jinha

8/8/23

Table of contents

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- :
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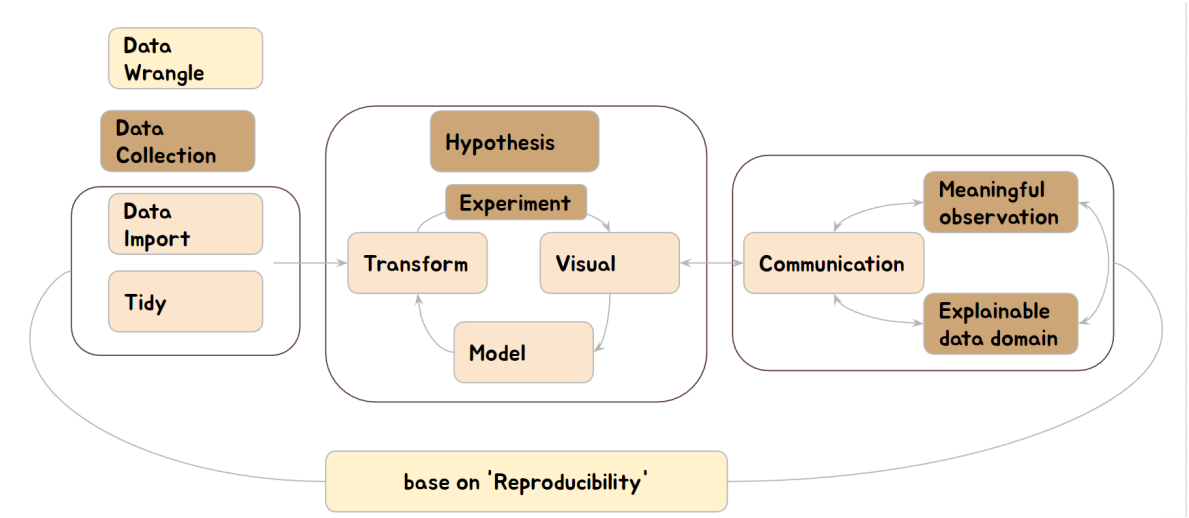

Data Wrangle
Data Collection
Data Import
Tidy
Hypothesis
Experiment
Transform
Visual
Model
Communication
Meaningful observation
Explainable data domain
base on 'Reproducibility'

R, Rstudio, markdown, Shiny server, PostgreSQL github . R ,
. Rafael A. Irizarry Hadley Wickham . .

books

title	authos	url
Introduction to Data Science with R	Rafael A. Irizarry	https://rafalab.github.io/dsbook/
R for Data Science	Garrett Grolemund, Hadley Wickham	https://r4ds.had.co.nz/index.html

- I hope you will get valuable experience with me.

  .!!! **jinha**

Part I

I. R

1 R & R studio

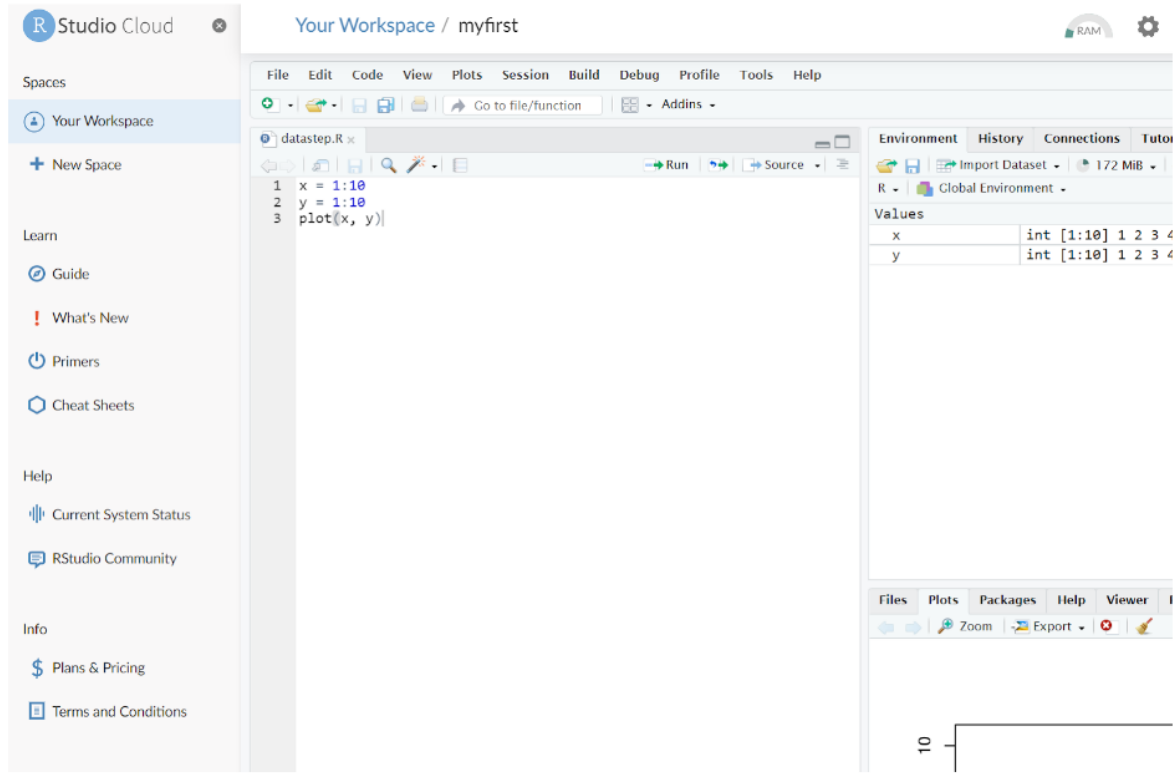
R R studio . rstudio cloud .

