

109-1: EE4052

通識課程： 計算機程式設計 之旅

Computer Programming

# Unit 03: 設定軟體 R 與 RStudio

連 豐 力

臺大電機系

Sep 2020 - Jan 2021

# 大綱

- R 的故事
- 安裝軟體：
  - R 軟體
    - The R Project for Statistical Computing
    - <https://www.r-project.org/>
  - RStudio 軟體
    - RStudio
    - <https://www.rstudio.com/>
- 軟體使用方式：
  - 主要方式 與 次要方式
- 程式測試：
  - 工作目錄，數據資料，繪圖，存檔

# 作業

# HW01: 檔案

On 9/30, 2020

- 主旨：初步數據處理繪圖與程式檔案儲存
- 繳交下面檔案，檔案名稱：  
HW01\_學號\_Install.xxx
  - 處理過程資料檔：HW01\_B01921001\_Install.RData
  - 歷史指定檔案：HW01\_B01921001\_Install.Rhistory
  - 主要指定檔案：HW01\_B01921001\_Install.R
  - 報告檔案：HW01\_B01921001\_Install.pdf
  - 上傳檔案到：<https://cool.ntu.edu.tw>
  - 繳交期限：10/5 (Mon), 11pm 以前
- 學習方式：
  - 請至下面網址輸入此次的學習方式所花的時間：
  - <https://forms.gle/TGYXj2uLoL4HwqLHA>

# R 的故事

# R 程式語言的故事

- R 程式語言是一套提供：數據處理，計算與圖形處理的軟體發展環境。
- R 程式語言也可以當作一般的高階程式語言來使用，類似 C++ 或 Java。

- 歷史脈絡：

- SPSS, SAS

- S 語言：1976年

- 貝爾實驗室 **John Chambers**，VAX, Unix
    - 用於提供資料分析使用的程式語言



- R 語言：1992年

- 紐西蘭 奧克蘭大學 **Ross Ihaka** 與 **Robert Gentleman**
    - 用於統計研究的軟體與環境



# R 程式語言的特點

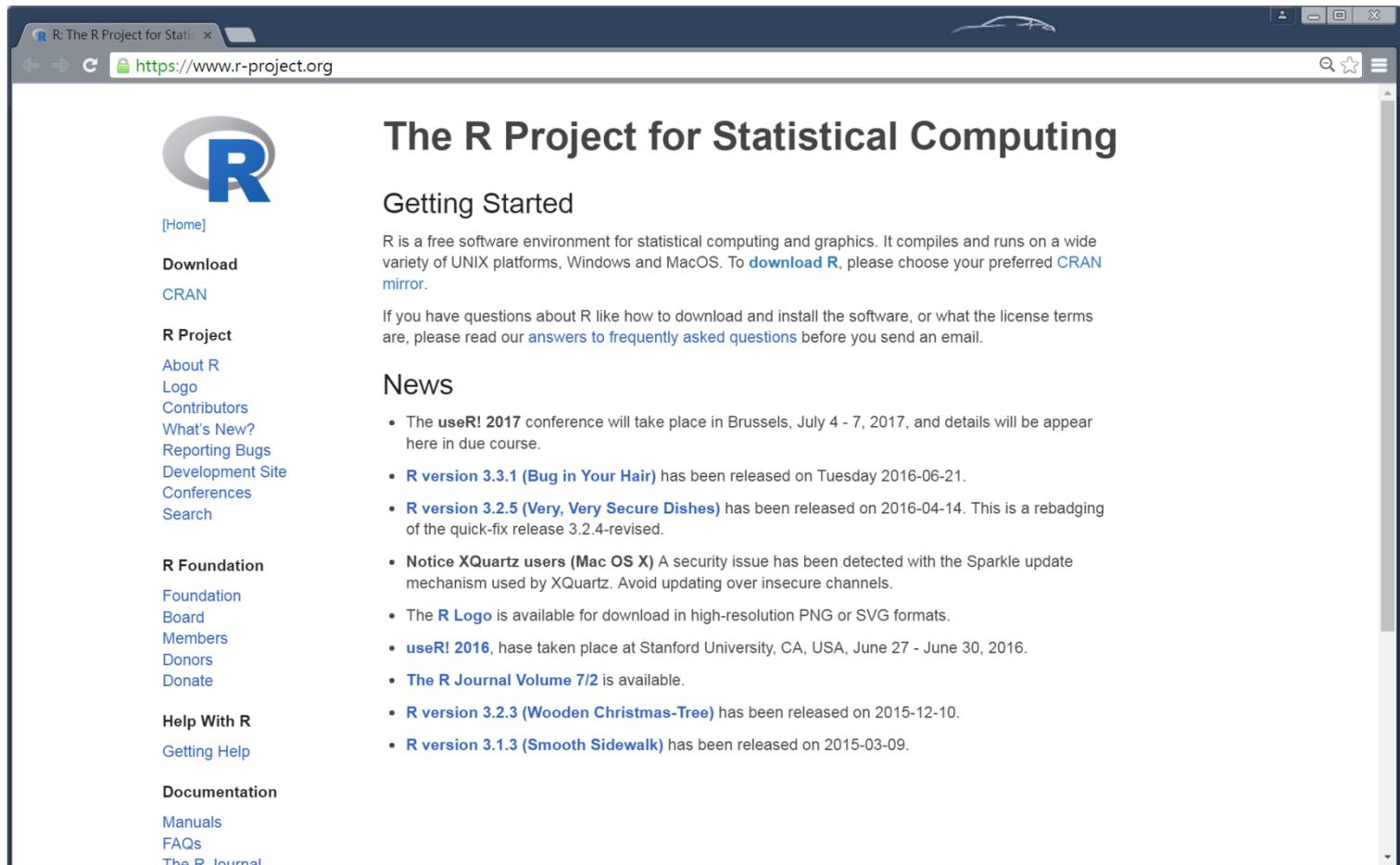
- 免費軟體，開放原始碼
- 程式設計思想非常簡單，幾乎就和寫公式一樣簡單
- 優勢：資料處理，資料統計，資料視覺化
- 強大的數學統計分析功能：預測，模型與分析
- 強大的科學資料視覺化功能，提供分析及圖形顯示工具
- 擴充套件：5000多個軟體套件，  
包含：統計計算，機器學習，金融分析，生物資訊，  
社會網路分析自然語言處理等
- 支援電腦系統：Windows, Mac-OS, Linux, 32位元, 64位元
- 支援其他的格式：SAS, SPSS, Matlab, Excel, Access 等

