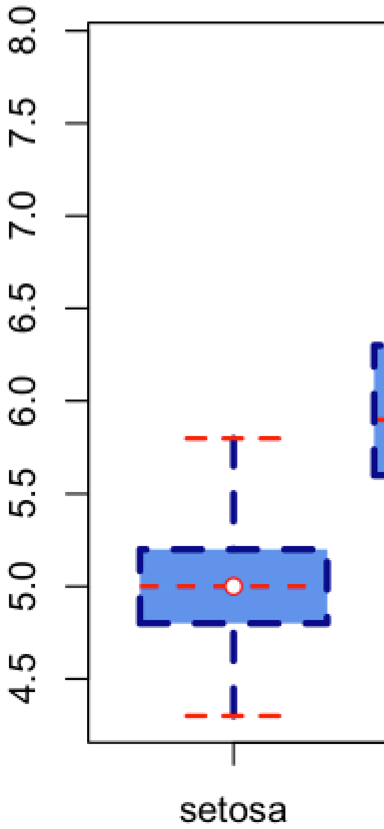
- -
- whisklwd -
- whiskcol -

- -
- staplelwd -
- staplecol -

- outlty - outlier ("blank")
- outlwd -
- outcol -
- outpch - (NA)
- outcex -
- -

```
par(mfrow=c(1,2))
# Default
boxplot(Sepal.Length ~ Species, data=iris)
# Modified
boxplot(Sepal.Length ~ Species, data=iris,
        boxlty=2, boxlwd=3, boxfill="cornflowerblue", boxcol="darkblue",
        medlty=2, medlwd=2, medcol="red", medpch=21, medcex=1, medbg="white",
        whisklty=2, whisklwd=3, whiskcol="darkblue",
        staplelty=2, staplelwd=2, staplecol="red",
        outlty=3, outlwd=3, outcol="grey", outpch=NA
        )
```





: https://riptutorial.com/ko/r/topic/1005/-

77:

Examples

:   .

```
x <- 1:5
x
## [1] 1 2 3 4 5
```

.

```
10:4
# [1] 10  9  8  7  6  5  4
```

```
1.25:5
# [1] 1.25 2.25 3.25 4.25
```

```
-4:4
#[1] -4 -3 -2 -1  0  1  2  3  4
```

seq ()

seq : 1   .

start (1)   .

(to)   .

```
seq(5)
# [1] 1 2 3 4 5
```

```
seq(2, 5) # or seq(from=2, to=5)
# [1] 2 3 4 5
```

(by)

```
seq(2, 5, 0.5) # or seq(from=2, to=5, by=0.5)
# [1] 2.0 2.5 3.0 3.5 4.0 4.5 5.0
```

seq   (length.out) ( )

```
seq(2,5, length.out = 10)
# [1] 2.0 2.3 2.6 2.9 3.2 3.5 3.8 4.1 4.4 4.7 5.0
```

, along.with length.out = length(x)   .

```
x = 1:8
seq(2,5,along.with = x)
# [1] 2.000000 2.428571 2.857143 3.285714 3.714286 4.142857 4.571429 5.000000
```

`seq` `seq_along` , `seq_len` `seq.int` . `seq_along` `seq_len` 1 N () . N , `seq_along` `seq_along` `seq_len` .

```
seq_along(x)
# [1] 1 2 3 4 5 6 7 8
```

`seq_along` .

```
# counting numbers 1 through 10
seq_len(10)
[1]  1  2  3  4  5  6  7  8  9 10
# indices of existing vector (or list) with seq_along
letters[1:10]
[1] "a" "b" "c" "d" "e" "f" "g" "h" "i" "j"
seq_along(letters[1:10])
[1]  1  2  3  4  5  6  7  8  9 10
```

`seq.int` `seq` .

`sequence` .

```
sequence(4)
# [1] 1 2 3 4
sequence(c(3, 2))
# [1] 1 2 3 1 2
sequence(c(3, 2, 5))
# [1] 1 2 3 1 2 1 2 3 4 5
```

R (: , ,) . function `vector()` .

```
vector('integer',2) # creates a vector of integers of size 2.
vector('character',2) # creates a vector of characters of size 2.
vector('logical',2) # creates a vector of logicals of size 2.
```

R .

```
integer(2) # is the same as vector('integer',2) and creates an integer vector with two
elements
character(2) # is the same as vector('integer',2) and creates an character vector with two
elements
logical(2) # is the same as vector('logical',2) and creates an logical vector with two
elements
```

. `c()` . C .

```
c(1, 2) # creates a integer vector of two elements: 1 and 2.
c('a', 'b') # creates a character vector of two elements: a and b.
c(T,F) # creates a logical vector of two elements: TRUE and FALSE.
```

R (: 1) 1 . (: 1.1), (: T F) (: 'a') . , , .

. R .

```
c(1,1.1,'a',T) # all types (integer, numeric, character and logical) are converted to the
'lowest' type which is character.
```

[(operator)] .

```
vec_int <- c(1,2,3)
vec_char <- c('a','b','c')
vec_int[2] # accessing the second element will return 2
vec_char[2] # accessing the second element will return 'b'
```

.

```
vec_int[2] <- 5 # change the second value from 2 to 5
vec_int # returns [1] 1 5 3
```

: (`seq()`) .

```
vec_int <- 1:10
vec_int # returns [1] 1 2 3 4 5 6 7 8 9 10
```

( )

```
vec_char <- c('a','b','c','d','e')
vec_char[2:4] # returns [1] "b" "c" "d"
vec_char[c(1,3,5)] # returns [1] "a" "c" "e"
```

. `c` :

```
xc <- c('a' = 5, 'b' = 6, 'c' = 7, 'd' = 8)
```

.

```
> xc
a b c d
5 6 7 8
```

`list` :

```
xl <- list('a' = 5, 'b' = 6, 'c' = 7, 'd' = 8)
```

.

```
> xl
$a
[1] 5
```

```
$b
[1] 6

$c
[1] 7

$d
[1] 8
```

setNames .

```
x <- 5:8
y <- letters[1:4]

xy <- setNames(x, y)
```

.

```
> xy
a b c d
5 6 7 8
```

, c .

names .

```
xy <- 5:8
names(xy) <- letters[1:4]
```

.

```
> xy["c"]
c
7
```

/ . .

```
mydf <- data.frame(let = c('c','a','b','d'))

> mydf
  let
1   c
2   a
3   b
4   d
```

xy num mydf . match xy .

```
mydf$num <- xy[match(mydf$let, names(xy))]
```

.

```
> mydf
  let num
1   c   7
2   a   5
3   b   6
4   d   8
```

rep ()

rep .

```
# repeat counting numbers, 1 through 5 twice
rep(1:5, 2)
[1] 1 2 3 4 5 1 2 3 4 5

# repeat vector with incomplete recycling
rep(1:5, 2, length.out=7)
[1] 1 2 3 4 5 1 2
```

/ . .

```
# same except repeat each integer next to each other
rep(1:5, each=2)
[1] 1 1 2 2 3 3 4 4 5 5
```

---

rep length .

```
# automated length repetition
rep(1:5, 1:5)
 [1] 1 2 2 3 3 3 4 4 4 4 5 5 5 5 5
# hand-fed repetition length vector
rep(1:5, c(1,1,1,2,2))
[1] 1 2 3 4 4 5 5
```

rep .

---

seq rep rep_len rep.int . rep .

```
# repeat counting numbers, 1 through 5 twice
rep.int(1:5, 2)
[1] 1 2 3 4 5 1 2 3 4 5

# repeat vector with incomplete recycling
rep_len(1:5, length.out=7)
[1] 1 2 3 4 5 1 2
```

:

R . .

- LETTERS : 26

- `letters` : 26
- `month.abb` :
- `month.name` :
- `pi` :

.

1) :

```
> letters
[1] "a" "b" "c" "d" "e" "f" "g" "h" "i" "j" "k" "l" "m" "n" "o" "p" "q" "r" "s" "t" "u" "v"
"w" "x" "y" "z"

> LETTERS[7:9]
[1] "G" "H" "I"

> letters[c(1,5,3,2,4)]
[1] "a" "e" "c" "b" "d"
```

2) :

```
> month.abb
 [1] "Jan" "Feb" "Mar" "Apr" "May" "Jun" "Jul" "Aug" "Sep" "Oct" "Nov" "Dec"

> month.name[1:4]
[1] "January"  "February" "March"    "April"

> month.abb[c(3,6,9,12)]
[1] "Mar" "Jun" "Sep" "Dec"
```

: https://riptutorial.com/ko/r/topic/1088/-

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Examples

,

R . R "" . R (`az` , `Az` , `0-9`), / (.) (_) . .

- (: `1a`), (`.11`) - (") : `` `1a` `` `` `.11` `` . backticks :

  ```
  list( '.11' ="a")
  #$`.11`
  #[1] "a"
  ```

- , . .

- . `ls()` -function .

.

. `foobar` , `foo.bar` , `foo_bar` , `.foobar`

R `<-` . `=` . . `a<-1` (`a < -1`) (`a <- 1`) .

```
> foo <- 42
> fooEquals = 43
```

`foo` `42` . `foo` `fooEquals` `42` , `fooEquals` `43` .

```
> foo
[1] 42
> fooEquals
[1] 43
```

`x` .

```
> (x <- 5)
[1] 5
# actually two function calls: first one to `<-`; second one to the `()`-function
> is.function(`(`)
[1] TRUE  # Often used in R help page examples for its side-effect of printing.
```

`->` .

```
> 5 -> x
> x
[1] 5
>
```

R . 1 .

- : .: . v <- c(2, 3, 7, 10) v2 <- c("a", "b", "c") .
- : , . a <- matrix(data = c(1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12), nrow = 4, ncol = 3, byrow = F) . . a[1,2] , [1] 5 .
- : mylist <- list (course = 'stat', date = '04/07/2009', num_isc = 7, num_cons = 6, num_mat = as.character(c(45020, 45679, 46789, 43126, 42345, 47568, 45674)), results = c(30, 19, 29, NA, 25, 26 ,27)) . ( ) . mylist$results mylist[[6]] . : mylist[6] R . mylist[[6]][2] (19), mylist[6][2] .
- data.frame : . . exam <- data.frame(matr = as.character(c(45020, 45679, 46789, 43126, 42345, 47568, 45674)), res_S = c(30, 19, 29, NA, 25, 26, 27), res_O = c(3, 3, 1, NA, 3, 2, NA), res_TOT = c(30,22,30,NA,28,28,27)) . exam$matr , exam[, 'matr'] exam[1] , exam[,1] . exam['rowname',] exam[1,] . (rownames-attribute) .

. ?Syntax . (R) . :

```
> a <- 1
> b <- 2
> c <- c(2,3,4)
> d <- c(10,10,10)
> e <- c(1,2,3,4)
> f <- 1:6
> W <- cbind(1:4,5:8,9:12)
> Z <- rbind(rep(0,3),1:3,rep(10,3),c(4,7,1))
```

```
> a+b # scalar + scalar
[1] 3
> c+d # vector + vector
[1] 12 13 14
> a*b # scalar * scalar
[1] 2
> c*d # vector * vector (componentwise!)
[1] 20 30 40
> c+a # vector + scalar
[1] 3 4 5
> c^2 #
[1]  4  9 16
> exp(c)
[1]  7.389056 20.085537 54.598150
```

!

```
> c+e # warning but.. no errors, since recycling is assumed to be desired.
[1] 3 5 7 6
Warning message:
In c + e : longer object length is not a multiple of shorter object length
```

R . . c + f # .

!

```
> Z+W # matrix + matrix #(componentwise)
> Z*W # matrix* matrix#(Standard product is always componentwise)
```

: V % * % W

```
> W + a # matrix+ scalar is still componentwise
     [,1] [,2] [,3]
[1,]    2    6   10
[2,]    3    7   11
[3,]    4    8   12
[4,]    5    9   13

> W + c # matrix + vector... : no warnings and R does the operation in a column-wise manner
     [,1] [,2] [,3]
[1,]    3    8   13
[2,]    5   10   12
[3,]    7    9   14
[4,]    6   11   16
```

"

R .

.

```
> foo <- 'foo'
> .foo <- 'bar'
```

`ls` .

```
> ls()
[1] "foo"
```

`all.names = TRUE` 'private' .

```
> ls(all.names = TRUE)
[1] ".foo"          "foo"
```

: https://riptutorial.com/ko/r/topic/9013/

79:

. .

Examples

( ).

```
x <- 1

foo <- function(x) {
    y <- 3
    z <- x + y
    return(z)
}

y
```

: 'y' () .

.

```
foo <- function(x) {
    x <- 2
    y <- 3
    z <- x + y
    return(z)
}

foo(1)
x
```

5

1

.

```
foo <- function() {
    y <- 3
    z <- x + y
    return(z)
}

foo()
```

4

( ) .

:

```
bar <- function() {
    z <- x + y
    return(z)
}

foo <- function() {
    y <- 3
    z <- bar()
    return(z)
}

foo()
```

bar () : 'y' .

:

```
foo <- function() {

    bar <- function() {
        z <- x + y
        return(z)
    }

    y <- 3
    z <- bar()
    return(z)
}

foo()
```

4

`<<-` . `bar()` `y` .

```
bar <- function() {
    z <- x + y
    return(z)
}

foo <- function() {
    y <<- 3
    z <- bar()
    return(z)
}

foo()
```

4

. .

R . .

`package:base` `package:base` .

```
e1 <- new.env(parent = baseenv())
e2 <- new.env(parent = e1)
```

.

```
assign("a", 3, envir = e1)
   get("a", envir = e1)
   get("a", envir = e2)
```

e2 e1 e1 e2 a 3 . , a e2 a e1 .

```
assign("a", 2, envir = e2)
   get("a", envir = e2)
   get("a", envir = e1)
```

2

on.exit() .

, . .

```
new_plot <- function(...) {

     old_pars <- par(mar = c(5,4,4,2) + .1, mfrow = c(1,1))
     on.exit(par(old_pars))
     plot(...)
 }
```

. " . . .

```
library(plyr)
library(dplyr)
```

: 'dplyr'

'package : plyr' .

, , , , , , , ,

'package : stats' .

,

'package : base' .

intersect, setdiff, setequal, union

package::function() .

: https://riptutorial.com/ko/r/topic/3138/-

80:

. package::function() . caret , pls plyr .

Microsoft R Open (Revolution R) BLAS / LAPACK .

Examples

foreach

foreach R . CPU . doSNOW .

foreach 1 100000 .

```
library(foreach)
library(doSNOW)

cl <- makeCluster(5, type = "SOCK")
registerDoSNOW(cl)

f <- foreach(i = 1:100000, .combine = c, .inorder = F) %dopar% {
    k <- i ** 2 + sqrt(i)
    k
}
```

foreach .combine . . c . "+" ( ) .

foreach-loop . k .

.	. . c , cbind , rbind , "+" , "*" ....
.inorder	TRUE (i) . FALSE . .
	base , mass , randomForest c("mass", "randomForest") .

parallel , .

localhost .

```
parallel::detectCores(all.tests = FALSE, logical = TRUE)
```

localhost .

```
parallelCluster <- parallel::makeCluster(parallel::detectCores())
```

, . mtcars . cyl mpg .

```
data <- mtcars
yfactor <- 'cyl'
zlevels <- sort(unique(data[[yfactor]]))
datay <- data[,1]
dataz <- data[,2]
datax <- data[,3:11]


fitmodel <- function(zlevel, datax, datay, dataz) {
  glm.fit(x = datax[dataz == zlevel,], y = datay[dataz == zlevel])
}
```

zlevels . , .

```
fitmodel <- function(zlevel, datax, datay, dataz) {
  glm.fit(x = datax[dataz == zlevel,], y = datay[dataz == zlevel])
}


for (zlevel in zlevels) {
  print("*****")
  print(zlevel)
  print(fitmodel(zlevel, datax, datay, dataz))
}
```

:

```
worker <- function(zlevel) {
    fitmodel(zlevel,datax, datay, dataz)
  }
```

parallel ., parallel . . .

```
wrapper <- function(datax, datay, dataz) {
  # force evaluation of all paramters not supplied by parallelization apply
  force(datax)
  force(datay)
  force(dataz)
  # these variables are now in an enviroment accessible by parallel function

  # function to be applied also in the environment
  fitmodel <- function(zlevel, datax, datay, dataz) {
    glm.fit(x = datax[dataz == zlevel,], y = datay[dataz == zlevel])
  }

  # calling in this environment iterating over single parameter zlevel
  worker <- function(zlevel) {
    fitmodel(zlevel,datax, datay, dataz)
  }
  return(worker)
}
```

.

```
parallelcluster <- parallel::makeCluster(parallel::detectCores())
models <- parallel::parLapply(parallelcluster,zlevels,
```

```
wrapper(datax, datay, dataz))
```

.

```
parallel::stopCluster(parallelcluster)
```

parallel par apply() .

RNG . set.seed() . ! .

. (parallel , snow) .

```
s <- seed
for (i in 1:numofcores) {
    s <- nextRNGStream(s)
    # send s to worker i as .Random.seed
}
```

.

```
clusterSetRNGStream(cl = parallelcluster, iseed)
```

mcparallelDo

mcparallelDo Unix (Linux MacOSX) R . . future .

```
data(ToothGrowth)
```

mcparallelDo .

```
mcparallelDo({glm(len ~ supp * dose, data=ToothGrowth)},"interactionPredictorModel")
```

.

```
binaryPredictorModel <- glm(len ~ supp, data=ToothGrowth)
gaussianPredictorModel <- glm(len ~ dose, data=ToothGrowth)
```

mcparallelDo targetEnvironment (: .GlobalEnv) ().

```
summary(interactionPredictorModel)
```

```
# Example of not returning a value until we return to the top level
for (i in 1:10) {
  if (i == 1) {
    mcparallelDo({2+2}, targetValue = "output")
  }
```

```
  if (exists("output")) print(i)
}

# Example of getting a value without returning to the top level
for (i in 1:10) {
  if (i == 1) {
    mcparallelDo({2+2}, targetValue = "output")
  }
  mcparallelDoCheck()
  if (exists("output")) print(i)
}
```

: https://riptutorial.com/ko/r/topic/1677/-

81:

R , `?Distributions` .

4 .

- **d** -
- **p** -
- **q** - .
- **r** -

R `?Distributions` .

Examples

`*norm` . :

```
dnorm(x, mean = 0, sd = 1, log = FALSE)
pnorm(q, mean = 0, sd = 1, lower.tail = TRUE, log.p = FALSE)
qnorm(p, mean = 0, sd = 1, lower.tail = TRUE, log.p = FALSE)
rnorm(n, mean = 0, sd = 1)
```

0

```
dnorm(0)
```

`0.3989423` .

`pnorm(0)` `.5` . , 0 .

`qnorm` `pnorm` `pnorm` . `qnorm(.5)` `0` .

, `rnorm` .

```
rnorm(10)
```

10 .

.

`rnorm(10, mean=4, sd= 3)`

`rbinom` `dbinom` , `pbinom` , `qbinom` `rbinom` .

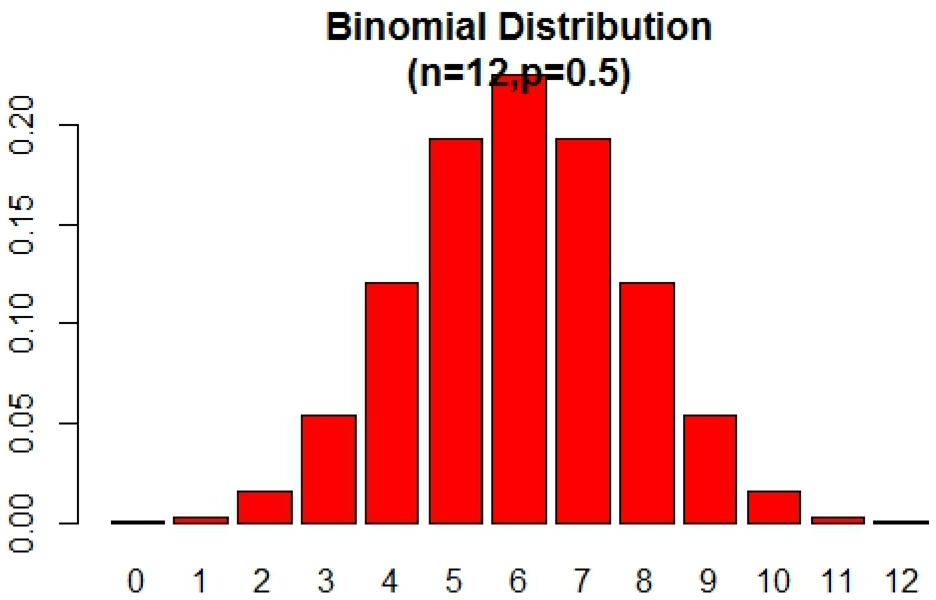
`dbinom()` . . x quantile (`x`) . `defining parameters` , `n` ( ) `p` ( ). , `n = 5` , `p = 0.5` X `0,1,2,3,4,5` . , `dbinom(x,n,p)` `x = 0, 1, 2, 3, 4, 5` `P( X = x )` .

```
#Binom(n = 5, p = 0.5) probabilities
```

```
> n <- 5; p<- 0.5; x <- 0:n
> dbinom(x,n,p)
[1] 0.03125 0.15625 0.31250 0.31250 0.15625 0.03125
#To verify the total probability is 1
> sum(dbinom(x,n,p))
[1] 1
>
```

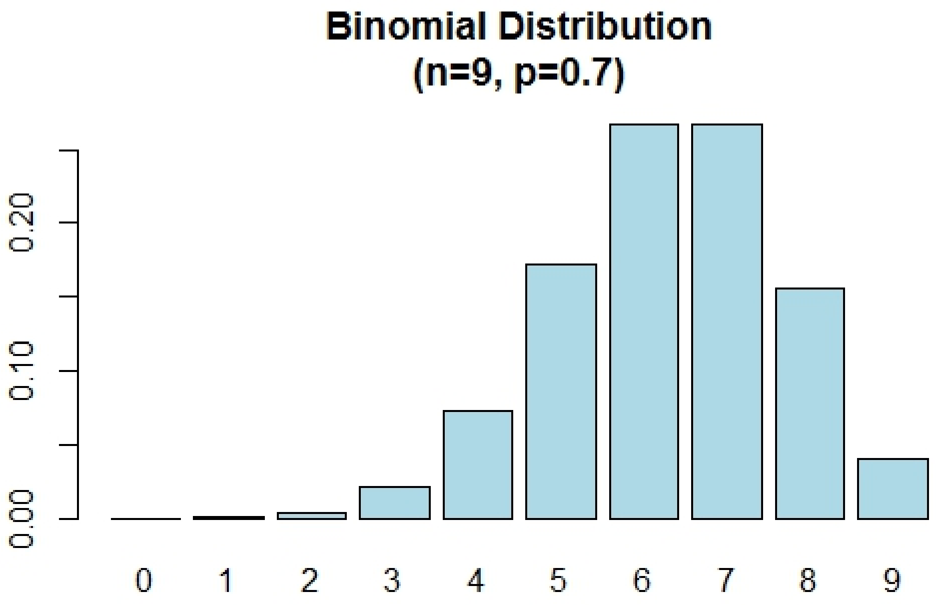
.

```
> x <- 0:12
> prob <- dbinom(x,12,.5)
> barplot(prob,col = "red",ylim = c(0,.2),names.arg=x,
                             main="Binomial Distribution\n(n=12,p=0.5)")
```



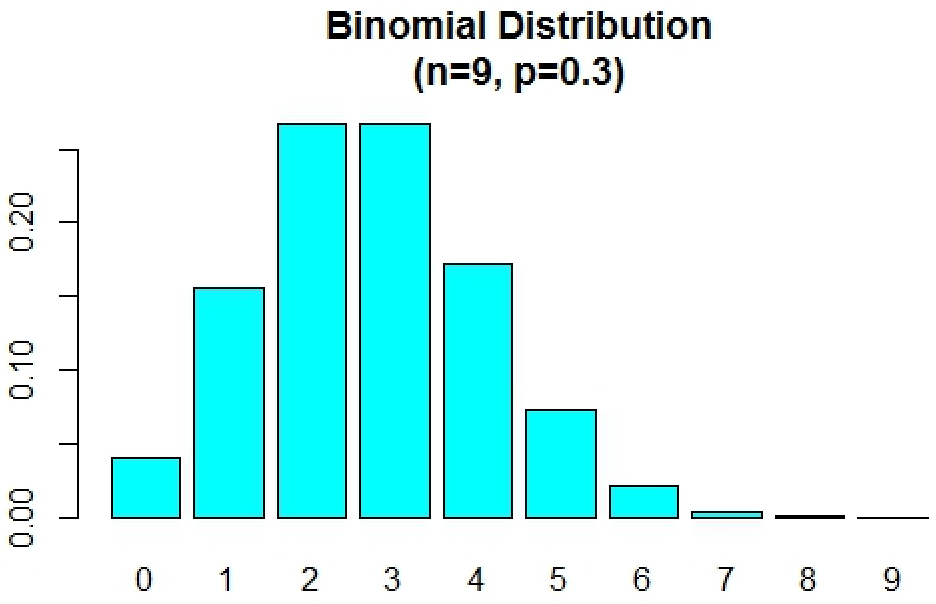
p = 0.5 . p 0.5 .

```
> n=9; p=.7; x=0:n; prob=dbinom(x,n,p);
> barplot(prob,names.arg = x,main="Binomial Distribution\n(n=9, p=0.7)",col="lightblue")
```



p 0.5 .

```
> n=9; p=.3; x=0:n; prob=dbinom(x,n,p);
> barplot(prob,names.arg = x,main="Binomial Distribution\n(n=9, p=0.3)",col="cyan")
```



pbinom() . P(X <= x) . x quantile (x) .

```
# Calculating Probabilities
# P(X <= 2) in a Bin(n=5,p=0.5) distribution
> pbinom(2,5,0.5)
```

```
[1] 0.5
```

.

```
# P(X <= 2) = P(X=0) + P(X=1) + P(X=2)
> sum(dbinom(0:2,5,0.5))
[1] 0.5
```

, : P(a <= X <= b)

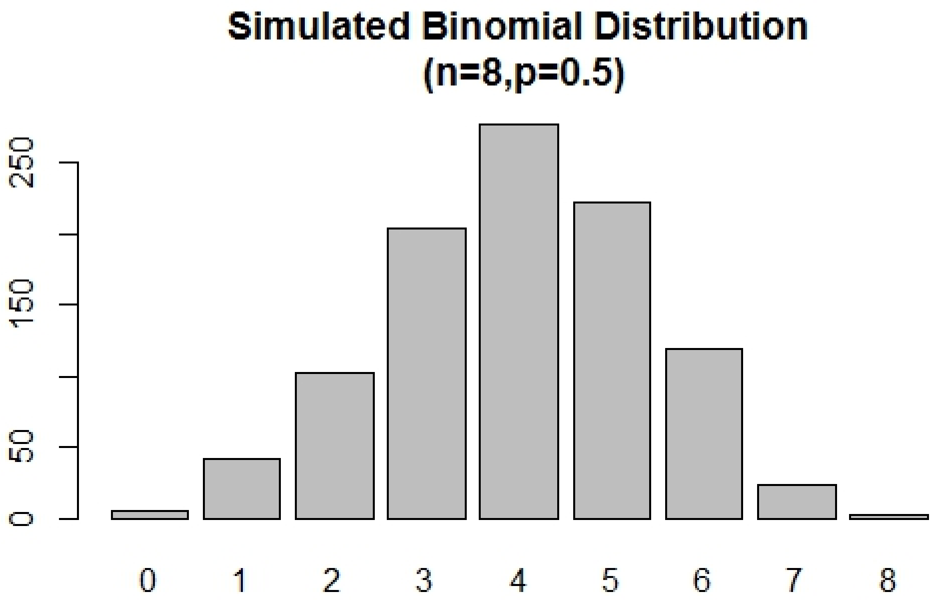
```
# P(3<= X <= 5) = P(X=3) + P(X=4) + P(X=5) in a Bin(n=9,p=0.6) dist
> sum(dbinom(c(3,4,5),9,0.6))
[1] 0.4923556
>
```

:

```
> n = 10; p = 0.4; x = 0:n;
> prob = dbinom(x,n,p)
> cdf = pbinom(x,n,p)
> distTable = cbind(x,prob,cdf)
> distTable
       x         prob         cdf
 [1,]  0 0.0060466176 0.006046618
 [2,]  1 0.0403107840 0.046357402
 [3,]  2 0.1209323520 0.167289754
 [4,]  3 0.2149908480 0.382280602
 [5,]  4 0.2508226560 0.633103258
 [6,]  5 0.2006581248 0.833761382
 [7,]  6 0.1114767360 0.945238118
 [8,]  7 0.0424673280 0.987705446
 [9,]  8 0.0106168320 0.998322278
[10,]  9 0.0015728640 0.999895142
[11,] 10 0.0001048576 1.000000000
>
```

rbinom() .

```
# Simulation
> xVal<-names(table(rbinom(1000,8,.5)))
> barplot(as.vector(table(rbinom(1000,8,.5))),names.arg =xVal,
                  main="Simulated Binomial Distribution\n (n=8,p=0.5)")
```



: https://riptutorial.com/ko/r/topic/1885/-

82:

Examples

split data.frame . (for lapply / sapply).

split .

.

```
testdata <- c("e", "o", "r", "g", "a", "y", "w", "q", "i", "s", "b", "v", "x", "h", "u")
```

voyels consonants ., .

.

```
vowels <- c('a','e','i','o','u','y')
letter_type <- ifelse(testdata %in% vowels, "vowels", "consonants")
```

letter_type testdata . vowels consonants split .

```
split(testdata, letter_type)
#$consonants
#[1] "r" "g" "w" "q" "s" "b" "v" "x" "h"

#$vowels
#[1] "e" "o" "a" "y" "i" "u"
```

/ letter_type .

split data.frames .

iris .

```
data(iris)
```

split , data.frame (: Species) :

```
> liris <- split(iris, iris$Species)
> names(liris)
[1] "setosa"     "versicolor" "virginica"
> head(liris$setosa)
  Sepal.Length Sepal.Width Petal.Length Petal.Width Species
1          5.1         3.5          1.4         0.2  setosa
2          4.9         3.0          1.4         0.2  setosa
3          4.7         3.2          1.3         0.2  setosa
4          4.6         3.1          1.5         0.2  setosa
5          5.0         3.6          1.4         0.2  setosa
6          5.4         3.9          1.7         0.4  setosa
```

(setosa).

. lapply lapply .

```
> (lcor <- lapply(liris, FUN=function(df) cor(df[,1:4])))

    $setosa
             Sepal.Length Sepal.Width Petal.Length Petal.Width
Sepal.Length    1.0000000   0.7425467    0.2671758   0.2780984
Sepal.Width     0.7425467   1.0000000    0.1777000   0.2327520
Petal.Length    0.2671758   0.1777000    1.0000000   0.3316300
Petal.Width     0.2780984   0.2327520    0.3316300   1.0000000

$versicolor
             Sepal.Length Sepal.Width Petal.Length Petal.Width
Sepal.Length    1.0000000   0.5259107    0.7540490   0.5464611
Sepal.Width     0.5259107   1.0000000    0.5605221   0.6639987
Petal.Length    0.7540490   0.5605221    1.0000000   0.7866681
Petal.Width     0.5464611   0.6639987    0.7866681   1.0000000

$virginica
             Sepal.Length Sepal.Width Petal.Length Petal.Width
Sepal.Length    1.0000000   0.4572278    0.8642247   0.2811077
Sepal.Width     0.4572278   1.0000000    0.4010446   0.5377280
Petal.Length    0.8642247   0.4010446    1.0000000   0.3221082
Petal.Width     0.2811077   0.5377280    0.3221082   1.0000000
```

(/)

```
> library(reshape)
> (topcor <- lapply(lcor, FUN=function(cormat){
   correlations <- melt(cormat,variable_name="correlatio);
   filtered <- correlations[correlations$X1 != correlations$X2,];
   filtered[which.max(filtered$correlation),]
}))

$setosa
           X1           X2     correlation
2 Sepal.Width Sepal.Length       0.7425467

$versicolor
            X1           X2     correlation
12 Petal.Width Petal.Length       0.7866681

$virginica
            X1           X2     correlation
3 Petal.Length Sepal.Length       0.8642247
```

. .

```
> (result <- do.call("rbind", topcor))

                     X1           X2     correlation
setosa      Sepal.Width Sepal.Length       0.7425467
versicolor  Petal.Width Petal.Length       0.7866681
virginica  Petal.Length Sepal.Length       0.8642247
```

split-apply-combine split

- - , .

mtcars (cyl) (mpg) . `mtcars` `mtcars` .

```
(spl <- split(mtcars, mtcars$cyl))
# $`4`
#                 mpg cyl  disp  hp drat    wt  qsec vs am gear carb
# Datsun 710     22.8   4 108.0  93 3.85 2.320 18.61  1  1    4    1
# Merc 240D      24.4   4 146.7  62 3.69 3.190 20.00  1  0    4    2
# Merc 230       22.8   4 140.8  95 3.92 3.150 22.90  1  0    4    2
# Fiat 128       32.4   4  78.7  66 4.08 2.200 19.47  1  1    4    1
# ...
#
# $`6`
#                 mpg cyl  disp  hp drat    wt  qsec vs am gear carb
# Mazda RX4      21.0   6 160.0 110 3.90 2.620 16.46  0  1    4    4
# Mazda RX4 Wag  21.0   6 160.0 110 3.90 2.875 17.02  0  1    4    4
# Hornet 4 Drive 21.4   6 258.0 110 3.08 3.215 19.44  1  0    3    1
# Valiant        18.1   6 225.0 105 2.76 3.460 20.22  1  0    3    1
# ...
#
# $`8`
#                     mpg cyl  disp  hp drat    wt  qsec vs am gear carb
# Hornet Sportabout   18.7   8 360.0 175 3.15 3.440 17.02  0  0    3    2
# Duster 360          14.3   8 360.0 245 3.21 3.570 15.84  0  0    3    4
# Merc 450SE          16.4   8 275.8 180 3.07 4.070 17.40  0  0    3    3
# Merc 450SL          17.3   8 275.8 180 3.07 3.730 17.60  0  0    3    3
# ...
```

. `spl$`4``, `spl$`6`` `spl$`8`` (`spl$"4"` `spl$"4"` `spl[["4"]]`).

`lapply` 2 mpg .

```
(best2 <- lapply(spl, function(x) tail(x[order(x$mpg),], 2)))
# $`4`
#                 mpg cyl disp hp drat    wt  qsec vs am gear carb
# Fiat 128       32.4   4 78.7 66 4.08 2.200 19.47  1  1    4    1
# Toyota Corolla 33.9   4 71.1 65 4.22 1.835 19.90  1  1    4    1
#
# $`6`
#                 mpg cyl disp  hp drat    wt  qsec vs am gear carb
# Mazda RX4 Wag  21.0   6  160 110 3.90 2.875 17.02  0  1    4    4
# Hornet 4 Drive 21.4   6  258 110 3.08 3.215 19.44  1  0    3    1
#
# $`8`
#                    mpg cyl disp  hp drat    wt  qsec vs am gear carb
# Hornet Sportabout 18.7   8  360 175 3.15 3.440 17.02  0  0    3    2
# Pontiac Firebird  19.2   8  400 175 3.08 3.845 17.05  0  0    3    2
```

`rbind` . `rbind(best2[["4"]], best2[["6"]], best2[["8"]])` , . .

```
do.call(rbind, best2)
#                     mpg cyl  disp  hp drat    wt  qsec vs am gear carb
# 4.Fiat 128          32.4   4  78.7  66 4.08 2.200 19.47  1  1    4    1
```

```
# 4.Toyota Corolla    33.9   4  71.1  65 4.22 1.835 19.90  1  1    4    1
# 6.Mazda RX4 Wag     21.0   6 160.0 110 3.90 2.875 17.02  0  1    4    4
# 6.Hornet 4 Drive    21.4   6 258.0 110 3.08 3.215 19.44  1  0    3    1
# 8.Hornet Sportabout 18.7   8 360.0 175 3.15 3.440 17.02  0  0    3    2
# 8.Pontiac Firebird  19.2   8 400.0 175 3.08 3.845 17.05  0  0    3    2
```

`best2` (2,) `rbind` (1,) .

.

```
do.call(rbind, lapply(split(mtcars, mtcars$cyl), function(x) tail(x[order(x$mpg),], 2)))
```

`lapply(split(x,f), FUN)` `?by` `lapply(split(x,f), FUN)` .

```
by(mtcars, mtcars$cyl, function(x) tail(x[order(x$mpg),], 2))
do.call(rbind, by(mtcars, mtcars$cyl, function(x) tail(x[order(x$mpg),], 2)))
```

: https://riptutorial.com/ko/r/topic/1073/-

83:

Drier R (SE) (NSE) 1 .

, `summarise()` `summarise_()` .

lazyeval NSE .

Examples

dplyr

NSE . SE .

dplyr lazyeval :

```
library(dplyr)
library(lazyeval)
```

NSE

```
filter(mtcars, cyl == 8)
filter(mtcars, cyl < 6)
filter(mtcars, cyl < 6 & vs == 1)
```

SE ( )

```
filter_(mtcars, .dots = list(~ cyl == 8))
filter_(mtcars, .dots = list(~ cyl < 6))
filter_(mtcars, .dots = list(~ cyl < 6, ~ vs == 1))
```

NSE

```
summarise(mtcars,  mean(disp))
summarise(mtcars,  mean_disp = mean(disp))
```

SE

```
summarise_(mtcars, .dots = lazyeval::interp(~ mean(x), x = quote(disp)))
summarise_(mtcars, .dots = setNames(list(lazyeval::interp(~ mean(x), x = quote(disp))),
"mean_disp"))
summarise_(mtcars, .dots = list("mean_disp" = lazyeval::interp(~ mean(x), x = quote(disp))))
```

NSE

```
mutate(mtcars, displ_l = disp / 61.0237)
```

SE

```
mutate_(
    .data = mtcars,
    .dots = list(
        "displ_l" = lazyeval::interp(
                        ~ x / 61.0237, x = quote(disp)
            )
         )
)
```

: https://riptutorial.com/ko/r/topic/9365/----

84:

Examples

Shiny RStudio R R .

Shiny .

- .R
- : ui.R server.R .

Shiny .

- **ui** : .
- **(server)** : .

```
library(shiny)

# Create the UI
ui <- shinyUI(fluidPage(
    # Application title
    titlePanel("Hello World!")
))

# Create the server function
server <- shinyServer(function(input, output){})

# Run the app
shinyApp(ui = ui, server = server)
```

ui.R

```
library(shiny)

# Define UI for application
shinyUI(fluidPage(
  # Application title
  titlePanel("Hello World!")
))
```

server.R

```
library(shiny)

# Define server logic
shinyServer(function(input, output){})
```

.

.

- :   ((0))
- :
-

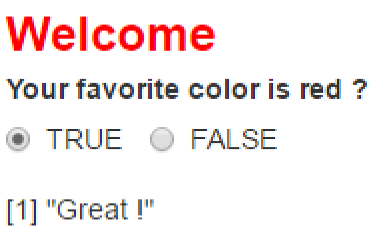
HTML   .

```
library(shiny)

ui <- fluidPage(
  radioButtons("radio",
               label = HTML('<FONT color="red"><FONT size="5pt">Welcome</FONT></FONT><br>
<b>Your favorite color is red ?</b>'),
               choices = list("TRUE" = 1, "FALSE" = 2),
               selected = 1,
               inline = T,
               width = "100%"),
  fluidRow(column(3, textOutput("value"))))


server <- function(input, output){
  output$value <- renderPrint({
    if(input$radio == 1){return('Great !')}
     else{return("Sorry !")}})}

shinyApp(ui = ui, server = server)
```



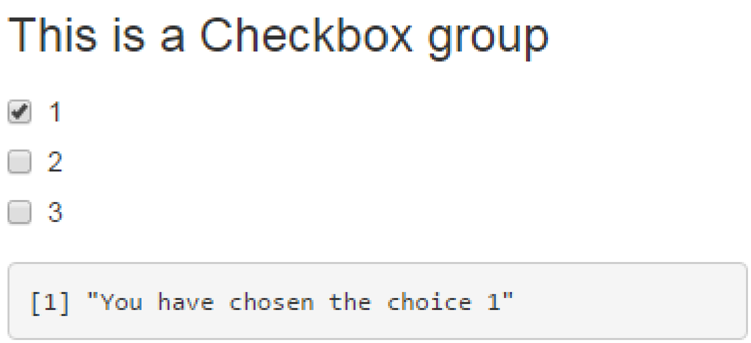
.   .

```
library(shiny)

ui <- fluidPage(
  checkboxGroupInput("checkGroup1", label = h3("This is a Checkbox group"),
                     choices = list("1" = 1, "2" = 2, "3" = 3),
                     selected = 1),
  fluidRow(column(3, verbatimTextOutput("text_choice")))
  )


server <- function(input, output){
  output$text_choice <- renderPrint({
    return(paste0("You have chosen the choice ",input$checkGroup1))})
}

shinyApp(ui = ui, server = server)
```



.

- :
- :
- selected : (NULL)
- :
-

HTML .

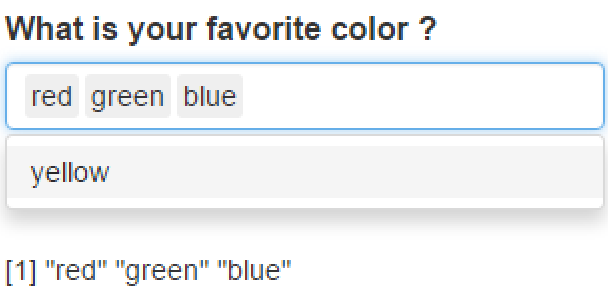
.

```
library(shiny)

ui <- fluidPage(
  selectInput("id_selectInput",
          label = HTML('<B><FONT size="3">What is your favorite color ?</FONT></B>'),
          multiple = TRUE,
          choices = list("red" = "red", "green" = "green", "blue" = "blue", "yellow" =
"yellow"),
          selected = NULL),
  br(), br(),
  fluidRow(column(3, textOutput("text_choice"))))


server <- function(input, output){
  output$text_choice <- renderPrint({
    return(input$id_selectInput)})
}

shinyApp(ui = ui, server = server)
```



.

-

:

- :
- selected : (NULL)
- multiple : TRUE FALSE
-
-
- selectize : TRUE FALSE (select.js)

HTML .

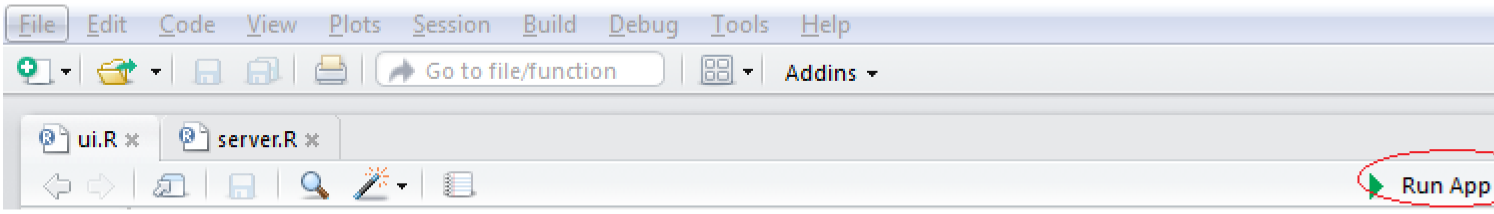
. `ui.R` `server.R` .

1.

`ui.R` `server.R` . `shinyApp()` Shiny .

```
shinyApp("path_to_the_folder_containing_the_files")
```

Rstudio Rstudio `ui.R` `server.R` .



Shiny App `runApp()` .

2.

R `shinyApp()` .

- :

```
library(shiny)

ui <- fluidPage() #Create the ui
server <- function(input, output){} #create the server

shinyApp(ui = ui, server = server) #run the App
```

- `appFile` Shiny `.R` .

```
shinyApp(appFile="path_to_my_R_file_containig_the_app")
```

actionButton	
checkboxGroupInput	

checkboxInput	
dateInput	
dateRangeInput	
fileInput	
helpText	
numericInput	
selectInput	
sliderInput	
submitButton	

```
library(shiny)

# Create the UI
ui <- shinyUI(fluidPage(
  titlePanel("Basic widgets"),

  fluidRow(

    column(3,
           h3("Buttons"),
           actionButton("action", label = "Action"),
           br(),
           br(),
           submitButton("Submit")),

    column(3,
           h3("Single checkbox"),
           checkboxInput("checkbox", label = "Choice A", value = TRUE)),

    column(3,
           checkboxGroupInput("checkGroup",
                              label = h3("Checkbox group"),
                              choices = list("Choice 1" = 1,
                                             "Choice 2" = 2, "Choice 3" = 3),
                              selected = 1)),

    column(3,
           dateInput("date",
                     label = h3("Date input"),
                     value = "2014-01-01"))
  ),

  fluidRow(

    column(3,
           dateRangeInput("dates", label = h3("Date range"))),
```

```
    column(3,
           fileInput("file", label = h3("File input"))),

    column(3,
           h3("Help text"),
           helpText("Note: help text isn't a true widget,",
                    "but it provides an easy way to add text to",
                    "accompany other widgets.")),

    column(3,
           numericInput("num",
                        label = h3("Numeric input"),
                        value = 1))
  ),

  fluidRow(

    column(3,
           radioButtons("radio", label = h3("Radio buttons"),
                        choices = list("Choice 1" = 1, "Choice 2" = 2,
                                       "Choice 3" = 3),selected = 1)),

    column(3,
           selectInput("select", label = h3("Select box"),
                       choices = list("Choice 1" = 1, "Choice 2" = 2,
                                      "Choice 3" = 3), selected = 1)),

    column(3,
           sliderInput("slider1", label = h3("Sliders"),
                       min = 0, max = 100, value = 50),
           sliderInput("slider2", "",
                       min = 0, max = 100, value = c(25, 75))
    ),

    column(3,
           textInput("text", label = h3("Text input"),
                     value = "Enter text..."))
  )

))

# Create the server function
server <- shinyServer(function(input, output){})

# Run the app
shinyApp(ui = ui, server = server)
```

`debug()` `debugonce()` Shiny . `browser()` Shiny . : `browser()`

Showcase server.R .

