

R軟體開放資料應用- 高速公路篇

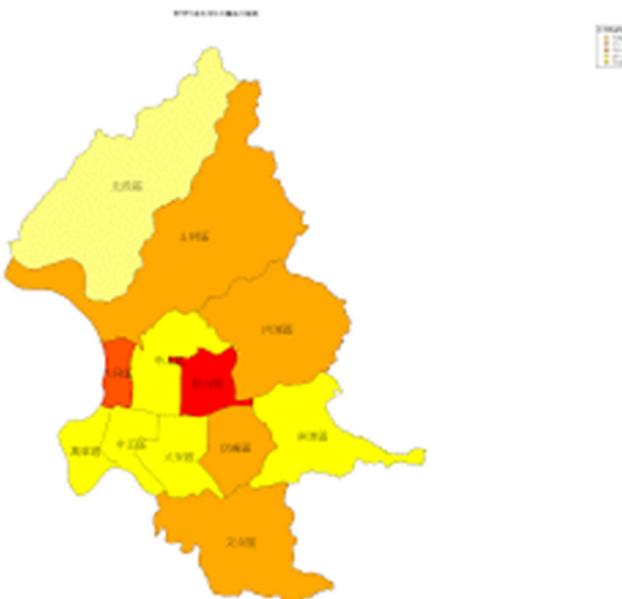
育達科技大學 資訊管理系所
李明昌 博士
108年5月8日

大綱

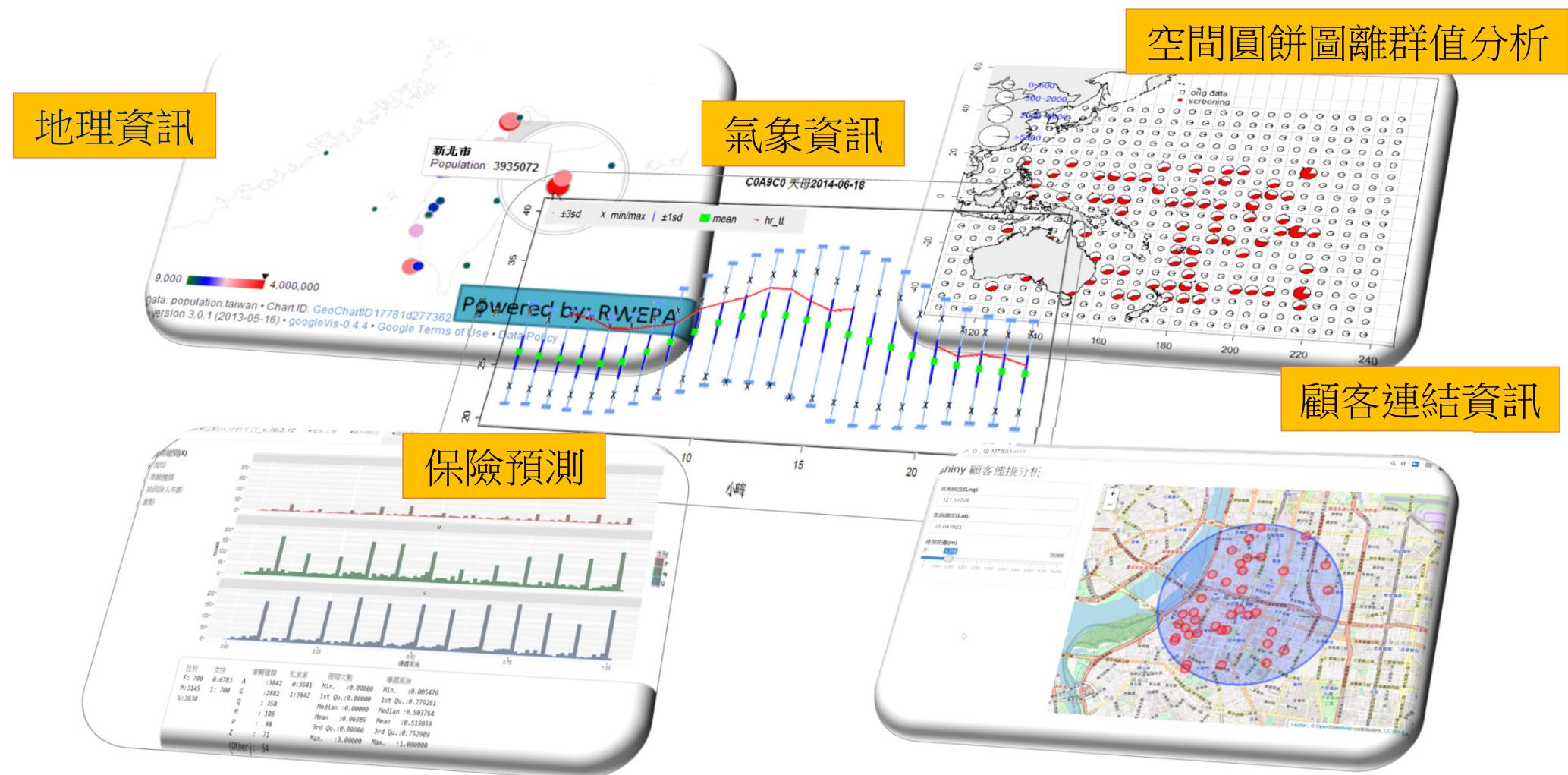
1. 資料分析/視覺化/互動式案例
2. 大數據分析工具與架構
3. R/RStudio簡介
4. 資料物件,套件,輔助說明
5. 開放資料分析-高速公路



1. 資料分析/視覺化/ 互動式案例



資料分析/視覺化/互動式案例



CWB 1,600萬筆資料

(Ubuntu server+ shiny server)

網頁呈現

http://rwepa.ddns.net:3838/sample-apps/cwb_vis_qc/

The screenshot displays the CWB QC visualization application interface. On the left, there is a '客製化選單' (Custom Selection Menu) with sliders for station ID (466900 淡水), month (1-12), hour (1-24), year range (1998-2014), and QC threshold (-10 to 10). In the center, there is a scatter plot titled 'QC_UKref/hr_tt_06mm_01hr_466900.txt' comparing '實際值-TT' (Actual Value-TT) on the Y-axis against '推估值-UK' (Predicted Value-UK) on the X-axis. A red 'X' marks an outlier. To the right, there is a histogram titled '學生化殘差直方圖' (Studentized Residual Histogram) showing the distribution of studentized residuals. At the bottom, a table shows the first 10 entries with columns: 觀測站 (Observation Station), 日期 (Date), 時 (Time), 觀測值TT (Actual Value TT), 推估值UK (Predicted Value UK), 學生化殘差 (Studentized Residual), CMT, SD, and Outliers. The table shows one entry: 466900, 20030601, 1, 23.8, 20.6, 5.163, 23.751, 2.159, 0.0227. Navigation buttons for 'Previous' and 'Next' are also present.

異常偵測

動態繪圖

客製化選單

R統計運算

2.大數據分析工具與架構



大數據分析工具

- Microsoft Excel 2016: 104萬餘筆資料限制

A	B	C	D	E	F	G	
1	WEEK_END_DATE	STORE_NUM	UPC	UNITS	VISITS	HHS	SPEND
1048572	14-Jan-09	367	1111009477	13	13	13	18.07
1048573	14-Jan-09	367	1111009497	20	18	18	27.8
1048574	14-Jan-09	367	1111009507	14	14	14	19.32
1048575	14-Jan-09	367	1111035398	4	3	3	14
1048576	14-Jan-09	367	1111038078	3	3	3	7.5

1,048,576筆資料限制

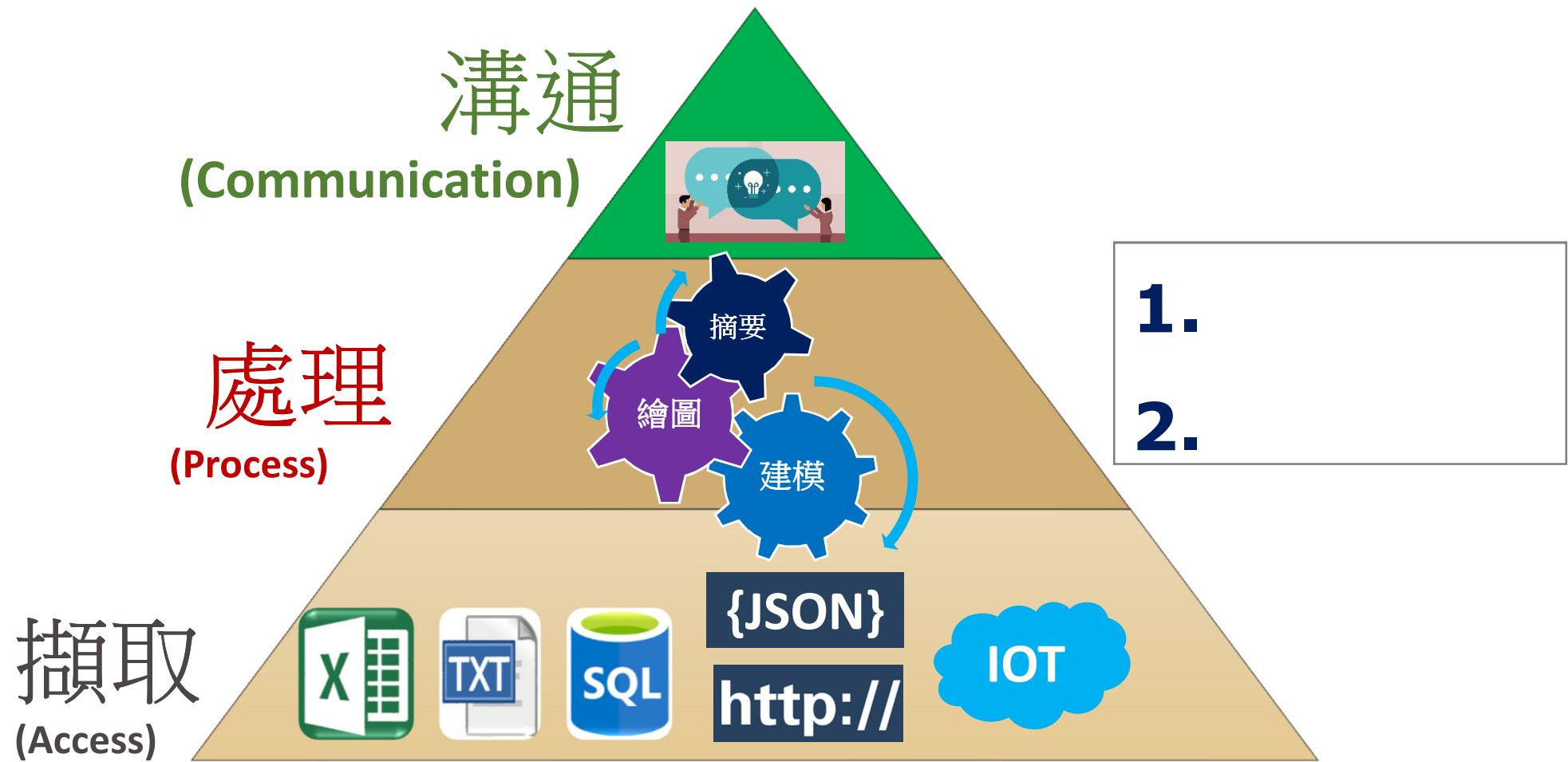
- 免費: 核心程式 + 套件(模組) + IDE



常用工具比較表

軟體	SPSS	SAS	Matlab	Python	R	Julia
Released	1968	1972	1984	1991	2000	2012
用途	統計軟體 (社會科學 用)	統計軟體 (價格較高)	科學計算 程式語言	程式語言 系統結合	統計,繪圖, 視覺化程 式語言	科學計算 程式語言
版本	商業版	商業版	商業版	自由軟體 物件導向	自由軟體 物件導向	自由軟體 物件導向
附加功 能	模組	模組	工具箱	免費模組	免費套件	免費模組
使用者	商管	商管	工科	工科+ 商管	商管+ 工科	商管+ 工科