# 安裝軟體

# 軟體使用方式

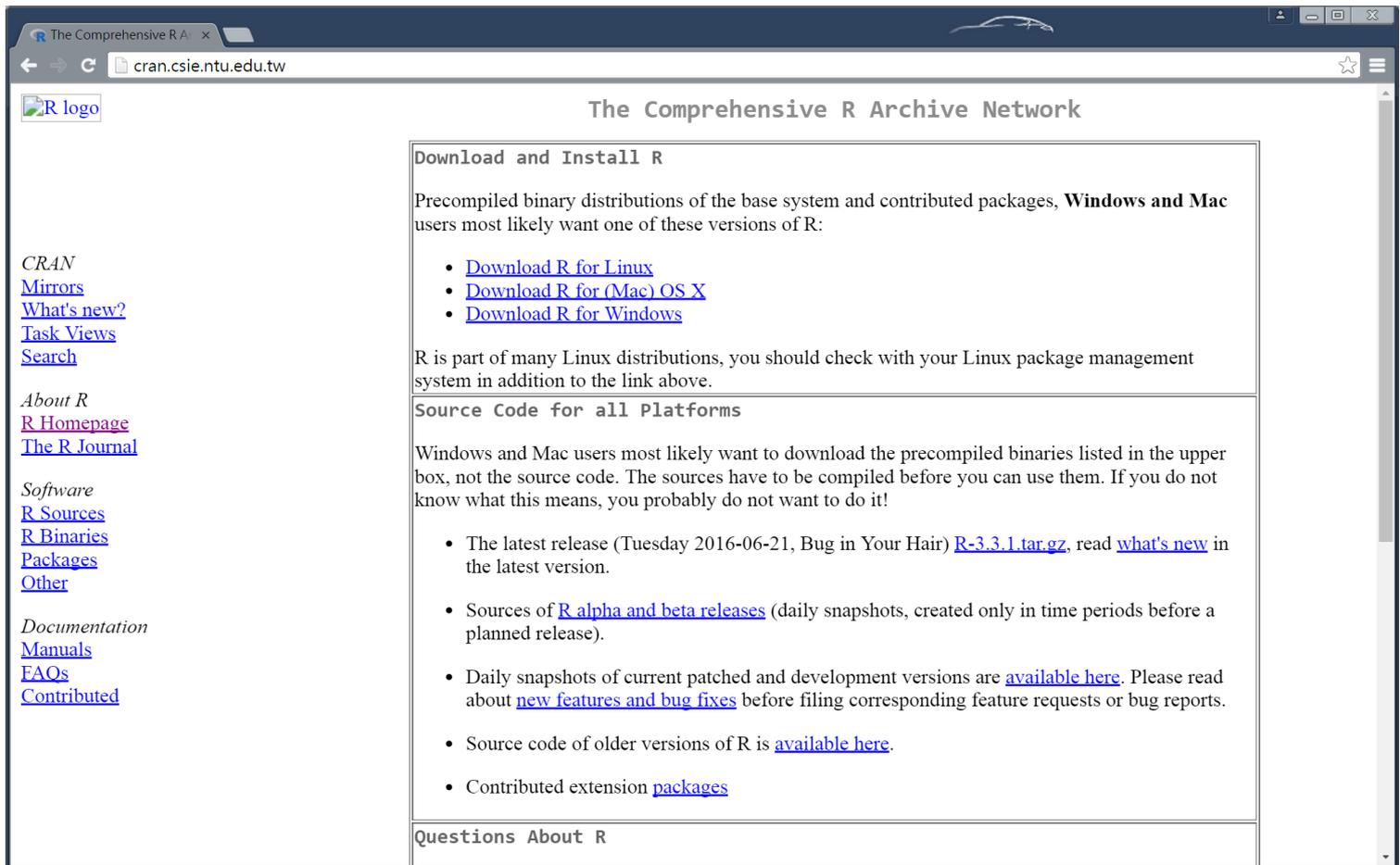
- 軟體使用方式
  - 主要方式
    - 桌機或筆電：Windows, Mac-IOS
  - 次要方式：
    - 平板 app 雲端連線：Android, iPad,
    - 電腦 app 雲端連線：
    - 桌機或筆電或平板 web 雲端連線：
- 安裝軟體：
  - R 軟體
    - The R Project for Statistical Computing
    - <https://www.r-project.org/>
  - RStudio 軟體
    - RStudio
    - <https://www.rstudio.com/>

- The R Project for Statistical Computing
  - <https://www.r-project.org/>



The screenshot shows the homepage of the R Project for Statistical Computing. The browser address bar displays <https://www.r-project.org>. The page features the R logo on the left, followed by navigation links for [Home], Download (CRAN), R Project (About R, Logo, Contributors, What's New?, Reporting Bugs, Development Site, Conferences, Search), R Foundation (Foundation, Board, Members, Donors, Donate), Help With R (Getting Help), and Documentation (Manuals, FAQs, The R Journal). The main content area is titled "The R Project for Statistical Computing" and includes a "Getting Started" section with introductory text and a link to download R. Below this is a "News" section with a list of recent events and releases, including the useR! 2017 conference, R version 3.3.1 (Bug in Your Hair), R version 3.2.5 (Very, Very Secure Dishes), a security issue for XQuartz users (Mac OS X), the R Logo download availability, useR! 2016 at Stanford University, The R Journal Volume 7/2, R version 3.2.3 (Wooden Christmas-Tree), and R version 3.1.3 (Smooth Sidewalk).

- The Comprehensive R Archive Network
  - <http://cran.csie.ntu.edu.tw/>



The screenshot shows a web browser window displaying the Comprehensive R Archive Network (CRAN) website. The browser's address bar shows the URL [cran.csie.ntu.edu.tw](http://cran.csie.ntu.edu.tw/). The page title is "The Comprehensive R Archive Network".

The main content area is titled "Download and Install R" and contains the following text:

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](#)

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

The next section is titled "Source Code for all Platforms" and contains the following text:

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 (Tuesday 2016-06-21, Bug in Your Hair) [R-3.3.1.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.
- Source code of older versions of R is [available here](#).
- Contributed extension [packages](#)

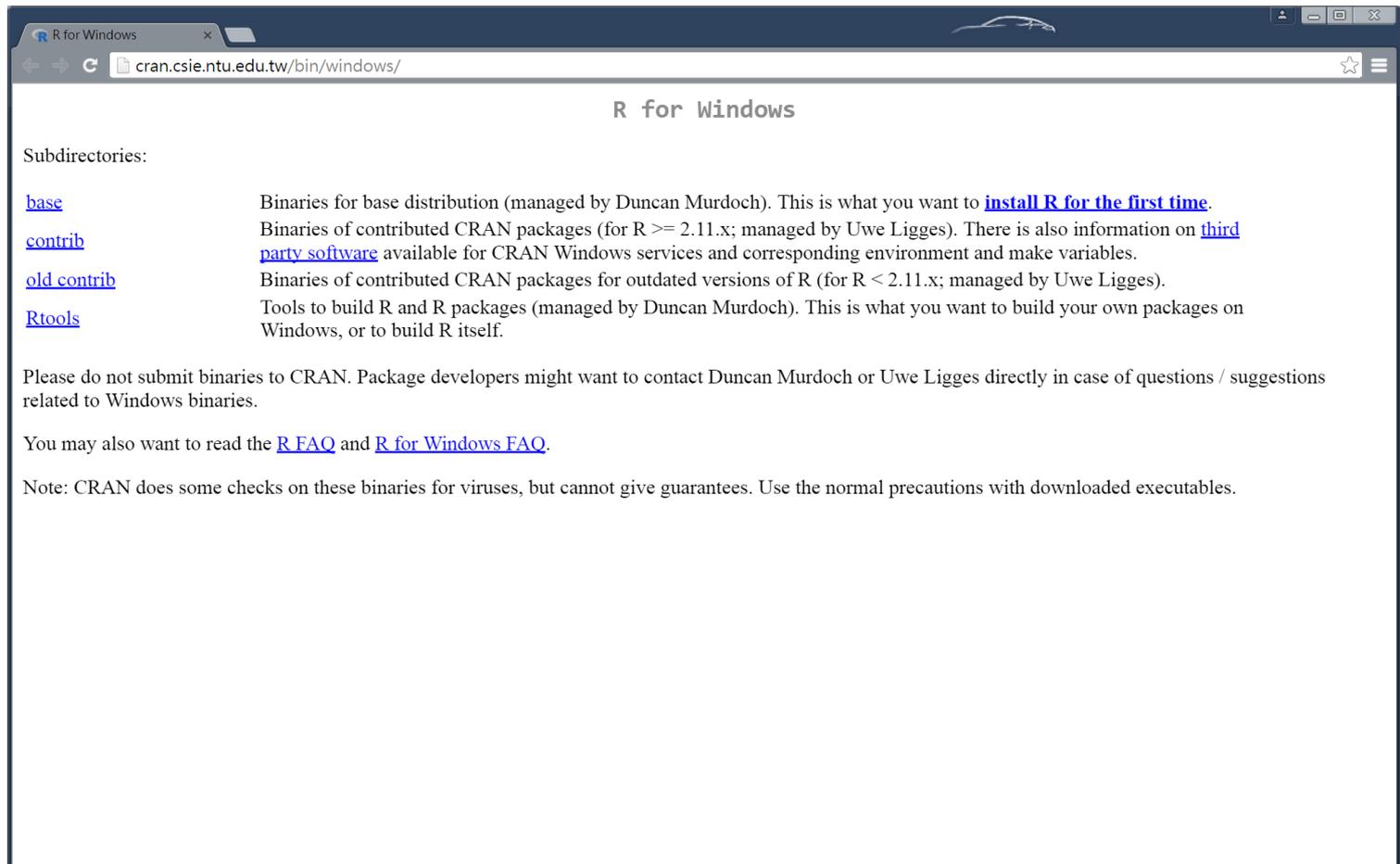
The left sidebar contains navigation links:

