109-1: EE4052

通識課程： 計算機程式設計 之旅

Computer Programming

Unit 10: 繪圖功能與文字

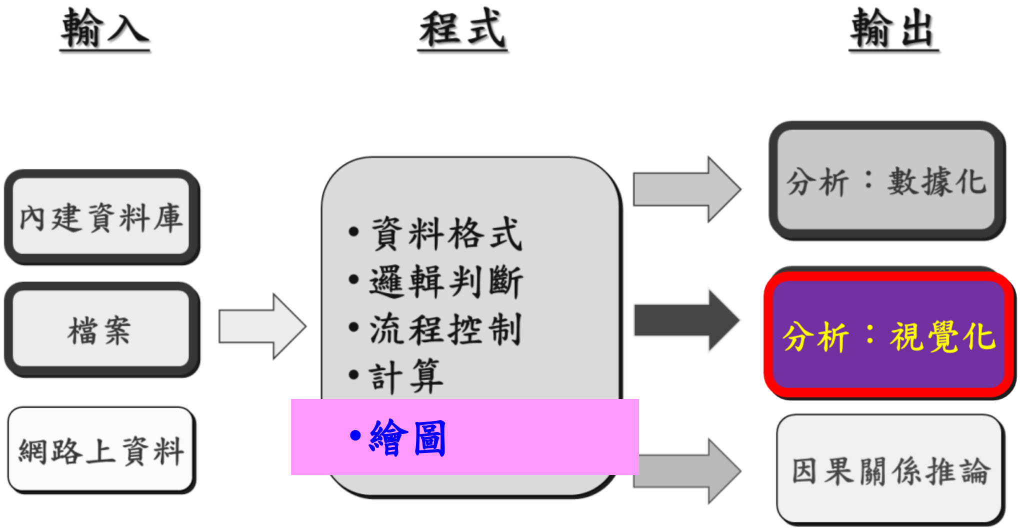
連 豐 力

臺 大 電 機 系

Sep 2020 - Jan 2021

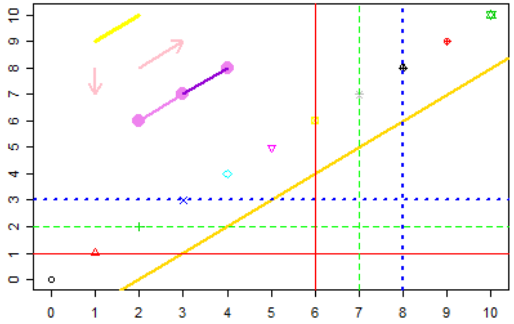
課程主題進度

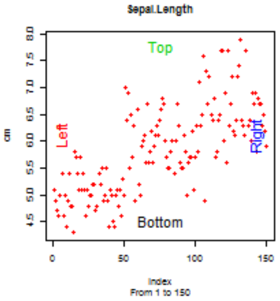
- **U01: 課程介紹：討論主題，作業，報告，進行方式**
- **U02: 主題，案例，程式，演算法，資源**
- **U03: 設定軟體 R 與 Rstudio**
- **U04: 數據處理與繪圖指令功能**
- **U05: 資料類別與基本運算**
- **U06: 邏輯判斷與流程控制**
- **U07: 函數：計算與排序**
- **U08: 多維度資料格式**
- **U09: 檔案資料輸入與輸出**
- **U10: 繪圖功能與文字**
- **U11: 多重繪圖與顏色**
- **U12: 影像與動畫**
- **U13: 資料間的相關性**
- **U14: 探索性資料分析**
- **U15: 資料連結分析**

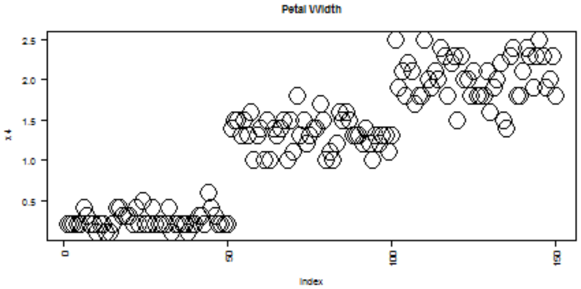


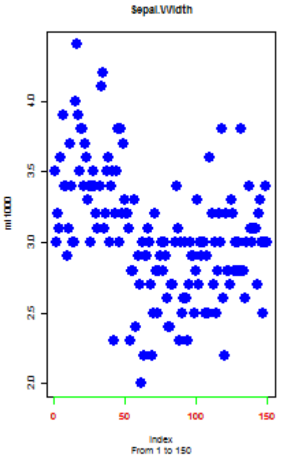
Unit 10: 繪圖功能與文字

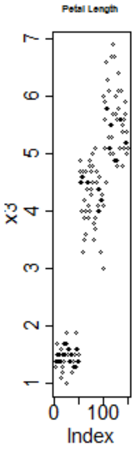
- 一張圖的長寬或大小，
  主標題，軸標題，字體等特性的設定
- 數據點的顏色要有變化
- 數據點的形式要有變化
- 數據加上不同註解

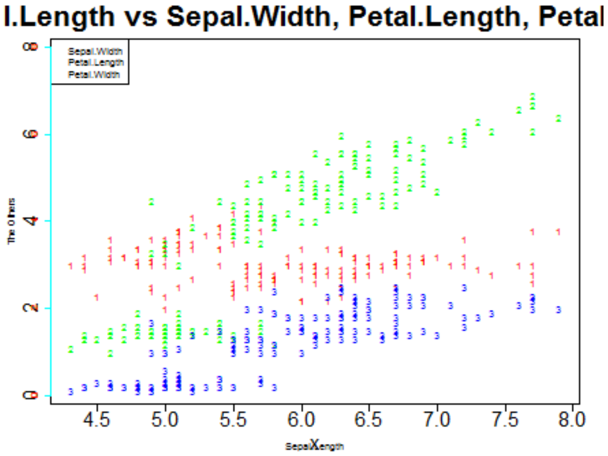












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- 繪圖視窗之設定
- 常用的圖形參數
- 座標軸及邊界
- 加入圖形元件
- 加入文字

