talk03 练习与作业

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0.1 练习和作业说明

将相关代码填写入以 “‘{r} “‘ 标志的代码框中，运行并看到正确的结果；

完成后，用工具栏里的”Knit” 按键生成 PDF 文档；

将生成的 PDF 改为：`姓名-学号-talk03 作业.pdf`，并提交到老师指定的平台/钉群。

0.2 talk03 内容回顾

- 二维表：`data.frame`, `tibble`
  - 声明
  - 操作
    - 增减行、列

    - 合并
  - 常用相关函数
    - nrow, ncol, dim , str , head, tail
  - data.frame 和 tibble 的不同
  - 高级技巧：
    - with, within

- IO
  - 系统自带函数
  - readr 带的函数
  - 不同格式的读取
  - 从网络、压缩文件读取

0.3 练习与作业：用户验证

请运行以下命令，验证你的用户名。

如你当前用户名不能体现你的真实姓名，请改为拼音后再运行本作业！

```
Sys.info()[["user"]]
```

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

```
Sys.getenv("HOME")
```

```
## [1] "C:/Users/rhong/Documents"
```

0.4 练习与作业 1，data.frame

注：以下内容来自 https://www.r-exercises.com/。

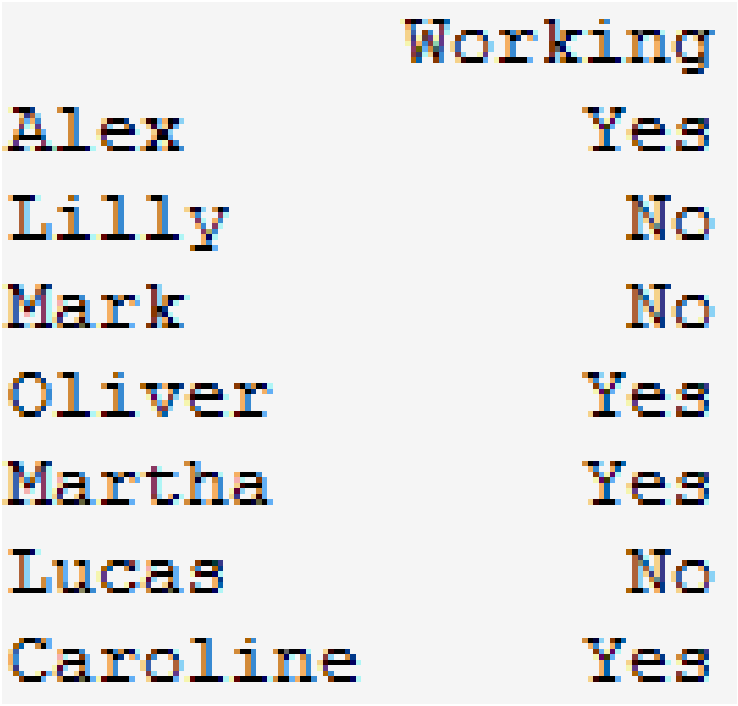
- **生成下面的 data.frame 的前三列，之后再增加 Sex 这列**

	Age	Height	Weight	Sex
Alex	25	177	57	F
Lilly	31	163	69	F
Mark	23	190	83	M
Oliver	52	179	75	M
Martha	76	163	70	F
Lucas	49	183	83	M
Caroline	26	164	53	F

```
names <- c("Alex", "Lilly", "Mark", "Oliver", "Martha", "Lucas", "Caroline")
age <- c(25, 31, 23, 52, 76, 49, 26)
height <- c(177, 165, 180, 175, 160, 185, 170)
weight <- c(70, 50, 80, 60, 45, 90, 65)
sex <- c("F", "F", "M", "M", "F", "M", "F")
## 先生成前三列;
df1 <- data.frame(Age = age, Height = height, Weight = weight,
  row.names = names)
## 再插入第四列
df1 <- cbind(df1, sex)
## 显示最终结果
df1
```

```
##          Age Height Weight sex
## Alex      25    177     70   F
## Lilly     31    165     50   F
## Mark      23    180     80   M
## Oliver    52    175     60   M
## Martha    76    160     45   F
## Lucas     49    185     90   M
## Caroline  26    170     65   F
```

- 生成以下 data.frame，确保 Working 这列的类型是 character，而不是 factor



	Working
Alex	Yes
Lilly	No
Mark	No
Oliver	Yes
Martha	Yes
Lucas	No
Caroline	Yes

```
working <- c("Yes", "No", "No", "Yes",  "Yes", "No", "Yes")
## 生成 data.frame
df1 <- data.frame(Working = working, row.names = names)
## 显示结果
df1
```

```
##          Working
## Alex         Yes
## Lilly         No
## Mark          No
## Oliver       Yes
## Martha       Yes
## Lucas         No
## Caroline     Yes
```

```
## 显示 Working 列的性质
with(df1, class(working))
```

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

- 检查系统自带变量 state.center 的内容，将其转化为 data.frame

```
## 代码写这里，并运行；
state.center
```

```
## $x
##  [1]  -86.7509 -127.2500 -111.6250  -92.2992 -119.7730 -105.5130  -72.3573
##  [8]  -74.9841  -81.6850  -83.3736 -126.2500 -113.9300  -89.3776  -86.0808
## [15]  -93.3714  -98.1156  -84.7674  -92.2724  -68.9801  -76.6459  -71.5800
## [22]  -84.6870  -94.6043  -89.8065  -92.5137 -109.3200  -99.5898 -116.8510
## [29]  -71.3924  -74.2336 -105.9420  -75.1449  -78.4686 -100.0990  -82.5963
## [36]  -97.1239 -120.0680  -77.4500  -71.1244  -80.5056  -99.7238  -86.4560
## [43]  -98.7857 -111.3300  -72.5450  -78.2005 -119.7460  -80.6665  -89.9941
## [50] -107.2560
##
## $y
##  [1] 32.5901 49.2500 34.2192 34.7336 36.5341 38.6777 41.5928 38.6777 27.8744
## [10] 32.3329 31.7500 43.5648 40.0495 40.0495 41.9358 38.4204 37.3915 30.6181
## [19] 45.6226 39.2778 42.3645 43.1361 46.3943 32.6758 38.3347 46.8230 41.3356
## [28] 39.1063 43.3934 39.9637 34.4764 43.1361 35.4195 47.2517 40.2210 35.5053
## [37] 43.9078 40.9069 41.5928 33.6190 44.3365 35.6767 31.3897 39.1063 44.2508
## [46] 37.5630 47.4231 38.4204 44.5937 43.0504
```

```
class(state.center)
```