.

- `runApp("MyApp", display.mode = "showcase")` `runApp("MyApp", display.mode = "showcase")` = "showcase" .
- Shiny app `DESCRIPTION` `DisplayMode: Showcase` `DisplayMode: Showcase` .

Reactive Log Visualizer . Reactive Log Visualizer R `options(shiny.reactlog=TRUE)` `options(shiny.reactlog=TRUE)` . Reactive Log Visualizer Windows Ctrl + F3 Mac Command + F3 . Reactive Log Visualizer .

: https://riptutorial.com/ko/r/topic/2044/

85:

- <- readline (prompt = " ")
- name <- readline (prompt = " ?")

Examples

R

R R .

`readline` .

```
name <- readline(prompt = "What is your name?")
```

, , . :

```
result <- readline(prompt = "What is the result of 1+1?")
while(result!=2){
    readline(prompt = "Wrong answer. What is the result of 1+1?")
}
```

.

`as.numeric` .

```
result <- as.numeric(readline(prompt = "What is the result of 1+1?"))
while(result!=2){
    readline(prompt = "Wrong answer. What is the result of 1+1?")
}
```

: https://riptutorial.com/ko/r/topic/5098/--

86:

R . , `+` `function (e1, e2) .Primitive("+")` `function (e1, e2) .Primitive("+")` e1 e2 . , `+`
.

:

```
`+` <- function(e1, e2) {e1-e2}

> 3+10
[1] -7
```

Examples

( ).

```
3+1:5
```

:

```
[1] 4 5 6 7 8
```

`:` `+` .

.

- `3+1:5`
- `3+c(1, 2, 3, 4, 5)` .
- `c(4, 5, 6, 7, 8)` 3 .

R `( )` :

```
(3+1):5
```

R .

```
[1] 4 5
```

( ) .

1.

`+` `-` :

```
> 3 + 4.5
# [1] 7.5
> 3 + 4.5 + 2
```

```
# [1] 9.5
> 3 + 4.5 + 2 - 3.8
# [1] 5.7
> 3 + NA
#[1] NA
> NA + NA
#[1] NA
> NA - NA
#[1] NA
> NaN - NA
#[1] NaN
> NaN + NA
#[1] NaN
```

( ) .

```
> a <- 3; B <- 4.5; cc <- 2; Dd <- 3.8 ;na<-NA;nan<-NaN
> a + B
# [1] 7.5
> a + B + cc
# [1] 9.5
> a + B + cc - Dd
# [1] 5.7
> B-nan
#[1] NaN
> a+na-na
#[1] NA
> a + na
#[1] NA
> B-nan
#[1] NaN
> a+na-na
#[1] NA
```

2.

. .

```
> A <- c(3, 4.5, 2, -3.8);
> A
# [1]  3.0  4.5  2.0 -3.8
> A + 2 # Adding a number
# [1]  5.0  6.5  4.0 -1.8
> 8 - A # number less vector
# [1]  5.0  3.5  6.0 11.8
> n <- length(A) #number of elements of vector A
> n
# [1] 4
> A[-n] + A[n] # Add the last element to the same vector without the last element
# [1] -0.8  0.7 -1.8
> A[1:2] + 3 # vector with the first two elements plus a number
# [1] 6.0 7.5
> A[1:2] - A[3:4] # vector with the first two elements less the vector with elements 3 and 4
# [1] 1.0 8.3
```

`sum` .

```
> sum(A)
# [1] 5.7
> sum(-A)
# [1] -5.7
> sum(A[-n]) + A[n]
# [1] 5.7
```

R . *()* . . .

```
> B <- c(3, 5, -3, 2.7, 1.8)
> B
# [1]  3.0  5.0 -3.0  2.7  1.8
> A
# [1]  3.0  4.5  2.0 -3.8
> A + B # the first element of A is repeated
# [1]  6.0  9.5 -1.0 -1.1  4.8
Warning message:
In A + B : longer object length is not a multiple of shorter object length
> B - A # the first element of A is repeated
# [1]  0.0  0.5 -5.0  6.5 -1.2
Warning message:
In B - A : longer object length is not a multiple of shorter object length
```

.

```
> B[1:n] + A
# [1]  6.0  9.5 -1.0 -1.1
> B[1:n] - A
# [1]  0.0  0.5 -5.0  6.5
```

sum .

```
> sum(A, B)
# [1] 15.2
> sum(A, -B)
# [1] -3.8
> sum(A)+sum(B)
# [1] 15.2
> sum(A)-sum(B)
# [1] -3.8
```

: https://riptutorial.com/ko/r/topic/4389/-

87:

Examples

randomForestSRC

.

CRAN `randomForestSRC` , .

```
require(randomForestSRC)

set.seed(130948) #Other seeds give similar comparative results
x1   <- runif(1000)
y    <- rnorm(1000, mean = x1, sd = .3)
data <- data.frame(x1 = x1, y = y)
head(data)
```

```
         x1          y
1 0.9604353  1.3549648
2 0.3771234  0.2961592
3 0.7844242  0.6942191
4 0.9860443  1.5348900
5 0.1942237  0.4629535
6 0.7442532 -0.0672639
```

```
(modRFSRC <- rfsrc(y ~ x1, data = data, ntree=500, nodesize = 5))
```

```
                         Sample size: 1000
                     Number of trees: 500
           Minimum terminal node size: 5
        Average no. of terminal nodes: 208.258
No. of variables tried at each split: 1
              Total no. of variables: 1
                            Analysis: RF-R
                              Family: regr
                      Splitting rule: mse
                % variance explained: 32.08
                          Error rate: 0.11
```

```
x1new   <- runif(10000)
ynew    <- rnorm(10000, mean = x1new, sd = .3)
newdata <- data.frame(x1 = x1new, y = ynew)

survival.results <- predict(modRFSRC, newdata = newdata)
survival.results
```

```
  Sample size of test (predict) data: 10000
                Number of grow trees: 500
  Average no. of grow terminal nodes: 208.258
         Total no. of grow variables: 1
```

```
                    Analysis: RF-R
                      Family: regr
      % variance explained: 34.97
       Test set error rate: 0.11
```

-

`survival` R. `lung` `survreg()` `survfit()` , `predict` .

2 2 `sex` .

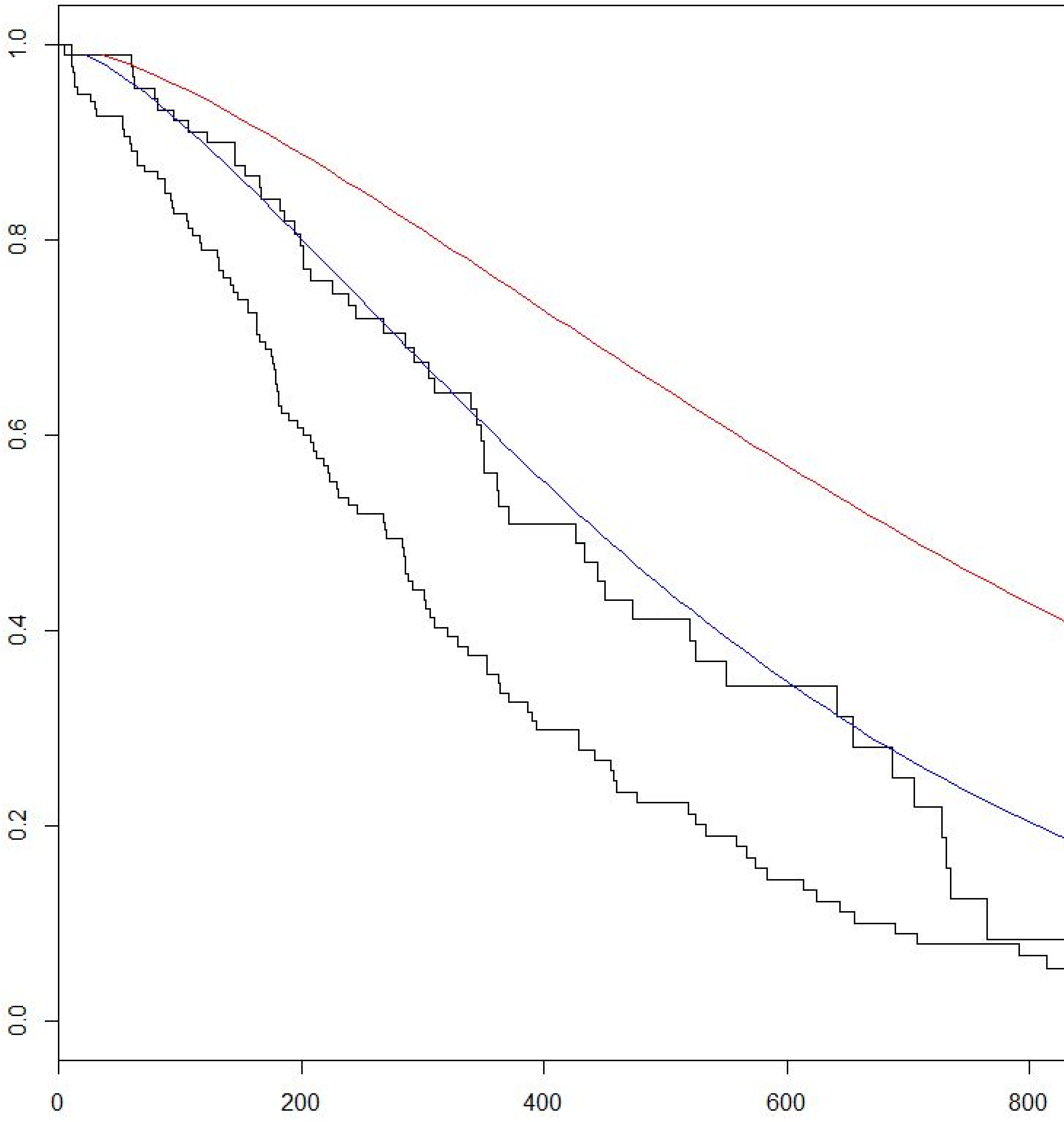
```
require(survival)
s <- with(lung,Surv(time,status))

sWei  <- survreg(s ~ as.factor(sex)+age+ph.ecog+wt.loss+ph.karno,dist='weibull',data=lung)

fitKM <- survfit(s ~ sex,data=lung)
plot(fitKM)

lines(predict(sWei, newdata = list(sex      = 1,
                                   age      = 1,
                                   ph.ecog  = 1,
                                   ph.karno = 90,
                                   wt.loss  = 2),
                                 type = "quantile",
                                 p    = seq(.01, .99, by = .01)),
                                 seq(.99, .01, by        =-.01),
                                 col = "blue")

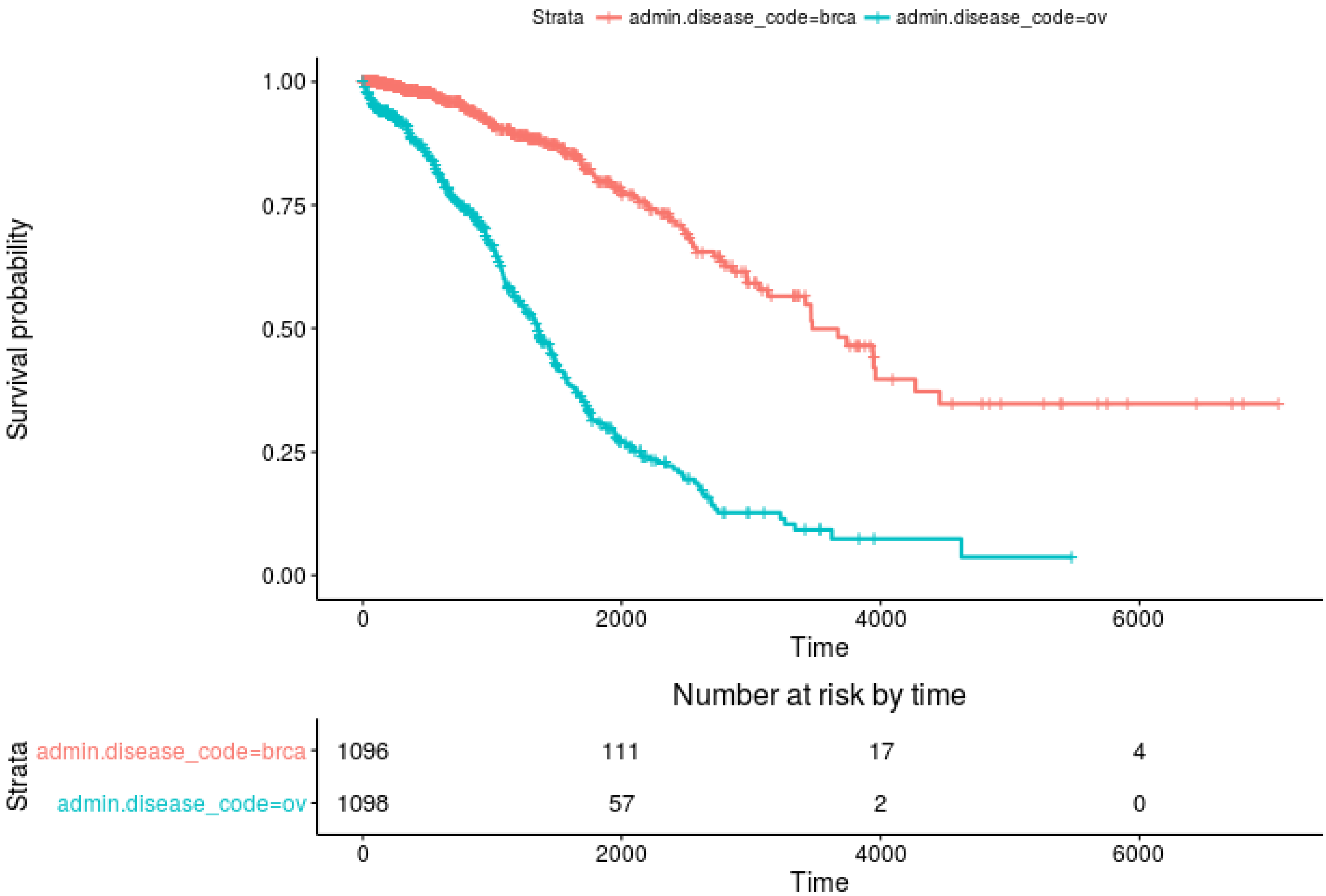
lines(predict(sWei, newdata = list(sex      = 2,
                                   age      = 1,
                                   ph.ecog  = 1,
                                   ph.karno = 90,
                                   wt.loss  = 2),
                                 type = "quantile",
                                 p    = seq(.01, .99, by = .01)),
                                 seq(.99, .01, by        =-.01),
                                 col = "red")
```



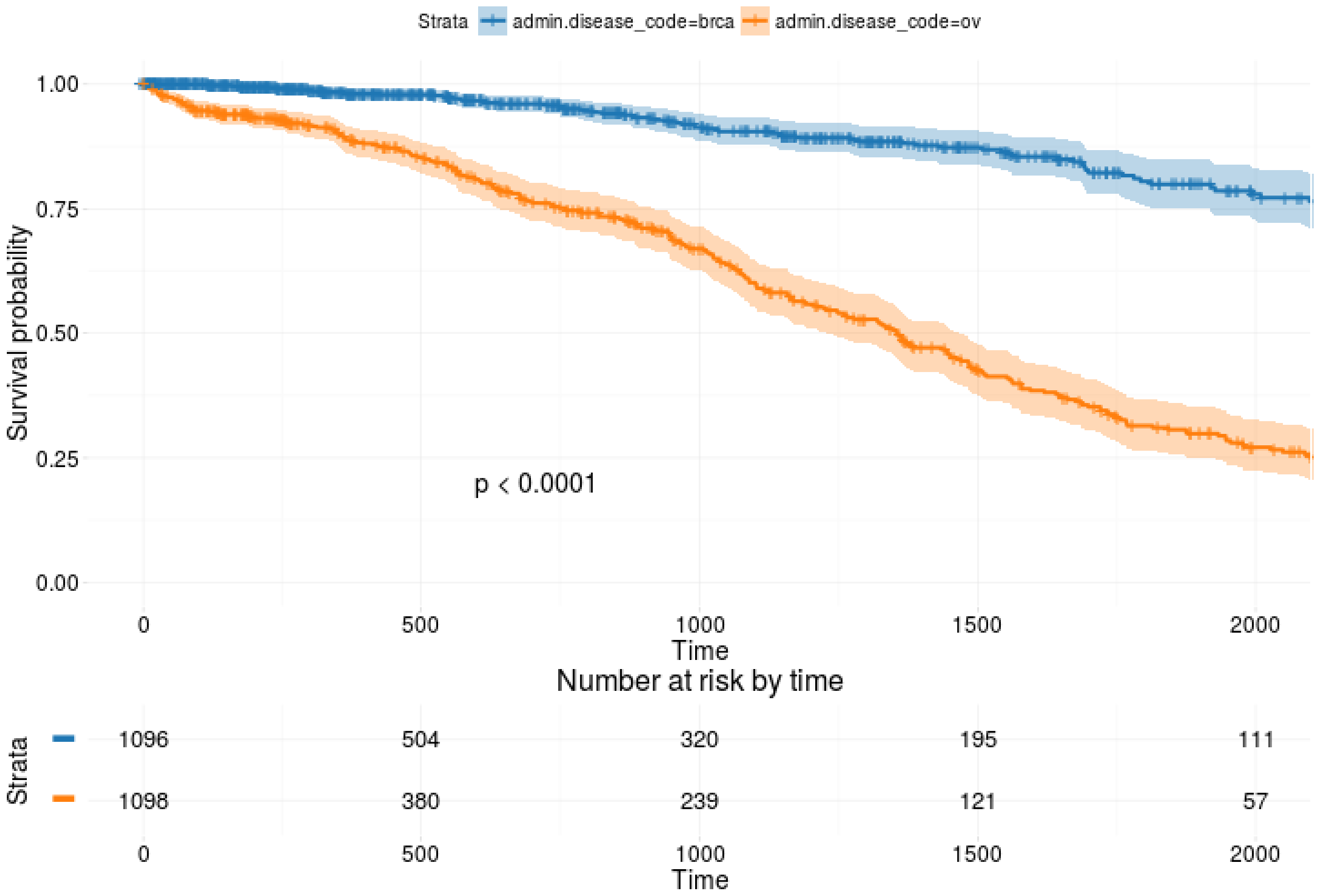
Kaplan Meier

```
install.packages('survminer')
source("https://bioconductor.org/biocLite.R")
biocLite("RTCGA.clinical") # data for examples
library(RTCGA.clinical)
survivalTCGA(BRCA.clinical, OV.clinical,
             extract.cols = "admin.disease_code") -> BRCAOV.survInfo
```

```
library(survival)
fit <- survfit(Surv(times, patient.vital_status) ~ admin.disease_code,
               data = BRCAOV.survInfo)
library(survminer)
ggsurvplot(fit, risk.table = TRUE)
```




```
ggsurvplot(
   fit,                     # survfit object with calculated statistics.
   risk.table = TRUE,       # show risk table.
   pval = TRUE,             # show p-value of log-rank test.
   conf.int = TRUE,         # show confidence intervals for
                            # point estimaes of survival curves.
   xlim = c(0,2000),        # present narrower X axis, but not affect
                            # survival estimates.
   break.time.by = 500,     # break X axis in time intervals by 500.
   ggtheme = theme_RTCGA(), # customize plot and risk table with a theme.
 risk.table.y.text.col = T, # colour risk table text annotations.
  risk.table.y.text = FALSE # show bars instead of names in text annotations
                            # in legend of risk table
)
```



http://r-addict.com/2016/05/23/Informationative- Survival-Plots.html

: https://riptutorial.com/ko/r/topic/3788/-

88: ()

- lm (, , , , na.action, = "qr", = TRUE, x = FALSE, y = FALSE, qr = TRUE, singular.ok = TRUE, contrasts = NULL, offset, .. .)

	Wilkinson-Rogers ; `response ~ ...` where `...` `data` .
	: `data` .
	( )
na.action	(`NA`) : see `?na.action`
	. `"qr"` `"model.frame"` (`"model.frame"` `model=TRUE`)
qr	QR
singular.ok	, (`NA`)
	. `?model.matrix.default` `contrasts.arg` . `options()` (`contrasts`) `contrast` (`?contrasts` `options()` .
	. . See `?model.offset`
...	(`lm.fit()` `lm.wfit()`)

Examples

mtcars

mtcars , ( ), 32 (`help(mtcars)`).

(`mpg`) (`wt`) .

```
plot(mpg ~ wt, data = mtcars, col=2)
```

() !. , `lm` .

```
fit <- lm(mpg ~ wt, data = mtcars)
```

`~` " " `mpg ~ wt` `mpg ~ wt` mpg . .

```
summary(fit)
```

.

```
Call:
lm(formula = mpg ~ wt, data = mtcars)

Residuals:
    Min      1Q  Median      3Q     Max 
-4.5432 -2.3647 -0.1252  1.4096  6.8727 

Coefficients:
            Estimate Std. Error t value Pr(>|t|)    
(Intercept)  37.2851     1.8776  19.858  < 2e-16 ***
wt           -5.3445     0.5591  -9.559 1.29e-10 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 3.046 on 30 degrees of freedom
Multiple R-squared:  0.7528,    Adjusted R-squared:  0.7446 
F-statistic: 91.38 on 1 and 30 DF,  p-value: 1.294e-10
```

.

- mpg (`wt` y) `37.2851 + (-5.3445) * wt`
- p-
- R^2 R^2 `mpg`

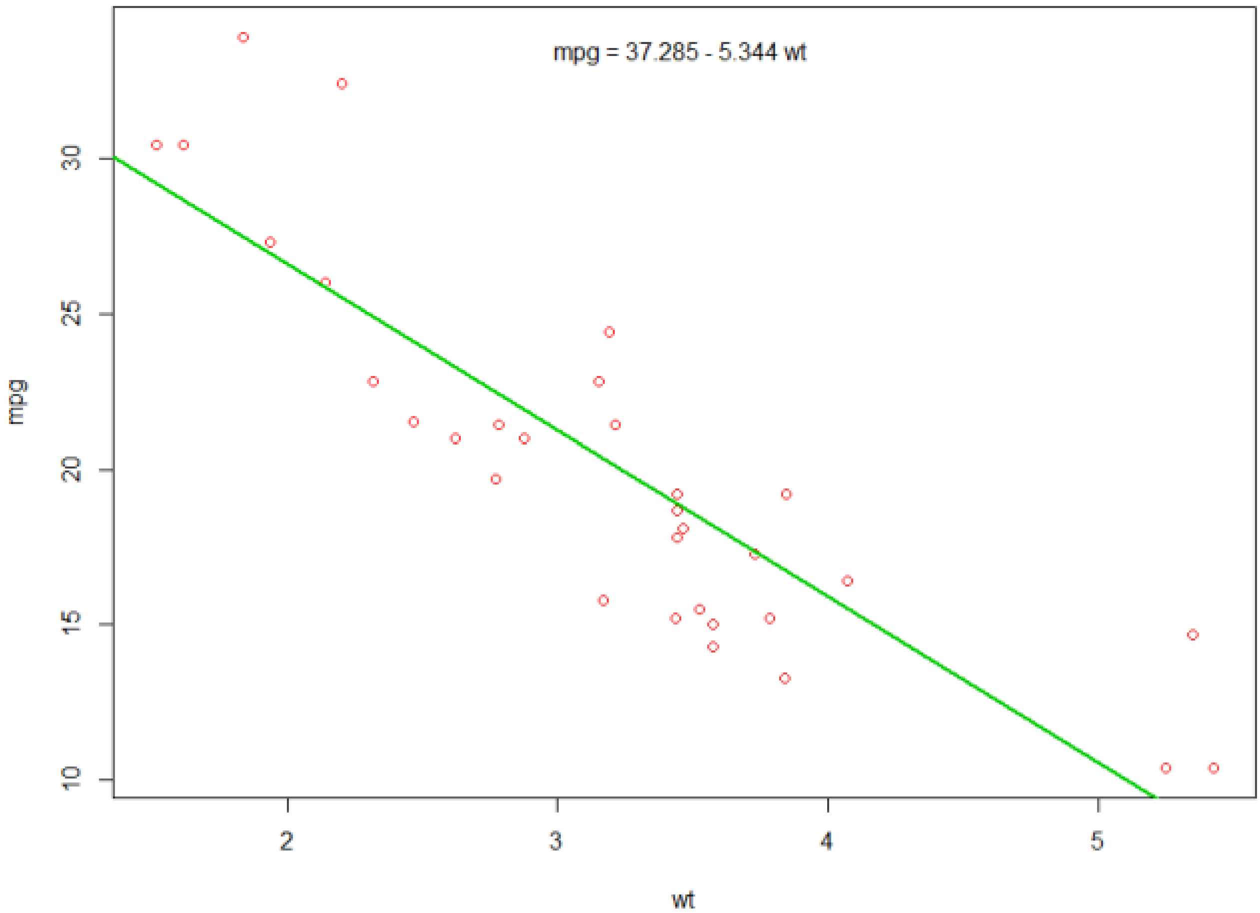
`mpg` .

```
abline(fit,col=3,lwd=2)
```

. `coef` `coef` . `paste0` `+/-` . `mtext` .

```
bs <- round(coef(fit), 3) 
lmlab <- paste0("mpg = ", bs[1],
             ifelse(sign(bs[2])==1, " + ", " - "), abs(bs[2]), " wt ")
mtext(lmlab, 3, line=-2)
```

.



()

mtcars ,   .

```
fit <- lm(mpg ~ wt, data = mtcars)
```

.

```
plot(mtcars$wt,mtcars$mpg,pch=18, xlab = 'wt',ylab = 'mpg')
lines(c(min(mtcars$wt),max(mtcars$wt)),
as.numeric(predict(fit, data.frame(wt=c(min(mtcars$wt),max(mtcars$wt))))))
```

! , , rsquare   . vector .

```
rp = vector('expression',3)
rp[1] = substitute(expression(italic(y) == MYOTHERVALUE3 + MYOTHERVALUE4 %*% x),
          list(MYOTHERVALUE3 = format(fit$coefficients[1], digits = 2),
                            MYOTHERVALUE4 = format(fit$coefficients[2], digits = 2)))[2]
rp[2] = substitute(expression(italic(R)^2 == MYVALUE),
             list(MYVALUE = format(summary(fit)$adj.r.squared,dig=3)))[2]
rp[3] = substitute(expression(Pearson-R == MYOTHERVALUE2),
             list(MYOTHERVALUE2 = format(cor(mtcars$wt,mtcars$mpg), digits = 2)))[2]

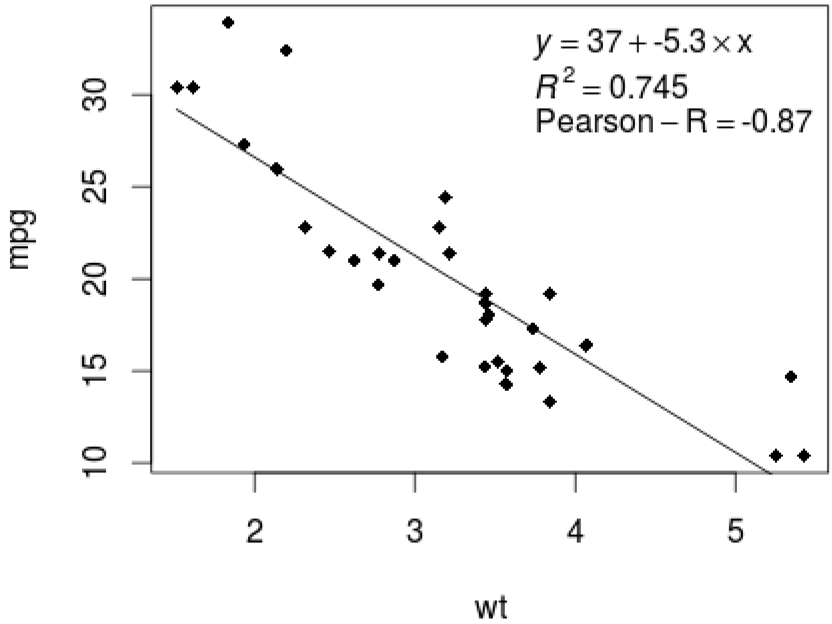
legend("topright", legend = rp, bty = 'n')
```

RMSE   . 10   .   .

```
rp = vector('expression',10)
```

`r[1]` .... ~ `r[10]` `r[10]`

.



. . .

- (Analytic Weights) : . , . .
- (Inverse Probability Weights - IPW) : . ( ) . .

`lm()` . `survey` `svyglm()` . `survey` . (: `lm()` `svyglm()` family `gaussian()` . .

```
data <- structure(list(lexptot = c(9.1595012302023, 9.86330744180814,
8.92372556833205, 8.58202430280175, 10.1133857229336), progvillm = c(1L,
1L, 1L, 1L, 0L), sexhead = c(1L, 1L, 0L, 1L, 1L), agehead = c(79L,
43L, 52L, 48L, 35L), weight = c(1.04273509979248, 1.01139605045319,
1.01139605045319, 1.01139605045319, 0.76305216550827)), .Names = c("lexptot",
"progvillm", "sexhead", "agehead", "weight"), class = c("tbl_df",
"tbl", "data.frame"), row.names = c(NA, -5L))
```

```
lm.analytic <- lm(lexptot ~ progvillm + sexhead + agehead,
                            data = data, weight = weight)
summary(lm.analytic)
```

```
Call:
```

```
lm(formula = lexptot ~ progvillm + sexhead + agehead, data = data,
    weights = weight)

Weighted Residuals:
         1          2          3          4          5
 9.249e-02  5.823e-01  0.000e+00 -6.762e-01 -1.527e-16

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 10.016054   1.744293   5.742    0.110
progvillm   -0.781204   1.344974  -0.581    0.665
sexhead      0.306742   1.040625   0.295    0.818
agehead     -0.005983   0.032024  -0.187    0.882

Residual standard error: 0.8971 on 1 degrees of freedom
Multiple R-squared:  0.467, Adjusted R-squared:  -1.132
F-statistic: 0.2921 on 3 and 1 DF,  p-value: 0.8386
```

(IPW)

```
library(survey)
data$X <- 1:nrow(data)             # Create unique id

# Build survey design object with unique id, ipw, and data.frame
des1 <- svydesign(id = ~X,  weights = ~weight, data = data)

# Run glm with survey design object
prog.lm <- svyglm(lexptot ~ progvillm + sexhead + agehead, design=des1)
```

```
Call:
svyglm(formula = lexptot ~ progvillm + sexhead + agehead, design = des1)

Survey design:
svydesign(id = ~X, weights = ~weight, data = data)

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 10.016054   0.183942  54.452   0.0117 *
progvillm   -0.781204   0.640372  -1.220   0.4371
sexhead      0.306742   0.397089   0.772   0.5813
agehead     -0.005983   0.014747  -0.406   0.7546
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for gaussian family taken to be 0.2078647)

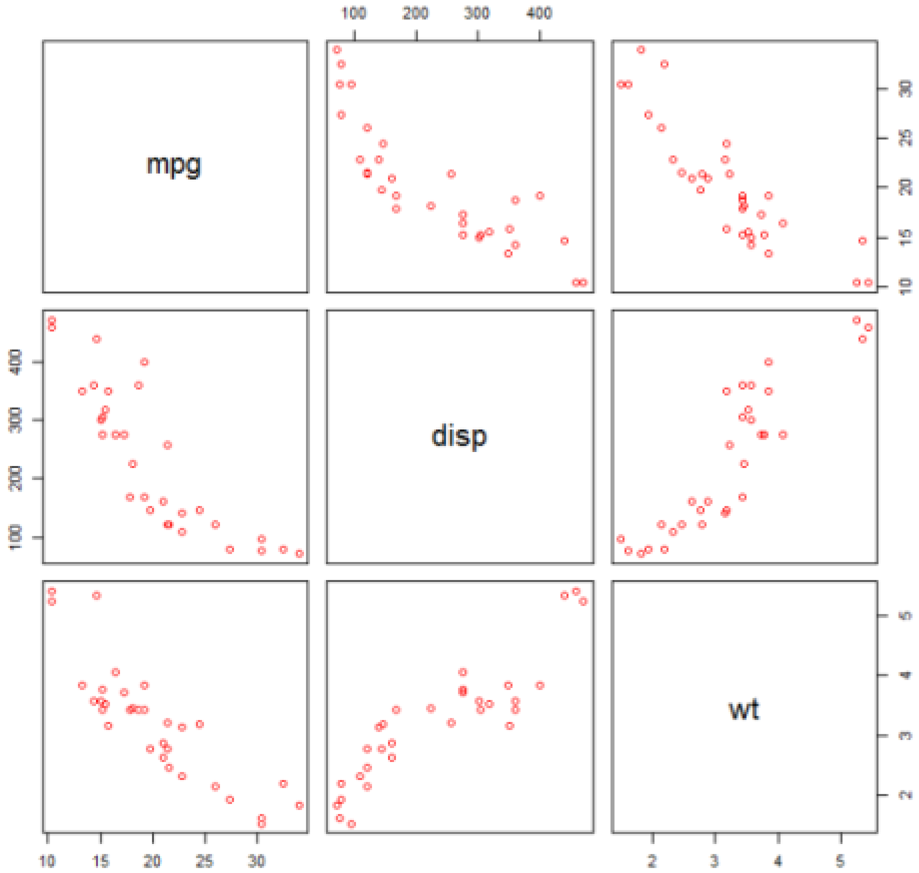
Number of Fisher Scoring iterations: 2
```

. . .

`mtcars` 2 `mtcars` . mtcars .

`mpg` (Miles / gallon), `disp` (Displacement (cu.in.)) `wt` (Weight (1000 lbs)) . `mpg` `disp` .

```
plot(mtcars[,c("mpg","disp","wt")])
```



disp .

```
fit0 = lm(mpg ~ wt+disp, mtcars)
summary(fit0)

# Coefficients:
#             Estimate Std. Error t value Pr(>|t|)
#(Intercept) 34.96055    2.16454  16.151 4.91e-16 ***
#wt          -3.35082    1.16413  -2.878  0.00743 **
#disp        -0.01773    0.00919  -1.929  0.06362 .
#---
#Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
#Residual standard error: 2.917 on 29 degrees of freedom
#Multiple R-squared:  0.7809,    Adjusted R-squared:  0.7658
```

2 I(disp^2) . R^2 .

```
fit1 = lm(mpg ~ wt+disp+I(disp^2), mtcars)
summary(fit1)

# Coefficients:
#               Estimate Std. Error t value Pr(>|t|)
#(Intercept) 41.4019837  2.4266906  17.061  2.5e-16 ***
#wt          -3.4179165  0.9545642  -3.581 0.001278 **
#disp        -0.0823950  0.0182460  -4.516 0.000104 ***
#I(disp^2)    0.0001277  0.0000328   3.892 0.000561 ***
#---
#Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
#Residual standard error: 2.391 on 28 degrees of freedom
#Multiple R-squared:  0.8578,    Adjusted R-squared:  0.8426
```

3 , .

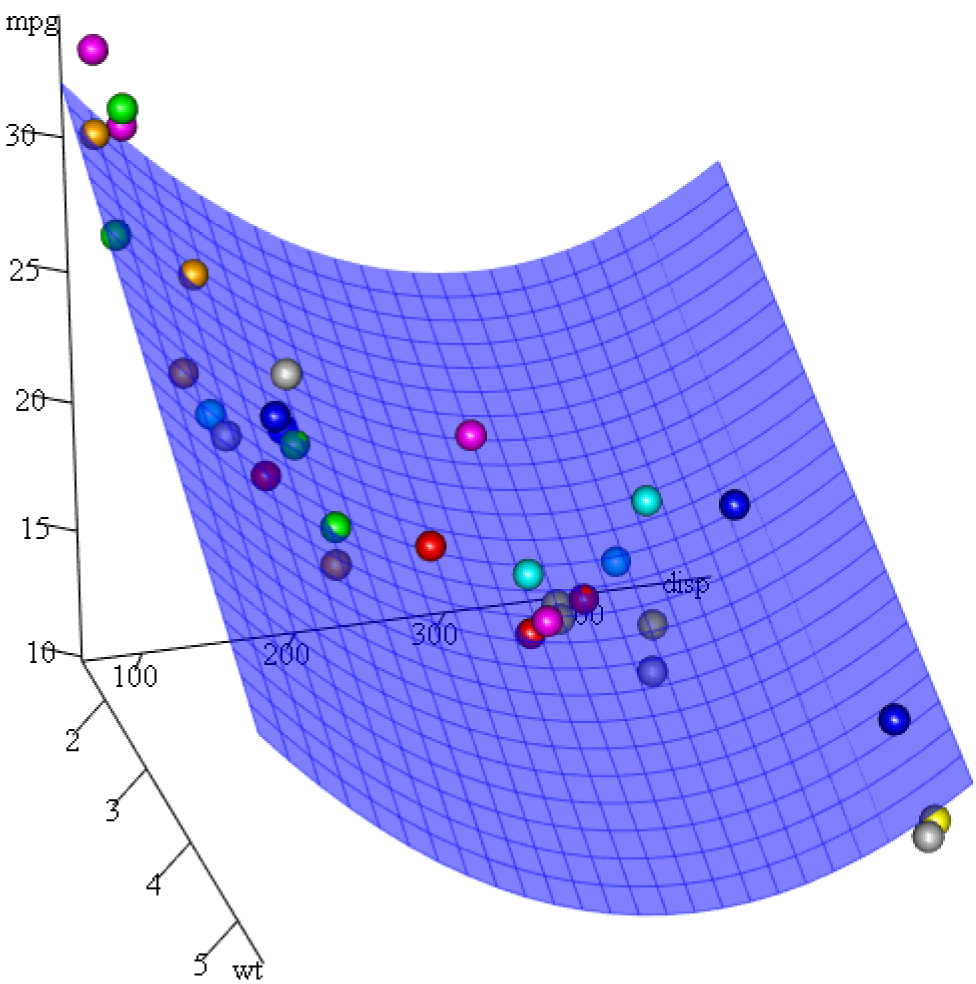
mpg = 41.4020-3.4179*wt-0.0824*disp+0.0001277*disp^2

`raw=TRUE` `poly` . (`help(ploy)`). .

```
summary(lm(mpg ~ wt+poly(disp, 2, raw=TRUE),mtcars))
```

, ? , R 3D . `Fit3d` `p3d` .

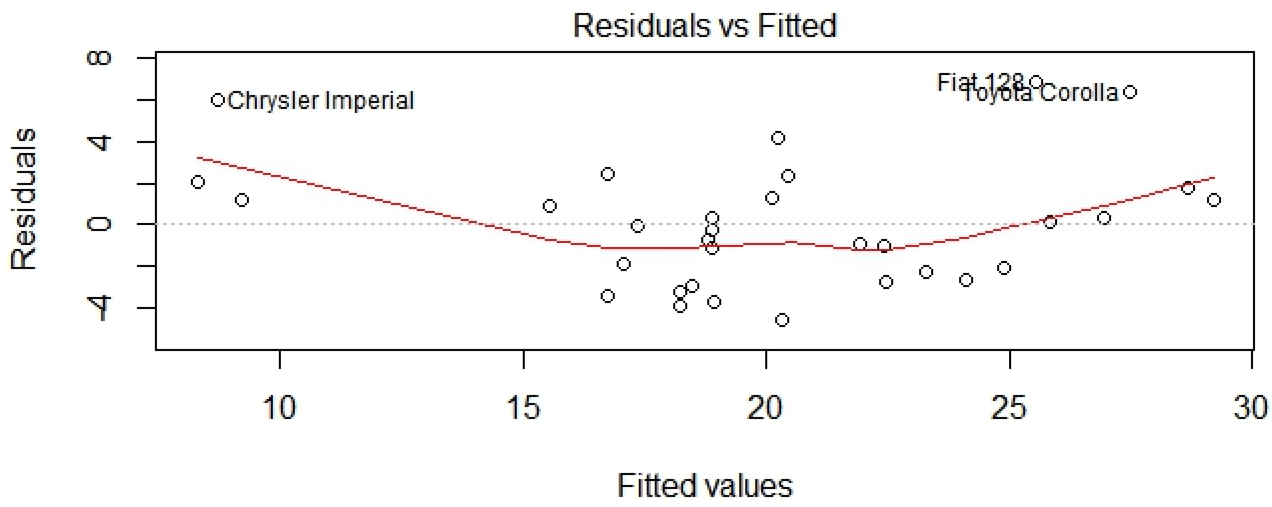
```
library(p3d)
Init3d(family="serif", cex = 1)
Plot3d(mpg ~ disp+wt, mtcars)
Axes3d()
Fit3d(fit1)
```

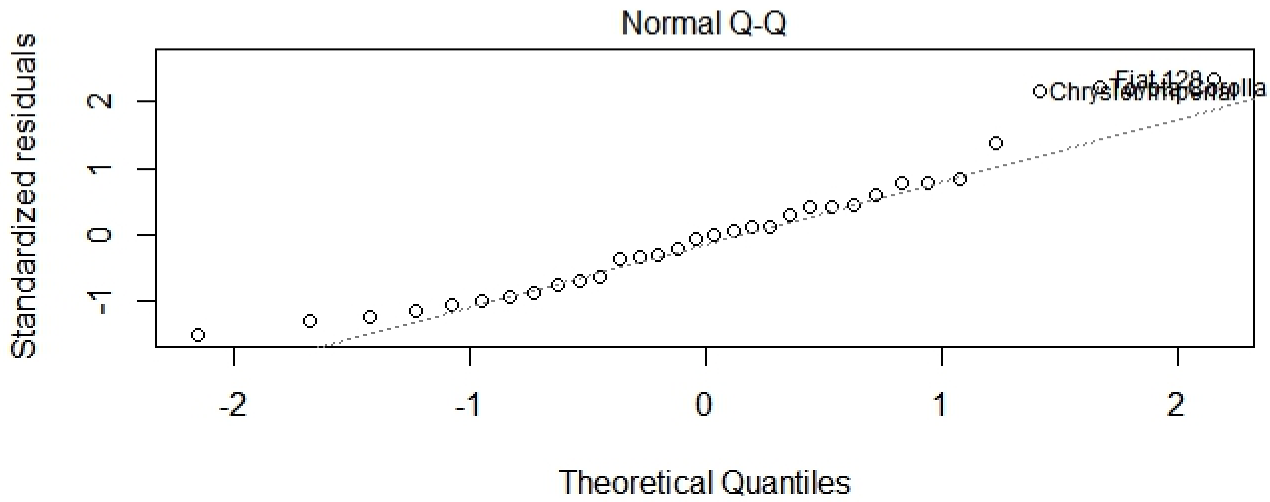


. .

```
# fit the model
fit <- lm(mpg ~ wt, data = mtcars)
#
```

```
par(mfrow=c(2,1))
# plot model object
plot(fit, which =1:2)
```





.

1. (`mpg`) (`wt`) . . . .
2. . . , QQ . .

"

`predict` . `mtcars` .

```
my_mdl <- lm(mpg ~ disp, data=mtcars)
my_mdl
```

```
Call:
lm(formula = mpg ~ disp, data = mtcars)

Coefficients:
(Intercept)         disp
   29.59985     -0.04122
```

.

```
set.seed(1234)
newdata <- sample(mtcars$disp, 5)
newdata
[1] 258.0  71.1  75.7 145.0 400.0

newdf <- data.frame(disp=newdata)
predict(my_mdl, newdf)
       1        2        3        4        5
18.96635 26.66946 26.47987 23.62366 13.11381
```

. `disp` .

.

1. data.frame .

```
predict(my_mdl, newdata)
Error in eval(predvars, data, env) :
   numeric 'envir' arg not of length one
```

2. :

```
newdf2 <- data.frame(newdata)
predict(my_mdl, newdf2)
Error in eval(expr, envir, enclos) : object 'disp' not found
```

y . `newdf` 'mpg' 'disp' .

```
newdf <- data.frame(mpg=mtcars$mpg[1:10], disp=mtcars$disp[1:10])
#     mpg  disp
# 1  21.0 160.0
# 2  21.0 160.0
# 3  22.8 108.0
# 4  21.4 258.0
# 5  18.7 360.0
# 6  18.1 225.0
# 7  14.3 360.0
# 8  24.4 146.7
# 9  22.8 140.8
# 10 19.2 167.6

p <- predict(my_mdl, newdf)

#root mean square error
sqrt(mean((p - newdf$mpg)^2, na.rm=TRUE))
[1] 2.325148
```

() : https://riptutorial.com/ko/r/topic/801/----

89:

. class 0, . mode mode . class class<- function class<- . S3 S . S4 .