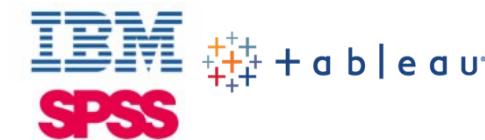
大數據分析架構 - APC



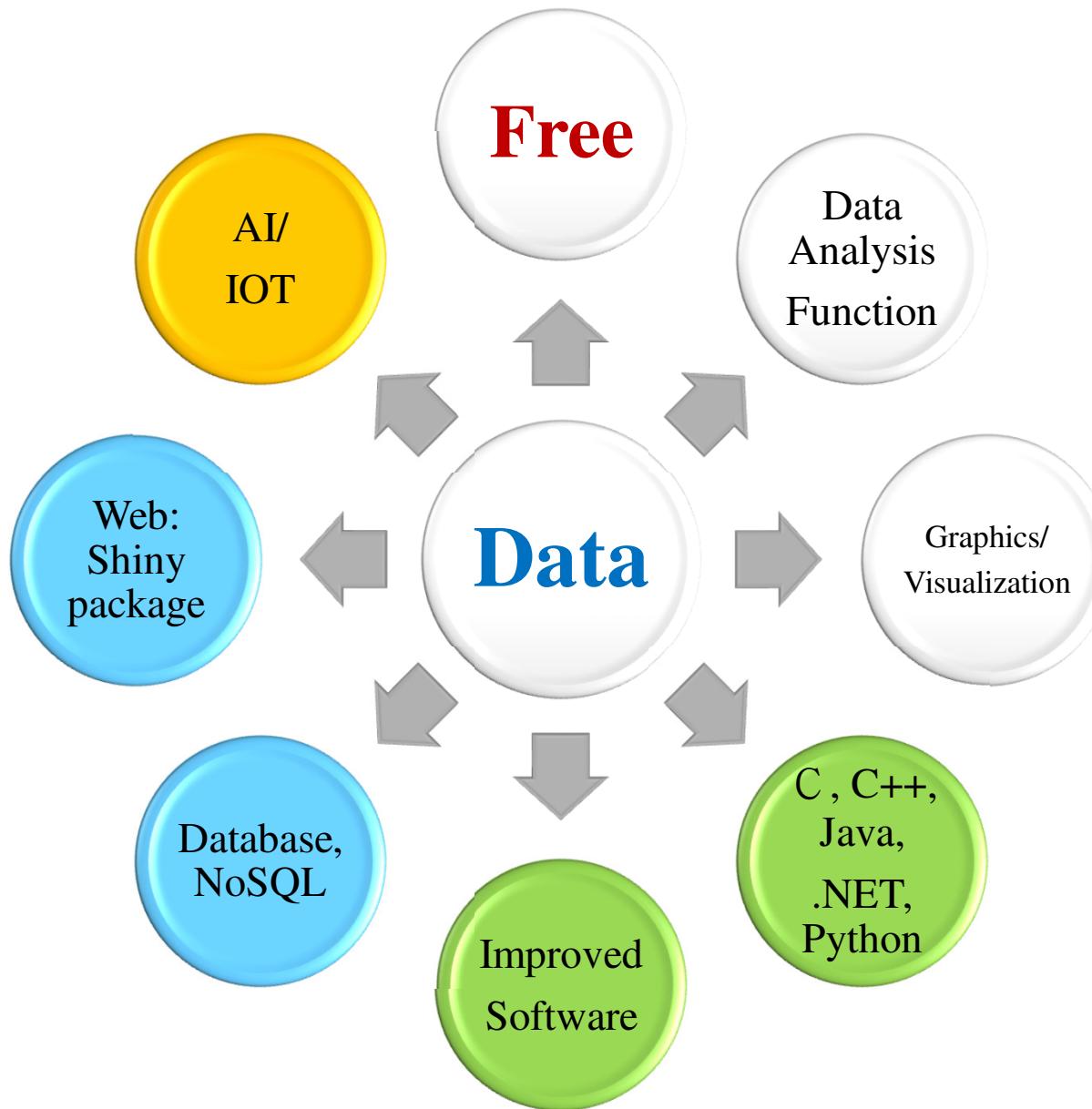
3.R/RStudio簡介

認識R

- 1976 - 貝爾實驗室 John Chambers, Rick Becker, and Allan Wilks研發S語言。
- 1993 - Ross Ihaka and Robert Gentleman, University of Auckland, New Zealand 研發R語言。
 - R是一種基於S語言所發展出具備統計分析、繪圖與資料視覺化的程式語言。
- 1997年—R的核心開發團隊 (R development core team) 成立，專責R原始碼的修改與編寫。
 - 2000年2月 — R 1.0.0
 - 2013年3月 — R 2.15.3
 - 2019年4月 — R 3.6.0



R-八大功能



R 汇入資料

- 文字檔
- Excel / OpenOffice / LibreOffice / PDF
- HTML / XML / JSON
- Minitab / SAS / SPSS / Stata
- Weka
- SQL / NoSQL
- 音樂檔
- 影像檔...

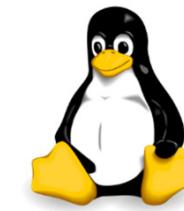
R-下載

- 官網: <http://www.r-project.org/>
- 選取左側 Download \ CRAN
- 選取 Taiwan CRAN

<https://ftp.yzu.edu.tw/CRAN/>

<http://ftp.yzu.edu.tw/CRAN/>

<http://cran.csie.ntu.edu.tw/>



- 選取 Download R for Windows

- [Download R for Linux](#)
- [Download R for \(Mac\) OS X](#)
- [Download R for Windows](#)

<http://cran.csie.ntu.edu.tw/>

R logo

The Comprehensive R Archive Network

CRAN
Mirrors
What's new?
Task Views
Search

About R
R Homepage
The R Journal

Software
R Sources
R Binaries
Packages
Other

Documentation
Manuals
FAQs
Contributed

套件

手冊

Download and Install R

Precompiled binary distributions of the base system and contributed packages, **Windows and Mac** users most likely want one of these versions of R:

- [Download R for Linux](#)
- [Download R for \(Mac\) OS X](#)
- [Download R for Windows](#)

下載

R is part of many Linux distributions, you should check with your Linux package management system in addition to the link above.

Source Code for all Platforms

Windows and Mac users most likely want to download the precompiled binaries listed in the upper box, not the source code. The sources have to be compiled before you can use them. If you do not know what this means, you probably do not want to do it!

- The latest release (Friday 2017-06-30, Single Candle) [R-3.4.1.tar.gz](#), read [what's new](#) in the latest version.
- Sources of [R alpha and beta releases](#) (daily snapshots, created only in time periods before a planned release).
- Daily snapshots of current patched and development versions are [available here](#). Please read about [new features and bug fixes](#) before filing corresponding feature requests or bug reports.

Download R for Windows

- 選取 base → [Download R 3.6.0 for Windows](#) (80 megabytes, 32/64 bit)

<u>base</u> <u>contrib</u> <u>old contrib</u> <u>Rtools</u>	<p> Binaries for base distribution (managed by Duncan Murdoch). This is what you want to install R for the first time.</p> <p>Binaries of contributed CRAN packages (for R \geq 2.11.x; managed by Uwe Ligges). There is also information on third party software available for CRAN Windows services and corresponding environment and make variables.</p> <p>Binaries of contributed CRAN packages for outdated versions of R (for R $<$ 2.11.x; managed by Uwe Ligges).</p> <p>Tools to build R and R packages (managed by Duncan Murdoch). This is what you want to build your own packages on Windows, or to build R itself.</p>
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R Manuals (手冊)

The R Manuals

edited by the R Development Core Team.

The following manuals for R were created on Debian Linux and may differ from the manuals for Mac or Windows on platform-specific pages, but most parts version of the manuals for each platform are part of the respective R installations. The manuals change with R, hence we provide versions for the most recent version for the patched release version (R-patched) and finally a version for the forthcoming R version that is still in development (R-devel).

Here they can be downloaded as PDF files, EPUB files, or directly browsed as HTML:

Manual

An Introduction to R is based on the former "Notes on R", gives an introduction to the language and how to use R for doing statistical analysis and graphics.

R Data Import/Export describes the import and export facilities available either in R itself or via packages which are available from CRAN.

R Installation and Administration

Writing R Extensions covers how to create your own packages, write R help files, and the foreign language (C, C++, Fortran, ...) interfaces.

A draft of **The R language definition** documents the language *per se*. That is, the objects that it works on, and the details of the expression evaluation process, which are useful to know when programming R functions.

R Internals: a guide to the internal structures of R and coding standards for the core team working on R itself.

The R Reference Index: contains all help files of the R standard and recommended packages in printable form. (9MB, approx. 3500 pages)

R-release

[HTML](#) | [PDF](#) | [EPUB](#)

contributed documentation
(貢獻文件, 免費啦)

R Manuals (續)

Contributed Documentation

[English](#) --- [Other Languages](#)

Manuals, tutorials, etc. provided by users of R. The R core team does not take any responsibility for contents, but we appreciate the effort very much and encourage everybody to contribute to this list! To submit, follow the submission instructions on the [CRAN main page](#). All material below is available directly from CRAN, you may also want to look at the list of [other R documentation](#) available on the Internet.

Note: Please use the [directory listing](#) to sort by name, size or date (e.g., to see which documents have been updated lately).