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

```
data.frame(state.center)
```

```
##            x       y
## 1   -86.7509 32.5901
## 2  -127.2500 49.2500
## 3  -111.6250 34.2192
## 4   -92.2992 34.7336
## 5  -119.7730 36.5341
## 6  -105.5130 38.6777
## 7   -72.3573 41.5928
## 8   -74.9841 38.6777
## 9   -81.6850 27.8744
## 10  -83.3736 32.3329
## 11 -126.2500 31.7500
## 12 -113.9300 43.5648
## 13  -89.3776 40.0495
## 14  -86.0808 40.0495
## 15  -93.3714 41.9358
## 16  -98.1156 38.4204
## 17  -84.7674 37.3915
## 18  -92.2724 30.6181
## 19  -68.9801 45.6226
## 20  -76.6459 39.2778
## 21  -71.5800 42.3645
## 22  -84.6870 43.1361
## 23  -94.6043 46.3943
## 24  -89.8065 32.6758
## 25  -92.5137 38.3347
## 26 -109.3200 46.8230
## 27  -99.5898 41.3356
## 28 -116.8510 39.1063
## 29  -71.3924 43.3934
## 30  -74.2336 39.9637
```

```
## 31 -105.9420 34.4764
## 32  -75.1449 43.1361
## 33  -78.4686 35.4195
## 34 -100.0990 47.2517
## 35  -82.5963 40.2210
## 36  -97.1239 35.5053
## 37 -120.0680 43.9078
## 38  -77.4500 40.9069
## 39  -71.1244 41.5928
## 40  -80.5056 33.6190
## 41  -99.7238 44.3365
## 42  -86.4560 35.6767
## 43  -98.7857 31.3897
## 44 -111.3300 39.1063
## 45  -72.5450 44.2508
## 46  -78.2005 37.5630
## 47 -119.7460 47.4231
## 48  -80.6665 38.4204
## 49  -89.9941 44.5937
## 50 -107.2560 43.0504
```

- 生成一个 50 行 * 5 列的 matrix，将其行名改为：row_i 格式，其中 i 为当前的行号，比如 row_1, row_2 等

```
## 代码写这里，并运行；
m <- matrix(sample(50 * 5), nrow = 50, ncol = 5)
rownames(m) <- paste0("row_", 1:50)
m
```

```
##        [,1] [,2] [,3] [,4] [,5]
## row_1   146   53  122   45   77
## row_2   163  176  100  185   75
```

```
## row_3   223  220  244  196  203
## row_4   183  112   68   40   78
## row_5    14   90  190  117  239
## row_6   184   36  128   79   48
## row_7   165   42  250  248   55
## row_8    82    4   28  228   41
## row_9   118  158  141  114  111
## row_10    8   72  202   99   12
## row_11  155  108   71  147  198
## row_12   74  119   70   22   65
## row_13  148   21  150   19  127
## row_14  205  166   97    6  101
## row_15  209   39   44   26   30
## row_16  189  149  212   85  181
## row_17   61   69  143  199  130
## row_18   66  195  162  137   17
## row_19    7  240   38   80   23
## row_20  151  197  140  171   89
## row_21   29  249  126  221   27
## row_22  188   25  138  234  113
## row_23  123  224   13   67  210
## row_24    9   59   46    5   10
## row_25  174   34  134  132  136
## row_26  235  121  153  238  131
## row_27  175  142  179  192   32
## row_28  180  193  144  222  169
## row_29   43   62  125   15   11
## row_30   51   31   86  225  208
## row_31   16   50  105   56   37
## row_32   92  103  227   33  215
## row_33  115  237  201  167   64
## row_34  243  216   98   52   58
## row_35  160  161  107  139  230
```

```
## row_36  204  214  226    3  116
## row_37   81  246   20  200  241
## row_38   60  110   73  194  129
## row_39  247  178  207  232   87
## row_40   47  217  242  231   93
## row_41  109  206   84  159  152
## row_42   94  133  164  172   76
## row_43  106   35  135  104  120
## row_44  229   49  211  186  182
## row_45    2  102  233   96   91
## row_46   83  213   57  170  177
## row_47  219   24  245   18  145
## row_48  124   63  156   54    1
## row_49  187   95  168  236  173
## row_50  157   88  218  191  154
```

- **使用系统自带变量 `VADeaths`，做如下练习：**
- 检查 `VADeaths` 的类型，如果不是 `data.frame`，则转换之；
- 添加新的一列，取名 `Total`，其值为每行的总合
- 调整列的顺序，将 `Total` 变为第一列。

```
## 代码写这里，并运行；
class(VADeaths)
```

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

```
df_deaths <- data.frame(VADeaths)
df_deaths$Total <- rowSums(df_deaths)
df_deaths <- df_deaths[, c(ncol(df_deaths), 1:(ncol(df_deaths) - 1))]
df_deaths
```

```
##       Total Rural.Male Rural.Female Urban.Male Urban.Female
## 50-54  44.2       11.7          8.7       15.4          8.4
## 55-59  67.7       18.1         11.7       24.3         13.6
## 60-64 103.5       26.9         20.3       37.0         19.3
## 65-69 161.6       41.0         30.9       54.6         35.1
## 70-74 241.4       66.0         54.3       71.1         50.0
```

