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2023-05-10



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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
  3. R by
  4. R by  
R
  5. R by  
tidyverse

### 1.3 R(Studio)

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

- 2:Install RStudio RStudio
- R

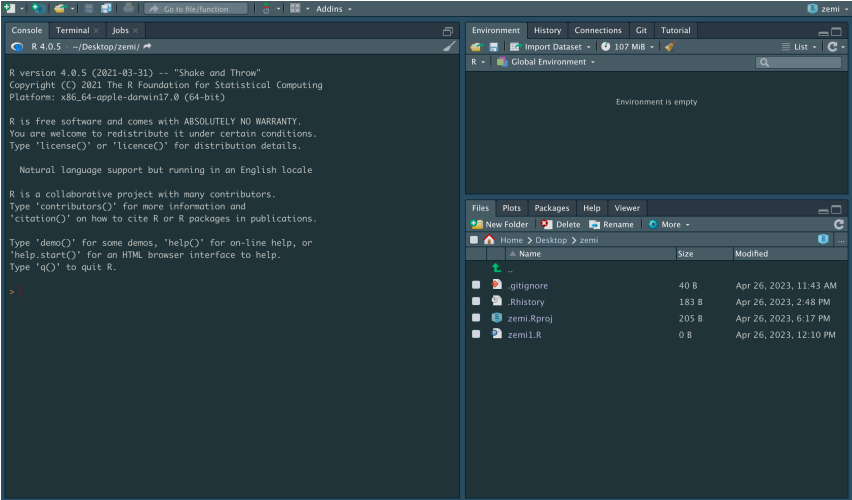
# Chapter 2

# Go!!

- 

## 2.1 RStudio

- RStudio
- 



## 2.2

-

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

## 2.3 R

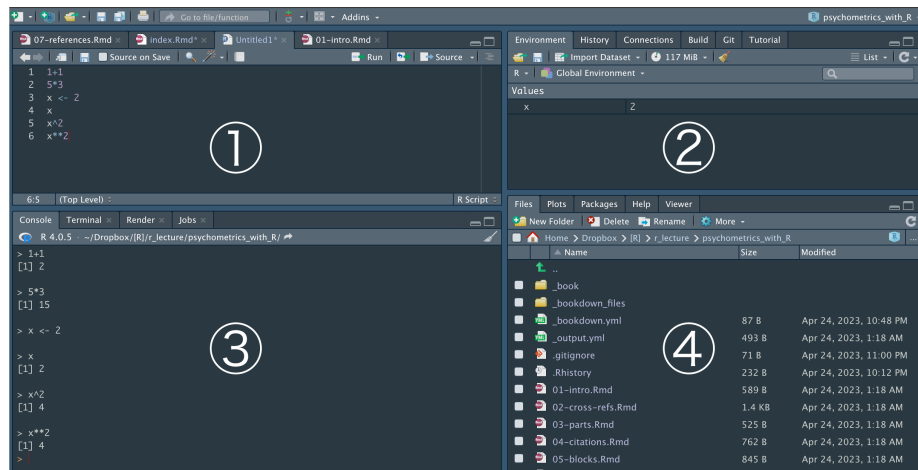
- Rstudio
- R

### 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  $\mathbb{R}$

- 

$\mathbb{R}$

### 3.1

`:` +

```
1 + 1
```

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

`:` -

```
5 - 2
```

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

`:` \*

```
4 * 5
```

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

`:` /

```
8 / 2
```

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

```

: ^** 42
4 ^ 2

## [1] 16
4 ** 2

## [1] 16
• 9÷2 4 1
• 1
: %/%

```

```
9%/%2
```

```
## [1] 4
mod : %%

```

```
9%%2
```

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

---

## 3.2

```

• 1
•
•
•
x <- 1 # <-
# #
#
#
• x 1
• x OK
• OK
•
x

```

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

---

<sup>1</sup> 2 ( )

```
•
y <- 1
z <- 2
y * z # 1*2
```

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

```
•
x <- 1 #x 1
x
```

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

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

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

```
•
x <- 2+5
x # 7
```

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

```
•
•
suuji <- 2 #suuji 2
suuji <- suuji + 1 #suuji=2 1      suuji
suuji # suuji
```

```
## [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
•      (numeric )

```

---

( x )	
log(x)	y
log(x, base=y)	x
sqrt(x)	x $e^x$
exp(x)	x
abs(x)	y x IEEE754 *
round(x,y)	x
floor(x)	x
ceiling(x)	

---

```

•

•          help()