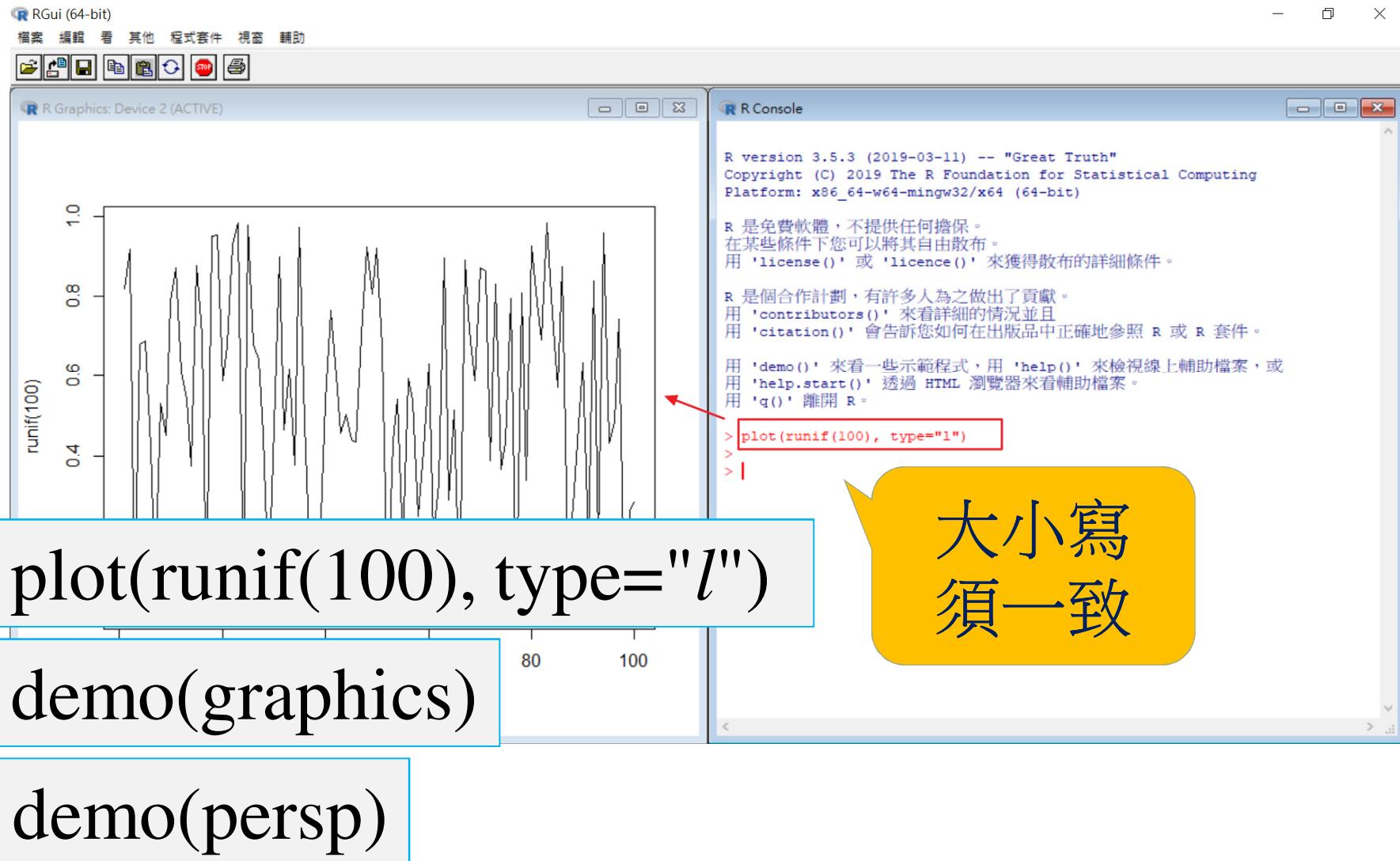
English Documents

Documents with more than 100 pages:

好書!

- “**Visual Statistics. Use R!**” by Alexey Shipunov ([PDF](#), 2016-06-06, 301 pages) are accessible from [Alexey Shipunov's English R page](#).
- “**Using R for Data Analysis and Graphics - Introduction, Examples and Commentary**” by John Maindonald ([PDF](#), data sets and scripts are available at [JM's homepage](#)).
- “**Practical Regression and Anova using R**” by Julian Faraway ([PDF](#), data sets and scripts are available at the [book homepage](#)).

R 執行畫面 - Windows



參考文獻

```
> citation()
```

To cite R in publications use:

R Core Team (2019). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL <https://www.R-project.org/>.

R 功能表

檔案



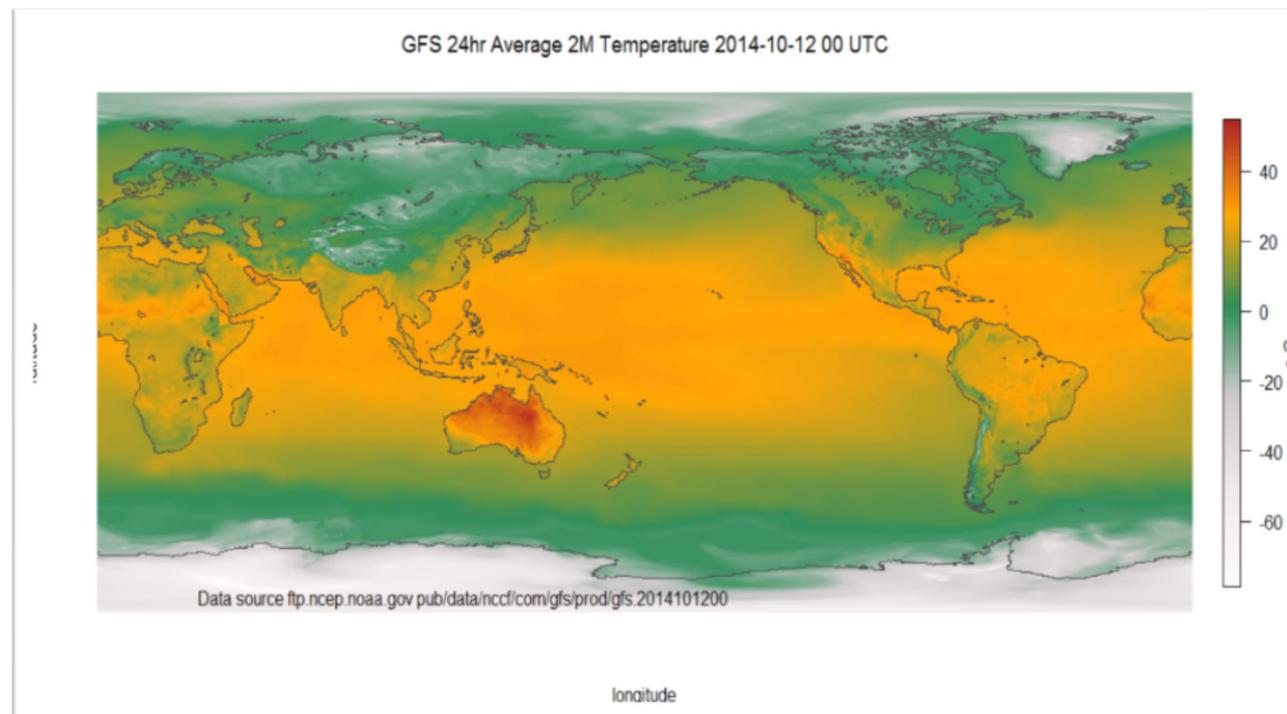
編輯



輔助



RStudio 簡介



RStudio 下載

- RStudio官網 <http://www.rstudio.com/>
- RStudio daily builds <https://dailies.rstudio.com/>



免費版

RStudio 下載 (續)

The screenshot shows the RStudio download page with two main sections: "RStudio Desktop Open Source License" (free) and "RStudio Server Open Source License". The desktop version is free, while the server version costs \$9,995 per year. Both versions include a "DOWNLOAD" button and a "Learn More" link.

	RStudio Desktop Open Source License	RStudio Server Open Source License
FREE	FREE	FREE
\$995 per year	\$9,995 per year	\$29,995 per year
DOWNLOAD	DOWNLOAD	DOWNLOAD
Learn More	Learn More	Learn More
TALK		
Learn More		

Below the download options, there is a comparison chart showing features supported by each version. The chart has two columns: "單機版" (Desktop) and "伺服器版本" (Server). Green dots indicate features available in both, while grey dots indicate features unique to the server version.

	單機版	伺服器版本
Integrated Tools for R	●	●
Priority Support	●	●
Access via Web Browser	●	●
Enterprise Security		●
Project Sharing	●	●
Manage Multiple R Sessions & Versions		●
Admin Dashboard	●	●
Load Balancing	●	●
One-Click Publishing		●
Self-Managed Content		●
Scheduled Reports		●

Red arrows point from the "FREE" and "TALK" buttons to the "單機版" and "伺服器版本" labels respectively. Red icons of a smartphone, tablet, and computer monitor are positioned to the right of the server section.

RStudio 下載 (續)

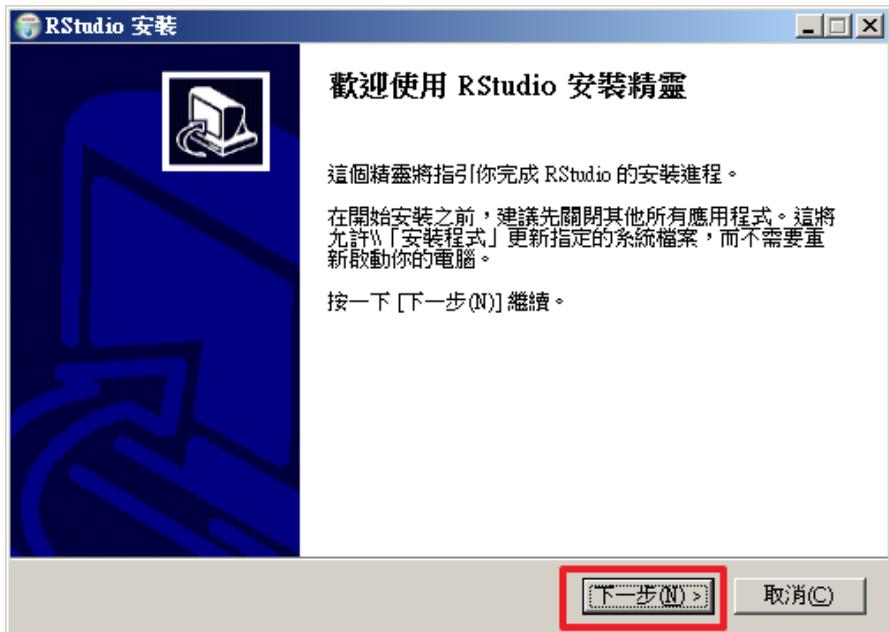
Installers for Supported Platforms

Installers	Size	Date
RStudio 1.1.463 - Windows Vista/7/8/10	85.8 MB	2018-10-29
RStudio 1.1.463 - Mac OS X 10.6+ (64-bit)	74.5 MB	2018-10-29
RStudio 1.1.463 - Ubuntu 12.04-15.10/Debian 8 (32-bit)	89.3 MB	2018-10-29