Unit 10

- 多張圖形
- 多張圖形之位置安排
- 一張圖多筆數據
- 顏色

Unit 11

大綱

作業

HW08：繪圖功能與文字

On 11/25, 2020

- 請使用 iris 的第一組數據 (Sepal.Length)，繪製一張圖，符合下面的要求：
  - 邊界文字縮放比： mex = 0.8
  - 下左上右四個邊界之預留距離： mar = c(6, 6, 3, 3)
  - x 軸（橫）之範圍：(-10, 160)
  - y 軸（縱）之範圍：(4, 8)
  - x 軸（橫）之名稱：Plant ID
  - y 軸（縱）之名稱：Length of Sepal
  - 整個圖形的之主標題：IRIS Data
  - 繪製顏色：blue
  - 點的型式：2 號，三角形
  - 文字及符號相對於內定值之縮放比：cex = 2
  - 在下面座標軸 (side=1)，座標線為綠色，座標數字為紅色
  - 在左上角加上標記：Plant ID vs Sepal.Length
  - 在 (120, 4) 的地方，放入文字：Plot the IRIS data, Sepal.Length
  - 在 (120, 4.5) 的地方，放入數學符號：y = x^2 + 5

On 11/25, 2020

HW08：繪圖功能與文字

- 繳交下面檔案，檔案名稱：HW08_學號_關鍵字.xxx
- 您可以繳交下面格式之中的任何一種格式的檔案：
  - 程式檔： HW08_B01921001_PlotFigure.R
  - 程式與結果檔： HW08_B01921001_PlotFigure.Rmd
    - 或轉成： HW08_B01921001_PlotFigure.html
  - 報告檔案： HW08_B01921001_PlotFigure.pdf

- 繳交方式與期限：
  - 上傳檔案到：https://cool.ntu.edu.tw
  - 繳交期限：11/30 (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

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繪圖視窗之設定

繪圖視窗

- plot( )
- windows( )
- curve( )

```
windows( width, height, pointsize, record, rescale, xpinch, ypinch,
        bg, canvas, gamma, xpos, ypos, buffered, title,
        restoreConsole, clickToConfirm, fillOddEven,
        family, antialias )

plot( x, y, ... )

curve( expr, from = NULL, to = NULL, n = 101, add = FALSE,
      type = "l", xname = "x", xlab = xname, ylab = NULL,
      log = NULL, xlim = NULL, ... )
```

繪圖視窗

- # in Mac OS
- quartz( )

  quartz(title, width, height, pointsize, family, antialias, type, file = NULL, bg, canvas, dpi)

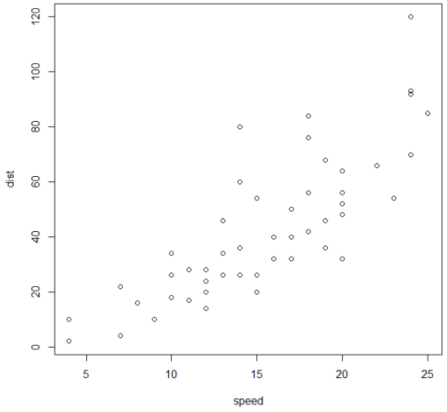
- windows(.)   -->   quartz(.)
- win.graph(.)   -->   dev.new(.)

- # in UNIX
- X11( )

  X11(width, height, pointsize, bg, gamma, xpos, ypos, title)

繪圖視窗

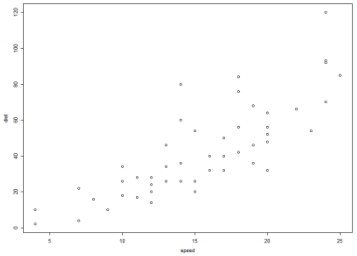
- data(cars)
- summary(cars)
- cars
- head(cars)
- tail(cars)
- str(cars)
- plot (cars)



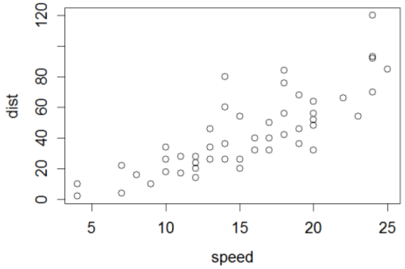
繪圖視窗之設定

- windows(width = 4.5, height = 3.3, pointsize = 8)

  # pointsize: 文字或符號字體大小



- windows(width = 8, height = 6, pointsize = 20)



- old.par <- par(mex = 0.8, mar = c(5, 5, 4, 2) + 0.1)

  # mex: 邊界文字的縮放比

  # mar: 下 左 上 右 四個邊界之預留距離

  # 下: side=1, 左: side=2, 上: side=3, 右: side=4

- plot (cars)

- par(old.par) # reset to previous settings

繪圖視窗之設定

- windows(width = 4.5, height = 3.3, pointsize = 8)
- old.par <- par(mex = 0.8, mar = c(5, 5, 4, 2) + 0.1)
- plot (cars)
- par(old.par)   # reset to previous settings

- win.graph(width = 4.5, height = 3.3, pointsize = 8)
- old.par <- par(mex = 0.8, mar = c(5, 5, 4, 2) + 0.1)
- plot(cars)
- par(old.par)   # reset to previous settings

繪圖視窗之設定

- windows(width, height, pointsize, record, rescale, xpinch, ypinch,
  bg, canvas, gamma, xpos, ypos, buffered, title,
  restoreConsole, clickToConfirm, fillOddEven,
  family, antialias)
- win.graph(width, height, pointsize)
- x11(width, height, pointsize, bg, gamma, xpos, ypos, title)
- X11(width, height, pointsize, bg, gamma, xpos, ypos, title)
- win.metafile(filename = "", width = 7, height = 7, pointsize = 12,
  family, restoreConsole = TRUE)
- win.print(width = 7, height = 7, pointsize = 12, printer = "",
  family, antialias, restoreConsole = TRUE)

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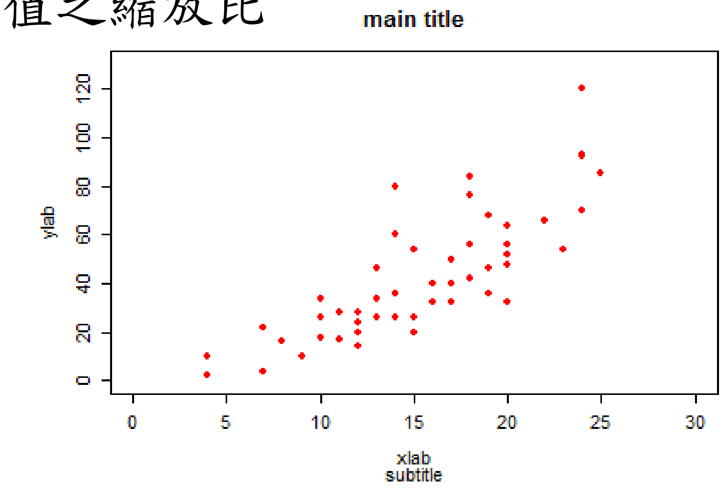
常用的圖形參數