- 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](#)

The bottom of the page has a section titled "Questions About R".

## ■ R for Windows

- <http://cran.csie.ntu.edu.tw/bin/windows/>

A screenshot of a web browser window showing the 'R for Windows' website. The browser's address bar displays 'cran.csie.ntu.edu.tw/bin/windows/'. The page title is 'R for Windows'. Under the heading 'Subdirectories:', there are four links: 'base', 'contrib', 'old.contrib', and 'Rtools', each followed by a descriptive paragraph. The 'base' link points to binaries for the base distribution. The 'contrib' link points to binaries for contributed CRAN packages (R >= 2.11.x). The 'old.contrib' link points to binaries for outdated versions of R (R < 2.11.x). The 'Rtools' link points to tools for building R and R packages. Below the subdirectories, there is a paragraph advising not to submit binaries to CRAN and providing contact information for Duncan Murdoch or Uwe Ligges. Another paragraph suggests reading the 'R FAQ' and 'R for Windows FAQ'. A final note mentions that CRAN checks binaries for viruses but cannot guarantee safety.

R for Windows

Subdirectories:

[base](#) Binaries for base distribution (managed by Duncan Murdoch). This is what you want to [install R for the first time](#).

[contrib](#) Binaries of contributed CRAN packages (for R >= 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.

[old.contrib](#) Binaries of contributed CRAN packages for outdated versions of R (for R < 2.11.x; managed by Uwe Ligges).

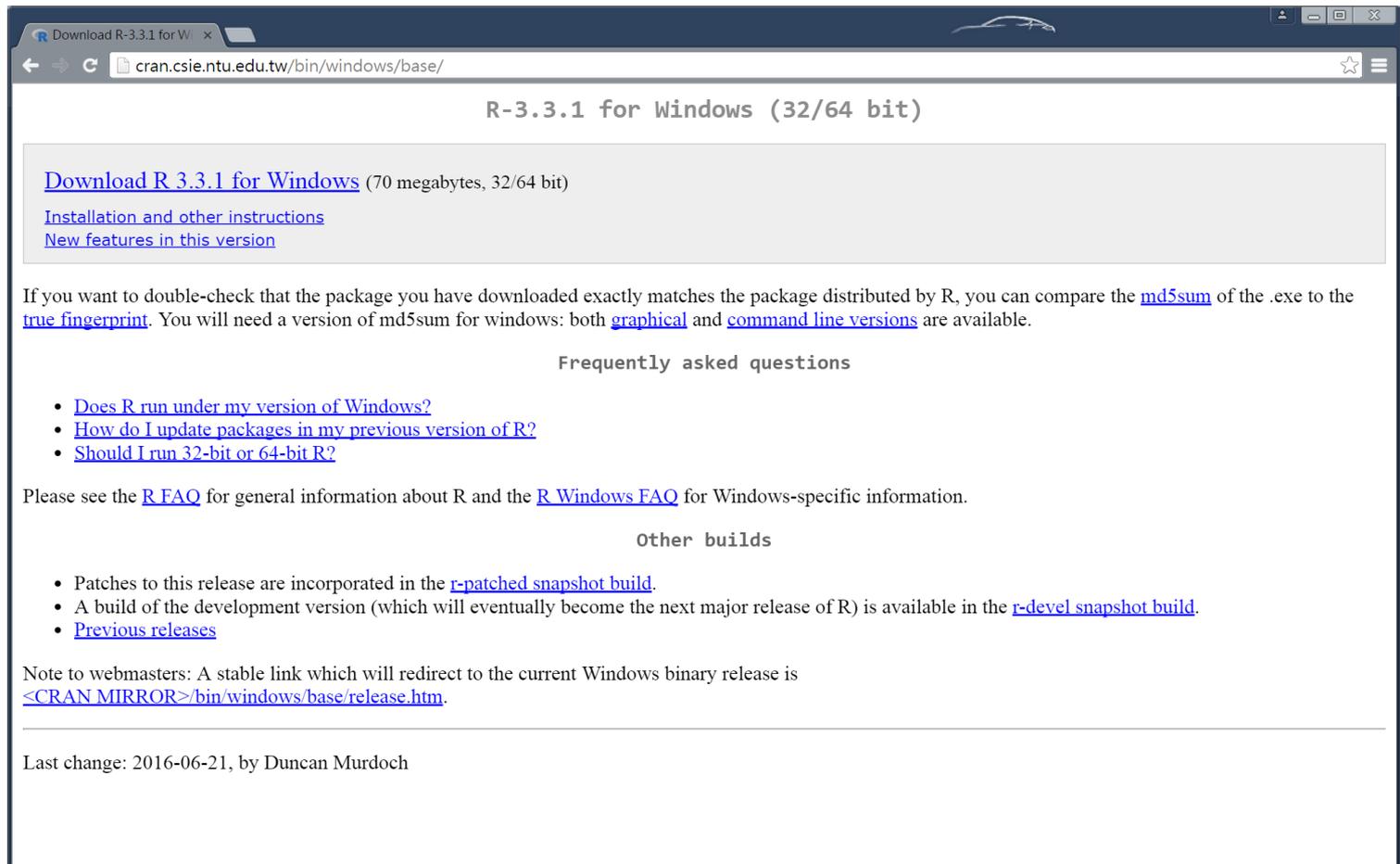
[Rtools](#) Tools to build R and R packages (managed by Duncan Murdoch). This is what you want to build your own packages on Windows, or to build R itself.

Please do not submit binaries to CRAN. Package developers might want to contact Duncan Murdoch or Uwe Ligges directly in case of questions / suggestions related to Windows binaries.