"" . class . mode . "" typeof "" " " mode . .

Examples

R . c() , . :

```
c(1, 2, 3)
## [1] 1 2 3
c(TRUE, TRUE, FALSE)
## [1]  TRUE  TRUE FALSE
c("a", "b", "c")
## [1] "a" "b" "c"
```

c() .

```
x <- c(1, 2, 5)
y <- c(3, 4, 6)
z <- c(x, y)
z
## [1] 1 2 5 3 4 6
```

" " .

R . class() str() . :

```
class(iris)
[1] "data.frame"

str(iris)
'data.frame':    150 obs. of  5 variables:
 $ Sepal.Length: num  5.1 4.9 4.7 4.6 5 5.4 4.6 5 4.4 4.9 ...
 $ Sepal.Width : num  3.5 3 3.2 3.1 3.6 3.9 3.4 3.4 2.9 3.1 ...
 $ Petal.Length: num  1.4 1.4 1.3 1.5 1.4 1.7 1.4 1.5 1.4 1.5 ...
 $ Petal.Width : num  0.2 0.2 0.2 0.2 0.2 0.4 0.3 0.2 0.2 0.1 ...
 $ Species     : Factor w/ 3 levels "setosa","versicolor",..: 1 1 1 1 1 1 1 1 1 ...

class(iris$Species)
[1] "factor"
```

data.frame str() . (Species) (Class Factor) . str() class() .

R . (: ,) . ?atomic : "logical", "integer", "numeric" (synonym "double"), "complex", "character" "raw" . class .

```
x <- 1826
class(x) <- "Date"
x
```

```
# [1] "1975-01-01"
 x <- as.Date("1970-01-01")
 class(x)
#[1] "Date"
 is(x,"Date")
#[1] TRUE
 is(x,"integer")
#[1] FALSE
 is(x,"numeric")
#[1] FALSE
  mode(x)
#[1] "numeric"
```

, , . R : " ":

```
mylist <- list( A = c(5,6,7,8), B = letters[1:10], CC = list( 5, "Z") )
```

.

- .

  ```
  f <- function(x) list(xplus = x + 10, xsq = x^2)

  f(7)
  # $xplus
  # [1] 17
  #
  # $xsq
  # [1] 49
  ```

- . .

  ```
  L <- list(x = 1:2, y = c("A","B"))
  DF <- data.frame(L)
  DF
  #   x y
  # 1 1 A
  # 2 2 B
  is.list(DF)
  # [1] TRUE
  ```

R ""-

: https://riptutorial.com/ko/r/topic/3563/

90:

Examples

. C .

.

```
teethVC = ToothGrowth[ToothGrowth$supp == 'VC',]
teethOJ = ToothGrowth[ToothGrowth$supp == 'OJ',]

permutationTest = function(vectorA, vectorB, testStat){
  N = 10^5
  fullSet = c(vectorA, vectorB)
  lengthA = length(vectorA)
  lengthB = length(vectorB)
  trials <- replicate(N,
                      {index <- sample(lengthB + lengthA, size = lengthA, replace = FALSE)
                      testStat((fullSet[index]), fullSet[-index])  } )
  trials
}
vec1 =teethVC$len;
vec2 =teethOJ$len;
subtractMeans = function(a, b){ return (mean(a) - mean(b))}
result = permutationTest(vec1, vec2, subtractMeans)
observedMeanDifference = subtractMeans(vec1, vec2)
result = c(result, observedMeanDifference)
hist(result)
abline(v=observedMeanDifference, col = "blue")
pValue = 2*mean(result <= (observedMeanDifference))
pValue
```

CSV .

```
permutationTest = function(vectorA, vectorB, testStat){
  N = 10^5
  fullSet = c(vectorA, vectorB)
  lengthA = length(vectorA)
  lengthB = length(vectorB)
  trials <- replicate(N,
                      {index <- sample(lengthB + lengthA, size = lengthA, replace = FALSE)
                      testStat((fullSet[index]), fullSet[-index])  } )
  trials
}
```

`testStat` . `teststat` `trials` .

`N = 10^5` . `N` .

, `trials` , .

.

```
subtractMeans = function(a, b){ return (mean(a) - mean(b))}
```

.

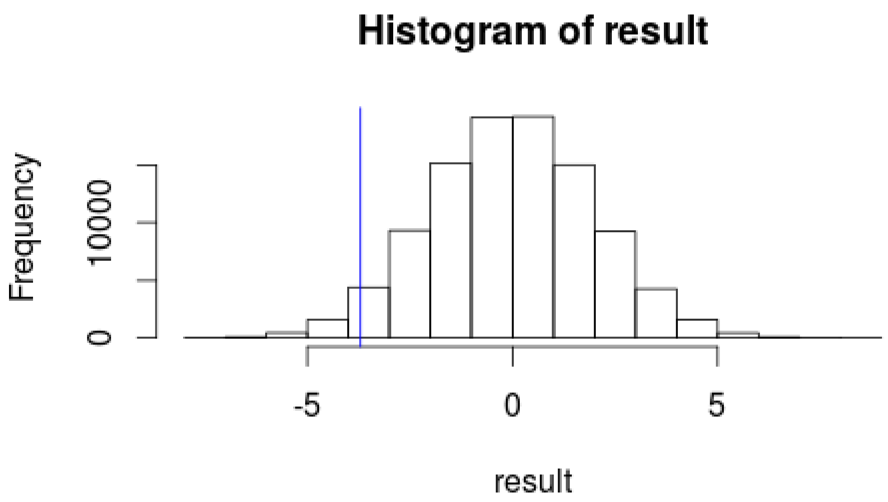
```
result = permutationTest(vec1, vec2, subtractMeans)
```

:

```
observedMeanDifference = subtractMeans(vec1, vec2)
```

.

```
hist(result)
abline(v=observedMeanDifference, col = "blue")
```



...

p- .

```
pValue = 2*mean(result >= (observedMeanDifference))
```

.

```
result >= (observedMeanDifference)
```

.

```
FALSE TRUE FALSE FALSE TRUE FALSE ...
```

`TRUE` `result` `observedMean` .

`mean` `TRUE` `1` , `FALSE` `0` `1` . , .

,   2 .   "" .

p- `0.06093939` . `0.06093939` .   C   .

: https://riptutorial.com/ko/r/topic/3216/--

91:

Examples

. `is.numeric()` . `is.numeric()` , `as.numeric()` .

```
x <- 12.3
y <- 12L

#confirm types
typeof(x)
[1] "double"
typeof(y)
[1] "integer"

# confirm both numeric
is.numeric(x)
[1] TRUE
is.numeric(y)
[1] TRUE

# logical to numeric
as.numeric(TRUE)
[1] 1

# While TRUE == 1, it is a double and not an integer
is.integer(as.numeric(TRUE))
[1] FALSE
```

Doubles R . 8 . R .

```
is.double(1)
TRUE
is.double(1.0)
TRUE
is.double(1L)
FALSE
```

. L . L .

```
typeof(1)
[1] "double"
class(1)
[1] "numeric"
typeof(1L)
[1] "integer"
class(1L)
[1] "integer"
```

double double . 8 4 . .

```
#  test speed on lots of arithmetic
microbenchmark(
  for( i in 1:100000){
  2L * i
  10L + i
},

for( i in 1:100000){
  2.0 * i
  10.0 + i
}
)
Unit: milliseconds
                                                  expr      min       lq     mean   median       uq
max neval
 for (i in 1:1e+05) {     2L * i     10L + i } 40.74775 42.34747 50.70543 42.99120 65.46864
94.11804   100
   for (i in 1:1e+05) {     2 * i     10 + i } 41.07807 42.38358 53.52588 44.26364 65.84971
83.00456   100
```

: https://riptutorial.com/ko/r/topic/9018/----

92: API (SparkR)

`SparkR` Spark . , , . SparkR SparkR

Examples

R

Sparks R Spark Cluster .

```
library(SparkR)
sc <- sparkR.init() # connection to Spark context
sqlContext <- sparkRSQL.init(sc) # connection to SQL context
```

IDE Spark .

Apache Spark . , (( ) () [ ] , IBM).

:

Spark . . Spark RDD .

:

( ) . RDD .

:

(3GB big csv) .

```
library(SparkR)
# next line is needed for direct csv import:
Sys.setenv('SPARKR_SUBMIT_ARGS'='"--packages" "com.databricks:spark-csv_2.10:1.4.0" "sparkr-shell"')
sc <- sparkR.init()
sqlContext <- sparkRSQL.init(sc)

# loading 3 GB big csv file:
train <- read.df(sqlContext, "/train.csv", source = "com.databricks.spark.csv", inferSchema = "true")
cache(train)
system.time(head(train))
# output: time elapsed: 125 s. This action invokes the caching at this point.
system.time(head(train))
# output: time elapsed: 0.2 s (!!)
```

RDD ( )

:

```
mtrdd <- createDataFrame(sqlContext, mtcars)
```

CSV :

csv Spark   csv   .

```
Sys.setenv('SPARKR_SUBMIT_ARGS'='"--packages" "com.databricks:spark-csv_2.10:1.4.0" "sparkr-shell"') # context for csv import read csv ->
sc <- sparkR.init()
sqlContext <- sparkRSQL.init(sc)
```

CSV .

```
train <- read.df(sqlContext, "/train.csv", header= "true", source =
"com.databricks.spark.csv", inferSchema = "true")
```

:

```
 customSchema <- structType(
    structField("margin", "integer"),
    structField("gross", "integer"),
    structField("name", "string"))

 train <- read.df(sqlContext, "/train.csv", header= "true", source =
"com.databricks.spark.csv", schema = customSchema)
```

API (SparkR) : https://riptutorial.com/ko/r/topic/5349/-api--sparkr-

93:

`stats` `glm()` : `glm()` `glm()` . CRAN .

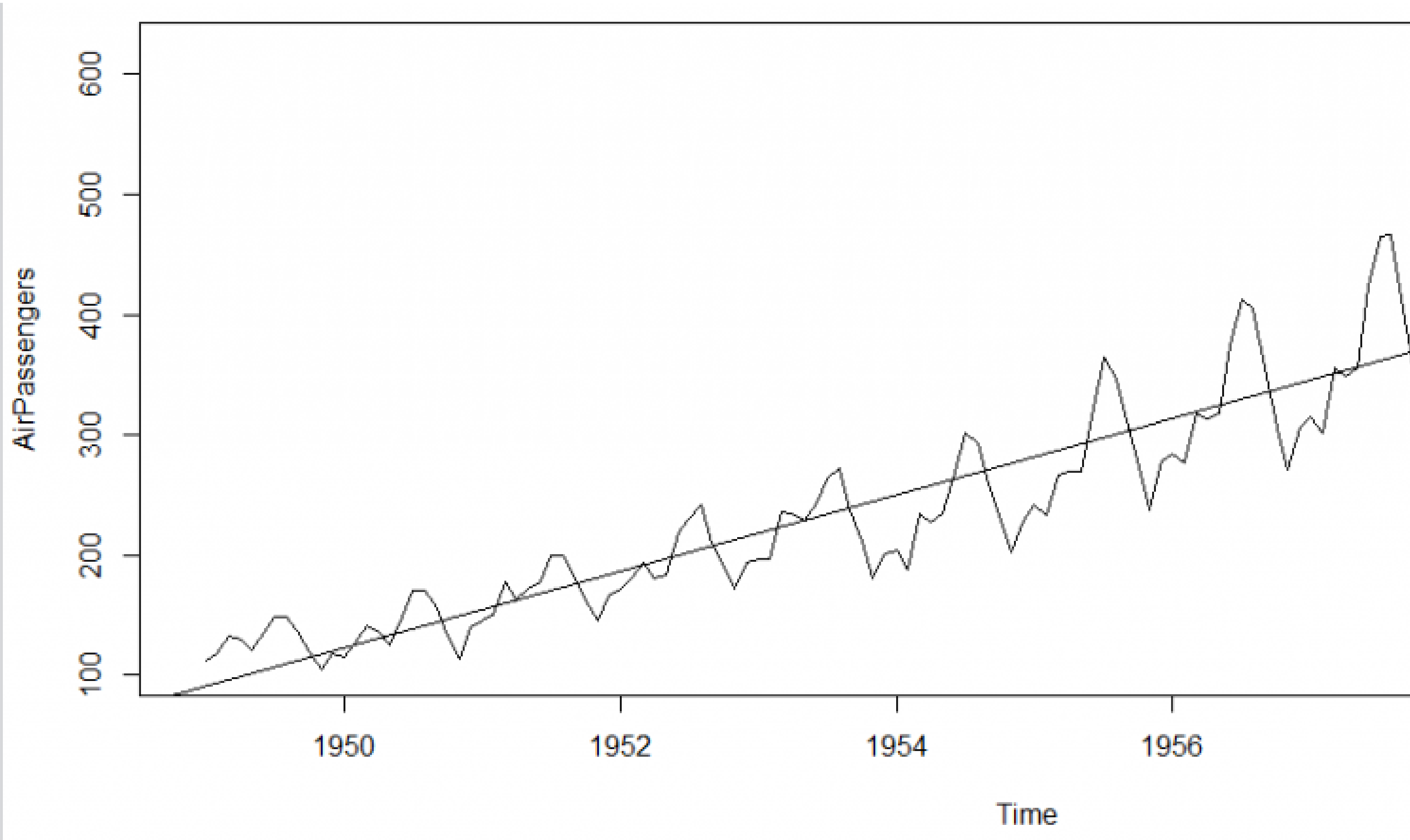
Examples

```
data(AirPassengers)
class(AirPassengers)
```

1 "ts"

Exploratory Data Analysis (EDA) .

```
plot(AirPassengers) # plot the raw data
abline(reg=lm(AirPassengers~time(AirPassengers))) # fit a trend line
```



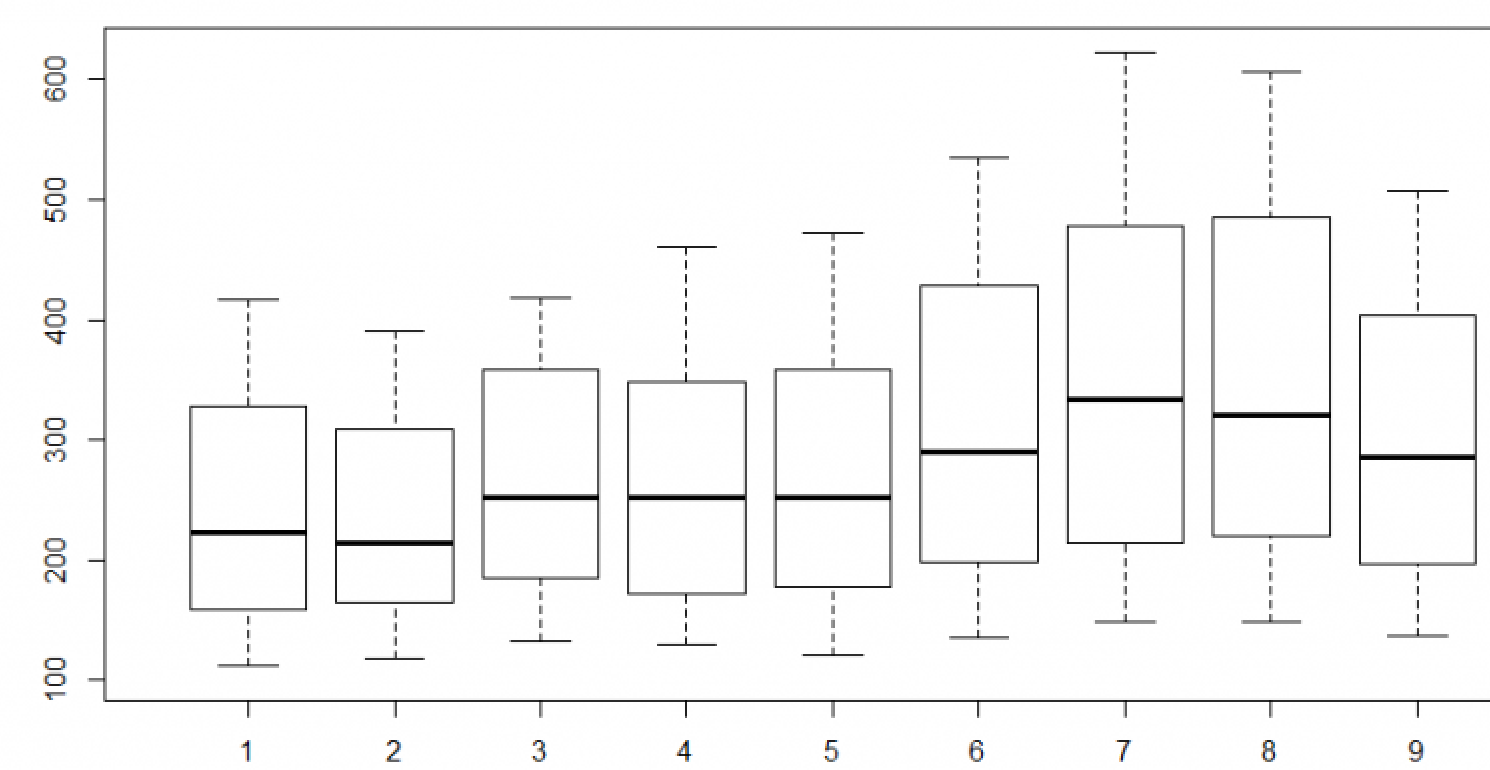
EDA :

```
cycle(AirPassengers)
```

```
     Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
1949   1   2   3   4   5   6   7   8   9  10  11  12
1950   1   2   3   4   5   6   7   8   9  10  11  12
1951   1   2   3   4   5   6   7   8   9  10  11  12
```

```
1952   1   2   3   4   5   6   7   8   9  10  11  12
1953   1   2   3   4   5   6   7   8   9  10  11  12
1954   1   2   3   4   5   6   7   8   9  10  11  12
1955   1   2   3   4   5   6   7   8   9  10  11  12
1956   1   2   3   4   5   6   7   8   9  10  11  12
1957   1   2   3   4   5   6   7   8   9  10  11  12
1958   1   2   3   4   5   6   7   8   9  10  11  12
1959   1   2   3   4   5   6   7   8   9  10  11  12
1960   1   2   3   4   5   6   7   8   9  10  11  12
```

```
boxplot(AirPassengers~cycle(AirPassengers)) #Box plot across months to explore seasonal
effects
```



TS

ts .ts ARIMA . window .

```
#Create a dummy dataset of 100 observations
x <- rnorm(100)

#Convert this vector to a ts object with 100 annual observations
x <- ts(x, start = c(1900), freq = 1)

#Convert this vector to a ts object with 100 monthly observations starting in July
x <- ts(x, start = c(1900, 7), freq = 12)

    #Alternatively, the starting observation can be a number:
    x <- ts(x, start = 1900.5, freq = 12)

#Convert this vector to a ts object with 100 daily observations and weekly frequency starting
in the first week of 1900
x <- ts(x, start = c(1900, 1), freq = 7)
```

```
#The default plot for a ts object is a line plot
plot(x)

#The window function can call elements or sets of elements by date

    #Call the first 4 weeks of 1900
    window(x, start = c(1900, 1), end = (1900, 4))

    #Call only the 10th week in 1900
    window(x, start = c(1900, 10), end = (1900, 10))

    #Call all weeks including and after the 10th week of 1900
    window(x, start = c(1900, 10))
```

`ts` .

```
#Create a dummy matrix of 3 series with 100 observations each
x <- cbind(rnorm(100), rnorm(100), rnorm(100))

#Create a multi-series ts with annual observation starting in 1900
x <- ts(x, start = 1900, freq = 1)

#R will draw a plot for each series in the object
plot(x)
```

: https://riptutorial.com/ko/r/topic/2701/--

94:

`Arima` , R `arima` .

ARIMA () . . ARIMA .

ARIMA .

Examples

Arima AR1

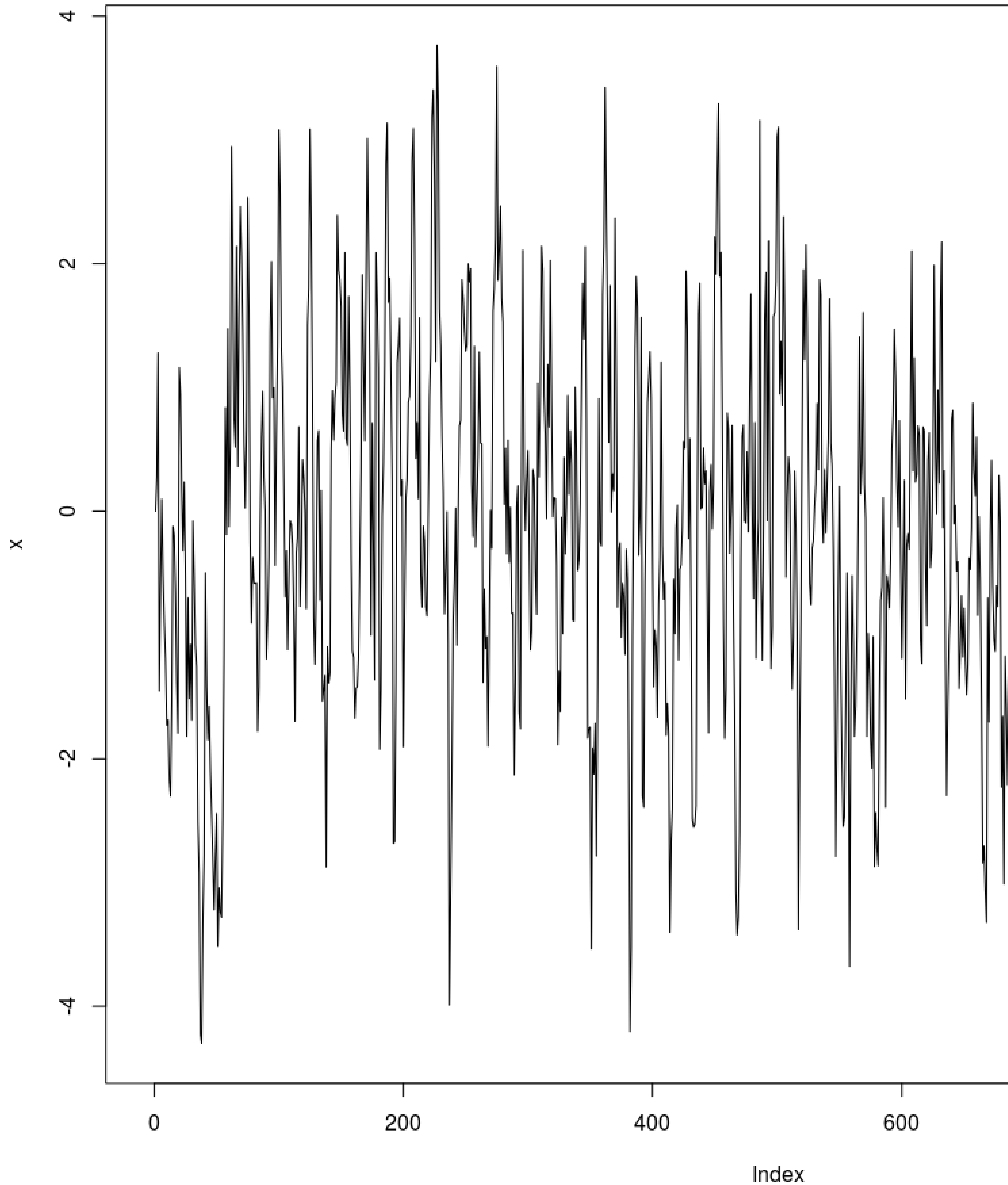
.

$x_t = .7x_{t-1} + \epsilon \qquad \epsilon \sim N(0,1)$

```
#Load the forecast package
library(forecast)

#Generate an AR1 process of length n (from Cowpertwait & Meltcalfe)
# Set up variables
set.seed(1234)
n <- 1000
x <- matrix(0,1000,1)
w <- rnorm(n)

# loop to create x
for (t in 2:n) x[t] <- 0.7 * x[t-1] + w[t]
plot(x,type='l')
```


4
2
0
-2
-4
x
0
200
400
600
Index

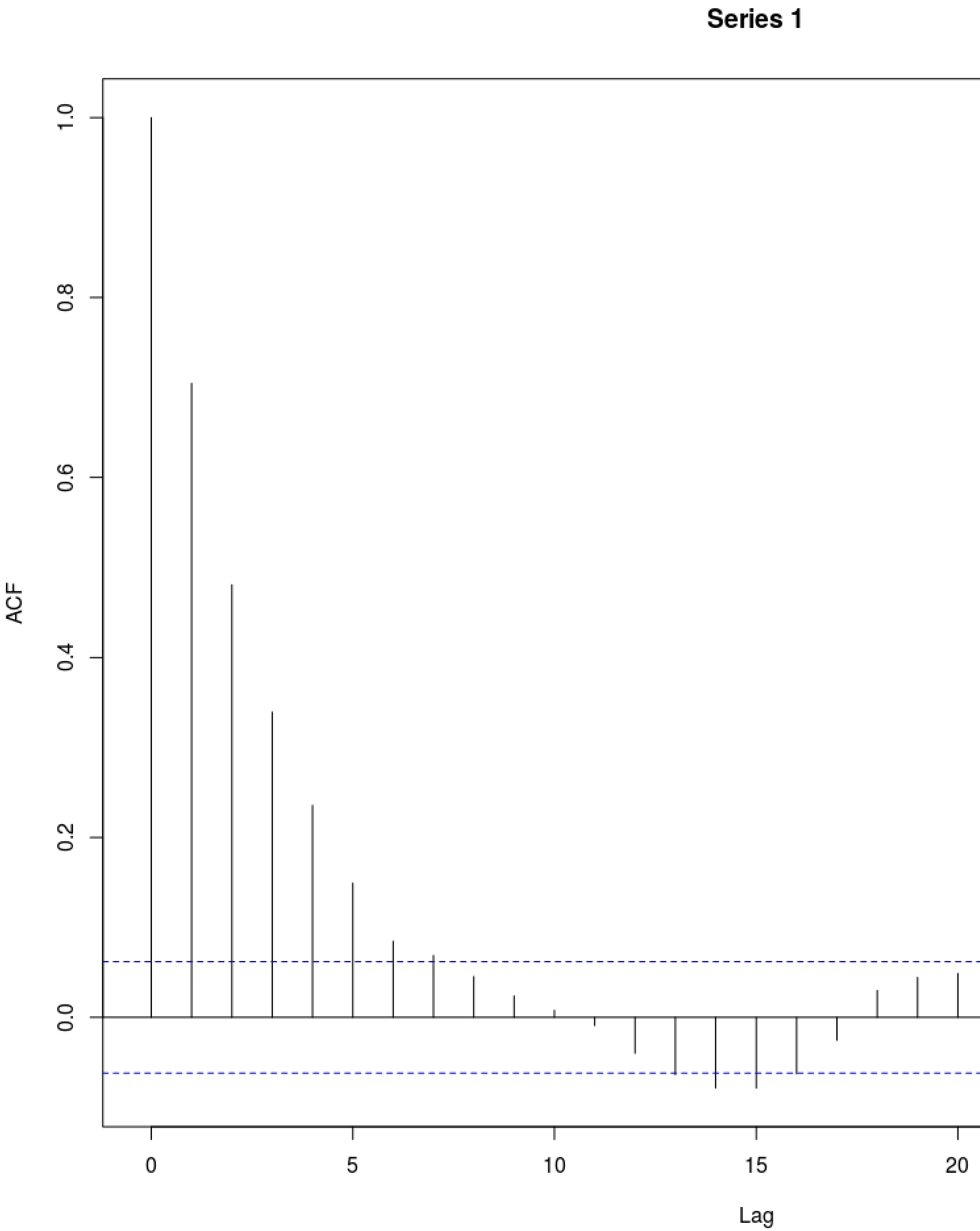
Arima 1, 0, MA 0 .

```
#Fit an AR1 model using Arima
fit <- Arima(x, order = c(1, 0, 0))
summary(fit)
# Series: x
# ARIMA(1,0,0) with non-zero mean
#
# Coefficients:
#          ar1  intercept
#       0.7040    -0.0842
# s.e.  0.0224     0.1062
#
# sigma^2 estimated as 0.9923:  log likelihood=-1415.39
# AIC=2836.79   AICc=2836.81   BIC=2851.51
#
# Training set error measures:
#                          ME      RMSE       MAE MPE MAPE    MASE       ACF1
# Training set -8.369365e-05 0.9961194 0.7835914 Inf  Inf 0.91488 0.02263595
# Verify that the model captured the true AR parameter
```

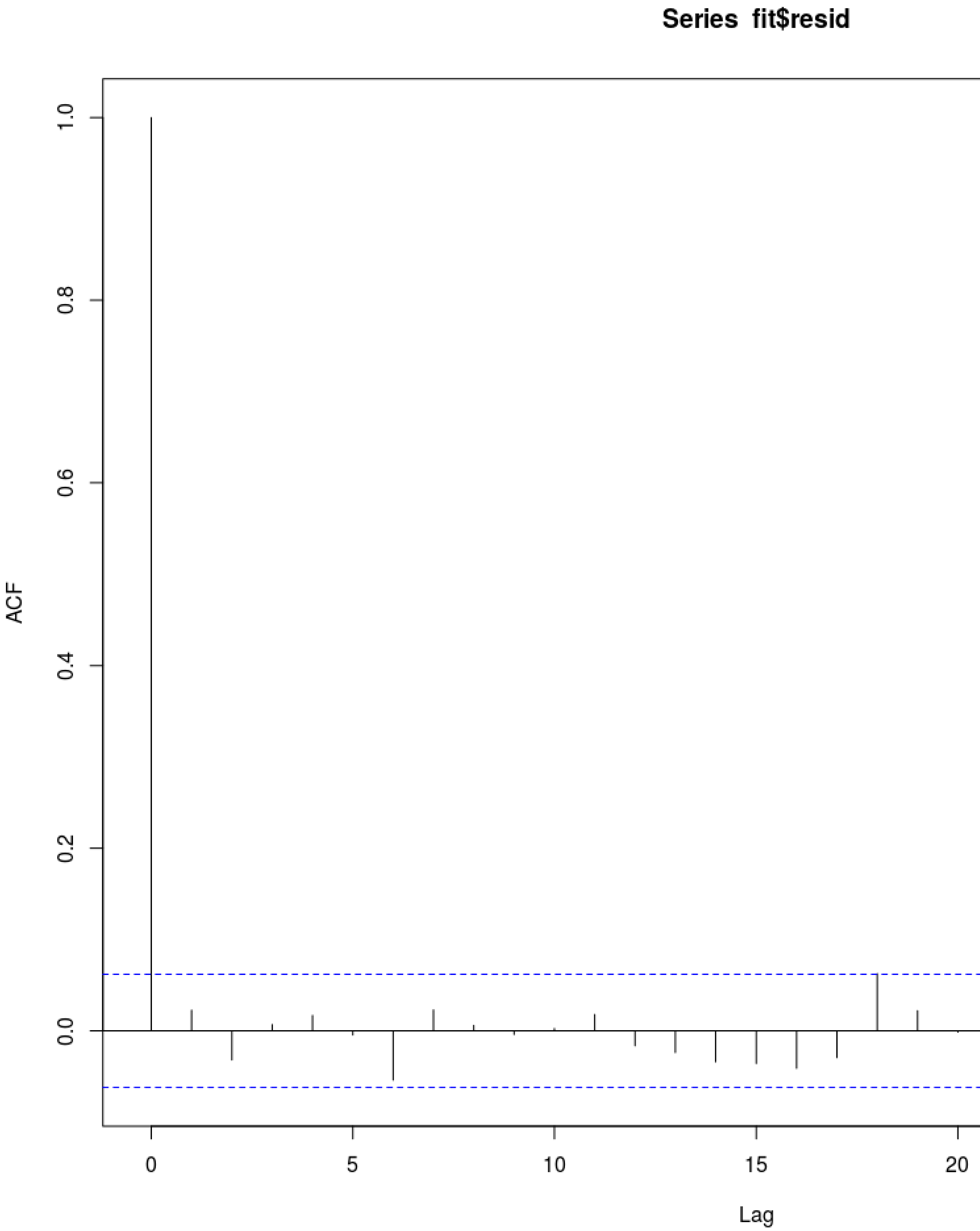
.

```
fit$coef[1]
#       ar1
# 0.7040085

#Verify that the model eliminates the autocorrelation
acf(x)
```


Series 1
ACF
1.0
0.8
0.6
0.4
0.2
0.0
0
5
10
15
20
Lag

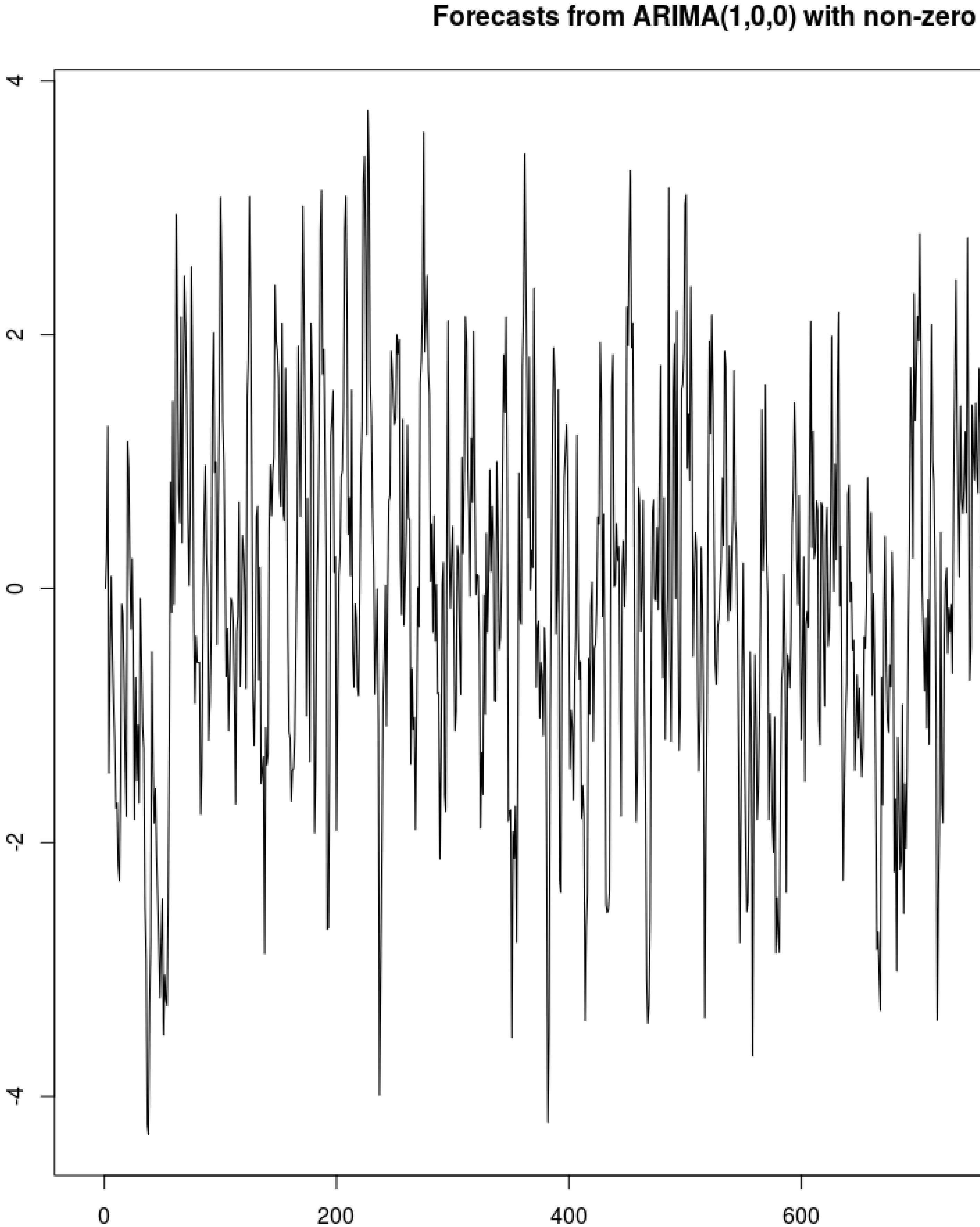
```
acf(fit$resid)
```


Series fit$resid
ACF
1.0
0.8
0.6
0.4
0.2
0.0
0
5
10
15
20
Lag

```
#Forecast 10 periods
fcst <- forecast(fit, h = 100)
fcst
     Point Forecast       Lo 80    Hi 80     Lo 95    Hi 95
1001    0.282529070 -0.9940493 1.559107 -1.669829 2.234887
1002    0.173976408 -1.3872262 1.735179 -2.213677 2.561630
1003    0.097554408 -1.5869850 1.782094 -2.478726 2.673835
1004    0.043752667 -1.6986831 1.786188 -2.621073 2.708578
1005    0.005875783 -1.7645535 1.776305 -2.701762 2.713514
...

#Call the point predictions
fcst$mean
# Time Series:
# Start = 1001
# End = 1100
# Frequency = 1
  [1]  0.282529070  0.173976408  0.097554408  0.043752667  0.005875783 -0.020789866 -
0.039562711 -0.052778954
  [9] -0.062083302
...

#Plot the forecast
plot(fcst)
```


Forecasts from ARIMA(1,0,0) with non-zero
4
2
0
-2
-4
0
200
400
600

: https://riptutorial.com/ko/r/topic/1725/-

95:

Examples

.zip

zip `unzip` `unzip` `utils` (base R) `unzip` .

```
unzip(zipfile = "bar.zip", exdir = "./foo")
```

`"bar.zip"` `"foo"` . . zip .

.zip

zip `utils` (base R) `unzip` .

```
unzip(zipfile = "bar.zip", list = TRUE)
```

`"bar.zip"` none . . zip .

.tar

tar `utils` (base R) `untar` .

```
untar(zipfile = "bar.tar", list = TRUE)
```

`"bar.tar"` none . . tar .

.tar

tar `utils` (R) `untar` .

```
untar(tarfile = "bar.tar", exdir = "./foo")
```

`"bar.tar"` `"foo"` . . tar .

.zip .

`for` zip .

```
for (i in dir(pattern=".zip$"))
    unzip(i)
```

`dir` `pattern` . `unzip` zip `i` .

: https://riptutorial.com/ko/r/topic/4323/------

96:

Examples

sum sum .

```
set.seed(20)
df1 <- data.frame(ID = rep(c("A", "B", "C"), each = 3), V1 = rnorm(9), V2 = rnorm(9))
m1 <- as.matrix(df1[-1])
```

. base R colSums

```
colSums(df1[-1], na.rm = TRUE)
```

na.rm = TRUE sum sum (NAs)

matrix .

```
colSums(m1, na.rm = TRUE)
```

lapply/sapply/vapply .

```
lapply(df1[-1], sum, na.rm = TRUE)
```

list . vector

```
sapply(df1[-1], sum, na.rm = TRUE)
```

```
vapply(df1[-1], sum, na.rm = TRUE, numeric(1))
```

MARGIN = 1 apply apply

```
apply(m1, 2, FUN = sum, na.rm = TRUE)
```

---

dplyr data.table .

```
library(dplyr)
df1 %>%
    summarise_at(vars(matches("^V\\d+")), sum, na.rm = TRUE)
```

summarise_at sum . V (\\d+) .

data.table .

```
library(data.table)
```

```
setDT(df1)[, lapply(.SD, sum, na.rm = TRUE), .SDcols = 2:ncol(df1)]
```

'data.table'('data.frame' `setDT(df1)`) `.SDcols` Data.table (`.SD`) `sum` .

/ .

```
df1 %>%
  group_by(ID) %>%
  summarise_at(vars(matches("^V\\d+")), sum, na.rm = TRUE)
```

`sum` `summarise_each` `summarise_at`

```
df1 %>%
    group_by(ID) %>%
    summarise_each(funs(sum(., na.rm = TRUE)))
```

`data.table` .

```
setDT(df1)[, lapply(.SD, sum, na.rm = TRUE), by = ID]
```

: https://riptutorial.com/ko/r/topic/2212/-

97:

R , .

.

Examples

```
a <- c(1, 2, 3)
b <- c(4, 5, 6)
mean_ab <- (a + b) / 2

d <- c(1, 0, 1)
only_1_3 <- a[d == 1]
```

```
mat <- matrix(c(1,2,3,4), nrow = 2, ncol = 2)
dimnames(mat) <- list(c(), c("a", "b", "c"))
mat[,] == mat
```

```
df <- data.frame(qualifiers = c("Buy", "Sell", "Sell"),
                 symbols = c("AAPL", "MSFT", "GOOGL"),
                 values = c(326.0, 598.3, 201.5))
df$symbols == df[[2]]
df$symbols == df[["symbols"]]
df[[2, 1]] == "AAPL"
```

```
l <- list(a = 500, "aaa", 98.2)
length(l)       == 3
class(l[1])     == "list"
class(l[[1]])   == "numeric"
class(l$a)      == "numeric"
```

```
env <- new.env()
env[["foo"]] = "bar"
env2 <- env
env2[["foo"]] = "BAR"

env[["foo"]] == "BAR"
get("foo", envir = env) == "BAR"
rm("foo", envir = env)
env[["foo"]] == NULL
```

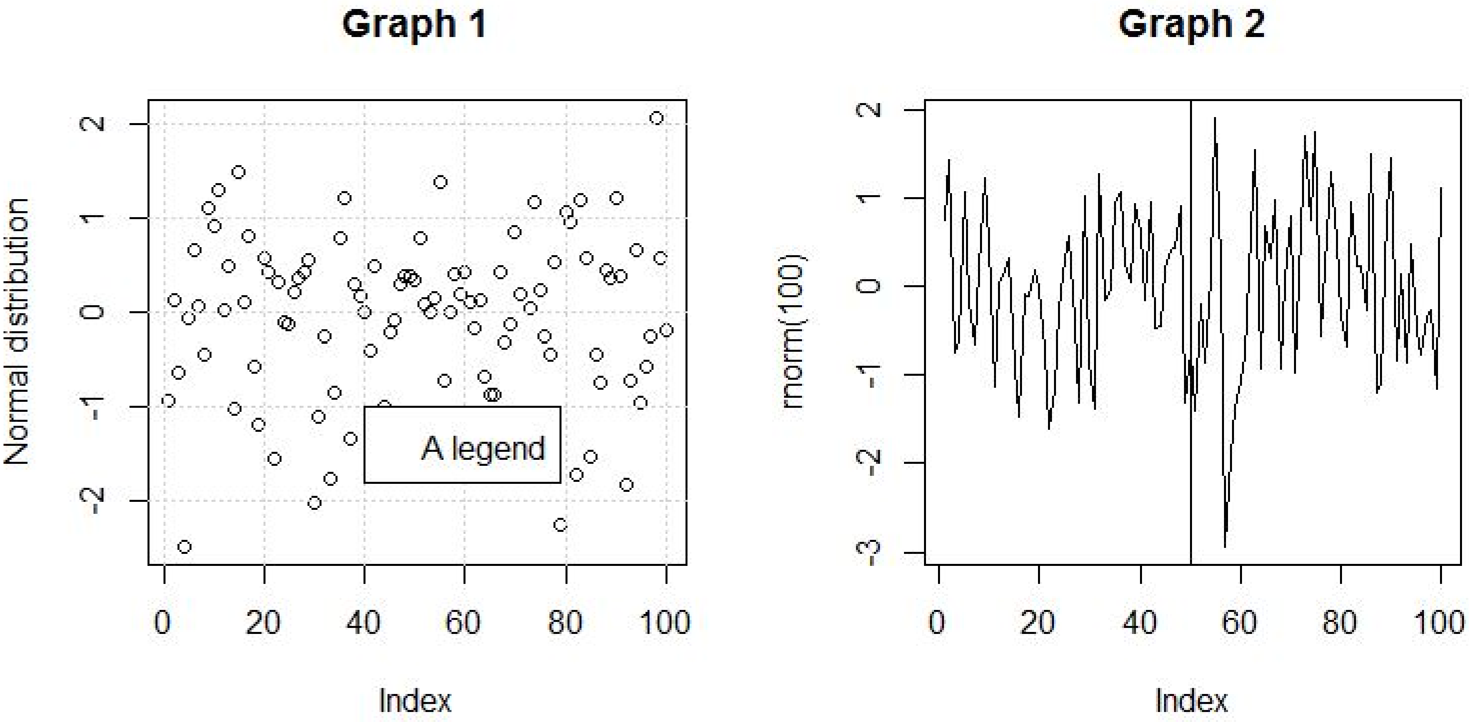
( )

```
# Creates a 1 row - 2 columns format
par(mfrow=c(1,2))

plot(rnorm(100), main = "Graph 1", ylab = "Normal distribution")
grid()
legend(x = 40, y = -1, legend = "A legend")

plot(rnorm(100), main = "Graph 2", type = "l")
abline(v = 50)
```

:




```
# Create 100 standard normals in a vector
x <- rnorm(100, mean = 0, sd = 1)

# Find the lenght of a vector
length(x)

# Compute the mean
mean(x)

# Compute the standard deviation
sd(x)

# Compute the median value
median(x)

# Compute the range (min, max)
range(x)

# Sum an iterable
sum(x)

# Cumulative sum (x[1], x[1]+x[2], ...)
cumsum(x)
```

```
# Display the first 3 elements
head(3, x)

# Display min, 1st quartile, median, mean, 3rd quartile, max
summary(x)

# Compute successive difference between elements
diff(x)

# Create a range from 1 to 10 step 1
1:10

# Create a range from 1 to 10 step 0.1
seq(1, 10, 0.1)

# Print a string
print("hello world")
```

: https://riptutorial.com/ko/r/topic/10827/--

98: (Excel, SAS, SPSS, Stata) I / O

Examples

rio . `import()` . `import()` URL .

```
import("example.csv")       # comma-separated values
import("example.tsv")       # tab-separated values
import("example.dta")       # Stata
import("example.sav")       # SPSS
import("example.sas7bdat")  # SAS
import("example.xlsx")      # Excel
```

`import()` , URL (HTTP HTTPS) . rio github .