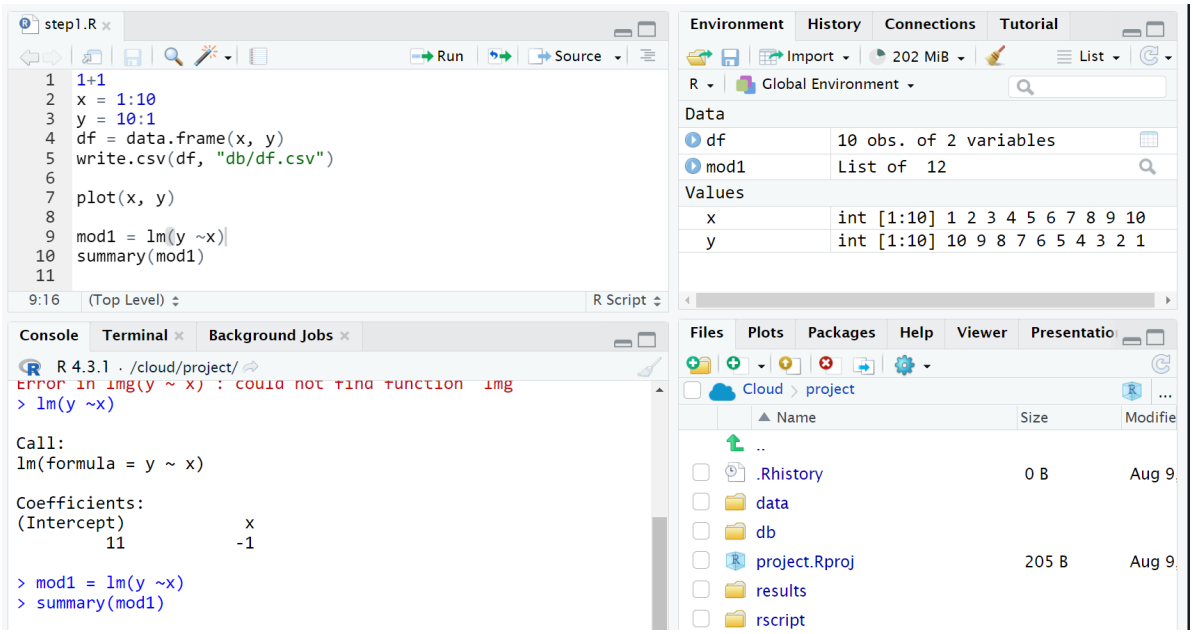
1.1 Rstudio Cloud

R studio cloud R R studio . , .

- Rstudio cloud
  - RStudio Cloud .
  - .
  - New Project .
  - .

.


Studio Cloud
Your Workspace / myfirst
Spaces
Your Workspace
New Space
Learn
Guide
What's New
Primers
Cheat Sheets
Help
Current System Status
RStudio Community
Info
Plans & Pricing
Terms and Conditions
File Edit Code View Plots Session Build Debug Profile Tools Help
datastep.R
1 x = 1:10
2 y = 1:10
3 plot(x, y)
Environment History Connections
Values
x int [1:10] 1 2 3 4
y int [1:10] 1 2 3 4
Files Plots Packages Help Viewer
Zoom Export
10


step1.R
1 1+1
2 x = 1:10
3 y = 10:1
4 df = data.frame(x, y)
5 write.csv(df, "db/df.csv")
6
7 plot(x, y)
8
9 mod1 = lm(y ~x)
10 summary(mod1)
11
9:16 (Top Level) R Script
Environment History Connections Tutorial
Import 202 MiB List
R Global Environment
Data
df 10 obs. of 2 variables
mod1 List of 12
Values
x int [1:10] 1 2 3 4 5 6 7 8 9 10
y int [1:10] 10 9 8 7 6 5 4 3 2 1
Console Terminal Background Jobs
R 4.3.1 · /cloud/project/
Error in lmg(y ~ x) : could not find function "lmg"
> lm(y ~x)
Call:
lm(formula = y ~ x)
Coefficients:
(Intercept) x
11 -1
> mod1 = lm(y ~x)
> summary(mod1)
Files Plots Packages Help Viewer Presentatio
Cloud project
Name Size Modifie
..
.Rhistory 0 B Aug 9
data
db
project.Rproj 205 B Aug 9
results
rscript

1.2 R and R studio on Window system

Windows R R .

1. R cran .

- .

