tidyverse

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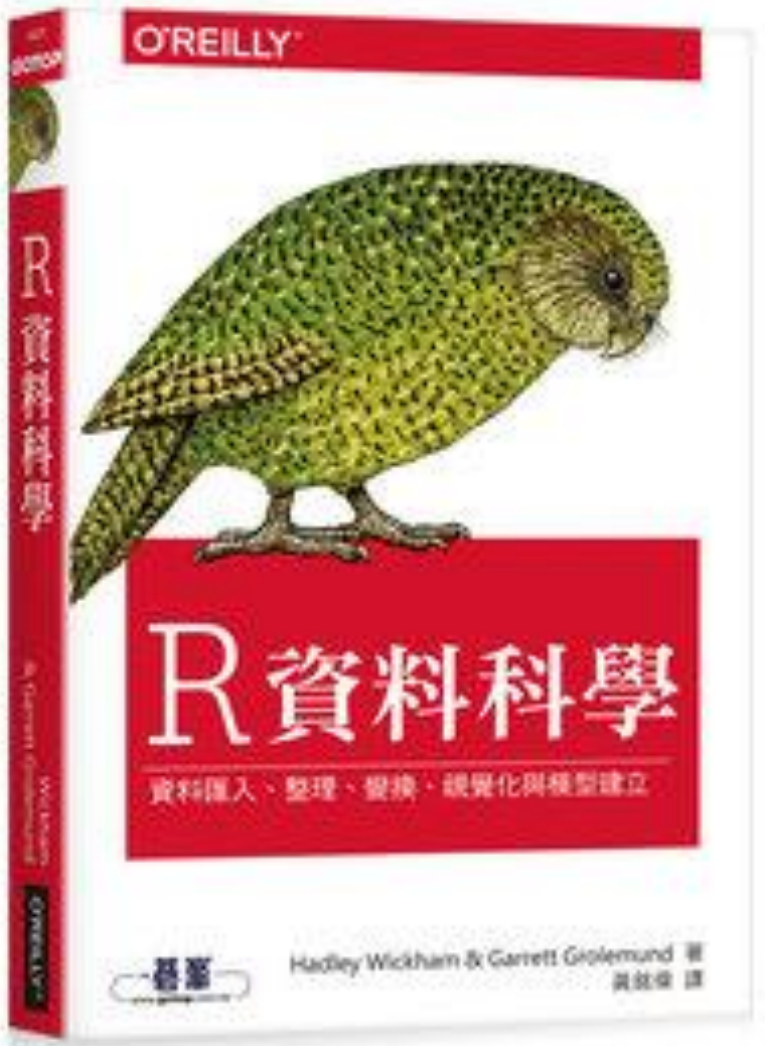
臺北榮民總醫院醫學研究部大數據中心

Topics

- R for data science
- tidyverse
- Function
- Resources

- 本次上課請開始使用 RStudio 軟體操作 !!!
- RStudio 裡執行 view() 但只顯示前1000筆(row)資料。當資料輸出量大時，請勿任意執行 view()，否則會使 RStudio 近乎當掉。

Lecture Source :



SECTION I

R FOR DATA SCIENCE

Hadley Wickham
the man who revolutionized R

https://commons.wikimedia.org/wiki/File:Hadley-wickham2016-02-04.jpg

COPSS Presidents' Award: Hadley Wickham

SEPTEMBER 2, 2019

Hadley Wickham wins the prestigious 2019 COPSS Presidents' Award

Hadley Wickham, Chief Scientist at RStudio, is the recipient of the 2019 COPSS Presidents' Award. This award is presented annually to a young member of one of the participating societies of COPSS in recognition of outstanding contributions to the profession of statistics. The award citation recognized Wickham "for influential work in statistical computing, visualization, graphics, and data analysis; for developing and implementing an impressively comprehensive computational infrastructure for data analysis through R software; for making statistical thinking and computing accessible to large audience; and for enhancing an appreciation for the important role of statistics among data scientists."

https://imstat.org/2019/09/02/copss-presidents-award-hadley-wickham/

http://hadley.nz/

Hadley Wickham

TEACHING

If you'd like to learn more about what I do, and how to use R effectively, I'd recommend starting with one of my books:

- R for Data Science, with Garrett Grolemund, introduces the key tools for doing data science with R.
- ggplot2: elegant graphics for data analysis shows you how to use ggplot2 to create graphics that help you understand your data.
- Advanced R helps you master R as a programming language, teaching you what makes R tick.
- R packages teaches good software engineering practices for R, using packages for bundling, documenting, and testing your code.

I also teach in person workshops from time-to-time; see the RStudio workshops page for more details.

CODE

Most of my work is in the form of open source R code, which you can find on my github. You can roughly divide my work into three categories: tools for data science, tools for data import, and software engineering tools.

DATA SCIENCE WITH THE TIDYVERSE

- ggplot2 for visualising data.
- dplyr for manipulating data.
- tidyr for tidying data.
- stringr for working with strings.
- lubridate for working with date/times.

DATA IMPORT

- readr for reading .csv and fwf files.
- readxl for reading .xls and .xlsx files.
- haven for SAS, SPSS, and Stata files.
- httr for talking to web APIs.
- rvest for scraping websites.
- xml2 for importing XML files.

SOFTWARE ENGINEERING

- devtools for general package development.
- roxygen2 for in-line documentation.
- testthat for unit testing
- pkgdown to create beautiful package websites

https://r4ds.had.co.nz/

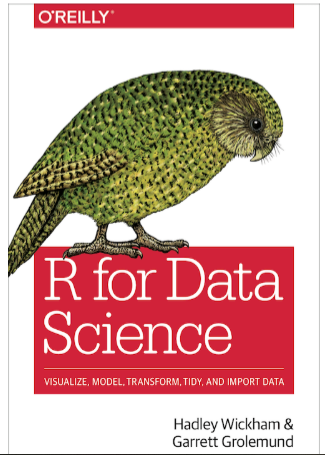
R for Data Science

Garrett Grolemund

Hadley Wickham

Welcome

This is the website for **"R for Data Science"**. This book will teach you how to do data science with R: You'll learn how to get your data into R, get it into the most useful structure, transform it, visualise it and model it. In this book, you will find a practicum of skills for data science. Just as a chemist learns how to clean test tubes and stock a lab, you'll learn how to clean data and draw plots—and many other things besides. These are the skills that allow data science to happen, and here you will find the best practices for doing each of these things with R. You'll learn how to use the grammar of graphics, literate programming, and reproducible research to save time. You'll also learn how to manage cognitive resources to facilitate discoveries when wrangling, visualising, and exploring data.



https://jrnold.github.io/r4ds-exercise-solutions/

R for Data Science: Exercise Solutions

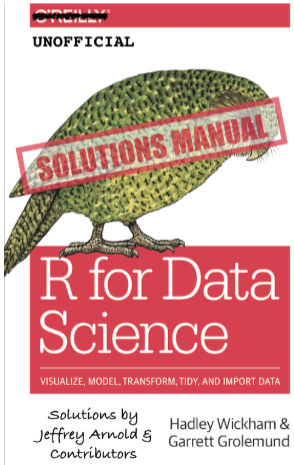
Jeffrey B. Arnold

February 27, 2019

Welcome

This book contains the **exercise solutions** for the book *R for Data Science*, by Hadley Wickham and Garret Grolemund (Wickham and Grolemund 2017).

R for Data Science itself is available online at r4ds.had.co.nz, and physical copy is published by O'Reilly Media and available from amazon.



Acknowledgments

These solutions have benefited from many contributors. A special thanks to:

- Garrett Grolemund and Hadley Wickham for writing the truly fantastic *R for Data Science*, without whom these solutions would not exist—literally.

https://adv-r.hadley.nz/

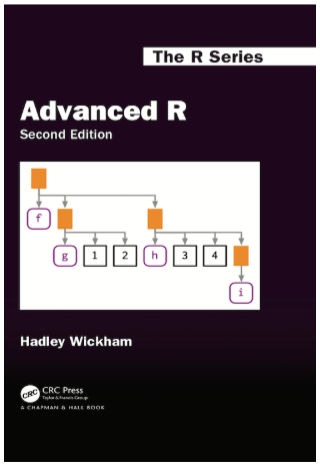
Advanced R

Hadley Wickham

Welcome

This is the website for 2nd edition of "**Advanced R**", a book in Chapman & Hall's R Series. The book is designed primarily for R users who want to improve their programming skills and understanding of the language. It should also be useful for programmers coming to R from other languages, as help you to understand why R works the way it does.

If you're looking for the electronic version of the 1st edition, you can find it online at http://adv-r.had.co.nz/.



License

https://r-pkgs.org/

R Packages

Hadley Wickham

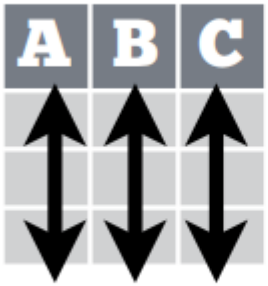
Jenny Bryan

R packages

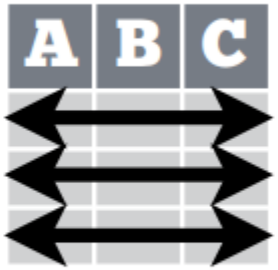
Packages are the fundamental units of reproducible R code. They include reusable R functions, the documentation that describes how to use them, and sample data. In this book you'll learn how to turn your code into packages that others can easily download and use. Writing a package can seem overwhelming at first. So start with the basics and improve it over time. It doesn't matter if your first version isn't perfect as long as the next version is better.

This edition is a work in progress. If you're looking for the electronic version of the 1st edition, you can find it online at http://r-pkgs.had.co.nz/.

A table is tidy if:



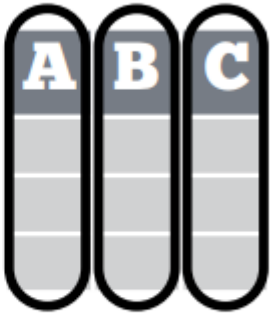
&



Each **variable** is in its own **column**

Each **observation**, or **case**, is in its own **row**

Tidy data:



Makes variables easy to access as vectors

https://github.com/rstudio/cheatsheets/raw/master/data-import.pdf

SECTION II

TIDYVERSE

https://www.tidyverse.org/

Tidyverse Packages Blog Learn Help Contribute

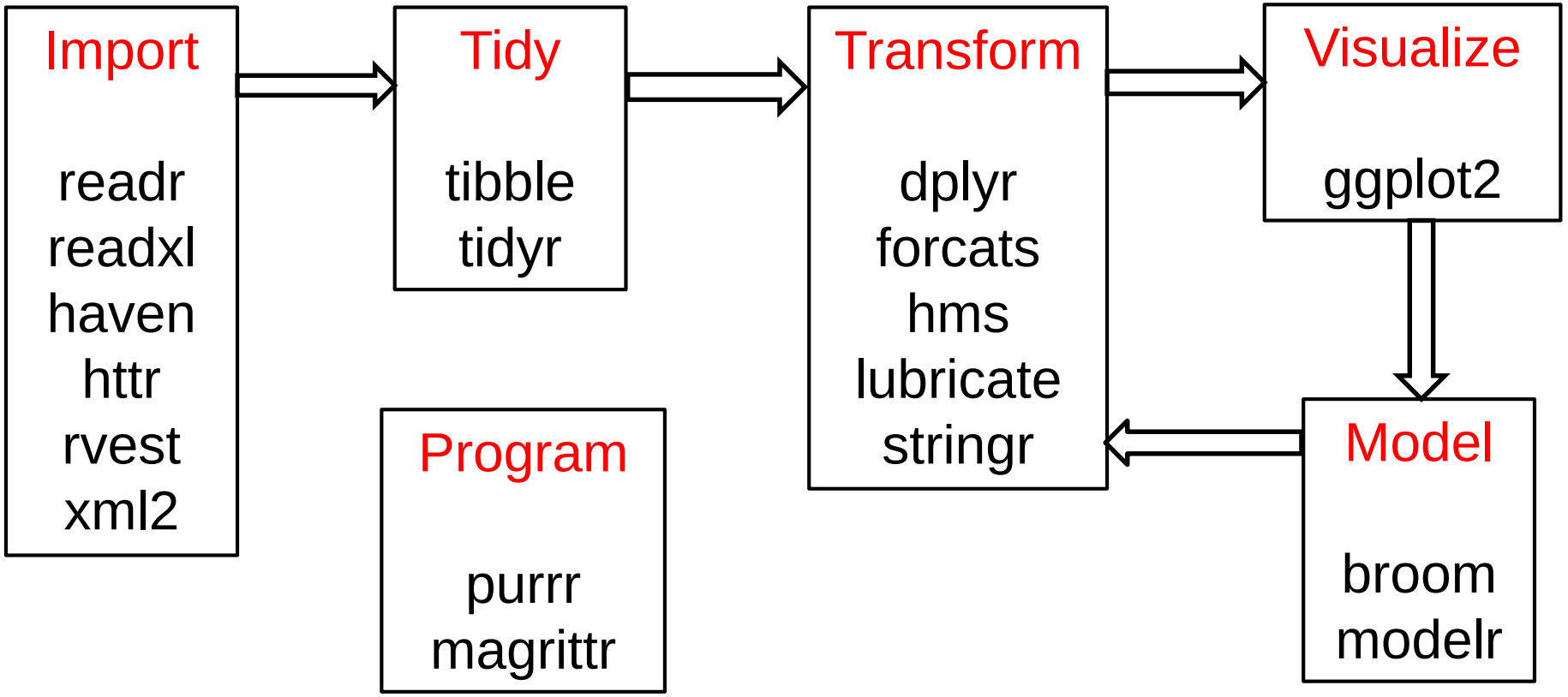
R packages for data science

The tidyverse is an opinionated **collection of R packages** designed for data science. All packages share an underlying design philosophy, grammar, and data structures.

Install the complete tidyverse with:

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

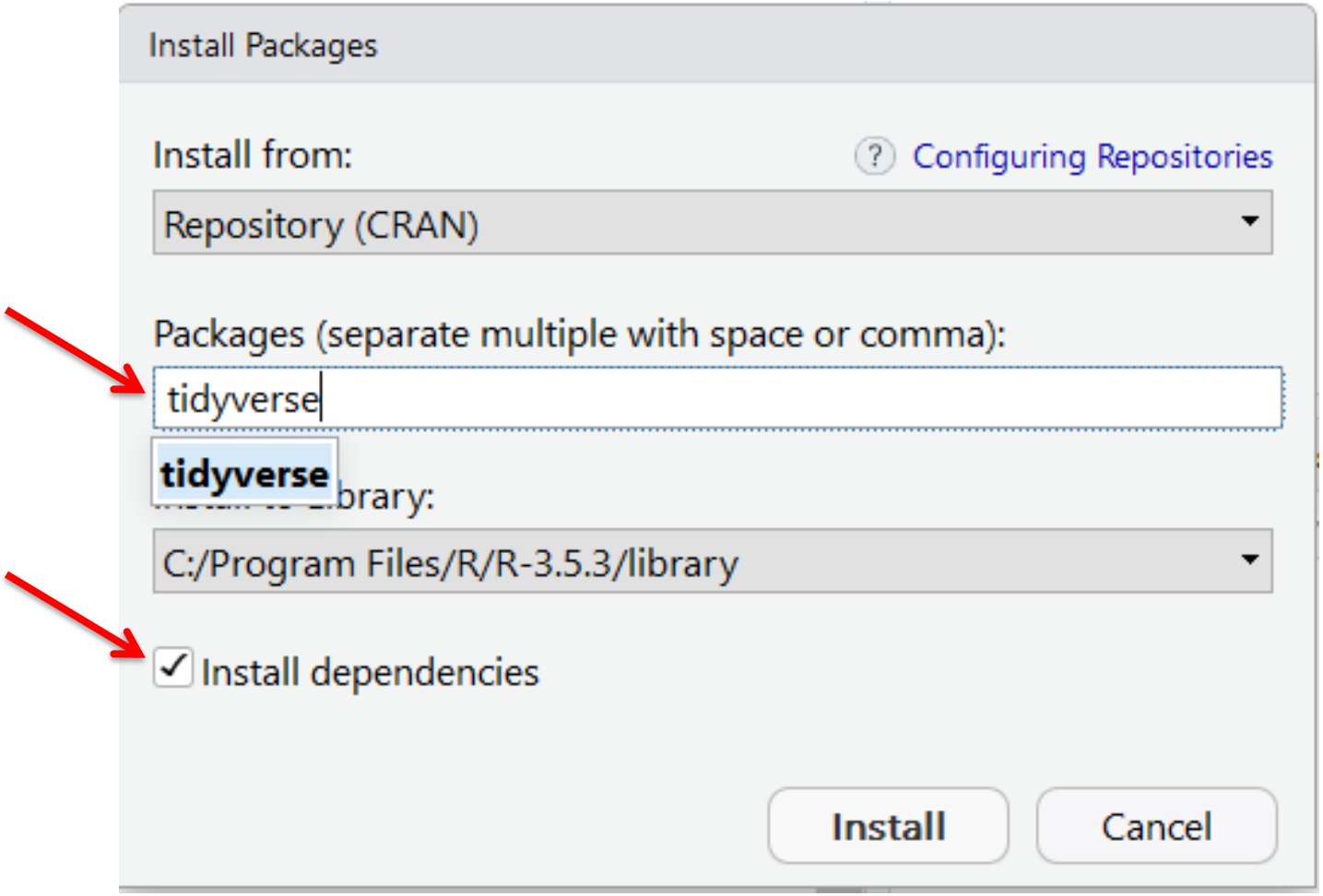
Flow of Data Processing



https://intro2r.library.duke.edu/data_management.html

安裝 tidyverse 套件(工具包)

RStudio



也可 install.packages("tidyverse")

載入 tidyverse

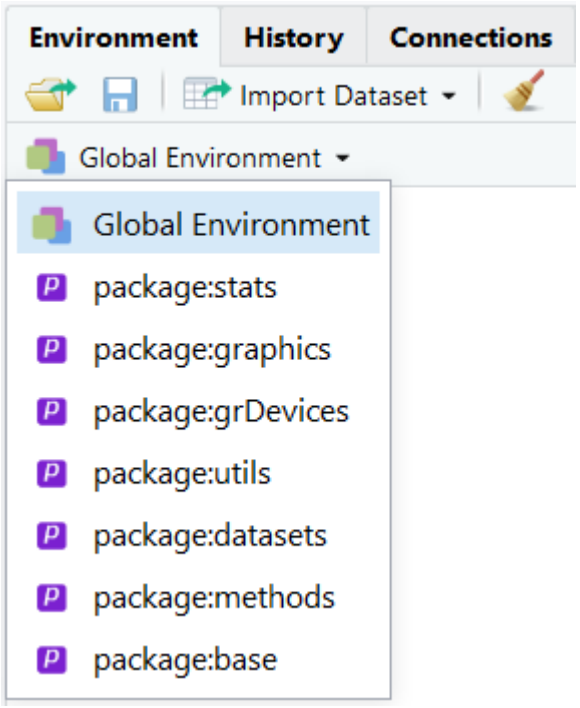
library(tidyverse)

- 會同時載入另外8個套件
- 顯示有2個函數會蓋過舊函數。如果還要使用舊函數，需加上舊套件名稱 (即：舊套件::舊函數)