`import()` .

```
import("example.csv", format = ",") #for csv file where comma is used as separator
import("example.csv", format = ";") #for csv file where semicolon is used as separator
```

Excel

Excel R .

R	
xlsx	
XLconnect	
openxlsx	C ++
readxl	C ++
RODBC	ODBC
gdata	

Java ODBC R OS . R 64 `xlsx` `XLconnect` Java 64 .

Excel . . `package::function` `package::function` . `openxlsx` `openxlsx` .

xlsx

```
library(xlsx)
```

.

```
xlsx::read.xlsx("Book1.xlsx", sheetIndex=1)

xlsx::read.xlsx("Book1.xlsx", sheetName="Sheet1")
```

XLconnect Excel

```
library(XLConnect)
wb <- XLConnect::loadWorkbook("Book1.xlsx")

# Either, if Book1.xlsx has a sheet called "Sheet1":
sheet1 <- XLConnect::readWorksheet(wb, "Sheet1")
# Or, more generally, just get the first sheet in Book1.xlsx:
sheet1 <- XLConnect::readWorksheet(wb, getSheets(wb)[1])
```

XLConnect Book1.xlsx Excel . Excel . Book1.xlsx myHeader , myBody myPcts . R ( ) :

```
Headerstyle <- XLConnect::getCellStyle(wb, "myHeader")
Bodystyle <- XLConnect::getCellStyle(wb, "myBody")
Pctsstyle <- XLConnect::getCellStyle(wb, "myPcts")
```

R . .

```
Headerrange <- expand.grid(row = 1, col = 1:8)
Bodyrange <- expand.grid(row = 2:6, col = c(1:5, 8))
Pctrange <- expand.grid(row = 2:6, col = c(6, 7))

XLConnect::setCellStyle(wb, sheet = "sheet1", row = Headerrange$row,
             col = Headerrange$col, cellstyle = Headerstyle)
XLConnect::setCellStyle(wb, sheet = "sheet1", row = Bodyrange$row,
             col = Bodyrange$col, cellstyle = Bodystyle)
XLConnect::setCellStyle(wb, sheet = "sheet1", row = Pctrange$row,
             col = Pctrange$col, cellstyle = Pctsstyle)
```

XLConnect . openxlsx .

openxlsx .

Excel openxlsx .

```
library(openxlsx)

openxlsx::read.xlsx("spreadsheet1.xlsx", colNames=TRUE, rowNames=TRUE)

#colNames: If TRUE, the first row of data will be used as column names.
#rowNames: If TRUE, first column of data will be used as row names.
```

R sheet sheet .

```
openxlsx::read.xlsx("spreadsheet1.xlsx", sheet = 1)
```

:

```
openxlsx::read.xlsx("spreadsheet1.xlsx", sheet = "Sheet1")
```

`openxlsx` . `detectDates` `TRUE` `TRUE` .

```
openxlsx::read.xlsx("spreadsheet1.xlsx", sheet = "Sheet1", detectDates= TRUE)
```

readxl read

Excel `readxl` `R` .

```
library(readxl)
```

`.xls` `.xlsx` .

```
readxl::read_excel("spreadsheet1.xls")
readxl::read_excel("spreadsheet2.xlsx")
```

.

```
readxl::read_excel("spreadsheet.xls", sheet = 1)
readxl::read_excel("spreadsheet.xls", sheet = "summary")
```

`col_names = TRUE` .

```
 readxl::read_excel("spreadsheet.xls", sheet = 1, col_names = TRUE)
```

`col_types` .

```
readxl::read_excel("spreadsheet.xls", sheet = 1, col_names = TRUE,
                   col_types = c("text", "date", "numeric", "numeric"))
```

Reading RODBC .

Excel Windows Access Database Engine (ACE) (JET) ODBC Excel . RODBC R .
. : JET / ACE .dll Windows / PC .

```
library(RODBC)

xlconn <- odbcDriverConnect('Driver={Microsoft Excel Driver (*.xls, *.xlsx, *.xlsm, *.xlsb)};
                              DBQ=C:\\Path\\To\\Workbook.xlsx')
```

```
df <- sqlQuery(xlconn, "SELECT * FROM [SheetName$]")
close(xlconn)
```

SQL JOIN UNION Excel . JET / ACE SQL . : DML , SELECT .

```
joindf <-  sqlQuery(xlconn, "SELECT t1.*, t2.* FROM [Sheet1$] t1
                             INNER JOIN [Sheet2$] t2
                             ON t1.[ID] = t2.[ID]")

uniondf <-  sqlQuery(xlconn, "SELECT * FROM [Sheet1$]
                              UNION
                              SELECT * FROM [Sheet2$]")
```

ODBC .

```
otherwkbkdf <- sqlQuery(xlconn, "SELECT * FROM
                                 [Excel 12.0 Xml;HDR=Yes;
                                 Database=C:\\Path\\To\\Other\\Workbook.xlsx].[Sheet1$];")
```

Reading gdata Excel .

.

Stata, SPSS SAS

foreign haven Stata, SPSS SAS . read .

```
# loading the packages
library(foreign)
library(haven)
library(readstata13)
library(Hmisc)
```

.

```
# reading Stata files with `foreign`
read.dta("path\to\your\data")
# reading Stata files with `haven`
read_dta("path\to\your\data")
```

foreign Stata 7-12 stata (.dta) . read.dta 13 . Stata readstata13 haven . readstata13

```
# reading recent Stata (13+) files with `readstata13`
read.dta13("path\to\your\data")
```

SPSS SAS

```
# reading SPSS files with `foreign`
read.spss("path\to\your\data.sav", to.data.frame = TRUE)
# reading SPSS files with `haven`
```

```
read_spss("path\to\your\data.sav")
read_sav("path\to\your\data.sav")
read_por("path\to\your\data.por")

# reading SAS files with `foreign`
read.ssd("path\to\your\data")
# reading SAS files with `haven`
read_sas("path\to\your\data")
# reading native SAS files with `Hmisc`
sas.get("path\to\your\data")   #requires access to saslib
# Reading SA XPORT format ( *.XPT ) files
sasxport.get("path\to\your\data.xpt")  # does not require access to SAS executable
```

SAScii SAS SET read.fwf . . https://github.com/ajdamico/SAScii.

write.foreign() . .

```
# writing to Stata, SPSS or SAS files with `foreign`
write.foreign(dataframe, datafile, codefile,
              package = c("SPSS", "Stata", "SAS"), ...)
write.foreign(dataframe, "path\to\data\file", "path\to\instruction\file", package = "Stata")

# writing to Stata files with `foreign`
write.dta(dataframe, "file", version = 7L,
          convert.dates = TRUE, tz = "GMT",
          convert.factors = c("labels", "string", "numeric", "codes"))

# writing to Stata files with `haven`
write_dta(dataframe, "path\to\your\data")

# writing to Stata files with `readstata13`
save.dta13(dataframe, file, data.label = NULL, time.stamp = TRUE,
  convert.factors = TRUE, convert.dates = TRUE, tz = "GMT",
  add.rownames = FALSE, compress = FALSE, version = 117,
  convert.underscore = FALSE)

# writing to SPSS files with `haven`
write_sav(dataframe, "path\to\your\data")
```

SPSS read.spss .

```
 foreign::read.spss('data.sav', to.data.frame=TRUE, use.value.labels=FALSE,
                    use.missings=TRUE, reencode='UTF-8')
# to.data.frame if TRUE: return a data frame
# use.value.labels if TRUE: convert variables with value labels into R factors with those
levels
# use.missings if TRUE: information on user-defined missing values will used to set the
corresponding values to NA.
# reencode character strings will be re-encoded to the current locale. The default, NA, means
to do so in a UTF-8 locale, only.
```

Feather (:) Python R Apache Arrow . data.frame tibble .

```
library(feather)

path <- "filename.feather"
df <- mtcars
```

```
write_feather(df, path)

df2 <- read_feather(path)

head(df2)
##  A tibble: 6 x 11
##     mpg   cyl  disp    hp  drat    wt  qsec    vs    am  gear  carb
##   <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
## 1  21.0     6   160   110  3.90 2.620 16.46     0     1     4     4
## 2  21.0     6   160   110  3.90 2.875 17.02     0     1     4     4
## 3  22.8     4   108    93  3.85 2.320 18.61     1     1     4     1
## 4  21.4     6   258   110  3.08 3.215 19.44     1     0     3     1
## 5  18.7     8   360   175  3.15 3.440 17.02     0     0     3     2
## 6  18.1     6   225   105  2.76 3.460 20.22     1     0     3     1

head(df)
##                    mpg cyl disp  hp drat    wt  qsec vs am gear carb
## Mazda RX4         21.0   6  160 110 3.90 2.620 16.46  0  1    4    4
## Mazda RX4 Wag     21.0   6  160 110 3.90 2.875 17.02  0  1    4    4
## Datsun 710        22.8   4  108  93 3.85 2.320 18.61  1  1    4    1
## Hornet 4 Drive    21.4   6  258 110 3.08 3.215 19.44  1  0    3    1
## Hornet Sportabout 18.7   8  360 175 3.15 3.440 17.02  0  0    3    2
## Valiant           18.1   6  225 105 2.76 3.460 20.22  1  0    3    1
```

.

: . , . .

(Excel, SAS, SPSS, Stata) I / O : https://riptutorial.com/ko/r/topic/5536/---excel--sas--spss--stata---i---o

99:

1. (x = character (), , = , = NA, = is.ordered (x), nmax = NA)
2. `?factor` .

`factor` .

1. `integer` .
2. `levels` .
3. `factor` .

, 1,000 .

```
set.seed(1)
Color <- sample(x = c("Red", "Blue", "Green", "Yellow"),
                size = 1000,
                replace = TRUE)
Color <- factor(Color)
```

`Color` .

```
#* 1. It is stored internally as an `integer` vector
typeof(Color)
```

```
[1] "integer"
```

```
#* 2. It maintains a `levels` attribute the shows the character representation of the values.
#* 3. Its class is stored as `factor`
attributes(Color)
```

```
$levels
[1] "Blue"   "Green"  "Red"    "Yellow"

$class
[1] "factor"
```

. . (`stringsAsFactors` : Unauthorized Biography). `Color` . , `Color` factor 1.7 .

```
#* Amount of memory required to store Color as a factor.
object.size(Color)
```

```
4624 bytes
```

```
#* Amount of memory required to store Color as a character
object.size(as.character(Color))
```

```
8232 bytes
```

, . ,

```
head(Color)
```

```
[1] Blue   Blue   Green  Yellow Red    Yellow
Levels: Blue Green Red Yellow
```

.

```
head(as.numeric(Color))
```

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

R .

```
head(levels(Color)[as.numeric(Color)])
```

```
[1] "Blue"   "Blue"   "Green"  "Yellow" "Red"    "Yellow"
```

.

```
head(Color)
```

```
[1] Blue   Blue   Green  Yellow Red    Yellow
Levels: Blue Green Red Yellow
```

2007 R (: `stringsAsFactors`). 1.7 , R , 2007 .

R . R .

1. /
2.

. (: "", "" "") . , ( ).

. . .

Examples

R . . . R .

```
charvar <- rep(c("n", "c"), each = 3)
f <- factor(charvar)
f
levels(f)
```

```
> f
[1] n n n c c c
Levels: c n
> levels(f)
[1] "c" "n"
```

.

```
levels(factor(charvar, levels = c("n","c")))

> levels(factor(charvar, levels = c("n","c")))
[1] "n" "c"
```

. .

```
> f <- factor(charvar, levels=c("n", "c"), labels=c("Newt", "Capybara"))
> f
[1] Newt     Newt     Newt     Capybara Capybara Capybara
Levels: Newt Capybara
```

.

```
> Weekdays <- factor(c("Monday", "Wednesday", "Thursday", "Tuesday", "Friday", "Sunday",
"Saturday"))
> Weekdays
[1] Monday    Wednesday Thursday  Tuesday   Friday    Sunday    Saturday
Levels: Friday Monday Saturday Sunday Thursday Tuesday Wednesday
> Weekdays <- factor(Weekdays, levels=c("Monday", "Tuesday", "Wednesday", "Thursday",
"Friday", "Saturday", "Sunday"), ordered=TRUE)
> Weekdays
[1] Monday    Wednesday Thursday  Tuesday   Friday    Sunday    Saturday
Levels: Monday < Tuesday < Wednesday < Thursday < Friday < Saturday < Sunday
```

, `droplevels()` .

```
> Weekend <- subset(Weekdays, Weekdays == "Saturday" |  Weekdays == "Sunday")
> Weekend
[1] Sunday   Saturday
Levels: Monday < Tuesday < Wednesday < Thursday < Friday < Saturday < Sunday
> Weekend <- droplevels(Weekend)
> Weekend
[1] Sunday   Saturday
Levels: Saturday < Sunday
```

. . .

```
set.seed(1)
colorful <- sample(c("red", "Red", "RED", "blue", "Blue", "BLUE", "green", "gren"),
                   size = 20,
                   replace = TRUE)
colorful <- factor(colorful)
```

R .

```
table(colorful)
```

```
colorful
blue  Blue  BLUE green  gren   red   Red   RED 
   3     1     4     2     4     1     3     2 
```

, ...

factor (factor_approach)

```
factor(as.character(colorful),
       levels = c("blue", "Blue", "BLUE", "green", "gren", "red", "Red", "RED"),
       labels = c("Blue", "Blue", "Blue", "Green", "Green", "Red", "Red", "Red"))
```

```
 [1] Green Blue  Red   Red   Blue  Red   Red   Red   Blue  Red   Green Green Green
Blue  Red   Green
[17] Red   Green Green Red  
Levels: Blue Blue Blue Green Green Red Red Red
Warning message:
In `levels<-`(`*tmp*`, value = if (nl == nL) as.character(labels) else
paste0(labels,  :
  duplicated levels in factors are deprecated
```

. "" . . .

ifelse (ifelse_approach)

```
factor(ifelse(colorful %in% c("blue", "Blue", "BLUE"),
       "Blue",
       ifelse(colorful %in% c("green", "gren"),
              "Green",
              "Red")))
```

```
 [1] Green Blue  Red   Red   Blue  Red   Red   Red   Blue  Red   Green Green Green
Blue  Red   Green
[17] Red   Green Green Red  
Levels: Blue Green Red
```

`ifelse` . `ifelse` .

(list_approach)

. factor `levels` .

```
levels(colorful) <-
     list("Blue" = c("blue", "Blue", "BLUE"),
          "Green" = c("green", "gren"),
          "Red" = c("red", "Red", "RED"))
```

```
 [1] Green Blue  Red   Red   Blue  Red   Red   Red   Blue  Red   Green Green Green
Blue  Red   Green
[17] Red   Green Green Red
Levels: Blue Green Red
```

. .

```
Unit: microseconds
          expr     min      lq      mean   median      uq     max neval cld
        factor  78.725  83.256  93.26023  87.5030  97.131 218.899   100  b
        ifelse 104.494 107.609 123.53793 113.4145 128.281 254.580   100   c
 list_approach  49.557  52.955  60.50756  54.9370  65.132 138.193   100 a
```

`ifelse` . . . .

Factor R . `as.character()` `x` `factor()` `as.factor()` . `x` .

, , .

```
# standard
factor(c(1,1,2,2,3,3))
[1] 1 1 2 2 3 3
Levels: 1 2 3
```

. `factor()` .

```
factor(c(1,1,2,2,3,3),
         levels = c(1,2,3,4,5))
[1] 1 1 2 2 3 3
Levels: 1 2 3 4 5
```

. . .

```
factor(c(1,1,2,2,3,3),
       levels = c(1,2,3,4,5),
       labels = c("Fox","Dog","Cow","Brick","Dolphin"))
[1] Fox Fox Dog Dog Cow Cow
Levels: Fox Dog Cow Brick Dolphin
```

`==` `!=` . .

```
factor(c(1,1,2,2,3,3),levels = c(1,2,3)) == factor(c(1,1,2,2,3,3),levels = c(1,2,3,4,5))
Error in Ops.factor(factor(c(1, 1, 2, 2, 3, 3), levels = c(1, 2, 3)),  :
  level sets of factors are different
```

RHS R .

`<` , `<=` , `>` `>=` . . `ordered = TRUE` `factor` `ordered` .

```
x <- factor(1:3, labels = c('low', 'medium', 'high'), ordered = TRUE)
print(x)
[1] low    medium high
```

```
Levels: low < medium < high

y <- ordered(3:1, labels = c('low', 'medium', 'high'))
print(y)
[1] high   medium low
Levels: low < medium < high

x < y
[1]  TRUE FALSE FALSE
```

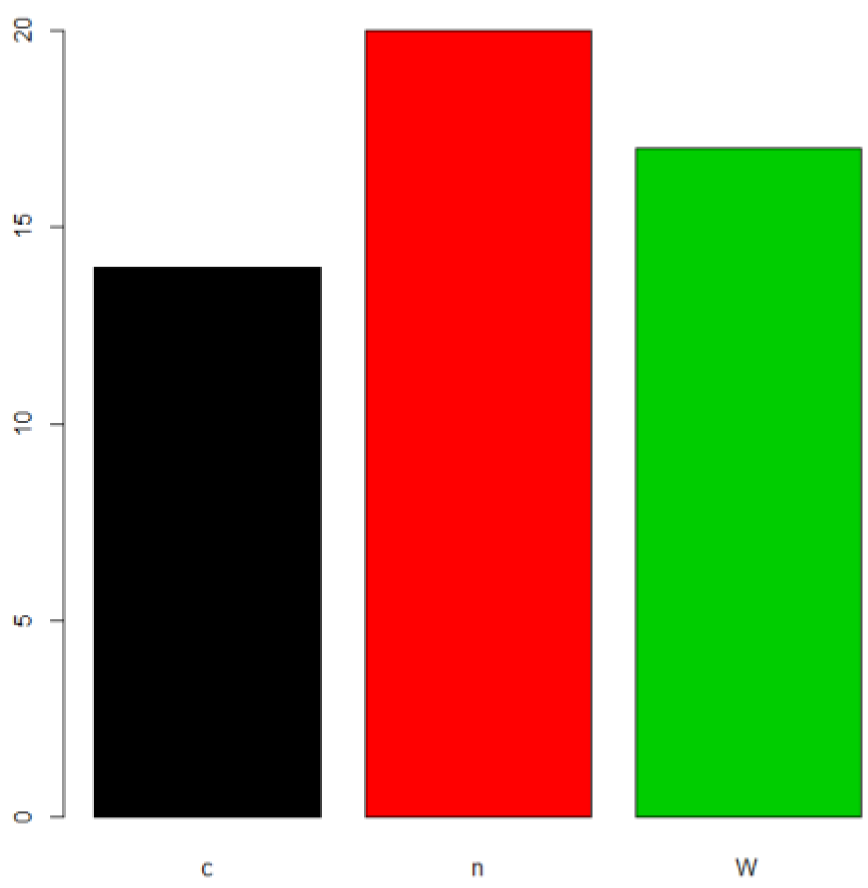
Factor .

levels as.character .

```
charvar <- rep(c("W", "n", "c"), times=c(17,20,14))
f <- factor(charvar)
levels(f)
# [1] "c" "n" "W"
```

levels (/) . , plot , :

```
plot(f,col=1:length(levels(f)))
```



levels levels labels ("" .). .

1.

levels .

```
ff <- factor(charvar, levels = c("n", "W", "c"))
levels(ff)
# [1] "n" "W" "c"

gg <- factor(charvar, levels = c("W", "c", "n"))
levels(gg)
# [1] "W" "c" "n"
```

, labels levels "" "" labels :

```
fm <- factor(as.numeric(f),levels = c(2,3,1),
             labels = c("nn", "WW", "cc"))
levels(fm)
# [1] "nn" "WW" "cc"

fm <- factor(LETTERS[1:6], levels = LETTERS[1:4],  # only 'A'-'D' as input
                 labels = letters[1:4])            # but assigned to 'a'-'d'
fm
#[1] a    b    c    d    <NA> <NA>
#Levels: a b c d
```

2. **relevel**

level relevel . , base .

```
g<-relevel(f, "n") # moves n to be the first level
levels(g)
# [1] "n" "c" "W"
```

f g .

```
all.equal(f, g)
# [1] "Attributes: < Component "levels": 2 string mismatches >"
all.equal(f, g, check.attributes = F)
# [1] TRUE
```

3.

, , levels reorder . levels .

```
table(g)
# g
#  n  c  W
# 20 14 17
```

reorder help(reorder)), : x , factor; X x . FUN X x levels . . .

```
g.ord <- reorder(g,rep(1,length(g)), FUN=sum) #increasing
levels(g.ord)
```

```
# [1] "c" "W" "n"
```

(-1)

```
g.ord.d <- reorder(g,rep(-1,length(g)), FUN=sum)
levels(g.ord.d)
# [1] "n" "W" "c"
```

.

```
data.frame(f,g,g.ord,g.ord.d)[seq(1,length(g),by=5),] #just same lines
#    f g g.ord g.ord.d
# 1  W W     W       W
# 6  W W     W       W
# 11 W W     W       W
# 16 W W     W       W
# 21 n n     n       n
# 26 n n     n       n
# 31 n n     n       n
# 36 n n     n       n
# 41 c c     c       c
# 46 c c     c       c
# 51 c c     c       c
```

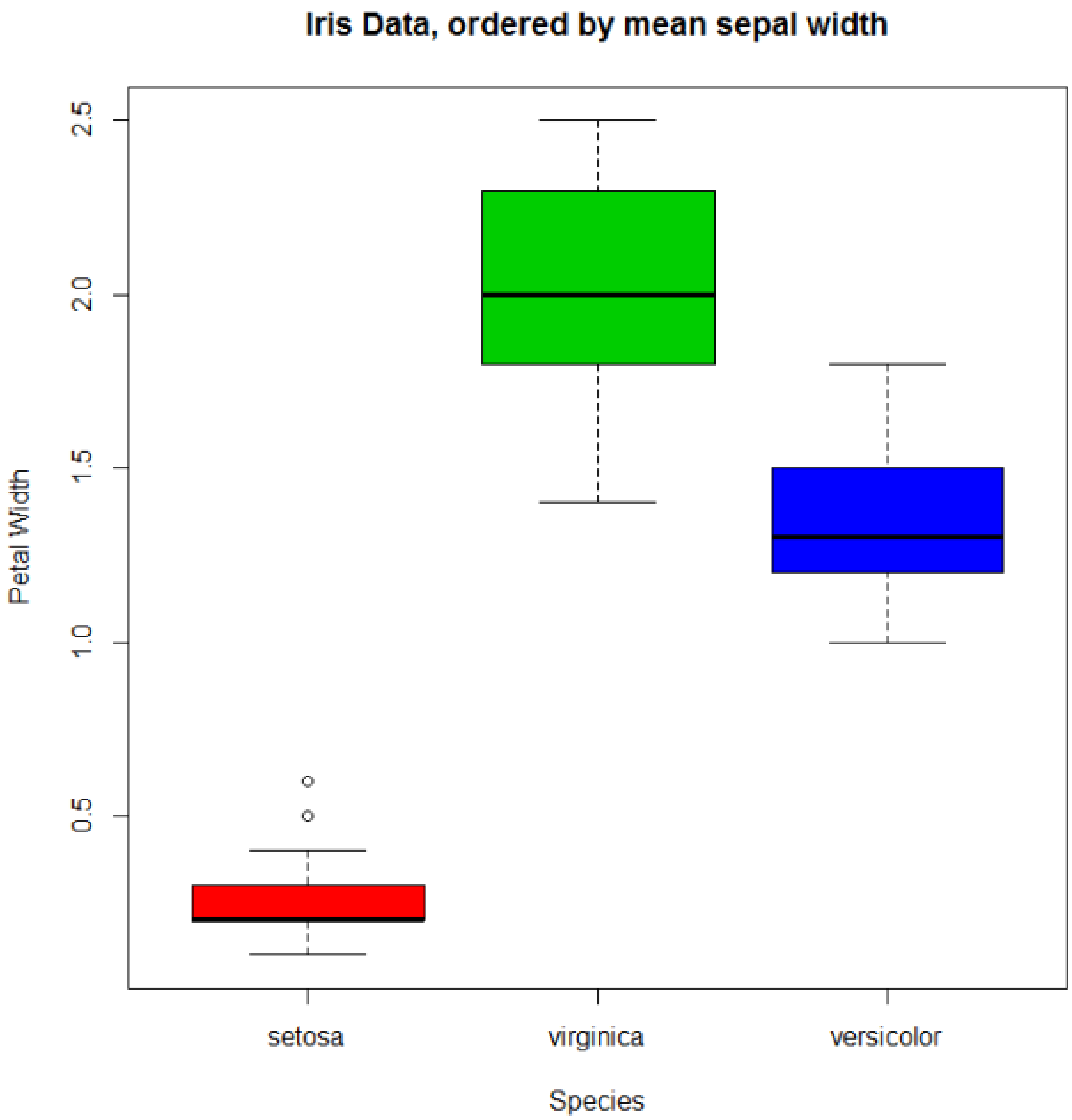
levels levels . iris (help("iris") help("iris") Species Sepal.Width Species .

```
miris <- iris  #help("iris") # copy the data
with(miris, tapply(Sepal.Width,Species,mean))
#    setosa versicolor  virginica
#     3.428      2.770      2.974

miris$Species.o<-with(miris,reorder(Species,-Sepal.Width))
levels(miris$Species.o)
# [1] "setosa"     "virginica"  "versicolor"
```

boxplot (with(miris, boxplot(Petal.Width~Species)) : *setosa* , *versicolor* , *virginica* . Sepal.Width :

```
boxplot(Petal.Width~Species.o, data = miris,
        xlab = "Species", ylab = "Petal Width",
        main = "Iris Data, ordered by mean sepal width", varwidth = TRUE,
        col = 2:4)
```



levels   levels   levels .   levels .

```
f1<-f
levels(f1)
# [1] "c" "n" "W"
levels(f1) <- c("upper","upper","CAP") #rename and grouping
levels(f1)
# [1] "upper" "CAP"

f2<-f1
levels(f2) <- c("upper","CAP", "Number") #add Number level, which is empty
levels(f2)
# [1] "upper"  "CAP"    "Number"
f2[length(f2):(length(f2)+5)]<-"Number" # add cases for the new level
table(f2)
# f2
#  upper    CAP Number
#     33     17      6
```

```
f3<-f1
levels(f3) <- list(G1 = "upper", G2 = "CAP", G3 = "Number") # The same using list
levels(f3)
# [1] "G1" "G2" "G3"
f3[length(f3):(length(f3)+6)]<-"G3" ## add cases for the new level
table(f3)
# f3
# G1 G2 G3
# 33 17  7
```

-

ordered . factors . levels , labels .

```
ordvar<-rep(c("Low", "Medium", "High"), times=c(7,2,4))

of<-ordered(ordvar,levels=c("Low", "Medium", "High"))
levels(of)
# [1] "Low"    "Medium" "High"

of1<-of
levels(of1)<- c("LOW", "MEDIUM", "HIGH")
levels(of1)
# [1] "LOW"    "MEDIUM" "HIGH"
is.ordered(of1)
# [1] TRUE
of1
# [1] LOW    LOW    LOW    LOW    LOW    LOW    LOW    MEDIUM MEDIUM HIGH   HIGH   HIGH   HIGH

# Levels: LOW < MEDIUM < HIGH
```

0

R . (, ,) . 5 .

, , , ,

. , 1 = , 2 = , 3 = , 4 = 5 :

4 , **4** , **3** , **1** , **2**

(:) . R ?

20 . .

```
set.seed(18)
ii <- sample(1:4, 20, replace=T)
ii
```

[1] 4 3 4 1 1 3 2 3 2 1 3 4 1 2 4 1 3 1 4 1

1 4 .

```
fii <- factor(ii, levels=1:4) # it is necessary to indicate the numeric levels
fii
```

[1] 4 3 4 1 1 3 2 3 2 1 3 4 1 2 4 1 3 1 4 1
: 1 2 3 4

.

```
levels(fii) <- c("empty", "low", "normal", "full")
fii
```

[1]
[11]
:

: https://riptutorial.com/ko/r/topic/1104/

100:

. R .

R . (`RSelenium` , `httr` , `curl` , `RCurl`), (`XML` , `xml2`) (`rvest`) .

API . .

. .

Examples

rvest

`rvest` Hadley Wickham Python [Beautiful Soup](#) . Hadley `xml2` HTML `libxml2` .

tidyverse , `rvest` .

- `xml2::read_html` HTML `xml2::read_html` ,
- CSS XPath `html_node` `html_nodes` .
- `html_text` `html_table` R .

[R Wikipedia](#) .

```
library(rvest)

url <- 'https://en.wikipedia.org/wiki/R_(programming_language)'

        # scrape HTML from website
url %>% read_html() %>%
    # select HTML tag with class="wikitable"
    html_node(css = '.wikitable') %>%
    # parse table into data.frame
    html_table() %>%
    # trim for printing
    dplyr::mutate(Description = substr(Description, 1, 70))

##    Release       Date                                                  Description
## 1     0.16             This is the last alpha version developed primarily by Ihaka
## 2     0.49 1997-04-23 This is the oldest source release which is currently availab
## 3     0.60 1997-12-05 R becomes an official part of the GNU Project. The code is h
## 4   0.65.1 1999-10-07 First versions of update.packages and install.packages funct
## 5      1.0 2000-02-29 Considered by its developers stable enough for production us
## 6      1.4 2001-12-19 S4 methods are introduced and the first version for Mac OS X
## 7      2.0 2004-10-04 Introduced lazy loading, which enables fast loading of data
## 8      2.1 2005-04-18 Support for UTF-8 encoding, and the beginnings of internatio
## 9     2.11 2010-04-22                          Support for Windows 64 bit systems.
## 10    2.13 2011-04-14 Adding a new compiler function that allows speeding up funct
## 11    2.14 2011-10-31 Added mandatory namespaces for packages. Added a new paralle
## 12    2.15 2012-03-30 New load balancing functions. Improved serialization speed f
## 13     3.0 2013-04-03 Support for numeric index values 231 and larger on 64 bit sy
```

data.frame . , `NA` .

. jQuery , `read_html` , `RSelenium` .

rvest

.

. .

```
library(rvest)

#Address of the login webpage
login<-
"https://stackoverflow.com/users/login?ssrc=head&returnurl=http%3a%2f%2fstackoverflow.com%2f"

#create a web session with the desired login address
pgsession<-html_session(login)
pgform<-html_form(pgsession)[[2]]  #in this case the submit is the 2nd form
filled_form<-set_values(pgform, email="*****", password="*****")
submit_form(pgsession, filled_form)

#pre allocate the final results dataframe.
results<-data.frame()

#loop through all of the pages with the desired info
for (i in 1:5)
{
  #base address of the pages to extract information from
  url<-"http://stackoverflow.com/users/**********?tab=answers&sort=activity&page="
  url<-paste0(url, i)
  page<-jump_to(pgsession, url)

  #collect info on the question votes and question title
  summary<-html_nodes(page, "div .answer-summary")
  question<-matrix(html_text(html_nodes(summary, "div"), trim=TRUE), ncol=2, byrow = TRUE)

  #find date answered, hyperlink and whether it was accepted
  dateans<-html_node(summary, "span") %>% html_attr("title")
  hyperlink<-html_node(summary, "div a") %>% html_attr("href")
  accepted<-html_node(summary, "div") %>% html_attr("class")

  #create temp results then bind to final results
  rtemp<-cbind(question, dateans, accepted, hyperlink)
  results<-rbind(results, rtemp)
}

#Dataframe Clean-up
names(results)<-c("Votes", "Answer", "Date", "Accepted", "HyperLink")
results$Votes<-as.integer(as.character(results$Votes))
results$Accepted<-ifelse(results$Accepted=="answer-votes default", 0, 1)
```

5 . ****** , .

: https://riptutorial.com/ko/r/topic/2890/---

101:

- ymd_hms (..., quiet = FALSE, tz = "UTC", locale = Sys.getlocale ("LC_TIME"))
- (tzone = "")
- (, , tzone = attr (, "tzone"))
- (num = NULL, units = "seconds", ...)
- (num = NULL, units = "second", ...)

CRAN .

```
install.packages("lubridate")
```

Github

```
library(devtools)
# dev mode allows testing of development packages in a sandbox, without interfering
# with the other packages you have installed.
dev_mode(on=T)
install_github("hadley/lubridate")
dev_mode(on=F)
```

lubridate :

```
vignette("lubridate")
```

`foo` :

```
help(foo)     # help about function foo
?foo          # same thing

# Example
# help("is.period")
# ?is.period
```

`foo` :

```
example("foo")

# Example
# example("interval")
```

Examples

`lubridate` datetime `lubridate` .

		R
		`%y` , `%Y`

		R
m (y d)		%m , %b , %h , %B
		%d , %e
h		%H , %I%p
m (h s)		%M
		%S

, ,, , , "2016-07-22" ymd_hms() ymd() , : "2016-07-22 13:04:47" .

(: / , -) . .

date Date .

```
library(lubridate)

mdy(c(' 07/02/2016 ', '7 / 03 / 2016', ' 7 / 4 / 16 '))
## [1] "2016-07-02" "2016-07-03" "2016-07-04"

ymd(c("20160724","2016/07/23","2016-07-25"))    # inconsistent separators
## [1] "2016-07-24" "2016-07-23" "2016-07-25"
```

Datetimes

ymd_hms ymd_hm ymd_h . datetime as.POSIXct strptime tz "UTC" .

datetime POSIXct .

```
x <- c("20160724 130102","2016/07/23 14:02:01","2016-07-25 15:03:00")
ymd_hms(x, tz="EST")
## [1] "2016-07-24 13:01:02 EST" "2016-07-23 14:02:01 EST"
## [3] "2016-07-25 15:03:00 EST"

ymd_hms(x)
## [1] "2016-07-24 13:01:02 UTC" "2016-07-23 14:02:01 UTC"
## [3] "2016-07-25 15:03:00 UTC"
```

lubridate as.POSIXct strptime datetimes strptime .

parse_date_time	POSIXct	. % lubridate datetime (: "ymd hms" strptime strptime . .
parse_date_time2	POSIXct; lt = TRUE ,	. strptime (%) .

	POSIXlt	
fast_strptime	POSIXlt; lt = FALSE POSIXct	. (- , / , :) % strptime .

```
x <- c('2016-07-22 13:04:47', '07/22/2016 1:04:47 pm')

parse_date_time(x, orders = c('mdy Imsp', 'ymd hms'))
## [1] "2016-07-22 13:04:47 UTC" "2016-07-22 13:04:47 UTC"

x <- c('2016-07-22 13:04:47', '2016-07-22 14:47:58')

parse_date_time2(x, orders = 'Ymd HMS')
## [1] "2016-07-22 13:04:47 UTC" "2016-07-22 14:47:58 UTC"

fast_strptime(x, format = '%Y-%m-%d %H:%M:%S')
## [1] "2016-07-22 13:04:47 UTC" "2016-07-22 14:47:58 UTC"
```

parse_date_time2 fast_strptime C .

?parse_date_time .

lubridate

Lubridate ymd() . y, m d - , .

```
mdy("07-21-2016")                 # Returns Date

## [1] "2016-07-21"

mdy("07-21-2016", tz = "UTC")     # Returns a vector of class POSIXt

## "2016-07-21 UTC"

dmy("21-07-2016")                 # Returns Date

## [1] "2016-07-21"

dmy(c("21.07.2016", "22.07.2016")) # Returns vector of class Date

## [1] "2016-07-21" "2016-07-22"
```

lubridate

```
date <- now()
date
## "2016-07-22 03:42:35 IST"

year(date)
## 2016

minute(date)
## 42
```

```
wday(date, label = T, abbr = T)
# [1] Fri
# Levels: Sun < Mon < Tues < Wed < Thurs < Fri < Sat

day(date) <- 31
## "2016-07-31 03:42:35 IST"

# If an element is set to a larger value than it supports, the difference
#  will roll over into the next higher element
day(date) <- 32
## "2016-08-01 03:42:35 IST"
```

. - . is.instant is.instant .

```
library(lubridate)

today_start <- dmy_hms("22.07.2016 12:00:00", tz = "IST") # default tz="UTC"
today_start
## [1] "2016-07-22 12:00:00 IST"
is.instant(today_start)
## [1] TRUE

now_dt <- ymd_hms(now(), tz="IST")
now_dt
## [1] "2016-07-22 13:53:09 IST"
is.instant(now_dt)
## [1] TRUE

is.instant("helloworld")
## [1] FALSE
is.instant(60)
## [1] FALSE
```

,

lubridate . .

```
# create interval by substracting two instants
today_start <- ymd_hms("2016-07-22 12-00-00", tz="IST")
today_start
## [1] "2016-07-22 12:00:00 IST"
today_end <- ymd_hms("2016-07-22 23-59-59", tz="IST")
today_end
## [1] "2016-07-22 23:59:59 IST"
span <- today_end - today_start
span
## Time difference of 11.99972 hours
as.interval(span, today_start)
## [1] 2016-07-22 12:00:00 IST--2016-07-22 23:59:59 IST

# create interval using interval() function
span <- interval(today_start, today_end)
[1] 2016-07-22 12:00:00 IST--2016-07-22 23:59:59 IST
```

.

```
duration(60, "seconds")
## [1] "60s"

duration(2, "minutes")
## [1] "120s (~2 minutes)"
```

: .

dseconds , dminutes .

?quick_durations .

```
dseconds(60)
## [1] "60s"

dhours(2)
## [1] "7200s (~2 hours)"

dyears(1)
## [1] "31536000s (~365 days)"
```

.

```
today_start + dhours(5)
## [1] "2016-07-22 17:00:00 IST"

today_start + dhours(5) + dminutes(30) + dseconds(15)
## [1] "2016-07-22 17:30:15 IST"
```

.

```
as.duration(span)
[1] "43199s (~12 hours)"
```

.

period seconds , hours . ?quick_periods .

```
period(1, "hour")
## [1] "1H 0M 0S"

hours(1)
## [1] "1H 0M 0S"

period(6, "months")
## [1] "6m 0d 0H 0M 0S"

months(6)
## [1] "6m 0d 0H 0M 0S"

years(1)
## [1] "1y 0m 0d 0H 0M 0S"
```

is.period .

```
is.period(years(1))
## [1] TRUE

is.period(dyears(1))
## [1] FALSE
```

```
now_dt <- ymd_hms(now(), tz="IST")
now_dt
## [1] "2016-07-22 13:53:09 IST"
```

round_date() - .

```
round_date(now_dt, "minute")
## [1] "2016-07-22 13:53:00 IST"

round_date(now_dt, "hour")
## [1] "2016-07-22 14:00:00 IST"

round_date(now_dt, "year")
## [1] "2017-01-01 IST"
```

floor_date() - .

```
floor_date(now_dt, "minute")
## [1] "2016-07-22 13:53:00 IST"

floor_date(now_dt, "hour")
## [1] "2016-07-22 13:00:00 IST"

floor_date(now_dt, "year")
## [1] "2016-01-01 IST"
```

ceiling_date() - .

```
ceiling_date(now_dt, "minute")
## [1] "2016-07-22 13:54:00 IST"

ceiling_date(now_dt, "hour")
## [1] "2016-07-22 14:00:00 IST"

ceiling_date(now_dt, "year")
## [1] "2017-01-01 IST"
```

, DST .

```
start_2012 <- ymd_hms("2012-01-01 12:00:00")
## [1] "2012-01-01 12:00:00 UTC"

# period() considers leap year calculations.
start_2012 + period(1, "years")
## [1] "2013-01-01 12:00:00 UTC"

# Here duration() doesn't consider leap year calculations.
start_2012 + duration(1)
## [1] "2012-12-31 12:00:00 UTC"
```

`with_tz` - .

```
nyc_time <- now("America/New_York")
nyc_time
## [1] "2016-07-22 05:49:08 EDT"

# corresponding Europe/Moscow time
with_tz(nyc_time, tzone = "Europe/Moscow")
## [1] "2016-07-22 12:49:08 MSK"
```

`force_tz` X .

```
nyc_time <- now("America/New_York")
nyc_time
## [1] "2016-07-22 05:49:08 EDT"

force_tz(nyc_time, tzone = "Europe/Moscow") # only timezone changes
## [1] "2016-07-22 05:49:08 MSK"
```

: https://riptutorial.com/ko/r/topic/2496/

102:

Examples

( ).

, *logit* *log-odds* . :

$$\sigma(t) = \frac{e^t}{e^t + 1} = \frac{1}{1 + e^{-t}}$$

-Inf; + Inf [0 1 . , .

`family = binomial` (`family = binomial(link="logit")` : *logit* `family = binomial(link="logit")` `glm` .

RMS .

:

```
url <- "http://biostat.mc.vanderbilt.edu/wiki/pub/Main/DataSets/titanic.txt"
titanic <- read.csv(file = url, stringsAsFactors = FALSE)
```

.

.

```
titanic$age[is.na(titanic$age)] <- mean(titanic$age, na.rm = TRUE)
```

:

```
titanic.train <- glm(survived ~ pclass + sex + age,
                     family = binomial, data = titanic)
```

:

```
summary(titanic.train)
```

:

```
Call:
glm(formula = survived ~ pclass + sex + age, family = binomial, data = titanic)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-2.6452  -0.6641  -0.3679   0.6123   2.5615

Coefficients:
             Estimate Std. Error z value Pr(>|z|)
```

```
(Intercept)  3.552261   0.342188  10.381  < 2e-16 ***
pclass2nd   -1.170777   0.211559  -5.534 3.13e-08 ***
pclass3rd   -2.430672   0.195157 -12.455  < 2e-16 ***
sexmale     -2.463377   0.154587 -15.935  < 2e-16 ***
age         -0.042235   0.007415  -5.696 1.23e-08 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 1686.8  on 1312  degrees of freedom
Residual deviance: 1165.7  on 1308  degrees of freedom
AIC: 1175.7

Number of Fisher Scoring iterations: 5
```

- .   .
- .   .
- , , z- (Wald z-) p- .
    - "dummified". . `I` .
    - 4 0.1 % .
    - .
    - ( ) .
    - (CI) `confint` `confint` .
- null Akaike Information Criterion (AIC) .
    - AIC .
    - . (,) .

:

```
exp(coef(titanic.train)[3])

 pclass3rd
0.08797765
```

1 3 1/10 .

:

```
confint(titanic.train)

Waiting for profiling to be done...
                  2.5 %      97.5 %
(Intercept)  2.89486872  4.23734280
pclass2nd   -1.58986065 -0.75987230
pclass3rd   -2.81987935 -2.05419500
sexmale     -2.77180962 -2.16528316
age         -0.05695894 -0.02786211
```

:

(,   )   .

```
with(titanic.train, pchisq(null.deviance - deviance, df.null - df.residual
, lower.tail = FALSE))
[1] 1.892539e-111
```

p- 0   .

: https://riptutorial.com/ko/r/topic/2892/--

103:

file.path file.path .

dir .

Examples

R . .

. .

. getwd() ?setwd .

```
set.seed(1)
for (i in 1:3)
  write.table(
    data.frame(id = 1:2, v = sample(letters, 2)),
    file = sprintf("file201%s.csv", i)
  )
```

CSV .

3 . list list .

```
file_names = c("file2011.csv", "file2012.csv", "file2013.csv")
file_contents = lapply(setNames(file_names, file_names), read.table)

# $file2011.csv
#   id v
# 1  1 g
# 2  2 j
#
# $file2012.csv
#   id v
# 1  1 o
# 2  2 w
#
# $file2013.csv
#   id v
# 1  1 f
# 2  2 w
```

str(file_contents) ?rbind ?lapply .

?read.table ?write.table .:

- R 2 ( )
-
  - CSV
  - TSV
  -
-
  -
-
  - SAS
  - SPSS
  -
  -
-
  - MySQL
  - SQLite
  - PostgreSQL

: https://riptutorial.com/ko/r/topic/5543/-

104:

(NLP) .

Examples

( ) . . : ( ) . . .