You may also want to read the [R FAQ](#) and [R for Windows FAQ](#).

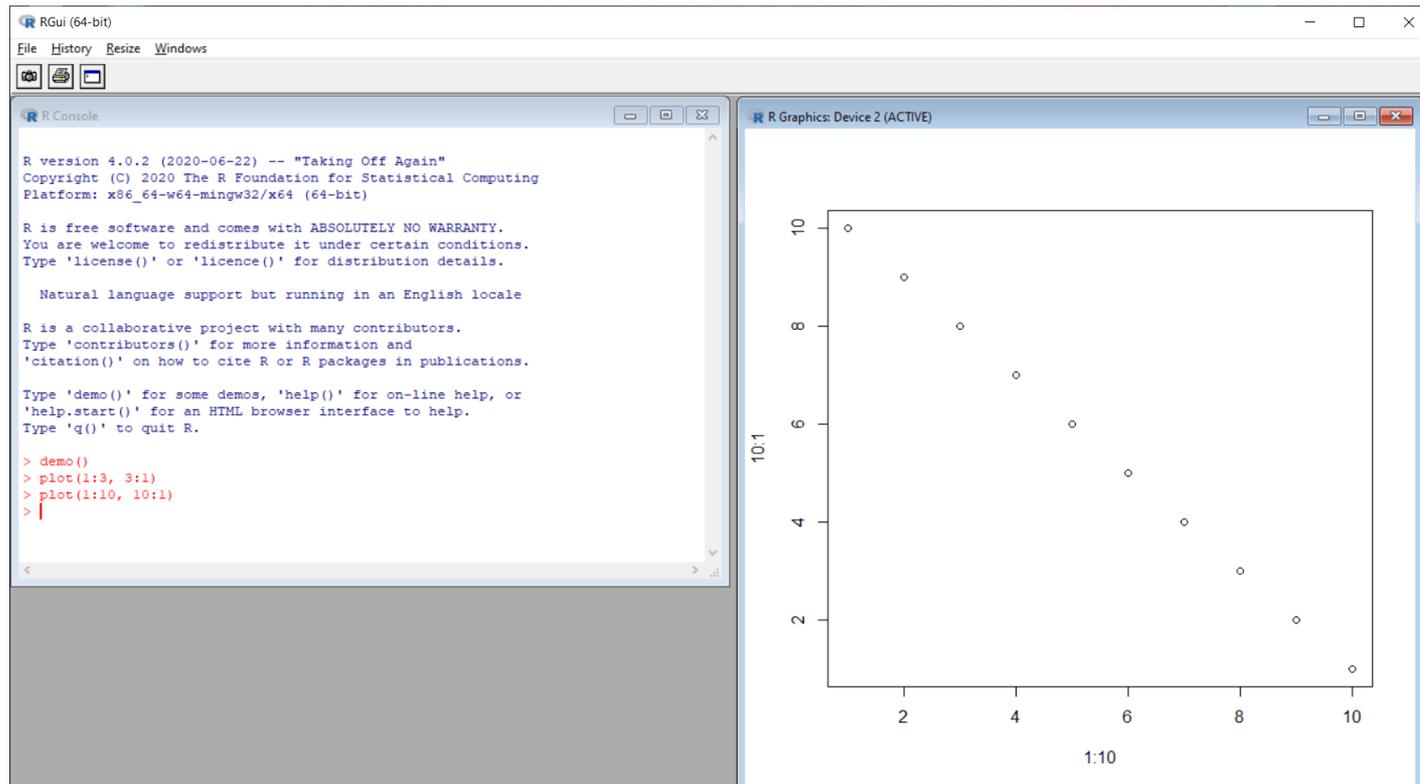
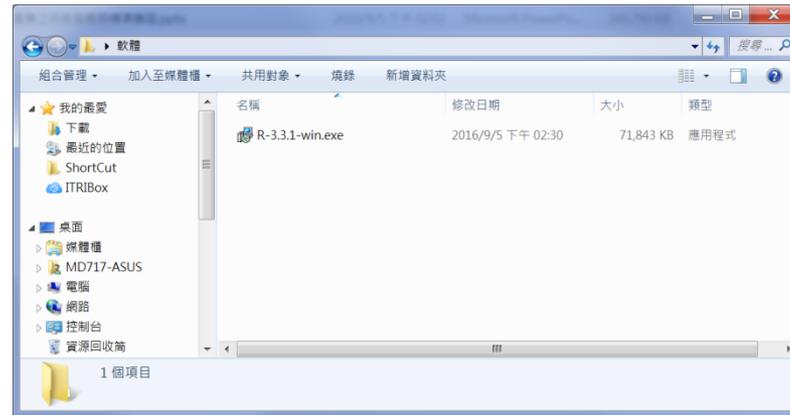
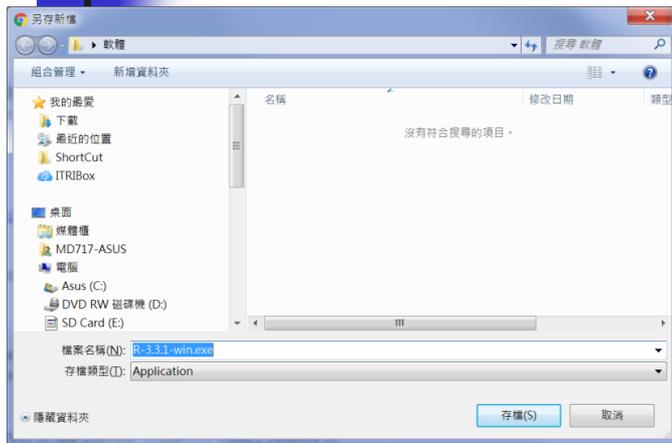
Note: CRAN does some checks on these binaries for viruses, but cannot give guarantees. Use the normal precautions with downloaded executables.

- R-4.0.2 for Windows (84 MB, 32/64 bit)
  - <http://cran.csie.ntu.edu.tw/bin/windows/base/>