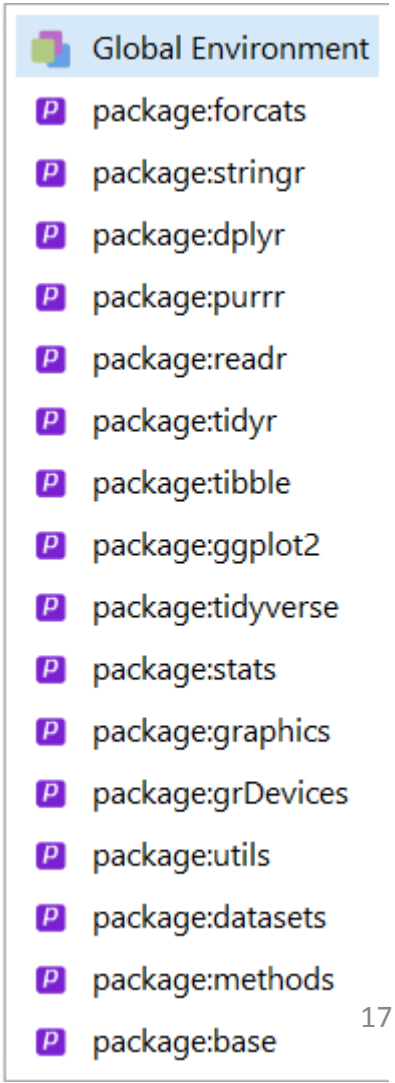
```
> library(tidyverse)
-- Attaching packages ---------------------------------------- tidyverse 1.3.0 --
√ ggplot2 3.3.3     √ purrr   0.3.4
√ tibble  3.1.0     √ dplyr   1.0.4
√ tidyr   1.1.2     √ stringr 1.4.0
√ readr   1.4.0     √ forcats 0.5.1
-- Conflicts ------------------------------------------- tidyverse_conflicts() --
x dplyr::filter() masks stats::filter()
x dplyr::lag()    masks stats::lag()
```

載入 tidyverse

- 載入前



- 載入後

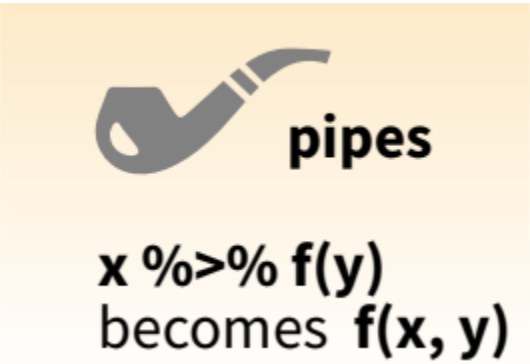


Most Important Features

- tibble : 簡化與優化傳統的data frame

```
> class(t)
[1] "spec_tbl_df" "tbl_df"      "tbl"         "data.frame"
> mode(t)
[1] "list"
```

- pipe : %>%



https://github.com/rstudio/cheatsheets/raw/master/data-transformation.pdf

插播

Skepticism about tidyverse

从另一个视角看 R 语言的方言 Tidyverse

Norm Matloff

关键词：Base R; tidyverse

译者：李嵩；校对：任焱、黄湘云；编辑：任焱

从另一个视角看 R 语言的 “方言”Tidyverse，以及 RStudio 对 Tidyverse 的提倡。

作者简介

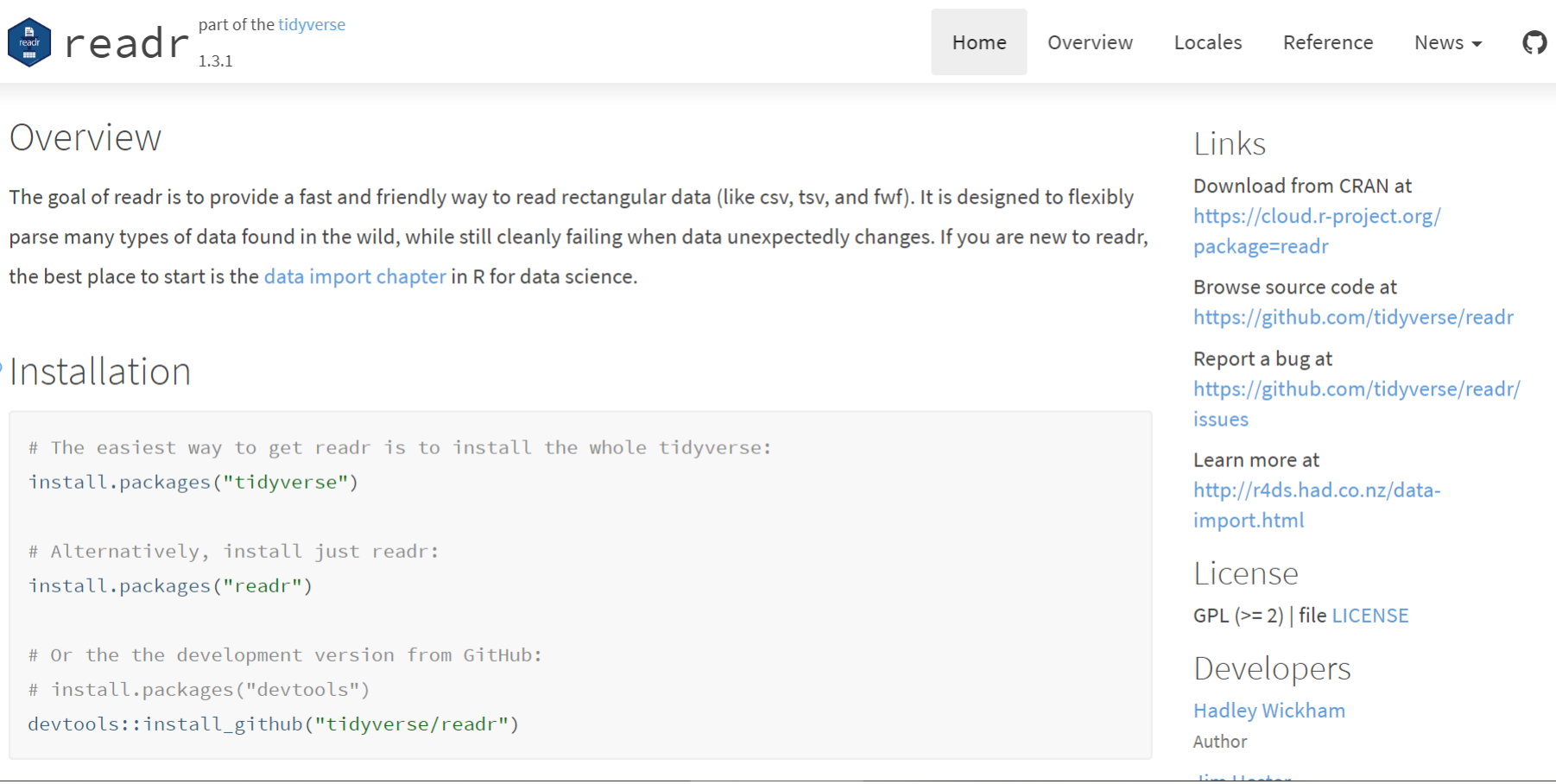
作者 Norm Matloff 为 UC Davis 计算机科学教授（曾任 UCD 统计学教授）。中文翻译及投稿至 COS 经过作者同意。文中的 “我” 为作者视角，但译文中存在的任何不妥之处当然很可能是由译者引入的，还望读者不吝赐教。

https://cosx.org/2020/10/alternative-view-tidyverse-r/
https://github.com/matloff/TidyverseSkeptic/blob/master/READMEFull.md

SECTION II-A

DATA IMPORT

https://readr.tidyverse.org/



https://readxl.tidyverse.org/

readxl part of the tidyverse 1.3.1.9000

Reference Articles News

Overview

The readxl package makes it easy to get data out of Excel and into R. Compared to many of the existing packages (e.g. gdata, xlsx, xlsReadWrite) readxl has no external dependencies, so it's easy to install and use on all operating systems. It is designed to work with *tabular* data.

readxl supports both the legacy `.xls` format and the modern xml-based `.xlsx` format. The libxls C library is used to support `.xls`, which abstracts away many of the complexities of the underlying binary format. To parse `.xlsx`, we use the RapidXML C++ library.

Installation

The easiest way to install the latest released version from CRAN is to install the whole tidyverse.

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

NOTE: you will still need to load readxl explicitly, because it is not a core tidyverse package loaded via `library(tidyverse)`.

Links

Download from CRAN at https://cloud.r-project.org/package=readxl

Browse source code at https://github.com/tidyverse/readxl

Report a bug at https://github.com/tidyverse/readxl/issues

Learn more at http://r4ds.had.co.nz/data-import.html

License

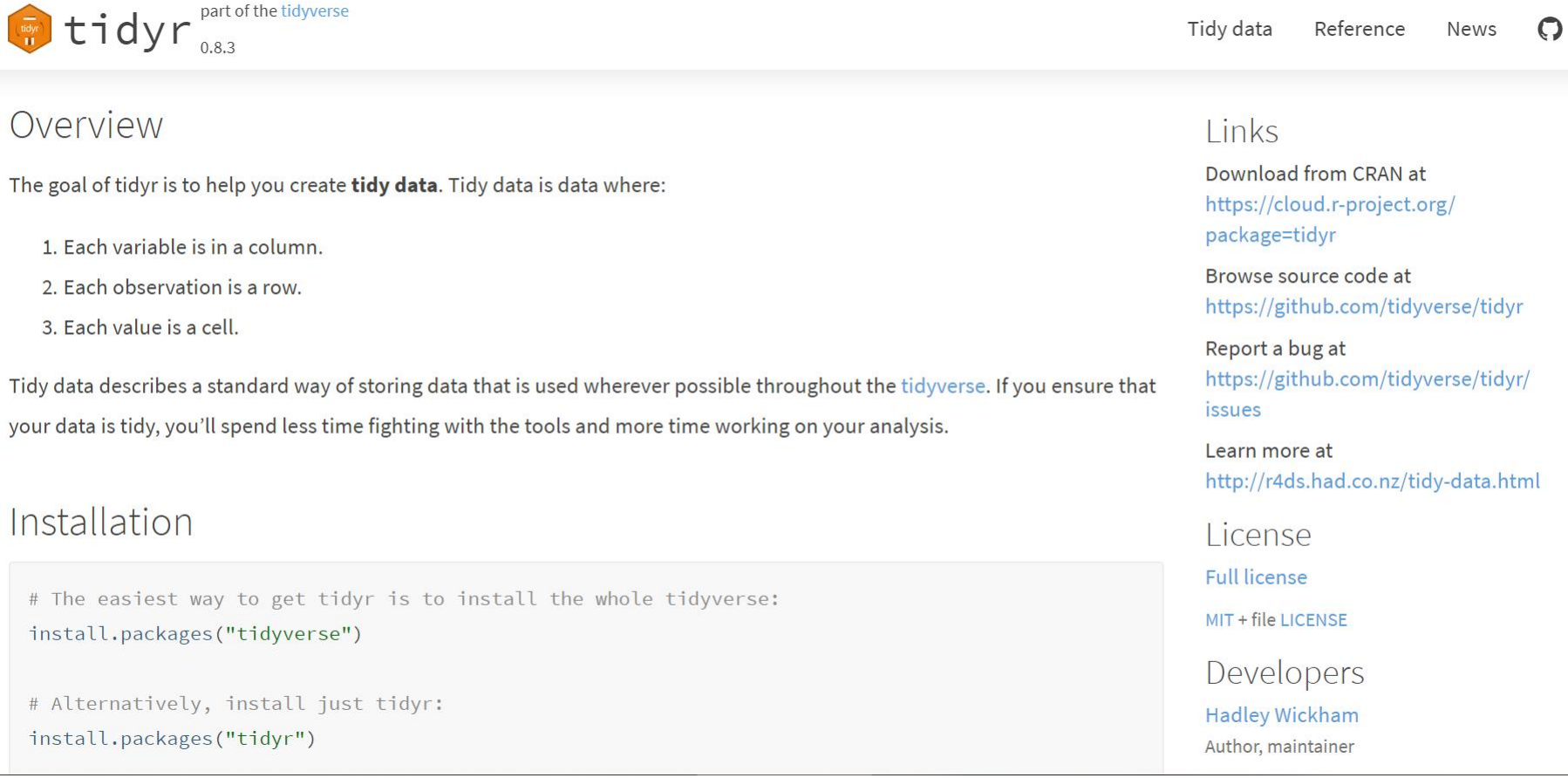
GPL-3

Developers

Hadley Wickham
Author

Jennifer Bryan

https://tidyr.tidyverse.org/



匯入示範資料

- 利用Import_tidyverse.r，匯入資料
- 將資料複製於D槽下，如果欲放置於其他位置，請同時更改Import_tidyverse.r
- 利用readr套件的read_fwf函數匯入
- 匯入速度相當快
- 不會將文字欄位轉換為因子(factor)
- # 資料與程式碼置於SampleData子目錄

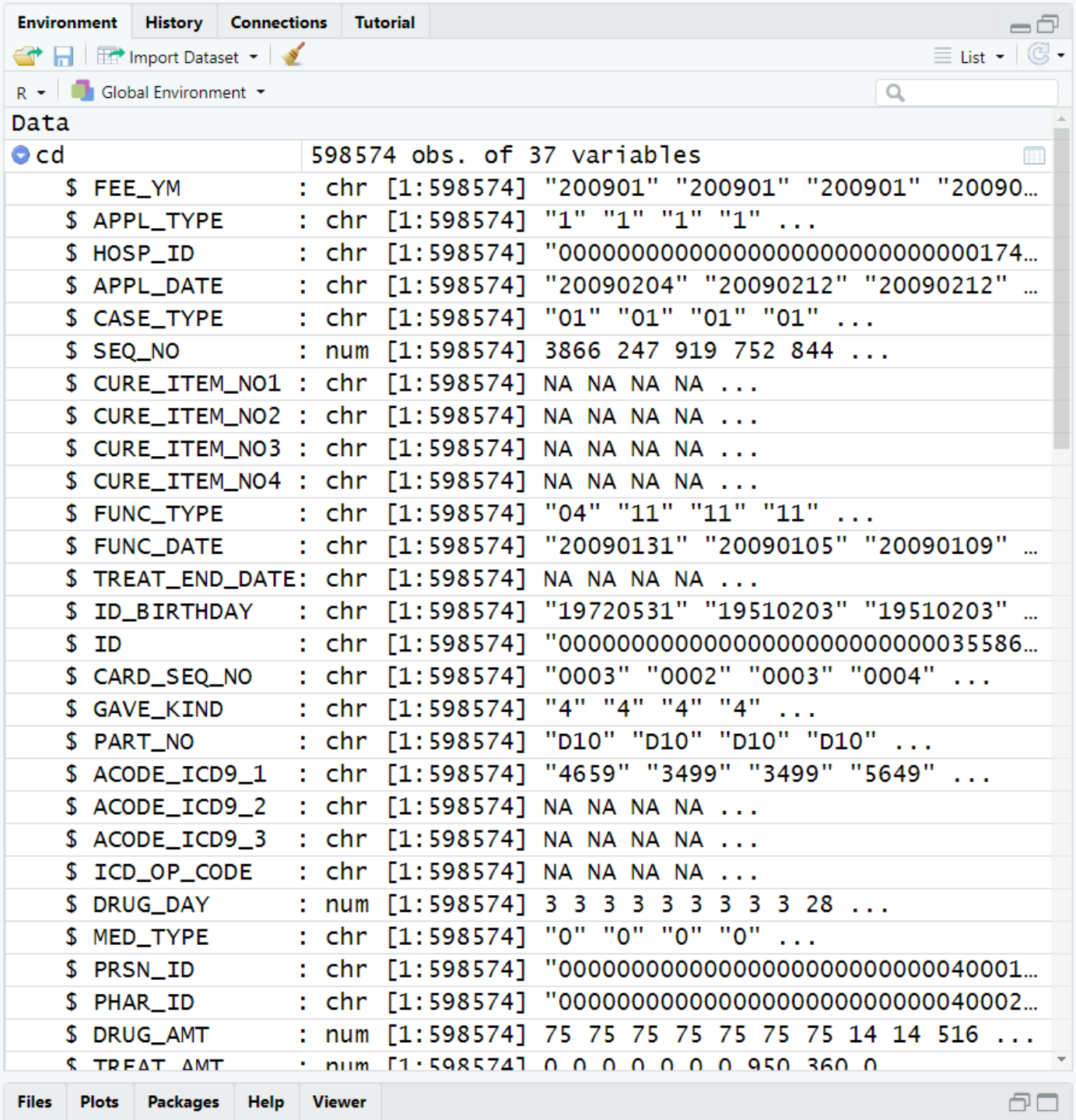
注意 !!!
以read_fwf函數匯入的資料集，如果資料集某處並無資料(空白)，R將其視為NA，而非長度為零的資料。與read.csv函數迥異

```
source("D:/SampleData/Import_tidyverse.r")
# CHANGE HERE !!! 更動.r檔的位置
```

```
> columntypes <- "ccccncccccccccccccccccncccnncncncnnnc"
> cd <- read_fwf(
+     paste(directory, "CD2009.DAT", sep = ""),
+     fwf_widths(columnwidths, columnnames),
+     col_types = columntypes,
+     progress = TRUE
+ )
>
> cd
# A tibble: 598,574 x 37
   FEE_YM APPL_TYPE HOSP_ID APPL_DATE CASE_TYPE SEQ_NO CURE_ITEM_NO1
    <chr>     <chr>   <chr>     <chr>     <chr>  <dbl>        <chr>
 1 200901         1 000000~ 20090204        01   3866           NA
 2 200901         1 000000~ 20090212        01    247           NA
 3 200901         1 000000~ 20090212        01    919           NA
 4 200901         1 000000~ 20090212        01    752           NA
 5 200901         1 000000~ 20090212        01    844           NA
 6 200901         1 000000~ 20090212        01    852           NA
 7 200901         1 000000~ 20090209        01   6542           NA
 8 200901         1 000000~ 20090207        09    389           D0
 9 200901         1 000000~ 20090207        09    369           NA
10 200901         1 000000~ 20090211        08   3196           33
# ... with 598,564 more rows, and 30 more variables:
#   CURE_ITEM_NO2 <chr>, CURE_ITEM_NO3 <chr>, CURE_ITEM_NO4 <chr>,
#   FUNC_TYPE <chr>, FUNC_DATE <chr>, TREAT_END_DATE <chr>,
#   ID_BIRTHDAY <chr>, ID <chr>, CARD_SEQ_NO <chr>, GAVE_KIND <chr>,
#   PART_NO <chr>, ACODE_ICD9_1 <chr>, ACODE_ICD9_2 <chr>,
#   ACODE_ICD9_3 <chr>, ICD_OP_CODE <chr>, DRUG_DAY <dbl>,
#   MED_TYPE <chr>, PRSN_ID <chr>, PHAR_ID <chr>, DRUG_AMT <dbl>,
#   TREAT_AMT <dbl>, TREAT_CODE <chr>, DIAG_AMT <dbl>, DSVC_NO <chr>,
#   DSVC_AMT <dbl>, BY_PASS_CODE <chr>, T_AMT <dbl>, PART_AMT <dbl>,
#   T_APPL_AMT <dbl>, ID_SEX <chr>
>
```

tibble

注意 !!!
以read_fwf函數匯入的資料集，如果資料集某處並無資料，R將其視為NA


Environment
History
Connections
Tutorial
Import Dataset
List
R
Global Environment
Data
cd
598574 obs. of 37 variables
$ FEE_YM : chr [1:598574] "200901" "200901" "200901" "20090…
$ APPL_TYPE : chr [1:598574] "1" "1" "1" "1" ...
$ HOSP_ID : chr [1:598574] "00000000000000000000000000000174…
$ APPL_DATE : chr [1:598574] "20090204" "20090212" "20090212" …
$ CASE_TYPE : chr [1:598574] "01" "01" "01" "01" ...
$ SEQ_NO : num [1:598574] 3866 247 919 752 844 ...
$ CURE_ITEM_NO1 : chr [1:598574] NA NA NA NA ...
$ CURE_ITEM_NO2 : chr [1:598574] NA NA NA NA ...
$ CURE_ITEM_NO3 : chr [1:598574] NA NA NA NA ...
$ CURE_ITEM_NO4 : chr [1:598574] NA NA NA NA ...
$ FUNC_TYPE : chr [1:598574] "04" "11" "11" "11" ...
$ FUNC_DATE : chr [1:598574] "20090131" "20090105" "20090109" …
$ TREAT_END_DATE: chr [1:598574] NA NA NA NA ...
$ ID_BIRTHDAY : chr [1:598574] "19720531" "19510203" "19510203" …
$ ID : chr [1:598574] "00000000000000000000000000035586…
$ CARD_SEQ_NO : chr [1:598574] "0003" "0002" "0003" "0004" ...
$ GAVE_KIND : chr [1:598574] "4" "4" "4" "4" ...
$ PART_NO : chr [1:598574] "D10" "D10" "D10" "D10" ...
$ ACODE_ICD9_1 : chr [1:598574] "4659" "3499" "3499" "5649" ...
$ ACODE_ICD9_2 : chr [1:598574] NA NA NA NA ...
$ ACODE_ICD9_3 : chr [1:598574] NA NA NA NA ...
$ ICD_OP_CODE : chr [1:598574] NA NA NA NA ...
$ DRUG_DAY : num [1:598574] 3 3 3 3 3 3 3 3 3 28 ...
$ MED_TYPE : chr [1:598574] "0" "0" "0" "0" ...
$ PRSN_ID : chr [1:598574] "00000000000000000000000000040001…
$ PHAR_ID : chr [1:598574] "00000000000000000000000000040002…
$ DRUG_AMT : num [1:598574] 75 75 75 75 75 75 75 14 14 516 ...
$ TREAT_AMT : num [1:598574] 0 0 0 0 0 0 0 950 360 0
Files
Plots
Packages
Help
Viewer