2. R .
3. Windows R
4. Base → Install R for the first Time
5. **Download R * for Windows**

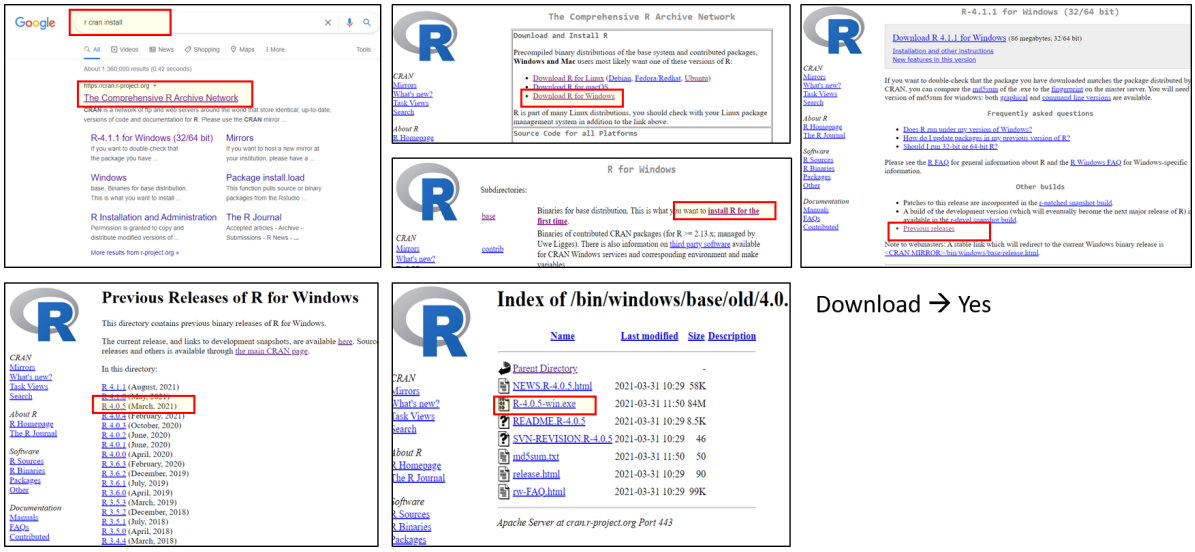


Figure 1.1: R

1.2.1 R studio install

R . Rstudio . https://posit.co/download/rstudio-desktop/

R studio .

1.2.2 R studio project

R . . .

. .

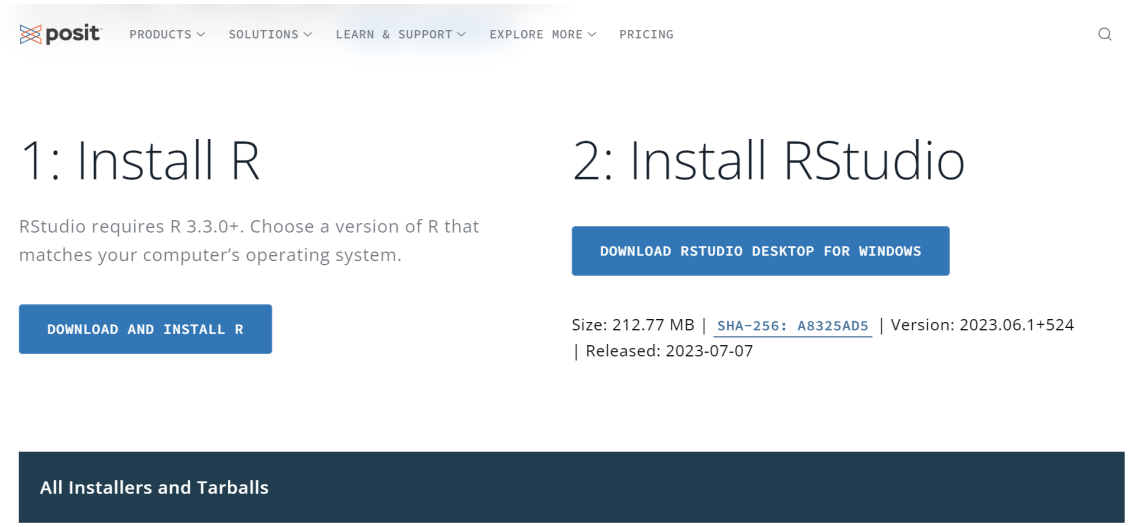


Figure 1.2: R

Windows .

, R .

1.3 R and R studio on Ubuntus

R . , . . , docs .

Google Doc Google Doc Download

2 R

2.1 vector matirx list

2.1.1 objects

(value) (variable) . .

```
a <-1
b <-2
c <- -1

a*b+c
```

```
[1] 1
```

. (numeric), (character), (logical) .

```
student_a_age  <- 43
student_a_name <- '  '
student_a_pass <- FALSE
```

, 0 .

2.1.2 (Vectors), (factors)

. c() c **concatenate** C . (missing value) NA NAN .
, my_vector[i] i .

```
student_all_age <- c(24, 31, 40, 16)
student_all_age
```

```
[1] 24 31 40 16
```

.

```
student_all_age[1]
student_all_age[1:2]
student_all_age[c(1, 3)]
student_all_age[-4]
```

. max(), min(), range(), length(), sum(), mean(), prod(), sd(), var(), sort() .

```
max(student_all_age)
```

```
[1] 40
```

```
length(student_all_age)
```

```
[1] 4
```

```
student_all_name <- c(' ', ' ', ' ', ' ')
summary(student_all_name)
```

```
   Length     Class      Mode
        4 character character
```

```
student_all_class <- c('group1','group2', 'group1', 'group2' )
summary(student_all_class)
```

```
   Length     Class      Mode
        4 character character
```

student_all_class group 1 2 . . sutdent_all_class .

```
student_all_group <-factor(c('group1','group2', 'group1', 'group2' ))
summary(student_all_group)
```

```
group1 group2
     2      2
```

group .

```
tapply(student_all_age, student_all_group, mean)
```

```
group1 group2
  32.0   23.5
```

*apply . , 1 . 2

2.1.3 (Matrix), (data frame), (list)

. (row) (column) , . .

```
A1 = matrix(
     c(1, 2, 3, 4, 5, 6, 7, 8),  #
     nrow=2,                     #
     ncol=4,                     #
     byrow = TRUE)               #
A1 #
```

1, 2, 3, 4, 5, 6, 7, 8

```
     [,1] [,2]
[1,]    1    2
[2,]    3    4
[3,]    5    6
[4,]    7    8
```

(column) .

```
dspub_class <- data.frame(
  'name'  = student_all_name,
  'age'   = student_all_age,
  'group' = student_all_group
)
dspub_class
```

```
  name age  group
1    24 group1
2    31 group2
3    40 group1
4    16 group2
```

tidyverse . %>% pipe . mutate .