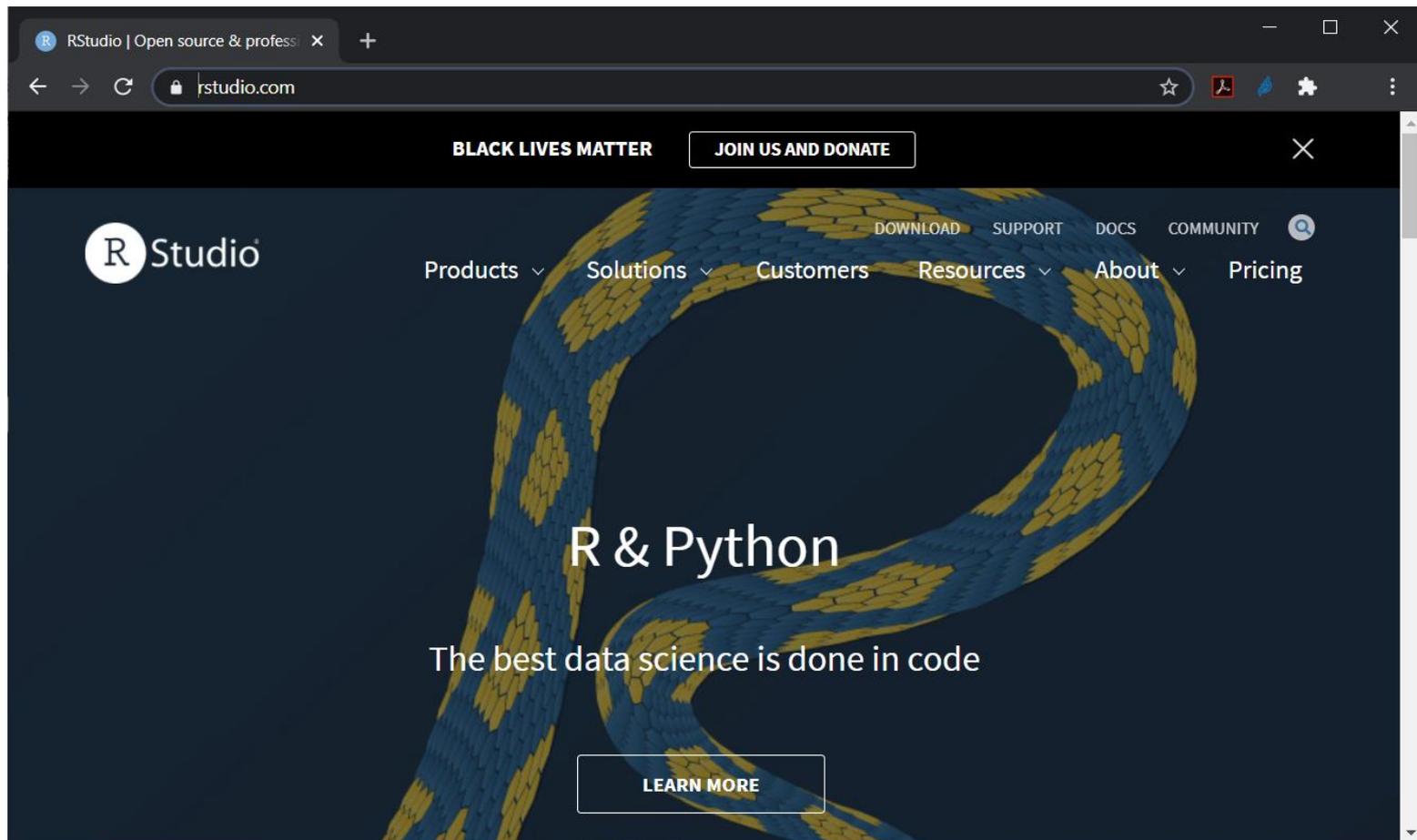
The screenshot shows a web browser window with the address bar containing [cran.csie.ntu.edu.tw/bin/windows/base/](http://cran.csie.ntu.edu.tw/bin/windows/base/). The page title is "R-3.3.1 for Windows (32/64 bit)". The main content includes a link to "Download R 3.3.1 for Windows (70 megabytes, 32/64 bit)", followed by links for "Installation and other instructions" and "New features in this version". A paragraph explains how to verify the download using md5sum, with links to "md5sum" and "true fingerprint". Below this is a section titled "Frequently asked questions" with three bullet points: "Does R run under my version of Windows?", "How do I update packages in my previous version of R?", and "Should I run 32-bit or 64-bit R?". Another paragraph refers to "R FAQ" and "R Windows FAQ". A section titled "Other builds" contains three bullet points: "Patches to this release are incorporated in the r-patched snapshot build.", "A build of the development version (which will eventually become the next major release of R) is available in the r-devel snapshot build.", and "Previous releases". A note to webmasters provides a stable link: <http://<CRAN MIRROR>/bin/windows/base/release.htm>. The footer states "Last change: 2016-06-21, by Duncan Murdoch".

# R 軟體安裝



## ■ RStudio

- <https://www.rstudio.com/>



## ■ RStudio download

- <https://rstudio.com/products/rstudio/download/>

	RStudio Desktop Open Source License	RStudio Desktop Commercial License	RStudio Server Open Source License	RStudio Server Pro Commercial License
	Free	\$995 /year	Free	\$4,975 /year (5 Named Users)
	<a href="#">DOWNLOAD</a>	<a href="#">BUY</a>	<a href="#">DOWNLOAD</a>	<a href="#">BUY</a>
	<a href="#">Learn more</a>	<a href="#">Learn more</a>	<a href="#">Learn more</a>	<a href="#">Evaluation   Learn more</a>
Integrated Tools for R	✓	✓	✓	✓
Priority Support		✓		✓
Access via Web Browser			✓	✓
Enterprise Security				✓
Project Sharing				✓
Manage Multiple R Sessions & Versions				✓
Admin Dashboard				✓
Load Balancing				✓
Auditing and Monitoring				✓
Data Connectivity				✓
Launcher				✓
Tutorial API				✓
License	AGPL	Commercial	AGPL	Commercial

## ■ RStudio download

- <https://rstudio.com/products/rstudio/download/#download>

RStudio Desktop 1.3.1093 - [Release Notes](#)

1. Install R. RStudio requires R 3.0.1+.
2. Download RStudio Desktop. Recommended for your system:



Requires Windows 10/8/7 (64-bit)



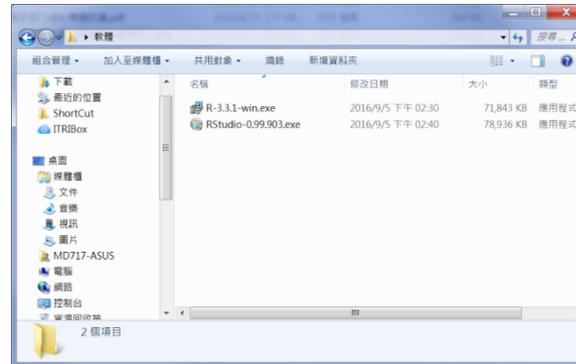
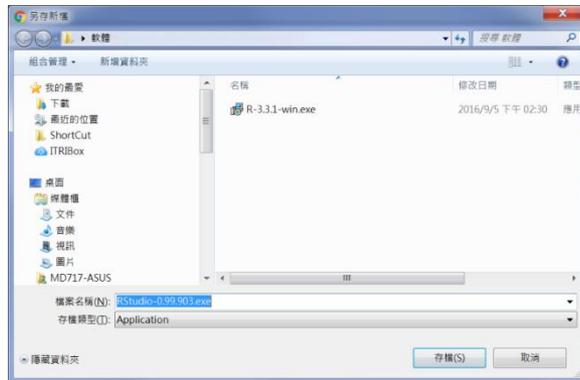
### All Installers

Linux users may need to [import RStudio's public code-signing key](#) prior to installation, depending on the operating system's security policy.

RStudio requires a 64-bit operating system. If you are on a 32 bit system, you can use an [older version of RStudio](#).