補充

讓空白還是空白

- 以read_fwf函數匯入的資料集，如果資料集某處並無資料(空白)，R將其視為NA (預設值)。想讓空白值匯入時維持空白，而非NA，需修改設定：

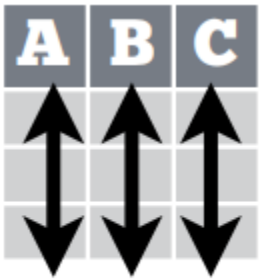
```
cd <- read_fwf(paste(directory, "CD2009.DAT", sep = ""), fwf_widths(columnwidths, columnnames), col_types = columntypes, progress = TRUE, na = "NA")

# 預設值 : na = c("", "NA")
# na : Character vector of strings to interpret as missing values
```

重要觀念

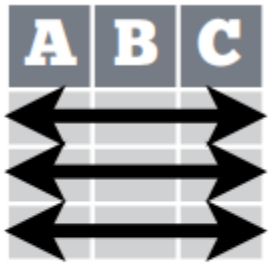
匯入完畢後了解資料性質

```
mode(cd)   # "list"
class(cd)   # "spec_tbl_df" "tbl_df" "tbl"  "data.frame"
# 檔案匯入後同時具有 tibble與 data frame 的特性

mode(cd$FEE_YM)   # "character"
class(cd$FEE_YM)   # "character"

is.vector(cd$FEE_YM)   # TRUE
is.factor(cd$FEE_YM)   # FALSE
is.list(cd$FEE_YM)   # FALSE
# 文字欄位沒被自動轉換為factor
```

名詞翻譯



Each **variable** is in its own **column**



Each **observation**, or **case**, is in its own **row**

變數　　一筆資料

欄位　　一筆觀察值

直行　　一筆紀錄(record)

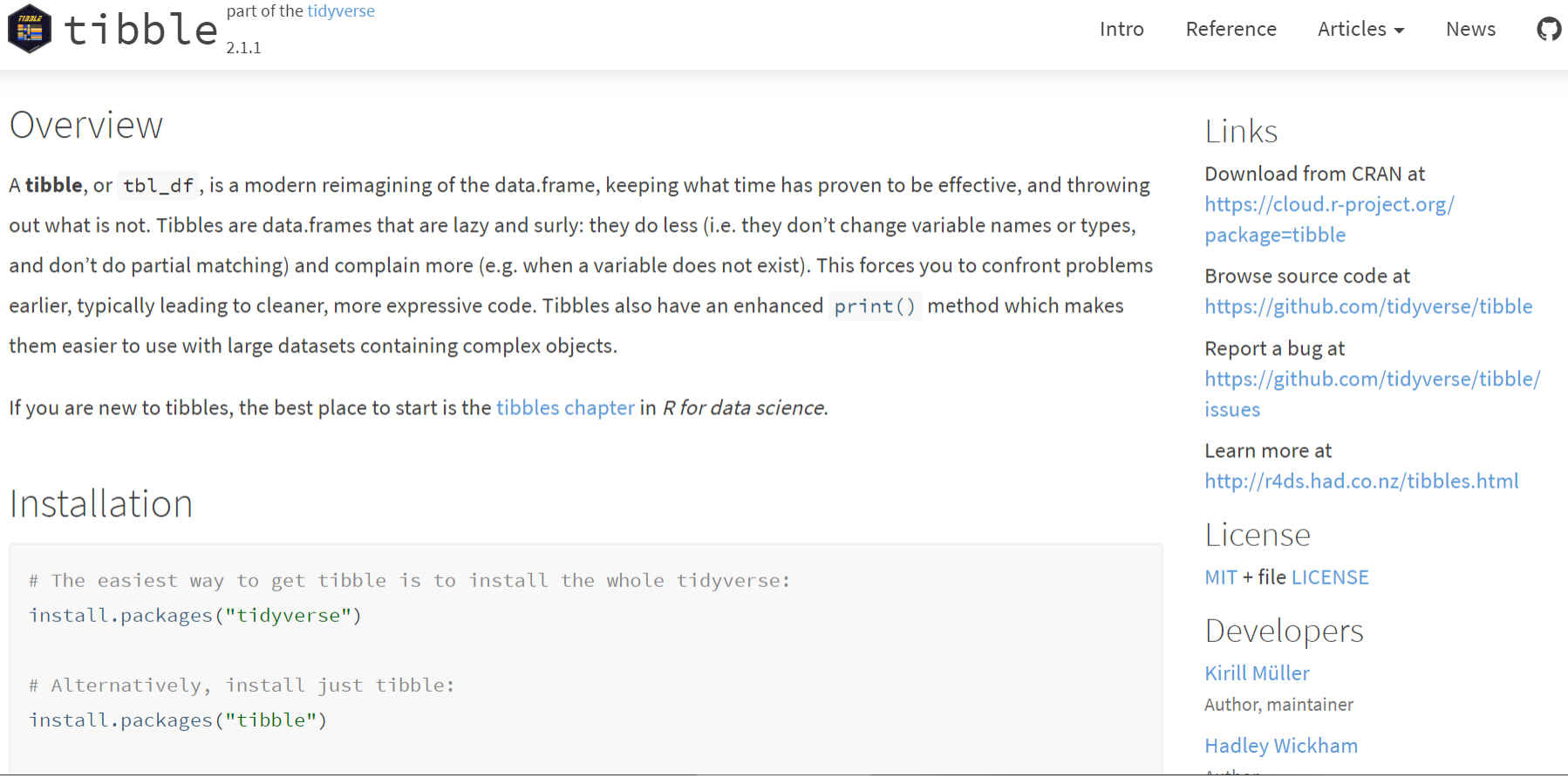
橫列

https://github.com/rstudio/cheatsheets/raw/master/data-import.pdf

SECTION II-B

TIBBLE

https://tibble.tidyverse.org/



tibble

- 簡化與優化傳統的data frame
- 可用as_tibble(df)，將既有的data frame轉成tibble
- 利用readr套件匯入的資料集，自動轉成tibble資料型態，而且
  - 不會自動將字元向量轉成因子(factor)
  - 不會自動更改欄名稱(column name)
  - 不會使用列名稱(row name)
  - 匯入速度快很多
- 適用於data frame的函數，也可用於tibble (tibble兼具data frame類別)

以 tibble函數 建立 tibble

```
tibble(
  x = 1:5,
  y = 1,
  z = x ^ 2 + y
)
```

* tibble函數會自動循環延展個別向量的元素，讓tibble成為整齊的矩形(整齊的tidy)結構

```
> tibble(
+   x = 1:5,
+   y = 1,
+   z = x ^ 2 + y
+ )
# A tibble: 5 x 3
      x     y     z
  <int> <dbl> <dbl>
1     1     1     2
2     2     1     5
3     3     1    10
4     4     1    17
5     5     1    26
>
```

以 tribble函數 建立 tibble

```
tribble(
  ~x, ~y, ~z,
  #--|--|----
  "a", 2, 3.6,
  "b", 1, 8.5
)
```

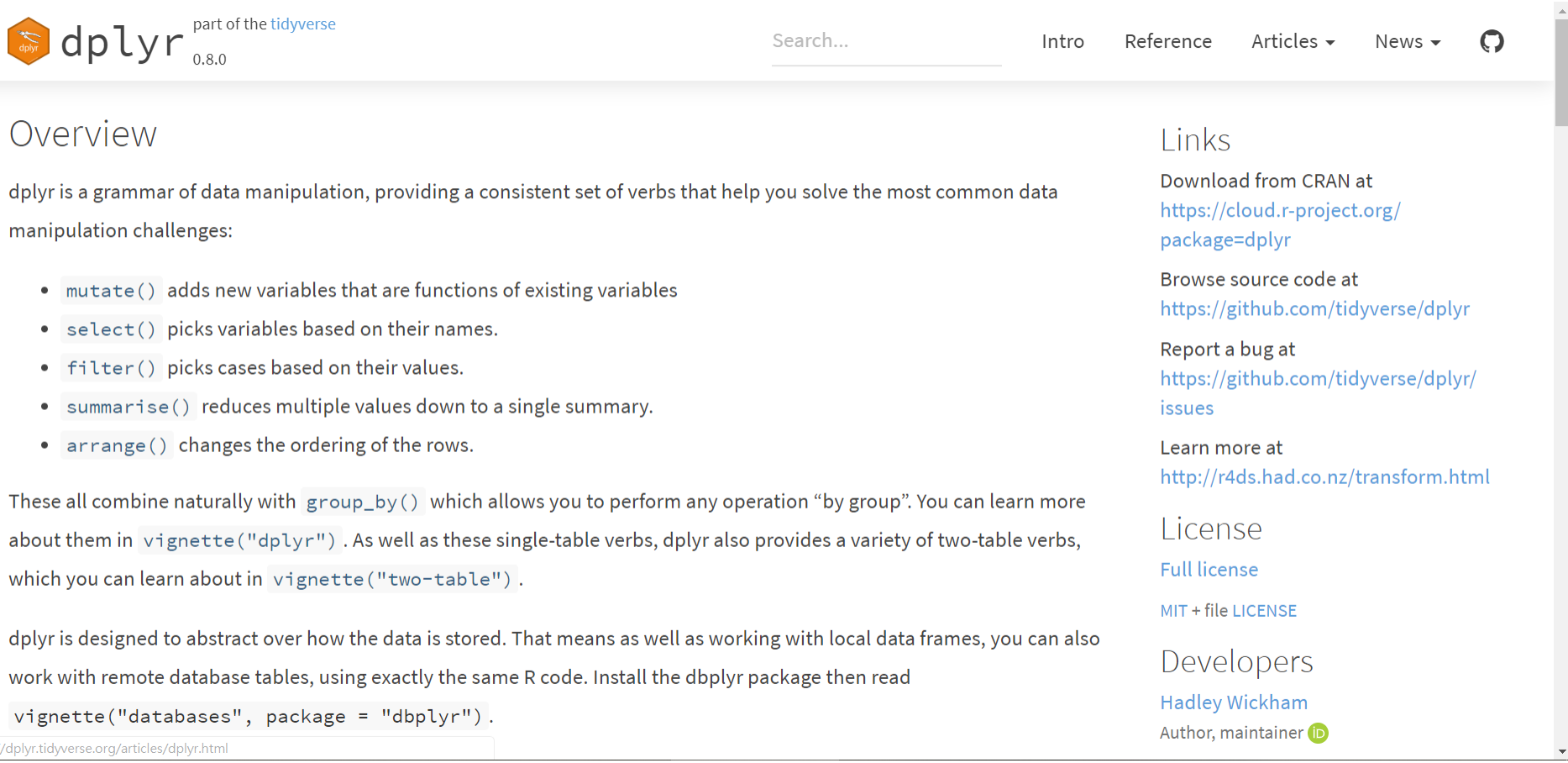
```
> tribble(
+   ~x, ~y, ~z,
+   #--|--|----
+   "a", 2, 3.6,
+   "b", 1, 8.5
+ )
# A tibble: 2 x 3
  x         y     z
  <chr> <dbl> <dbl>
1 a         2   3.6
2 b         1   8.5
> |
```

* transposed tibble

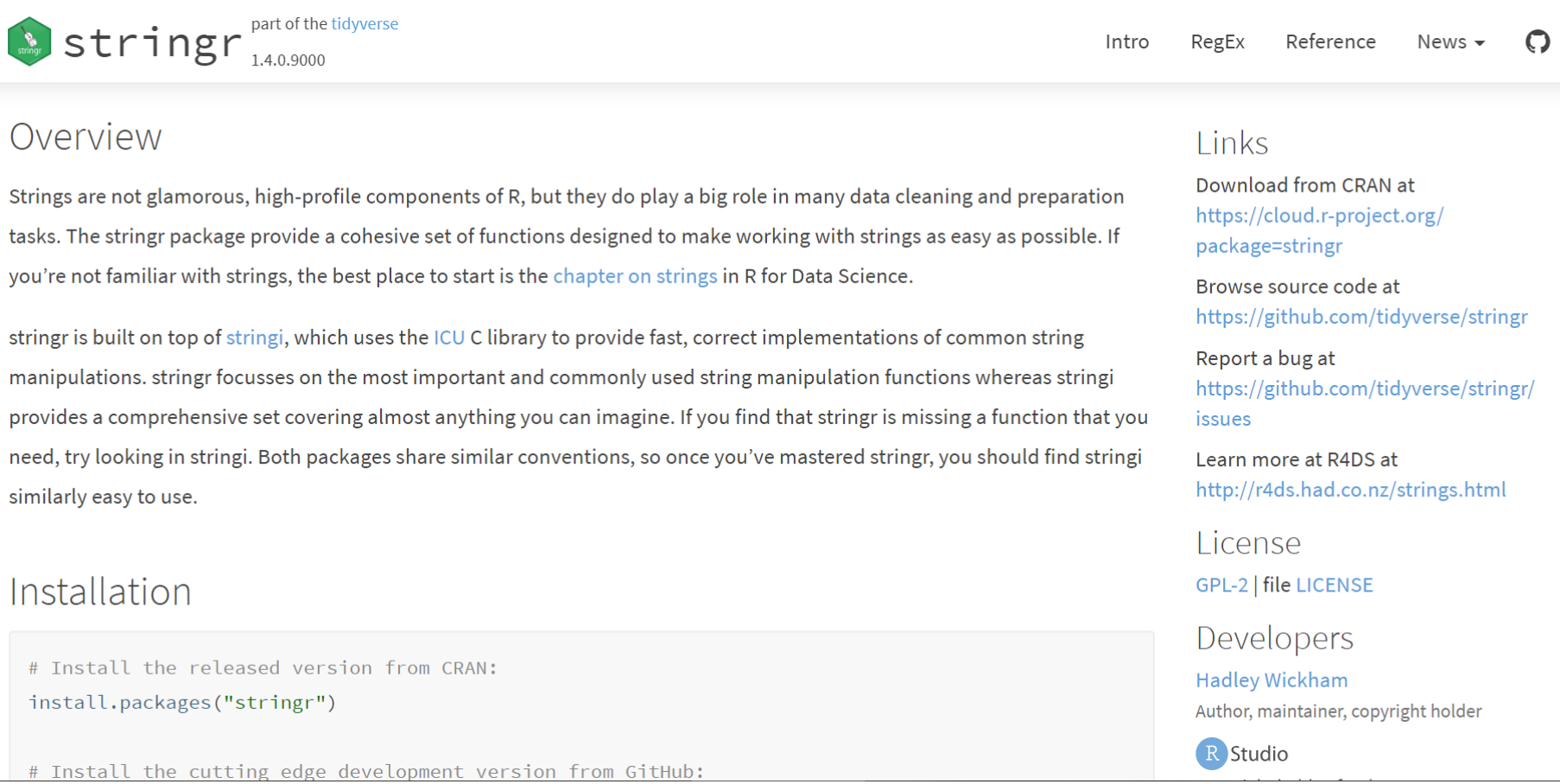
SECTION II-C

DATA MANIPULATION

https://dplyr.tidyverse.org/



https://stringr.tidyverse.org/



https://stringr.tidyverse.org/articles/regular-expressions.html

Regular expressions

Source: `vignettes/regular-expressions.Rmd`

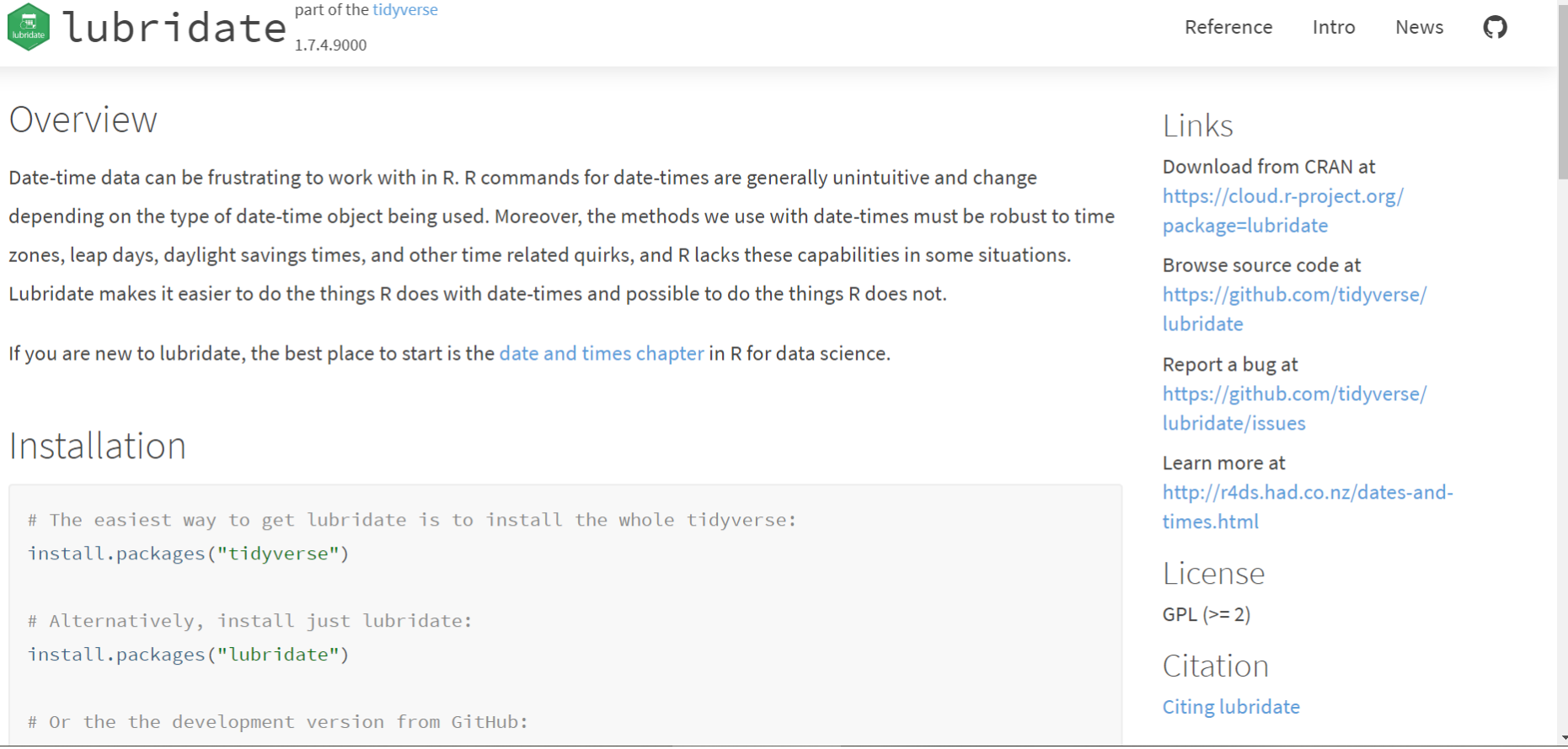
Regular expressions are a concise and flexible tool for describing patterns in strings. This vignette describes the key features of stringr's regular expressions, as implemented by stringi. It is not a tutorial, so if you're unfamiliar regular expressions, I'd recommend starting at http://r4ds.had.co.nz/strings.html. If you want to master the details, I'd recommend reading the classic *Mastering Regular Expressions* by Jeffrey E. F. Friedl.