RStudio 安裝

1



2



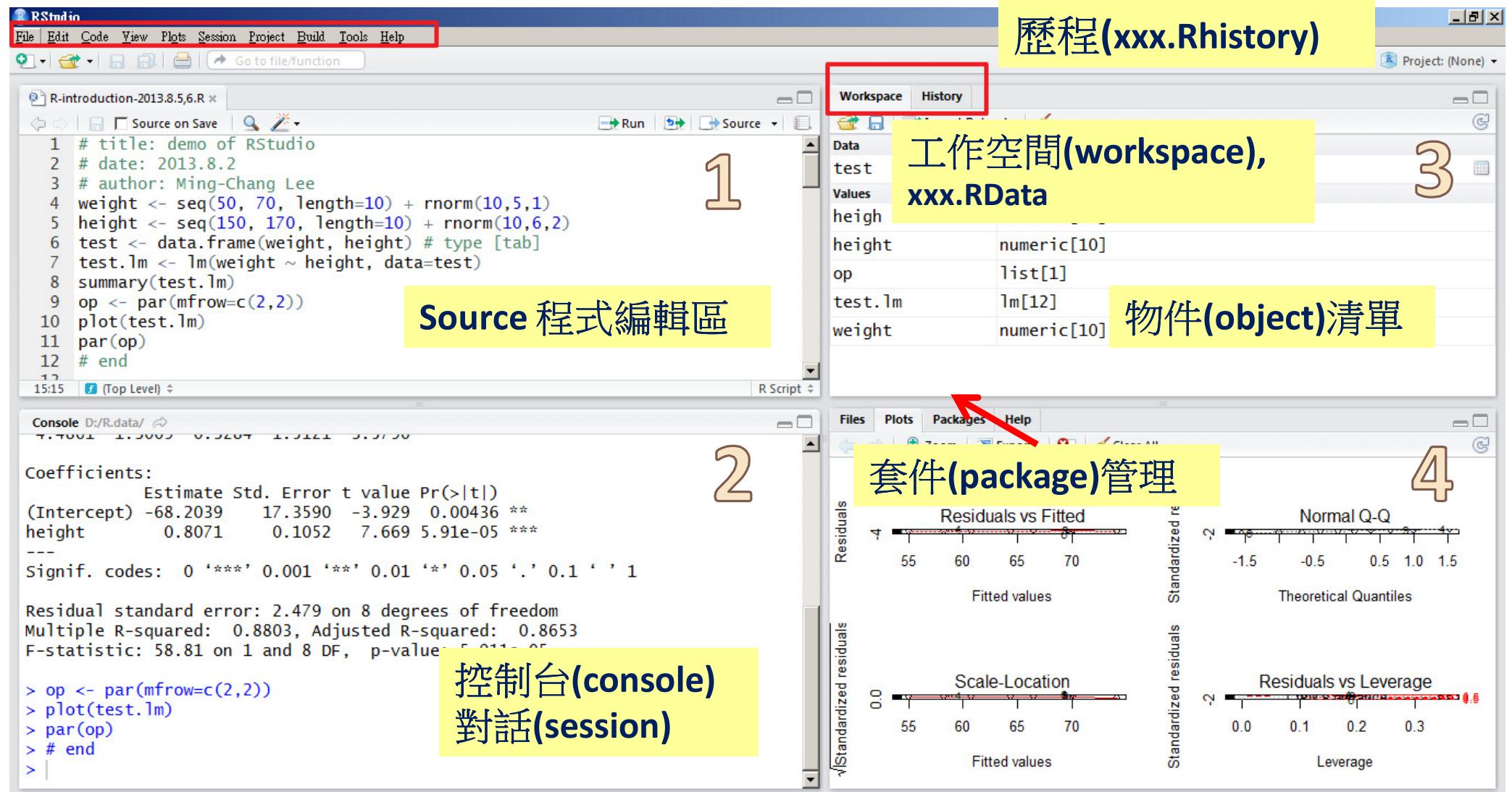
3



4

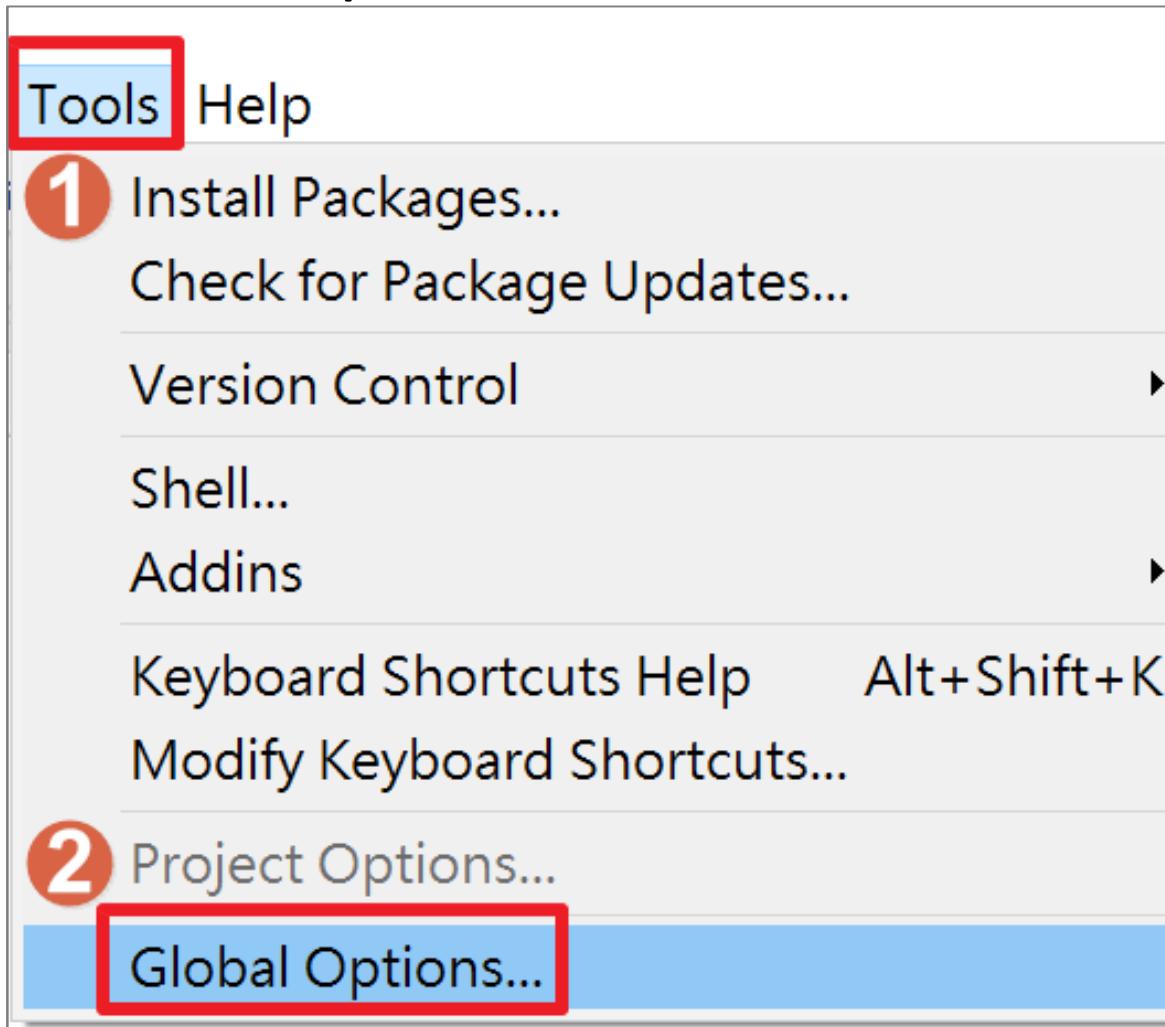


RStudio 使用環境



RStudio 選項設定

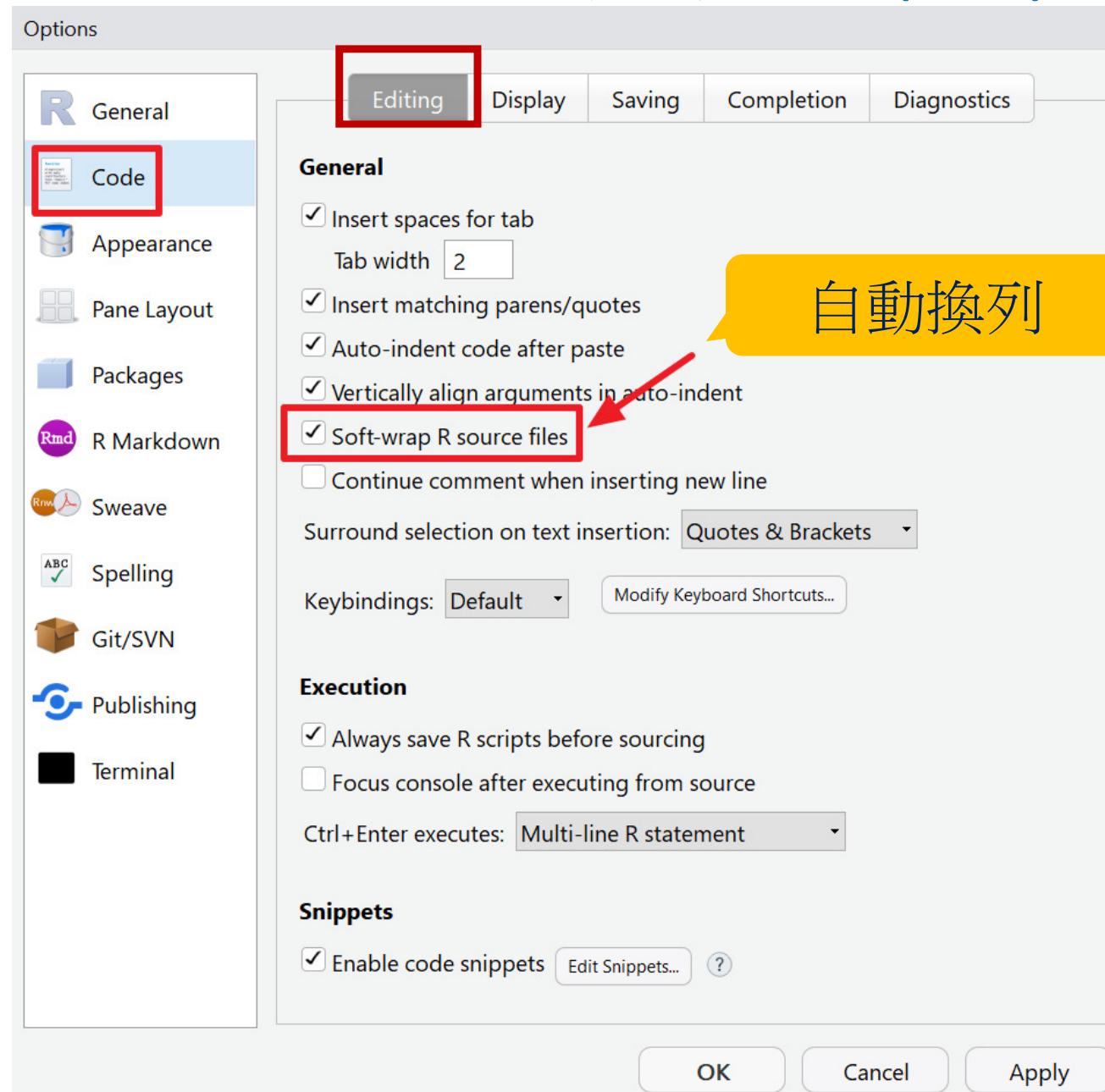
- Tools → Global Options...



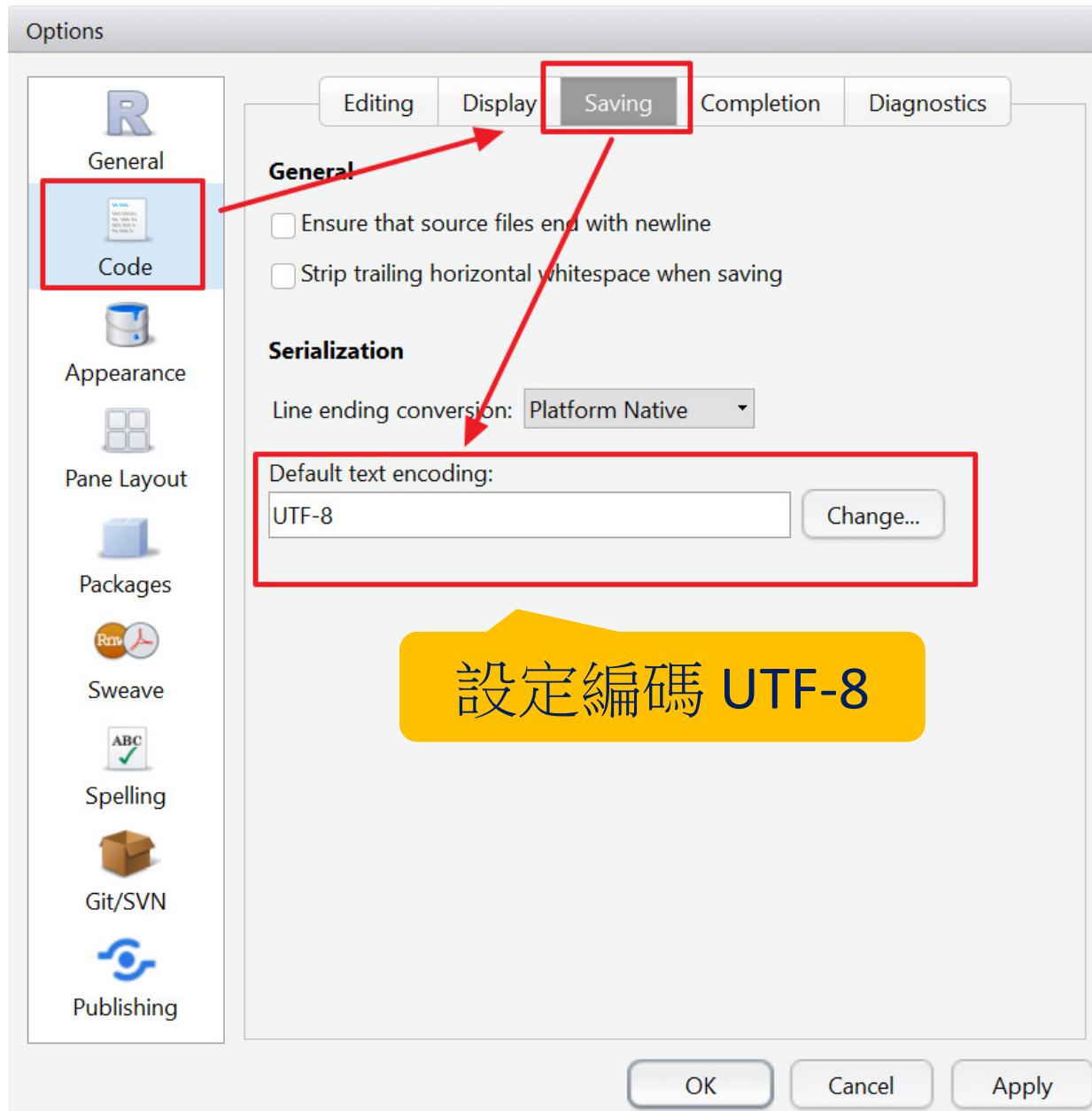
RStudio 選項設定(續)