- **用系统自带的 swiss 数据做练习：**
- 取子集，选取第 1, 2, 3, 10, 11, 12 and 13 行，第 Examination, Education 和 Infant.Mortality 列；
- 将 Sarine 行 Infant.Mortality 列的值改为 NA；
- 增加一列，命名为 Mean，其值为当前行的平均值；

```
## 代码写这里，并运行；
(df_swiss <- swiss[c(1, 2, 3, 10, 11, 12, 13),
  c("Examination", "Education", "Infant.Mortality")])
```

```
##              Examination Education Infant.Mortality
## Courtelary            15        12             22.2
## Delemont               6         9             22.2
## Franches-Mnt           5         5             20.2
## Sarine                16        13             24.4
## Veveyse               14         6             24.5
## Aigle                 21        12             16.5
## Aubonne               14         7             19.1
```

```
df_swiss["Sarine", "Infant.Mortality"] <- NA
df_swiss
```

```
##              Examination Education Infant.Mortality
```

```
## Courtelary            15        12             22.2
## Delemont               6         9             22.2
## Franches-Mnt           5         5             20.2
## Sarine                16        13               NA
## Veveyse               14         6             24.5
## Aigle                 21        12             16.5
## Aubonne               14         7             19.1
```

```
df_swiss$Mean <- rowMeans(df_swiss)
head(df_swiss)
```

```
##               Examination Education Infant.Mortality     Mean
## Courtelary             15        12             22.2 16.40000
## Delemont                6         9             22.2 12.40000
## Franches-Mnt            5         5             20.2 10.06667
## Sarine                 16        13               NA       NA
## Veveyse                14         6             24.5 14.83333
## Aigle                  21        12             16.5 16.50000
```

- 将下面三个变量合并生成一个 data.frame

```
Id <- LETTERS

x <- seq(1,43,along.with=Id)

y <- seq(-20,0,along.with=Id)
```

```
## 代码写这里，并运行；
Id <- LETTERS
x <- seq(1, 43, along.with = Id)
y <- seq(-20, 0, along.with = Id)
data.frame(Id, x, y)
```

```
##    Id     x     y
## 1   A  1.00 -20.0
## 2   B  2.68 -19.2
## 3   C  4.36 -18.4
## 4   D  6.04 -17.6
## 5   E  7.72 -16.8
## 6   F  9.40 -16.0
## 7   G 11.08 -15.2
## 8   H 12.76 -14.4
## 9   I 14.44 -13.6
## 10  J 16.12 -12.8
## 11  K 17.80 -12.0
## 12  L 19.48 -11.2
## 13  M 21.16 -10.4
## 14  N 22.84  -9.6
## 15  O 24.52  -8.8
## 16  P 26.20  -8.0
## 17  Q 27.88  -7.2
## 18  R 29.56  -6.4
## 19  S 31.24  -5.6
## 20  T 32.92  -4.8
## 21  U 34.60  -4.0
## 22  V 36.28  -3.2
## 23  W 37.96  -2.4
## 24  X 39.64  -1.6
## 25  Y 41.32  -0.8
## 26  Z 43.00   0.0
```

问： `seq` 函数中的 `along.with` 参数的意义是什么？请举例说明。

答：seq 函数中的 along.with 参数的意义是指定序列的长度，即 along.with 参数指定的变量的长度。

```
## 代码写这里，并运行；
seq(1, 19, along.with = 1:10)
```

```
##  [1]  1  3  5  7  9 11 13 15 17 19
```

```
seq(1, 19, along.with = 1:19)
```

```
##  [1]  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19
```

- **提供代码，合并以下两个 data.frame**

```
> df1 的内容
Id Age
1 14
2 12
3 15
4 10

>df2 的内容
Id Sex Code
1 F a
2 M b
3 M c
4 F d
```

合并之后的结果：

```
> M
Id Age Sex Code
1 14 F a
2 12 M b
3 15 M c
4 10 F d
```

```
## 代码写这里，并运行；
library(dplyr)
```

```
## Warning: 程辑包'dplyr'是用R版本4.1.3 来建造的
```

```
##
## 载入程辑包: 'dplyr'
```

```
## The following objects are masked from 'package:stats':
##
##     filter, lag
```

```
## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
Id <- 1:4
Age <- c(14, 12, 15, 10)
Sex <- c("F", "M", "M", "F")
Code <- c("a", "b", "c", "d")
df1 <- data.frame(Id, Age)
df2 <- data.frame(Id, Sex, Code)
M <- left_join(df1, df2, by = "Id")
M
```

```
##   Id Age Sex Code
## 1  1  14   F    a
## 2  2  12   M    b
## 3  3  15   M    c
## 4  4  10   F    d
```

- 从上面的 data.frame 中删除 code 列

```
## 代码写这里，并运行；
(M <- M[, -4])
```

```
##   Id Age Sex
## 1  1  14   F
## 2  2  12   M
## 3  3  15   M
## 4  4  10   F
```

- 练习，回答代码中的问题

```
## 1. 生成一个10 行2 列的data.frame
df3 <- data.frame( data = 1:10, group = c("A","B") )
## 2. 增加一列，其长度是1，可以吗？
cbind(df3, newcol = 1);
## 3. 增加一列，其长度是10，可以吗？
cbind(df3, newcol = 1:10);
## 4. 增加一列，其长度是2，可以吗？
cbind(df3, newcol = 1:2);
## 5. 增加一列，其长度是3，可以吗？
cbind(df3, newcol = 1:3);
```

答：2. 可以，3. 可以，4. 可以，5. 不可以。增加的列的长度必须与原 data.frame 的行数是整数倍。

0.5 练习与作业 2，tibble

- 运行以下代码，生成一个新的 tibble：

```
## 如果系统中没有 lubridate 包，则安装:
if (!require("lubridate")){
  chooseCRANmirror();
  install.packages("lubridate");
}
```

```
## 载入需要的程辑包: lubridate

## Warning: 程辑包'lubridate'是用R版本4.1.3 来建造的

##
## 载入程辑包: 'lubridate'

## The following objects are masked from 'package:base':
##
##     date, intersect, setdiff, union
```

```
library(lubridate);

if (!require("tibble")){
  chooseCRANmirror();
  install.packages("tibble");
}
```

```
## 载入需要的程辑包: tibble

## Warning: 程辑包'tibble'是用R版本4.1.3 来建造的
```

```
library(tibble);

tibble(
  a = lubridate::now() + runif(1e3) * 86400,
  b = lubridate::today() + runif(1e3) * 30,
```

```
  c = 1:1e3,
  d = runif(1e3),
  e = sample(letters, 1e3, replace = TRUE)
)
```

```
## # A tibble: 1,000 x 5
##    a                   b              c      d e
##    <dttm>              <date>     <int>  <dbl> <chr>
##  1 2022-09-10 13:31:07 2022-09-27     1 0.326  i
##  2 2022-09-10 01:31:39 2022-09-16     2 0.226  w
##  3 2022-09-10 10:25:54 2022-09-11     3 0.748  s
##  4 2022-09-09 16:08:08 2022-10-05     4 0.0435 f
##  5 2022-09-10 08:44:28 2022-09-25     5 0.0521 b
##  6 2022-09-10 10:49:09 2022-09-26     6 0.348  e
##  7 2022-09-09 21:33:01 2022-09-14     7 0.0984 l
##  8 2022-09-09 21:21:11 2022-09-10     8 0.521  h
##  9 2022-09-10 01:24:25 2022-10-02     9 0.923  i
## 10 2022-09-10 03:52:25 2022-09-15    10 0.702  k
## # ... with 990 more rows
```