圖形參數

- xlim: # x 軸（橫）之範圍; xlim[1]: 左邊界，xlim[2]: 右邊界
- ylim: # y 軸（縱）之範圍; ylim[1]: 下邊界，ylim[2]: 上邊界
- xlab: # x 軸（橫）之名稱，出現在橫軸下方
- ylab: # y 軸（縱）之名稱，出現在橫軸左方
- main: # 整個圖形的之主標題，出現在圖形的上方
- sub: # 副標題，出現在橫軸下方
- cex: # 文字及符號相對於內定值之縮放比
- pch: # 點的型式
- col: # 繪圖的顏色

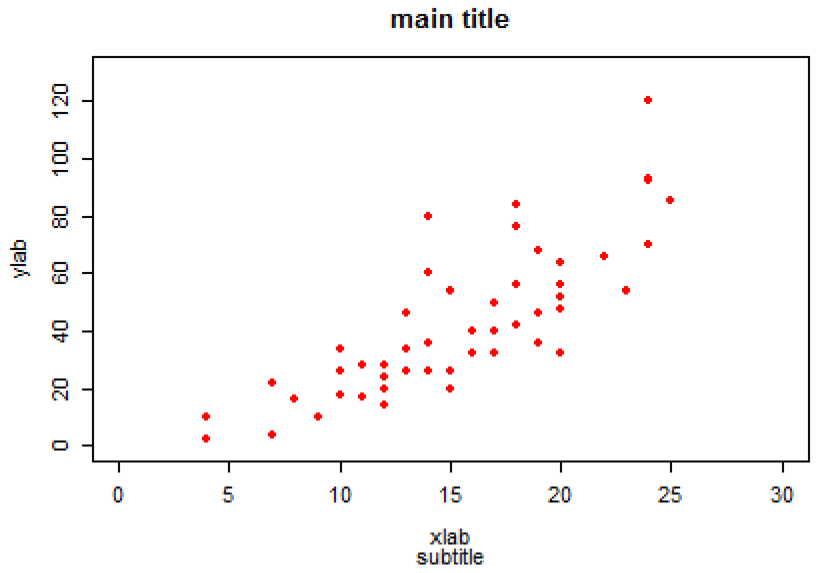


圖形參數

- windows(width = 4.5, height = 3.3, pointsize = 8)

- old.par <- par(mex = 0.8, mar = c(7, 5, 4, 2) + 0.1)

- plot(cars, xlim = c(0, 30), ylim = c(0, 130), xlab = "xlab", ylab = "ylab", main = "main title", sub = "subtitle", cex = 0.8, pch = 16, col = "red")



- par(old.par)

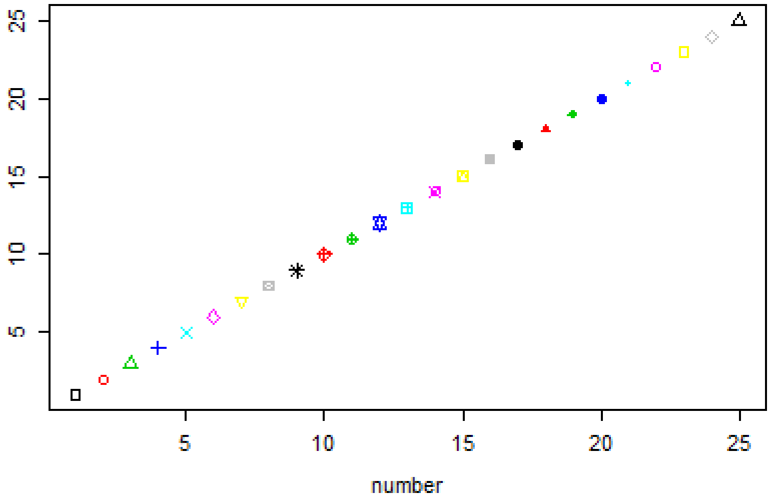
  # reset to previous settings

Graphical Parameters
http://www.statmethods.net/advgraphs/parameters.html
R Graphical Parameters Cheat Sheet
http://gastonsanchez.com/visually-enforced/resources/2015/09/22/R-cheat-sheet-graphical-parameters/

圖形參數

- windows(width = 4.5, height = 3.3, pointsize = 8)
- old.par <- par(mex = 0.8, mar = c(5, 5, 4, 2) + 0.1)
- plot(1:25, pch = 0:25, col = 1:8, xlab = "number", ylab = "")
- par(old.par)

  # reset to previous settings



Graphical Parameters
http://www.statmethods.net/advgraphs/parameters.html
R Graphical Parameters Cheat Sheet
http://gastonsanchez.com/visually-enforced/resources/2015/09/22/R-cheat-sheet-graphical-parameters/

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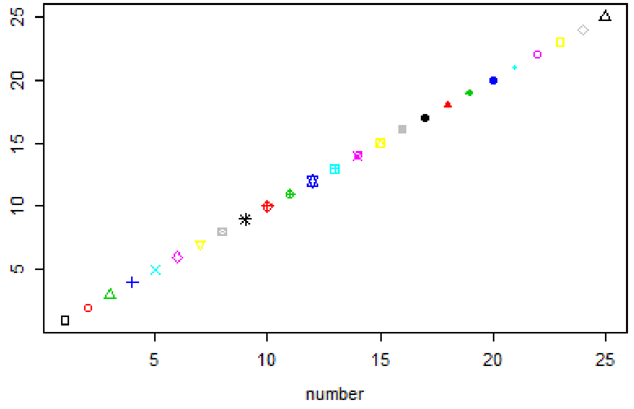
座標軸及邊界