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

```
dspub_class %>%
  group_by(group) %>%
  summarize(avg = mean(age))
```

```
# A tibble: 2 x 2
  group    avg
  <fct>  <dbl>
1 group1  32
2 group2  23.5
```

. DSpub group1 gropu2 . / , / . .

```
homework1 <- dspub_class %>%
  group_by(group) %>%
  mutate(avg_age = mean(age))
homework2 <- dspub_class %>%
  group_by(group) %>%
  mutate(max_age = max(age))
```

```
homework1
```

```
# A tibble: 4 x 4
# Groups:   group [2]
  name    age group  avg_age
  <chr> <dbl> <fct>    <dbl>
1       24 group1    32
2       31 group2    23.5
3       40 group1    32
4       16 group2    23.5
```

```
homework2
```

```
# A tibble: 4 x 4
# Groups:   group [2]
  name    age group  max_age
  <chr> <dbl> <fct>    <dbl>
1       24 group1      40
2       31 group2      31
3       40 group1      40
4       16 group2      31
```

, list .

```
second_week_dspub <-
  list(
       student_all_age,
       student_all_class,
       student_all_group,
       student_all_name,
       dspub_class,
       homework1,
       homework2
       )
second_week_dspub
```

```
[[1]]
[1] 24 31 40 16

[[2]]
[1] "group1" "group2" "group1" "group2"

[[3]]
[1] group1 group2 group1 group2
Levels: group1 group2

[[4]]
[1] " " " " " " " " " "

[[5]]
  name age  group
1    24 group1
```

```
2    31 group2
3    40 group1
4    16 group2

[[6]]
# A tibble: 4 x 4
# Groups:   group [2]
  name    age group  avg_age
  <chr> <dbl> <fct>    <dbl>
1       24 group1    32
2       31 group2    23.5
3       40 group1    32
4       16 group2    23.5

[[7]]
# A tibble: 4 x 4
# Groups:   group [2]
  name    age group  max_age
  <chr> <dbl> <fct>    <dbl>
1       24 group1      40
2       31 group2      31
3       40 group1      40
4       16 group2      31
```

, list . list .

```
second_week_dspub[[7]]
```

```
# A tibble: 4 x 4
# Groups:   group [2]
  name    age group  max_age
  <chr> <dbl> <fct>    <dbl>
1       24 group1      40
2       31 group2      31
3       40 group1      40
4       16 group2      31
```

2.2

. **1+2** , **log2(10)** . Rsutdio .

```r
3+4;4-3;4/3;3*4
log2(10)
abs(-4)
sqrt(4)
```

.

Operator	Description
+	addition
-	subtraction
*	multiplication
/	division
^ or **	exponentiation
x %% y	modulus (x mod y) 5%%2 is 1
x %/% y	integer division 5%/%2 is 2

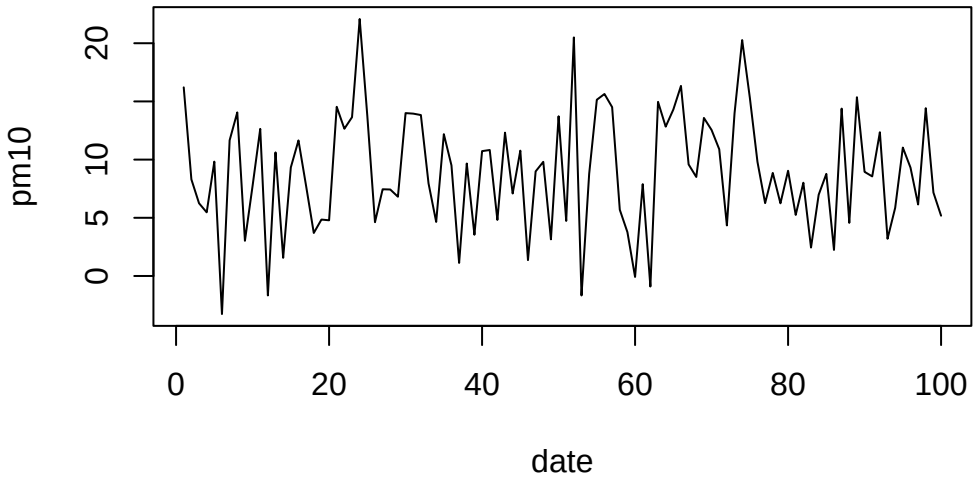
Operator	Description
<	less than
<=	less than or equal to
>	greater than
>=	greater than or equal to
==	exactly equal to
!=	not equal to
!x	Not x
x	y
x & y	x AND y
isTRUE(x)	test if X is TRUE

Operator	Description
Logarithms and exponentials	log2(x), log10(x), exp(x)
Trigonometric functions	cos(x), sin(x), tan(x), acos(x), asin(x), atan(x)
Others	abs(x): absolute value; sqrt(x): square root.