Regular expressions are the default pattern engine in stringr. That means when you use a pattern matching function with a bare string, it's equivalent to wrapping it in a call to `regex()`:

```
# The regular call:
str_extract(fruit, "nana")
# Is shorthand for
str_extract(fruit, regex("nana"))
```

Contents

https://lubridate.tidyverse.org/



lubridate part of the tidyverse 1.7.4.9000

Reference Intro News

Overview

Date-time data can be frustrating to work with in R. R commands for date-times are generally unintuitive and change depending on the type of date-time object being used. Moreover, the methods we use with date-times must be robust to time zones, leap days, daylight savings times, and other time related quirks, and R lacks these capabilities in some situations. Lubridate makes it easier to do the things R does with date-times and possible to do the things R does not.

If you are new to lubridate, the best place to start is the date and times chapter in R for data science.

Installation

```
# The easiest way to get lubridate is to install the whole tidyverse:
install.packages("tidyverse")

# Alternatively, install just lubridate:
install.packages("lubridate")

# Or the the development version from GitHub:
```

Links

Download from CRAN at https://cloud.r-project.org/package=lubridate

Browse source code at https://github.com/tidyverse/lubridate

Report a bug at https://github.com/tidyverse/lubridate/issues

Learn more at http://r4ds.had.co.nz/dates-and-times.html

License

GPL (>= 2)

Citation

Citing lubridate

重要觀念 重要觀念 重要觀念

dplyr 套件

- select( ) : 依名稱(column name(s))挑出變數(欄位)
- filter( ) : 依觀察值(value)挑出資料(rows)
- arrange( ) : 依條件(欄內的值)排序資料(rows)
- mutate( ) : 依既有變數創造新的變數(欄位)
- summarize( ) : 從很多值產生單一的摘要資訊

- group_by( ) : 與上述函數併用，分組運算

select( )

```
> select(cd, FEE_YM, FUNC_TYPE)
# A tibble: 598,574 x 2
   FEE_YM FUNC_TYPE
   <chr>  <chr>
 1 200901 04
 2 200901 11
 3 200901 11
 4 200901 11
 5 200901 11
 6 200901 11
 7 200901 04
 8 200901 06
 9 200901 06
10 200901 10
# ... with 598,564 more rows
```

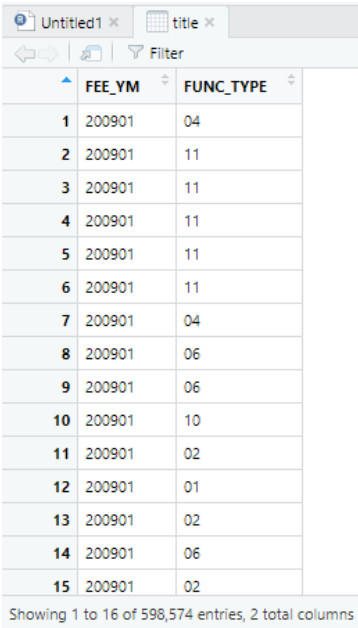
select(cd, FEE_YM, FUNC_TYPE)

- 假設已先利用Import_tidyverse.r匯入資料
- 從資料集裡挑出FEE_YM與FUNC_TYPE欄位
- 第一個參數為資料集變數
- 欲挑出的欄位從第二個參數起排列

view(select(cd, FEE_YM, FUNC_TYPE))

select(cd, FEE_YM, FUNC_TYPE) %>% view()

cd %>% select(FEE_YM, FUNC_TYPE) %>% view()



	FEE_YM	FUNC_TYPE
1	200901	04
2	200901	11
3	200901	11
4	200901	11
5	200901	11
6	200901	11
7	200901	04
8	200901	06
9	200901	06
10	200901	10
11	200901	02
12	200901	01
13	200901	02
14	200901	06
15	200901	02

Showing 1 to 16 of 598,574 entries, 2 total columns

select( )

```
> select(cd, SPECIALTY = FUNC_TYPE)
# A tibble: 598,574 x 1
   SPECIALTY
   <chr>
 1 04
 2 11
 3 11
 4 11
 5 11
 6 11
 7 04
 8 06
 9 06
10 10
# ... with 598,564 more rows
```

select(cd, SPECIALTY = FUNC_TYPE)

- 可在挑選欄位時順便更改欄位名稱 (只是螢幕/運算的名稱改變，原始資料的欄位名稱維持不變)
- 單純更改欄位名稱可用rename函數，其他欄位則維持不動

rename(cd, SPECIALTY = FUNC_TYPE)

```
> rename(cd, SPECIALTY = FUNC_TYPE)
# A tibble: 598,574 x 37
   FEE_YM APPL_TYPE HOSP_ID APPL_DATE CASE_TYPE SEQ_NO CURE_ITEM_NO1
   <chr>  <chr>     <chr>   <chr>     <chr>      <dbl> <chr>
 1 200901 1         000000~ 20090204  01          3866 NA
 2 200901 1         000000~ 20090212  01           247 NA
 3 200901 1         000000~ 20090212  01           919 NA
 4 200901 1         000000~ 20090212  01           752 NA
 5 200901 1         000000~ 20090212  01           844 NA
 6 200901 1         000000~ 20090212  01           852 NA
 7 200901 1         000000~ 20090209  01          6542 NA
 8 200901 1         000000~ 20090207  09           389 D0
 9 200901 1         000000~ 20090207  09           369 NA
10 200901 1         000000~ 20090211  08          3196 33
# ... with 598,564 more rows, and 30 more variables:
#   CURE_ITEM_NO2 <chr>, CURE_ITEM_NO3 <chr>, CURE_ITEM_NO4 <chr>,
#   SPECIALTY <chr>, FUNC_DATE <chr>, TREAT_END_DATE <chr>,
#   ID_BIRTHDAY <chr>, ID <chr>, CARD_SEQ_NO <chr>, GAVE_KIND <chr>,
#   PART_NO <chr>, ACODE_ICD9_1 <chr>, ACODE_ICD9_2 <chr>,
#   ACODE_ICD9_3 <chr>, ICD_OP_CODE <chr>, DRUG_DAY <dbl>,
#   MED_TYPE <chr>, PRSN_ID <chr>, PHAR_ID <chr>, DRUG_AMT <dbl>,
#   TREAT_AMT <dbl>, TREAT_CODE <chr>, DIAG_AMT <dbl>, DSVC_NO <chr>,
#   DSVC_AMT <dbl>, BY_PASS_CODE <chr>, T_AMT <dbl>, PART_AMT <dbl>,
#   T_APPL_AMT <dbl>, ID_SEX <chr>
```

filter( )

```
> select(cd, FEE_YM, FUNC_TYPE) %>%
+     filter(FUNC_TYPE == "01")
# A tibble: 94,485 x 2
   FEE_YM FUNC_TYPE
   <chr>  <chr>
 1 200901 01
 2 200901 01
 3 200901 01
 4 200901 01
 5 200901 01
 6 200901 01
 7 200901 01
 8 200901 01
 9 200901 01
10 200901 01
# ... with 94,475 more rows
```

```
select(cd, FEE_YM, FUNC_TYPE) %>%
  filter(FUNC_TYPE == "01")
```

- %>% (pipe) : **從目前的結果資料 繼續往下操作**
- %>% 不宜放在隔行的開頭，R會誤判只執行到前行尾
- 挑出科別(FUNC_TYPE)為家庭醫學科的資料
- 原本filter函數第一個參數應為資料集變數，因沿用上方的資料，故省略
- 可列多個篩選條件，以逗點分開
- 程式寫法次序也可對調 (先篩後挑)

```
filter(cd, FUNC_TYPE == "01") %>% select(FEE_YM, FUNC_TYPE)
```

arrange( )

```
> select(cd, FEE_YM, FUNC_TYPE) %>%
+     filter(FUNC_TYPE == "01") %>%
+     arrange(desc(FEE_YM))
# A tibble: 94,485 x 2
   FEE_YM FUNC_TYPE
   <chr>  <chr>
 1 200912 01
 2 200912 01
 3 200912 01
 4 200912 01
 5 200912 01
 6 200912 01
 7 200912 01
 8 200912 01
 9 200912 01
10 200912 01
# ... with 94,475 more rows
```

```
select(cd, FEE_YM, FUNC_TYPE) %>%
  filter(FUNC_TYPE == "01") %>%
  arrange(desc(FEE_YM))
```

- 依費用年月(FEE_YM)反向(desc)排序資料
- 預設為遞增排序
- 原本arrange函數第一個參數應為資料集變數，因沿用上方的資料，故省略
- 可列多個排序條件，在函數內以逗點分開

```
arrange(cd, desc(FEE_YM))
```

```
> arrange(cd, desc(FEE_YM))
# A tibble: 598,574 x 37
   FEE_YM APPL_TYPE HOSP_ID APPL_DATE CASE_TYPE SEQ_NO CURE_ITEM_NO1
   <chr>  <chr>     <chr>   <chr>     <chr>       <dbl> <chr>
 1 200912 1         000000~ 20100102  04            156 01
 2 200912 1         000000~ 20100120  09           3359 NA
 3 200912 1         000000~ 20100106  92            191 NA
```

mutate( )

```
> select(cd, FEE_YM, FUNC_TYPE) %>%
+     filter(FUNC_TYPE == "01") %>%
+     arrange(desc(FEE_YM)) %>%
+     mutate(YM_SPEC = paste(FEE_YM, FUNC_TYPE, sep = ""))
# A tibble: 94,485 x 3
   FEE_YM FUNC_TYPE YM_SPEC
   <chr>  <chr>     <chr>
 1 200912 01        20091201
 2 200912 01        20091201
 3 200912 01        20091201
 4 200912 01        20091201
 5 200912 01        20091201
 6 200912 01        20091201
 7 200912 01        20091201
 8 200912 01        20091201
 9 200912 01        20091201
10 200912 01        20091201
# ... with 94,475 more rows
```

```
select(cd, FEE_YM, FUNC_TYPE) %>%
  filter(FUNC_TYPE == "01") %>%
  arrange(desc(FEE_YM)) %>%
  mutate(YM_SPEC = paste(FEE_YM, FUNC_TYPE, sep = ""))
```

- 新增欄位：多由其他欄位經函數轉換而得
- 原本mutate函數第一個參數應為資料集變數，因沿用上方的資料，故省略
- 可新增多個欄位，在函數內以逗點分開
- 只是運算時增加欄位，原始的cd內容並無變化

```
mutate(cd, YM_SPEC = paste(FEE_YM, FUNC_TYPE, sep = ""))
```

summarize( )

```
> select(cd, FEE_YM, FUNC_TYPE) %>%
+     filter(FUNC_TYPE == "01") %>%
+     arrange(desc(FEE_YM)) %>%
+     mutate(YM_SPEC = paste(FEE_YM, FUNC_TYPE, sep = "")) %>%
+     summarize(monthcount = n_distinct(FEE_YM))
# A tibble: 1 x 1
  monthcount
       <int>
1         12
```

```
select(cd, FEE_YM, FUNC_TYPE) %>%
  filter(FUNC_TYPE == "01") %>%
  arrange(desc(FEE_YM)) %>%
  mutate(YM_SPEC = paste(FEE_YM, FUNC_TYPE, sep = "")) %>%
  summarize(monthcount = n_distinct(FEE_YM))
```

- 產生單一的摘要資訊：多係利用函數轉換而得
- 原本summarize函數第一個參數應為資料集變數，因沿用上方的資料，故省略
- 可同時計算多個摘要資訊，在函數內以逗點分開

```
> summarize(cd, n_distinct(FEE_YM))
# A tibble: 1 x 1
  `n_distinct(FEE_YM)`
                 <int>
1                   12
```

```
summarize(cd, n_distinct(FEE_YM))
```

summarize( )

- 共有多少筆資料(row count)

```
summarize(cd, visitcount = n())
```

- 有多少個不同的年月份

```
summarize(cd, monthcount = n_distinct(FEE_YM))
```

- 每次就診平均醫療費用

```
summarize(cd, avgmoneypervisit = mean(T_AMT))
```

- 一次就診花費最多的費用

```
summarize(cd, max(T_AMT))  # 顯示欄位名稱 max(T_AMT)
```

- 有哪些不同的年月份

```
view(distinct(cd, FEE_YM))   # 等於unique(cd$FEE_YM)
```

插播提醒

NA - 1

CURE_ITEM_NO1
特定治療項目代號（一）

```
summarize(cd, n_distinct(CURE_ITEM_NO1))  # w/ NA
summarize(cd, n_distinct(CURE_ITEM_NO1, na.rm = TRUE))  # w/o NA

summarize(cd, sum(is.na(CURE_ITEM_NO1)))  # count of NA
summarize(cd, sum(!is.na(CURE_ITEM_NO1)))  # count of non-NA

distinct(cd, CURE_ITEM_NO1)    # w/ NA
drop_na(cd, CURE_ITEM_NO1) %>%
   distinct(CURE_ITEM_NO1)    # w/o NA
filter(cd, !is.na(CURE_ITEM_NO1)) %>%
   distinct(CURE_ITEM_NO1)    # w/o NA
```

插播提醒

NA - 2

```
select(cd, CURE_ITEM_NO1) %>%
   drop_na() %>%
   summarize(n())    # w/o NA
select(cd, CURE_ITEM_NO1) %>%
   summarize(n())    # w/ NA

view(na.omit(cd$CURE_ITEM_NO1))    # w/o NA
length(na.omit(cd$CURE_ITEM_NO1))    # w/o NA

view(unique(cd$CURE_ITEM_NO1))    # w/ NA
view(unique(na.omit(cd$CURE_ITEM_NO1)))    # w/o NA

view(table(cd$CURE_ITEM_NO1))    # w/o NA
view(table(cd$CURE_ITEM_NO1, useNA = "always"))    # w/ NA
```

group_by( )

```
> select(cd, FEE_YM, FUNC_TYPE) %>%
+     filter(FUNC_TYPE == "01") %>%
+     arrange(desc(FEE_YM)) %>%
+     mutate(YM_SPEC = paste(FEE_YM, FUNC_TYPE, sep = "")) %>%
+     group_by(FEE_YM) %>%
+     summarize(visitcountbymonth = n())
# A tibble: 12 x 2
   FEE_YM visitcountbymonth
   <chr>              <int>
 1 200901              8190
 2 200902              7562
 3 200903              8151
 4 200904              8075
 5 200905              7354
 6 200906              6685
 7 200907              6930
 8 200908              6831
 9 200909              7350
10 200910              9096
11 200911              8574
12 200912              9687
```

```
select(cd, FEE_YM, FUNC_TYPE) %>%
  filter(FUNC_TYPE == "01") %>%
  arrange(desc(FEE_YM)) %>%
  mutate(YM_SPEC = paste(FEE_YM, FUNC_TYPE, sep = "")) %>%
  group_by(FEE_YM) %>%
  summarize(visitcountbymonth = n())
```

- 先分組，再進行後續運算，分組呈現結果
- 上例只是配合前面例子延伸，實際可簡化為：

```
filter(cd, FUNC_TYPE == "01") %>%
  group_by(FEE_YM) %>%
  summarize(n())
```

group_by( )

```
group_by(cd, FEE_YM) %>%
  summarize(visitcount = n())
```

```
> group_by(cd, FEE_YM) %>%
+     summarize(visitcount = n())
# A tibble: 12 x 2
   FEE_YM visitcount
   <chr>       <int>
 1 200901      47186
 2 200902      47593
 3 200903      51198
 4 200904      51205
 5 200905      48121
 6 200906      46594
 7 200907      48125
 8 200908      47162
 9 200909      49486
10 200910      54604
11 200911      52461
12 200912      54839
```

- 先分組，再進行後續運算，分組呈現結果

```
group_by(cd, FEE_YM, ID_SEX) %>%
  summarize(visitcount = n())
```

```
> group_by(cd, FEE_YM, ID_SEX) %>%
+     summarize(visitcount = n())
# A tibble: 24 x 3
# Groups:   FEE_YM [12]
   FEE_YM ID_SEX visitcount
   <chr>  <chr>       <int>
 1 200901 F           25775
 2 200901 M           21411
 3 200902 F           26614
 4 200902 M           20979
 5 200903 F           28742
 6 200903 M           22456
 7 200904 F           28937
 8 200904 M           22268
 9 200905 F           27042
10 200905 M           21079
# ... with 14 more rows
```

- 可列多個分組依據，在函數內以逗點分開

group_by( )

- 每人看診幾次(幾筆記錄)

```
group_by(cd, ID) %>% summarize(n())
```

- 每人每月看診幾次

```
group_by(cd, ID, FEE_YM) %>% summarize(n())
```

- 每人每季看診幾次

```
mutate(cd, Q = ifelse(FEE_YM %in% c("200901", "200902", "200903"), "Q1",
  ifelse(FEE_YM %in% c("200904", "200905", "200906"), "Q2",
  ifelse(FEE_YM %in% c("200907", "200908", "200909"), "Q3", "Q4")))) %>%
  group_by(ID, Q) %>% summarize(n())

group_by(cd, ID, Q = ifelse(FEE_YM %in% c("200901", "200902", "200903"), "Q1",
  ifelse(FEE_YM %in% c("200904", "200905", "200906"), "Q2",
  ifelse(FEE_YM %in% c("200907", "200908", "200909"), "Q3", "Q4")))) %>%
  summarize(VisitCount = n()) %>%
  pivot_wider(names_from = Q, values_from = VisitCount)
```

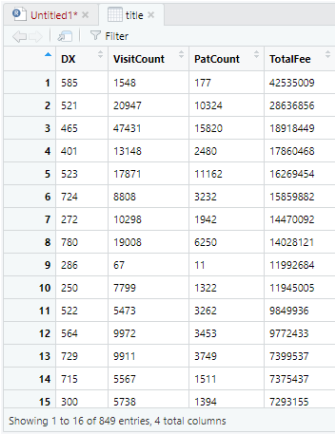
group_by( )