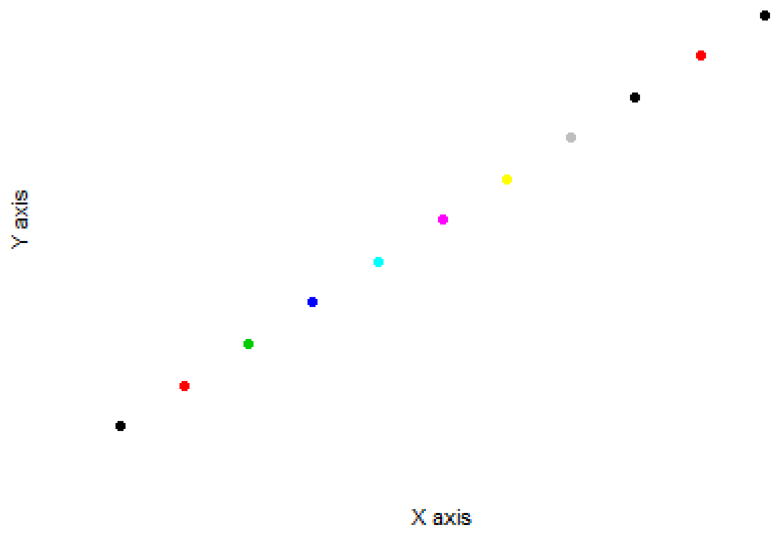
座標軸及邊界參數

- axis: # 設定座標軸之函數
- axes: # axes = TRUE : 要畫座標軸; axes = FALSE : 不要畫座標軸
- xaxt: # xaxt = “n” : 不要畫 x 軸
- yaxt: # yaxt = “n” : 不要畫 y 軸
- col.axis: # 座標軸之文字顏色
- side: # 繪圖區域邊界的編號
- mex: # 邊界文字之縮放比
- mar: # 下 左 上 右 四個邊界之預留距離



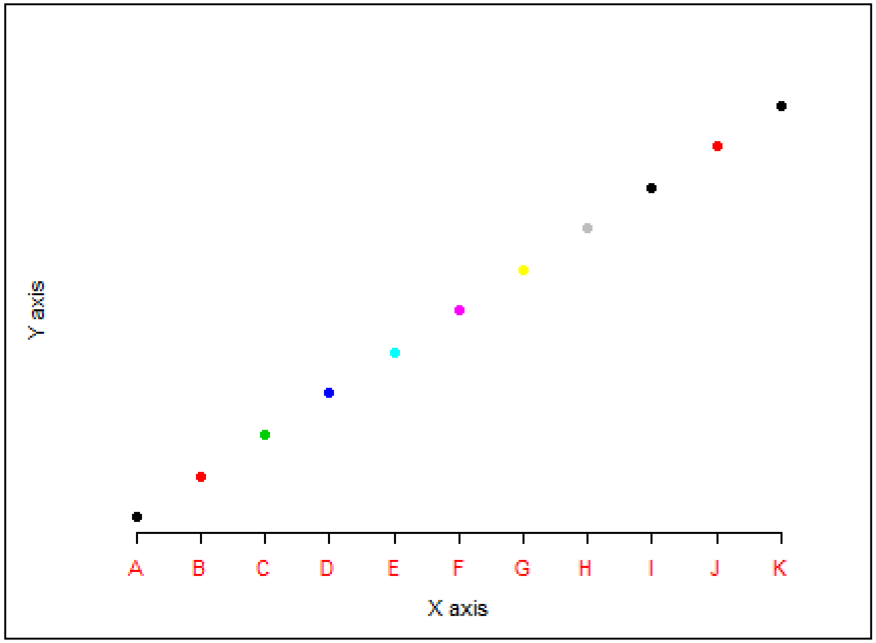
座標軸及邊界參數

- windows(width = 4.5, height = 3.3, pointsize = 8)
- old.par <- par(mex = 0.8, mar = c(5, 5, 4, 3) + 0.1)
- plot(0:10, 0:10, col = 1:10, pch = 16, xlab = "X axis", ylab = "Y axis", axes = FALSE)



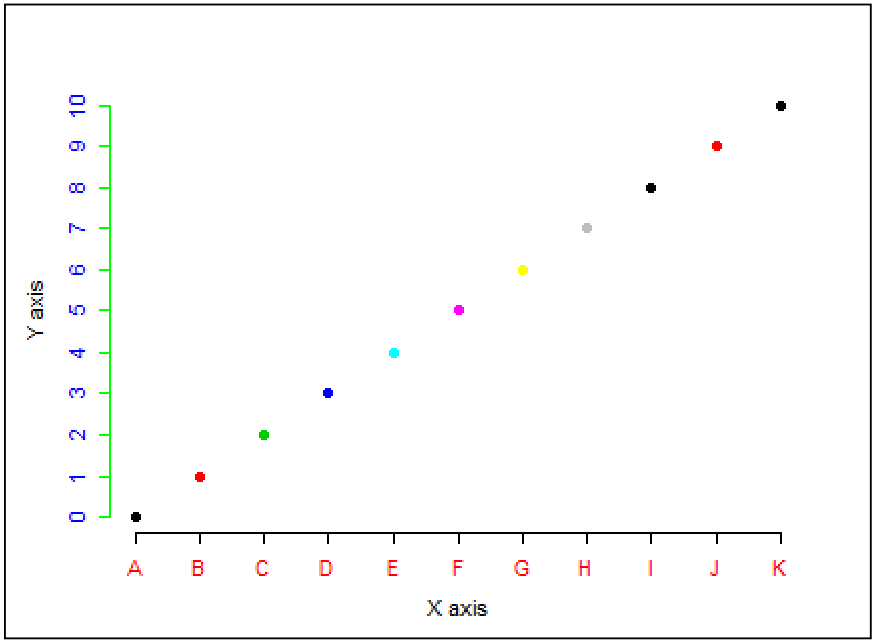
座標軸及邊界參數

- plot(0:10, 0:10, col = 1:10, pch = 16, xlab = "X axis", ylab = "Y axis", axes = FALSE)
- axis(side = 1, col = "black", col.axis = "red", at = 0:10, label = LETTERS[1:11])