```

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

## 3.4

- `suuji + 1`

```
suuji <- 2
suuji + 1
```

```
moji <- " "
moji + 1
```

- `3`
- `suuji` `2` `numeric double`
- `moji` `character`
- `character` `+`
- `+`
- `typeof()` `mode()`

```
typeof(suuji)
```

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

```
typeof(moji)
```

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

- `TRUE FALSE` `logical`
  - `suuji moji` `mode(suuji) mode(moji)`
  - `typeof(suuji) mode(suuji)`
- 

## 3.5

- `zemi` `exercise_ch3.R` `R`
- `exercise_ch3.R`

```

1. abs(-5)
2. x <- exp(10)    log(x)

```

```

1. round(0.45, 1) 0.5  0.4
   IEEE          5
2. floor(0.45 * 10)/10      0.5
   x      y      floor(x * 10^y + 0.5)/10^y

```



## Chapter 4

- 1. in  $\mathbb{R}$
  2. in  $\mathbb{R}$
- $\mathbb{R}$

### 4.1

- $\mathbb{R}$

#### 4.1.1

- 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

```
v2_6 <- c(2:6) # n:m n m  
v2_6
```

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

```

•      =
•
•
v

## [1] 2 4 2 3 5
v+2 #

## [1] 4 6 4 5 7
2*v #

## [1] 4 8 4 6 10

```

```

• v v-2 v/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
```

- `length()`

```
length(v1)
```

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

- $v_1 v_2 \quad - / \wedge$
- $\quad 1 \quad 2$

- $\quad n$

- $x \quad n \quad x[n]$

- $v=c(2,4,2,3,5)$

- $2 \quad 4 \quad v[2]$

- $2 \quad ( \quad 4,2,3) \quad v[2:4]$

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

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

### 4.1.2

- $\quad 2$
- $2 \ 3 \quad \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{pmatrix} \quad M \quad \text{matrix()}$

```
# 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
```

---

## 4.2

- `rbind()` `cbind()`
- 

- 

( x )	
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

- 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
```

- age `min()`, `median()`, `sd()`, `sum()`, `range()`, `length()`, `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

4.3

3.7 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
```

---

## 4.4

- R
  - R
  - 
  - 
  -
- 

## 4.5

- zemi exercise\_ch4.R R
- exercise\_ch4.R

- 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

1. x y siswa\_gonyu(x,y)

2. siswa\_gonyu(0.4445,3)



# Chapter 5

- R

## 5.1

- 
- 
- R

## 5.2

- 
- `install.packages()`
- tidyverse<sup>1</sup>
- tidyverse R

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

- tidyverse

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

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

---

<sup>1</sup> <sup>2</sup> ( )



# Chapter 6

- 
- 1.            in  $\mathbb{R}$
- 2.            in  $\mathbb{R}$
- $\mathbb{R}$

## 6.1

- $$\begin{array}{c} \bullet \\ \bullet \end{array} 4$$

Name	Age	Height	Weight	Gender
Tanaka	10	149.5	36	male
Suzuki	18	153	48	female
Okada	41	171	58	male
Watanabe	26	174.5	65	male

- R
- `data.frame()`

```
#
name <- c("Tanaka", "Suzuki", "Okada", "Watanabe")
age <- c(10, 18, 36, 23) #
height <- c(149.5, 153.0, 171.0, 174.5)
weight <- c(36, 48, 58, 65)
gender <- c("male", "female", "male", "male")
```

1	2	( )
---	---	-----

```
# data.frame()
#      df
df <- data.frame(name, age, height, weight, gender)
df
```

```
##      name age height weight gender
## 1 Tanaka  10  149.5    36   male
## 2 Suzuki  18  153.0    48 female
## 3 Okada   36  171.0    58   male
## 4 Watanabe 23  174.5    65   male
```

## 6.2

- 
- 
- CSV .csv Excel .xlsx, .xls
- 

### 6.2.1

- 
- R
- R
- 2

- 
- 

### 6.2.2 csv

- csv read.csv() <sup>3</sup>
- sokutei.csv csv data
- head()

```
data <- read.csv("sokutei.csv")
```

```
head(data) #head()
```

### 6.2.3 Excel

- Excel readxl

---

```
2 getwd() setwd(" ")
```

```
3 tidyverse read_csv() tibble
```

```

• readxl      read_excel()
• sokutei.xls sokutei

install.packages("readxl") #
library(readxl)
sokutei <- read_excel("sokutei.xls")

```

#### 6.2.4

- 
- 
- data
- sokutei.csv read\_csv("data/sokutei.csv")

### 6.3

- zemi data
- sokutei.csv data
- sokutei\_csv
- head() sokutei\_csv
- sokutei.xls data
- sokutei\_excel
- head() sokutei\_excel