- 每個人看診幾次？依照看診次數排序

```
group_by(cd, ID) %>%
    summarize(VisitCount = n()) %>%
    arrange(desc(VisitCount))
```

- 只看主診斷碼的前三位數，各種診斷各有幾筆記錄？幾位病人？申報多少費用？請依費用多寡排序

```
group_by(cd, DX = substr(ACODE_ICD9_1, 1, 3)) %>%
    summarize(VisitCount = n(), PatCount = n_distinct(ID),
TotalFee = sum(T_AMT)) %>%
    arrange(desc(TotalFee)) %>%
    view()
```



Untitled1* | title

Filter

	DX	VisitCount	PatCount	TotalFee
1	585	1548	177	42535009
2	521	20947	10324	28636856
3	465	47431	15820	18918449
4	401	13148	2480	17860468
5	523	17871	11162	16269454
6	724	8808	3232	15859882
7	272	10298	1942	14470092
8	780	19008	6250	14028121
9	286	67	11	11992684
10	250	7799	1322	11945005
11	522	5473	3262	9849936
12	564	9972	3453	9772433
13	729	9911	3749	7399537
14	715	5567	1511	7375437
15	300	5738	1394	7293155

Showing 1 to 16 of 849 entries, 4 total columns

group_by( )

- 各年齡層與性別，各有幾筆記錄？幾位病人？申報多少費用？

```
mutate(cd, AgeGroup =
paste(as.integer(substr(ID_BIRTHDAY, 1, 4)) %/% 10,
'0s', sep = '')) %>%
    group_by(AgeGroup, ID_SEX) %>%
    summarize(VisitCount = n(), PatCount =
n_distinct(ID), TotalFee = sum(T_AMT))
```

%/% ：回傳商數
%% ：回傳餘數

```
> mutate(cd, AgeGroup = paste(as.integer(substr(ID_BIRTHDAY, 1, 4)) %/% 1
0, '0s', sep = '')) %>%
+     group_by(AgeGroup, ID_SEX) %>%
+     summarize(VisitCount = n(), PatCount = n_distinct(ID), TotalFee = su
m(T_AMT))
# A tibble: 21 x 5
# Groups:   AgeGroup [11]
   AgeGroup ID_SEX VisitCount PatCount TotalFee
   <chr>    <chr>       <int>    <int>    <dbl>
 1 1900s    F              23        2    14414
 2 1910s    F            1220       50  1453279
 3 1910s    M            1311       35  1661913
 4 1920s    F           12571      403 13692403
 5 1920s    M           16414      443 18914051
 6 1930s    F           30777      971 36269590
 7 1930s    M           26863      839 31209116
 8 1940s    F           38700     1381 46142980
 9 1940s    M           29971     1268 35322377
10 1950s    F           53272     2553 51782555
# ... with 11 more rows
```

group_by( )

- 各年齡層與性別，各共申報多少費用？

```
mutate(cd, AgeGroup =
paste(as.integer(substr(ID_BIRTHDAY, 1, 4)) %/% 10,
'0s', sep = '')) %>%
    group_by(AgeGroup, ID_SEX) %>%
    summarize(TotalFee = sum(T_AMT)) %>%
    pivot_wider(names_from = ID_SEX, values_from =
TotalFee)
```

%/% ：回傳商數
%% ：回傳餘數

```
# A tibble: 11 x 3
# Groups:   AgeGroup [11]
   AgeGroup        F        M
   <chr>       <dbl>    <dbl>
 1 1900s       14414       NA
 2 1910s     1453279  1661913
 3 1920s    13692403 18914051
 4 1930s    36269590 31209116
 5 1940s    46142980 35322377
 6 1950s    51782555 50998326
 7 1960s    39141931 46099932
 8 1970s    30921657 41494693
 9 1980s    26017789 16358637
10 1990s    16448260 14969228
11 2000s    17483010 22835550
```

group_by( )

- 在就診日為2009年的紀錄裡，每個人第一次看診日期？最後一次看診日期？相差多久？

```
filter(cd, substr(FUNC_DATE, 1, 4) == '2009') %>%
    group_by(ID) %>%
    summarize( FirstDate = min(FUNC_DATE),
                        LastDate = max(FUNC_DATE),
                        as.Date(LastDate, '%Y%m%d') -
as.Date(FirstDate, '%Y%m%d') )
```

```
> filter(cd, substr(FUNC_DATE, 1, 4) == '2009') %>%
+     group_by(ID) %>%
+     summarize(FirstDate = min(FUNC_DATE), LastDate = max(FUNC_DATE), as.
Date(LastDate, '%Y%m%d') - as.Date(FirstDate, '%Y%m%d'))
# A tibble: 36,081 x 4
   ID              FirstDate LastDate `as.Date(LastDate, "%Y%m%d") - a~
   <chr>           <chr>     <chr>    <drtn>
 1 000000000000000~ 20090211  20091107 269 days
 2 000000000000000~ 20090125  20091226 335 days
 3 000000000000000~ 20090115  20091219 338 days
 4 000000000000000~ 20090218  20091113 268 days
 5 000000000000000~ 20090523  20090523   0 days
 6 000000000000000~ 20090130  20091209 313 days
 7 000000000000000~ 20090110  20091211 335 days
 8 000000000000000~ 20090206  20091109 276 days
 9 000000000000000~ 20090223  20091223 303 days
10 000000000000000~ 20090731  20090803   3 days
#     with 36,071 more rows
```

group_by( )

- 在門急診的用藥紀錄(oo)裡，有四種降血糖藥各開立幾次？各有幾次就診有開立？

```
filter(oo, DRUG_NO %in% c('B007152100', 'B022671100', 'B020786100', 'B023206100')) %>%
    mutate(FK = paste(FEE_YM, APPL_TYPE, HOSP_ID, APPL_DATE, CASE_TYPE, SEQ_NO)) %>% # 前六個欄位用來連結cd檔
    group_by(DRUG_NO) %>%
    summarize(n(), n_distinct(FK))
```

```
# B007152100 : GLUCOPHAGE
# B022671100 : AMARYL
# B020786100 : GLUCOBAY
# B023206100 : ACTOS
```

```
> filter(oo, DRUG_NO %in% c('B007152100', 'B022671100', 'B020786100', 'B023206100')) %>%
+     mutate(FK = paste(FEE_YM, APPL_TYPE, HOSP_ID, APPL_DATE, CASE_TYPE, SEQ_NO)) %>%  # 前六個欄位用來連結cd檔
+     group_by(DRUG_NO) %>%
+     summarize(n(), n_distinct(FK))
# A tibble: 4 x 3
  DRUG_NO    `n()` `n_distinct(FK)`
  <chr>      <int>            <int>
1 B007152100   671              671
2 B020786100  1242             1242
3 B022671100  2032             2027
4 B023206100   539              539
```

插播

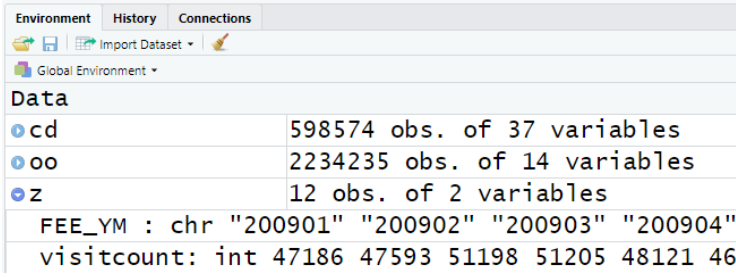
縮減分組

```
count(cd, FUNC_TYPE) %>% view()    # 47 entries

mutate(cd, SPECIALTY = fct_lump(FUNC_TYPE)) %>%
  count(SPECIALTY) %>% view()    # 45 entries (44 + Other)

mutate(cd, SPECIALTY = fct_lump(FUNC_TYPE, n = 8)) %>%
  count(SPECIALTY)    # 8 entries + Other

mutate(cd, SPECIALTY = fct_lump(FUNC_TYPE, n = 8)) %>%
  count(SPECIALTY, sort = TRUE)    # descending order by count
```

https://dplyr.tidyverse.org/reference/tally.html
https://forcats.tidyverse.org/reference/fct_lump.html
https://r4ds.had.co.nz/factors.html#modifying-factor-order

插播提醒

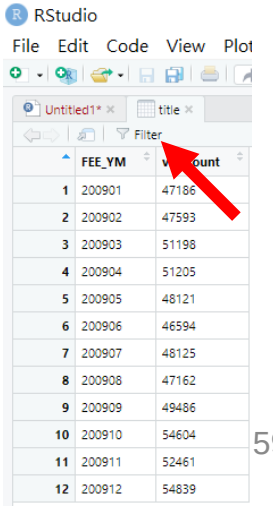
以grid格式顯示結果




```
z <- group_by(cd, FEE_YM) %>%
  summarize(visitcount = n())
```

- 將結果設為(儲存為)某變數，RStudio的Environment window即顯示該變數的摘要資訊，於其上點擊，Editor window即顯示以欄列方格呈現的結果，於其上點擊Show in new window按鈕，即能另開視窗呈現

```
view(z)   # 亦可以view函數指令顯示結果
```




```
group_by(cd, FEE_YM) %>%
  summarize(visitcount = n()) %>% view()
```

插播提醒

匯出資料

```
group_by(cd, FEE_YM) %>%
    summarize(visitcount = n()) %>%
    write_csv("D:/ZZZ.csv")    # CHANGE HERE !!!
```

- 有多種設定，亦可轉換為多種格式
- 輸出檔案的字元編碼一般預設為UTF-8

https://readr.tidyverse.org/reference/write_delim.html

Exercise

- 門診就診檔(cd)內2009年1月1日就診紀錄中，依照病患生日排序後，取出前五筆紀錄

```
filter(cd, FUNC_DATE == '20090101') %>%
    arrange(ID_BIRTHDAY) %>%
    head(5) %>%
    view()

# 不能用 top_n 函數 (top_n係取每group的前幾筆)
```

Exercise

- 請計算門診就診檔(cd)中，主診斷為糖尿病(ICD-9-CM 250.x 或ICD-10-CM E08-E13)的紀錄共有幾筆？有幾人？這些病人性別分布？

```
filter(cd, substr(ACODE_ICD9_1, 1, 3) == '250' | substr(ACODE_ICD9_1, 1, 3) == 'E08' | substr(ACODE_ICD9_1, 1, 3) == 'E09' | substr(ACODE_ICD9_1, 1, 3) == 'E10' | substr(ACODE_ICD9_1, 1, 3) == 'E11' | substr(ACODE_ICD9_1, 1, 3) == 'E12' | substr(ACODE_ICD9_1, 1, 3) == 'E13')
```

```
filter(cd, substr(ACODE_ICD9_1, 1, 3) == '250' | substr(ACODE_ICD9_1, 1, 3) == 'E08' | substr(ACODE_ICD9_1, 1, 3) == 'E09' | substr(ACODE_ICD9_1, 1, 3) == 'E10' | substr(ACODE_ICD9_1, 1, 3) == 'E11' | substr(ACODE_ICD9_1, 1, 3) == 'E12' | substr(ACODE_ICD9_1, 1, 3) == 'E13') %>% summarize(n_distinct(ID))
```

```
filter(cd, substr(ACODE_ICD9_1, 1, 3) == '250' | substr(ACODE_ICD9_1, 1, 3) == 'E08' | substr(ACODE_ICD9_1, 1, 3) == 'E09' | substr(ACODE_ICD9_1, 1, 3) == 'E10' | substr(ACODE_ICD9_1, 1, 3) == 'E11' | substr(ACODE_ICD9_1, 1, 3) == 'E12' | substr(ACODE_ICD9_1, 1, 3) == 'E13') %>%
  group_by(ID_SEX) %>%
  summarize(n_distinct(ID))
```

插播提醒

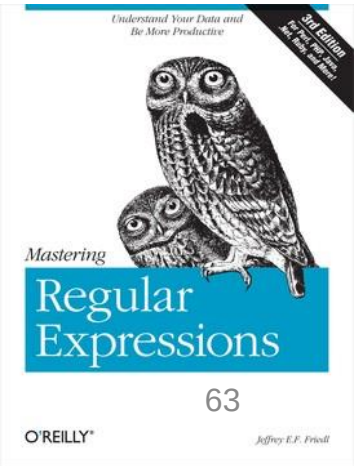
篩選條件的各種寫法

```
filter(cd, substr(ACODE_ICD9_1, 1, 3) == '250' | substr(ACODE_ICD9_1, 1, 3)
== 'E08' | substr(ACODE_ICD9_1, 1, 3) == 'E09' | substr(ACODE_ICD9_1, 1, 3)
== 'E10' | substr(ACODE_ICD9_1, 1, 3) == 'E11' | substr(ACODE_ICD9_1, 1, 3)
== 'E12' | substr(ACODE_ICD9_1, 1, 3) == 'E13')
```

```
filter(cd, substr(ACODE_ICD9_1, 1, 3) %in% c('250', 'E08', 'E09', 'E10', 'E11',
'E12', 'E13'))
```

```
filter(cd, str_detect(ACODE_ICD9_1, "^(250|E0[89]|E1[0-3])"))
```

```
# regex : regular expressions
# ^ : the start of the string
# ( | ) : either … or …
# [ ] : any one
# [ - ] : any one from … to …
```



Exercise

- 請計算門診就診檔(cd)中，病人就診時的年齡

```
select(cd, ID_BIRTHDAY, FUNC_DATE) %>%
   mutate( Age = as.integer( as.Date(FUNC_DATE, '%Y%m%d') - as.Date(ID_BIRTHDAY, '%Y%m%d' ) ) %/% 365.25 )

# FUNC_DATE與ID_BIRTHDAY為文字，需轉換為日期才能加減
# 如果ID_BIRTHDAY只提供年月，操作上加上日(01) : paste(ID_BIRTHDAY, '01')
#日期需明白轉換成數字(as.integer或as.numeric)後才能相除
# %/% : 整除，商數，去除餘數
```

插播

一個函數套用在多個欄位

- 請計算門診就診檔(cd)中，每次就診的平均醫師診察費、藥費、檢查費、總醫療費用、部分負擔費用

```
cd %>%
   summarize( across(c(DIAG_AMT, DRUG_AMT, TREAT_AMT,
T_AMT, PART_AMT), mean) )

# 比較一下
cd %>%
   summarize( mean(DIAG_AMT), mean(DRUG_AMT),
mean(TREAT_AMT), mean(T_AMT), mean(PART_AMT) )
```

SECTION II-D

COMBINE TABLES

Relational Data

- union()
- intersect()
- setdiff()
- inner_join() / full_join()
- left_join() / right_join()
- semi_join()
- anti_join()

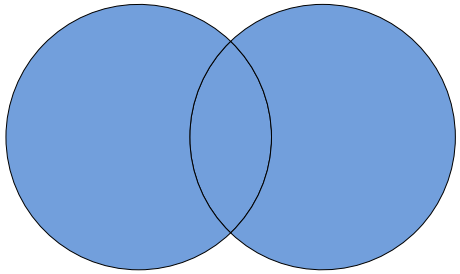
set operations

mutating joins

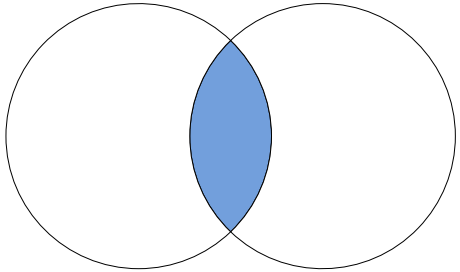
filtering joins

SET OPERATIONS

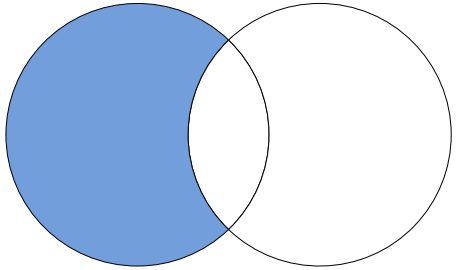
- UNION (A ∪ B)
  - combining rows



- INTERSECT (A ∩ B)
  - finding common rows



- SETDIFF (A - B)
  - finding different rows



https://dplyr.tidyverse.org/reference/setops.html

Set Operations – 1

- 在門診就診檔(cd)裡，如果僅依主診斷碼來診斷三高(高血壓、高血糖、高血脂)：
  - 多少人至少有一高?
  - 多少人有三高(三種病)?
  - 多少人有糖尿病 而且 有高血壓?
  - 多少人有糖尿病 但是 沒有高血壓?

Set Operations – 1A-1

- 多少人至少有一高? (只看主診斷碼)

```
x <- filter(cd, substr(ACODE_ICD9_1, 1, 3) == '401' |
substr(ACODE_ICD9_1, 1, 3) == 'I10')

y <- filter(cd, substr(ACODE_ICD9_1, 1, 3) %in% c('250', 'E08',
'E09', 'E10', 'E11', 'E12', 'E13'))

z <- filter(cd, substr(ACODE_ICD9_1, 1, 3) == '272' |
substr(ACODE_ICD9_1, 1, 3) == 'E78')

union(x, y, z) %>% summarize(n_distinct(ID))
```

Set Operations – 1A-2

- 多少人至少有一高? (只看主診斷碼)

```
x <- filter(cd, substr(ACODE_ICD9_1, 1, 3) == '401' |
substr(ACODE_ICD9_1, 1, 3) == 'I10') %>% select(ID)

y <- filter(cd, substr(ACODE_ICD9_1, 1, 3) %in% c('250', 'E08',
'E09', 'E10', 'E11', 'E12', 'E13')) %>% select(ID)

z <- filter(cd, substr(ACODE_ICD9_1, 1, 3) == '272' |
substr(ACODE_ICD9_1, 1, 3) == 'E78') %>% select(ID)

count(union(x, y, z))  # x, y, z只剩一個欄位(較佳解法 以免搞混)
count(union_all(x, y, z))   # 意義：因三高來就診的總就診次數
```

union會
刪除重複值

union_all會保留重複值

Set Operations – 1B

- 多少人有三高(一個人有三種病)? (只看主診斷碼)

```
x <- filter(cd, substr(ACODE_ICD9_1, 1, 3) == '401' |
substr(ACODE_ICD9_1, 1, 3) == 'I10') %>% select(ID)

y <- filter(cd, substr(ACODE_ICD9_1, 1, 3) %in% c('250', 'E08',
'E09', 'E10', 'E11', 'E12', 'E13')) %>% select(ID)

z <- filter(cd, substr(ACODE_ICD9_1, 1, 3) == '272' |
substr(ACODE_ICD9_1, 1, 3) == 'E78') %>% select(ID)

count(intersect(x, y, z))   # x, y, z 只剩一個欄位
# 理論上最好同時考慮主次診斷 !!!
```

intersect會刪除重複值

Set Operations – 1C

- 多少人有糖尿病 而且 有高血壓? (只看主診斷碼)

```
x <- filter(cd, substr(ACODE_ICD9_1, 1, 3) == '401' |
substr(ACODE_ICD9_1, 1, 3) == 'I10') %>% select(ID)

y <- filter(cd, substr(ACODE_ICD9_1, 1, 3) %in% c('250', 'E08',
'E09', 'E10', 'E11', 'E12', 'E13')) %>% select(ID)

count(intersect(x, y))
# 理論上最好同時考慮主次診斷 !!!
```