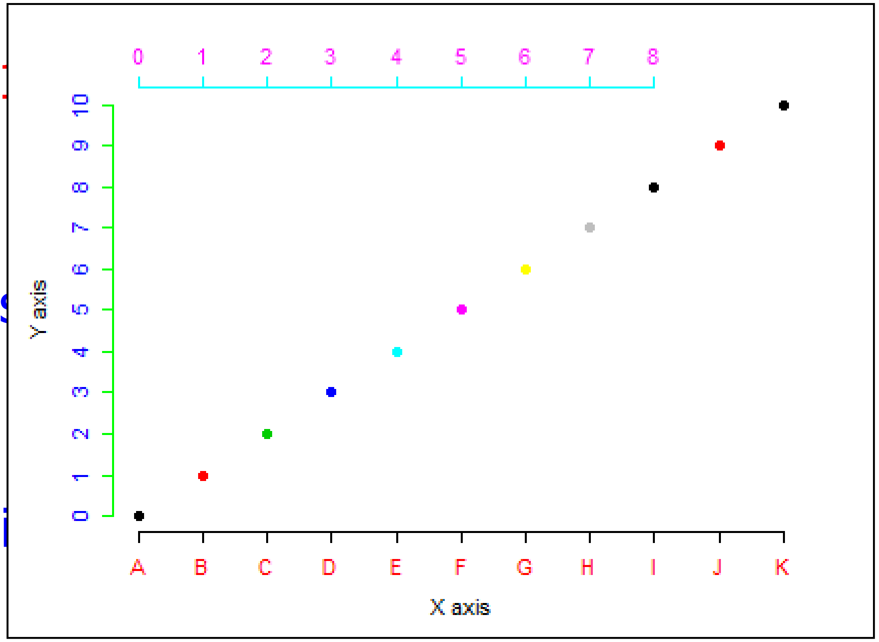
座標軸及邊界參數

- plot(0:10, 0:10, col = 1:10, pch = 16, xlab = "X axis", ylab = "Y axis", axes = FALSE)
- axis(side = 1, col = "black", col.axis = "red", at = 0:10, label = LETTERS[1:11])
- axis(side = 2, col = "green", col.axis = "blue", at = seq(from = 0, to = 10, by = 1))

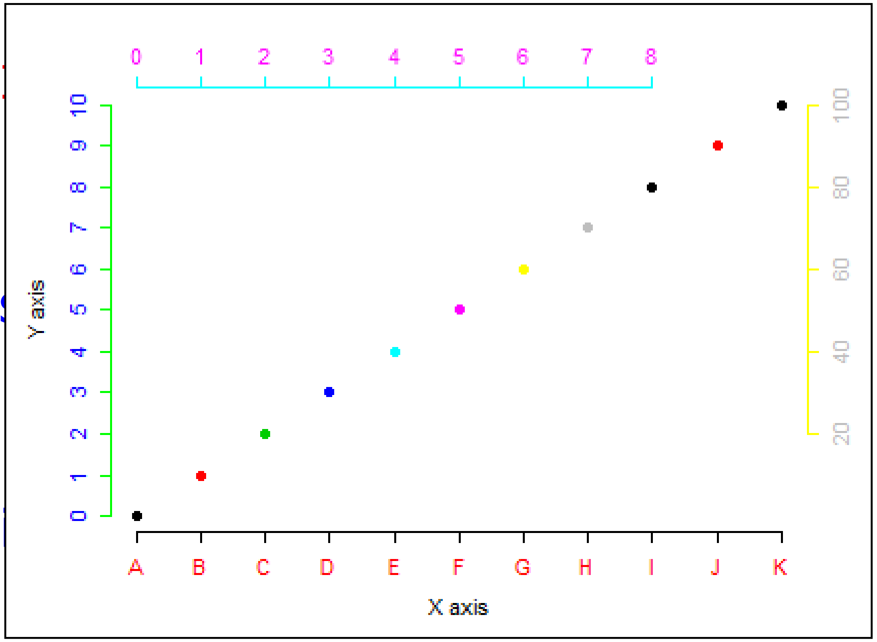


座標軸及邊界參數

- plot(0:10, 0:10, col = 1:10, pch =
  axes = FALSE)
- axis(side = 1, col = "black", col.axis
  LETTERS[1:11])
- axis(side = 2, col = "green", col.axi
  10, by = 1))
- axis(side = 3, col = "cyan", col.axis = "magenta", at = seq(from = 0, to = 8, by = 1))



座標軸及邊界參數



- plot(0:10, 0:10, col = 1:10, pch =
  axes = FALSE)
- axis(side = 1, col = "black", col.axis
  LETTERS[1:11])
- axis(side = 2, col = "green", col.ax
  10, by = 1))
- axis(side = 3, col = "cyan", col.axis = "magenta", at = seq(from = 0, to = 8, by = 1))
- axis(side = 4, col = "yellow", col.axis = "gray", at = seq(from = 2, to = 10, by = 2), label = c(20, 40, 60, 80, 100))
- par(old.par)

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加入圖形元件

加入圖形元件 – 點 線 框

points( )	# 打點
lines( )	# 畫線
abline( )	# 畫 y = b x + a 的直線
segments( )	# 畫線段
arrows( )	# 畫箭頭
box( )	# 在原圖形最外圍加上框框
lty	# 直線的樣式
lwd	# 直線的寬度

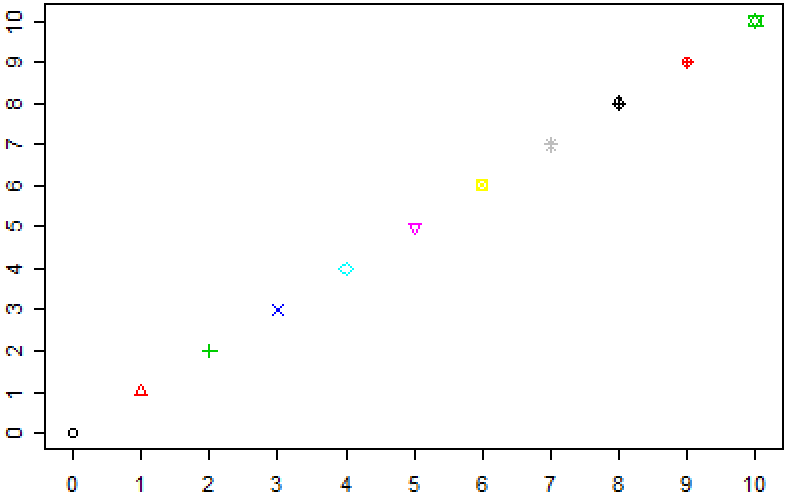
加入圖形元件 – 點 線 框

- x <- c(2, 3, 4)
- y <- c(6, 7, 8)

- windows(width = 4.5, height = 3.3, pointsize = 8)
- old.par <- par(mex = 0.8, mar = c(5, 4, 4, 2) + 0.1)