RStudio 選項設定(續)



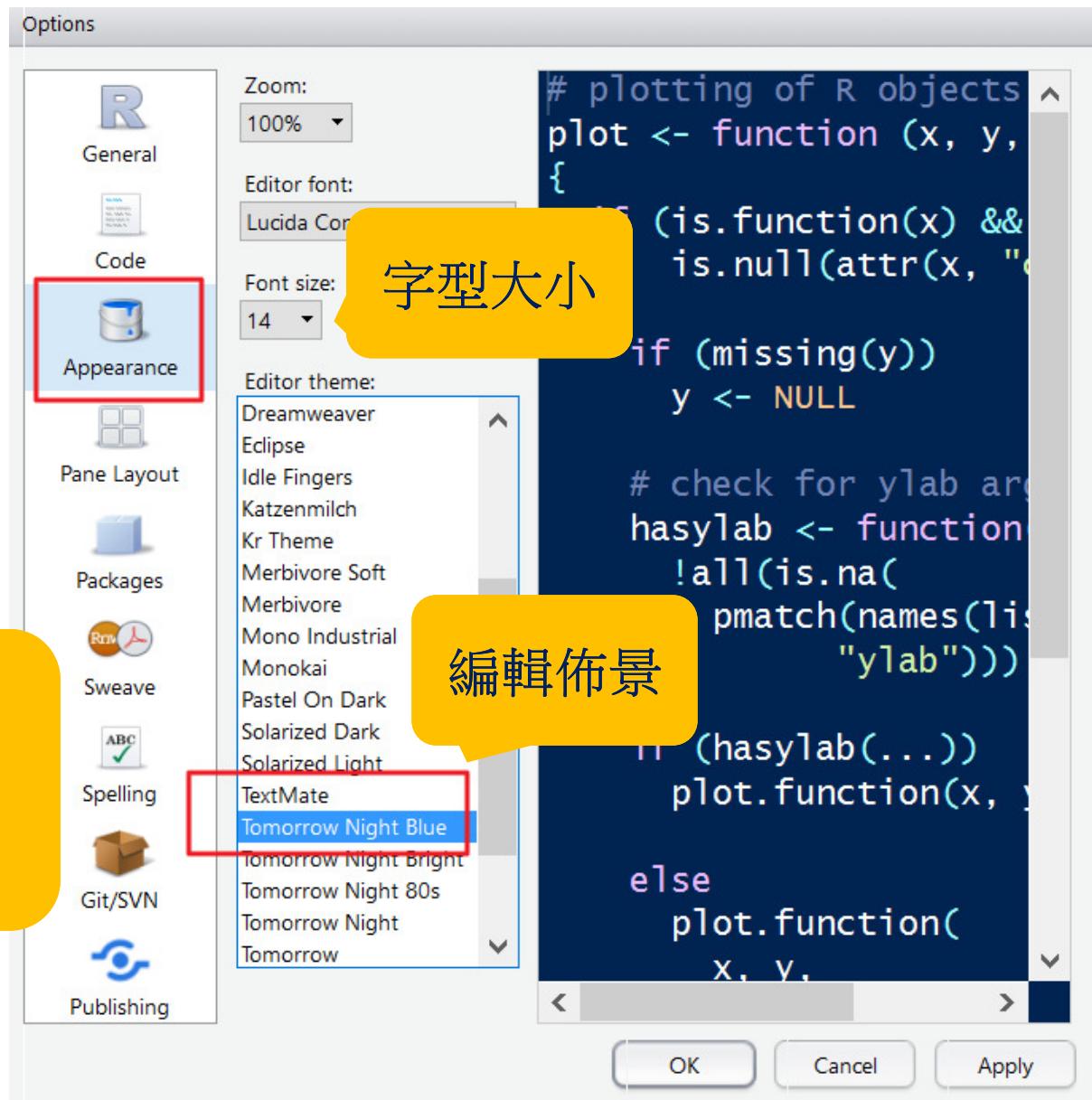
RStudio 選項設定(續)



RStudio 選項設定(續)

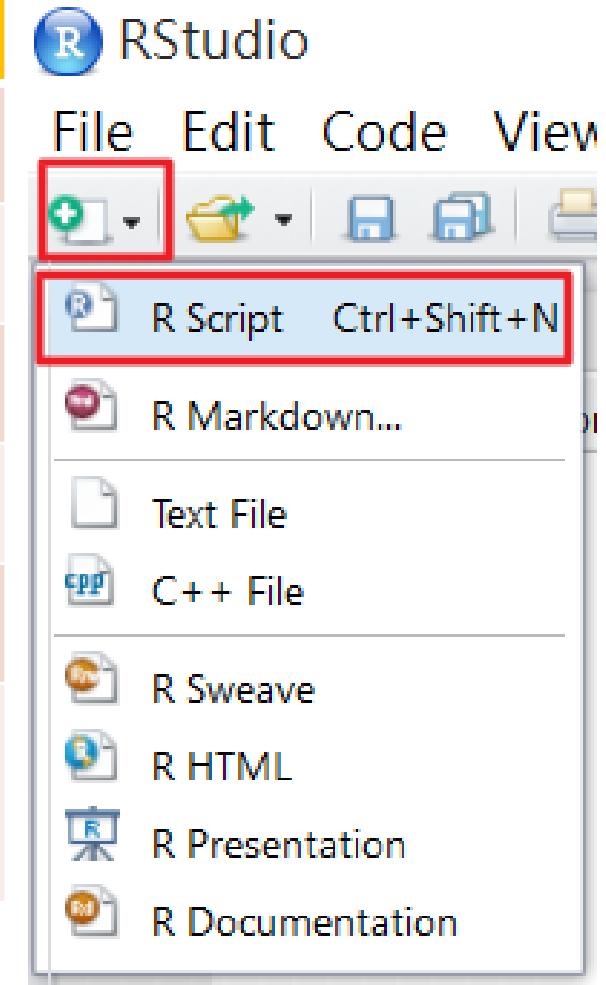
- Appearance \ Editor theme
- 預設值:
TextMate

- 完成設定
- 關閉 RStudio
- 重新開啟 RStudio



RStudio 快速鍵

快速鍵功能	功能
Ctrl + Shift + N	建立新的R程式
Ctrl + S	儲存檔案
Ctrl + Shift + R	建立章節 (-----)
Ctrl + Enter	執行程式
Ctrl + Shift + F10	重新啟動R
Alt + Shift + K	快速鍵總表 (Esc 退出)



R + Editor

- R – 原生環境
- RStudio – IDE 整合介面
- Eclipse
 - StatET 3.6.1:
An Eclipse based IDE (integrated development environment) plug-in for R.
 - <http://www.walware.de/goto/statet>
- 如何安裝 [Visual Studio R] 工具
 - <https://docs.microsoft.com/zh-tw/visualstudio/r/visual-studio-r-tools-for-visual-studio?view=vs-2017>



4. 資料物件, 套件, 輔助說明

資料型態 Data Type

- 數值 int, numeric
- 字串 character
- 邏輯值 logic (TRUE / FALSE)
- 日期 Date

- R資料物件指標從1開始 例: **x[1]**
- 轉換為數值 **as.numeric()**
- 轉換為字串 **as.character()**

資料物件

向量 vector

北部	中部	南部
----	----	----

矩陣matrix

1	3	5
2	4	6

陣列array

1.1	4.4	7.7
2.2	5.5	8.8
3.3	6.6	9.9

資料框data.frame

1	男	62
2	女	50
3	女	54
4	男	72

資料框：以串列方式儲存，但其長度相同。

串列list

北部	中部	南部
1	3	5
2	4	6

1	男	62
2	女	50
3	女	54
4	男	72

向量

矩陣

資料框

串列：
每一個元素其資料型別
與長度可以不相同。

矩陣預設採用
直行填入資料

套件

- 使用套件兩部曲 - 先安裝, 再載入套件
- # 安裝套件(一生一次)
install.packages("套件名稱")
- # 載入套件(每次使用)
library(套件名稱)

R套件 - 40類別

(2019.5.4)

Contributed Packages

Available Packages

Currently, the CRAN package repository features 14147 available packages.

[Table of available packages, sorted by date of publication](#)

[Table of available packages, sorted by name](#)

Installation of Packages

Please type `help("INSTALL")` or `help("install.packages")` in R for information on how to install packages from this repository. The manual [R Installation and Administration](#) (also contained in the R base sources) explains the process in detail.

[CRAN Task Views](#) allow you to browse packages by topic and provide tools to automatically install all packages for special areas of interest. Currently 40 views are available.

40個類別

R套件 - 40類別 (續)

Task Views - R套件區分成40個類別

更新日期: 2019.3.19

CRAN Task View : <https://cran.r-project.org/web/views/>

套件區分成 40 個類別, 中文說明如下:

RWEPA → task

編號 主題 英文說明 中文說明

- 01, **Bayesian**, Bayesian Inference, 貝氏統計
- 02, **ChemPhys**, Chemometrics and Computational Physics, 計量化學學, 計算物理
- 03, **ClinicalTrials**, Clinical Trial Design, Monitoring, and Analysis, 臨床試驗設計, 監測和分析
- 04, **Cluster**, Cluster Analysis & Finite Mixture Models, 群集分析, 有限混合模型
- 05, **Databases**, Databases with R, R與資料庫連接
- 06, **DifferentialEquations**, Differential Equations, 微分方程
- 07, **Distributions**, Probability Distributions, 機率分配
- 08, **Econometrics**, Computational Econometrics, 計量經濟
- 09, **Environmetrics**, Analysis of Ecological and Environmental Data, 生態, 環境資料分析
- 10, **ExperimentalDesign**, Design of Experiments (DoE) & Analysis of Experimental Data, 實驗設計, 實驗資料分析

輔助說明

- 常用輔助說明方法

```
help.start() # 線上說明首頁
```

```
?plot # 檢視plot函數  
help(plot)
```

```
help.search("regression") # 檢視所有說明  
??regression
```



GOOGLE

plot 函數說明

1.函數

2.套件

3.R文件

R Documentation

plot{graphics}

① ②

Generic X-Y Plotting

Description

Generic function for plotting of R objects. For more details about the graphical parameter arguments, see [par](#).

For simple scatter plots, [plot.default](#) will be used. However, there are plot methods for many R objects, including [functions](#), [data.frames](#), [density](#) objects, etc. Use `methods(plot)` and the documentation for these.