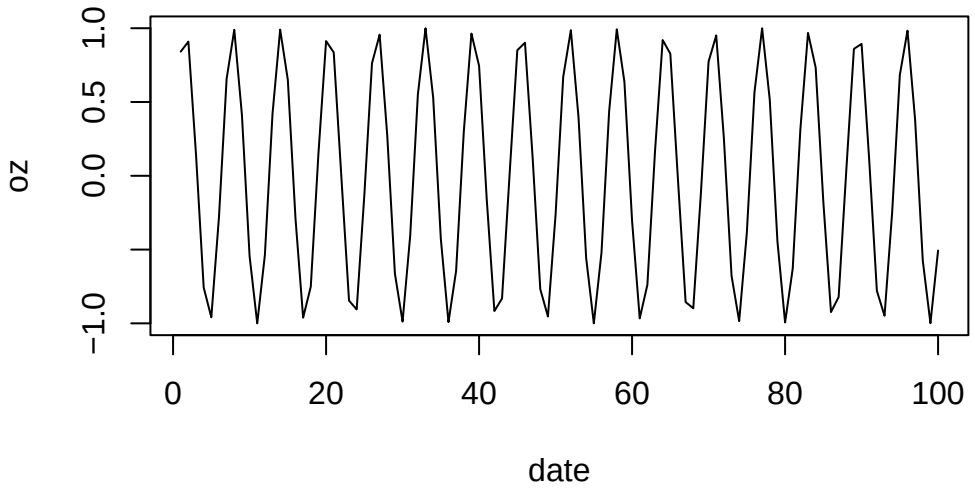
.

```r
pm10 = rnorm(n=100, mean = 10, sd = 5) #    10      5  100       pm10
date= rep(1:100)  # 1   100
```

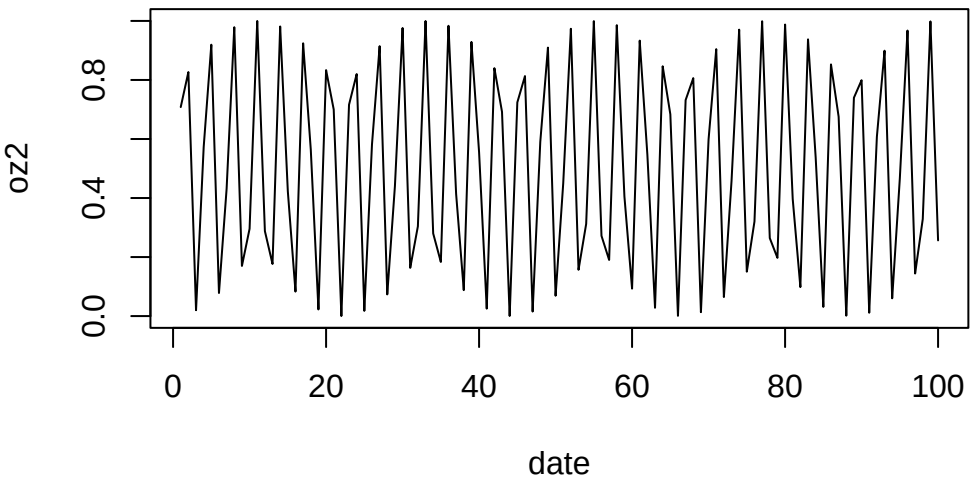
```r
plot(x=date, y=pm10, type = "l") # "l" line       .
```



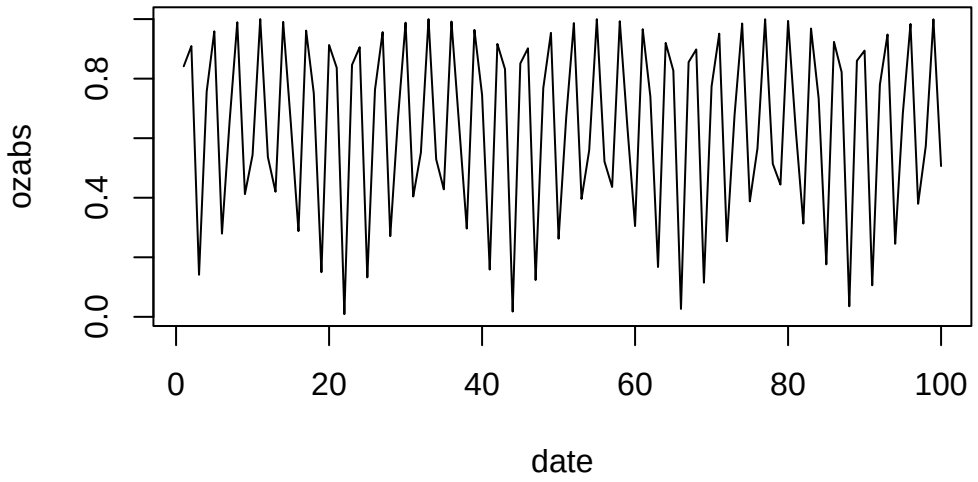

```r
oz = sin(date) #                    . sine
plot(x=date, y = oz, type = "l") #
```