从中可以看出，tibble 支持一些细分数据类型，包括：

- <dttm>
- <date>

等；

- 生成一个如下的 tibble，完成以下任务：

```
df <- tibble(
  x = runif(5),
  y = rnorm(5)
)
```

任务：

- 取一列，比如 x 这一列，得到一个 tibble；
- 取一列，比如 y 这一列，得到一个 vector；

```
## 代码写这里，并运行；
df <- tibble(
  x = runif(5),
  y = rnorm(5)
)
df["x"]
```

```
## # A tibble: 5 x 1
##         x
##     <dbl>
## 1 0.493
## 2 0.917
## 3 0.856
## 4 0.0256
## 5 0.782
```

```
df$y
```

```
## [1]  0.478923432  0.008944953 -2.090207816 -0.158646217  0.612396930
```

- 用 tibble 函数创建一个新的空表，并逐行增加一些随机的数据，共增加三行：

```
## 代码写这里，并运行；
## 新 tibble, with defined columns ... 创建表头
tb <- tibble( name = character(), age = integer(), salary = double() );
```

```
## 增加三行随机数据;
tb <- add_row(tb, name = sample(letters, 3),
  age = sample(50, 3), salary = sample(1000, 3))
tb
```

```
## # A tibble: 3 x 3
##   name    age salary
##   <chr> <int>  <dbl>
## 1 n        26    641
## 2 q        29    734
## 3 d         3    317
```

- ** 请解释为什么下面第一行代码能够运行成功，但第二个不行？**

这个可以：

`data.frame(a = 1:6, b = LETTERS[1:2]);`

但下面这个不行：

`tibble(a = 1:6, b = LETTERS[1:2]);`

问：为什么？tibble 循环的规则是什么？

答：Only values of size one are recycled.

- **attach 和 detach:**

问：这个两个函数的用途是什么？请用 `iris` 这个系统自带变量举例说明。

答：attach() 函数将一个数据框绑定到当前的搜索路径中，这样就可以直接使用数据框中的变量名而不用加上数据框的名字。detach() 函数将一个数据框从当前的搜索路径中分离出来。

```
try(head(Septal.Length))
```

```
## Error in head(Septal.Length) : 找不到对象'Septal.Length'
```

```
# Sepal.Length 是 iris 数据框中的变量名，但是在当前的搜索路径中没有，所以不能直接使用
attach(iris)
# attach() 函数将 iris 数据框绑定到当前的搜索路径中，之后就可以直接访问 Sepal.Length 这个变
head(Sepal.Length)
```

```
## [1] 5.1 4.9 4.7 4.6 5.0 5.4
```

```
detach(iris)
```

- **使用内置变量 airquality:**
- 检查它是否是 tibble;
- 如果不是，转化为 tibble;

```
## 代码写这里，并运行;
is_tibble(airquality)
```

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

```
airquality <- as_tibble(airquality)
is_tibble(airquality)
```

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

- **问：tibble::enframe 函数的用途是什么？请举例说明：**

答：enframe() 函数将一个向量转换为一个数据框，其中第一列是向量的名字，第二列是向量的值。

```
head(iris$Sepal.Length, n = 10)
```

```
##  [1] 5.1 4.9 4.7 4.6 5.0 5.4 4.6 5.0 4.4 4.9
```

```
enframe(iris$Sepal.Length[1:10])
```

```
## # A tibble: 10 x 2
##     name value
##    <int> <dbl>
##  1     1   5.1
##  2     2   4.9
##  3     3   4.7
##  4     4   4.6
##  5     5   5
##  6     6   5.4
##  7     7   4.6
##  8     8   5
##  9     9   4.4
## 10    10   4.9
```

- **简述 `tibble` 相比 `data.frame` 的优势？并用实例展示**

答：tibble 显示每一列的数据类型，而 data.frame 不显示。tibble 按顺序计算列，而 data.frame 同时计算所有列。tibble 取子集将得到一个 tibble，而 data.frame 取子集可能得到 vector。data.frame 存在部分匹配的问题，而 tibble 不存在。

```
## 代码写这里，并运行；
df1 <- data.frame(aaa = 1:6, b = LETTERS[1:6])
tib1 <- tibble(aaa = 1:6, b = LETTERS[1:6])
df1[, 1]
```

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

```
# dataframe 子集变成了向量类型而不是 data.frame
tib1[, 1]
```

```
## # A tibble: 6 x 1
##     aaa
##   <int>
## 1     1
## 2     2
## 3     3
## 4     4
## 5     5
## 6     6
```

```
# tibble 子集仍然是 tibble 类型

tibble(a = 1:6, b = a * 2)
```

```
## # A tibble: 6 x 2
##       a     b
##   <int> <dbl>
## 1     1     2
## 2     2     4
## 3     3     6
## 4     4     8
## 5     5    10
## 6     6    12
```

```
# tibble 按顺序计算列; dataframe 同时计算所有列.
try(data.frame(a = 1:6, b = a * 2))
```

```
## Error in data.frame(a = 1:6, b = a * 2) : 找不到对象'a'
```

0.6 练习与作业 3：IO

- **提供代码，正确读取以下文件：**

注：数据在当前目录下的 data/ 子目录里

- Table0.txt
- Table1.txt
- Table2.txt
- Table3.txt
- Table4.txt
- Table5.txt
- Table6.txt
- states1.csv
- states2.csv