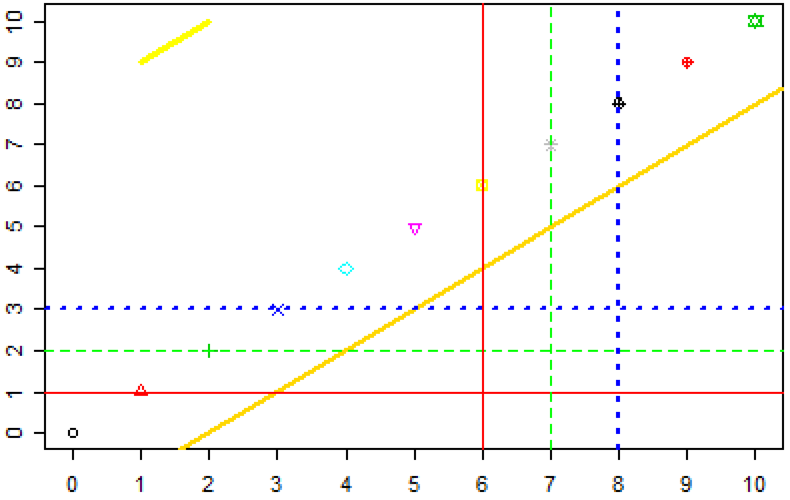
- plot(0:10, 0:10, xlab = "", ylab = "", pch = 1:11, col = 1:8, axes = FALSE)

- axis(side = 1, at = 0:10)
- axis(side = 2, at = 0:10)
- box()



加入圖形元件 – 點 線 框

- lines(c(1, 2), c(9, 10), col = "yellow", lwd = 3)
- abline(a = -2, b = 1, col = "gold", lwd = 2)
- # horizontal line
- abline(h = 1:3, lty = 1:3, lwd = c(1.0, 1.5, 2.0), col = c("red", "green", "blue"))
- # vertical lines
- abline(v = 6:8, lty = 1:3, lwd = c(1.0, 1.5, 2.0), col = c("red", "green", "blue"))



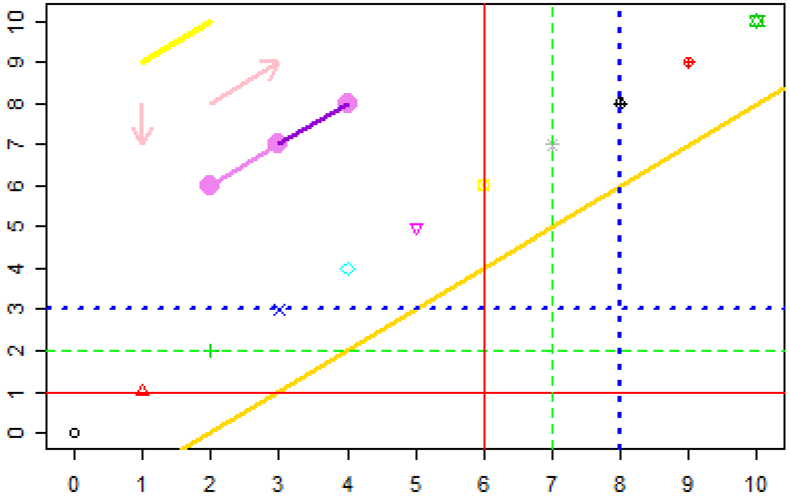
加入圖形元件 – 點 線 框

- points(x, y, col = "violet", pch = 16, cex = 2)

- segments(x[1], y[1], x[2], y[2], col = "violet", lwd = 2)
- segments(x[2], y[2], x[3], y[3], col = "dark violet", lwd = 2)

- arrows(1, 7, 1, 8, code = 1, length = 0.1, col = "pink", lwd = 2)
- arrows(2, 8, 3, 9, code = 2, length = 0.1, col = "pink", lwd = 2)

- par(old.par)



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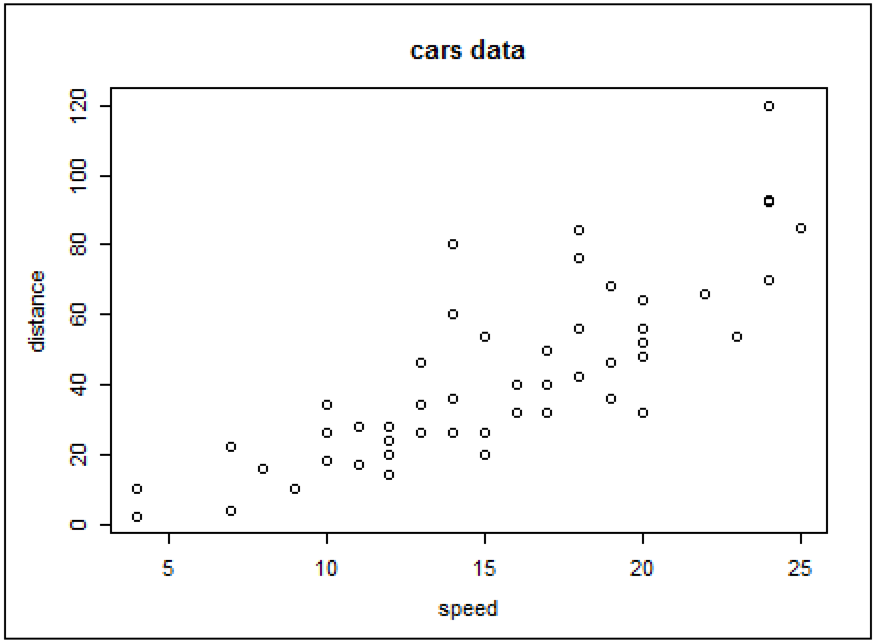
加入文字

加入文字

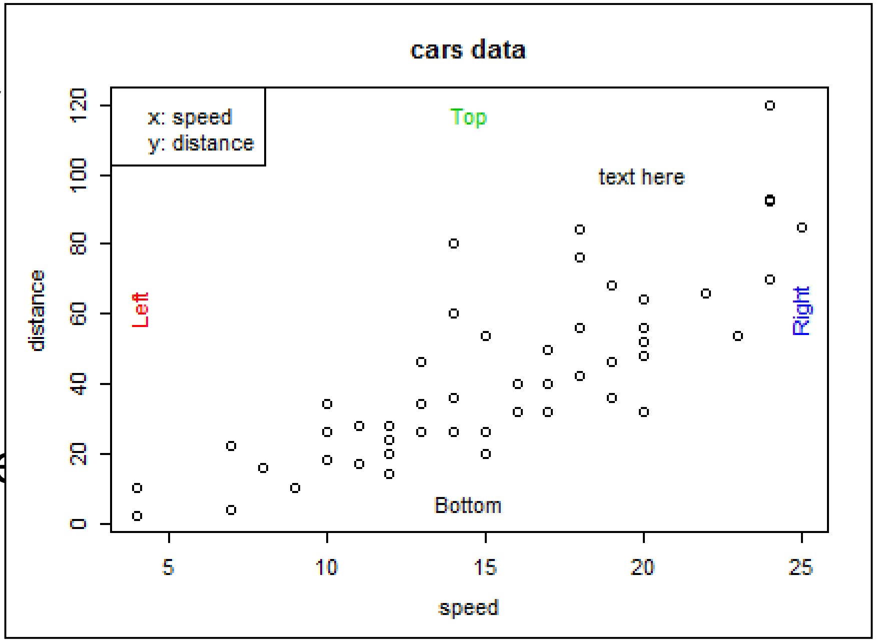
- text: # 加入文字
- title: # 加入註解
- legend: # 加入圖標，圖例，備註
- mtext: # 在邊界加入文字