4.簡單說明

5.詳細說明

Usage

`plot(x, y, ...)`

6.方法

Arguments

`type="n"`

x

the coordinates of points in the plot. Alternatively, a single plotting structure, function or *any R object with a plot method* can be provided.

7.參數

R 高效能計算

- 計算2300萬筆數字平方，CPU時間約 0.06秒

```
> # R 高效能計算
> x <- c(1:23000000)
> x2 <- x^2
> head(x)
[1] 1 2 3 4 5 6
> head(x2)
[1] 1 4 9 16 25 36
> system.time(x2 <- x^2)
      user   system elapsed
    0.07     0.00   0.06
```

物件, 工作目錄

ls 列出所有物件
ls()

刪除特定物件
rm(x)

getwd 取得工作目錄
getwd()

setwd 設定工作目錄
setwd("C:/rdata")

5. 開放資料分析- 高速公路

交通部統計查詢網

The screenshot shows the homepage of the Ministry of Transportation and Communications Statistical Query Network. The main menu includes Main Inquiry, Simple Inquiry, Industry Category Inquiry, Statistical Report, and Other Data Banks. The main content area displays categories of traffic statistics:

類別		主要查詢細分類
郵政	郵政	函件、包裹、快捷郵件、儲金、匯兌、壽險、兩岸郵件、兩岸匯兌、郵政機構
鐵路	臺鐵	客運量、貨運量、行車事故
	高鐵	客運量、行車事故
	捷運	臺北捷運、高雄捷運、桃園機場捷運、新北捷運
公路	公路運輸	客運量(汽車、市區、公路)、貨運量
	高速公路	通行量(計次收費、計程收費)、通行費(計次收費、計程收費)、 交通事故 、 交通違規
	監理	車輛登記數、領有駕照人數、監理規費、交通違規
	交通事故	道安會統計(30日)、警政署統計(24小時)
	其他	道路長度面積、橋梁座數、汽車停車位
	計程車調查	■ 細分類項目
	遊覽車調查	■ 細分類項目
	自用小客車調查	■ 細分類項目
	機車調查	■ 細分類項目
	水運 港埠	國輪 海事

A red box highlights the "高速公路" (Highway) category under the "公路" (Road) section, and a red arrow points to the "交通事故" (Traffic Accidents) and "交通違規" (Traffic Violations) items under the "高速公路" category.

交通事故

主要查詢 簡易查詢 跨業別查詢 統計報告 其他資料庫

交通事故

主要資料查詢網頁
✓高速公路交通事故

查詢 3

統計期 87年 至 108年3月 週期 月 1

統計值或增減率 統計值 2

統計表、圖或下載 統計表(顯示於Excel)

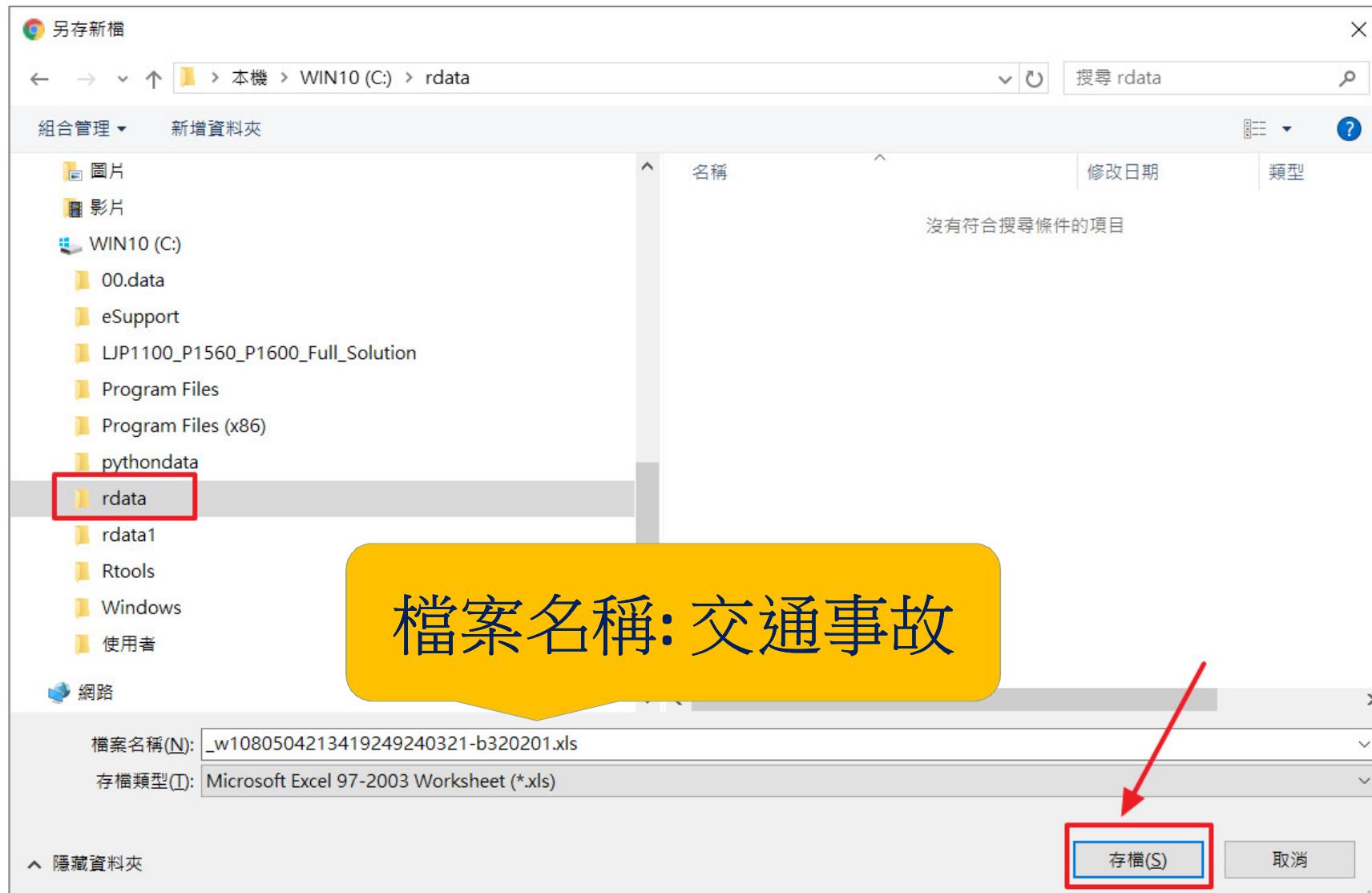
高速公路交通事故

統計項

高速公路交通事故

- 肇事件數(件)
- 死亡人數(人)
- 受傷人數(人)
- 取締違規件數(件)

交通事故 – 另存新檔



資料處理

輸入時間

刪除前2列

1	高速公路交通事故				表格數：1
2	時間	肇事件數(件)	死亡人數(人)	受傷人數(人)	取締違規件數(件)
3	90年 1月	11	14	11	226,951
4	90年 2月	9	10	7	224,654
5	90年 3月	5	5	0	190,020

改為 2001/1/1

改為沒有 , 符號

資料處理 (續)

220	108年1月	10	10	9	54,664
221	108年2月	4	4	1	40,741
222	108年3月	7	8	30	49,632

刪除後5列

223	產生時間:108/05/04 21:34:19
224	說明：1.本表數字僅含A1類（指造成人員當場或24小時內死亡之交通事故）。 2.自106年7月起，按國道公路警察局轄管交通事故資料統計。
225	
226	
227	資料來源：內政部警政署。
228	
229	

高速公路交通事故

輸入工作表名稱

資料處理 – 完成結果

A	B	C	D	E	
1	時間	肇事件數(件)	死亡人數(人)	受傷人數(人)	取締違規件數(件)
2	2001/1/1	11	14	11	226951
3	2001/2/1	9	10	7	224654
4	2001/3/1	5	5	0	190020
206	2018/1/1	5	5	9	34407
207	2018/2/1	2	2	0	26135
208	2018/3/1	6	7	4	52655
209	2018/4/1	6	8	6	53692
210	2018/5/1	4	4	2	61864
211	2018/6/1	10	10	3	49923
212	2018/7/1	2	2	2	54556
213	2018/8/1	8	10	4	65614
214	2018/9/1	7	8	9	48026
215	2018/10/1	8	10	10	66932
216	2018/11/1	3	3	2	59636
217	2018/12/1	2	4	3	44865
218	2019/1/1	10	10	9	54664
219	2019/2/1	4	4	1	40741
220	2019/3/1	7	8	30	49632

檔案 \ 另存新檔 CSV



匯入資料

匯入CSV: `read.table`

```
> # 匯入資料
> highway <- read.table("交通事故.csv", header=TRUE, sep=",", stringsAsFactors=FALSE)
> # 刪除多餘的最後一筆資料
> highway <- highway[-220, ]
```

- [列, 行]
- -220 表示刪除第220列

時間	肇事件數.件.	死亡人數.人.	受傷人數.人.	取締違規件數.件.
198 2017/6/1	6	6	8	52021

字串不要轉換成factor,
保持原字串型態

206	2018/4/1	0	0	0	53692
209	2018/5/1	4	4	2	61864
210	2018/6/1	10	10	3	49923
211	2018/7/1	2	2	2	54556
212	2018/8/1	8	10	4	65614
213	2018/9/1	7	8	9	48026
214	2018/10/1	8	10	10	66932
215	2018/11/1	3	3	2	59636
216	2018/12/1	2	4	3	44865
217	2019/1/1	10	10	9	54664
218	2019/2/1	4	4	1	40741
219	2019/3/1	7	8	30	49632

資料處理

- 欄位名稱 **names**
- 顯示前6筆 **head**

```
> names(highway)
[1] "時間"          "肇事件數.件."    "死亡人數.人."    "受傷人數.人."    "取締違規件數.件."
> names(highway) <- c("時間", "肇事件數", "死亡人數", "受傷人數", "取締違規件數")
> head(highway)
   時間 肇事件數 死亡人數 受傷人數 取締違規件數
1 2001/1/1      11       14      11     226951
2 2001/2/1       9       10       7     224654
3 2001/3/1       5       5       0     190020
4 2001/4/1       7       10      8     185002
5 2001/5/1       3       3       8     179906
6 2001/6/1      13       14      7     182040
```

```
highway$時間 <- as.Date(highway$時間)
```

- **as.Date()**: 轉換為日期資料
- 資料物件\$欄位名稱: 讀取一欄

219列, 5欄

理解資料

> str(highway)

```
'data.frame': 219 obs. of 5 variables:
$ 時間      : chr "2001/1/1" "2001/2/1" "2001/3/1" "2001/4/1" ...
$ 肇事件數   : int 11 9 5 7 3 13 8 8 3 3 ...
$ 死亡人數   : int 14 10 5 10 3 14 10 9 4 3 ...
$ 受傷人數   : int 11 7 0 8 8 7 6 10 4 2 ...
$ 取締違規件數: int 226951 224654 190020 185002 179906 182040 185358 186165 164295 183824 ...
```

> summary(highway)

時間
Length:219
Class :character
Mode :character

肇事件數
Min. : 1.000
1st Qu.: 4.000
Median : 6.000
Mean : 6.534
3rd Qu.: 8.500
Max. :17.000

	死亡人數	受傷人數	取締違規件數
Min.	1.000	0.000	25822
1st Qu.	5.000	3.000	51729
Median	7.000	6.000	60616
Mean	7.744	7.553	78312
3rd Qu.	10.000	10.000	80399
Max.	38.000	47.000	229986

- 類別型變數: 個數
- 數值型個數: 6力分析

Min.	: 最小值 Minimum
1st Qu.	: 25百分位數
Median	: 中位數
Mean	: 平均值
3rd Qu.	: 75百分位數
Max.	: 最大值 Maximum