注 2：每个文件读取需要提供两种方法，一种是利用系统自带函数，另一种是 readr 包的函数；

```
## 用系统自带函数，并显示读取的内容;
read.table("data/Table0.txt", header = FALSE)
```

```
##         V1 V2  V3 V4 V5
## 1     Alex 25 177 57  F
## 2    Lilly 31 163 69  F
## 3     Mark 23 190 83  M
## 4   Oliver 52 179 75  M
## 5   Martha 76 163 70  F
```

```
## 6    Lucas 49 183 83  M
## 7 Caroline 26 164 53  F
```

```
read.table("data/Table1.txt", header = TRUE)
```

```
##       Name Age Height Weight Sex
## 1     Alex  25    177     57   F
## 2    Lilly  31    163     69   F
## 3     Mark  23    190     83   M
## 4   Oliver  52    179     75   M
## 5   Martha  76    163     70   F
## 6    Lucas  49    183     83   M
## 7 Caroline  26    164     53   F
```

```
read.table("data/Table2.txt", header = TRUE, quote = "/", skip = 1)
```

```
##       Name Age Height Weight Sex
## 1     Alex  25    177     57   F
## 2    Lilly  31    163     69   F
## 3     Mark  23    190     83   M
## 4   Oliver  52    179     75   M
## 5   Martha  76    163     70   F
## 6    Lucas  49    183     83   M
## 7 Caroline  26    164     53   F
```

```
read.table("data/Table3.txt", header = TRUE, skip = 1,
  na.strings = c("", "NA", "--", "*", "**"))
```

```
##       Name Age Height Weight Sex
## 1     Alex  25    177     57   F
## 2    Lilly  31     NA     69   F
## 3     Mark  NA    190     83   M
## 4   Oliver  52    179     75   M
```

```
## 5   Martha  76     NA     70   F
## 6    Lucas  49    183     NA   M
## 7 Caroline  26    164     53   F
```

```
# Table4.txt 身高数据 Height 中的值有逗号去掉
table4 <- read.table("data/Table4.txt", header = TRUE,
  na.strings = c("", "NA", "--", "*", "**"))
within(table4, Height <- as.numeric(gsub(",", "", Height)))
```

```
##       Name Age Height Weight Sex
## 1     Alex  25    177     57   F
## 2    Lilly  31     NA     69   F
## 3     Mark  NA    190     83   M
## 4   Oliver  52    179     75   M
## 5   Martha  76     NA     70   F
## 6    Lucas  49    183     NA   M
## 7 Caroline  26    164     53   F
```

```
table5 <- read.table("data/Table5.txt", header = TRUE, sep = ";",
  na.strings = c("", "NA", "--", "*", "**"))
table5$Height <- as.numeric(gsub(",", "", table5$Height))
table5
```

```
##       Name Age Height Weight Sex
## 1     Alex  25    177     57   F
## 2    Lilly  31     NA     69   F
## 3     Mark  NA    190     83   M
## 4   Oliver  52    179     75   M
## 5   Martha  76     NA     70   F
## 6    Lucas  49    183     NA   M
## 7 Caroline  26    164     53   F
```

```
read.table("data/Table6.txt", header = TRUE,
  comment.char = "@", skip = 1)
```

```
##          Name Age Height Weight Sex
## 1        Alex  25    177     57   F
## 2      Lilly  31    163     69   F
## 3        Mark  23    190     83   M
## 4     Oliver  52    179     75   M
## 5     Martha  76    163     70   F
## 6      Lucas  49    183     83   M
## 7   Caroline  26    164     53   F
## 8        Alex  25    177     57   F
## 9      Lilly  31    163     69   F
## 10       Mark  23    190     83   M
## 11    Oliver  52    179     75   M
## 12    Martha  76    163     70   F
## 13     Lucas  49    183     83   M
## 14  Caroline  26    164     53   F
## 15       Alex  25    177     57   F
## 16     Lilly  31    163     69   F
## 17       Mark  23    190     83   M
## 18    Oliver  52    179     75   M
## 19    Martha  76    163     70   F
## 20     Lucas  49    183     83   M
## 21  Caroline  26    164     53   F
## 22       Alex  25    177     57   F
## 23     Lilly  31    163     69   F
## 24       Mark  23    190     83   M
## 25    Oliver  52    179     75   M
## 26    Martha  76    163     70   F
## 27     Lucas  49    183     83   M
## 28  Caroline  26    164     53   F
## 29       Alex  25    177     57   F
```

```
## 30     Lilly  31    163     69   F
## 31      Mark  23    190     83   M
## 32    Oliver  52    179     75   M
## 33    Martha  76    163     70   F
## 34     Lucas  49    183     83   M
## 35  Caroline  26    164     53   F
## 36      Alex  25    177     57   F
## 37     Lilly  31    163     69   F
## 38      Mark  23    190     83   M
## 39    Oliver  52    179     75   M
## 40    Martha  76    163     70   F
## 41     Lucas  49    183     83   M
## 42  Caroline  26    164     53   F
## 43      Alex  25    177     57   F
## 44     Lilly  31    163     69   F
## 45      Mark  23    190     83   M
## 46    Oliver  52    179     75   M
## 47    Martha  76    163     70   F
## 48     Lucas  49    183     83   M
## 49  Caroline  26    164     53   F
## 50      Alex  25    177     57   F
## 51     Lilly  31    163     69   F
## 52      Mark  23    190     83   M
## 53    Oliver  52    179     75   M
## 54    Martha  76    163     70   F
## 55     Lucas  49    183     83   M
## 56  Caroline  26    164     53   F
## 57      Alex  25    177     57   F
## 58     Lilly  31    163     69   F
## 59      Mark  23    190     83   M
## 60    Oliver  52    179     75   M
## 61    Martha  76    163     70   F
## 62     Lucas  49    183     83   M
```

```