. R `tm` ( ) .

```
require(tm)
doc1 <- "drugs hospitals doctors"
doc2 <- "smog pollution environment"
doc3 <- "doctors hospitals healthcare"
doc4 <- "pollution environment water"
corpus <- c(doc1, doc2, doc3, doc4)
tm_corpus <- Corpus(VectorSource(corpus))
```

`Corpus` `VectorSource` `tm` `Corpus` `Corpus` . `VectorSource` . `tm_corpus` ( ) .

```
str(tm_corpus)
List of 4
 $ 1:List of 2
  ..$ content: chr "drugs hospitals doctors"
  ..$ meta   :List of 7
  .. ..$ author       : chr(0)
  .. ..$ datetimestamp: POSIXlt[1:1], format: "2017-06-03 00:31:34"
  .. ..$ description  : chr(0)
  .. ..$ heading      : chr(0)
  .. ..$ id           : chr "1"
  .. ..$ language     : chr "en"
  .. ..$ origin       : chr(0)
  .. ..- attr(*, "class")= chr "TextDocumentMeta"
  ..- attr(*, "class")= chr [1:2] "PlainTextDocument" "TextDocument"
[truncated]
```

`Corpus` , `Corpus` ( ) . `tm` `tm_map` . `tm_map` `apply` .

```
tm_corpus <- tm_map(tm_corpus, tolower)
tm_corpus <- tm_map(tm_corpus, removeWords, stopwords("english"))
tm_corpus <- tm_map(tm_corpus, removeNumbers)
tm_corpus <- tm_map(tm_corpus, PlainTextDocument)
tm_corpus <- tm_map(tm_corpus, stemDocument, language="english")
tm_corpus <- tm_map(tm_corpus, stripWhitespace)
tm_corpus <- tm_map(tm_corpus, PlainTextDocument)
```

.

```
tdm <- TermDocumentMatrix(tm_corpus)
```

```
<<TermDocumentMatrix (terms: 8, documents: 4)>>
```

```
Non-/sparse entries: 12/20
Sparsity           : 62%
Maximal term length: 9
Weighting          : term frequency (tf)
```

```
as.matrix(tdm)

           Docs
Terms        character(0) character(0) character(0) character(0)
  doctor                1            0            1            0
  drug                  1            0            0            0
  environ               0            1            0            1
  healthcar             0            0            1            0
  hospit                1            0            1            0
  pollut                0            1            0            1
  smog                  0            1            0            0
  water                 0            0            0            1
```

.   (4 , 4) (: `environment` - `environ`).

/ (,) .

: https://riptutorial.com/ko/r/topic/10119/--

105: % <> % : ?

NAMESPACE .

Examples

. " `zzz.R` `utils.R` . , :

```
#' Pipe operator
#'
#' @name %>%
#' @rdname pipe
#' @keywords internal
#' @export
#' @importFrom magrittr %>%
#' @usage lhs \%>\% rhs
NULL
```

% <> % : ? : https://riptutorial.com/ko/r/topic/10547/--------lt--gt-------

106: R

" ( ) . .

. , () . .

- Peng, RD (2011). . Science, 334 (6060), 1226-1227] . http://doi.org/10.1126/science.1213847
- Peng, Roger D. R. Leanpub, 2015. . https://leanpub.com/reportwriting .

Examples

`dput()` `dget()`

( ) `dput()` . R .

: . getwd() ?setwd .

```
dput(mtcars, file = 'df.txt')
```

`dget()` R GlobalEnvironment .

```
df <- dget('df.txt')
```

R . .

R . . R . `checkpoint` .

2014-09-17 CRAN Microsoft R Archived Network . R .

1. (R) .
2. `checkpoint::checkpoint('YYYY-MM-DD')` .

`checkpoint` R_home (`"~/"`) `.checkpoint` . . , `checkpoint` `.R` `library()` `require()` CRAN .

PRO .
CONTRA . .

R : https://riptutorial.com/ko/r/topic/4087/--r

107:

R ?

.

.

```
c(1,2,3) + c(1,2,3,4,5,6)
[1] 2 4 6 5 7 9
```

.

```
c(1,2,3,1,2,3) + c(1,2,3,4,5,6)
```

.

```
c(1,2,3) + c(1,2,3,4,5,6,7)
[1] 2 4 6 5 7 9 8
Warning message:
In c(1, 2, 3) + c(1, 2, 3, 4, 5, 6, 7) :
  longer object length is not a multiple of shorter object length
```

:

```
matrix(nrow =5, ncol = 2, 1:5 )
     [,1] [,2]
[1,]    1    1
[2,]    2    2
[3,]    3    3
[4,]    4    4
[5,]    5    5
```

Examples

.

.

```
my_vec <-   c(1,2,3,4,5,6,7,8,9,10)
my_vec[c(TRUE, FALSE)]

[1] 1 3 5 7 9
```

.

.

```
my_vec <-   c("foo", "bar", "soap", "mix")
```

```
my_vec == "bar"

[1] FALSE  TRUE FALSE FALSE
```

"" .

: https://riptutorial.com/ko/r/topic/5649/

108: ()

("regex" "regexp") . R ?regex Regex Docs . SO / " R-regex pattern .

- "[AB]" A B .
- "[[:alpha:]]"
- "[[:lower:]]" . "[az]" . : ú .
- "[[:upper:]]" . "[AZ]" (: Ú .
- "[[:digit:]]" 0, 1, 2, ... 9 "[0-9]" .

+ , * ? . - + , * 0 ? 0 1 .

.

- "^..." .
- "...$" .

R .

- R - ("\" R). \s R \\s .
- R UTF-8 U . [\U{1F600}] [\U1F600] match , Ruby u .

reg101 R .

R Programmming wikibook .

Examples

```
string <- '    some text on line one;
and then some text on line two     '
```

" " . . gsub .

R 3.2.0

```
gsub(pattern = "(^ +| +$)",
     replacement = "",
     x = string)

[1] "some text on line one; \nand then some text on line two"
```

R 3.2.0

```
trimws(x = string)

[1] "some text on line one; \nand then some text on line two"
```

R 3.2.0

```
sub(pattern = "^ +",
    replacement = "",
    x = string)

[1] "some text on line one; \nand then some text on line two     "
```

R 3.2.0

```
trimws(x = string,
       which = "left")

[1] "some text on line one; \nand then some text on line two     "
```

R 3.2.0

```
sub(pattern = " +$",
    replacement = "",
    x = string)

[1] "    some text on line one; \nand then some text on line two"
```

R 3.2.0

```
trimws(x = string,
       which = "right")

[1] "    some text on line one; \nand then some text on line two"
```

```
gsub(pattern = "\\s",
     replacement = "",
     x = string)

[1] "sometextonlineone;andthensometextonlinetwo"
```

(`\t`), (`\r` `\n`) .

"YYYYMMDD"

`YYYYMMDD` (: `20170101_results.csv` . .

```
\\d{4}(0[1-9]|1[012])(0[1-9]|[12][0-9]|3[01])
```

: 0000-9999 , 01-12 01-31 01-31 .

:

```
> grepl("\\d{4}(0[1-9]|1[012])(0[1-9]|[12][0-9]|3[01])", "20170101")
[1] TRUE
> grepl("\\d{4}(0[1-9]|1[012])(0[1-9]|[12][0-9]|3[01])", "20171206")
[1] TRUE
> grepl("\\d{4}(0[1-9]|1[012])(0[1-9]|[12][0-9]|3[01])", "29991231")
[1] TRUE
```

: (: 20170229 (2017).

```
> grepl("\\d{4}(0[1-9]|1[012])(0[1-9]|[12][0-9]|3[01])", "20170229")
[1] TRUE
```

.

```
is.Date <- function(x) {return(!is.na(as.Date(as.character(x), format = '%Y%m%d')))}
```

```
> is.Date(c("20170229", "20170101", 20170101))
[1] FALSE  TRUE  TRUE
```

regex 50 Commonwealth / Territory (www.50states.com).

```
regex <-
"(A[LKSZR])|(C[AOT])|(D[EC])|(F[ML])|(G[AU])|(HI)|(I[DLNA])|(K[SY])|(LA)|(M[EHDAINSOT])|(N[EVHJMYCD])|(M
```

:

```
> test <- c("AL", "AZ", "AR", "AJ", "AS", "DC", "FM", "GU","PW", "FL", "AJ", "AP")
> grepl(us.states.pattern, test)
 [1]  TRUE  TRUE  TRUE FALSE  TRUE  TRUE  TRUE  TRUE  TRUE  TRUE FALSE FALSE
>
```

:

50 state.abb R- state.abb from state (:

```
> data(state)
> test %in% state.abb
[1]  TRUE  TRUE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE  TRUE FALSE FALSE
```

AL, AZ, AR, FL 50 TRUE .

.

```
us.phones.regex <- "^\\s*(\\+\\s*1(-?|\\s+))*[0-9]{3}\\s*-?\\s*[0-9]{3}\\s*-?\\s*[0-9]{4}$"
```

+1-xxx-xxx-xxxx . / / ( ) (: +1-xxx-xxx-xx xx . - : xxx xxx xxx : xxxxxxxxxx . +1 .

:

```
us.phones.regex <- "^\\s*(\\+\\s*1(-?|\\s+))*[0-9]{3}\\s*-?\\s*[0-9]{3}\\s*-?\\s*[0-9]{4}$"

phones.OK <- c("305-123-4567", "305 123 4567", "+1-786-123-4567",
    "+1 786 123 4567", "7861234567", "786 - 123   4567", "+ 1 786 - 123   4567")

phones.NOK <- c("124-456-78901", "124-456-789", "124-456-78 90",
    "124-45 6-7890", "12 4-456-7890")
```

:

```
> grepl(us.phones.regex, phones.OK)
[1] TRUE TRUE TRUE TRUE TRUE TRUE TRUE
>
```

:

```
 > grepl(us.phones.regex, phones.NOK)
[1] FALSE FALSE FALSE FALSE FALSE
>
```

:

- `\\s` , .

R

R `"\"` `grep` , `sub` , `gsub` . 3 4 . . .

```
x <- c( "a\nb", "c\td", "e    f")
x  # how it's stored
   #  [1] "a\nb"   "c\td"   "e    f"
cat(x)   # how it will be seen with cat
#a
#b c    d e    f

gsub(patt="\\n|\\t", repl="    ", x)
#[1] "a    b" "c    d" "e    f"
```

( ) . . 4 .

```
gsub("\\n|    ", "\t", x)
#[1] "a\tb" "c\td" "e\tf"
```

Perl POSIX

R . POSIX . R . `perl = TRUE` .

/

`perl = TRUE` look-ahead look-behind .

- `"(?<=A)B"` B , A `"ABACADABRA"` , `"abacadabra"` `"aBacadabra"` .

() : https://riptutorial.com/ko/r/topic/5748/---

109:

for . for .

```
for ( [index] in [domain]){
  [body]
}
```

1. [index] [domain] .
2. [domain] .
3. [body] .

, for .

```
x <- 1:4
cumulative_sum <- 0
for (i in x){
  cumulative_sum <- cumulative_sum + x[i]
}
cumulative_sum
```

For

For . , apply . for . , for .

' 'for . .

```
[output] <- [vector_of_length]
for ([index] in [length_safe_domain]){
  [output][index] <- [body]
}
```

(. " x_squared <- x^2).

```
x <- 1:100
x_squared <- vector("numeric", length = length(x))
for (i in seq_along(x)){
  x_squared[i] <- x[i]^2
}
```

, x_squared x "numeric" x_squared . seq_along " " . seq_along for . for (i in 1:length(x)) , x 0 1:0 (0 R).).

apply for apply . for .

For . .

`mtcars` for (`colMeans`).

```
column_mean_loop <- vector("numeric", length(mtcars))
for (k in seq_along(mtcars)){
  column_mean_loop[k] <- mean(mtcars[[k]])
}
```

for .

```
col_mean_fn <- function(x) mean(x)
column_mean_apply <- vapply(mtcars, col_mean_fn, numeric(1))
```

.

```
identical(column_mean_loop,
          unname(column_mean_apply)) #* vapply added names to the elements
                                     #* remove them for comparison
```

. apply . . .

Examples

(`mtcars` .

A :

```
squared_deviance <- vector("list", length(mtcars))
for (i in seq_along(mtcars)){
  squared_deviance[[i]] <- (mtcars[[i]] - mean(mtcars[[i]]))^2
}
```

`squared_deviance` 11 .

```
class(squared_deviance)
length(squared_deviance)
```

B :

```
squared_deviance <- vector("list", length(mtcars))
Squared_deviance <- setNames(squared_deviance, names(mtcars))
for (k in names(mtcars)){
  squared_deviance[[k]] <- (mtcars[[k]] - mean(mtcars[[k]]))^2
}
```

`data.frame` ? , . `data.frame` `for` .

```
squared_deviance <- mtcars #copy the original
squared_deviance[TRUE]<-NA  #replace with NA or do squared_deviance[,]<-NA
for (i in seq_along(mtcars)){
  squared_deviance[[i]] <- (mtcars[[i]] - mean(mtcars[[i]]))^2
}
```

```
dim(squared_deviance)
[1] 32 11
```

(B) .

For

.

1. for for
2. for
3. `*apply`
4. `colMeans`

. . .

.

```
column_mean_poor <- NULL
for (i in 1:length(mtcars)){
  column_mean_poor[i] <- mean(mtcars[[i]])
}
```

```
column_mean_optimal <- vector("numeric", length(mtcars))
for (i in seq_along(mtcars)){
  column_mean_optimal <- mean(mtcars[[i]])
}
```

`vapply`

```
column_mean_vapply <- vapply(mtcars, mean, numeric(1))
```

`colMeans`

```
column_mean_colMeans <- colMeans(mtcars)
```

( )

```
Unit: microseconds
     expr     min       lq     mean   median       uq     max neval  cld
     poor 240.986 262.0820 287.1125 275.8160 307.2485 442.609   100    d
  optimal 220.313 237.4455 258.8426 247.0735 280.9130 362.469   100   c
   vapply 107.042 109.7320 124.4715 113.4130 132.6695 202.473   100 a
 colMeans 155.183 161.6955 180.2067 175.0045 194.2605 259.958   100  b
```

`for` `for` . for .

for .

vapply . ( ).

colMeans vapply . colMeans as.matrix (mtcars A data.frame) vapply .

: while repeat

R while repeat .

---

while

while .

```
while (condition) {
    ## do something
    ## in loop body
}
```

condition . condition TRUE condition FALSE (break). for while . .

```
for (i in 0:4) {
    cat(i, "\n")
}
# 0
# 1
# 2
# 3
# 4

i <- 0
while (i < 5) {
    cat(i, "\n")
    i <- i + 1
}
# 0
# 1
# 2
# 3
# 4
```

while i <- i + 1 .

---

break while .

```
iter <- 0
while (TRUE) {
    if (runif(1) < 0.25) {
        break
    } else {
        iter <- iter + 1
    }
```

```
}
iter
#[1] 4
```

condition TRUE break . iter PRNG () .

---

repeat

repeat while (TRUE) { ## something } .

```
repeat ({
    ## do something
    ## in loop body
})
```

{} () . repeat ,

```
iter <- 0
repeat ({
    if (runif(1) < 0.25) {
        break
    } else {
        iter <- iter + 1
    }
})
iter
#[1] 2
```

---

break break

break . , .

```
while (TRUE) {
    while (TRUE) {
        cat("inner loop\n")
        break
    }
    cat("outer loop\n")
}
```

. , .

```
while (TRUE) {
    cat("outer loop body\n")
    while (TRUE) {
        cat("inner loop body\n")
        x <- runif(1)
        if (x < .3) {
            break
        } else {
            cat(sprintf("x is %.5f\n", x))
```

```
        }
    }
}
```

break return . return break return() .

```
(function() {
    while (TRUE) {
        cat("outer loop body\n")
        while (TRUE) {
            cat("inner loop body\n")
            x <- runif(1)
            if (x < .3) {
                return()
            } else {
                cat(sprintf("x is %.5f\n", x))
            }
        }
    }
})()
```

(exit) <<- .

```
exit <- FALSE
while (TRUE) {
    cat("outer loop body\n")
    while (TRUE) {
        cat("inner loop body\n")
        x <- runif(1)
        if (x < .3) {
            exit <<- TRUE
            break
        } else {
            cat(sprintf("x is %.5f\n", x))
        }
    }
    if (exit) break
}
```

: https://riptutorial.com/ko/r/topic/2201/--

110:

. , R . R . set , `setdiff` , `intersect` , `union` , `setequal` `%in%` . `v %in% S` `S` `v` .

R , Rcpp .

Examples

R .

```
v = "A"
w = c("A", "A")
```

. R .

```
setequal(v, w)
# TRUE
```

:

```
x = c(1, 2, 3)
y = c(2, 4)

union(x, y)
# 1 2 3 4

intersect(x, y)
# 2

setdiff(x, y)
# 1 3
```

`, ?union .`

`%in%` .

```
v = "A"
w = c("A", "A")

w %in% v
# TRUE TRUE

v %in% w
# TRUE
```

( ).

%in% TRUE FALSE FALSE .

```
c(1, NA) %in% c(1, 2, 3, 4)
# TRUE FALSE
```

?`%in%` .

""

(x, y) x X Y Y expand.grid expand.grid expand.grid :

```
X = c(1, 1, 2)
Y = c(4, 5)

expand.grid(X, Y)

#   Var1 Var2
# 1    1    4
# 2    1    4
# 3    2    4
# 4    1    5
# 5    1    5
# 6    2    5
```

data.frame. "" . unique lapply do.call .

```
m = do.call(expand.grid, lapply(list(X, Y), unique))

#   Var1 Var2
# 1    1    4
# 2    2    4
# 3    1    5
# 4    2    5
```

---

f(x,y) .

```
m$p = with(m, Var1*Var2)
#   Var1 Var2  p
# 1    1    4  4
# 2    2    4  8
# 3    1    5  5
# 4    2    5 10
```

, 2 . outer .

```
uX = unique(X)
uY = unique(Y)

outer(setNames(uX, uX), setNames(uY, uY), `*`)

#   4  5
# 1 4  5
```

```
# 2 8 10
```

.

/ /

`unique` ( ).

```
x = c(2, 1, 1, 2, 1)

unique(x)
# 2 1
```

.

`duplicated` `duplicated` :

```
duplicated(x)
# FALSE FALSE TRUE TRUE TRUE
```

`anyDuplicated(x) > 0L` .

/

.

```
xtab_set <- function(A, B){
    both    <-  union(A, B)
    inA     <-  both %in% A
    inB     <-  both %in% B
    return(table(inA, inB))
}

A = 1:20
B = 10:30

xtab_set(A, B)

#         inB
# inA     FALSE TRUE
#   FALSE     0   10
#   TRUE      9   11
```

Venn .

: https://riptutorial.com/ko/r/topic/1383/-

111: I / O ( )

.

Examples

rgdal rgdal rgdal . readOGR readOGR . ArcGIS dsn shapefile . layer shapefile (map map.shp).

```
library(rgdal)
readOGR(dsn = "path\to\the\folder\containing\the\shapefile", layer = "map")
```

shapefile writeOGR . R. dsn layer . obligatory 4. . ogrDrivers() . shapfile ArcGis QGis driver = "ESRI Shapefile" .

```
writeOGR(Rmap, dsn = "path\to\the\folder\containing\the\shapefile", layer = "map",
         driver = "ESRI Shapefile" )
```

---

tmap rgdal::reagOGR() read_shape() . read_shape() read_shape() . tmap .

I / O ( ) : https://riptutorial.com/ko/r/topic/5538/---i---o-----

112:

I / O

Examples

map ()

`maps` `map()` R .

:

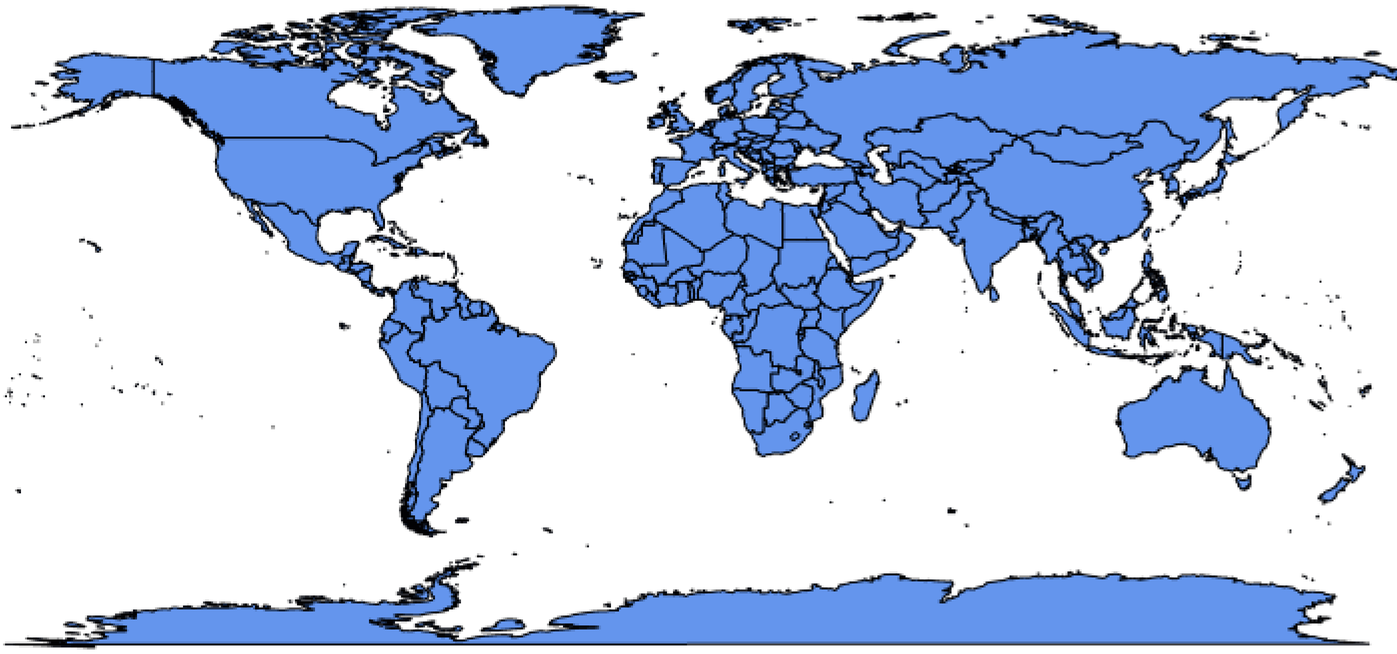
```
require(maps)
map()
```

`col` 16 .

```
require(maps)
map(col = "cornflowerblue")
```

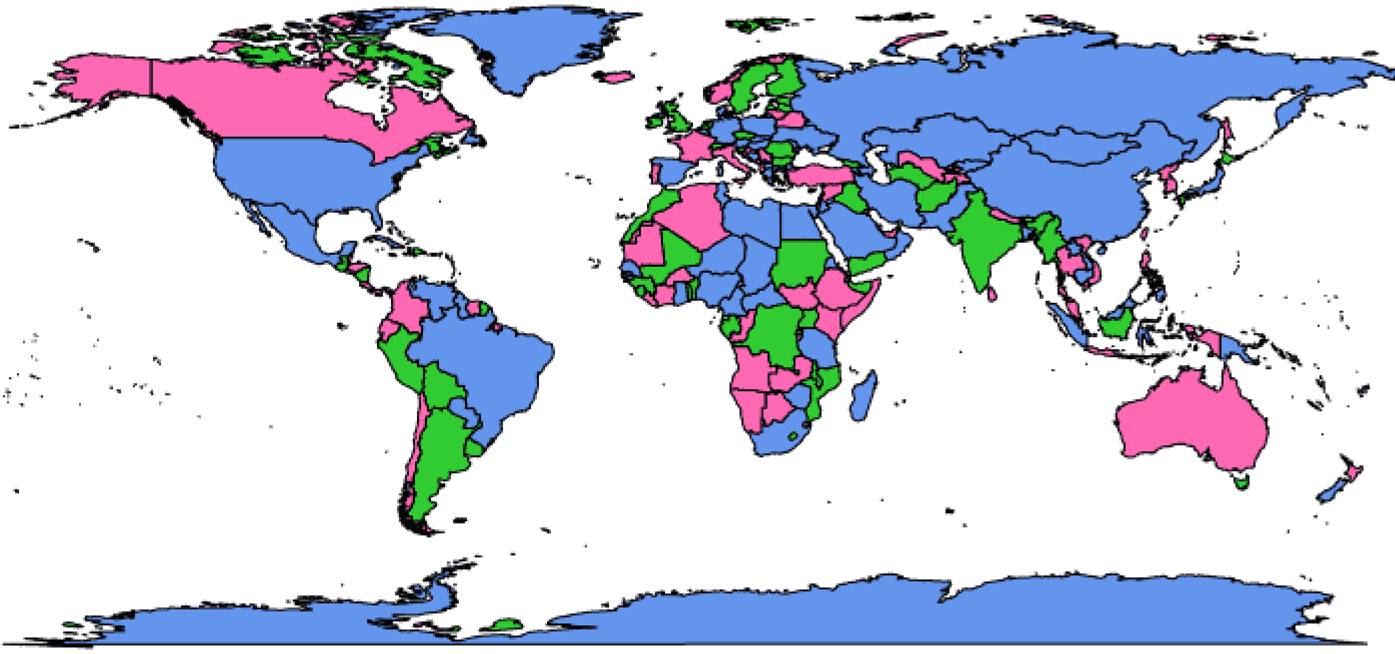
col fill = TRUE .

```
require(maps)
map(fill = TRUE, col = c("cornflowerblue"))
```



fill = TRUE , col .

```
require(maps)
map(fill = TRUE, col = c("cornflowerblue", "limegreen", "hotpink"))
```



col .

. "choropleth" .

choropleth database "county" "state" map() unemp county.fips "state" .

```
require(maps)
if(require(mapproj)) {    # mapproj is used for  projection="polyconic"
  # color US county map by 2009 unemployment rate
  # match counties to map using FIPS county codes
  # Based on J's solution to the "Choropleth Challenge"
  # Code improvements by Hack-R (hack-r.github.io)

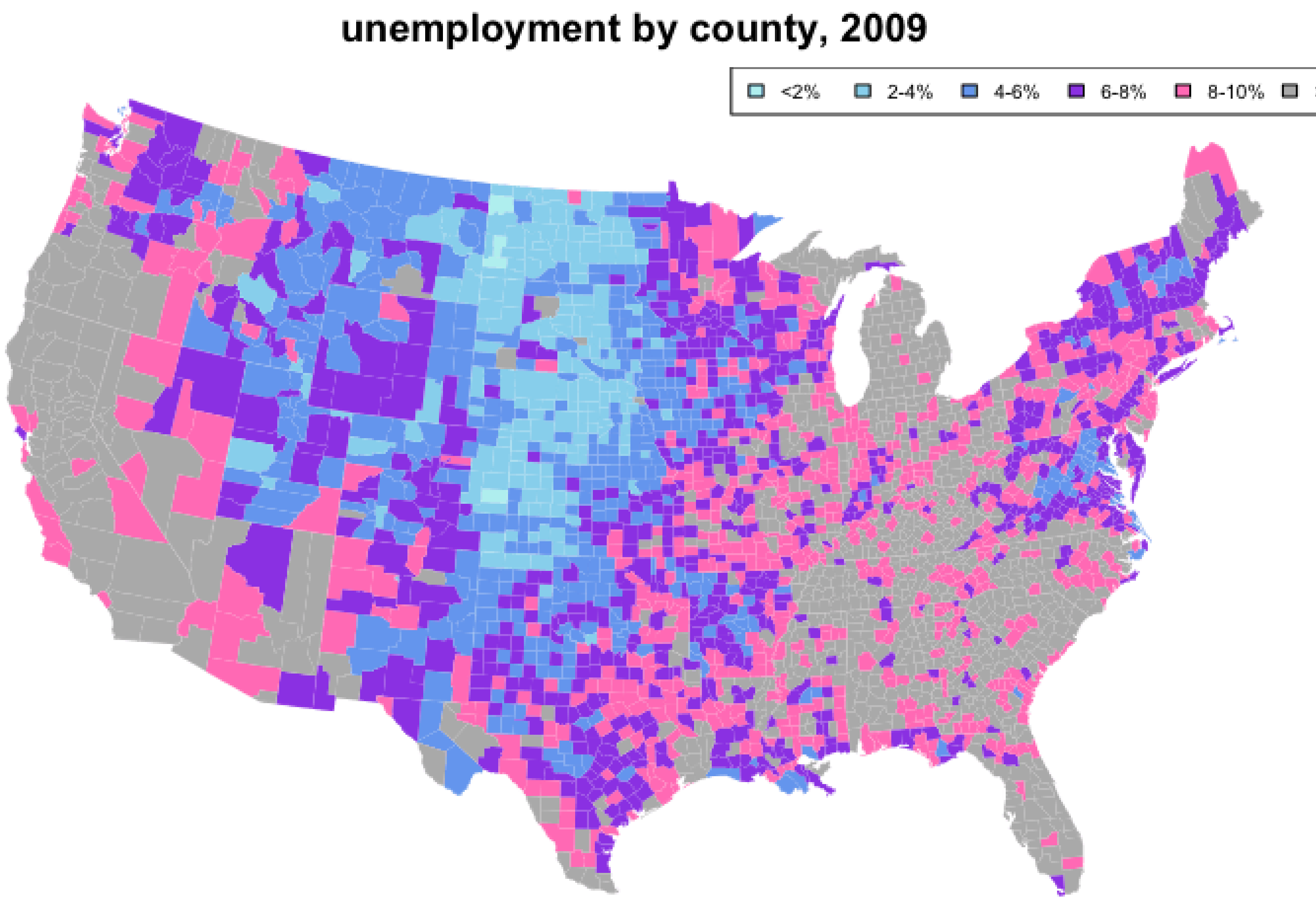
  # load data
  # unemp includes data for some counties not on the "lower 48 states" county
  # map, such as those in Alaska, Hawaii, Puerto Rico, and some tiny Virginia
  #  cities
  data(unemp)
  data(county.fips)

  # define color buckets
  colors = c("paleturquoise", "skyblue", "cornflowerblue", "blueviolet", "hotpink",
"darkgrey")
  unemp$colorBuckets <- as.numeric(cut(unemp$unemp, c(0, 2, 4, 6, 8, 10, 100)))
  leg.txt <- c("<2%", "2-4%", "4-6%", "6-8%", "8-10%", ">10%")

  # align data with map definitions by (partial) matching state,county
  # names, which include multiple polygons for some counties
```

```
  cnty.fips <- county.fips$fips[match(map("county", plot=FALSE)$names,
                                    county.fips$polyname)]
  colorsmatched <- unemp$colorBuckets[match(cnty.fips, unemp$fips)]

  # draw map
  par(mar=c(1, 1, 2, 1) + 0.1)
  map("county", col = colors[colorsmatched], fill = TRUE, resolution = 0,
      lty = 0, projection = "polyconic")
  map("state", col = "white", fill = FALSE, add = TRUE, lty = 1, lwd = 0.1,
      projection="polyconic")
  title("unemployment by county, 2009")
  legend("topright", leg.txt, horiz = TRUE, fill = colors, cex=0.6)
}
```



Google Viz 50

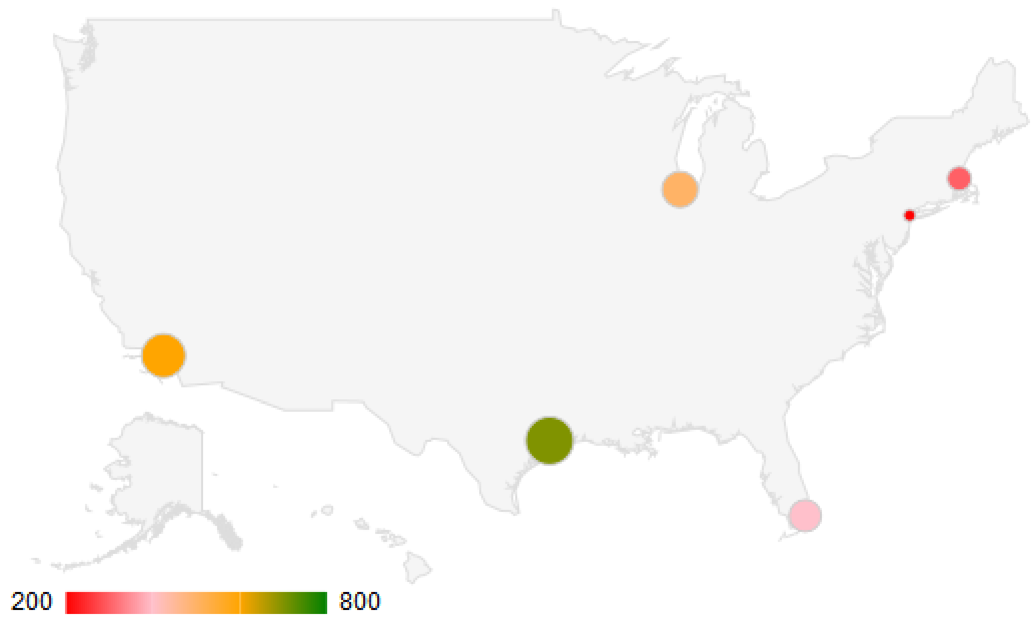
50 ( ) choropleth () .

50 Google . Google API `googleVis` , `ggmap` `RgoogleMaps` .

```
require(googleVis)

G4 <- gvisGeoChart(CityPopularity, locationvar='City', colorvar='Popularity',
                   options=list(region='US', height=350,
                                displayMode='markers',
                                colorAxis="{values:[200,400,600,800],
                                 colors:[\'red', \'pink\', \'orange',\'green']}")
```

```
)
plot(G4)
```

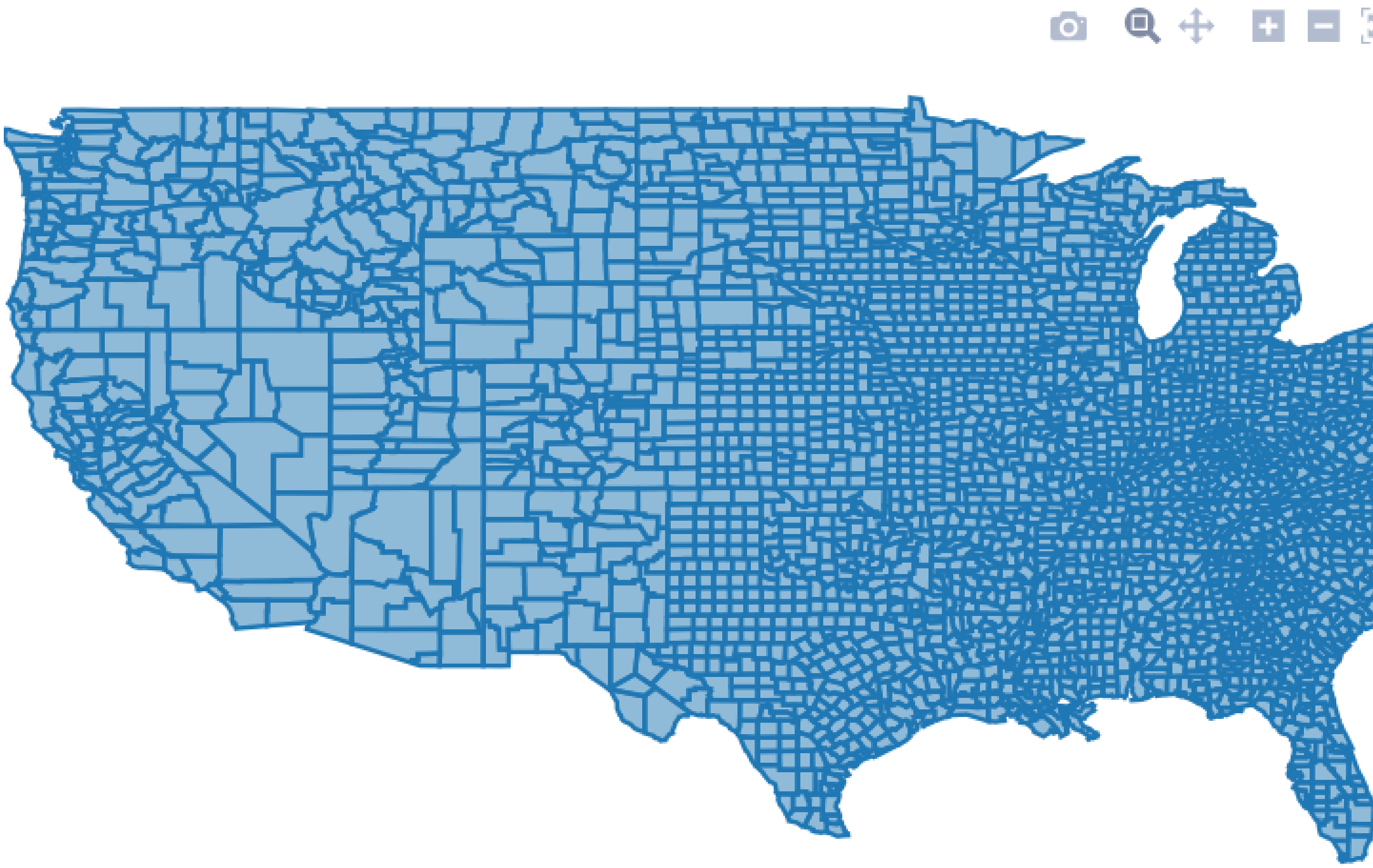


Data: CityPopularity • Chart ID: GeoChartID28504adb439a • googleVis-0.5.2
R version 3.1.0 (2014-04-10) • Google Terms of Use • Documentation and Data Policy

`gvisGeoChart()` `maps` `map()` choropleth `maps` . `colorvar` `locationvar` `colorvar` . `options` (`height`), (`markers`) (`colors` `colorAxis` `colors`) .

`plotly` , . `plotly` . (`plot_ly()` `ggplotly()`), plotly "" (`plot_geo()` `plot_mapbox()`), . .

```
library(plotly)
map_data("county") %>%
    group_by(group) %>%
    plot_ly(x = ~long, y = ~lat) %>%
    add_polygons() %>%
    layout(
        xaxis = list(title = "", showgrid = FALSE, showticklabels = FALSE),
        yaxis = list(title = "", showgrid = FALSE, showticklabels = FALSE)
    )
```



plot_geo() plot_mapbox() plot_ly() plot_ly() . .

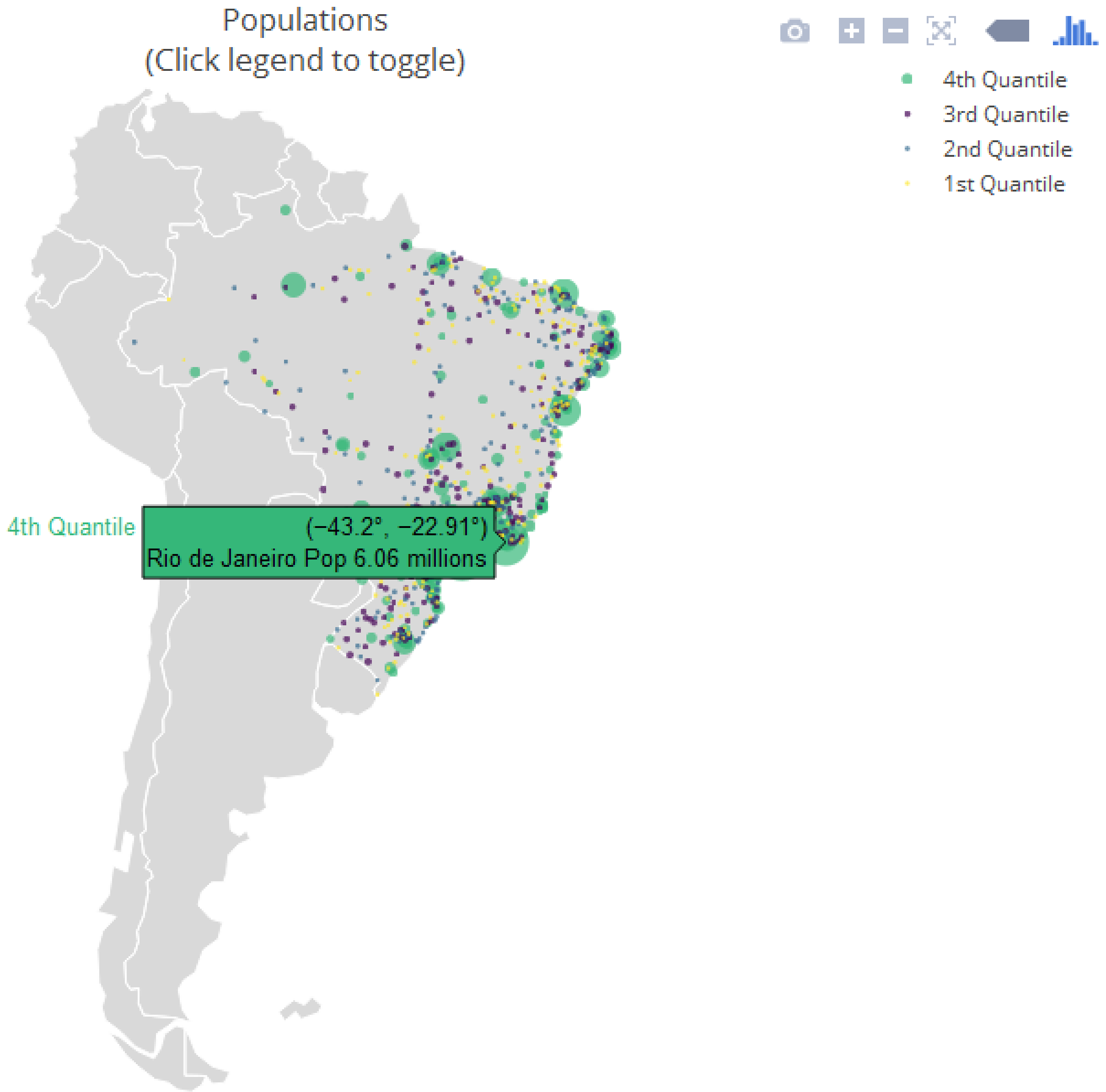
layout.geo / " " . maps world.cities "" .

: poph (poph . q quantile . ge . .

```
library(maps)
dfb <- world.cities[world.cities$country.etc=="Brazil",]
library(plotly)
dfb$poph <- paste(dfb$name, "Pop", round(dfb$pop/1e6,2), " millions")
dfb$q <- with(dfb, cut(pop, quantile(pop), include.lowest = T))
levels(dfb$q) <- paste(c("1st", "2nd", "3rd", "4th"), "Quantile")
dfb$q <- as.ordered(dfb$q)

ge <- list(
  scope = 'south america',
  showland = TRUE,
  landcolor = toRGB("gray85"),
  subunitwidth = 1,
  countrywidth = 1,
  subunitcolor = toRGB("white"),
  countrycolor = toRGB("white")
)

plot_geo(dfb, lon = ~long, lat = ~lat, text = ~poph,
    marker = ~list(size = sqrt(pop/10000) + 1, line = list(width = 0)),
    color = ~q, locationmode = 'country names') %>%
layout(geo = ge, title = 'Populations<br>(Click legend to toggle)')
```



HTML

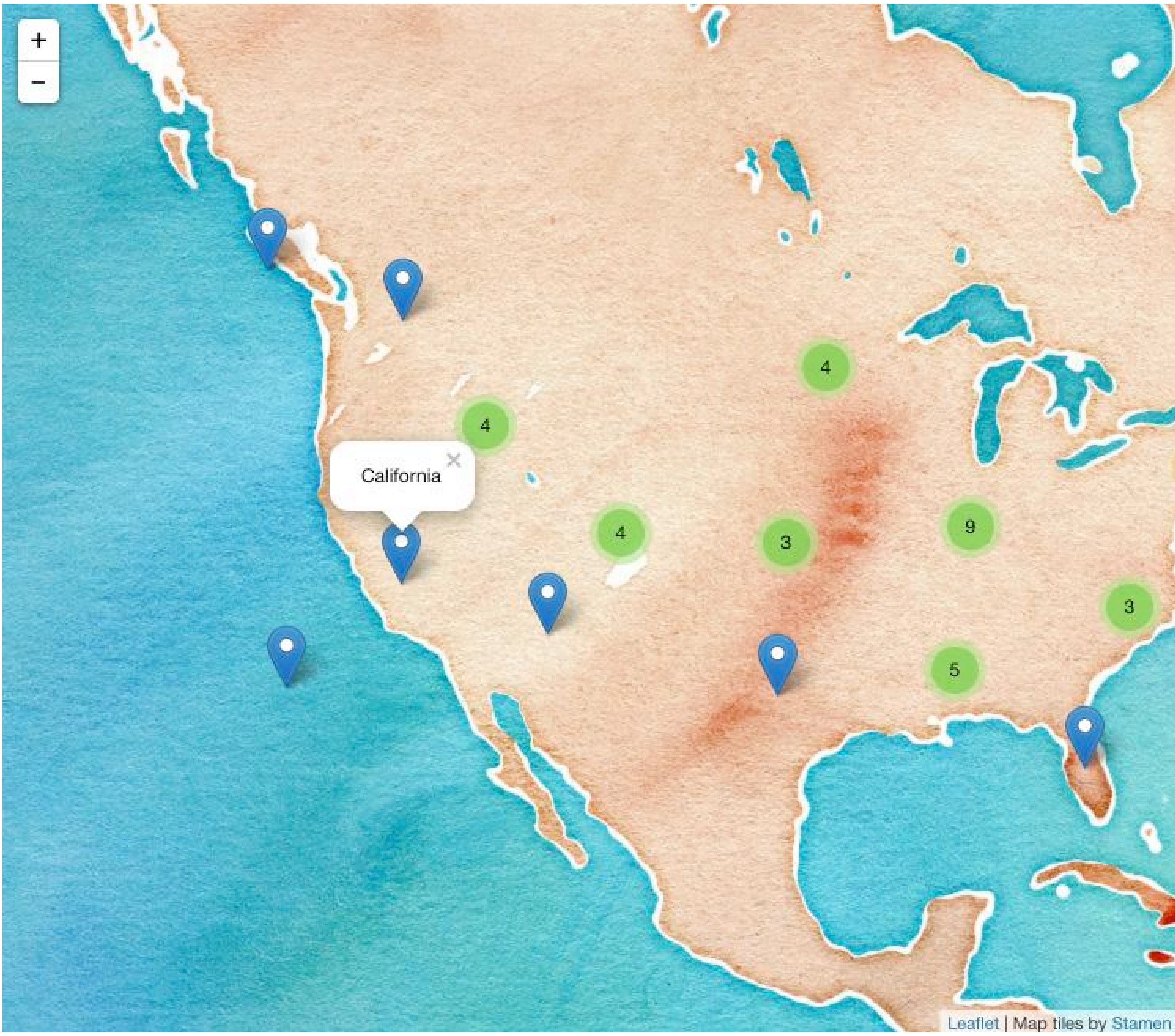
. RStudio htmlwidgets `leaflet` `htmlwidgets` . RMarkdown Shiny .