問題討論

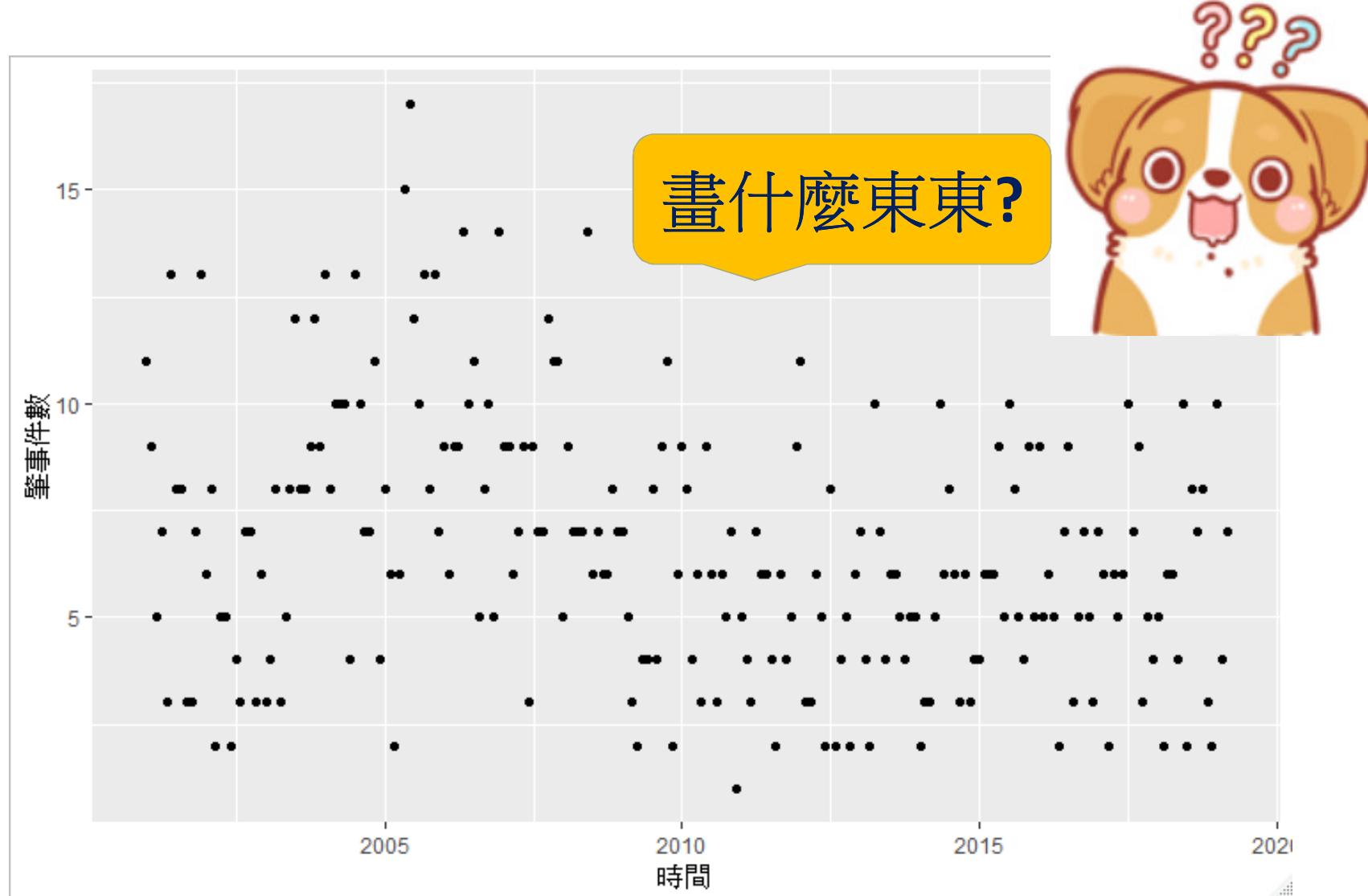
- Q1. 哪些月份肇事件數較多?
- Q2. 繪製各年累計肇事件數統計圖?
- Q3. 取締違規件數與肇事件數關係為何?
- Q4. 預測未來?

資料處理

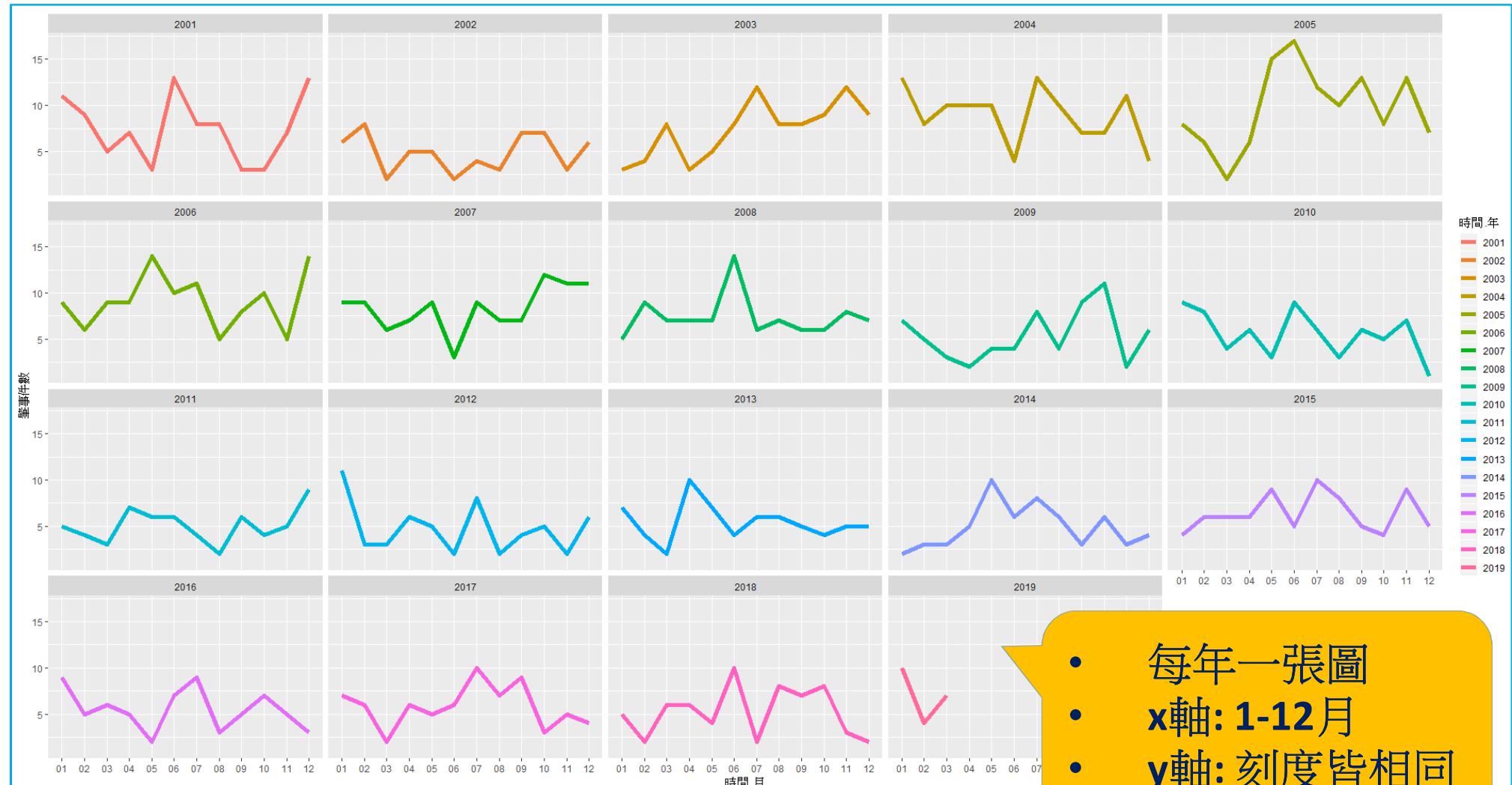
```
# 新增年的資料行  
highway$時間.年 <- factor(format(highway$時間, format="%Y"))  
# 新增月的資料行  
highway$時間.月 <- factor(format(highway$時間, format="%m"))
```