OS	Download	Size	SHA-256
Windows 10/8/7	<a href="#">RStudio-1.3.1093.exe</a>	171.62 MB	62b9e60a
macOS 10.13+	<a href="#">RStudio-1.3.1093.dmg</a>	148.66 MB	bd4d3a4
Ubuntu 16	<a href="#">rstudio-1.3.1093-amd64.deb</a>	124.33 MB	72f05048
Ubuntu 18/Debian 10	<a href="#">rstudio-1.3.1093-amd64.deb</a>	126.80 MB	ff222177
Fedora 19/Red Hat 7	<a href="#">rstudio-1.3.1093-x86_64.rpm</a>	146.96 MB	ed1f6ef8
Fedora 28/Red Hat 8	<a href="#">rstudio-1.3.1093-x86_64.rpm</a>	151.05 MB	01a978f3
Debian 9	<a href="#">rstudio-1.3.1093-amd64.deb</a>	127.00 MB	a747f9f9
SLES/OpenSUSE 12	<a href="#">rstudio-1.3.1093-x86_64.rpm</a>	119.43 MB	5016cbcf
OpenSUSE 15	<a href="#">rstudio-1.3.1093-x86_64.rpm</a>	128.40 MB	cf47e32d

# RStudio 軟體安裝



A screenshot of the RStudio interface. The console shows the R version 4.0.2 (2020-06-22) -- "Taking off Again" and the RStudio logo. The plot window shows a scatter plot of data points.

```
R version 4.0.2 (2020-06-22) -- "Taking off Again"
Copyright (C) 2020 The R Foundation for Statistical Computing
Platform: x86_64-w64-mingw32/x64 (64-bit)

R is free software and comes with ABSOLUTELY NO WARRANTY.
You are welcome to redistribute it under certain conditions.
Type 'license()' or 'licence()' for distribution details.

R is a collaborative project with many contributors.
Type 'contributors()' for more information and
'citation()' on how to cite R or R packages in publications.

Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

> plot(1:10,10:1)
>
```

x	y
1	10
2	9
3	8
4	7
5	6
6	5
7	4
8	3
9	2
10	1

# 使用軟體

# 程式軟體使用 - 工作目錄

- 建立一個工作目錄，存放檔案，  
例如：`H:/MyData`
- 開啟 RStudio：點選 RStudio 捷徑
- 設定工作目錄：

點選 **Session / Set Working Directory / Choose Directroy**

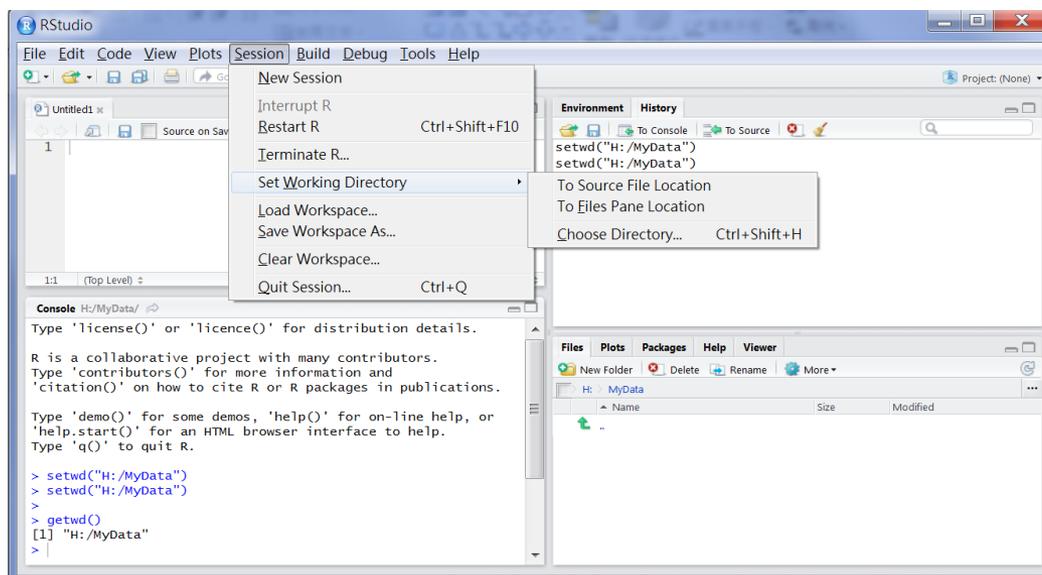
選取目錄：`H:/MyData/`

可以看到：`setwd("H:/MyData")`

- 或者直接輸入：  
`setwd("H:/MyData")`
- 檢查一下，輸入：  
`getwd()`
- 會看到：  
`[1] "H:/MyData"`

**注意：**

**目錄名稱，不要有中文字，  
包含：放在桌面，使用者等之下，  
可能都會有中文字目錄。  
建議在 D: or E: 等下面直接建目錄，  
例如：`D:/MyData, E:/DataR`**



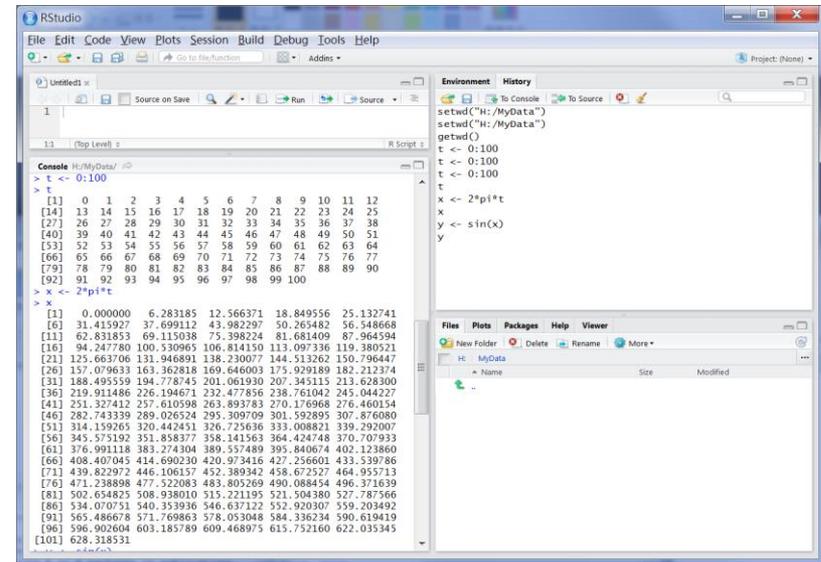
# 程式軟體使用 - 數據與繪圖

## ■ 建立一組數據，（數列）：

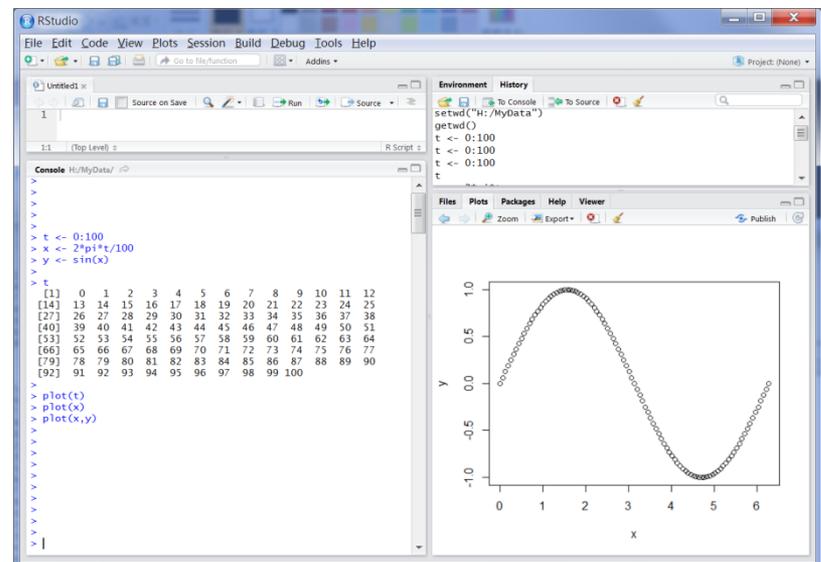
- `t <- 0:100`
- `x <- 2*pi*t/100`
- `y <- sin(x)`