Set Operations – 1D

- 多少人有糖尿病 但是 沒有高血壓? (只看主診斷碼)

```
x <- filter(cd, substr(ACODE_ICD9_1, 1, 3) == '401' |
substr(ACODE_ICD9_1, 1, 3) == 'I10') %>% select(ID)

y <- filter(cd, substr(ACODE_ICD9_1, 1, 3) %in% c('250', 'E08',
'E09', 'E10', 'E11', 'E12', 'E13')) %>% select(ID)

count(setdiff(y, x))
# rows that appear only in the first tibble, not in others

count(setdiff(x, y))   # 比較一下
# 理論上最好同時考慮主次診斷 !!!
```

Set Operations – 2A

- 在2009下半年方有糖尿病主診斷者(2009上半年無)？

```
x <- filter(cd, FEE_YM %in% c('200901', '200902', '200903',
'200904', '200905', '200906'), substr(ACODE_ICD9_1, 1, 3) %in%
c('250', 'E08', 'E09', 'E10', 'E11', 'E12', 'E13')) %>% select(ID)

y <- filter(cd, FEE_YM %in% c('200907', '200908', '200909',
'200910', '200911', '200912'), substr(ACODE_ICD9_1, 1, 3) %in%
c('250', 'E08', 'E09', 'E10', 'E11', 'E12', 'E13')) %>% select(ID)

setdiff(y, x)
# 找new cases，以計算incidence
```

Set Operations – 2B

- 在2009上半年有因糖尿病就診者， 2009下半年亦有就診者？

```
x <- filter(cd, FEE_YM %in% c('200901', '200902', '200903', '200904', '200905', '200906'), substr(ACODE_ICD9_1, 1, 3) %in% c('250', 'E08', 'E09', 'E10', 'E11', 'E12', 'E13')) %>% select(ID)

y <- filter(cd, FEE_YM %in% c('200907', '200908', '200909', '200910', '200911', '200912'), substr(ACODE_ICD9_1, 1, 3) %in% c('250', 'E08', 'E09', 'E10', 'E11', 'E12', 'E13')) %>% select(ID)

intersect(x, y)
# 計算compliance
```

Set Operations – 2C

- 在2009上半年有因糖尿病就診者， 2009下半年無因糖尿病就診者？

```
x <- filter(cd, FEE_YM %in% c('200901', '200902', '200903', '200904', '200905', '200906'), substr(ACODE_ICD9_1, 1, 3) %in% c('250', 'E08', 'E09', 'E10', 'E11', 'E12', 'E13')) %>% select(ID)

y <- filter(cd, FEE_YM %in% c('200907', '200908', '200909', '200910', '200911', '200912'), substr(ACODE_ICD9_1, 1, 3) %in% c('250', 'E08', 'E09', 'E10', 'E11', 'E12', 'E13')) %>% select(ID)

setdiff(x, y)
# 計算compliance
```

Set Operations – 3

- 在cd檔裡，同一次就診時同時有開立血糖檢查[健保碼：09005C]與HBA1C檢查[健保碼：09006C]者，共有哪幾次？

```
x <- filter(oo, DRUG_NO %in% c('09005C')) %>%
   select(FEE_YM, APPL_TYPE, HOSP_ID, APPL_DATE, CASE_TYPE, SEQ_NO)

y <- filter(oo, DRUG_NO %in% c('09006C')) %>%
   select(FEE_YM, APPL_TYPE, HOSP_ID, APPL_DATE, CASE_TYPE, SEQ_NO)

z <- intersect(x, y)
```

intersect會刪除重複值

oo	2234235 obs. of 14 variables
x	15886 obs. of 6 variables
y	4547 obs. of 6 variables
z	3862 obs. of 6 variables

JOIN

https://pixabay.com/illustrations/team-work-building-puzzle-pieces-3738261/

https://pixy.org/4762655/

捷瑞有限公司

現金日記簿

101 年度

傳票編號	收付日	總摘要	收付帳戶	支出總額	收入總額	科目代號	科目名稱	明細摘要	支出明細	收入明細
1010001	101/01/02	公司設立	華南活存NT		1,000,000.00	306	股東出資	張大光		500,000.00
		同上而省略				306	股東出資	陳中明		250,000.00
						306	股東出資	李小亮		250,000.00
1010002	101/01/03	簽約繳房租	華南活存NT	32,000.00		254	押金	房屋押金	20,000.00	
		同上而省略				203	租金支出	1月份租金	10,000.00	
						245	其他雜費	公證費	2,000.00	
1010003	101/01/03	買自用電腦一套	華南活存NT	33,000.00		251	電腦用品	桌上型電腦一套	25,000.00	
						251	電腦用品	OFFICE軟體一套	8,000.00	
1010004	101/01/03	提領零用金	華南活存NT	20,000.00		601	調撥轉出	提領零用金	20,000.00	
1010004	101/01/03	提領零用金	零用現金NT		20,000.00	501	調撥轉入	提領零用金		20,000.00
1010005	101/01/04	文具、粉刷、拜拜	零用現金NT	6,000.00		204	文具用品	文具一批	2,000.00	
						208	修繕費	粉刷辦公室	3,000.00	
						245	其他雜費	拜拜水果餅乾	1,000.00	
1010006	101/01/05	聯強-進10套電腦	華南活存NT	250,000.00		201	進貨	主機10台	200,000.00	
						201	進貨	螢幕10台	50,000.00	

帳戶總覽 | 收支表 | 日記簿 | 帳戶明細 | 傳票 | 科目明細 | 說明

https://www.jrcpa.tw/images/download/捷瑞記帳系統.xls

JOIN

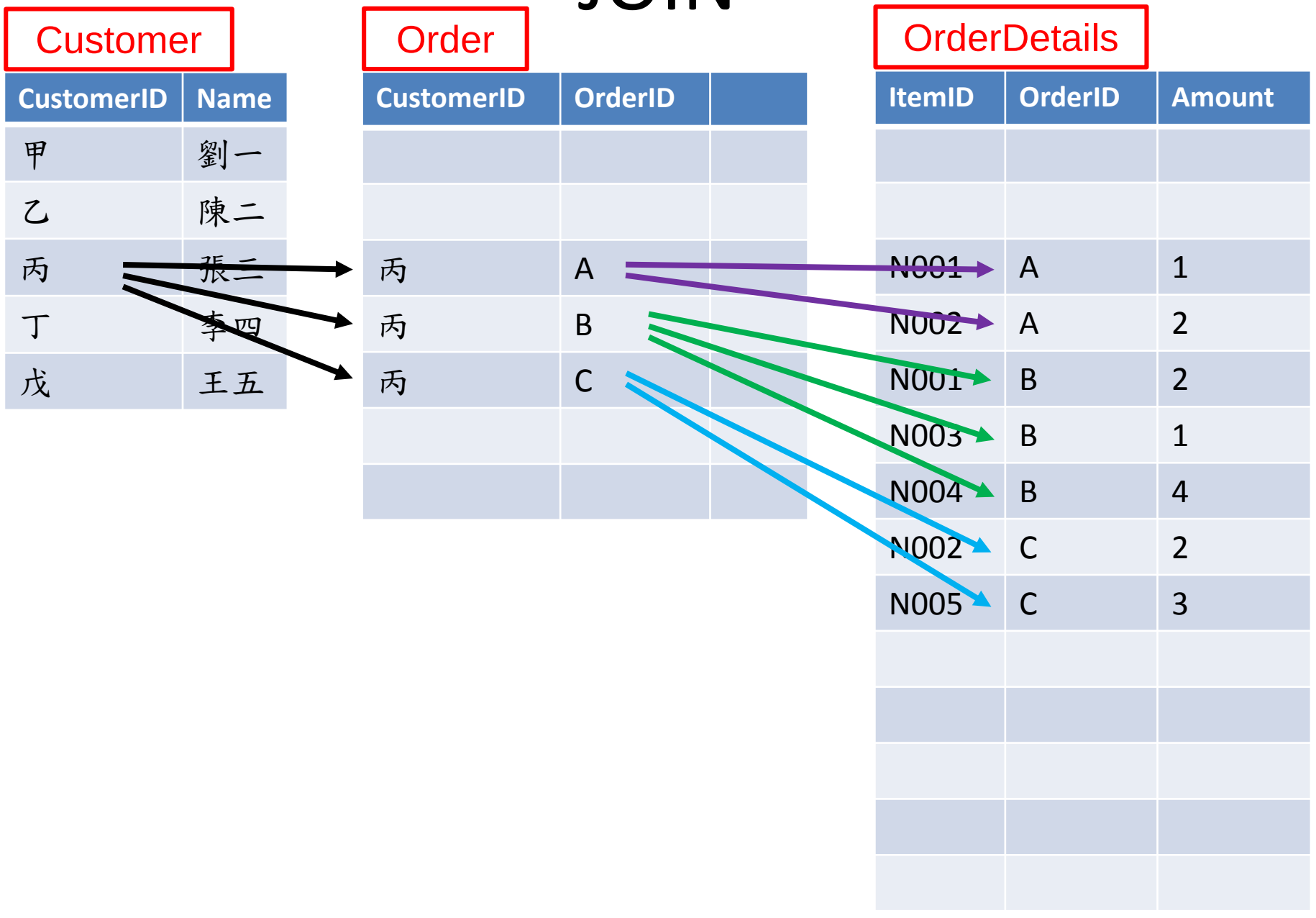
Customer

CustomerID	Name	Tel.
甲	劉一	
乙	陳二	
丙	張三	
丁	李四	
戊	王五	

Order

CustomerID	OrderID			
丙	A			
丙	B			
丙	C			

JOIN

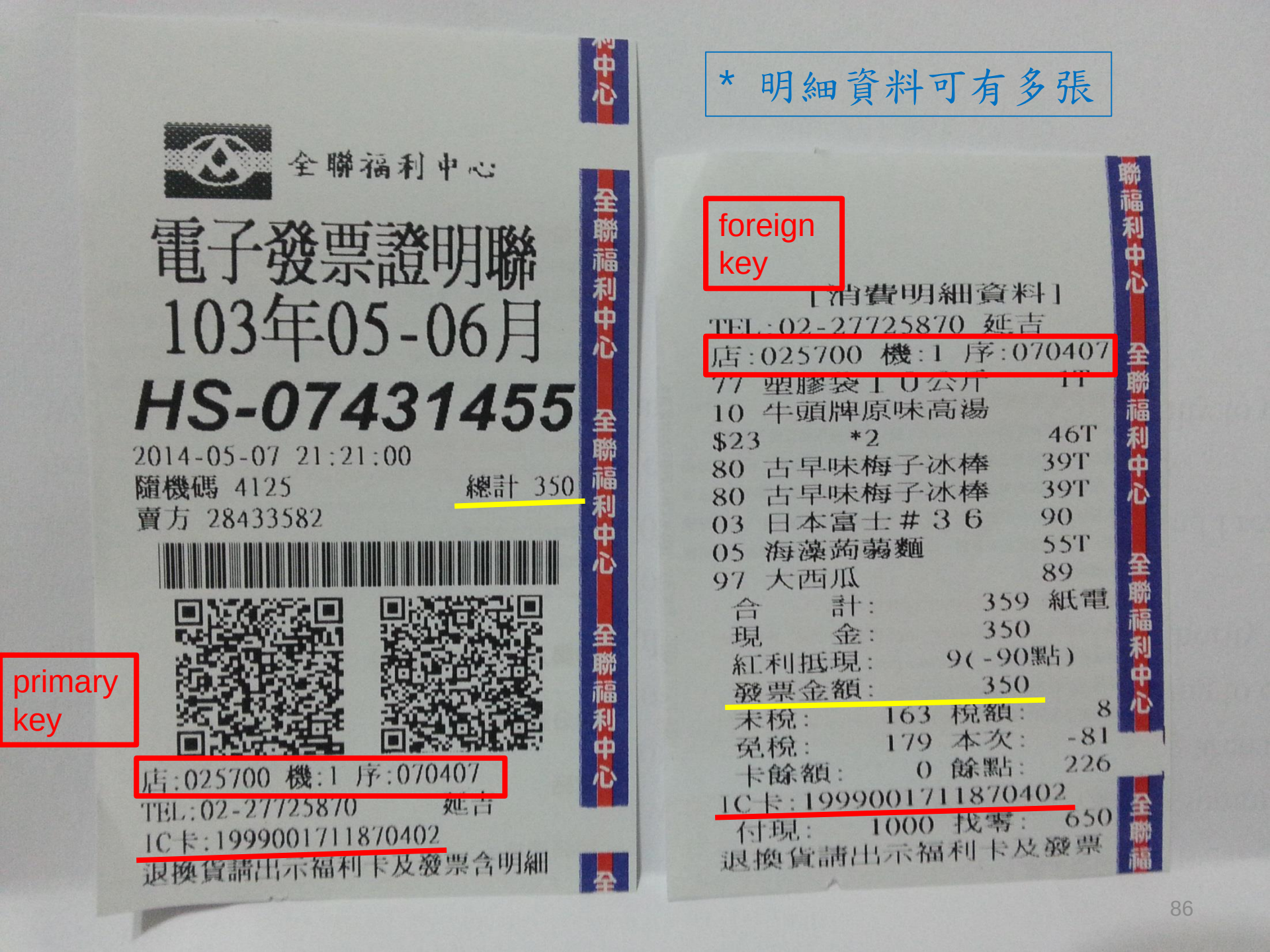

Customer
CustomerID
Name
甲
劉一
乙
陳二
丙
張三
丁
李四
戊
王五
Order
CustomerID
OrderID
丙
A
丙
B
丙
C
OrderDetails
ItemID
OrderID
Amount
N001
A
1
N002
A
2
N001
B
2
N003
B
1
N004
B
4
N002
C
2
N005
C
3

~ CD


全聯福利中心
電子發票證明聯
103年05-06月
HS-07431455
2014-05-07 21:21:00
隨機碼 4125
總計 350
賣方 28433582
店:025700 機:1 序:070407
TEL:02-27725870 延吉
IC卡:1999001711870402
退換貨請出示福利卡及發票含明細
全聯福利中心 全聯福利中心 全聯福利中心

~ OO


退換貨請出示福利卡及發票含明細
[消費明細資料]
TEL:02-27725870 延吉
店:025700 機:1 序:070407
77 塑膠袋１０公斤 1T
10 牛頭牌原味高湯
$23 *2 46T
80 古早味梅子冰棒 39T
80 古早味梅子冰棒 39T
03 日本富士＃３６ 90
05 海藻蒟蒻麵 55T
97 大西瓜 89
合 計: 359 紙電
現 金: 350
紅利抵現: 9(-90點)
發票金額: 350
未稅: 163 稅額: 8
免稅: 179 本次: -81
卡餘額: 0 餘點: 226
IC卡:1999001711870402
付現: 1000 找零: 650
退換貨請出示福利卡及發票
全聯福利中心
全聯福利中心
全聯福利中心
全聯福


* 明細資料可有多張
全聯福利中心
電子發票證明聯
103年05-06月
HS-07431455
2014-05-07 21:21:00
隨機碼 4125
總計 350
賣方 28433582
店:025700 機:1 序:070407
TEL:02-27725870 延吉
IC卡:1999001711870402
退換貨請出示福利卡及發票含明細
primary key
foreign key
[消費明細資料]
TEL:02-27725870 延吉
店:025700 機:1 序:070407
10 牛頭牌原味高湯
$23 *2 46T
80 古早味梅子冰棒 39T
80 古早味梅子冰棒 39T
03 日本富士#36 90
05 海藻蒟蒻麵 55T
97 大西瓜 89
合計: 359 紙電
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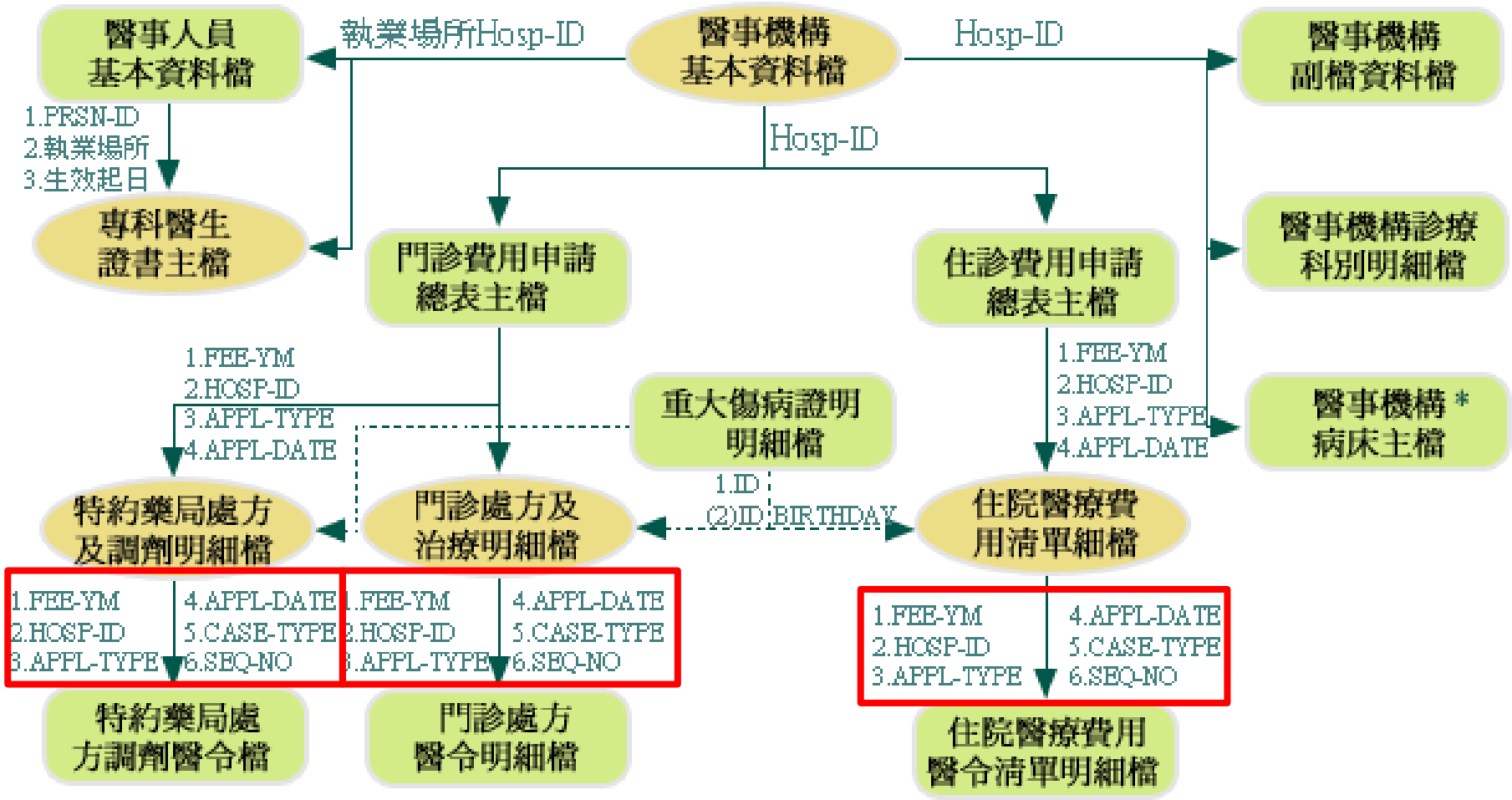
退換貨請出示福利卡及發票

健保檔案關係

代碼	中文檔名	資料描述
CT	門診費用申請總表主檔	每家醫療院所一個月一筆記錄
CD	門診處方及治療明細檔	每次就診一筆記錄
OO	門診處方醫令明細檔	每一項開立藥品或檢驗項目一筆記錄
CT --(1-to-n)--> CD --(1-to-n)--> OO		
DT	住院費用申請總表主檔	每家醫療院所一個月一筆記錄
DD	住院醫療費用清單明細檔	每次住院(可分月申報)一筆記錄
DO	住院醫療費用醫令清單明細檔	每一項開立藥品或檢驗項目一筆記錄
DT --(1-to-n)--> DD --(1-to-n)--> DO		
GD	特約藥局處方及調劑明細檔	每張調劑處方箋一筆記錄
GO	特約藥局處方調劑醫令檔	每一項調劑藥品一筆記錄
CT --(1-to-n)--> GD --(1-to-n)--> GO		

各檔案間串檔變項說明



http://nhird.nhri.org.tw/file_date/connect2.gif

Mutating Joins

Mutating joins combine variables from the two data.frames:

`inner_join()` return all rows from `x` where there are matching values in `y`, and all columns from `x` and `y`. If there are multiple matches between `x` and `y`, all combination of the matches are returned.