加入文字

- `windows( width = 4.5, height = 3.3, pointsize = 8 )`
- `old.par <- par( mex = 0.8, mar = c(5, 5, 4, 2) + 0.1 )`
- `plot( cars, xlab = "", ylab = "" )`
- `title( main = "cars data", xlab = "speed", ylab = "distance" )`



加入文字



- windows(width = 4.5, height = 3.3,
- old.par <- par(mex = 0.8, mar = c(
- plot(cars, xlab = "", ylab = "")
- title(main = "cars data", xlab = "spe
- text(20, 100, label = "text here")
- legend("topleft", legend = c("x: speed", "y: distance"))
- mtext(text = c("Bottom", "Left", "Top", "Right"), side = 1:4, col = 1:4, line = -2)

# line = -2: 往內移動兩個線寬度

- par(old.par)

加入文字

- legend 位置：

topleft,	top,	topright
left,	center,	right
bottomleft,	bottom,	bottomright

加入文字 – 用滑鼠

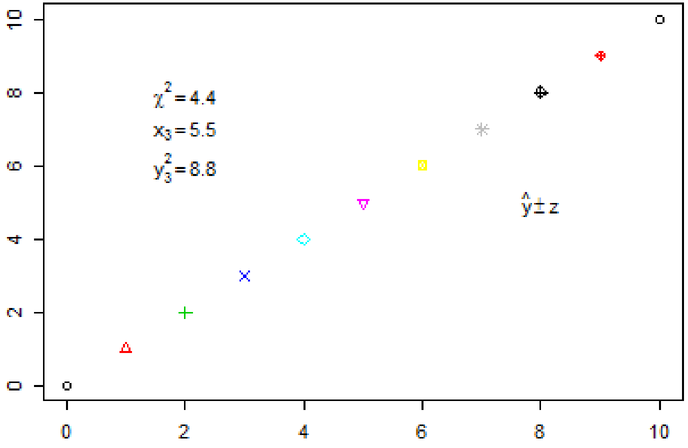
- windows(width = 4.5, height = 3.3, pointsize = 8)
- old.par <- par(mex = 0.8, mar = c(5, 5, 4, 2) + 0.1)
- plot(cars, xlab = "", ylab = "")
- title(main = "cars data", xlab = "speed", ylab = "distance")
- text(20, 100, label = "text here")
- legend(locator(1), legend = c("x: speed", "y: distance"))
- mtext(text = c("Bottom", "Left", "Top", "Right"), side = 1:4, col = 1:4, line = -2)
- par(old.par)

加入數學符號

```
windows( width = 4.5, height = 3.3, pointsize = 8 )

old.par <- par( mex = 0.8, mar = c(5, 5, 4, 2) + 0.1 )

plot(0:10, 0:10, xlab = "", ylab = "", pch = 1:10, col = 1:10)
text( 2, 8, label = expression( chi^2 == "4.4" ) )
text( 2, 7, label = expression( x[3] == "5.5" ) )
text( 2, 6, label = expression( y[3]^2 == "8.8" ) )
text( 8, 5, label = expression( hat(y) %+-% z ) )
```

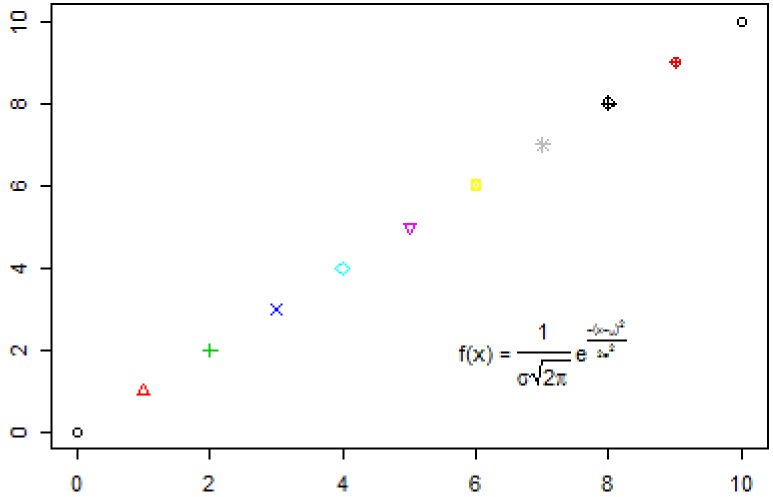


加入數學符號

- label.eq <- expression(paste("f(x) = ", frac(1, sigma*sqrt(2 * pi)), " ", e^{frac(-(x - mu)^2, 2*sigma^2)}))

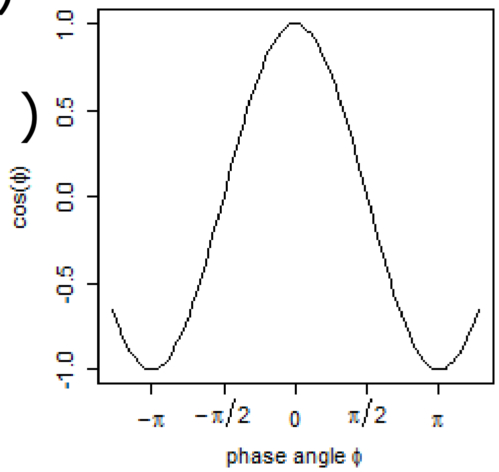
- text(7, 2, label = label.eq)

- par(old.par)