`leaflet()` ( ) . . (choropleth) . `leaflet()` data.frame function-style ~ quotation .

`state.name` `state.center` :

```
library(leaflet)

data.frame(state.name, state.center) %>%
    leaflet() %>%
    addProviderTiles('Stamen.Watercolor') %>%
    addMarkers(lng = ~x, lat = ~y,
               popup = ~state.name,
               clusterOptions = markerClusterOptions())
```



(, .)

Dynamic Leaflet

Shiny .

ui `leafletOutput()` `renderLeaflet()` .

```
library(shiny)
library(leaflet)

ui <- fluidPage(
    leafletOutput("my_leaf")
)

server <- function(input, output, session){

    output$my_leaf <- renderLeaflet({
```

```
        leaflet() %>%
            addProviderTiles('Hydda.Full') %>%
            setView(lat = -37.8, lng = 144.8, zoom = 10)

    })

}

shinyApp(ui, server)
```

renderLeaflet .

leafletProxy() .

leaflet leafletProxy . .

```
library(shiny)
library(leaflet)

ui <- fluidPage(
    sliderInput(inputId = "slider",
                label = "values",
                min = 0,
                max = 100,
                value = 0,
                step = 1),
    leafletOutput("my_leaf")
)

server <- function(input, output, session){
    set.seed(123456)
    df <- data.frame(latitude = sample(seq(-38.5, -37.5, by = 0.01), 100),
                     longitude = sample(seq(144.0, 145.0, by = 0.01), 100),
                     value = seq(1,100))

    ## create static element
    output$my_leaf <- renderLeaflet({

        leaflet() %>%
            addProviderTiles('Hydda.Full') %>%
            setView(lat = -37.8, lng = 144.8, zoom = 8)

    })

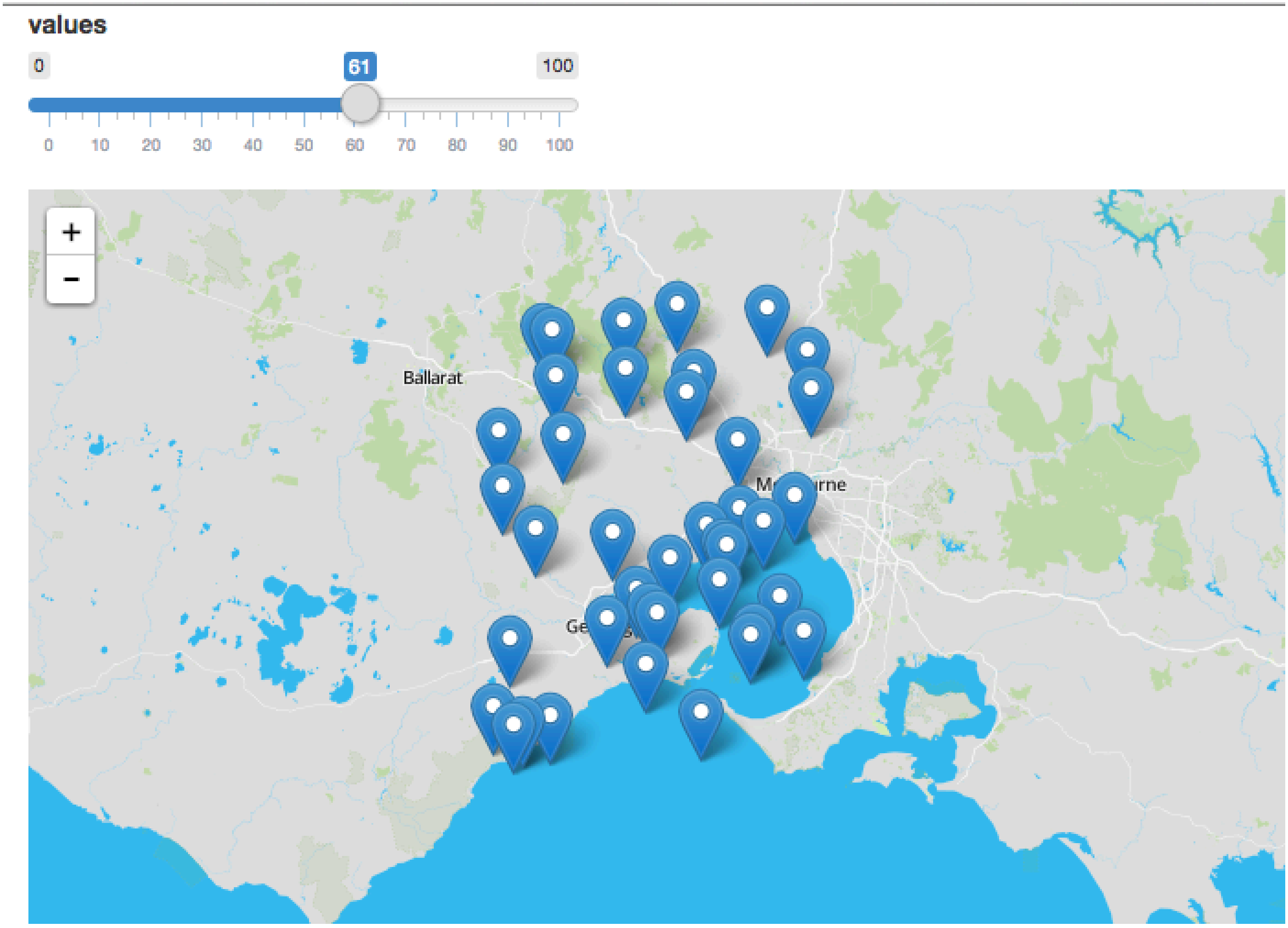
    ## filter data
    df_filtered <- reactive({
        df[df$value >= input$slider, ]
    })

    ## respond to the filtered data
    observe({

        leafletProxy(mapId = "my_leaf", data = df_filtered()) %>%
            clearMarkers() %>%   ## clear previous markers
            addMarkers()
    })

}
```

```
shinyApp(ui, server)
```



: https://riptutorial.com/ko/r/topic/1372/-

113: 2

	.
	- .
importFrom	( )

Examples

roxygen2

roxygen2

roxygen2 Hadley Wickham .

#' R . @ . .

```
#' @author The Author
```

, :

```
mean<-function(x) sum(x)/length(x)
```

( ).

```
#' Mean
#'
#' A function to compute the mean of a vector
#' @param x A numeric vector
#' @keyword mean
#' @importFrom base sum
#' @export
#' @examples
#' mean(1:3)
#' \dontrun{ mean(1:1e99) }
mean<-function(x) sum(x)/length(x)
```

- `#' Mean` , .
- `@param` . `@export` `@export` .
- `@keyword` .
- `@importFrom` . `@import` .

- `@example` .
    - .
    - `\dontrun` - -.

`devtools::document()` . `devtools::check()` .

2 : https://riptutorial.com/ko/r/topic/5171/-2

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R ,   .

R   .   R .

Examples

"table"   (`data.frame` , `table` ,

(plain-text)   ( )   :

:   . getwd()   ?setwd .

```
..w = options()$width
options(width = 500) # reduce text wrapping
sink(file = "mytab.txt")
   summary(mtcars)
sink()
options(width = ..w)
rm(..w)
```

CSV ( )   .

:   . getwd()   ?setwd .

```
write.csv(mtcars, file="mytab.csv")
```

- `knitr::kable`
-
- `tables::tabular`
-
- xtable

`utils` `Sweave`   LaTeX , ,   .

- Knitr RMarkdown

: https://riptutorial.com/ko/r/topic/9039/

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Examples

R CPU (:

```
system.time(print("hello world"))

# [1] "hello world"
#    user  system elapsed
#       0       0       0
```

.

```
system.time({
    library(numbers)
    Primes(1,10^5)
})
```

.

```
fibb <- function (n) {
    if (n < 3) {
        return(c(0,1)[n])
    } else {
        return(fibb(n - 2) + fibb(n -1))
    }
}

system.time(fibb(30))
```

proc.time ()

`proc.time()` CPU (`proc.time()` . .

```
proc.time()

#        user     system    elapsed
#     284.507    120.397 515029.305
```

. :

```
t1 <- proc.time()
fibb <- function (n) {
    if (n < 3) {
        return(c(0,1)[n])
    } else {
        return(fibb(n - 2) + fibb(n -1))
    }
}
print("Time one")
```

```
print(proc.time() - t1)

t2 <- proc.time()
fibb(30)

print("Time two")
print(proc.time() - t2)
```

.

```
source('~/.active-rstudio-document')

# [1] "Time one"
#    user  system elapsed
#       0       0       0

# [1] "Time two"
#    user  system elapsed
#   1.534   0.012   1.572
```

`system.time()` / `proc.time()` .

```
print(t1 <- system.time(replicate(1000,12^2)))
##  user  system elapsed
## 0.000   0.000   0.002
```

`proc.time` .

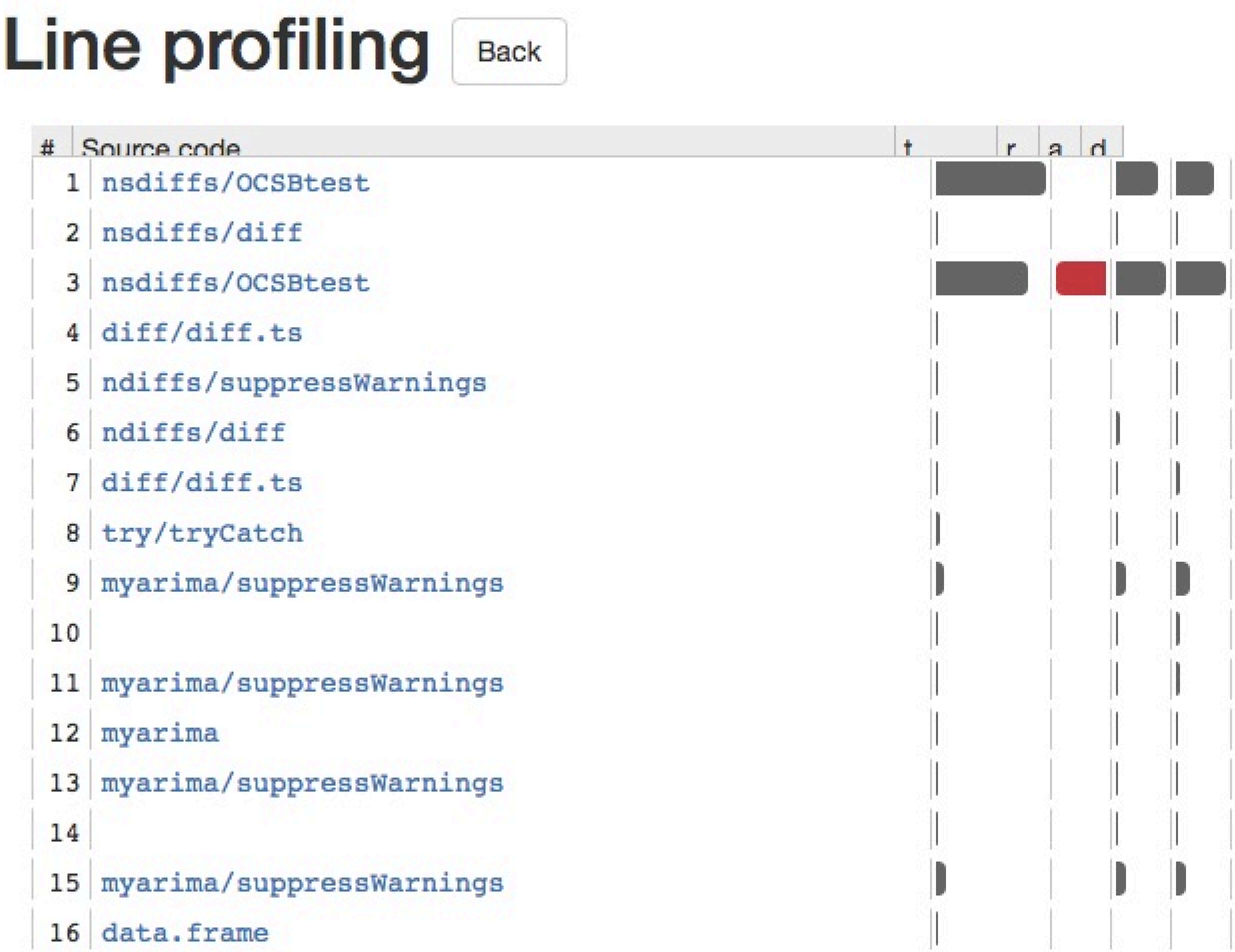
```
str(t1)
## Class 'proc_time'  Named num [1:5] 0 0 0.002 0 0
##  ..- attr(*, "names")= chr [1:5] "user.self" "sys.self" "elapsed" "user.child" ...
```

Hadley Wickham lineprof . `auto.arima` .

```
library(lineprof)
library(forecast)

l <- lineprof(auto.arima(AirPassengers))
shine(l)
```

. R . .



Microbenchmark . , .

```
system.time(print("hello world"))

# [1] "hello world"
#    user  system elapsed
#       0       0       0
```

`system.time` `proc.time` `proc.time` . "hello world" 1 1 . . .

```
library(microbenchmark)
microbenchmark(print("hello world"))

# Unit: microseconds
#                  expr    min     lq     mean  median     uq     max neval
# print("hello world") 26.336 29.984 44.11637 44.6835 45.415 158.824   100
```

`print("hello world")` 100 44 . "hello world" 100 .

`print("hello world")` `cat("hello world\n")` .

```
microbenchmark(cat("hello world\n"))

# Unit: microseconds
```

```
#                    expr    min      lq     mean median     uq     max neval
# cat("hello world\\n") 14.093 17.6975 23.73829 19.319 20.996 119.382   100
```

cat() print() .

microbenchmark .

```
microbenchmark(print("hello world"), cat("hello world\n"))
# Unit: microseconds
# expr                      min     lq     mean  median     uq     max neval
# print("hello world") 29.122 31.654 39.64255 34.5275 38.852 192.779   100
# cat("hello world\\n")  9.381 12.356 13.83820 12.9930 13.715  52.564   100
```

microbenchmark " " .

6 data.table .

:

id , time status data.table . id . 7 false .

```
library(microbenchmark)
library(data.table)

set.seed(20160723)
dt <- data.table(id = c(rep(seq(1:10000), each = 10)),
                time = c(rep(seq(1:10000), 10)),
                status = c(sample(c(TRUE, FALSE), 10000*10, replace = TRUE)))
setkey(dt, id, time)  ## create copies of the data so the 'updates-by-reference' don't affect
other expressions
dt1 <- copy(dt)
dt2 <- copy(dt)
dt3 <- copy(dt)
dt4 <- copy(dt)
dt5 <- copy(dt)
dt6 <- copy(dt)

microbenchmark(

  expression_1 = {
    dt1[ dt1[order(time), .I[.N], by = id]$V1, status := status * time < 7 ]
    },

  expression_2 = {
    dt2[,status := c(.SD[-.N, status], .SD[.N, status * time > 7]), by = id]
    },

  expression_3 = {
    dt3[dt3[,.N, by = id][,cumsum(N)], status := status * time > 7]
    },

  expression_4 = {
    y <- dt4[,.SD[.N],by=id]
    dt4[y, status := status & time > 7]
  },

  expression_5 = {
```

```
    y <- dt5[, .SD[.N, .(time, status)], by = id][time > 7 & status]
    dt5[y, status := FALSE]
  },

  expression_6 = {
    dt6[ dt6[, .I == .I[which.max(time)], by = id]$V1 & time > 7, status := FALSE]
    },

  times = 10L ## specify the number of times each expression is evaluated
)

# Unit: milliseconds
#          expr         min          lq        mean      median         uq          max neval
# expression_1   11.646149   13.201670   16.808399   15.643384   18.78640    26.321346    10
# expression_2 8051.898126 8777.016935 9238.323459 8979.553856 9281.93377 12610.869058    10
# expression_3    3.208773    3.385841    4.207903    4.089515    4.70146     5.654702    10
# expression_4   15.758441   16.247833   20.677038   19.028982   21.04170    36.373153    10
# expression_5 7552.970295 8051.080753 8702.064620 8861.608629 9308.62842  9722.234921    10
# expression_6   18.403105   18.812785   22.427984   21.966764   24.66930    28.607064    10
```

`expression_3` .

data.table -

data.table - data.table

: https://riptutorial.com/ko/r/topic/2149/--

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Examples

combn .

```
combn(LETTERS, 3)

# Showing only first 10.
     [,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8] [,9] [,10]
[1,] "A"  "A"  "A"  "A"  "A"  "A"  "A"  "A"  "A"  "A"
[2,] "B"  "B"  "B"  "B"  "B"  "B"  "B"  "B"  "B"  "B"
[3,] "C"  "D"  "E"  "F"  "G"  "H"  "I"  "J"  "K"  "L"
```

expand.grid .

```
expand.grid(LETTERS, LETTERS, LETTERS)
# or
do.call(expand.grid, rep(list(LETTERS), 3))

# Showing only first 10.
   Var1 Var2 Var3
1     A    A    A
2     B    A    A
3     C    A    A
4     D    A    A
5     E    A    A
6     F    A    A
7     G    A    A
8     H    A    A
9     I    A    A
10    J    A    A
```

, outer .

```
# FUN here is used as a function executed on each resulting pair.
# in this case it's string concatenation.
outer(LETTERS, LETTERS, FUN=paste0)

# Showing only first 10 rows and columns
      [,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8] [,9] [,10]
 [1,] "AA" "AB" "AC" "AD" "AE" "AF" "AG" "AH" "AI" "AJ"
 [2,] "BA" "BB" "BC" "BD" "BE" "BF" "BG" "BH" "BI" "BJ"
 [3,] "CA" "CB" "CC" "CD" "CE" "CF" "CG" "CH" "CI" "CJ"
 [4,] "DA" "DB" "DC" "DD" "DE" "DF" "DG" "DH" "DI" "DJ"
 [5,] "EA" "EB" "EC" "ED" "EE" "EF" "EG" "EH" "EI" "EJ"
 [6,] "FA" "FB" "FC" "FD" "FE" "FF" "FG" "FH" "FI" "FJ"
 [7,] "GA" "GB" "GC" "GD" "GE" "GF" "GG" "GH" "GI" "GJ"
 [8,] "HA" "HB" "HC" "HD" "HE" "HF" "HG" "HH" "HI" "HJ"
 [9,] "IA" "IB" "IC" "ID" "IE" "IF" "IG" "IH" "II" "IJ"
[10,] "JA" "JB" "JC" "JD" "JE" "JF" "JG" "JH" "JI" "JJ"
```

```
choose(length(LETTERS), 5)
[1] 65780
```

```
length(letters)^5
[1] 11881376
```

: https://riptutorial.com/ko/r/topic/5836/-

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caret R . . , , , .

caret .

Examples

preProcess() . x preProcess() .

preProcess() method . .

1.
2.
3. Box-Cox / Yeo-Johnson /
4.
5.
6.
7.
8. PCA
9. ICA
10.

mtcars , .

```
auto_index <- createDataPartition(mtcars$mpg, p = .8,
                                  list = FALSE,
                                  times = 1)

mt_train <- mtcars[auto_index,]
mt_test <- mtcars[-auto_index,]

process_mtcars <- preProcess(mt_train, method = c("center","scale","spatialSign"))

mtcars_train_transf <- predict(process_mtcars, mt_train)
mtcars_test_tranf <- predict(process_mtcars,mt_test)
```

: https://riptutorial.com/ko/r/topic/4271/-

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Examples

Rcpp

(`first`) `x_i` `cos(x_{i-1} + 1)` `len` .

```
repeatedCosPlusOne <- function(first, len) {
  x <- numeric(len)
  x[1] <- first
  for (i in 2:len) {
    x[i] <- cos(x[i-1] + 1)
  }
  return(x)
}
```

(`cos(x[i-1]+1)`) for , . R "x + 1 " R .

Rcpp C ++ .

```
library(Rcpp)
cppFunction("NumericVector repeatedCosPlusOneRcpp(double first, int len) {
  NumericVector x(len);
  x[0] = first;
  for (int i=1; i < len; ++i) {
    x[i] = cos(x[i-1]+1);
  }
  return x;
}")
```

.

```
all.equal(repeatedCosPlusOne(1, 1e6), repeatedCosPlusOneRcpp(1, 1e6))
# [1] TRUE
system.time(repeatedCosPlusOne(1, 1e6))
#    user  system elapsed
#   1.274   0.015   1.310
system.time(repeatedCosPlusOneRcpp(1, 1e6))
#    user  system elapsed
#   0.028   0.001   0.030
```

, Rcpp R 1.31 0.03 1 .

Rcpp , `len` (`first`) `x_i` `cos(x_{i-1} + 1)` :

```
repeatedCosPlusOne <- function(first, len) {
  x <- numeric(len)
  x[1] <- first
  for (i in 2:len) {
    x[i] <- cos(x[i-1] + 1)
```

```
  }
  return(x)
}
```

R .

```
library(compiler)
repeatedCosPlusOneCompiled <- cmpfun(repeatedCosPlusOne)
```

.

```
all.equal(repeatedCosPlusOne(1, 1e6), repeatedCosPlusOneCompiled(1, 1e6))
# [1] TRUE
system.time(repeatedCosPlusOne(1, 1e6))
#    user  system elapsed
#   1.175   0.014   1.201
system.time(repeatedCosPlusOneCompiled(1, 1e6))
#    user  system elapsed
#   0.339   0.002   0.341
```

1.20 0.34 1 .

`repeatedCosPlusOne` , `Reduce` :

```
iterFunc <- function(init, n, func) {
  funcs <- replicate(n, func)
  Reduce(function(., f) f(.), funcs, init = init, accumulate = TRUE)
}
repeatedCosPlusOne_vec <- function(first, len) {
  iterFunc(first, len - 1, function(.) cos(. + 1))
}
```

`repeatedCosPlusOne_vec` "" `repeatedCosPlusOne` . 2 .

```
library(microbenchmark)
microbenchmark(
  repeatedCosPlusOne(1, 1e4),
  repeatedCosPlusOne_vec(1, 1e4)
)
#> Unit: milliseconds
#>                               expr       min        lq      mean    median        uq      max
neval cld
#>      repeatedCosPlusOne(1, 10000)  8.349261  9.216724 10.22715 10.23095 11.10817 14.33763
100  a
#>  repeatedCosPlusOne_vec(1, 10000) 14.406291 16.236153 17.55571 17.22295 18.59085 24.37059
100   b
```

- : https://riptutorial.com/ko/r/topic/1203/-----

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Examples

N

`tm` .

```
require(RWeka)
require(tau)
require(tm)
require(tm.plugin.webmining)
require(wordcloud)

# Scrape Google Finance ---------------------------------------------------
googlefinance <- WebCorpus(GoogleFinanceSource("NASDAQ:LFVN"))

# Scrape Google News ------------------------------------------------------
lv.googlenews <- WebCorpus(GoogleNewsSource("LifeVantage"))
p.googlenews  <- WebCorpus(GoogleNewsSource("Protandim"))
ts.googlenews <- WebCorpus(GoogleNewsSource("TrueScience"))

# Scrape NYTimes ----------------------------------------------------------
lv.nytimes <- WebCorpus(NYTimesSource(query = "LifeVantage", appid = nytimes_appid))
p.nytimes  <- WebCorpus(NYTimesSource("Protandim", appid = nytimes_appid))
ts.nytimes <- WebCorpus(NYTimesSource("TrueScience", appid = nytimes_appid))

# Scrape Reuters ----------------------------------------------------------
lv.reutersnews <- WebCorpus(ReutersNewsSource("LifeVantage"))
p.reutersnews  <- WebCorpus(ReutersNewsSource("Protandim"))
ts.reutersnews <- WebCorpus(ReutersNewsSource("TrueScience"))

# Scrape Yahoo! Finance ---------------------------------------------------
lv.yahoofinance <- WebCorpus(YahooFinanceSource("LFVN"))

# Scrape Yahoo! News ------------------------------------------------------
lv.yahoonews <- WebCorpus(YahooNewsSource("LifeVantage"))
p.yahoonews  <- WebCorpus(YahooNewsSource("Protandim"))
ts.yahoonews <- WebCorpus(YahooNewsSource("TrueScience"))

# Scrape Yahoo! Inplay ----------------------------------------------------
lv.yahooinplay <- WebCorpus(YahooInplaySource("LifeVantage"))

# Text Mining the Results -------------------------------------------------
corpus <- c(googlefinance, lv.googlenews, p.googlenews, ts.googlenews, lv.yahoofinance,
lv.yahoonews, p.yahoonews,
ts.yahoonews, lv.yahooinplay) #lv.nytimes, p.nytimes, ts.nytimes,lv.reutersnews,
p.reutersnews, ts.reutersnews,

inspect(corpus)
wordlist <- c("lfvn", "lifevantage", "protandim", "truescience", "company", "fiscal",
"nasdaq")

ds0.1g <- tm_map(corpus, content_transformer(tolower))
ds1.1g <- tm_map(ds0.1g, content_transformer(removeWords), wordlist)
ds1.1g <- tm_map(ds1.1g, content_transformer(removeWords), stopwords("english"))
```

```
ds2.1g <- tm_map(ds1.1g, stripWhitespace)
ds3.1g <- tm_map(ds2.1g, removePunctuation)
ds4.1g <- tm_map(ds3.1g, stemDocument)

tdm.1g <- TermDocumentMatrix(ds4.1g)
dtm.1g <- DocumentTermMatrix(ds4.1g)

findFreqTerms(tdm.1g, 40)
findFreqTerms(tdm.1g, 60)
findFreqTerms(tdm.1g, 80)
findFreqTerms(tdm.1g, 100)

findAssocs(dtm.1g, "skin", .75)
findAssocs(dtm.1g, "scienc", .5)
findAssocs(dtm.1g, "product", .75)

tdm89.1g <- removeSparseTerms(tdm.1g, 0.89)
tdm9.1g  <- removeSparseTerms(tdm.1g, 0.9)
tdm91.1g <- removeSparseTerms(tdm.1g, 0.91)
tdm92.1g <- removeSparseTerms(tdm.1g, 0.92)

tdm2.1g <- tdm92.1g

# Creates a Boolean matrix (counts # docs w/terms, not raw # terms)
tdm3.1g <- inspect(tdm2.1g)
tdm3.1g[tdm3.1g>=1] <- 1

# Transform into a term-term adjacency matrix
termMatrix.1gram <- tdm3.1g %*% t(tdm3.1g)

# inspect terms numbered 5 to 10
termMatrix.1gram[5:10,5:10]
termMatrix.1gram[1:10,1:10]

# Create a WordCloud to Visualize the Text Data ---------------------------
notsparse <- tdm2.1g
m = as.matrix(notsparse)
v = sort(rowSums(m),decreasing=TRUE)
d = data.frame(word = names(v),freq=v)

# Create the word cloud
pal = brewer.pal(9,"BuPu")
wordcloud(words = d$word,
          freq = d$freq,
          scale = c(3,.8),
          random.order = F,
          colors = pal)
```

RColorBrewer `random.order` .

1-gram .

n-gram . TDM n-gram .

R n-gram `tm` bi-gram n-gram . , ( ) .

, `tm` . . tau `textcnt()` tokenizer .

```
tokenize_ngrams <- function(x, n=3)
return(rownames(as.data.frame(unclass(textcnt(x,method="string",n=n)))))
```

`tm` `RWeka` :

```
# BigramTokenize
BigramTokenizer <- function(x) NGramTokenizer(x, Weka_control(min = 2, max = 2))
```

1-gram .

```
# Create an n-gram Word Cloud ----------------------------------------------
tdm.ng <- TermDocumentMatrix(ds5.1g, control = list(tokenize = BigramTokenizer))
dtm.ng <- DocumentTermMatrix(ds5.1g, control = list(tokenize = BigramTokenizer))

# Try removing sparse terms at a few different levels
tdm89.ng <- removeSparseTerms(tdm.ng, 0.89)
tdm9.ng  <- removeSparseTerms(tdm.ng, 0.9)
tdm91.ng <- removeSparseTerms(tdm.ng, 0.91)
tdm92.ng <- removeSparseTerms(tdm.ng, 0.92)

notsparse <- tdm91.ng
m = as.matrix(notsparse)
v = sort(rowSums(m),decreasing=TRUE)
```

```
d = data.frame(word = names(v),freq=v)

# Create the word cloud
pal = brewer.pal(9,"BuPu")
wordcloud(words = d$word,
          freq = d$freq,
          scale = c(3,.8),
          random.order = F,
          colors = pal)
```

Hack-R . .

: https://riptutorial.com/ko/r/topic/3579/-

120: R .

( ) . .

Examples

. . . (2017 5).

2017 5 .

1

2

R

R .

```
library("devtools")
library("twitteR")
library("ROAuth")
```

.

```
api_key <- XXXXXXXXXXXXXXXXXXXXXX
api_secret <- XXXXXXXXXXXXXXXXXXXXXX
access_token <- XXXXXXXXXXXXXXXXXXXXXX
access_token_secret <- XXXXXXXXXXXXXXXXXXXXXX


setup_twitter_oauth(api_key,api_secret)
```

`XXXXXXXXXXXXXXXXXXXXXX` ( ).

.

```
search.string <- "#coffee"
no.of.tweets <- 1000

c_tweets <- searchTwitter(search.string, n=no.of.tweets, lang="en")
```

"" 1000 .

. (sapply).

```
coffee_tweets = sapply(c_tweets, function(t) t$getText())

coffee_tweets <- sapply(coffee_tweets,function(row) iconv(row, "latin1", "ASCII", sub=""))
```

head .

```
head(coffee_tweets)
```

R . : https://riptutorial.com/ko/r/topic/10086/-r--

121: (%> %)

magrittr , dplyr R R .

. .

- lhs %> % rhs # `rhs(lhs)`
- `rhs(lhs, a = 1)` lhs %> % rhs (a = 1) #
- lhs %> rhs (a = 1, b =.) # `rhs(a = 1, b = lhs)` `rhs(a = 1, b = lhs)`
- lhs % <> % rhs # `lhs <- rhs(lhs)` `lhs <- rhs(lhs)`
- lhs % $ % rhs (a) # `with(lhs, rhs(lhs$a))`
- lhs % T> % rhs # `{ rhs(lhs); lhs }` `{ rhs(lhs); lhs }`

lhs	rhs
magrittr .	magrittr

`%>%`

`magrittr` `dplyr` (`dplyr` `magrittr`) . *API* " " tidyverse .

`magrittr` `%<>%` , `%$%` T `%T>%` . (`+` , `[` , `[[` , etc.]) .

(`+` , `*` , `^` , `&` , `%in%`) `?'%>%'` `help('%>%')` `pkg:magrittr`).

RStudio `Ctrl+Shift+M` (*Windows* *Linux*), `Cmd+Shift+M` (*Mac*) `Cmd+Shift+M` .

, . .

- ()
- (`object %>% rm()` `object`)

Examples

`%>%` . `magrittr` . (LHS) (RHS) . :

```
library(magrittr)

1:10 %>% mean
# [1] 5.5

# is equivalent to
mean(1:10)
```

```
# [1] 5.5
```

. . years . .

```
years <- factor(2008:2012)

# nesting
as.numeric(as.character(years))

# piping
years %>% as.character %>% as.numeric
```

RHS (Right Hand Side) LHS ( ) . .

```
# example with grepl
# its syntax:
# grepl(pattern, x, ignore.case = FALSE, perl = FALSE, fixed = FALSE, useBytes = FALSE)

# note that the `substring` result is the *2nd* argument of grepl
grepl("Wo", substring("Hello World", 7, 11))

# piping while naming other arguments
"Hello World" %>% substring(7, 11) %>% grepl(pattern = "Wo")

# piping with .
"Hello World" %>% substring(7, 11) %>% grepl("Wo", .)

# piping with . and curly braces
"Hello World" %>% substring(7, 11) %>% { c(paste('Hi', .)) }
#[1] "Hi World"

#using LHS multiple times in argument with curly braces and .
"Hello World" %>% substring(7, 11) %>% { c(paste(. ,'Hi', .)) }
#[1] "World Hi World"
```

. .

```
. %>% RHS
```

, .

```
library(magrittr) # needed to include the pipe operators
library(lubridate)
read_year <- . %>% as.character %>% as.Date %>% year

# Creating a dataset
df <- data.frame(now = "2015-11-11", before = "2012-01-01")
#          now     before
# 1 2015-11-11 2012-01-01

# Example 1: applying `read_year` to a single character-vector
df$now %>% read_year
# [1] 2015

# Example 2: applying `read_year` to all columns of `df`
df %>% lapply(read_year) %>% as.data.frame  # implicit `lapply(df, read_year)
```

```
#    now before
# 1 2015   2012

# Example 3: same as above using `mutate_all`
library(dplyr)
df %>% mutate_all(funs(read_year))
# if an older version of dplyr use `mutate_each`
#    now before
# 1 2015   2012
```

`functions` `functions` .

```
read_year
# Functional sequence with the following components:
#
#  1. as.character(.)
#  2. as.Date(.)
#  3. year(.)
#
# Use 'functions' to extract the individual functions.
```

.

```
read_year[[2]]
# function (.)
# as.Date(.)
```

.

% <> %

`magrittr` `rhs` infix-operator `%<>%` . (`<-`). `%<>%` .

```
library(magrittr)
library(dplyr)

df <- mtcars
```

```
df <- df %>% select(1:3) %>% filter(mpg > 20, cyl == 6)
```

```
df %>% select(1:3) %>% filter(mpg > 20, cyl == 6) -> df
```

`df` .

```
df %<>% select(1:3) %>% filter(mpg > 20, cyl == 6)
```

% $ %

`%$%` R . `data` (, `lm`) data.frame (dplyr).

`%$%` . `cor.test` `cor.test` `cor.test` .

```
library(magrittr)
library(dplyr)
mtcars %>%
  filter(wt > 2) %$%
  cor.test(hp, mpg)

#>
#>  Pearson's product-moment correlation
#>
#> data:  hp and mpg
#> t = -5.9546, df = 26, p-value = 2.768e-06
#> alternative hypothesis: true correlation is not equal to 0
#> 95 percent confidence interval:
#>  -0.8825498 -0.5393217
#> sample estimates:
#>        cor
#> -0.7595673
```

`%>%` data.frame `filter()` , `%$%` `cor.test()` .

base R `with()` .

dplyr ggplot2

`%>%` dplyr ggplot . (EDA) . ggplot .

```
library(dplyr)
library(ggplot)


diamonds %>%
    filter(depth > 60) %>%
    group_by(cut) %>%
    summarize(mean_price = mean(price)) %>%
    ggplot(aes(x = cut, y = mean_price)) +
        geom_bar(stat = "identity")
```

% T> %

R (: , ,) .

`%T>%` (tee) `lhs` . , tee `%>%` . , `rhs` / `lhs` .

: , , . `%T>%` `%>%` `all_letters` `NULL` `NULL` .

```
all_letters <- c(letters, LETTERS) %>%
    sort %T>%
    write.csv(file = "all_letters.csv")

read.csv("all_letters.csv") %>% head()
#   x
# 1 a
# 2 A
# 3 b
# 4 B
```

```
# 5 c
# 6 C
```

: save() . load() load() . ( ).

```
all_letters <- c(letters, LETTERS) %>%
    sort %T>%
    save(file = "all_letters.RData")

load("all_letters.RData", e <- new.env())

get("all_letters", envir = e)
# Error in get("all_letters", envir = e) : object 'all_letters' not found

get(".", envir = e)
#  [1] "a" "A" "b" "B" "c" "C" "d" "D" "e" "E" "f" "F" "g" "G" "h" "H" "i" "I" "j" "J"
# [21] "k" "K" "l" "L" "m" "M" "n" "N" "o" "O" "p" "P" "q" "Q" "r" "R" "s" "S" "t" "T"
# [41] "u" "U" "v" "V" "w" "W" "x" "X" "y" "Y" "z" "Z"

# Work-around
save2 <- function(. = ., name, file = stop("'file' must be specified")) {
  assign(name, .)
  call_save <- call("save", ... = name, file = file)
  eval(call_save)
}

all_letters <- c(letters, LETTERS) %>%
    sort %T>%
    save2("all_letters", "all_letters.RData")
```

(%> %) : https://riptutorial.com/ko/r/topic/652/-----gt------

122:

. :

CRAN (Comprehensive R Archive Network) .

Examples

dplyr .

```
help(package = "dplyr")
```

.

dplyr

```
data(package = "dplyr")
```

.

dplyr .

```
library(dplyr)
ls("package:dplyr")
```

: . .

```
## Checking package version which was installed at past or
## installed currently but not loaded in the current session

packageVersion("seqinr")
# [1] '3.3.3'
packageVersion("RWeka")
# [1] '0.4.29'
```

```
search()
```

```
(.packages())
```

: https://riptutorial.com/ko/r/topic/7408/-

123:

- install.packages (pkgs, lib, repos, method, destdir, dependencies, ...)

pkgs	. `repos = NULL` .
lib	.
repos	, URL, `NULL`
destdir	
	/install / import / suggest ( ). `repos = NULL` .
...	'download.file' OS X Windows .

-

Examples

R , . () R . R CRAN .

CRAN

CRAN .

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

`"dplyr"` .

`c()` .

```
install.packages(c("dplyr", "tidyr", "ggplot2"))
```

`install.packages` `getOption("repos")` CRAN . CRAN `repos` .

```
install.packages("dplyr", repos = "https://cloud.r-project.org/")
```

`repos` . `?install.packages` `?install.packages` .

(: package `data.table`) . ( ) `dependencies` `TRUE` `TRUE` .

```
install.packages("data.table", dependencies = TRUE)
```

Bioconductor

Bioconductor Bioinformatics . `biocLite` .

```
## Try http:// if https:// URLs are not supported
source("https://bioconductor.org/biocLite.R")
biocLite()
```

. . Bioconductor `RImmPort` `RImmPort` .

```
source("https://bioconductor.org/biocLite.R")
biocLite("RImmPort")
```

.

```
install.packages(path_to_source, repos = NULL, type="source")

install.packages("~/Downloads/dplyr-master.zip", repos=NULL, type="source")
```

`path_to_source` .

zip tar.gz .

```
install.packages(file.choose(), repos=NULL)
```

GUI RStudio .

1 : .

2 : .

3 : (.zip; .tar.gz)

4 : *Browse ()* (: crayon_1.3.1.zip) *( )*

R devtools `install_local()` .

```
library(devtools)
install_local("~/Downloads/dplyr-master.zip")
```

GitHub

GitHub `devtools` .

```
library(devtools)
install_github("authorName/repositoryName")
```

github `ggplot2` ,

```
devtools::install_github("tidyverse/ggplot2")
```

master `ggplot2` . `ref` . , `googleway` `dev_general` .

```
devtools::install_github("SymbolixAU/googleway", ref = "dev_general")
```

`ghit` `ghit` . github .

```
install.packages("ghit")
ghit::install_github("google/CausalImpact")
```

Github http://www.github.com/settings/tokens/ (? install_github). :

1. ```
   install.packages(c("curl", "httr"))
   ```
2. ```
   config = httr::config(ssl_verifypeer = FALSE)
   ```
3. ```
    install.packages("RCurl")
    options(RCurlOptions = c(getOption("RCurlOptions"),ssl.verifypeer = FALSE,
   ssl.verifyhost = FALSE ) )
   ```
4. ```
   getOption("RCurlOptions")
   ```

   .

   ```
   ssl.verifypeer ssl.verifyhost

   FALSE          FALSE
   ```
5. ```
   library(httr)
   set_config(config(ssl_verifypeer = 0L))
   ```

   . " CA "
6. .

   ```
   install_github("username/package_name",auth_token="abc")
   ```

`GITHUB_PAT` .

```
Sys.setenv(GITHUB_PAT = "access_token")
devtools::install_github("organisation/package_name")
```
```

Github PAT , .Rprofile . .

CLI -

pacman R .

pacman p_load ( ) . pacman pacman . .

```
p_load(data.table, dplyr, ggplot2)
```

library , require install.packages pacman .

```
library(pacman)
p_load(data.table, dplyr, ggplot2)
```

.

```
pacman::p_load(data.table, dplyr, ggplot2)
```

pacman .

pacman ( ) pacman :

```
if(!(require(pacman)) install.packages("pacman")
pacman::p_load(data.table, dplyr, ggplot2)
```

R . ( )

```
R CMD build my_package
```

R . R .

```
unloadNamespace("my_package")
library(my_package)
```

devtools . R

```
devtools::install()
```

.

: https://riptutorial.com/ko/r/topic/1719/-

124:

. .

- grep ("", "", optional_args)
- grepl ("query", "subject", optional_args)
- gsub ("(group1) (group2)", "\\ group #", "subject")

(: `\1`) `pattern` `sub` `gsub` `replacement` `\\1` .

(grep, sub, regexpr) PCRE (Perl Compatible Regular Expression) . `perl=TRUE` . R .

-
- stringr

Examples

```
# example data
test_sentences <- c("The quick brown fox quickly", "jumps over the lazy dog")
```

.

```
sub("brown","red", test_sentences)
#[1] "The quick red fox quickly"       "jumps over the lazy dog"
```

, `"fast"` `"fastly"` . :

```
sub("quick", "fast", test_sentences)
#[1] "The fast red fox quickly"       "jumps over the lazy dog"
```

`sub` `gsub` .

```
gsub("quick", "fast", test_sentences)
#[1] "The fast red fox fastly"       "jumps over the lazy dog"
```

.

```
# example data
test_sentences <- c("The quick brown fox", "jumps over the lazy dog")
```

?

`grepl()` . TRUE / FALSE ("Boolean") .

"" .

```
grepl("fox", test_sentences)
#[1]  TRUE FALSE
```

`grep` . . "fox" .

```
grep("fox", test_sentences)
#[1] 1
```

,

```
# each of the following lines does the job:
test_sentences[grep("fox", test_sentences)]
test_sentences[grepl("fox", test_sentences)]
grep("fox", test_sentences, value = TRUE)
# [1] "The quick brown fox"
```

`"fox"` `fixed = TRUE` (`grep` `grepl`).

```
grep("fox", test_sentences, fixed = TRUE)
#[1] 1
```

`grep` with `invert = TRUE` . `-grep(...)` `!grepl(...)` `-grep(...)` .

`grepl(pattern, x)` `grep(pattern, x)` `x` `pattern` . `pattern[1]` `x[1]` , `pattern[2]` `x[2]` , .

`grepl` `TRUE` `FALSE` . . `summary` :

```
# example data
test_sentences <- c("The quick brown fox", "jumps over the lazy dog")

# find matches
matches <- grepl("fox", test_sentences)

# overview
summary(matches)
```

.

PCRE `g` .

R : :

- sub(pattern,replacement,text) sub(pattern,replacement,text) pattern .
- gsub(pattern,replacement,text) sub .
- regexpr(pattern,text) .
- gregexpr(pattern,text) .

:

```
set.seed(123)
teststring <- paste0(sample(letters,20),collapse="")

# teststring
#[1] "htjuwakqxzpgrsbncvyo"
```

.

```
sub("[aeiouy]"," ** HERE WAS A VOWEL** ",teststring)
#[1] "htj ** HERE WAS A VOWEL** wakqxzpgrsbncvyo"

gsub("[aeiouy]"," ** HERE WAS A VOWEL** ",teststring)
#[1] "htj ** HERE WAS A VOWEL** w ** HERE WAS A VOWEL** kqxzpgrsbncv ** HERE WAS A VOWEL**  ** HERE WAS A VOWEL** "
```

.

```
regexpr("[^aeiou][aeiou]+",teststring)
#[1] 3
#attr(,"match.length")
#[1] 2
#attr(,"useBytes")
#[1] TRUE
```

2 3 . : ju

:

```
gregexpr("[^aeiou][aeiou]+",teststring)
#[[1]]
#[1]  3  5 19
#attr(,"match.length")
#[1] 2 2 2
#attr(,"useBytes")
#[1] TRUE
```

. . regmatches regexpr .

.

```
matches <- gregexpr("[^aeiou][aeiou]+",teststring)
regmatches(teststring,matches)
#[[1]]
```

```
#[1] "ju" "wa" "yo"
```

, (.):

```
teststring2 <- "this is another string to match against"
regmatches(teststring2,matches)
#[[1]]
#[1] "is" " i" "ri"
```

: Perl `perl=TRUE` .

, `grepl("fox", test_sentences)` . .