`left_join()` return all rows from `x`, and all columns from `x` and `y`. Rows in `x` with no match in `y` will have `NA` values in the new columns. If there are multiple matches between `x` and `y`, all combinations of the matches are returned.

`right_join()` return all rows from `y`, and all columns from `x` and y. Rows in `y` with no match in `x` will have `NA` values in the new columns. If there are multiple matches between `x` and `y`, all combinations of the matches are returned.

`full_join()` return all rows and all columns from both `x` and `y`. Where there are not matching values, returns `NA` for the one missing.

https://dplyr.tidyverse.org/reference/join.html

inner_join (1 : n)

Customer

CustomerID	Name
甲	劉一
乙	陳二
丙	張三
丁	李四
戊	王五

Order

CustomerID	OrderID	…
甲	A	
甲	A	
乙	B	
丙	A	
丙	B	
丙	C	
戊	B	
戊	D	
己	A	
己	B	

inner_join(Customer, Order, by = "CustomerID")

CustomerID	Name	OrderID	…
甲	劉一	A	
甲	劉一	A	
乙	陳二	B	
丙	張三	A	
丙	張三	B	
丙	張三	C	
戊	王五	B	
戊	王五	D	

- 依據雙方對應欄位的相同值，擷取各種組合

inner_join (1 : 1)

```
DMdrug <- tribble(
   ~DRUG_ID, ~DRUG_NAME,
   'B007152100', 'GLUCOPHAGE',
   'B022671100', 'AMARYL',
   'B020786100', 'GLUCOBAY',
   'B023206100', 'ACTOS'
)

inner_join(oo, DMdrug, by = c("DRUG_NO" = "DRUG_ID")) %>%
   view()
inner_join(oo, DMdrug, by = c("DRUG_NO" = "DRUG_ID")) %>%
   select(DRUG_NO, DRUG_NAME) %>% view()
```

假設藥名沒有重複

欄位前後需加引號

等號前方為第一個tibble的連結欄位，後方為第二個tibble的連結欄位。如果兩者相同，可只寫一個，例：
by = "DRUG_NO"

inner_join (1 : 1)

注意！
已改名

假設藥名
沒有重複

```
DMdrug <- tribble(
   ~DRUG_NO, ~DRUG_NAME,
   'B007152100', 'GLUCOPHAGE',
   'B022671100', 'AMARYL',
   'B020786100', 'GLUCOBAY',
   'B023206100', 'ACTOS'
)

inner_join(oo, DMdrug, by = "DRUG_NO") %>%
   mutate(FK = paste(FEE_YM, APPL_TYPE, HOSP_ID, APPL_DATE, CASE_TYPE, SEQ_NO)) %>%
   group_by(DRUG_NAME) %>%
   summarize(n(), n_distinct(FK))
```

與稍早的例子
互相比較一下

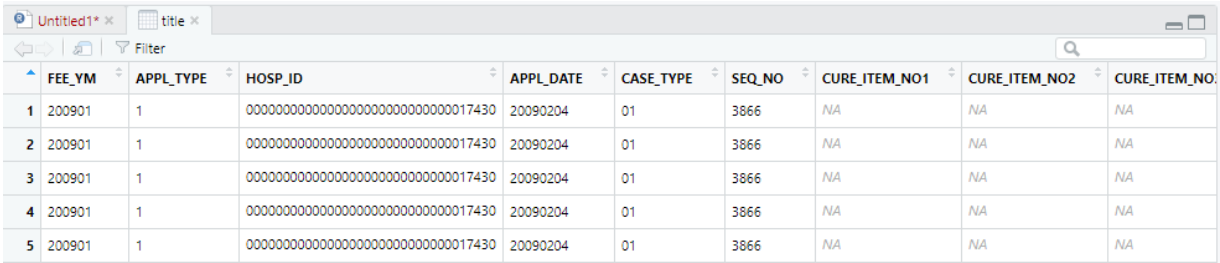
```
filter(oo, DRUG_NO %in% c('B007152100', 'B022671100', 'B020786100', 'B023206100')) %>%
   mutate(FK = paste(FEE_YM, APPL_TYPE, HOSP_ID, APPL_DATE, CASE_TYPE, SEQ_NO)) %>%
   group_by(DRUG_NO) %>%
   summarize(n(), n_distinct(FK))
```

inner_join (1 : n)

```
# 1 entry
x <- filter(cd, FEE_YM == "200901", APPL_TYPE == "1", HOSP_ID == "00000000000000000000000000017430", APPL_DATE == "20090204", CASE_TYPE == "01", SEQ_NO == "3866") %>% view()

# 5 entries
inner_join(x, oo, by = c("FEE_YM", "APPL_TYPE", "HOSP_ID", "APPL_DATE", "CASE_TYPE", "SEQ_NO")) %>% view()
```

雖然cd檔只有一筆，連結oo檔後，cd檔部分顯示5次，而原oo檔前六個欄位則未出現



Untitled1* | title

Filter

	FEE_YM	APPL_TYPE	HOSP_ID	APPL_DATE	CASE_TYPE	SEQ_NO	CURE_ITEM_NO1	CURE_ITEM_NO2	CURE_ITEM_NO
1	200901	1	00000000000000000000000000017430	20090204	01	3866	NA	NA	NA
2	200901	1	00000000000000000000000000017430	20090204	01	3866	NA	NA	NA
3	200901	1	00000000000000000000000000017430	20090204	01	3866	NA	NA	NA
4	200901	1	00000000000000000000000000017430	20090204	01	3866	NA	NA	NA
5	200901	1	00000000000000000000000000017430	20090204	01	3866	NA	NA	NA

inner_join (1 : n)

cd	598574 obs. of 37 variables
oo	2234235 obs. of 14 variables
x	94485 obs. of 37 variables
y	307662 obs. of 45 variables
z	307662 obs. of 45 variables

```
x <- filter(cd, FUNC_TYPE == "01")  # 限家醫科

y <- filter(cd, FUNC_TYPE == "01") %>%
  inner_join(oo, by = c("FEE_YM", "APPL_TYPE", "HOSP_ID", "APPL_DATE",
"CASE_TYPE", "SEQ_NO"))  # 家醫科的cd檔與oo檔inner_join

z <- inner_join(cd, oo, by = c("FEE_YM", "APPL_TYPE", "HOSP_ID", "APPL_DATE",
"CASE_TYPE", "SEQ_NO")) %>%
  filter(FUNC_TYPE == "01")  # 另一種寫法

filter(cd, FUNC_TYPE == "01") %>%
  inner_join(oo, by = c("FEE_YM", "APPL_TYPE", "HOSP_ID", "APPL_DATE",
"CASE_TYPE", "SEQ_NO")) %>%
  filter(DRUG_NO %in% c('B007152100', 'B022671100', 'B020786100', 'B023206100'))
%>%
  group_by(PRSN_ID) %>%
  summarize(n())  # 家醫科每一位醫師各曾開立幾筆糖尿病藥
```

left_join

Customer

CustomerID	Name
甲	劉一
乙	陳二
丙	張三
丁	李四
戊	王五

Order

CustomerID	OrderID	…
甲	A	
甲	A	
乙	B	
丙	A	
丙	B	
丙	C	
戊	B	
戊	D	
己	A	
己	B	

left_join(Customer, Order, by = "CustomerID")

CustomerID	Name	OrderID	…
甲	劉一	A	
甲	劉一	A	
乙	陳二	B	
丙	張三	A	
丙	張三	B	
丙	張三	C	
丁	李四	NA	
戊	王五	B	
戊	王五	D	

- 依據雙方對應欄位的相同值，擷取各種組合，加上保留左方tibble找不到對應者(其對應右方tibble的欄位值以NA替換)

left_join

```
x <- inner_join(cd, oo, by = c("FEE_YM", "APPL_TYPE",
"HOSP_ID", "APPL_DATE", "CASE_TYPE", "SEQ_NO"))

y <- left_join(cd, oo, by = c("FEE_YM", "APPL_TYPE", "HOSP_ID",
"APPL_DATE", "CASE_TYPE", "SEQ_NO"))

z <- left_join(oo, cd, by = c("FEE_YM", "APPL_TYPE", "HOSP_ID",
"APPL_DATE", "CASE_TYPE", "SEQ_NO"))
```

cd	598574 obs. of 37 variables
oo	2234235 obs. of 14 variables
x	2234235 obs. of 45 variables
y	2311630 obs. of 45 variables
z	2234235 obs. of 45 variables

```
inner_join(cd, oo, by = c("FEE_YM", "APPL_TYPE", "HOSP_ID",
"APPL_DATE", "CASE_TYPE", "SEQ_NO")) %>% summarize(n())

left_join(cd, oo, by = c("FEE_YM", "APPL_TYPE", "HOSP_ID",
"APPL_DATE", "CASE_TYPE", "SEQ_NO")) %>% summarize(n())

left_join(oo, cd, by = c("FEE_YM", "APPL_TYPE", "HOSP_ID",
"APPL_DATE", "CASE_TYPE", "SEQ_NO")) %>% summarize(n())
```

left_join

```
mutate(cd, FK = paste(FEE_YM, APPL_TYPE, HOSP_ID, APPL_DATE, CASE_TYPE, SEQ_NO)) %>%
  summarize(recordcount = n(), visitcount = n_distinct(FK), IDcount = n_distinct(ID))
# 598574   598574   36109

mutate(oo, FK = paste(FEE_YM, APPL_TYPE, HOSP_ID, APPL_DATE, CASE_TYPE, SEQ_NO)) %>%
  summarize(recordcount = n(), visitcount = n_distinct(FK))
# 2234235   521179   (oo檔裡無ID欄位)

inner_join(cd, oo, by = c("FEE_YM", "APPL_TYPE", "HOSP_ID", "APPL_DATE", "CASE_TYPE", "SEQ_NO"))  %>%
  mutate(FK = paste(FEE_YM, APPL_TYPE, HOSP_ID, APPL_DATE, CASE_TYPE, SEQ_NO)) %>%
  summarize(recordcount = n(), visitcount = n_distinct(FK), IDcount = n_distinct(ID))
# 2234235   521179   35735 (有些人僅看診未拿處方箋)

left_join(cd, oo, by = c("FEE_YM", "APPL_TYPE", "HOSP_ID", "APPL_DATE", "CASE_TYPE", "SEQ_NO"))  %>%
  mutate(FK = paste(FEE_YM, APPL_TYPE, HOSP_ID, APPL_DATE, CASE_TYPE, SEQ_NO)) %>%
  summarize(recordcount = n(), visitcount = n_distinct(FK), IDcount = n_distinct(ID))
# 2311630   598574   36109

full_join(cd, oo, by = c("FEE_YM", "APPL_TYPE", "HOSP_ID", "APPL_DATE", "CASE_TYPE", "SEQ_NO"))  %>%
  mutate(FK = paste(FEE_YM, APPL_TYPE, HOSP_ID, APPL_DATE, CASE_TYPE, SEQ_NO)) %>%
  summarize(recordcount = n(), visitcount = n_distinct(FK), IDcount = n_distinct(ID))
# 2311630   598574   36109
```

right_join

```
left_join(oo, cd, by = c("FEE_YM", "APPL_TYPE", "HOSP_ID", "APPL_DATE", "CASE_TYPE", "SEQ_NO"))  %>%
   mutate(FK = paste(FEE_YM, APPL_TYPE, HOSP_ID, APPL_DATE, CASE_TYPE, SEQ_NO)) %>%
   summarize(recordcount = n(), visitcount = n_distinct(FK), IDcount = n_distinct(ID))
# 2234235  521179  35735

right_join(cd, oo, by = c("FEE_YM", "APPL_TYPE", "HOSP_ID", "APPL_DATE", "CASE_TYPE", "SEQ_NO"))  %>%
   mutate(FK = paste(FEE_YM, APPL_TYPE, HOSP_ID, APPL_DATE, CASE_TYPE, SEQ_NO)) %>%
   summarize(recordcount = n(), visitcount = n_distinct(FK), IDcount = n_distinct(ID))
# 2234235  521179  35735
### right_join(x, y, by = ...) 等同 left(y, x, by = ...)
```

full_join

Customer

CustomerID	Name
甲	劉一
乙	陳二
乙	陳二
丙	張三
丁	李四
戊	王五

Order

CustomerID	OrderID	…
甲	A	
甲	A	
乙	B	
丙	A	
丙	B	
丙	C	
戊	B	
戊	D	
己	A	
己	B	

full_join(Customer, Order, by = "CustomerID")

CustomerID	Name	OrderID	…
甲	劉一	A	
甲	劉一	A	
乙	陳二	B	
乙	陳二	B	
丙	張三	A	
丙	張三	B	
丙	張三	C	
丁	李四	NA	
戊	王五	B	
戊	王五	D	
己	NA	A	
己	NA	B	

- 依據雙方對應欄位的相同值，擷取各種組合，加上保留左方與右方tibble找不到對應者

Filtering Joins

Filtering joins keep cases from the left-hand data.frame:

`semi_join()` return all rows from `x` where there are matching values in `y`, keeping just columns from `x`.

A semi join differs from an inner join because an inner join will return one row of `x` for each matching row of `y`, where a semi join will never duplicate rows of `x`.

`anti_join()` return all rows from `x` where there are not matching values in `y`, keeping just columns from `x`.

- semi_join(x, y, by = ...) : 根據對應欄位(by = ...)，挑出x裡能與y對應的紀錄
- anti_join(x, y, by = ...) : 根據對應欄位(by = ...)，挑出x裡無法與y對應的紀錄

https://dplyr.tidyverse.org/reference/join.html

semi_join

Customer

CustomerID	Name
甲	劉一
乙	陳二
丙	張三
丁	李四
戊	王五

Order

CustomerID	OrderID	…
甲	A	
甲	A	
乙	B	
丙	A	
丙	B	
丙	C	
戊	B	
戊	D	
己	A	
己	B	

semi_join(Customer, Order, by = "CustomerID")

CustomerID	Name
甲	劉一
乙	陳二
丙	張三
戊	王五

- 以第一個tibble (Customer)為主體，根據對應欄位(by = …)，挑出第一個tibble裡能與第二個tibble (Order)對應的紀錄

semi_join

- 在門診檔裡，找出曾接受HBA1C檢查的就診(cd)記錄。

```
z <- filter(oo, DRUG_NO %in% c('09006C'))
# z : 有HBA1C的oo紀錄

semi_join(cd, z, by = c("FEE_YM", "APPL_TYPE",
"HOSP_ID", "APPL_DATE", "CASE_TYPE", "SEQ_NO"))

# 主體為cd，挑出能與oo相match的cd紀錄
```

semi_join

- 在門診檔裡，就診時有開立HBA1C檢查，卻無糖尿病診斷碼，請列出其cd記錄。

```
z <- filter(oo, DRUG_NO %in% c('09006C'))    # 4547

semi_join(cd, z, by =  c("FEE_YM", "APPL_TYPE", "HOSP_ID", "APPL_DATE", "CASE_TYPE",
"SEQ_NO"))  # 4546 (其中有一次就診開立兩次HBA1C檢查)

semi_join(cd, z, by = c("FEE_YM", "APPL_TYPE", "HOSP_ID", "APPL_DATE", "CASE_TYPE",
"SEQ_NO")) %>%
   filter(str_detect(ACODE_ICD9_1, "^(250|E0[89]|E1[0-3])") | str_detect(ACODE_ICD9_2,
"^(250|E0[89]|E1[0-3])") | str_detect(ACODE_ICD9_3, "^(250|E0[89]|E1[0-3])"))    # 3671

semi_join(cd, z, by = c("FEE_YM", "APPL_TYPE", "HOSP_ID", "APPL_DATE", "CASE_TYPE",
"SEQ_NO")) %>%
   filter( (!str_detect(ACODE_ICD9_1, "^(250|E0[89]|E1[0-3])") | is.na(ACODE_ICD9_1)),
(!str_detect(ACODE_ICD9_2, "^(250|E0[89]|E1[0-3])") | is.na(ACODE_ICD9_2)),
(!str_detect(ACODE_ICD9_3, "^(250|E0[89]|E1[0-3])") | is.na(ACODE_ICD9_3)) )
# 875 (= 4546 - 3671)
```

勿忘NA

anti_join

Customer

CustomerID	Name
甲	劉一
乙	陳二
丙	張三
丁	李四
戊	王五

Order

CustomerID	OrderID	…
甲	A	
甲	A	
乙	B	
丙	A	
丙	B	
丙	C	
戊	B	
戊	D	
己	A	
己	B	

anti_join(Customer, Order, by = "CustomerID")

CustomerID	Name
丁	李四

- 以第一個tibble (Customer)為主體，根據對應欄位(by = …)，挑出第一個tibble裡無法與第二個tibble (Order)對應的紀錄

anti_join

- 在門診檔裡，就診時有糖尿病診斷碼，卻無開立血糖檢查，請列出其cd記錄。

```
z <- filter(oo, DRUG_NO %in% c('09005C'))   # 15886 項檢查

filter(cd, str_detect(ACODE_ICD9_1, "^(250|E0[89]|E1[0-3])") | str_detect(ACODE_ICD9_2, "^(250|E0[89]|E1[0-3])") | str_detect(ACODE_ICD9_3, "^(250|E0[89]|E1[0-3])"))   # 24699 有診斷

filter(cd, str_detect(ACODE_ICD9_1, "^(250|E0[89]|E1[0-3])") | str_detect(ACODE_ICD9_2, "^(250|E0[89]|E1[0-3])") | str_detect(ACODE_ICD9_3, "^(250|E0[89]|E1[0-3])")) %>%
   semi_join(z, by = c("FEE_YM", "APPL_TYPE", "HOSP_ID", "APPL_DATE", "CASE_TYPE", "SEQ_NO"))   # 7142 有診斷且有開立檢查

filter(cd, str_detect(ACODE_ICD9_1, "^(250|E0[89]|E1[0-3])") | str_detect(ACODE_ICD9_2, "^(250|E0[89]|E1[0-3])") | str_detect(ACODE_ICD9_3, "^(250|E0[89]|E1[0-3])")) %>%
   anti_join(z, by = c("FEE_YM", "APPL_TYPE", "HOSP_ID", "APPL_DATE", "CASE_TYPE", "SEQ_NO"))
# 17557 (= 24699 - 7142) 有診斷但無開立檢查
```