## ■ 繪圖：

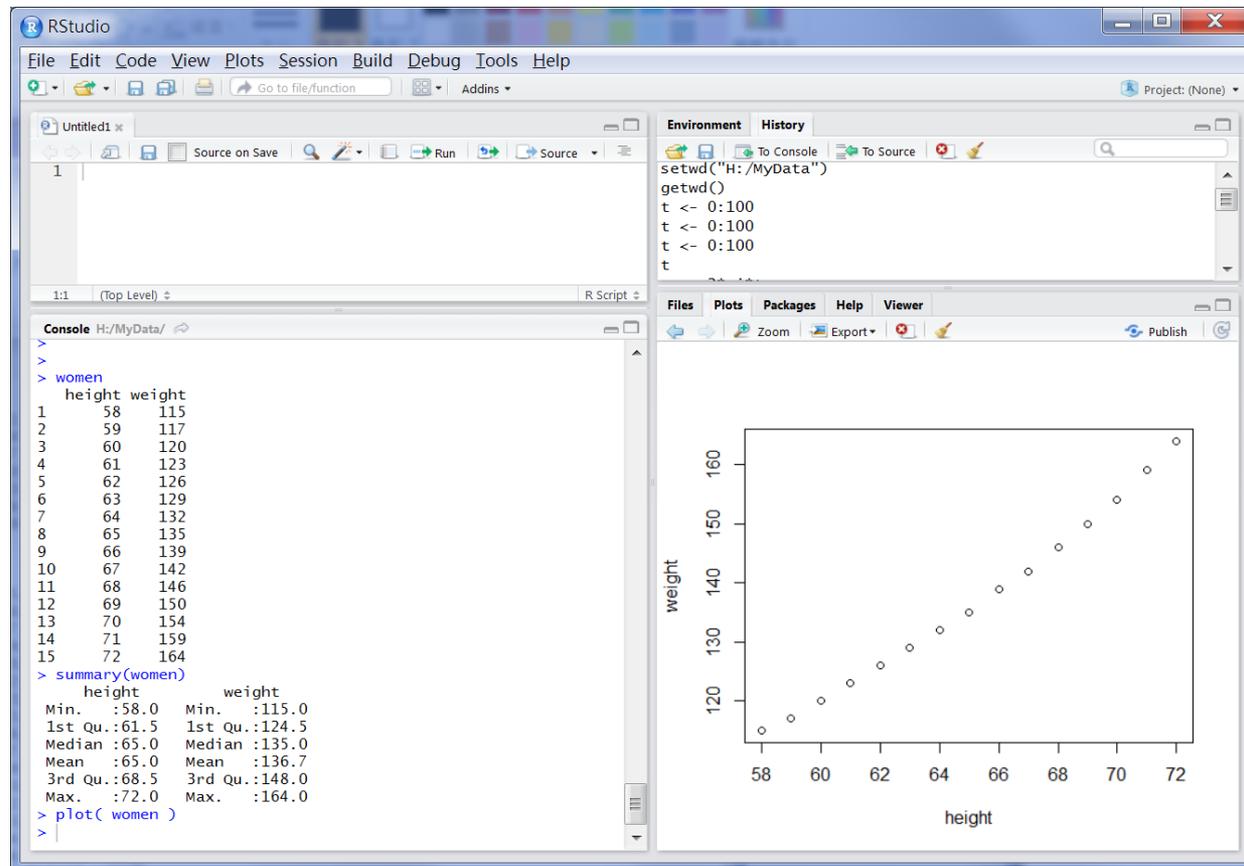
- `plot( t )`
- `plot( x, y )`
- `plot( title, label )`



```
File Edit Code View Plots Session Build Debug Tools Help
[1] 0 1 2 3 4 5 6 7 8 9 10 11 12
[14] 13 14 15 16 17 18 19 20 21 22 23 24 25
[27] 26 27 28 29 30 31 32 33 34 35 36 37 38
[40] 39 40 41 42 43 44 45 46 47 48 49 50 51
[53] 52 53 54 55 56 57 58 59 60 61 62 63 64
[66] 65 66 67 68 69 70 71 72 73 74 75 76 77
[79] 78 79 80 81 82 83 84 85 86 87 88 89 90
[92] 91 92 93 94 95 96 97 98 99 100
> x <- 2*pi*t
> x
[1] 0.000000 6.283185 12.566371 18.849556 25.132741
[6] 31.415927 37.699112 43.982297 50.265482 56.548668
[11] 62.831853 69.115038 75.398224 81.681409 87.964594
[16] 94.247780 100.530965 106.814150 113.097336 119.380521
[21] 125.663706 131.946891 138.230077 144.513262 150.796447
[26] 157.079633 163.362818 169.646003 175.929189 182.212374
[31] 188.495559 194.778745 201.061930 207.345115 213.628300
[36] 219.911486 226.194671 232.477856 238.761042 245.044227
[41] 251.327412 257.610598 263.893783 270.176968 276.460154
[46] 282.743339 289.026524 295.309709 301.592895 307.876080
[51] 314.159265 320.442451 326.725636 333.008821 339.292007
[56] 345.573192 351.856378 358.141563 364.424748 370.707933
[61] 376.991118 383.274304 389.557489 395.840674 402.123860
[66] 408.407045 414.690230 420.973416 427.256601 433.539786
[71] 439.822972 446.106157 452.389342 458.672527 464.955713
[76] 471.238898 477.522083 483.805269 490.088454 496.371639
[81] 502.654825 508.938010 515.221195 521.504380 527.787566
[86] 534.070751 540.353936 546.637122 552.920307 559.203492
[91] 565.486678 571.769863 578.053048 584.336234 590.619419
[96] 596.902604 603.185789 609.468975 615.752160 622.035345
[101] 628.318531
```



- 使用內建的資料庫：
  - women
  - summary( women )
  - plot( women )



# 程式軟體使用 - 儲存至檔案

- 儲存工作內容資料至檔案 \*.RData

- 點選 Session / Save Workspace As

輸入檔名： HW01\_B01921001\_Install (作業標號\_學號)

在工作目錄，可以看到： HW01\_B01921001\_Install.RData

- 儲存歷史指令資料至檔案 \*.Rhistory

- 點選右上視窗的 "History"
  - 點選 "磁碟片" 儲存歷史指令資料

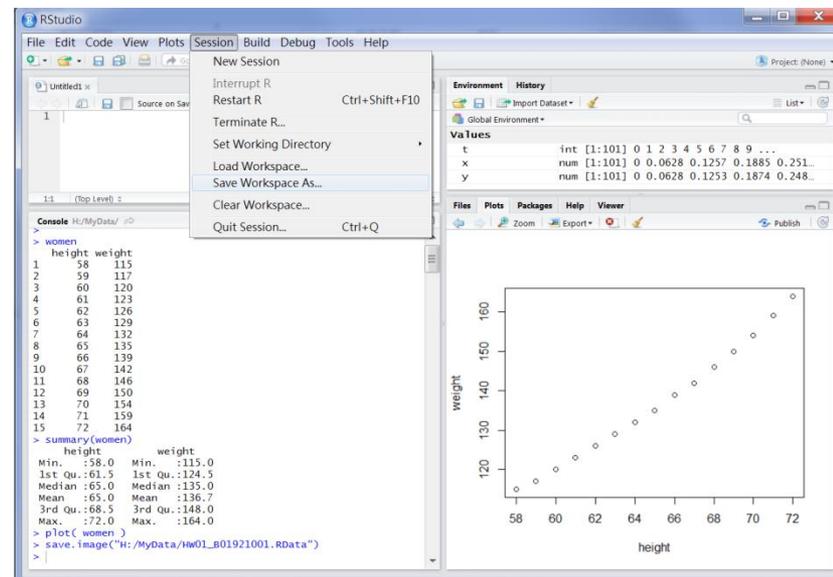
輸入檔名：

HW01\_B01921001\_Install

(作業標號\_學號)