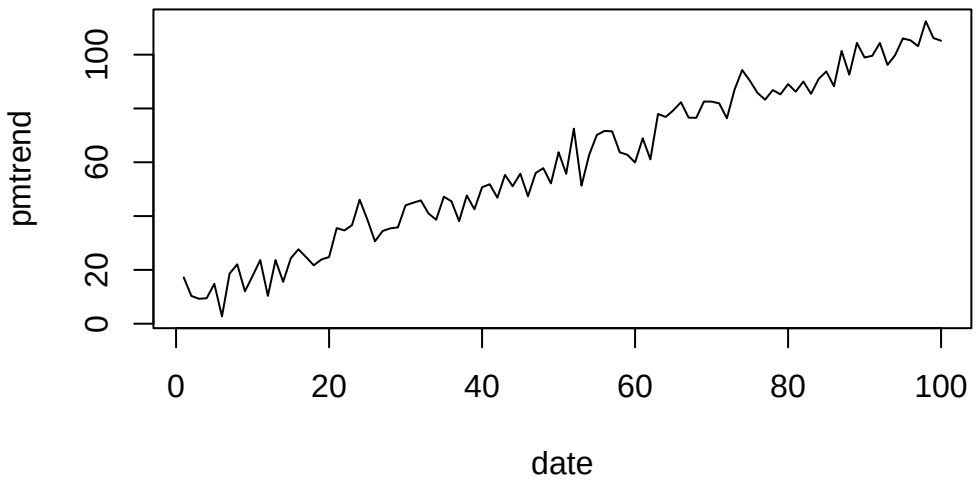

```
oz2 = oz**2 # -          .
plot(x=date, y = oz2, type = "l") #
```



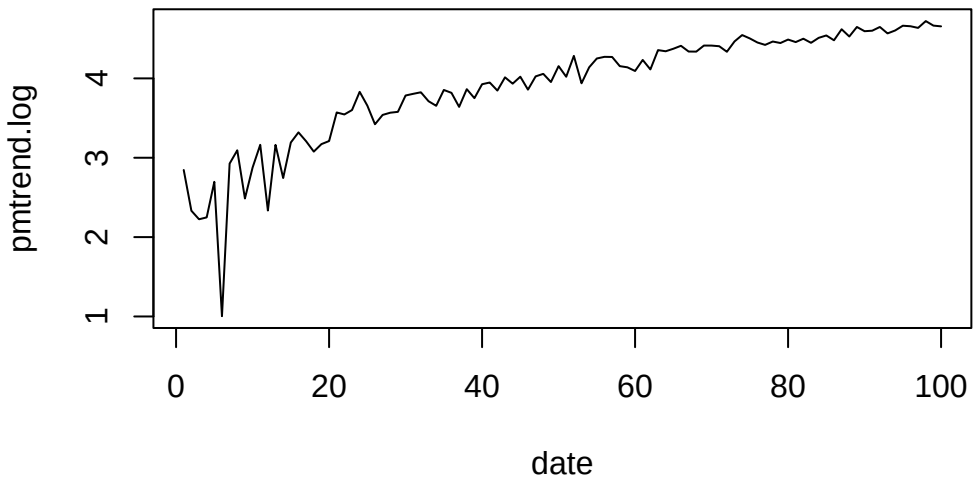
```r
ozabs = abs(oz) #          ?
plot(x=date, y = ozabs, type = "l") #
```




```r
pmtrend = pm10 + date  #      pm10
plot(x=date, y = pmtrend, type="l")
```




```
pmtrend.log = log(pmtrend) #        .                .
plot(x=date, y = pmtrend.log, type="l") #
```



2.3

if-else . 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 5 A B .

```
nums<- 1
if (nums <5) {
        chars = 'A'
} else{
        chars = 'B'
}
chars
```

```
[1] "A"
```

```
nums <- 6
if (nums <5) {
        chars = 'A'
} else{
        chars = 'B'
}
chars
```

```
[1] "B"
```

.

```
a<-round(rnorm(10)*10)
a
```

```
 [1] -13   6 -17  -3  -5  10  10  -4   7   1
```

```
tab <- ifelse(a>0, ' ', ' ')
tab
```

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

```
data.frame(a, tab)
```

```
     a  tab
1  -13
2    6
3  -17
4   -3
5   -5
6   10
7   10
8   -4
9    7
10   1
```

any() all() . any() TRUE TRUE , all() TRUE TRUE .

```
new.var <- c(1, 2, NA)
is.na(new.var)
```

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

```
any(is.na(new.var))
```

```
[1] TRUE
```

```
all(is.na(new.var))
```

```
[1] FALSE
```

index IF (Where) . iris Sepal.Length , Sepal.Length Species . ?

```
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
```

```r
table(iris$Species)
```

```
    setosa versicolor  virginica
        50         50         50
```

```r
max(iris$Sepal.Length)
```

```
[1] 7.9
```

```r
max.length <- which.max(iris$Sepal.Length)
iris$Species[max.length]
```

```
[1] virginica
Levels: setosa versicolor virginica
```

iris Sepal.Length , Sepal.Length Species .

```r
min(iris$Sepal.Length)
```

```
[1] 4.3
```

```r
min.length <- which.min(iris$Sepal.Length)
iris$Species[min.length]
```

```
[1] setosa
Levels: setosa versicolor virginica
```

2.4

R . , , , . 2

```r
addtive.function = function(x, y ){
  x + y
```

```
}
```

```
addtive.function(100, 2)
```

```
[1] 102
```

2 abs . #-# .

```
abs.function= function(x, y ){
  #--#
}
```

avg . length , .

```
my_vector<- 1:50
avg <- function(x){
        sum(x)/length(x)
}
avg(my_vector)
```

```
[1] 25.5
```