## 63  Caroline  26    164     53   F
## 64       Alex  25    177     57   F
## 65      Lilly  31    163     69   F
## 66       Mark  23    190     83   M
## 67     Oliver  52    179     75   M
## 68     Martha  76    163     70   F
## 69      Lucas  49    183     83   M
## 70  Caroline  26    164     53   F
## 71       Alex  25    177     57   F
## 72      Lilly  31    163     69   F
## 73       Mark  23    190     83   M
## 74     Oliver  52    179     75   M
## 75     Martha  76    163     70   F
## 76      Lucas  49    183     83   M
## 77  Caroline  26    164     53   F
## 78       Alex  25    177     57   F
## 79      Lilly  31    163     69   F
## 80       Mark  23    190     83   M
## 81     Oliver  52    179     75   M
## 82     Martha  76    163     70   F
## 83      Lucas  49    183     83   M
## 84  Caroline  26    164     53   F
## 85       Alex  25    177     57   F
## 86      Lilly  31    163     69   F
## 87       Mark  23    190     83   M
## 88     Oliver  52    179     75   M
## 89     Martha  76    163     70   F
## 90      Lucas  49    183     83   M
## 91  Caroline  26    164     53   F
## 92       Alex  25    177     57   F
## 93      Lilly  31    163     69   F
## 94       Mark  23    190     83   M
## 95     Oliver  52    179     75   M
```

```
## 96    Martha  76    163     70   F
## 97     Lucas  49    183     83   M
## 98  Caroline  26    164     53   F
## 99      Alex  25    177     57   F
## 100    Lilly  31    163     69   F
## 101     Mark  23    190     83   M
## 102   Oliver  52    179     75   M
## 103   Martha  76    163     70   F
## 104    Lucas  49    183     83   M
## 105 Caroline  26    164     53   F
```

```
# Table6.txt 中 @ 为注释符号

read.csv("data/states1.csv", header = TRUE)
```

```
##                X Population Income Illiteracy Life.Exp Murder HS.Grad Frost
## 1        Alabama       3615   3624        2.1    69.05   15.1    41.3    20
## 2         Alaska        365   6315        1.5    69.31   11.3    66.7   152
## 3        Arizona       2212   4530        1.8    70.55    7.8    58.1    15
## 4       Arkansas       2110   3378        1.9    70.66   10.1    39.9    65
## 5     California      21198   5114        1.1    71.71   10.3    62.6    20
## 6       Colorado       2541   4884        0.7    72.06    6.8    63.9   166
## 7    Connecticut       3100   5348        1.1    72.48    3.1    56.0   139
## 8       Delaware        579   4809        0.9    70.06    6.2    54.6   103
## 9        Florida       8277   4815        1.3    70.66   10.7    52.6    11
## 10       Georgia       4931   4091        2.0    68.54   13.9    40.6    60
## 11        Hawaii        868   4963        1.9    73.60    6.2    61.9     0
## 12         Idaho        813   4119        0.6    71.87    5.3    59.5   126
## 13      Illinois      11197   5107        0.9    70.14   10.3    52.6   127
## 14       Indiana       5313   4458        0.7    70.88    7.1    52.9   122
## 15          Iowa       2861   4628        0.5    72.56    2.3    59.0   140
## 16        Kansas       2280   4669        0.6    72.58    4.5    59.9   114
## 17      Kentucky       3387   3712        1.6    70.10   10.6    38.5    95
## 18     Louisiana       3806   3545        2.8    68.76   13.2    42.2    12
```

```
## 19          Maine       1058   3694        0.7    70.39    2.7    54.7   161
## 20       Maryland       4122   5299        0.9    70.22    8.5    52.3   101
## 21  Massachusetts       5814   4755        1.1    71.83    3.3    58.5   103
## 22       Michigan       9111   4751        0.9    70.63   11.1    52.8   125
## 23      Minnesota       3921   4675        0.6    72.96    2.3    57.6   160
## 24    Mississippi       2341   3098        2.4    68.09   12.5    41.0    50
## 25       Missouri       4767   4254        0.8    70.69    9.3    48.8   108
## 26        Montana        746   4347        0.6    70.56    5.0    59.2   155
## 27       Nebraska       1544   4508        0.6    72.60    2.9    59.3   139
## 28         Nevada        590   5149        0.5    69.03   11.5    65.2   188
## 29  New Hampshire        812   4281        0.7    71.23    3.3    57.6   174
## 30     New Jersey       7333   5237        1.1    70.93    5.2    52.5   115
## 31     New Mexico       1144   3601        2.2    70.32    9.7    55.2   120
## 32       New York      18076   4903        1.4    70.55   10.9    52.7    82
## 33 North Carolina       5441   3875        1.8    69.21   11.1    38.5    80
## 34   North Dakota        637   5087        0.8    72.78    1.4    50.3   186
## 35           Ohio      10735   4561        0.8    70.82    7.4    53.2   124
## 36       Oklahoma       2715   3983        1.1    71.42    6.4    51.6    82
## 37         Oregon       2284   4660        0.6    72.13    4.2    60.0    44
## 38   Pennsylvania      11860   4449        1.0    70.43    6.1    50.2   126
## 39   Rhode Island        931   4558        1.3    71.90    2.4    46.4   127
## 40 South Carolina       2816   3635        2.3    67.96   11.6    37.8    65
## 41   South Dakota        681   4167        0.5    72.08    1.7    53.3   172
## 42      Tennessee       4173   3821        1.7    70.11   11.0    41.8    70
## 43          Texas      12237   4188        2.2    70.90   12.2    47.4    35
## 44           Utah       1203   4022        0.6    72.90    4.5    67.3   137
## 45        Vermont        472   3907        0.6    71.64    5.5    57.1   168
## 46       Virginia       4981   4701        1.4    70.08    9.5    47.8    85
## 47     Washington       3559   4864        0.6    71.72    4.3    63.5    32
## 48  West Virginia       1799   3617        1.4    69.48    6.7    41.6   100
## 49      Wisconsin       4589   4468        0.7    72.48    3.0    54.5   149
## 50        Wyoming        376   4566        0.6    70.29    6.9    62.9   173
##      Area
```

```