加入數學符號

- x <- seq(from = -4, to = 4, length = 101)
- win.graph(width = 2.8, height = 2.8, pointsize = 8)
- old.par <- par(mex = 0.8, mar = c(5, 5, 3, 2) + 0.1)
- xlab <- expression(paste("phase angle ", phi))
- ylab <- expression(paste("cos(", phi, ")"))
- plot(x, cos(x), type = "l", xaxt = "n", xlab = xlab, ylab = ylab)
- label <- expression(-pi, -pi / 2, 0, pi / 2, pi)
- axis(side = 1, at = c(-pi, -pi / 2, 0, pi / 2, pi), label = label)
- par(old.par)



數學符號 expression( )

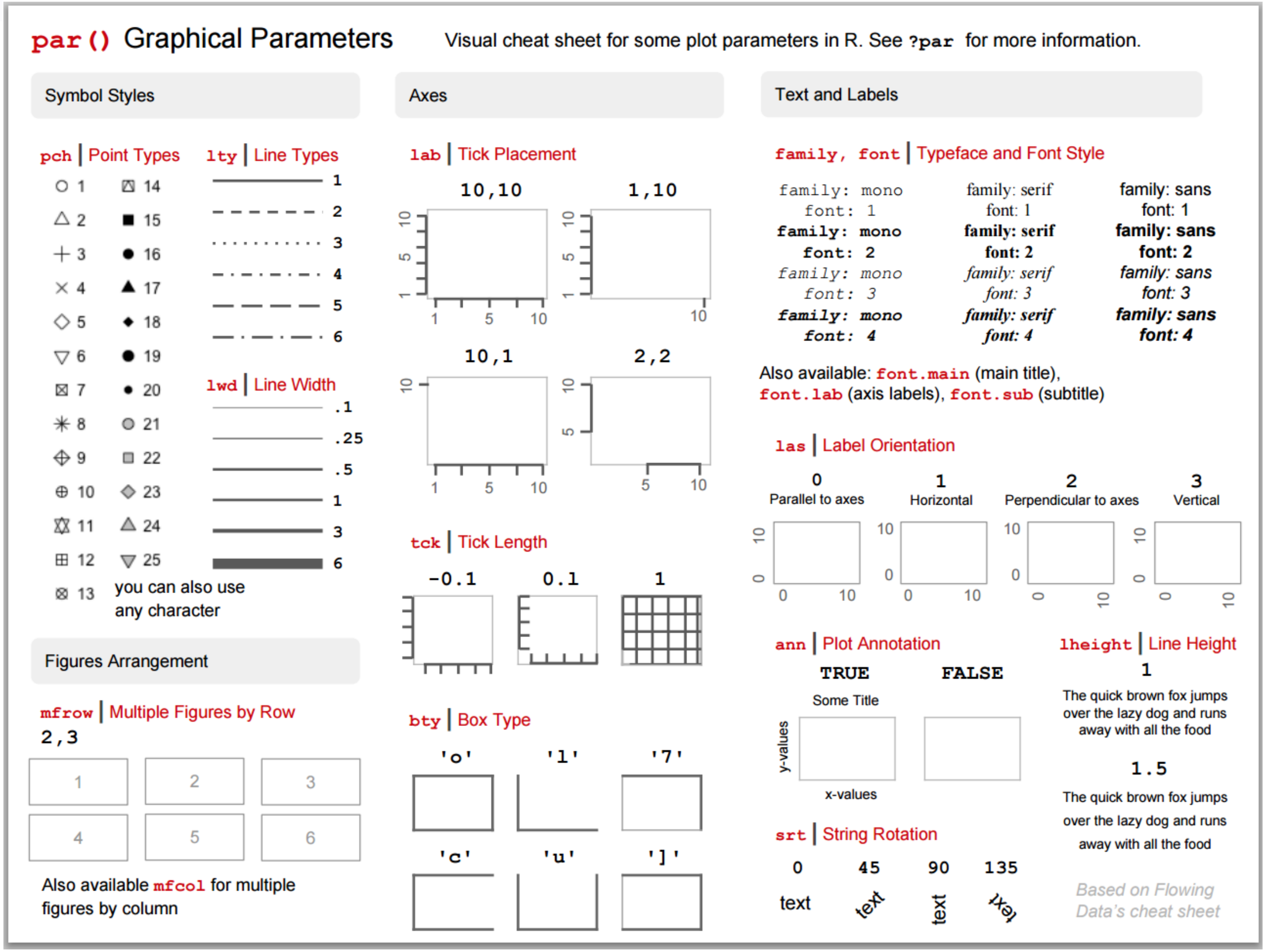
- ?plotmath
- demo(plotmath)

字型之圖形參數

- font: # 文字及符號之字型
- font.axis: # 座標軸數字，文字及符號之字型
- font.lab: # 座標軸標記之字型
- font.mian: # 主標題文字及符號之字型
- font.sub: # 副標題文字及符號之字型

- demo(Hershey)

Graphical Parameters Cheat Sheet



par() Graphical Parameters

Visual cheat sheet for some plot parameters in R. See ?par for more information.

Symbol Styles

pch | Point Types

○ 1	▨ 14
△ 2	■ 15
+ 3	● 16
× 4	▲ 17
◇ 5	◆ 18
▽ 6	● 19
⊠ 7	• 20
✳ 8	○ 21
⊕ 9	□ 22
⊕ 10	◇ 23
✡ 11	△ 24
⊞ 12	▽ 25
⊗ 13	you can also use any character

lty | Line Types

1, 2, 3, 4, 5, 6

lwd | Line Width

.1, .25, .5, 1, 3, 6

Figures Arrangement

mfrow | Multiple Figures by Row

2,3

Also available mfcol for multiple figures by column

Axes

lab | Tick Placement

tck | Tick Length

bty | Box Type

Text and Labels

family, font | Typeface and Font Style

family: mono font: 1	family: serif font: 1	family: sans font: 1
family: mono font: 2	**family: serif font: 2**	**family: sans font: 2**
family: mono font: 3	*family: serif font: 3*	*family: sans font: 3*
family: mono font: 4	***family: serif font: 4***	***family: sans font: 4***

Also available: font.main (main title), font.lab (axis labels), font.sub (subtitle)

las | Label Orientation

0	1	2	3
Parallel to axes	Horizontal	Perpendicular to axes	Vertical

ann | Plot Annotation

srt | String Rotation

lheight | Line Height

1

The quick brown fox jumps
over the lazy dog and runs
away with all the food

1.5

The quick brown fox jumps
over the lazy dog and runs
away with all the food

Based on Flowing Data's cheat sheet

http://gastonsanchez.com/visually-enforced/resources/2015/09/22/R-cheat-sheet-graphical-parameters/

http://www.statmethods.net/advgraphs/parameters.html