, , , .

```
tabs <- function(x){
        data.frame( ' '      = mean(x),
                    '  '  = length(x),
                    ' '    = max(x),
                    ' '    = min(x)
        )
}

tabs(my_vector)
```

```
1 25.5       50     50      1
```

,

```r
avg <- function(x, arithmetic = TRUE){
  n <- length(x)
  ifelse(arithmetic, sum(x)/n, prod(x)^(1/n))
}
```

2.5 , vectorization, functionals

2.5.1 for loop

1a, 2a, 3a, 4a, 5a, 6a, 7a, 8a, 9a, 10a , ?

```r
c('1a', '2a', '10a') #
```

```
[1] "1a"  "2a"  "10a"
```

, .

```r
for (i in 1:10){
  print(paste0(i, 'a'))
}
```

```
[1] "1a"
[1] "2a"
[1] "3a"
[1] "4a"
[1] "5a"
[1] "6a"
[1] "7a"
[1] "8a"
[1] "9a"
[1] "10a"
```

, .

```r
paste0(1:10, "a")
```

```
 [1] "1a"  "2a"  "3a"  "4a"  "5a"  "6a"  "7a"  "8a"  "9a"  "10a"
```

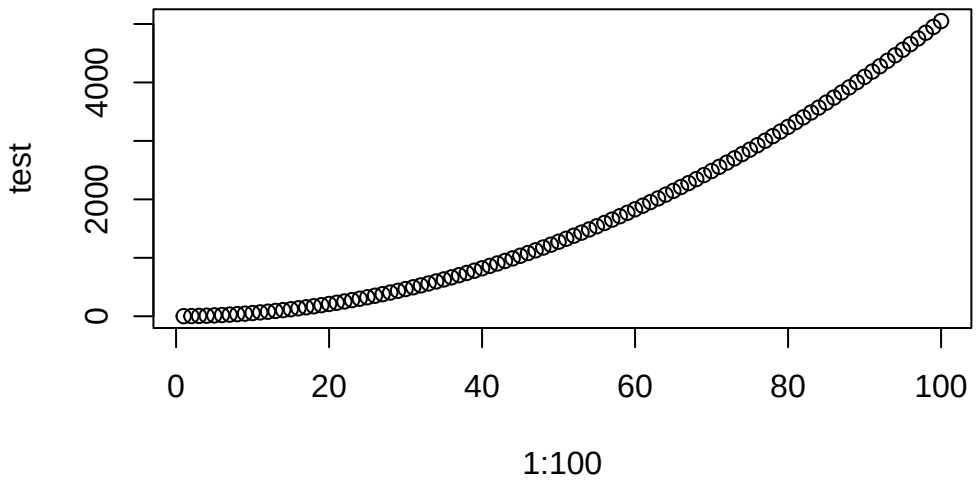
1:n , 1 100

```r
compute <- function(n){ sum(1:n)}
compute(10)
```

```
[1] 55
```

```r
test <-c()
for (n in 1:100){
  test[n] <- compute(n)
}

plot(1:100, test)
```



2.5.2 vectorization apply

ifelse . . ifesel 10 1 . apply . **past0(1:10,“a”)** . 2 3 . **for if** . .

```r
n2 <- c(1:9*2)
n3 <- c(1:9*3)
n2*n3
```

```
[1]   6  24  54  96 150 216 294 384 486
```

2 3

```
new.function<-function(n2){
  c(1:9*2) * c(1:9*n2)
}

new.function( 4)
```

```
[1]   8  32  72 128 200 288 392 512 648
```

3 1, 2, 3, 4, 5, 6, 7, 8, 9

```
sapply(1:9, new.function)
```

```
     [,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8] [,9]
[1,]    2    4    6    8   10   12   14   16   18
[2,]    8   16   24   32   40   48   56   64   72
[3,]   18   36   54   72   90  108  126  144  162
[4,]   32   64   96  128  160  192  224  256  288
[5,]   50  100  150  200  250  300  350  400  450
[6,]   72  144  216  288  360  432  504  576  648
[7,]   98  196  294  392  490  588  686  784  882
[8,]  128  256  384  512  640  768  896 1024 1152
[9,]  162  324  486  648  810  972 1134 1296 1458
```

ifelse for . apply . **tidyverse** `apply, lapply, sapply` .

2.6 iris data apply

R . . iris .

```
data("iris")
```

iris . 3 150 . :

- Sepal.Length ( )

- Sepal.Width ( )
- Petal.Length ( )
- Petal.Width ( )
- Species ( ): .
  - ‘setosa’( ), ‘versicolor’( ), ‘virginica’( ) 3 .

```
library(tidyverse)
iris %>% head()
```

```
  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
```

Species , . . , , .

apply . apply .

```
iris_num=iris[, c(1:4)] # Species
iris_num=iris %>% select(1:4) # tidyverse
#       , sd     .
iris_num %>% pull(Sepal.Length) %>% mean()
```

```
[1] 5.843333
```

```
iris_num %>% pull(Sepal.Width)  %>% mean()
```

```
[1] 3.057333
```

```
iris_num %>% pull(Petal.Length) %>% mean()
```

```
[1] 3.758
```

```
iris_num %>% pull(Petal.Width)  %>% mean()
```

```
[1] 1.199333
```

```
  iris_num %>% pull(Sepal.Length) %>% sd()
```

```
[1] 0.8280661
```

```
  iris_num %>% pull(Sepal.Width)  %>% sd()
```

```
[1] 0.4358663
```

```
  iris_num %>% pull(Petal.Length) %>% sd()
```

```
[1] 1.765298
```

```
  iris_num %>% pull(Petal.Width)  %>% sd()
```

```
[1] 0.7622377
```

median . , . , . apply . apply , lapply list . sapply lapply .

```
  apply(iris_num, 2, mean)
```