`perl = TRUE` . `fixed = TRUE` . .

```
# example data
test_sentences <- c("The quick brown fox", "jumps over the lazy dog")

grepl("fox", test_sentences, perl = TRUE)
#[1]  TRUE FALSE
```

. `grepl` . .

```
searchCorpus <- function(corpus, pattern) {
  return(tm_index(corpus, FUN = function(x) {
    grepl(pattern, x, ignore.case = TRUE, perl = TRUE)
  }))
}
```

: https://riptutorial.com/ko/r/topic/1123/---

125: (CSV, TSV)

- (, = TRUE, sep = ",", quote = "" ", dec =". ", = , comment.char =" ", ...)
- read.csv2 (, = TRUE, sep = ";", quote = "" ", dec =", ", = TRUE, comment.char =" ", ...)
- read_csv (file, col_names = TRUE, col_types = NULL, locale = default_locale (), na = c ("", "NA"), comment = "", trim_ws = TRUE, skip = 0, n_max = -1 , progress = interactive ())
- stringAsFactors = FALSE, verbose = getOption ("datatable", "auto", nrows = -1L, header = "auto", na.strings = "NA" (: "integer") dec = if (sep! = "0"), = 1L, = 0L, select = NULL, drop = NULL, colClasses = NULL, integer64 = getOption ("datatable.integer64" ("datatable.showProgress"), # default : TRUE . ",". ",". ", col.names, check.names = FALSE, =" ", strip.white = TRUE, showProgress = getOption table = getOption ("datatable.fread.datatable") #default : TRUE)

	CSV
	logical : .csv ?
	:
	:
	:
	logical : TRUE .
comment.char	character : csv . .
...	`read.table`

. .RData Feather .

/ Input Output .

Examples

.csv

R

(CSV) `read.csv` `sep = ","` `read.table` .

```
# get the file path of a CSV included in R's utils package
csv_path <- system.file("misc", "exDIF.csv", package = "utils")

# path will vary based on installation location
csv_path
## [1] "/Library/Frameworks/R.framework/Resources/library/utils/misc/exDIF.csv"

df <- read.csv(csv_path)

df
##    Var1 Var2
## 1  2.70    A
## 2  3.14    B
## 3 10.00    A
## 4 -7.00    A
```

file.choose .

```
df <- read.csv(file.choose())
```

- read.table , read.csv header = TRUE .
- as.is = TRUE stringsAsFactors = FALSE factor stringsAsFactors = FALSE .
- read.csv2 sep = ";" dec = ","

---

readr read_csv , stringsAsFactors = FALSE read.csv stringsAsFactors = FALSE .

```
library(readr)

df <- read_csv(csv_path)

df
## # A tibble: 4 x 2
##    Var1  Var2
##   <dbl> <chr>
## 1  2.70     A
## 2  3.14     B
## 3 10.00     A
## 4 -7.00     A
```

data.table

data.table fread . read.table fread .

```
# get the file path of a CSV included in R's utils package
csv_path <- system.file("misc", "exDIF.csv", package = "utils")

# path will vary based on R installation location
csv_path
## [1] "/Library/Frameworks/R.framework/Resources/library/utils/misc/exDIF.csv"

dt <- fread(csv_path)
```

```
dt
##      Var1 Var2
## 1:  2.70    A
## 2:  3.14    B
## 3: 10.00    A
## 4: -7.00    A
```

`input` .

- (: `"filename.csv"`),
- (: `"grep 'word' filename"`)
- (: `"input1, input2 \n A, B \n C, D"`).

`fread` `data.table` `data.frame` data.table `[]` . `data.table` `data.table` `FALSE` `FALSE` .

```
df <- fread(csv_path, data.table = FALSE)

class(df)
## [1] "data.frame"

df
##    Var1 Var2
## 1  2.70    A
## 2  3.14    B
## 3 10.00    A
## 4 -7.00    A
```

- `fread` `read.table` `read.table` . `na.comment` . `#` .
- `fread` `"` `quote` .
- `fread` .

.tsv (R)

`file.path` . Windows, Mac Linux `paste` .

```
FilePath <- file.path(AVariableWithFullProjectPath,"SomeSubfolder","SomeFileName.txt.gz")

Data <- as.matrix(read.table(FilePath, header=FALSE, sep ="\t"))
```

.

. .

. `FilePath` 0 79 % `8970` `8970` .

```
system.time(expr=Data<-as.matrix(read.table(file=FilePath,header=FALSE,sep=" ") ))
```

`system.time` 267 .

```
   user  system elapsed
265.563   1.949 267.563
```

.

```
FilePath <- "SomeFile"
connection<- gzfile(FilePath,open="r")
TableList <- list()
Counter <- 1
system.time(expr= while ( length( Vector<-as.matrix(scan(file=connection, sep=" ", nlines=1,
quiet=TRUE)) ) > 0 ) {
    TableList[[Counter]]<-Vector
    Counter<-Counter+1
})
   user  system elapsed
165.976   0.060 165.941
close(connection)
system.time(expr=(Data <- do.call(rbind,TableList)))
   user  system elapsed
  0.477   0.088   0.565
```

`read.matrix` `futile.matrix` . 1 .

.csv

R

`write.csv()` CSV .

```
write.csv(mtcars, "mtcars.csv")
```

`row.names = FALSE` `na = ""` .

`readr::write_csv` `write.csv` .

```
library(readr)

write_csv(mtcars, "mtcars.csv")
```

csv

```
files = list.files(pattern="*.csv")
data_list = lapply(files, read.table, header = TRUE)
```

. data.frame data.frame .

```
df <- do.call(rbind, data_list)
```

`;` `,` `.` `.` `;` `,` ( ). .

:

```
Column1 Column2   Column3           Column4Column5
1647    pi        'important'       3.141596.28318
1731    euler     'quite important' 2.718285.43656
1979    answer    'The Answer.'     42      42
```

constants.txt .

R

```
df <- read.fwf('constants.txt', widths = c(8,10,18,7,8), header = FALSE, skip = 1)

df
#>      V1     V2                 V3         V4        V5
#> 1 1647     pi         'important'    3.14159   6.28318
#> 2 1731  euler   'quite important'    2.71828   5.43656
#> 3 1979 answer       'The Answer.'    42        42.0000
```

:

- (Column4Column5).
- widths .
- read.fwf() .

---

reader

```
library(readr)

df <- read_fwf('constants.txt',
               fwf_cols(Year = 8, Name = 10, Importance = 18, Value = 7, Doubled = 8),
               skip = 1)
df
#> # A tibble: 3 x 5
#>    Year    Name        Importance    Value  Doubled
#>    <int>   <chr>            <chr>    <dbl>    <dbl>
#> 1  1647      pi       'important'  3.14159  6.28318
#> 2  1731   euler 'quite important'  2.71828  5.43656
#> 3  1979  answer     'The Answer.' 42.00000 42.00000
```

:

- readr fwf_* (fwf_empty) .
- R .
- .

(CSV, TSV) : https://riptutorial.com/ko/r/topic/481/----------csv--tsv--

126: : +

parse .

eval .

Examples

.

```
# the string
str <- "1+1"

# A string is not an expression.
is.expression(str)
[1] FALSE

eval(str)
[1] "1+1"

# parse convert string into expressions
parsed.str <- parse(text="1+1")

is.expression(parsed.str)
[1] TRUE

eval(parsed.str)
[1] 2
```

: + : https://riptutorial.com/ko/r/topic/5746/-----plus-

127:

( ) () . . .

. . , , . , : (Fourier synthesis) .

( ) . . , . . , , .

.

. (:) . (Joseph Fourier) .

(Liemann) , .

, Dirac . . , 3 3 (4 -) .

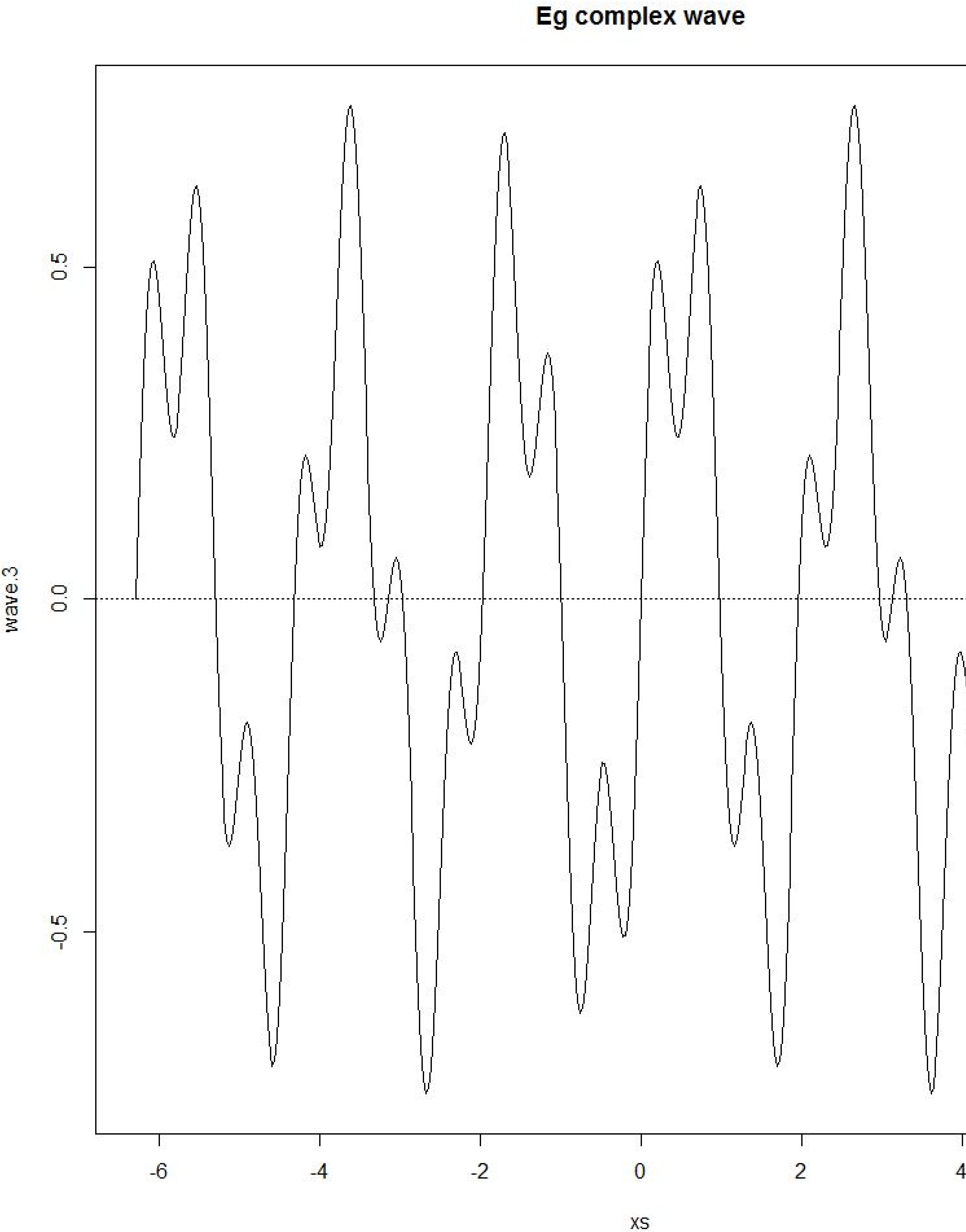
. Fourier . $\mathbb{R}$ $\mathbb{R}^n$ ( ) (DTFT, = $\mathbb{Z}$), DFT, group = $\mathbb{Z} \bmod N$) (= S1,). . (FFT) DFT .

Examples

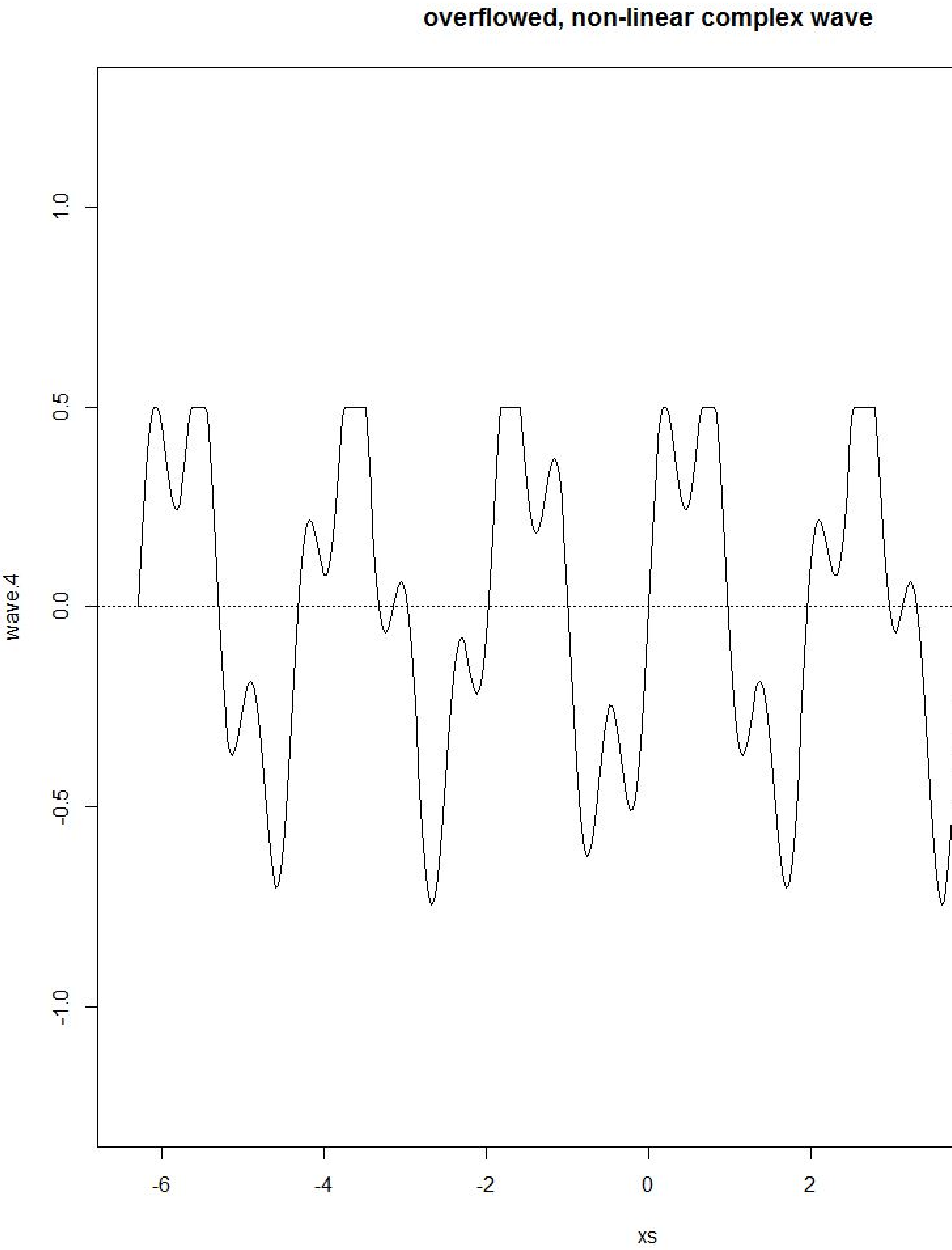
(Joseph Fourier) . . . .

```
# Sine waves
xs <- seq(-2*pi,2*pi,pi/100)
wave.1 <- sin(3*xs)
wave.2 <- sin(10*xs)
par(mfrow = c(1, 2))
plot(xs,wave.1,type="l",ylim=c(-1,1)); abline(h=0,lty=3)
plot(xs,wave.2,type="l",ylim=c(-1,1)); abline(h=0,lty=3)

# Complex Wave
wave.3 <- 0.5 * wave.1 + 0.25 * wave.2
plot(xs,wave.3,type="l"); title("Eg complex wave"); abline(h=0,lty=3)
```


Eg complex wave
wave.3
0.5
0.0
-0.5
-6
-4
-2
0
2
4
xs

```
wave.4 <- wave.3
wave.4[wave.3>0.5] <- 0.5
plot(xs,wave.4,type="l",ylim=c(-1.25,1.25))
title("overflowed, non-linear complex wave")
abline(h=0,lty=3)
```


overflowed, non-linear complex wave
wave.4
1.0
0.5
0.0
-0.5
-1.0
-6
-4
-2
0
2
xs

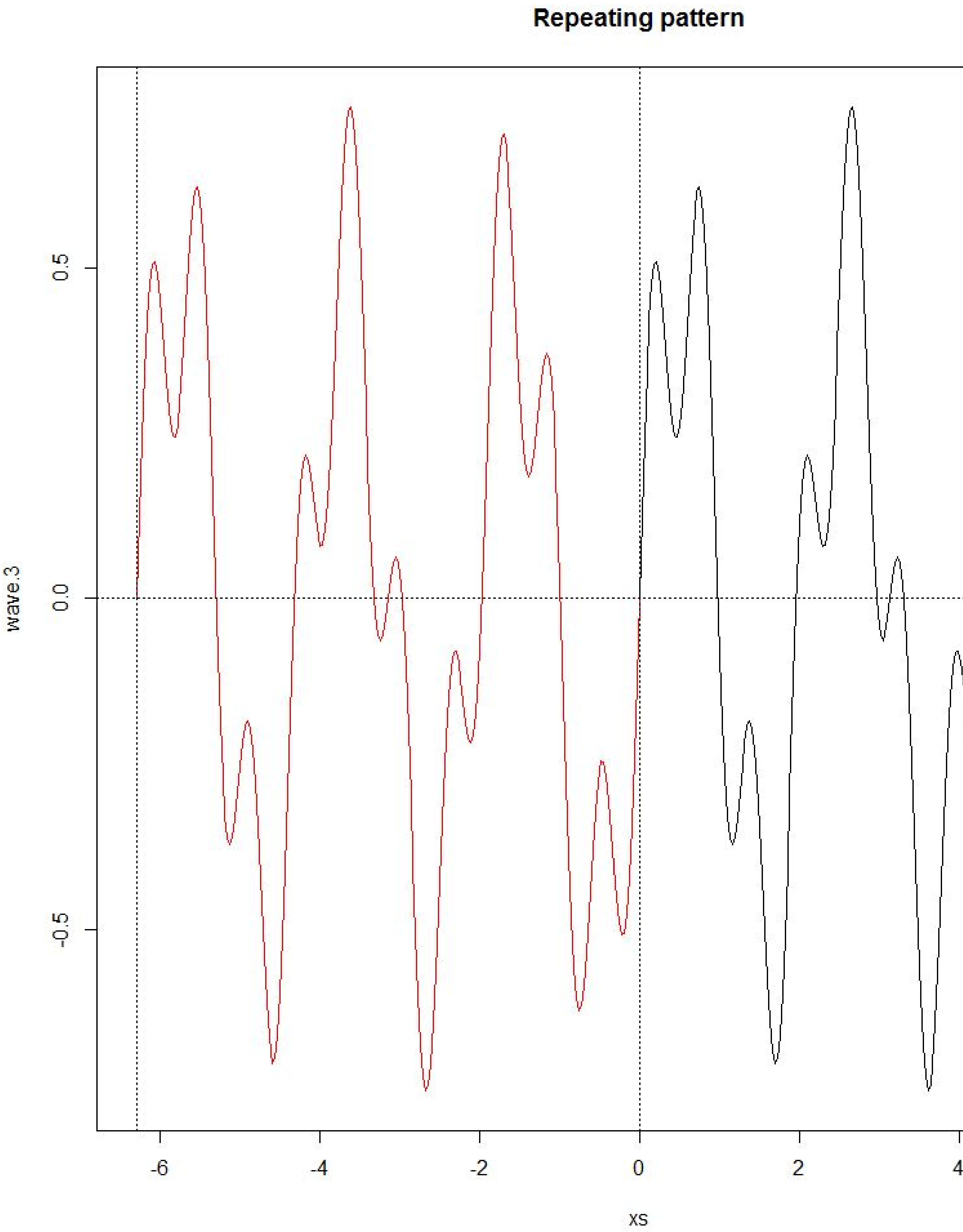
. , (,). f λ (, λ = v / f0, v) . .

:

- T ,
- (sr) ( ). . si, N . si = TN
- f0 1T. . , 12π. . f0 1 , 2 2 * f0, 3 3 * f0 .

```
repeat.xs     <- seq(-2*pi,0,pi/100)
wave.3.repeat <- 0.5*sin(3*repeat.xs) + 0.25*sin(10*repeat.xs)
plot(xs,wave.3,type="l")

title("Repeating pattern")
points(repeat.xs,wave.3.repeat,type="l",col="red");
abline(h=0,v=c(-2*pi,0),lty=3)
```


Repeating pattern
wave.3
0.5
0.0
-0.5
-6
-4
-2
0
2
4
xs

R .

```
plot.fourier <- function(fourier.series, f.0, ts) {
                        w <- 2*pi*f.0 trajectory <- sapply(ts, function(t)
fourier.series(t,w))
                        plot(ts, trajectory, type="l", xlab="time", ylab="f(t)");
                        abline(h=0,lty=3)}
```

: https://riptutorial.com/ko/r/topic/4139/---

128:

R , . subsetting .

:

NA [NA] (NA s)

NA .

NA "" ""(typeof(NA)), "" . x[NA] x[rep_len(as.logical(NA), length(x))] x[as.logical(NA)] (NA) x x . :

```
x <- 1:3
x[NA]
## [1] NA NA NA
```

""/ "" NA NA (NA).

```
x[as.integer(NA)]
## [1] NA

x[c(NA, 1, NA, NA)]
## [1] NA  1 NA NA
```

:

[> length(x) NA , NULL . [[when [(, length(dim(x)) > 2 bounds) .

```
(1:3)[10]
## [1] NA
(1:3)[[10]]
## Error in (1:3)[[10]] : subscript out of bounds
as.matrix(1:3)[10]
## [1] NA
as.matrix(1:3)[, 10]
## Error in as.matrix(1:3)[, 10] : subscript out of bounds
list(1, 2, 3)[10]
## [[1]]
## NULL
list(1, 2, 3)[[10]]
## Error in list(1, 2, 3)[[10]] : subscript out of bounds
```

"names" "" .

```
c(a = 1, b = 2)["c"]
## <NA>
##   NA
list(a = 1, b = 2)["c"]
## <NA>
## NULL
```

:

?Extract .

Examples

( ) [:

```
# create an example vector
v1 <- c("a", "b", "c", "d")

# select the third element
v1[3]
## [1] "c"
```

[. .

```
v1 <- c("a", "b", "c", "d")

v1[c(1, 3)]
## [1] "a" "c"
```

. (-) . , v1 v1[-1] . . , v1[-c(1,3)] .

```
> v1[-1]
[1] "b" "c" "d"
> v1[-c(1,3)]
[1] "b" "d"
```

.

```
> v1=="c"
[1] FALSE FALSE  TRUE FALSE
> which(v1=="c")
[1] 3
```

(names) :

```
v <- 1:3
names(v) <- c("one", "two", "three")

v
##  one   two three
##    1     2     3

v["two"]
## two
##   2
```

[[1 .

```
v[[c(1, 2)]]
```

```
## Error in v[[c(1, 2)]] :
##  attempt to select more than one element in vectorIndex

v[["two"]]
## [1] 2
```

. , . y x x[y] , if length(y) < length(x) y length(x) .

```
v[c(TRUE, FALSE, TRUE)]
##  one three
##    1     3

v[c(FALSE, TRUE)]  # recycled to 'c(FALSE, TRUE, FALSE)'
## two
##   2

v[TRUE]   # recycled to 'c(TRUE, TRUE, TRUE)'
##  one   two three
##    1     2     3

v[FALSE]   # handy to discard elements but save the vector's type and basic structure
## named integer(0)
```

[:

```
l1 <- list(c(1, 2, 3), 'two' = c("a", "b", "c"), list(10, 20))
l1
## [[1]]
## [1] 1 2 3
##
## $two
## [1] "a" "b" "c"
##
## [[3]]
## [[3]][[1]]
## [1] 10
##
## [[3]][[2]]
## [1] 20

l1[1]
## [[1]]
## [1] 1 2 3

l1['two']
## $two
## [1] "a" "b" "c"

l1[[2]]
## [1] "a" "b" "c"

l1[['two']]
## [1] "a" "b" "c"
```

[l1[2] . [[.

( ). [. length > 1 [[[( ) ""

```
l1[c(3, 1)]
## [[1]]
## [[1]][[1]]
## [1] 10
##
## [[1]][[2]]
## [1] 20
##
##
## [[2]]
## [1] 1 2 3
```

:

```
l1[[c(3, 1)]]
## [1] 10
```

.

```
l1[[3]][[1]]
## [1] 10
```

`$` `[` `[[` , . `$` :

```
l1$two
## [1] "a" "b" "c"
```

`$` .

```
l1$t
## [1] "a" "b" "c"
```

`[[`

```
l1[["t"]]
## NULL
l1[["t", exact = FALSE]]
## [1] "a" "b" "c"
```

`options(warnPartialMatchDollar = TRUE)` `$` "".

```
l1$t
## [1] "a" "b" "c"
## Warning message:
## In l1$t : partial match of 't' to 'two'
```

`[` . . `[i, j]` `[i, j]` `i` `j` . 1 .

```
## a sample matrix
mat <- matrix(1:6, nrow = 2, dimnames = list(c("row1", "row2"), c("col1", "col2", "col3")))

mat
```

```
#      col1 col2 col3
# row1    1    3    5
# row2    2    4    6
```

mat[i,j] i , j mat . i 2 j 1 . i j .

```
mat[ , 3]
## row1 row2
##    5    6

mat[1, ]
# col1 col2 col3
#    1    3    5
```

( ) .

```
mat[ , 'col1']
# row1 row2
#    1    2
```

. 2 1 . drop = FALSE [: :

```
## This selects the first row as a vector
class(mat[1, ])
# [1] "integer"

## Whereas this selects the first row as a 1x3 matrix:
class(mat[1, , drop = F])
# [1] "matrix"
```

.

```
mat[1:2, 2:3]  ## A 2x2 matrix
#      col2 col3
# row1    3    5
# row2    4    6
```

Nx2 N ( ). (1st row, 1st column), (1st row, 3rd column), (2nd row, 3rd column), (2nd row, 1st column) :

```
mat
#      col1 col2 col3
# row1    1    3    5
# row2    2    4    6

ind = rbind(c(1, 1), c(1, 3), c(2, 3), c(2, 1))
ind
#      [,1] [,2]
# [1,]    1    1
# [2,]    1    3
# [3,]    2    3
# [4,]    2    1
```

```
mat[ind]
# [1] 1 5 6 2
```

1 `ind` `mat` `ind` `mat` .

.

```
> df3 <- data.frame(x = 1:3, y = c("a", "b", "c"), stringsAsFactors = FALSE)

> df3
##   x y
## 1 1 a
## 2 2 b
## 3 3 c

> df3[1]   # Subset a variable by number
##   x
## 1 1
## 2 2
## 3 3

> df3["x"]   # Subset a variable by name
##   x
## 1 1
## 2 2
## 3 3

> is.data.frame(df3[1])
## TRUE

> is.list(df3[1])
## TRUE
```

[[]] $.

```
> df3[[2]]    # Subset a variable by number using [[ ]]
## [1] "a" "b" "c"

> df3[["y"]]  # Subset a variable by name using [[ ]]
## [1] "a" "b" "c"

> df3$x    # Subset a variable by name using $
## [1] 1 2 3

> typeof(df3$x)
## "integer"

> is.vector(df3$x)
## TRUE
```

2 `i` `j` .

```
> df3[1, 2]    # Subset row and column by number
## [1] "a"

> df3[1, "y"]  # Subset row by number and column by name
## [1] "a"
```

```
> df3[2, ]     # Subset entire row by number
##   x y
## 2 2 b

> df3[ , 1]    # Subset all first variables
## [1] 1 2 3

> df3[ , 1, drop = FALSE]
##   x
## 1 1
## 2 2
## 3 3
```

: j () i data.frame . drop FALSE .

```
> is.vector(df3[, 2])
## TRUE

> is.data.frame(df3[2, ])
## TRUE

> is.data.frame(df3[, 2, drop = FALSE])
## TRUE
```

[[[. , R (isTRUE(is.object(x)) "class".) . [/ [[.

, [.data.frame (is.object(iris)) [.data.frame [[.data.frame "matrix" "" . "data.frame" [.data.frame [.data.frame [.

```
iris[invalidArgument, ]
## Error in `[.data.frame`(iris, invalidArgument, ) :
##   object 'invalidArgument' not found
```

[:

```
x = structure(1:5, class = "myClass")
x[c(3, 2, 4)]
## [1] 3 2 4
'[.myClass' = function(x, i) cat(sprintf("We'd expect '%s[%s]' to be returned but this a
custom `[` method and should have a `?[.myClass` help page for its behaviour\n",
deparse(substitute(x)), deparse(substitute(i))))

x[c(3, 2, 4)]
## We'd expect 'x[c(3, 2, 4)]' to be returned but this a custom `[` method and should have a
`?[.myClass` help page for its behaviour
## NULL
```

.subset ([[ ] .subset2 [. "" ("class" ( ) "" unclass(x)) .

```
.subset(x, c(3, 2, 4))
## [1] 3 2 4
```

.

```
> x <- 11:20
> x
 [1] 11 12 13 14 15 16 17 18 19 20
```

R 1-indexed, `x[1]` `11` . `x` .

```
> x[c(2,4,6)]
[1] 12 14 16
```

R .

```
> x[c(-1,-3)]
[1] 12 14 15 16 17 18 19 20
```

. `TRUE` .

```
> x[c(rep(TRUE,5),rep(FALSE,5))]
[1] 11 12 13 14 15 16
```

.

```
> x[c(TRUE,FALSE)]
[1] 11 13 15 17 19
> x[c(TRUE,FALSE,FALSE)]
[1] 11 14 17 20
```

A B . `+` , `-` , `/` , `*` , `^` . .

	B	
+	A + B	A B
-	A - B	A B .
/	A / B	A B .
*	A * B	A B .
^	A ^ (- 1)	, A .

(Linear Algebra) " (true)" `%*%` . , A B `A %*% B` . `A` `ncol()` `nrow()` `B` `nrow()` .

nrow ()	(A)	A .
ncol ()	ncol (A)	A .
rownames ()	rownames (A)	A .

colnames ()	colnames (A)	A .
rowMeans ()	rowMeans (A)	A .
colMeans ()	colMeans (A)	A .
upper.tri ()	upper.tri (A)	.
		A
lower.tri ()	lower.tri (A)	.
		A
det ()	det (A)	A .
()	(A)	- A .
diag ()	(A)	0
		A
()	)	A .
()	(A)	A .
is.matrix ()	is.matrix (A)	A TRUE FALSE .
as.matrix ()	as.matrix (x)	x .

: https://riptutorial.com/ko/r/topic/1686/-

129:

Examples

: , .

R new.env environment () . . hash TRUE .

```
H <- new.env(hash = TRUE)
H <- new.env()
```

, 29 size . R environment size . size .

```
object.size(new.env())
# 56 bytes

object.size(new.env(size = 10e4))
# 56 bytes
```

[[<- $<- environment , " " ([<-) :

```
H <- new.env()

H[["key"]] <- rnorm(1)

key2 <- "xyz"
H[[key2]] <- data.frame(x = 1:3, y = letters[1:3])

H$another_key <- matrix(rbinom(9, 1, 0.5) > 0, nrow = 3)

H["error"] <- 42
#Error in H["error"] <- 42 :
#  object of type 'environment' is not subsettable
```

R , (object[[key]] <- value) (object$key <- value) (: key2).

, environment . - .

```
H[["key3"]] <- "original value"

H[["key3"]] <- "new value"

H[["key3"]]
#[1] "new value"
```

[[$, [:

```
H[["key"]]
#[1] 1.630631
```

```
H[[key2]]   ## assuming key2 <- "xyz"
#   x y
# 1 1 a
# 2 2 b
# 3 3 c

H$another_key
#       [,1]  [,2]  [,3]
# [1,]  TRUE  TRUE  TRUE
# [2,] FALSE FALSE FALSE
# [3,]  TRUE  TRUE  TRUE

H[1]
#Error in H[1] : object of type 'environment' is not subsettable
```

---

environment .

```
names(H)
#[1] "another_key" "xyz"         "key"         "key3"

ls(H)
#[1] "another_key" "key"         "key3"        "xyz"

str(H)
#<environment: 0x7828228>

ls.str(H)
# another_key :  logi [1:3, 1:3] TRUE FALSE TRUE TRUE FALSE TRUE ...
# key :  num 1.63
# key3 :  chr "new value"
# xyz : 'data.frame':    3 obs. of  2 variables:
#  $ x: int  1 2 3
#  $ y: chr  "a" "b" "c"
```

rm .

```
rm(list = c("key", "key3"), envir = H)

ls.str(H)
# another_key :  logi [1:3, 1:3] TRUE FALSE TRUE TRUE FALSE TRUE ...
# xyz : 'data.frame':    3 obs. of  2 variables:
#  $ x: int  1 2 3
#  $ y: chr  "a" "b" "c"
```

---

environment , *environment* .

```
H2 <- new.env()

H2[["a"]] <- LETTERS
H2[["b"]] <- as.list(x = 1:5, y = matrix(rnorm(10), 2))
H2[["c"]] <- head(mtcars, 3)
H2[["d"]] <- Sys.Date()
H2[["e"]] <- Sys.time()
H2[["f"]] <- (function() {
```

```
    H3 <- new.env()
    for (i in seq_along(names(H2))) {
        H3[[names(H2)[i]]] <- H2[[names(H2)[i]]]
    }
    H3
})()

ls.str(H2)
# a :  chr [1:26] "A" "B" "C" "D" "E" "F" "G" "H" "I" "J" "K" ...
# b : List of 5
#  $ : int 1
#  $ : int 2
#  $ : int 3
#  $ : int 4
#  $ : int 5
# c : 'data.frame':    3 obs. of  11 variables:
#  $ mpg : num  21 21 22.8
#  $ cyl : num  6 6 4
#  $ disp: num  160 160 108
#  $ hp  : num  110 110 93
#  $ drat: num  3.9 3.9 3.85
#  $ wt  : num  2.62 2.88 2.32
#  $ qsec: num  16.5 17 18.6
#  $ vs  : num  0 0 1
#  $ am  : num  1 1 1
#  $ gear: num  4 4 4
#  $ carb: num  4 4 1
# d :  Date[1:1], format: "2016-08-03"
# e :  POSIXct[1:1], format: "2016-08-03 19:25:14"
# f : <environment: 0x91a7cb8>

ls.str(H2$f)
# a :  chr [1:26] "A" "B" "C" "D" "E" "F" "G" "H" "I" "J" "K" ...
# b : List of 5
#  $ : int 1
#  $ : int 2
#  $ : int 3
#  $ : int 4
#  $ : int 5
# c : 'data.frame':    3 obs. of  11 variables:
#  $ mpg : num  21 21 22.8
#  $ cyl : num  6 6 4
#  $ disp: num  160 160 108
#  $ hp  : num  110 110 93
#  $ drat: num  3.9 3.9 3.85
#  $ wt  : num  2.62 2.88 2.32
#  $ qsec: num  16.5 17 18.6
#  $ vs  : num  0 0 1
#  $ am  : num  1 1 1
#  $ gear: num  4 4 4
#  $ carb: num  4 4 1
# d :  Date[1:1], format: "2016-08-03"
# e :  POSIXct[1:1], format: "2016-08-03 19:25:14"
```

`environment` R / .

```
names(H2)
#[1] "a" "b" "c" "d" "e" "f"
```

```
H2[[c("a", "b")]]
#Error in H2[[c("a", "b")]] :
#  wrong arguments for subsetting an environment

Keys <- c("a", "b")
H2[[Keys]]
#Error in H2[[Keys]] : wrong arguments for subsetting an environment
```

vapply list2env .

```
E1 <- new.env()
invisible({
    vapply(letters, function(x) {
        E1[[x]] <- rnorm(1)
        logical(0)
    }, FUN.VALUE = logical(0))
})

all.equal(sort(names(E1)), letters)
#[1] TRUE

Keys <- letters
E2 <- list2env(
    setNames(
        as.list(rnorm(26)),
        nm = Keys),
    envir = NULL,
    hash = TRUE
)

all.equal(sort(names(E2)), letters)
#[1] TRUE
```

- for .

:

R . . . R .

:

```
# Generic unique string generator
unique_strings <- function(n){
    string_i <- 1
    string_len <- 1
    ans <- character(n)
    chars <- c(letters,LETTERS)
    new_strings <- function(len,pfx){
    for(i in 1:length(chars)){
        if (len == 1){
        ans[string_i] <<- paste(pfx,chars[i],sep='')
        string_i <<- string_i + 1
        } else {
        new_strings(len-1,pfx=paste(pfx,chars[i],sep=''))
        }
        if (string_i > n) return ()
    }
```

```
    }
    while(string_i <= n){
    new_strings(string_len,'')
    string_len <- string_len + 1
    }
    sample(ans)
}

# Generate timings using an enviornment
timingsEnv <- plyr::adply(2^(10:15),.mar=1,.fun=function(i){
    strings <- unique_strings(i)
    ht1 <- new.env(hash=TRUE)
    lapply(strings, function(s){ ht1[[s]] <<- 0L})
    data.frame(
    size=c(i,i),
    seconds=c(
        system.time(for (j in 1:i) ht1[[strings[j]]]==0L)[3]),
    type = c('1_hashedEnv')
    )
})

timingsHash <- plyr::adply(2^(10:15),.mar=1,.fun=function(i){
    strings <- unique_strings(i)
    ht <- hash::hash()
    lapply(strings, function(s) ht[[s]] <<- 0L)
    data.frame(
    size=c(i,i),
    seconds=c(
        system.time(for (j in 1:i) ht[[strings[j]]]==0L)[3]),
    type = c('3_stringHash')
    )
})
```

: listenv

package:listenv , . . package:future package:future package:future . .
package : hash .

```
timingsListEnv <- plyr::adply(2^(10:15),.mar=1,.fun=function(i){
    strings <- unique_strings(i)
    le <- listenv::listenv()
    lapply(strings, function(s) le[[s]] <<- 0L)
    data.frame(
    size=c(i,i),
    seconds=c(
        system.time(for (k in 1:i) le[[k]]==0L)[3]),
    type = c('2_numericListEnv')
    )
})
```

: https://riptutorial.com/ko/r/topic/5179/-

130:

Examples

. ,   . matrix matrix   .

```
matrix(data = 1:6, nrow = 2, ncol = 3)
##      [,1] [,2] [,3]
## [1,]    1    3    5
## [2,]    2    4    6
```

, 1 6 2 3 . data   , nrow   , ncol   .   .   byrow   .

```
matrix(data = 1:6, nrow = 2, ncol = 3, byrow = TRUE)
##      [,1] [,2] [,3]
## [1,]    1    2    3
## [2,]    4    5    6
```

.   . :

```
matrix(data = c(TRUE, TRUE, TRUE, FALSE, FALSE, FALSE), nrow = 3, ncol = 2)
##      [,1]  [,2]
## [1,] TRUE FALSE
## [2,] TRUE FALSE
## [3,] TRUE FALSE
matrix(data = c("a", "b", "c", "d", "e", "f"), nrow = 3, ncol = 2)
##      [,1] [,2]
## [1,] "a"  "d"
## [2,] "b"  "e"
## [3,] "c"  "f"
```

.   . rownames colnames   .   NULL NULL .   .

```
mat1 <- matrix(data = 1:6, nrow = 2, ncol = 3, byrow = TRUE)
rownames(mat1)
## NULL
colnames(mat1)
## NULL
rownames(mat1) <- c("Row 1", "Row 2")
colnames(mat1) <- c("Col 1", "Col 2", "Col 3")
mat1
##       Col 1 Col 2 Col 3
## Row 1     1     2     3
## Row 2     4     5     6
```

.   .

class , is as   1   .

```
class(mat1)
## [1] "matrix"
is.matrix(mat1)
```

```
## [1] TRUE
as.vector(mat1)
## [1] 1 4 2 5 3 6
```

: https://riptutorial.com/ko/r/topic/9019/

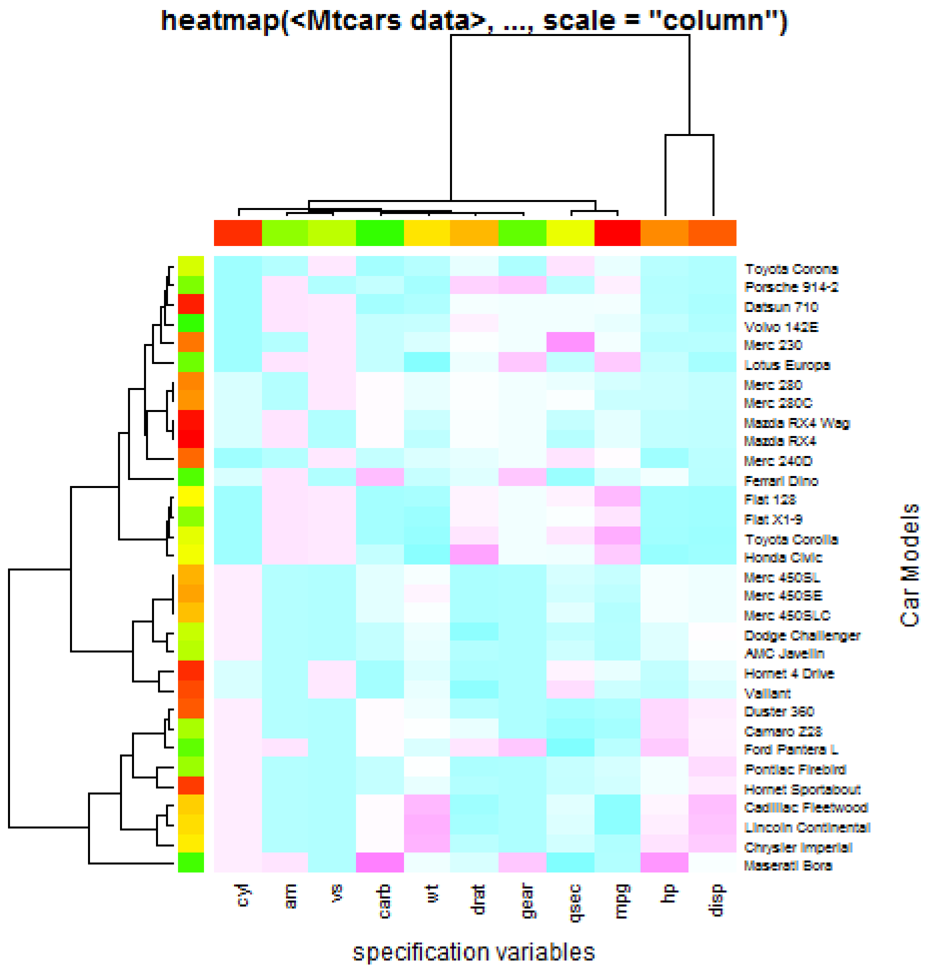
131: .2

Examples

:: heatmap

1 ( )

```
require(graphics); require(grDevices)
x  <- as.matrix(mtcars)
rc <- rainbow(nrow(x), start = 0, end = .3)
cc <- rainbow(ncol(x), start = 0, end = .3)
hv <- heatmap(x, col = cm.colors(256), scale = "column",
              RowSideColors = rc, ColSideColors = cc, margins = c(5,10),
              xlab = "specification variables", ylab =  "Car Models",
              main = "heatmap(<Mtcars data>, ..., scale = \"column\")")
```

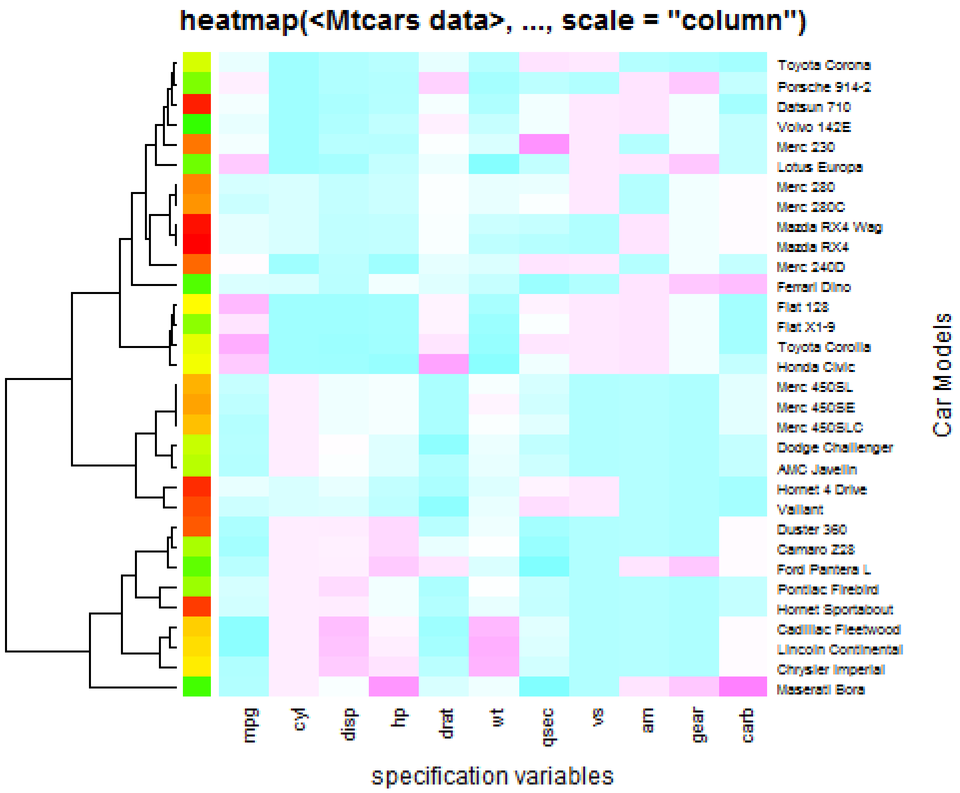



```
utils::str(hv) # the two re-ordering index vectors
# List of 4
#  $ rowInd: int [1:32] 31 17 16 15 5 25 29 24 7 6 ...
#  $ colInd: int [1:11] 2 9 8 11 6 5 10 7 1 4 ...
#  $ Rowv  : NULL
```

```
#   $ Colv   : NULL
```