- 在工作目錄，可以看到：

HW01\_B01921001\_Install.Rhistory



# 程式軟體使用 - 儲存至檔案

## ■ 儲存主要指令資料至檔案 \*.R

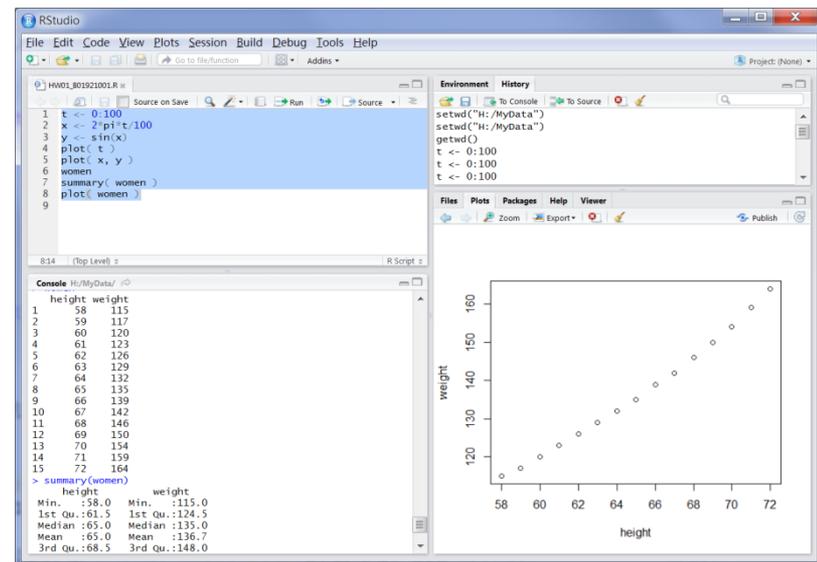
- 點選左上視窗，開啟一個空白的區間
- 輸入下面指令：

- `t <- 0:100`
- `x <- 2*pi*t/100`
- `y <- sin(x)`
- `plot( t )`
- `plot( x, y )`
- `women`
- `summary( women )`
- `plot( women )`

- 點選“磁碟片”儲存該指令資料

輸入檔名：`HW01_B01921001_Install` (作業標號\_學號)

在工作目錄，可以看到：`HW01_B01921001_Install.R`



# 程式軟體使用

- 設定路徑 setwd, getwd
- 開啟檔案
- 載入資料庫
- 數列 t <- 0:100; x <- 2\*pi\*t/100; y <- sin(x)
- 繪圖 plot( t ); plot( x, y );
- 開啟資料庫 women
- 資料庫內容 summary( women )
- 繪圖 plot( women )
- 儲存資料至檔案 \*.RData, \*.Rhistory, \*.R
- 編輯結果 \*.pptx 文字編輯，圖形複製，再轉成 \*.pdf

名稱	修改日期	類型	大小
 HW01_B01921001.pptx	2016/9/18 上午 11:50	Microsoft PowerPo...	135 KB
 HW01_B01921001.R	2016/9/18 上午 11:37	R 檔案	1 KB
 HW01_B01921001.RData	2016/9/18 上午 11:15	R Workspace	4 KB
 HW01_B01921001.Rhistory	2016/9/18 上午 11:18	RHISTORY 檔案	1 KB

# R Markdown

<https://rmarkdown.rstudio.com/>

The image shows two RStudio windows side-by-side, illustrating R Markdown output.

**Left Window: image-graphics.Rmd**

```
16
17 - ## Using Terrain Colors
18
19 - ```{r}
20 image(x, y, volcano, col=terrain.colors(100),axes=FALSE)
21 contour(x, y, volcano, levels=seq(90, 200, by=5), add=TRUE, col="brown")
22 axis(1, at=x.at)
23 axis(2, at=y.at)
24 box()
25 title(main="Maunga Whau Volcano", sub = "col=terrain.colors(100)", font.main=4)
26 ```
```

The plot shows a topographic map of Maunga Whau Volcano with contour lines and terrain shading. The x-axis is labeled 'x' and the y-axis is labeled 'y'. The title is "Maunga Whau Volcano".

**Right Window: nb-example.Rmd**

```
9
10 - # Notebook example
11 This is an R Markdown document. Markdown is a simple formatting syntax for authoring HTML, PDF, and MS Word
12 documents. For more details on using R Markdown see <http://rmarkdown.rstudio.com>.
13
14 When you click the Knit button a document will be generated that includes both content as well as the output of
15 any embedded R code chunks within the document. You can embed an R code chunk like this:
16
17 ```{r cars}
18 summary(cars)
19
20 speed      dist
21 Min.   : 4.0   Min.   : 2.00
22 1st Qu.:12.0  1st Qu.:26.00
23 Median :15.0  Median :36.00
24 Mean   :15.4   Mean   :42.98
25 3rd Qu.:19.0  3rd Qu.:56.00
26 Max.   :25.0   Max.   :120.00
27
28 - ## Including Plots
29 You can also embed plots, for example:
30
31 ```{r pressure, echo=FALSE}
32 library(ggplot2)
33 applot(Sepal.Length, Petal.Length, data = iris, color = Species, size = Petal.Width)
34 ```
```

The output shows the summary of the 'cars' dataset and a scatter plot of Sepal.Length vs Petal.Length from the iris dataset. The plot uses different colors and sizes for different species: setosa (red), versicolor (green), and virginica (blue).

**Console**

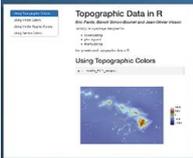
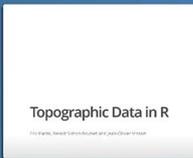
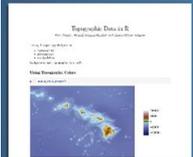
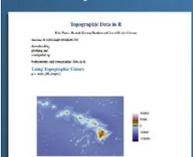
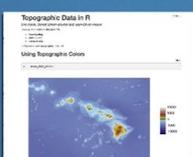
```
cluster "Finding Groups in Data": Cluster Analysis 2.0.4
Extended Rousseeuw et al.
codetools Code Analysis Tools for R 0.2-14
```

# R Markdown

<https://rmarkdown.rstudio.com/>



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<https://rmarkdown.rstudio.com/>

- 網站：`https://rmarkdown.rstudio.com/`
- 指令：`install.packages("rmarkdown")`
- 功能集：
  - <https://www.rstudio.com/wp-content/uploads/2016/03/rmarkdown-cheatsheet-2.0.pdf>
- 使用手冊：
  - <https://www.rstudio.com/wp-content/uploads/2015/03/rmarkdown-reference.pdf>
- 使用案例：
  - <https://rmarkdown.rstudio.com/gallery.html>