## 1   50708
## 2  566432
## 3  113417
## 4   51945
## 5  156361
## 6  103766
## 7    4862
## 8    1982
## 9   54090
## 10  58073
## 11   6425
## 12  82677
## 13  55748
## 14  36097
## 15  55941
## 16  81787
## 17  39650
## 18  44930
## 19  30920
## 20   9891
## 21   7826
## 22  56817
## 23  79289
## 24  47296
## 25  68995
## 26 145587
## 27  76483
## 28 109889
## 29   9027
## 30   7521
## 31 121412
## 32  47831
## 33  48798
```

```
## 34  69273
## 35  40975
## 36  68782
## 37  96184
## 38  44966
## 39   1049
## 40  30225
## 41  75955
## 42  41328
## 43 262134
## 44  82096
## 45   9267
## 46  39780
## 47  66570
## 48  24070
## 49  54464
## 50  97203
```

```
stats2 <- read.csv("data/states2.csv", header = TRUE,
  sep = ";", dec = ",")
stats2
```

```
##                 X Population Income Illiteracy Life.Exp Murder HS.Grad Frost
## 1         Alabama       3615   3624        2.1    69.05   15.1    41.3    20
## 2          Alaska        365   6315        1.5    69.31   11.3    66.7   152
## 3         Arizona       2212   4530        1.8    70.55    7.8    58.1    15
## 4        Arkansas       2110   3378        1.9    70.66   10.1    39.9    65
## 5      California      21198   5114        1.1    71.71   10.3    62.6    20
## 6        Colorado       2541   4884        0.7    72.06    6.8    63.9   166
## 7     Connecticut       3100   5348        1.1    72.48    3.1    56.0   139
## 8        Delaware        579   4809        0.9    70.06    6.2    54.6   103
## 9         Florida       8277   4815        1.3    70.66   10.7    52.6    11
## 10        Georgia       4931   4091        2.0    68.54   13.9    40.6    60
## 11         Hawaii        868   4963        1.9    73.60    6.2    61.9     0
```

```
## 12          Idaho   813  4119  0.6 71.87  5.3 59.5 126
## 13       Illinois 11197  5107  0.9 70.14 10.3 52.6 127
## 14        Indiana  5313  4458  0.7 70.88  7.1 52.9 122
## 15           Iowa  2861  4628  0.5 72.56  2.3 59.0 140
## 16         Kansas  2280  4669  0.6 72.58  4.5 59.9 114
## 17       Kentucky  3387  3712  1.6 70.10 10.6 38.5  95
## 18      Louisiana  3806  3545  2.8 68.76 13.2 42.2  12
## 19          Maine  1058  3694  0.7 70.39  2.7 54.7 161
## 20       Maryland  4122  5299  0.9 70.22  8.5 52.3 101
## 21  Massachusetts  5814  4755  1.1 71.83  3.3 58.5 103
## 22       Michigan  9111  4751  0.9 70.63 11.1 52.8 125
## 23      Minnesota  3921  4675  0.6 72.96  2.3 57.6 160
## 24    Mississippi  2341  3098  2.4 68.09 12.5 41.0  50
## 25       Missouri  4767  4254  0.8 70.69  9.3 48.8 108
## 26        Montana   746  4347  0.6 70.56  5.0 59.2 155
## 27       Nebraska  1544  4508  0.6 72.60  2.9 59.3 139
## 28         Nevada   590  5149  0.5 69.03 11.5 65.2 188
## 29  New Hampshire   812  4281  0.7 71.23  3.3 57.6 174
## 30     New Jersey  7333  5237  1.1 70.93  5.2 52.5 115
## 31     New Mexico  1144  3601  2.2 70.32  9.7 55.2 120
## 32       New York 18076  4903  1.4 70.55 10.9 52.7  82
## 33 North Carolina  5441  3875  1.8 69.21 11.1 38.5  80
## 34   North Dakota   637  5087  0.8 72.78  1.4 50.3 186
## 35           Ohio 10735  4561  0.8 70.82  7.4 53.2 124
## 36       Oklahoma  2715  3983  1.1 71.42  6.4 51.6  82
## 37         Oregon  2284  4660  0.6 72.13  4.2 60.0  44
## 38   Pennsylvania 11860  4449  1.0 70.43  6.1 50.2 126
## 39   Rhode Island   931  4558  1.3 71.90  2.4 46.4 127
## 40 South Carolina  2816  3635  2.3 67.96 11.6 37.8  65
## 41   South Dakota   681  4167  0.5 72.08  1.7 53.3 172
## 42      Tennessee  4173  3821  1.7 70.11 11.0 41.8  70
## 43          Texas 12237  4188  2.2 70.90 12.2 47.4  35
## 44           Utah  1203  4022  0.6 72.90  4.5 67.3 137
```

```
## 45        Vermont        472   3907        0.6    71.64    5.5    57.1   168
## 46       Virginia       4981   4701        1.4    70.08    9.5    47.8    85
## 47     Washington       3559   4864        0.6    71.72    4.3    63.5    32
## 48  West Virginia       1799   3617        1.4    69.48    6.7    41.6   100
## 49      Wisconsin       4589   4468        0.7    72.48    3.0    54.5   149
## 50        Wyoming        376   4566        0.6    70.29    6.9    62.9   173
##       Area
## 1   50708
## 2  566432
## 3  113417
## 4   51945
## 5  156361
## 6  103766
## 7    4862
## 8    1982
## 9   54090
## 10  58073
## 11   6425
## 12  82677
## 13  55748
## 14  36097
## 15  55941
## 16  81787
## 17  39650
## 18  44930
## 19  30920
## 20   9891
## 21   7826
## 22  56817
## 23  79289
## 24  47296
## 25  68995
## 26 145587
```

```
## 27  76483
## 28 109889
## 29   9027
## 30   7521
## 31 121412
## 32  47831
## 33  48798
## 34  69273
## 35  40975
## 36  68782
## 37  96184
## 38  44966
## 39   1049
## 40  30225
## 41  75955
## 42  41328
## 43 262134
## 44  82096
## 45   9267
## 46  39780
## 47  66570
## 48  24070
## 49  54464
## 50  97203
```

```
if (!require("readr")){
  chooseCRANmirror()
  install.packages("readr")
}
```

```
## 载入需要的程辑包: readr
```

```
## Warning: 程辑包'readr'是用R版本4.1.3 来建造的
```

```
library(readr)
## 用 readr 包的函数读取，并显示读取的内容；
read_table("data/Table0.txt", col_names = FALSE, show_col_types = FALSE)
```

```
## # A tibble: 7 x 5
##   X1          X2    X3    X4 X5
##   <chr>    <dbl> <dbl> <dbl> <chr>
## 1 Alex        25   177    57 F
## 2 Lilly       31   163    69 F
## 3 Mark        23   190    83 M
## 4 Oliver      52   179    75 M
## 5 Martha      76   163    70 F
## 6 Lucas       49   183    83 M
## 7 Caroline    26   164    53 F
```

```
read_table("data/Table1.txt", col_names = TRUE, show_col_types = FALSE)
```

```
