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Chapter 1

Ready?

1.1 R(Studio)

- R
- RStudio R R
- OK

1.2 Tips!

- R
1. R by R
 2. R by & Tidyverse R

1.3 R(Studio)

- (<https://posit.co/download/rstudio-desktop/>)
- 1:Install R R
- 2:Install RStudio RStudio
- R

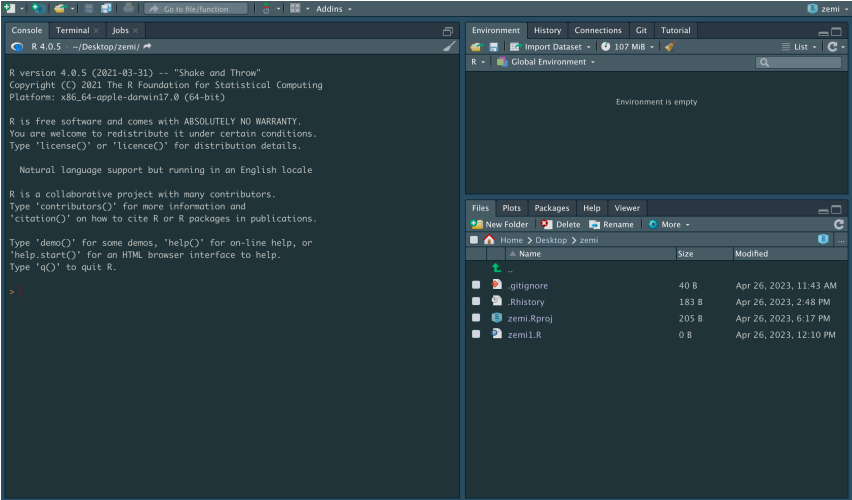
Chapter 2

Go!!

-

2.1 RStudio

- RStudio
-



2.2

-

- Console
 -
 - `> 1+1` **Enter mac return**
 - `[1] 2`
 - `2 1+1` `[1] 1`
-

2.3 R

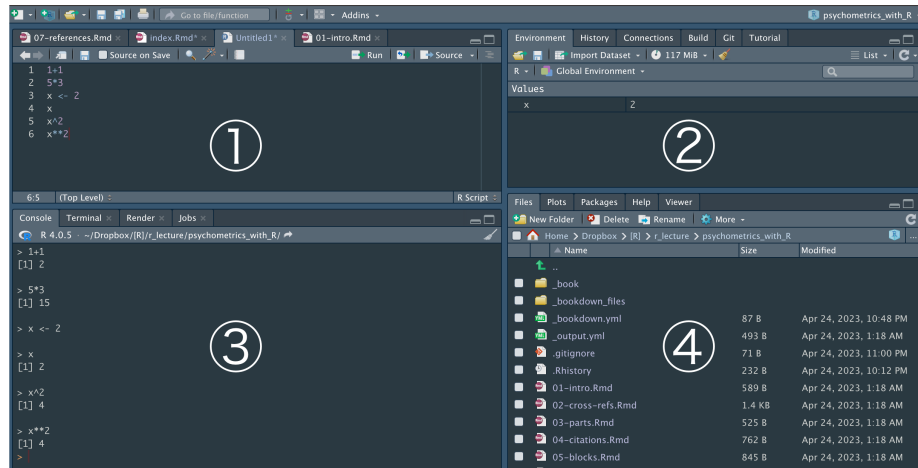
- Rstudio
- R

R

- RStudio R Script
- R R
untitled1 R

RStudio

-



R

R

- untitled1
- 1 1+1 **ctrl+Enter** mac command+return
- ([1] 2)

- R **ctrl+s** mac command+s

- test.R
- R test.R ×
- R test.R
- R

-
- 2 5-2
- 2 **ctrl+Enter**
- 2 ([1] 3)
- 1 **ctrl+Enter**
- 1 ([1] 2)
- **ctrl+Enter**
- **ctrl+shift+Enter** mac command+shift+return
- **ctrl+Enter**

R

- 1.
- 2.
- 3.
- ...

2.4

- R
- R
- New Directry → New Project

- Create Project
-
- .Rproj
- mac Document sugoi_project
-
-
- 1. .Rproj Rstudio
- 2.