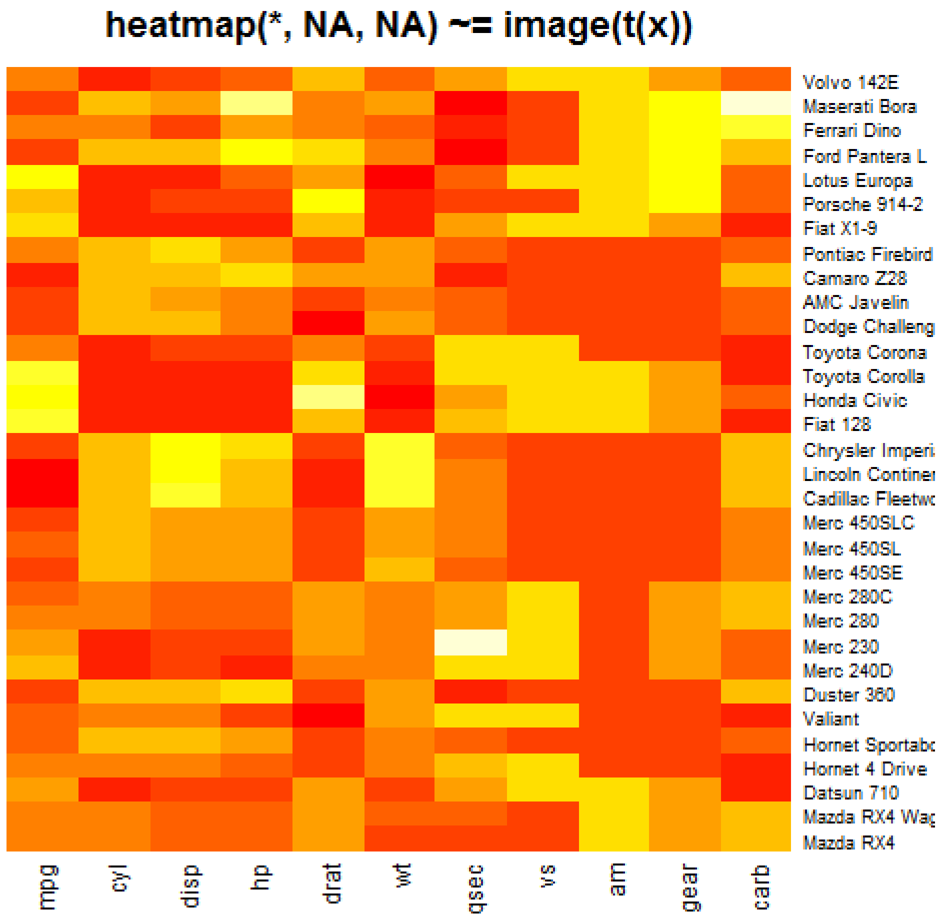
2 (( ))

```
heatmap(x, Colv = NA, col = cm.colors(256), scale = "column",
        RowSideColors = rc, margins = c(5,10),
        xlab = "specification variables", ylab =  "Car Models",
        main = "heatmap(<Mtcars data>, ..., scale = \"column\")")
```



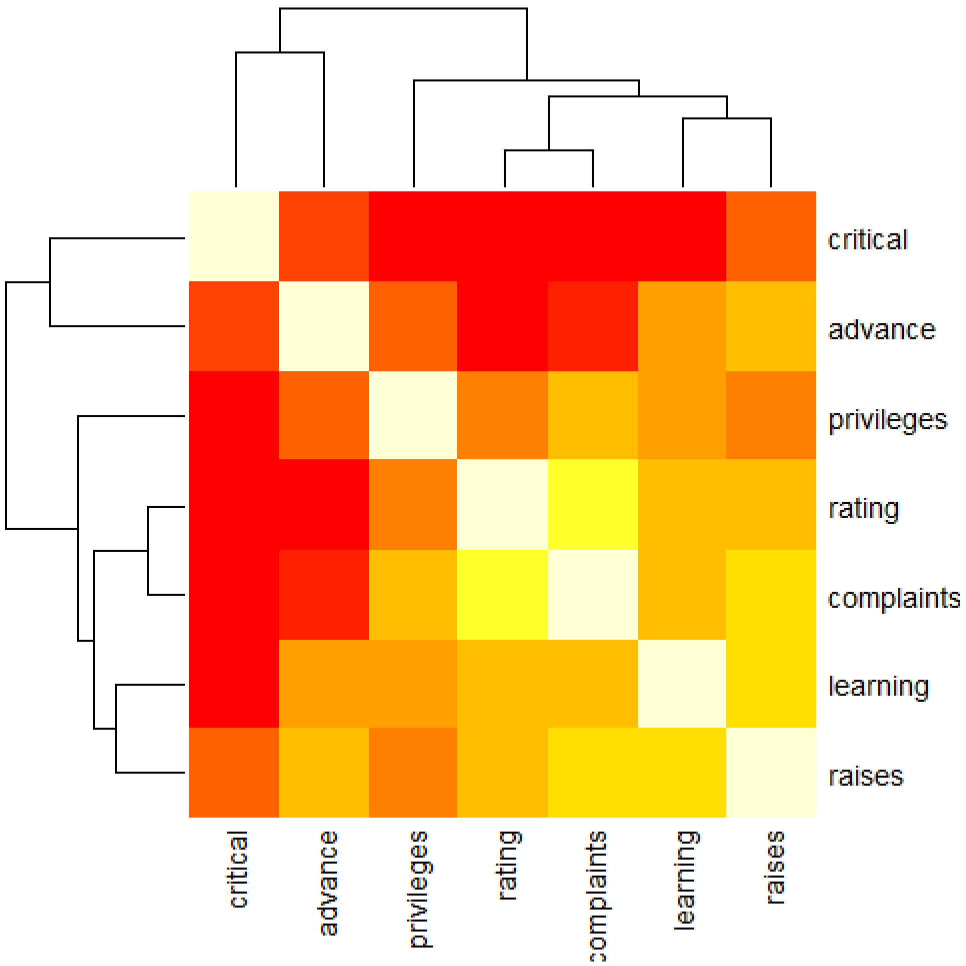
3 (" ")

```
heatmap(x, Rowv = NA, Colv = NA, scale = "column",
        main = "heatmap(*, NA, NA) ~= image(t(x))")
```



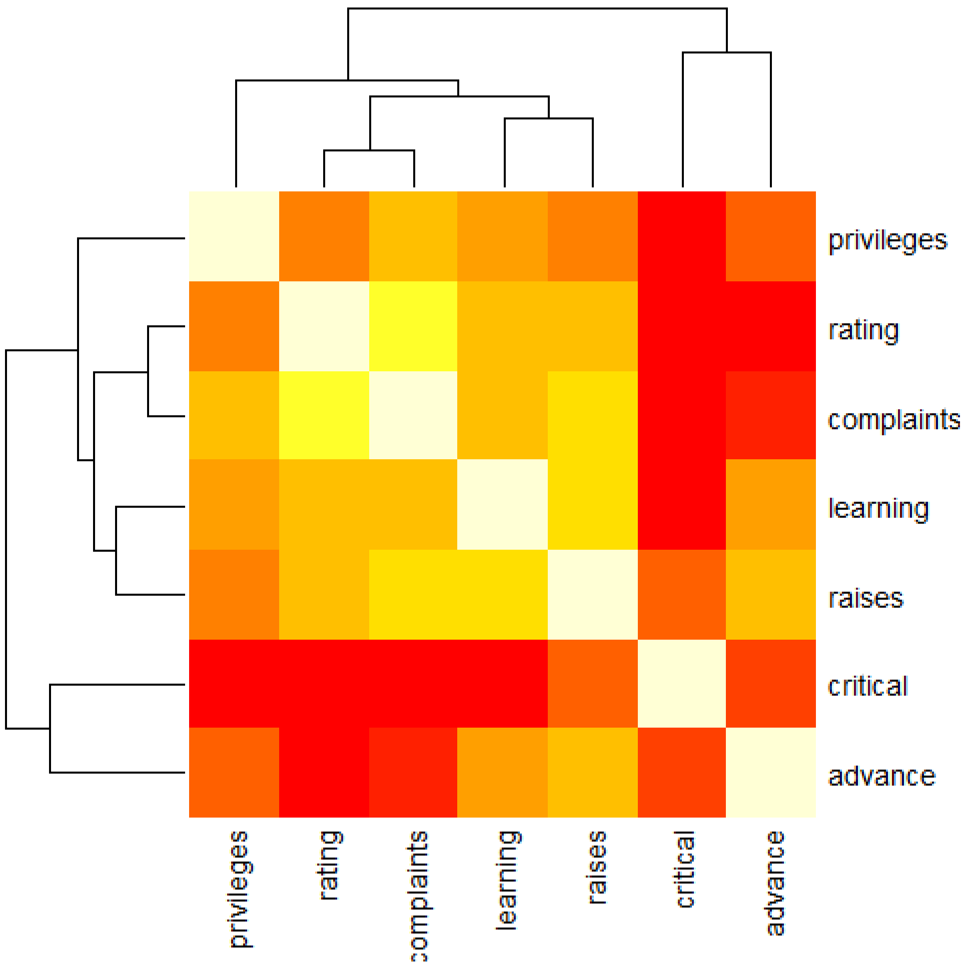
4 (reorder ())

```
round(Ca <- cor(attitude), 2)
#             rating complaints privileges learning raises critical advance
# rating        1.00       0.83       0.43     0.62   0.59     0.16    0.16
# complaints    0.83       1.00       0.56     0.60   0.67     0.19    0.22
# privileges    0.43       0.56       1.00     0.49   0.45     0.15    0.34
# learning      0.62       0.60       0.49     1.00   0.64     0.12    0.53
# raises        0.59       0.67       0.45     0.64   1.00     0.38    0.57
# critical      0.16       0.19       0.15     0.12   0.38     1.00    0.28
# advance       0.16       0.22       0.34     0.53   0.57     0.28    1.00
symnum(Ca) # simple graphic
#             rt cm p l rs cr a
# rating      1
# complaints +  1
# privileges .  .  1
# learning   ,  .  . 1
# raises     .  ,  . , 1
# critical            .  1
# advance          . . .    1
# attr(,"legend")
# [1] 0 ‘ ’ 0.3 ‘.’ 0.6 ‘,’ 0.8 ‘+’ 0.9 ‘*’ 0.95 ‘B’ 1
heatmap(Ca,                 symm = TRUE, margins = c(6,6))
```



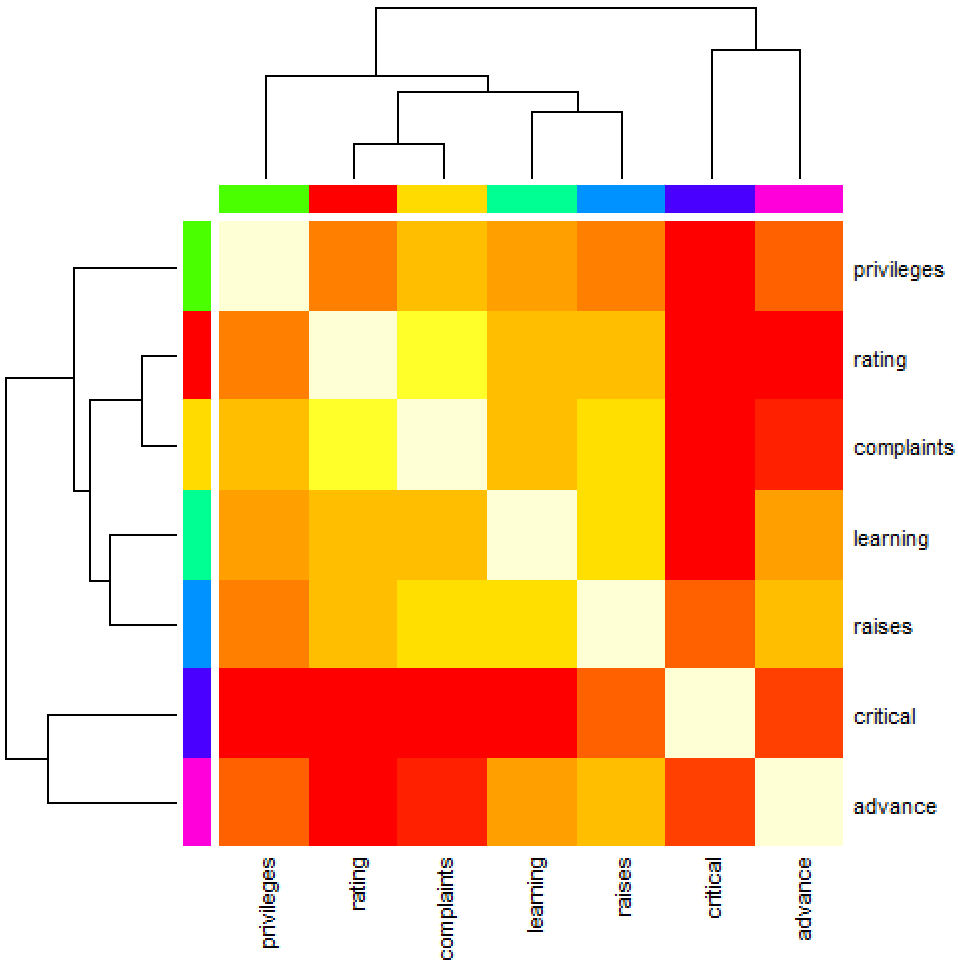
5 (*NO* reorder ())

```
heatmap(Ca, Rowv = FALSE, symm = TRUE, margins = c(6,6))
```



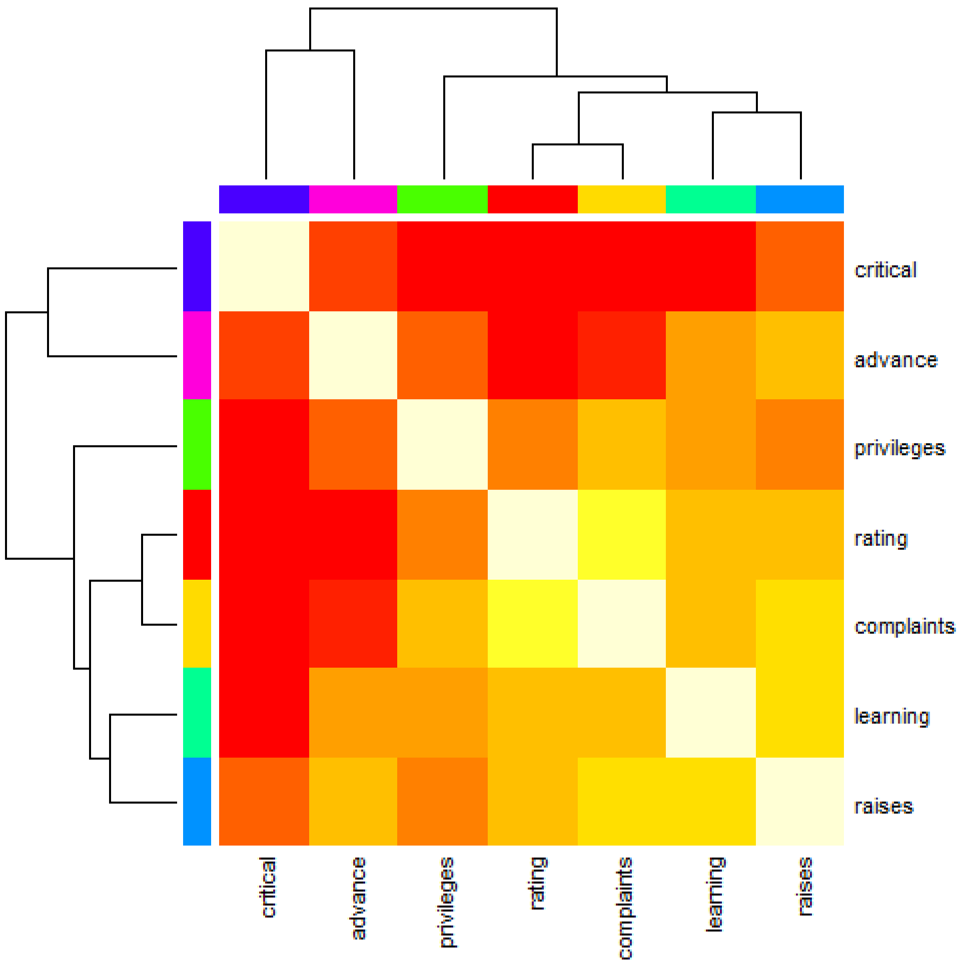
6 (,)

```
cc <- rainbow(nrow(Ca))
heatmap(Ca, Rowv = FALSE, symm = TRUE, RowSideColors = cc, ColSideColors = cc,
    margins = c(6,6))
```



7 ( )

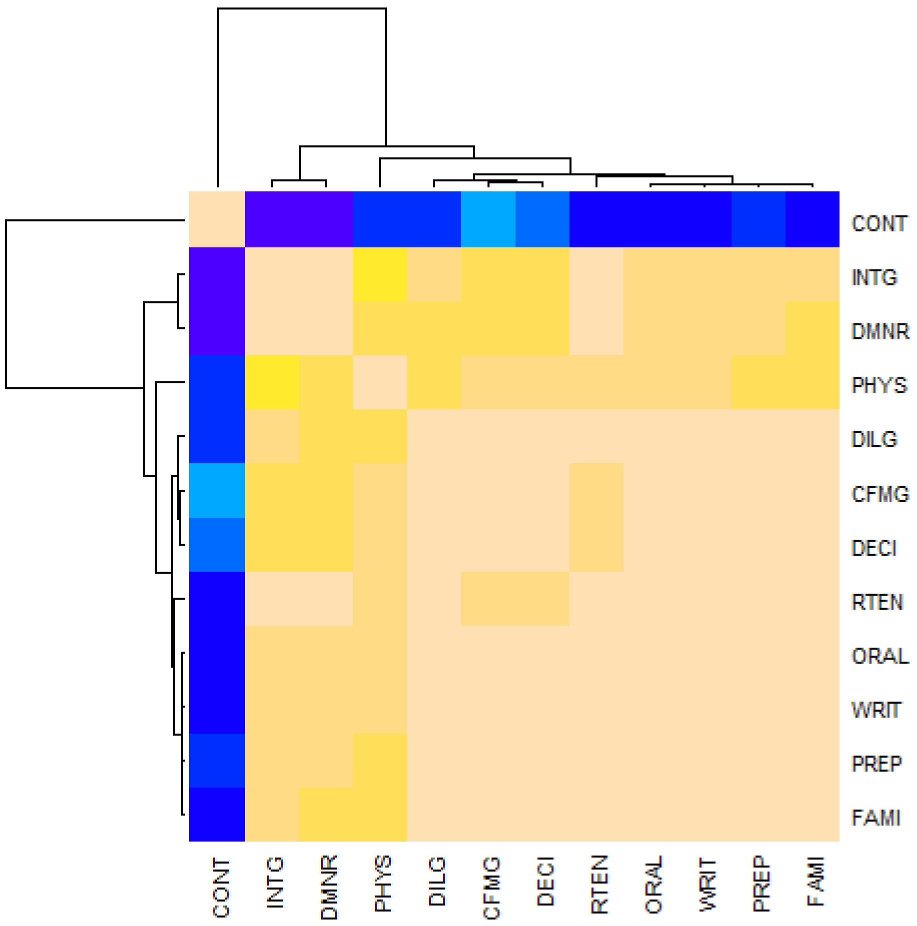
```
heatmap(Ca,         symm = TRUE, RowSideColors = cc, ColSideColors = cc,
    margins = c(6,6))
```



8 (cor ()   )

```
symnum( cU <- cor(USJudgeRatings) )
#      CO I DM DI CF DE PR F O W PH R
# CONT 1
# INTG    1
# DMNR    B 1
# DILG    + +  1
# CFMG    + +  B  1
# DECI    + +  B  B  1
# PREP    + +  B  B  B  1
# FAMI    + +  B  *  *  B  1
# ORAL    * *  B  B  *  B  B 1
# WRIT    * +  B  *  *  B  B B 1
# PHYS    , ,  +  +  +  +  + + + 1
# RTEN    * *  *  *  *  B  * B B *  1
# attr(,"legend")
# [1] 0 ‘ ’ 0.3 ‘.’ 0.6 ‘,’ 0.8 ‘+’ 0.9 ‘*’ 0.95 ‘B’ 1

hU <- heatmap(cU, Rowv = FALSE, symm = TRUE, col = topo.colors(16),
             distfun = function(c) as.dist(1 - c), keep.dendro = TRUE)
```




```
## The Correlation matrix with same reordering:
round(100 * cU[hU[[1]], hU[[2]]])
#       CONT INTG DMNR PHYS DILG CFMG DECI RTEN ORAL WRIT PREP FAMI
# CONT   100  -13  -15    5    1   14    9   -3   -1   -4    1   -3
# INTG   -13  100   96   74   87   81   80   94   91   91   88   87
# DMNR   -15   96  100   79   84   81   80   94   91   89   86   84
# PHYS     5   74   79  100   81   88   87   91   89   86   85   84
# DILG     1   87   84   81  100   96   96   93   95   96   98   96
# CFMG    14   81   81   88   96  100   98   93   95   94   96   94
# DECI     9   80   80   87   96   98  100   92   95   95   96   94
# RTEN    -3   94   94   91   93   93   92  100   98   97   95   94
# ORAL    -1   91   91   89   95   95   95   98  100   99   98   98
# WRIT    -4   91   89   86   96   94   95   97   99  100   99   99
# PREP     1   88   86   85   98   96   96   95   98   99  100   99
# FAMI    -3   87   84   84   96   94   94   94   98   99   99  100
```

```
## The column dendrogram:
utils::str(hU$Colv)
# --[dendrogram w/ 2 branches and 12 members at h = 1.15]
#   |--leaf "CONT"
#   `--[dendrogram w/ 2 branches and 11 members at h = 0.258]
#      |--[dendrogram w/ 2 branches and 2 members at h = 0.0354]
#      |  |--leaf "INTG"
#      |  `--leaf "DMNR"
#      `--[dendrogram w/ 2 branches and 9 members at h = 0.187]
#         |--leaf "PHYS"
#         `--[dendrogram w/ 2 branches and 8 members at h = 0.075]
#            |--[dendrogram w/ 2 branches and 3 members at h = 0.0438]
#            |  |--leaf "DILG"
```

```
#             |  `--[dendrogram w/ 2 branches and 2 members at h = 0.0189]
#             |     |--leaf "CFMG"
#             |     `--leaf "DECI"
#             `--[dendrogram w/ 2 branches and 5 members at h = 0.0584]
#                |--leaf "RTEN"
#                `--[dendrogram w/ 2 branches and 4 members at h = 0.0187]
#                   |--[dendrogram w/ 2 branches and 2 members at h = 0.00657]
#                   |  |--leaf "ORAL"
#                   |  `--leaf "WRIT"
#                   `--[dendrogram w/ 2 branches and 2 members at h = 0.0101]
#                      |--leaf "PREP"
#                      `--leaf "FAMI"
```

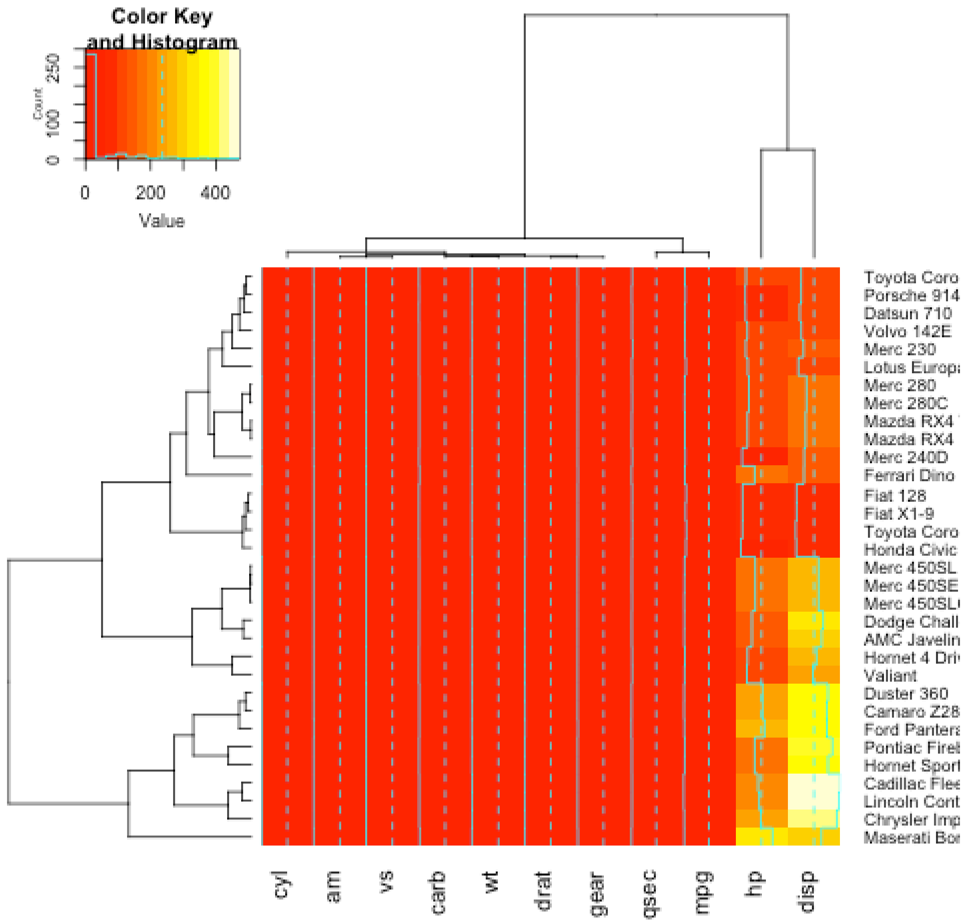
2

:

```
x  <- as.matrix(mtcars)
```

heatmap.2 - heatmap ,

```
require(gplots)
heatmap.2(x)
```

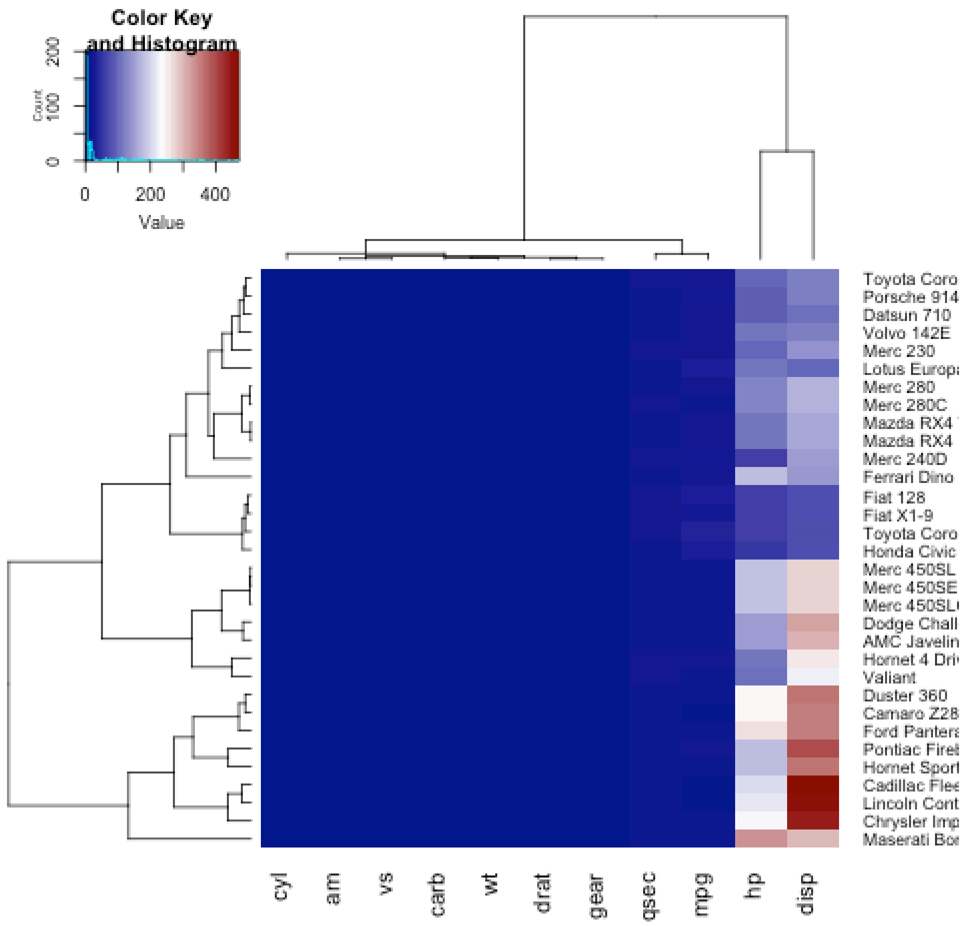


, x y main , xlab ylab .

```
heatmap.2(x, main = "My main title: Overview of car features", xlab="Car features", ylab =
"Car brands")
```

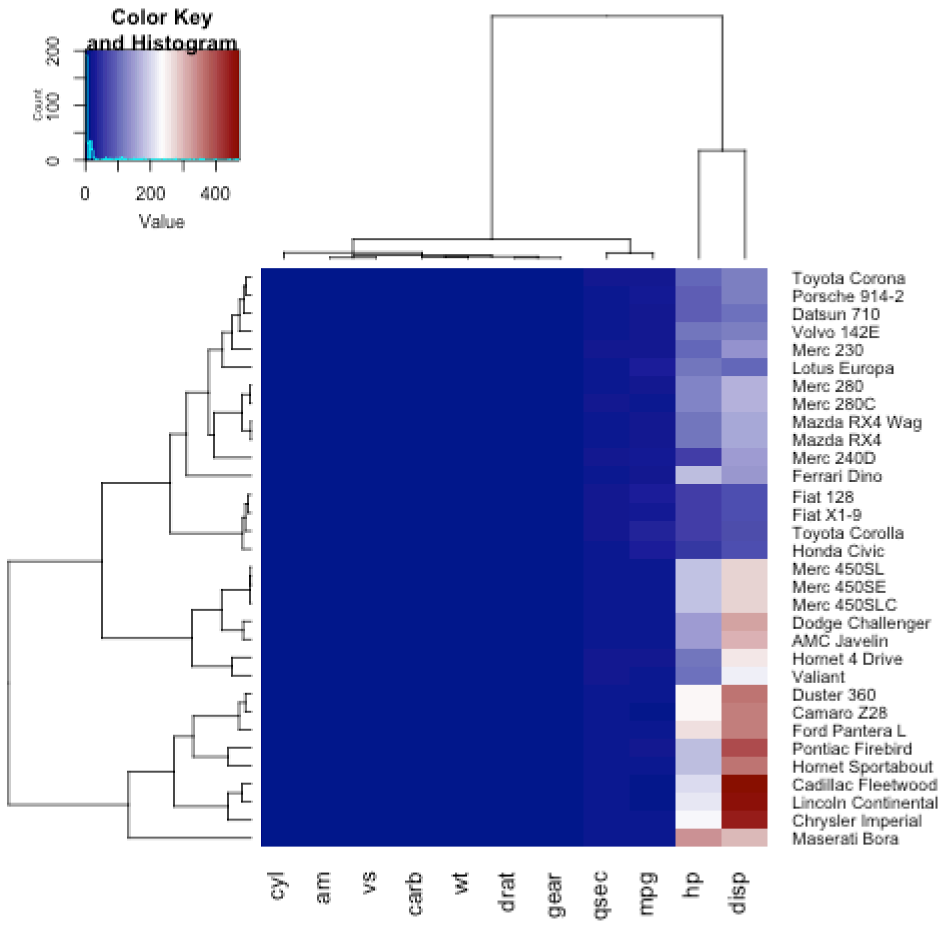
colorRampPalette col .

```
heatmap.2(x, trace="none", key=TRUE, Colv=FALSE,dendrogram = "row",col =
colorRampPalette(c("darkblue","white","darkred"))(100))
```



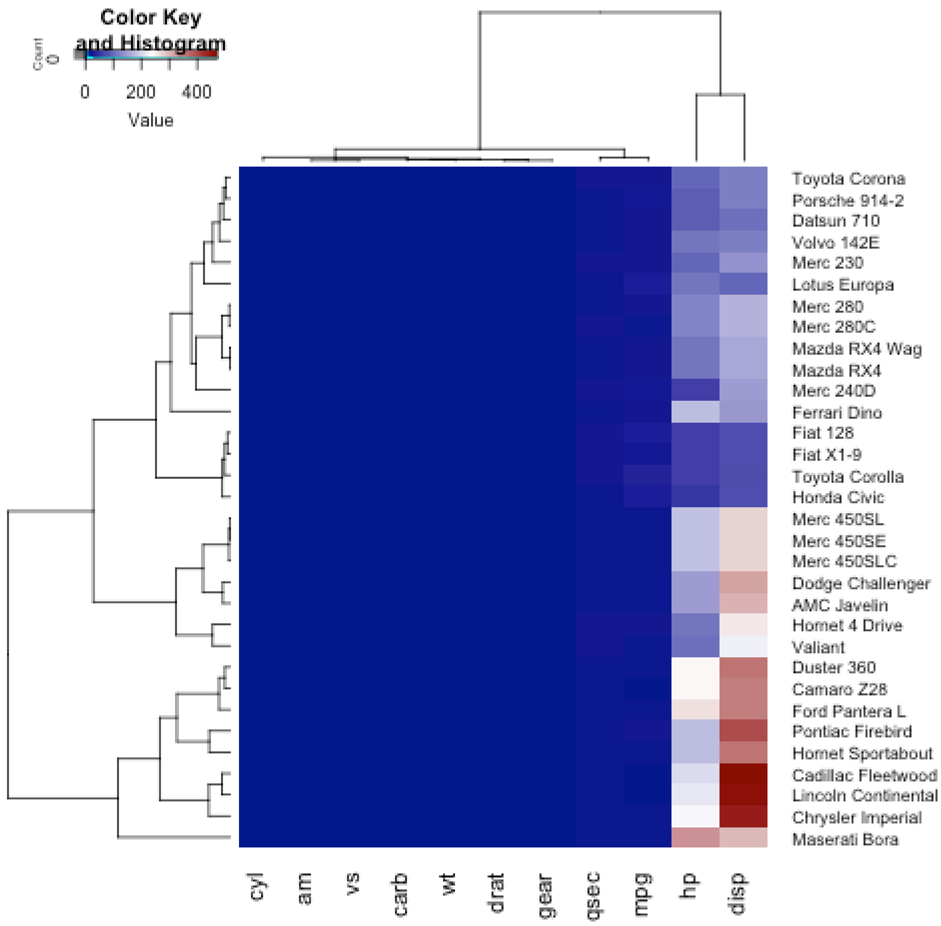
y () . margins .

```
heatmap.2(x, trace="none", key=TRUE,col =
colorRampPalette(c("darkblue","white","darkred"))(100), margins=c(5,8))
```



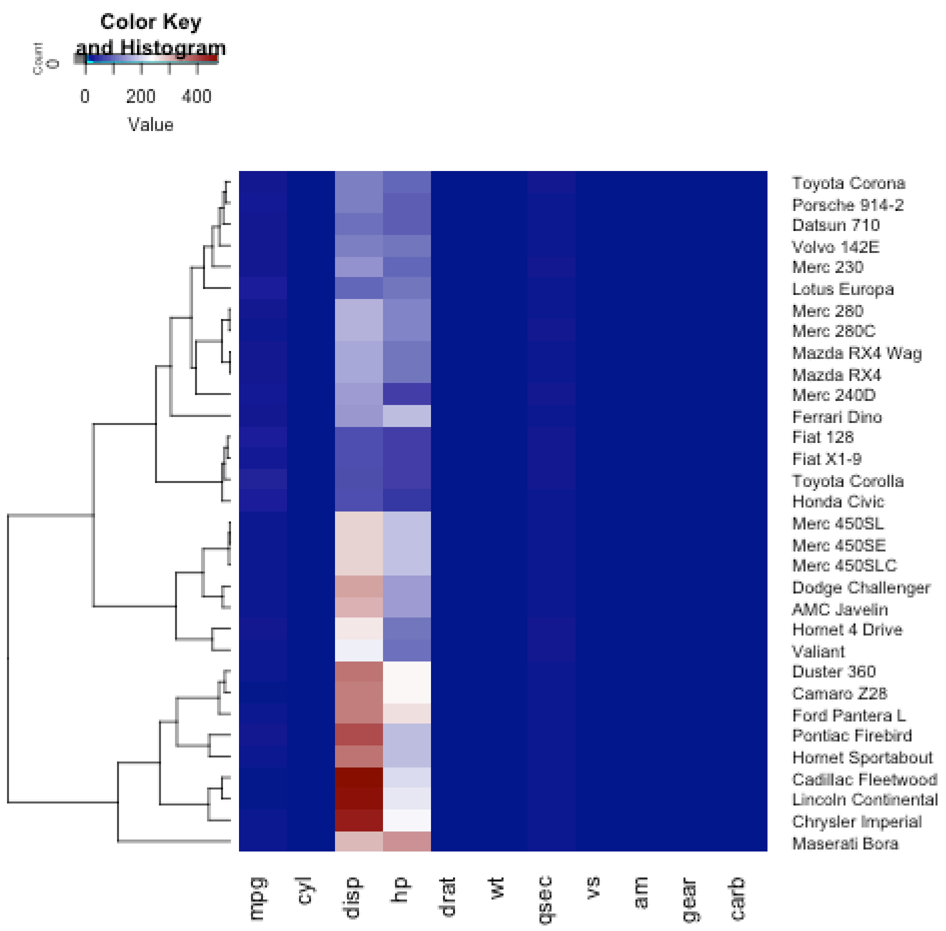
Color Key
and Histogram
Count
0
100
200
0
200
400
Value
Toyota Corona
Porsche 914-2
Datsun 710
Volvo 142E
Merc 230
Lotus Europa
Merc 280
Merc 280C
Mazda RX4 Wag
Mazda RX4
Merc 240D
Ferrari Dino
Fiat 128
Fiat X1-9
Toyota Corolla
Honda Civic
Merc 450SL
Merc 450SE
Merc 450SLC
Dodge Challenger
AMC Javelin
Hornet 4 Drive
Valiant
Duster 360
Camaro Z28
Ford Pantera L
Pontiac Firebird
Hornet Sportabout
Cadillac Fleetwood
Lincoln Continental
Chrysler Imperial
Maserati Bora
cyl
am
vs
carb
wt
drat
gear
qsec
mpg
hp
disp

`lhei` `lwid` (,) .



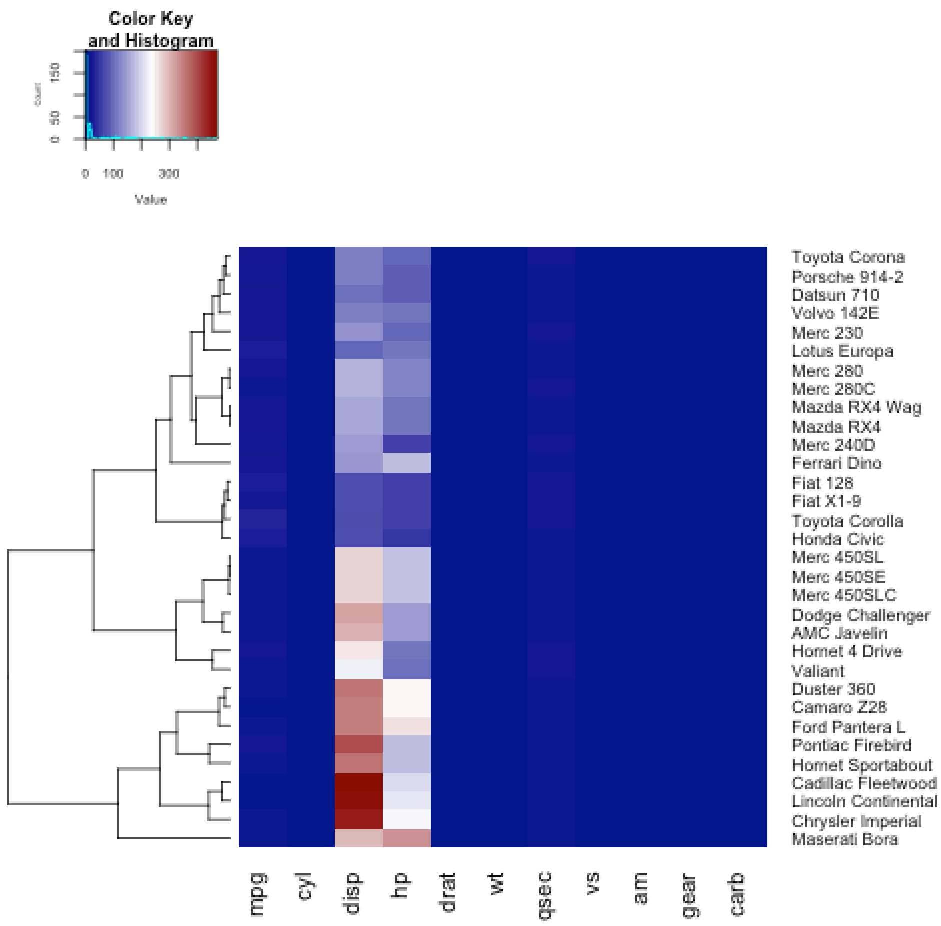
( ) `Colv=FALSE` (`Rowv=FALSE`) `dendogram` .

```
heatmap.2(x, trace="none", key=TRUE, Colv=FALSE, dendrogram = "row", col =
colorRampPalette(c("darkblue","white","darkred"))(100), margins=c(5,8), lwid = c(5,15), lhei =
c(3,15))
```



, par cex.main, cex.lab, cex.axis .

```
par(cex.main=1, cex.lab=0.7, cex.axis=0.7)
heatmap.2(x, trace="none", key=TRUE, Colv=FALSE, dendrogram = "row", col =
colorRampPalette(c("darkblue","white","darkred"))(100), margins=c(5,8), lwid = c(5,15), lhei =
c(5,15))
```



.2 : https://riptutorial.com/ko/r/topic/4814/------2

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119		Hack-R
120	R .	Umberto
121	(%> %)	42-, Alexandru Papiu, Alihan Zıhna, alistaire, AndreyAkinshin, Artem Klevtsov, Atish, Axeman, Benjamin, Carlos Cinelli, CMichael, DrPositron, Franck Dernoncourt, Frank, Gal Dreiman, Gavin Simpson, Gregor, ikashnitsky, James McCalden, Kay Brodersen, Matt, polka, RamenChef, Ryan Hilbert, Sam Firke, seasmith, Shawn Mehan, Simplans, Spacedman, SymbolixAU, thelatemail, tomw, TriskalJM, user2100721
122		Frank, Sowmya S. Manian
123		Aaghaz Hussain, akraf, alko989, Andrew Brēza, Artem Klevtsov, Arun Balakrishnan, Christophe D., CL., Frank, gitblame, Hack-R, hongsy, Jaap, kaksat, kneijenhuijs, lmckeogh, loki, Marc Brinkmann, Miha, Peter Humburg, Pragyaditya Das, Raj

		Padmanabhan, seasmith, SymbolixAU, theArun, user890739, xamgore, zx8754
124		Abdou, Alex, Artem Klevtsov, David Arenburg, David Leal, Frank, Gavin Simpson, Jaap, NWaters, R. Schifini, SommerEngineering, Steve_Corrin, Tensibai, thelatemail, user2100721
125	(CSV, TSV)	a.powell, Aaghaz Hussain, abhiieor, Alex, alistaire, Andrea Cirillo, bartektartanus, Carl Witthoft, Carlos Cinelli, catastrophic-failure, cdrini, Charmgoggles, Crops, DaveRGP, David Arenburg, Dawny33, Derwin McGeary, EDi, Eric Lecoutre, FoldedChromatin, Frank, Gavin Simpson, gitblame, Hairizuan Noorazman, herbaman, ikashnitsky, Jaap, Jeromy Anglim, JHowIX, joeyreid, Jordan Kassof, K.Daisey, kitman0804, kneijenhuijs, lmo, loki, Miha, PAC, polka, russellpierce, Sam Firke, stats-hb, Thomas, Uwe, zacdav, zelite, zx8754
126	: +	YCR
127		Hack-R
128		42-, Agriculturist, alexis_laz, alistaire, dayne, Frank, Gavin Simpson, Gregor, L.V.Rao, Mario, mrip, RamenChef, smci, user2100721, zx8754
129		nrussell, russellpierce
130		dayne, Frank
131	.2	AndreyAkinshin, Nanami