## # A tibble: 7 x 5
##   Name       Age Height Weight Sex
##   <chr>    <dbl>  <dbl>  <dbl> <chr>
## 1 Alex        25    177     57 F
## 2 Lilly       31    163     69 F
## 3 Mark        23    190     83 M
## 4 Oliver      52    179     75 M
## 5 Martha      76    163     70 F
## 6 Lucas       49    183     83 M
## 7 Caroline    26    164     53 F
```

```
table2 <- read_table("data/Table2.txt", col_names = TRUE, skip = 1, show_col_types = FA
table2[, c(1,5)] <- lapply(table2[, c(1, 5)],
  gsub, pattern = "/", replacement = "")
table2
```

```
## # A tibble: 7 x 5
```

```
##   Name       Age Height Weight Sex
##   <chr>    <dbl>  <dbl>  <dbl> <chr>
## 1 Alex        25    177     57 F
## 2 Lilly       31    163     69 F
## 3 Mark        23    190     83 M
## 4 Oliver      52    179     75 M
## 5 Martha      76    163     70 F
## 6 Lucas       49    183     83 M
## 7 Caroline    26    164     53 F
```

```
read_table("data/Table3.txt", col_names = TRUE, skip = 1,
  na = c("", "NA", "--", "*", "**"), show_col_types = FALSE)
```

```
## # A tibble: 7 x 5
##   Name       Age Height Weight Sex
##   <chr>    <dbl>  <dbl>  <dbl> <chr>
## 1 Alex        25    177     57 F
## 2 Lilly       31     NA     69 F
## 3 Mark        NA    190     83 M
## 4 Oliver      52    179     75 M
## 5 Martha      76     NA     70 F
## 6 Lucas       49    183     NA M
## 7 Caroline    26    164     53 F
```

```
read_table("data/Table4.txt", col_names = TRUE,
  na = c("", "NA", "--", "*", "**"), show_col_types = FALSE)
```

```
## # A tibble: 7 x 5
##   Name       Age Height Weight Sex
##   <chr>    <dbl>  <dbl>  <dbl> <chr>
## 1 Alex        25    177     57 F
## 2 Lilly       31     NA     69 F
## 3 Mark        NA    190     83 M
## 4 Oliver      52    179     75 M
```

```
## 5 Martha      76     NA     70 F
## 6 Lucas       49    183     NA M
## 7 Caroline    26    164     53 F
```

```
read_delim("data/Table5.txt", col_names = TRUE, delim = ";",
  na = c("", "NA", "--", "*", "**"), show_col_types = FALSE)
```

```
## # A tibble: 7 x 5
##   Name       Age Height Weight Sex
##   <chr>    <dbl>  <dbl>  <dbl> <chr>
## 1 Alex        25    177     57 F
## 2 Lilly       31     NA     69 F
## 3 Mark        NA    190     83 M
## 4 Oliver      52    179     75 M
## 5 Martha      76     NA     70 F
## 6 Lucas       49    183     NA M
## 7 Caroline    26    164     53 F
```

```
read_table("data/Table6.txt", col_names = TRUE, skip = 1,
  comment = "@", show_col_types = FALSE)
```

```
## # A tibble: 105 x 5
##    Name       Age Height Weight Sex
##    <chr>    <dbl>  <dbl>  <dbl> <chr>
##  1 Alex        25    177     57 F
##  2 Lilly       31    163     69 F
##  3 Mark        23    190     83 M
##  4 Oliver      52    179     75 M
##  5 Martha      76    163     70 F
##  6 Lucas       49    183     83 M
##  7 Caroline    26    164     53 F
##  8 Alex        25    177     57 F
##  9 Lilly       31    163     69 F
## 10 Mark        23    190     83 M
```

```
## # ... with 95 more rows
```

```
read_csv("data/states1.csv", col_names = TRUE, show_col_types = FALSE)
```

```
## New names:
## * `` -> `...1`
```

```
## # A tibble: 50 x 9
##    ...1        Population Income Illiteracy Life E~1 Murder HS Gr~2 Frost   Area
##    <chr>            <dbl>  <dbl>      <dbl>    <dbl>  <dbl>   <dbl> <dbl>  <dbl>
##  1 Alabama           3615   3624        2.1     69.0   15.1    41.3    20  50708
##  2 Alaska             365   6315        1.5     69.3   11.3    66.7   152 566432
##  3 Arizona           2212   4530        1.8     70.6    7.8    58.1    15 113417
##  4 Arkansas          2110   3378        1.9     70.7   10.1    39.9    65  51945
##  5 California       21198   5114        1.1     71.7   10.3    62.6    20 156361
##  6 Colorado          2541   4884        0.7     72.1    6.8    63.9   166 103766
##  7 Connecticut       3100   5348        1.1     72.5    3.1    56     139   4862
##  8 Delaware           579   4809        0.9     70.1    6.2    54.6   103   1982
##  9 Florida           8277   4815        1.3     70.7   10.7    52.6    11  54090
## 10 Georgia           4931   4091        2       68.5   13.9    40.6    60  58073
## # ... with 40 more rows, and abbreviated variable names 1: `Life Exp`,
## #   2: `HS Grad`
```

```
# 读取 states2.csv . colon 转换成点, 使用分号作为分隔符
read_delim("data/states2.csv", col_names = TRUE,
  locale = locale(decimal_mark = ","), delim = ";", show_col_types = FALSE)
```

```
## New names:
## * `` -> `...1`
```

```
## # A tibble: 50 x 9
##    ...1        Population Income Illiteracy Life E~1 Murder HS Gr~2 Frost   Area
##    <chr>            <dbl>  <dbl>      <dbl>    <dbl>  <dbl>   <dbl> <dbl>  <dbl>
##  1 Alabama           3615   3624        2.1     69.0   15.1    41.3    20  50708
```

```
##  2 Alaska            365   6315        1.5     69.3   11.3    66.7   152 566432
##  3 Arizona          2212   4530        1.8     70.6    7.8    58.1    15 113417
##  4 Arkansas         2110   3378        1.9     70.7   10.1    39.9    65  51945
##  5 California      21198   5114        1.1     71.7   10.3    62.6    20 156361
##  6 Colorado         2541   4884        0.7     72.1    6.8    63.9   166 103766
##  7 Connecticut      3100   5348        1.1     72.5    3.1    56     139   4862
##  8 Delaware          579   4809        0.9     70.1    6.2    54.6   103   1982
##  9 Florida          8277   4815        1.3     70.7   10.7    52.6    11  54090
## 10 Georgia          4931   4091        2       68.5   13.9    40.6    60  58073
## # ... with 40 more rows, and abbreviated variable names 1: `Life Exp`,
## #   2: `HS Grad`
```