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

```
  lapply(iris_num, mean)
```

```
$Sepal.Length
[1] 5.843333

$Sepal.Width
[1] 3.057333

$Petal.Length
[1] 3.758

$Petal.Width
[1] 1.199333
```

```
sapply(iris_num, mean)
```

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

, , . . stat_smry

```
stat_smry = function(x){
  list(
    mean  =mean(x),
    median=median(x),
    std   = sd(x)
  )
}
```

sapply .

```
sapply(iris_num, stat_smry)
```

```
       Sepal.Length Sepal.Width Petal.Length Petal.Width
mean   5.843333     3.057333    3.758        1.199333
median 5.8          3           4.35         1.3
std    0.8280661    0.4358663   1.765298     0.7622377
```

lapply . .
. lapply tt list do.call(rbidn, .) .rbind row bind list ,
. , .

```
tt = lapply(iris_num, stat_smry)
```

```
names(tt) #
```

```
[1] "Sepal.Length" "Sepal.Width"  "Petal.Length" "Petal.Width"
```

```
tt[[1]]   #       "Sepal.Length"
```

```
$mean
[1] 5.843333

$median
[1] 5.8

$std
[1] 0.8280661
```

```r
  do.call(rbind, tt) #
```

```
             mean     median std
Sepal.Length 5.843333 5.8    0.8280661
Sepal.Width  3.057333 3      0.4358663
Petal.Length 3.758    4.35   1.765298
Petal.Width  1.199333 1.3    0.7622377
```

3

3.1

.

rstudio upload . . .

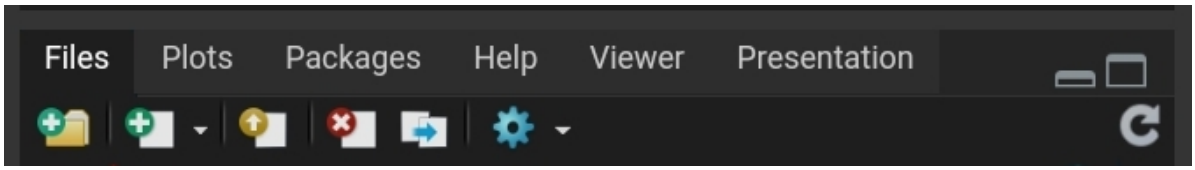


Figure 3.1:

, . .

. download.file , .

```
download.file("https://raw.githubusercontent.com/jinhaslab/opendata/main/kwcs/kwcsData6th.
```

.

```
kwcs = readRDS("data/kwcsData6th.rds")
#head(kwcs)
```

.

```
download.file("https://raw.githubusercontent.com/jinhaslab/opendata/main/kwcs/pdf3.pdf", "
```

3.2

3.2.1 CSV

`read.csv`, `write.csv` . iris .

```
data(iris)
write.csv(iris, "data/iris.csv")
iris_import = read.csv("data/iris.csv")
```

`data(iris)` R iris . iris 150 5 (, , , ,) .
`write.csv(iris, "data/iris.csv")` iris CSV . "data/iris.csv"
. data iris.csv . data . write.csv
CSV . CSV . `iris_import = read.csv("data/iris.csv")`
iris.csv R `iris_import` . `read.csv` . ,
. X . , R iris CSV , R .

3.2.2 excel

iris excel

, Excel writexl . xlsx readxl . `install.packages`
.

```
install.packages("writexl")
install.packages("readxl")
```

```
library(writexl)
library(readxl)
```

iris Excel . `write_xlsx` , , . `write_xlsx` writexl
, (iris) ("data/iris_saved.xlsx") Excel .

```
# iris     Excel
write_xlsx(iris, "data/iris_saved.xlsx")
```

```
iris_xlsx <- readxl::read_xlsx("data/iris_saved.xlsx")
```

`readxl::read_xlsx("iris_saved.xlsx")`, read_xlsx readxl , Excel R
. `rreadxl::: readxl` read_xlsx .
.

“data/iris_saved.xlsx”: Excel . iris_xlsx: . iris_xlsx .

3.2.3 stata, sas, spss

haven SPSS, Stata, SAS R . iris haven , .

```
install.packages("haven")
```

```
library(haven)
```

STATA.dta

```
haven::write_dta(iris, "data/iris_stata.dta")
```

error . stata . error . , . _ . Sepal.Length Sepal_Length . gsub .

```
names(iris) <- gsub("\\.", "_", names(iris))
write_dta(iris, "data/iris_saved.dta")
```

data stata .

SPASS.sav

```
# iris     SPSS
write_sav(iris, "data/iris_spss.sav")
```

```
#    SPSS
iris_from_spss <- read_sav("data/iris_spss.sav")
```

`write_sav`: haven , R SPSS .sav . `read_sav`: SPSS .sav R .

SAS, sas7bdat

```
# iris     SAS
write_sas(iris, "data/iris_sas.sas7bdat")
```

```
Warning: `write_sas()` was deprecated in haven 2.5.2.
i Please use `write_xpt()` instead.
```

```r
#    SAS
iris_from_sas <- read_sas("data/iris_sas.sas7bdat")
```

4 Summary

In summary, this book has no content whatsoever.

```
1 + 1
```

```
[1] 2
```