2.5

- zemi
 - zemi
 - zemi.Rproj
- ※ zemi

Chapter 3

•

1. in \mathbb{R}

2. in \mathbb{R}

3.1

: +

```
1 + 1
```

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

: -

```
5 - 2
```

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

: *

```
4 * 5
```

```
## [1] 20
```

: /

```
8 / 2
```

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

: ^ ** 4^2

```
4 ^ 2
```

```
## [1] 16
```

```
4 ** 2
```

```
## [1] 16
```

3.2

- 1
-
-
-

```
x <- 1 # <-
```

```
# #
#
#
```

- x 1
x OK
- OK
-

```
x
```

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

-

```
y <- 1
```

```
z <- 2
```

```
y * z # 1*2
```

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

-

```
x <- 1 #x 1
```

```
x
```

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

¹tidyverse

```
x <- 2 #x 2
x
```

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

```
•
```

```
x <- 2+5
x # 7
```

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

```
•
```

```
•
```

```
z <- 2 #z 2
z <- z + 1 #z=2 1      z
z # z
```

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

```
•
```

```
• moji
```

```
# " "
# ' '
#
```

```
moji <- " "
moji
```

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

```
{-} - x 3 y 6 - x y 2 45
```

3.3

- R
- sqrt()
- ()

```
sqrt(2)
```

```
## [1] 1.414214
```

- xxx()
- ()
-

- `sqrt(2)` 2 1.414214

-
- `log()`
- 10

```
log(10)
```

```
## [1] 2.302585
```

- 2 base=10 10

```
log(10, base = 10)
```

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

-

- `help()`
- `()` `help()`
- `log()` `help(log)`
- Rstudio

3.4

- R

3.4.1

- 1
- `c()`
-
- 5 2,4,2,3,5 v

```
v <- c(2, 4, 2, 3, 5) #  
v # v
```

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

- 2,3,4,5,6

```
v <- c(2:6) # n:m n m  
v
```

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

-
-
-

```
v+2 #
```

```
## [1] 4 5 6 7 8
```

```
2*v #
```

```
## [1] 4 6 8 10 12
```

- $v - 2v/2 v^2$

- R
- 2

```
v1 <- c(1, 2)
```

```
v2 <- c(2, 4)
```

- +
- 1 2 (2 4)

```
v1 + v2
```

```
## [1] 3 6
```

- * 1 2

```
v1 * v2
```

```
## [1] 2 8
```

-
- R %*%

```
v1 %*% v2
```

```
## [1]
```

```
## [1,] 10
```

- =

```
# v1 3 v2 2
```

```
# v2 1 v1
```

```
v1 <- c(1, 2, 3) #3
```

```
v2 <- c(2, 4) #2
v1 + v2 #
```

```
## Warning in v1 + v2: longer object length is not a multiple of shorter object
## length
```

```
## [1] 3 6 5
```

- $v_1 v_2 = \frac{1}{2}$

- $x_n = x[n]$
- $v = c(2, 4, 2, 3, 5)$
- $v[2] = 4$

```
v[2]
```

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

- $v[2:4] = c(4, 2, 3)$

```
v[2:4]
```

```
## [1] 3 4 5
```

3.4.2

- $M = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{pmatrix}$

```
# 1:6 c(1:6) 1,2,3,4,5,6
# 6 2 (row) 3 (col)
#byrow = T 6 z
#byrow = T
```

```
M <- matrix(1:6, nrow = 2, ncol = 3, byrow = T)
M
```

```
##      [,1] [,2] [,3]
## [1,]    1    2    3
## [2,]    4    5    6
```

-


```

v1 <- c(1,2,3)
v2 <- c(1,1,1) #2    v1 v2

rbind(v1, v2) #v1 v2 (row)

##      [,1] [,2] [,3]
## v1     1     2     3
## v2     1     1     1
cbind(v1, v2) #v1 v2 (column)

```

```

##      v1 v2
## [1,]  1  1
## [2,]  2  1
## [3,]  3  1
rbind(M, v1) #

```

```

##      [,1] [,2] [,3]
##          1     2     3
##          4     5     6
## v1      1     2     3

```

```

• x      x[      ]
•      M

# 2 1      M21
M21 <- M[2,1]

# 2
M[2,]

```

```

## [1] 4 5 6

# 1
M[,1]