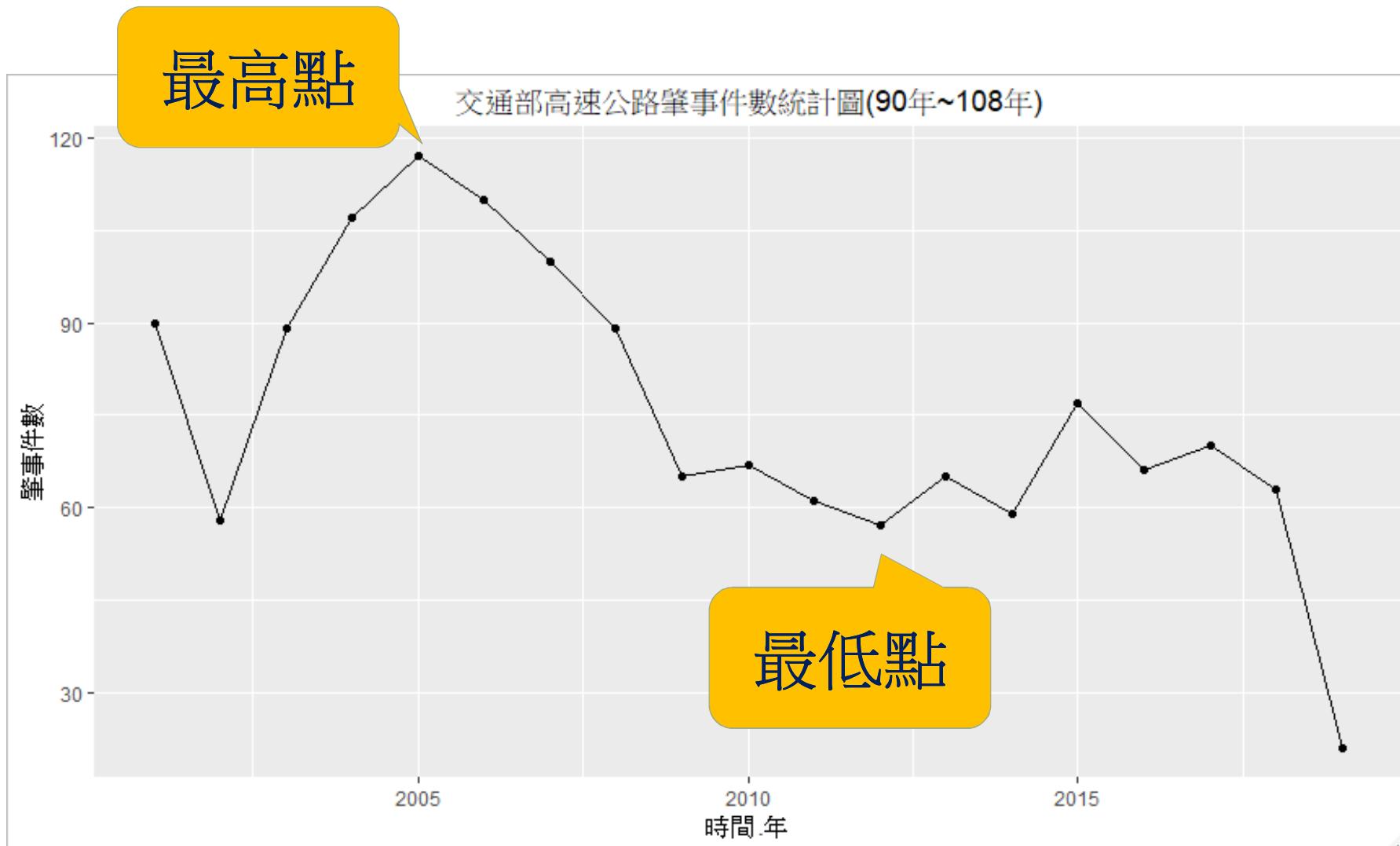
Q1. 哪些月份肇事件數較多？



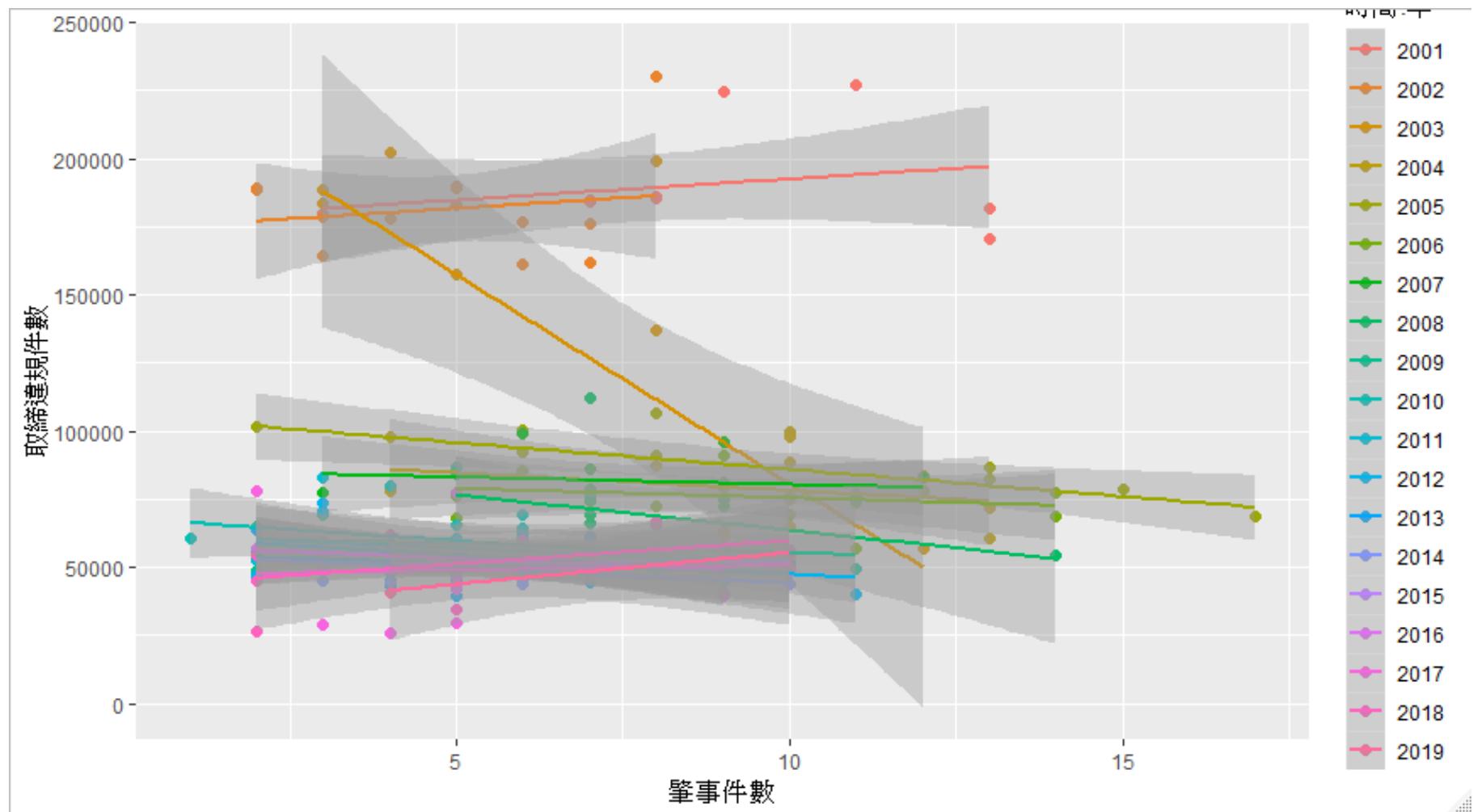
Q1. 哪些月份肇事件數較多？



Q2. 繪製各年累計肇事件數統計圖?



Q3. 取締違規件數與肇事件數關係為何?



Q4. 預測未來?

```
> highway.ts <- ts(data=highway$肇事件數, start=c(2001,1), frequency=12)  
> highway.ts
```

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2001	11	9	5	7	3	13	8	8	3	3	7	13
2002	6	8	2								3	6
2003	3	4	8								12	9
2004	13	8	10								11	4
2005	8	6	2								13	7
2006	9	6	9	9	14	10	11	5	8	10	5	14
2007	9	9	6	7	9	3	9	7	7	12	11	11
2008	5	9	7	7	14	6	7	6	6	8	7	
2009	7	5	3	2	4	4	8	4	9	11	2	6
2010	9	8	4	6	3	9	6	3	6	5	7	1
2011	5	4	3	7	6	6	4	2	6	4	5	9
2012	11	3	3	6	5	2	8	2	4	5	2	6
2013	7	4	2	10	7	4	6	6	5	4	5	5
2014	2	3	3	5	10	6	8	6	3	6	3	4
2015	4	6	6	6	9	5	10	8	5	4	9	5
2016	9	5	6	5	2	7	9	3	5	7	5	3
2017	7	6	2	6	5	6	10	7	9	3	5	4
2018	5	2	6	6	4	10	2	8	7	8	3	2
2019	10	4	7									

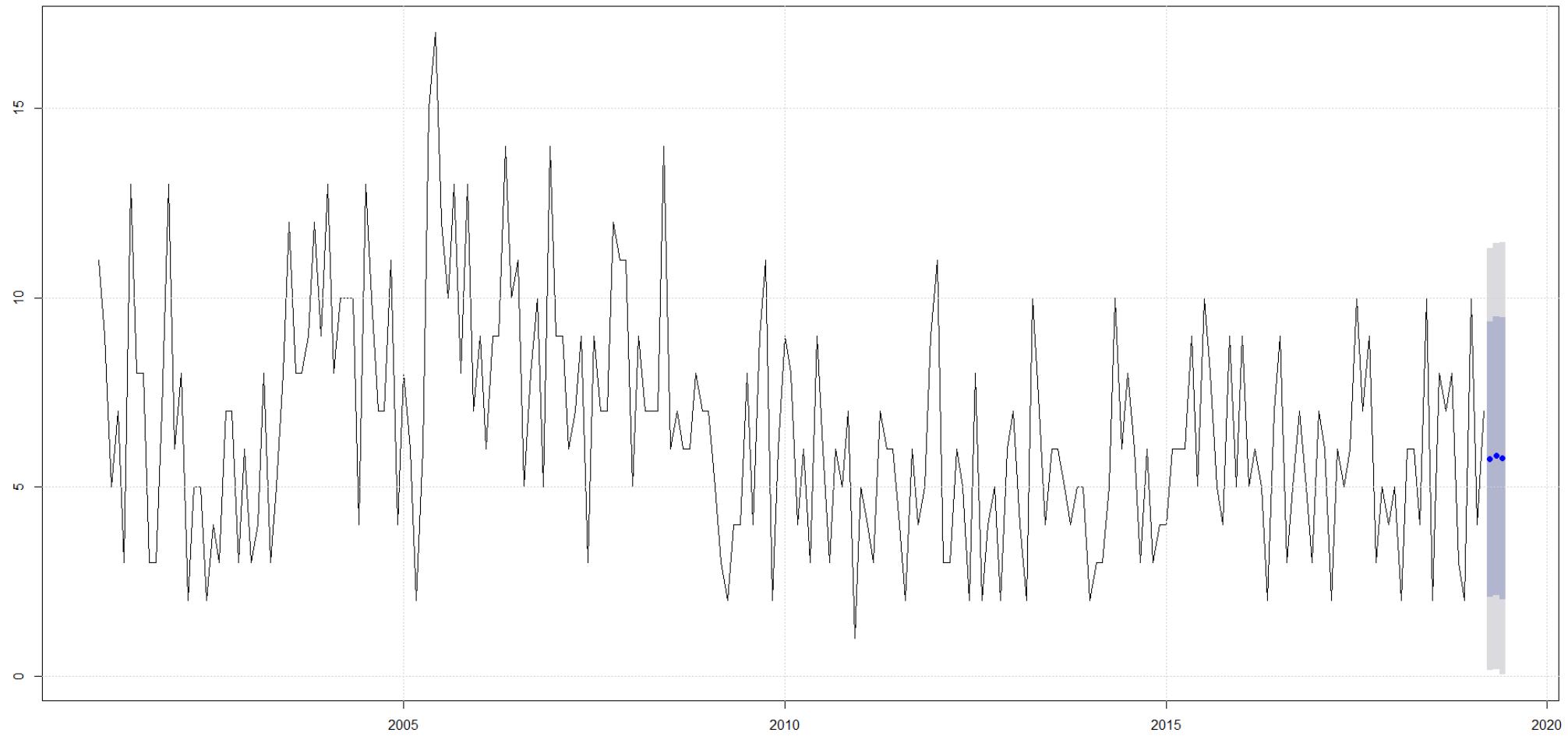
時間序列 ts

auto.arima {forecast}

```
> fit <- auto.arima(highway.ts)
> forecast(fit, h=3) # 未來3個月(1季)
      Point Forecast     Lo 80     Hi 80     Lo 95     Hi 95
Apr 2019      5.722879 2.071014 9.374745 0.13783277 11.30793
May 2019      5.806275 2.117146 9.495404 0.16423886 11.44831
Jun 2019      5.745338 2.012203 9.478474 0.03600074 11.45468
>
> plot(forecast(fit, h=3))
```

預測

交通部高速公路肇事件數統計圖2001年~2019年-預測未來3個月
製表:RWEPA



參考資料

Using R for Data Analysis and Graphics

Introduction, Code and Commentary

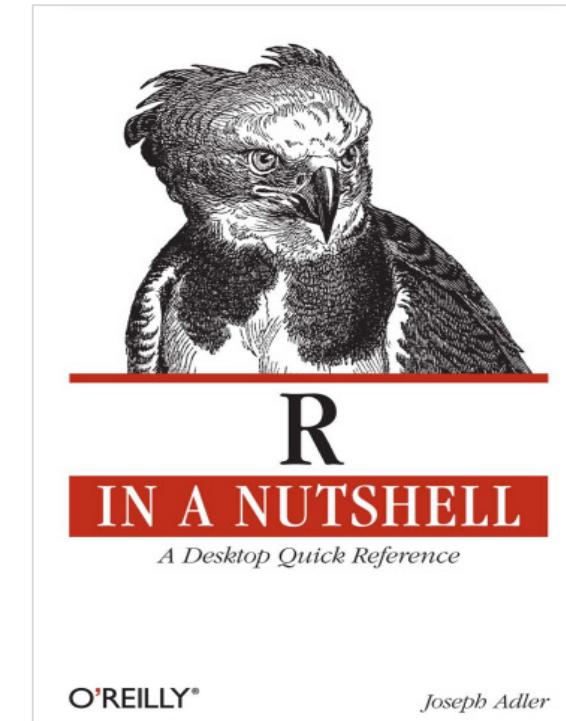
J H Maindonald

Centre for Mathematics and Its Applications,
Australian National University.



(基礎)

(進階)



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謝謝您的聆聽

Q & A

育達科技大學 資訊管理系
李明昌

alan9956@gmail.com

<http://rwepa.blogspot.tw/>