插播提醒

Debugging

```
semi_join(cd, oo, by = c("FEE_YM", "APPL_TYPE", "HOSP_ID",
"APPL_DATE", "CASE_TYPE", "SEQ_NO"))
# 521,179
anti_join(cd, oo, by = c("FEE_YM", "APPL_TYPE", "HOSP_ID",
"APPL_DATE", "CASE_TYPE", "SEQ_NO"))
# 77,395 就診未開立處方箋

semi_join(oo, cd, by = c("FEE_YM", "APPL_TYPE", "HOSP_ID",
"APPL_DATE", "CASE_TYPE", "SEQ_NO"))
# 2,234,235
anti_join(oo, cd, by = c("FEE_YM", "APPL_TYPE", "HOSP_ID",
"APPL_DATE", "CASE_TYPE", "SEQ_NO"))
# 0 開立處方項目卻無就診紀錄
```

Exercise

- 找出2009年耗用門診醫療費用最多的病人所有申報紀錄

```
x <- group_by(cd, ID) %>%
   summarize(TotalFee = sum(T_AMT)) %>%
   summarize(MaxFee = max(TotalFee)) %>% as.numeric()
# 依ID分組，分兩步找出最大值，將結果由tibble型態轉為數值型態

y <- group_by(cd, ID) %>%
   summarize(TotalFee = sum(T_AMT)) %>%
   filter(TotalFee == x)
# 找出個人總費用為最大值者(未必1人)

view(semi_join(cd, y, by = "ID"))
# 比對最大值的ID者，挑出cd裡的紀錄
```

SECTION III

FUNCTION

插播提醒

Recode in dplyr

```
cd %>%
   mutate( GENDER = recode(ID_SEX, M = 1, F = 2, .default = 3) ) %>%
   select(ID_SEX, GENDER) %>%
   head(15) %>%
   view()
```

https://dplyr.tidyverse.org/reference/recode.html

插播提醒

case_when in dplyr

```
mutate(cd, SPECIALTY = case_when(
    FUNC_TYPE == "00" ~ "不分科",
    FUNC_TYPE == "01" ~ "家醫科",
    ...
    ...
    ...
    ...
    TRUE ~ "未知"
)) %>%
    select(FUNC_TYPE, SPECIALTY) %>%
    head(15)
```

完整程式碼在
PPT備忘稿處

https://dplyr.tidyverse.org/reference/case_when.html

插播提醒

fct_recode in forcats

```
mutate(cd, SPECIALTYMAJOR = fct_recode(FUNC_TYPE,
    "不分科" = "00",
    "家醫科" = "01",
    "家醫科" = "EA",
    "老人醫學科" = "AK",   …
    …
    …
    …
)) %>%
    count(FUNC_TYPE, SPECIALTYMAJOR) %>%
    view()
```

完整程式碼在PPT備忘稿處

* 缺點：沒有others選項，當是其他值時，直接列出原值

https://forcats.tidyverse.org/reference/fct_recode.html
https://r4ds.had.co.nz/factors.html#modifying-factor-levels

Function

Input

- Scalar (element)
- Vector
- List
- …

Output

- Scalar
- Vector
- List
- …

內建函數

```
x <- 1
sum(x)    # scalar -> scalar
summary(x)    # scalar -> scalars
sqrt(x)    # scalar -> scalar
```

```
> x <- 1
> sum(x)
[1] 1
> summary(x)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
      1       1       1       1       1       1
> sqrt(x)
[1] 1
```

```
y <- 1:6
sum(y)    # vector -> scalar
summary(y)    # vector -> scalars
sqrt(y)    # vector -> vector
```

```
> y <- 1:6
> sum(y)
[1] 21
> summary(y)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
   1.00    2.25    3.50    3.50    4.75    6.00
> sqrt(y)
[1] 1.000000 1.414214 1.732051 2.000000 2.236068 2.449490
```

1 scalar -> 1 scalar

```
source("D:/SampleData/Specialty_Scalar.r")
# CHANGE HERE !!! 請更動放置Specialty_Scalar.r檔的位置

x <- "01"
specialty(x)   # "家醫科"   #  R 4.0.4 版會產生 "\u5bb6\u91ab\u79d1"
view(specialty(x))   # "家醫科"

x <- c("01", "02")
specialty(x)   # Error ... 必須是長度為 1 的向量
specialty(cd$FUNC_TYPE)    # Error

# R / RStudio 的資料顯示碰到中文時，常有亂碼的情形，不過只是顯示亂碼，內部與輸出仍正常運作。一般將結果匯出至檔案時，字元編碼預設為UTF-8。
```

請參閱函數的程式碼

vector -> vector

```
# 解決方法
y1 <- map(cd$FUNC_TYPE, specialty)   # (tidyverse函數) 輸出 list
y2 <- map_chr(cd$FUNC_TYPE, specialty)   # 輸出 vector (character)
y3 <- lapply(cd$FUNC_TYPE, specialty)   # (r 內建函數) 輸出 list
y4 <- sapply(cd$FUNC_TYPE, specialty)   # (r 內建函數) 輸出 vector


y1 %>% head(10000) %>% as.data.frame() %>% write_delim("D:/y1.txt")
y2 %>% head(10000) %>% as.data.frame() %>% write_delim("D:/y2.txt")
y3 %>% head(10000) %>% as.data.frame() %>% write_delim("D:/y3.txt")
y4 %>% head(10000) %>% as.data.frame() %>% write_delim("D:/y4.txt")
# 為節省時間，只取前一萬筆資料
# 需先轉換為 data frame 後才能輸出至檔案
```

vector -> vector

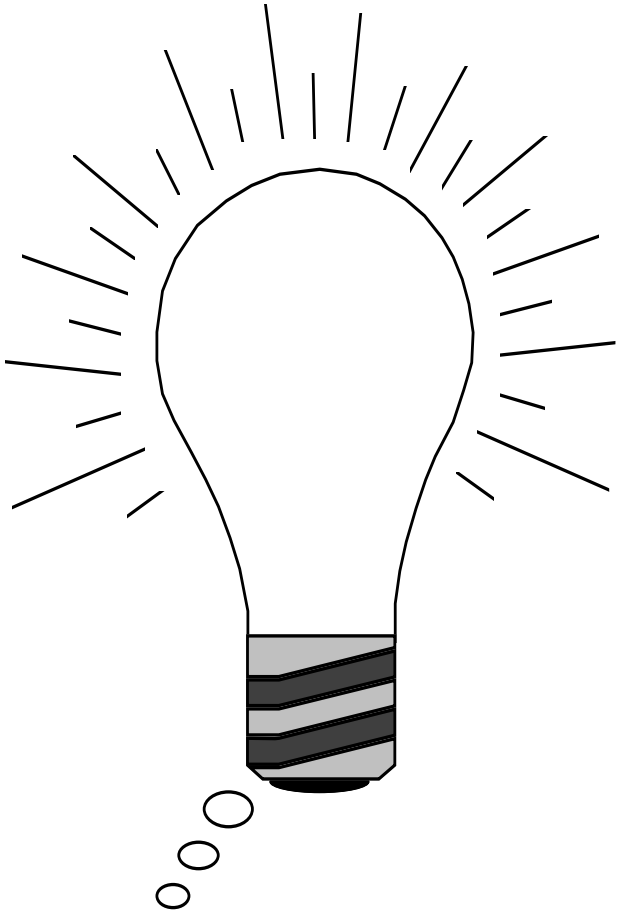
請參閱函數的程式碼

```
source("D:/SampleData/Specialty_Vector.r")
# CHANGE HERE !!! 更動.r檔的位置

x1 <- "01"
view( specialty(x1) )   #"家醫科"
x2 <- c("01", "02")
view( specialty(x2) )   #"家醫科" "內科"
specialty(cd$FUNC_TYPE) %>% head(15) %>% view()

mutate(cd, SPECIALTY = specialty(FUNC_TYPE), SPECIALTYMAJOR =
specialty.major(FUNC_TYPE)) %>%
   select(FUNC_TYPE, SPECIALTY, SPECIALTYMAJOR) %>%
   head(100) %>% view()
```

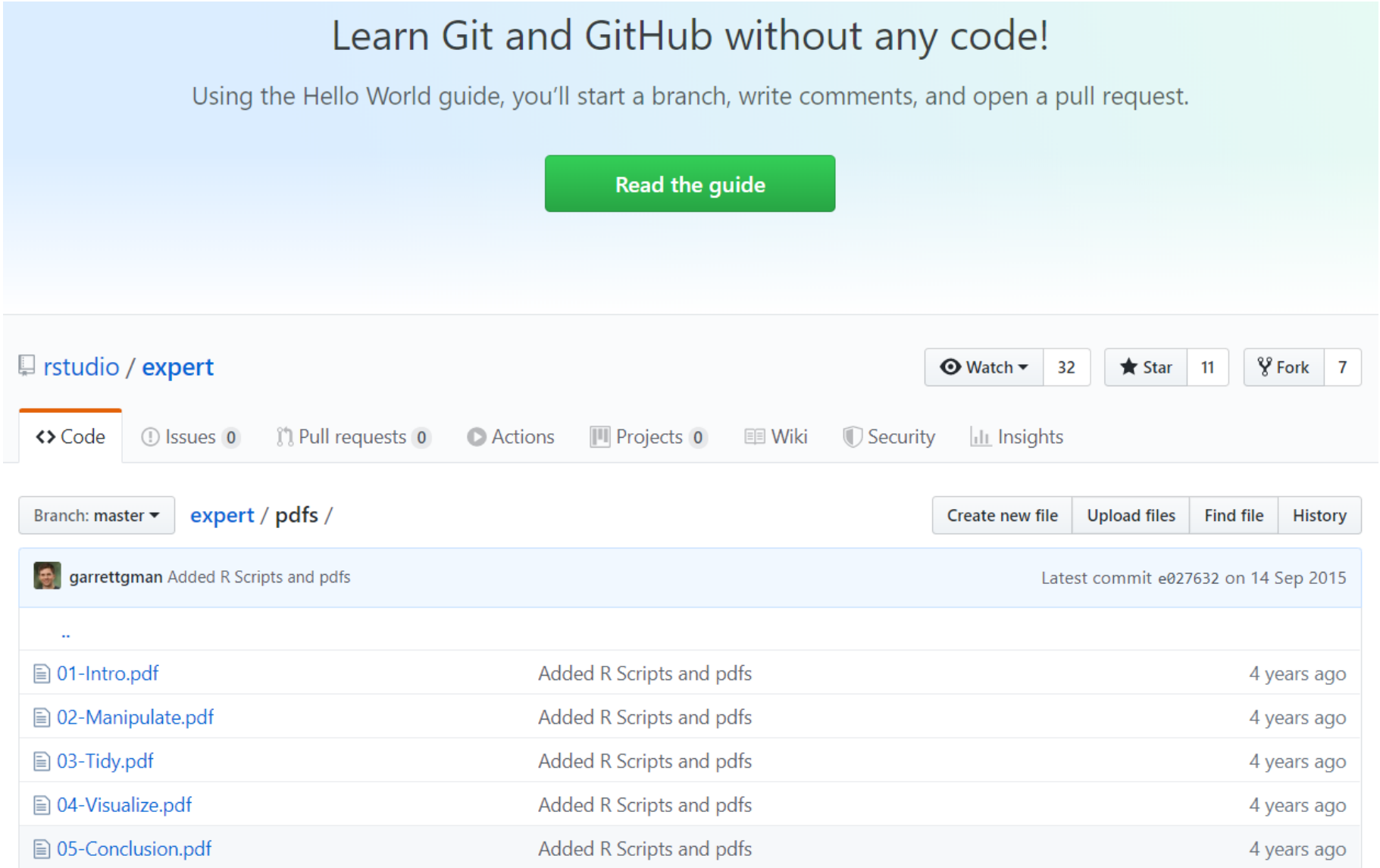
Thanks for Your Attention !



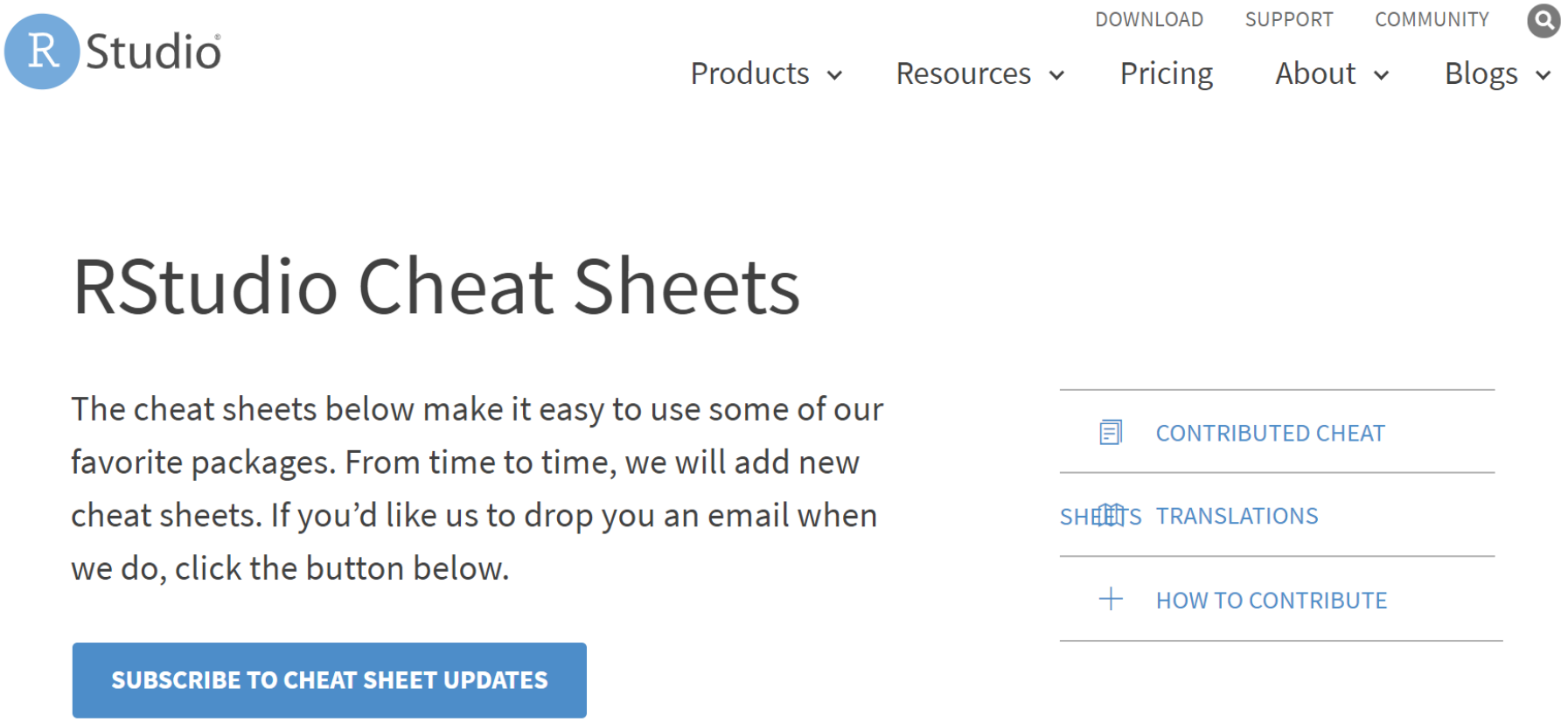
SECTION IV

RESOURCES

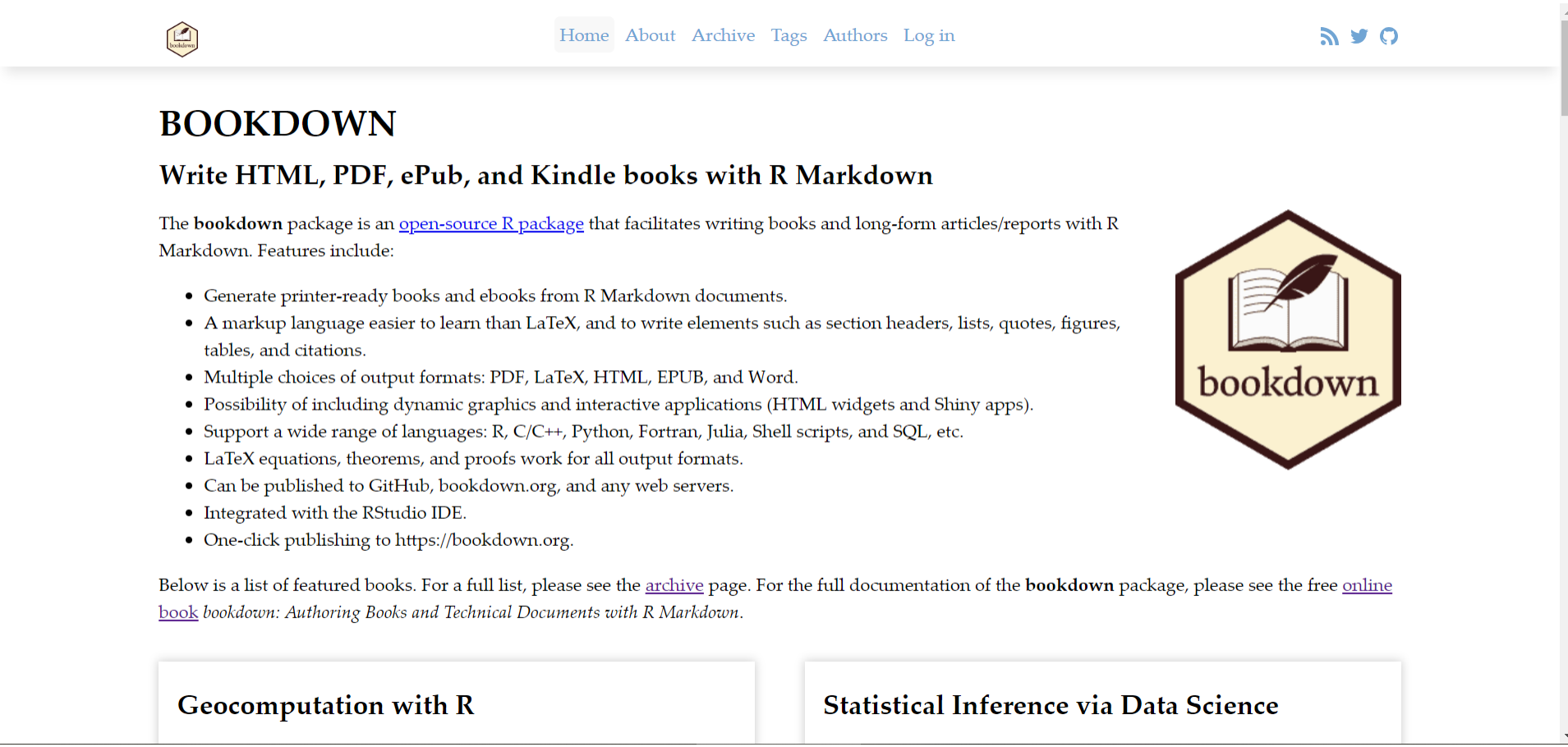
https://github.com/rstudio/expert



https://rstudio.com/resources/cheatsheets/
https://github.com/rstudio/cheatsheets



https://bookdown.org/



https://bookdown.org/home/archive/

https://bookdown.org/wangminjie/R4DS/

数据科学中的 R 语言

王敏杰

2021-02-16

前言

你好，这里是四川师范大学研究生公选课《数据科学中的R语言》的课程内容。考虑到大家来自不同的学院，有着不同的学科背景，因此讲授的内容不会太深奥（要有信心喔）。

比如在课程中以下内容就不会出现

$$f(x) = \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}x^2}$$

而出现更多的是

https://static-bcrf.biochem.wisc.edu/courses/Tabular-data-analysis-with-R-and-Tidyverse/book/

Tabular data analysis with R and Tidyverse:

Environmental Health