```

```

## [1] 1 4

# 1,2 1,3
M[c(1,2),c(1,3)]

```

```

##      [,1] [,2]
## [1,]    1    3
## [2,]    4    6

```

```

• n n      + -
•          %*%

M # 2 3

##      [,1] [,2] [,3]
## [1,]    1    2    3
## [2,]    4    5    6
M2 <- matrix(c(1,2,0,1,0,2), nrow = 3, ncol = 2, byrow = T) # 3 2
M2 # 2 3

##      [,1] [,2]
## [1,]    1    2
## [2,]    0    1
## [3,]    0    2

# MN
M %*% M2

##      [,1] [,2]
## [1,]    1   10
## [2,]    4   25

# MN
M2 %*% M

##      [,1] [,2] [,3]
## [1,]    9   12   15
## [2,]    4    5    6
## [3,]    8   10   12

v <- c(1,2,3) #

# %*%
#
v %*% M2 # M2%*%v

##      [,1] [,2]
## [1,]    1   10

```

3.5

- rbind() cbind()
-

•

(x)	
<hr/>	
summary(x)	
max(x)	x
min(x)	x
mean(x)	x
median(x)	x
var(x)	x
sd(x)	x
sum(x)	x
range(x)	x
length(x)	x
sort(x)	x
sort(x, decreasing = TRUE)	x
<hr/>	

• 5

```
age <- c(36, 16, 43, 18, 22) #5
```

• age

```
summary(age) #
```

```
##      Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##       16      18      22      27      36      43
```

```
max(age) #      5      43
```

```
## [1] 43
```

```
mean(age) #      5      27
```

```
## [1] 27
```

```
var(age) #      5      141
```

```
## [1] 141
```

```
length(age) #      5      5
```

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

• age min(), median(),sd(),sum(),range(),sort()

•

• M

•
•

(x)		
matrix(0, nrow=2, ncol=3)	2 3	
diag(5)	5×5	
diag(X) <- 1	X	1
t(X)	X	
solve(X)	X	
det(X)	X	
rowSums(X)	X	
colSums(X)	X	
RowMeans(X)	X	
colMeand(X)	X	

• M

3.6

- a 149cm, b 153cm, c 169cm, d 174cm
- a 36kg, b 48kg, c 61kg, d 65kg

1. 4 h
2. h
3. 1cm 0.39
4. 4 w
5. h w 2×4 M
6. M b
7. w h2

Chapter 4

- R

4.1

OK

- R
-
-
-

```
<- function ( ) {  
}
```

- $a/(1-x)$ $a x$
- `inf_geo()`

```
inf_geo <- function (a, x) {  
  a/(1-x)  
}
```

-

```
#a=1 x=0.8  
inf_geo(1, 0.8)
```

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

4.2

-
-
- R

4.3

-
- `install.packages()`¹
- tidyverse
- tidyverse R

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

- tidyverse

```
# RStudio
library(tidyverse) # " "
```

- `install.packages()`
- `library()` Rstudio
- R `library()`

¹tidyverse

Chapter 5

-

1. in R

2. in R

R

```
age_vector      gender_vector      data.frame()
age <- c(18, 21, 22, 23, 34) #
gender <- c("female", "male", "male", "female", "female") #
first_dataframe <- data.frame(age, gender)
first_dataframe
```

```
##  age gender
## 1  18 female
## 2  21  male
## 3  22  male
## 4  23 female
## 5  34 female
```

```
1 18  2 21  ...
```

Excel

R

\$

first_dataframe

```
first_dataframe$gender
```

```
## [1] "female" "male"  "male"  "female" "female"
```

```
mean(first_dataframe$age)
```

```
## [1] 23.6
```

- income 10, 100, 1000, 10000, 100000
- city "ibaraki", "takatsuki", "ibaraki", "takatsuki", "takatsuki"
- income city income_data
- income_data income
- RStudio

5.1

Chapter 2

CSV .csv Excel .xlsx, .xls

1

5.2

5.2.1 CSV .csv

CSV read.csv sotsuron.csv

```
data_original <- read.csv("sotsuron.csv")
```

csv data_original data_original

- tidy_data.csv https://www.dropbox.com/s/wm46esg4dicye8j/tidy_data.csv?dl=0
- read.csv data

5.3

"Environment" data head(data)
str(data)