109-1: EE4052

通識課程： 計算機程式設計 之旅

Computer Programming

Unit 11: 多重繪圖與顏色

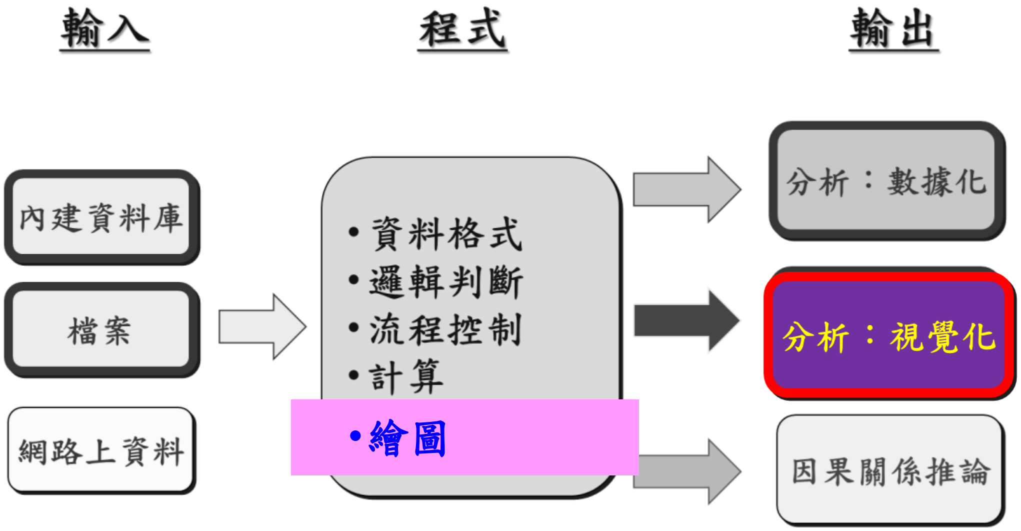
連　豐　力

臺 大 電 機 系

Sep 2020 - Jan 2021

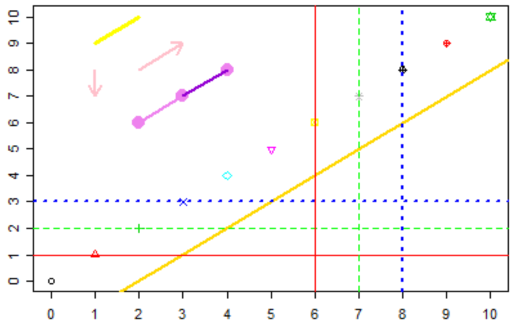
課程主題進度

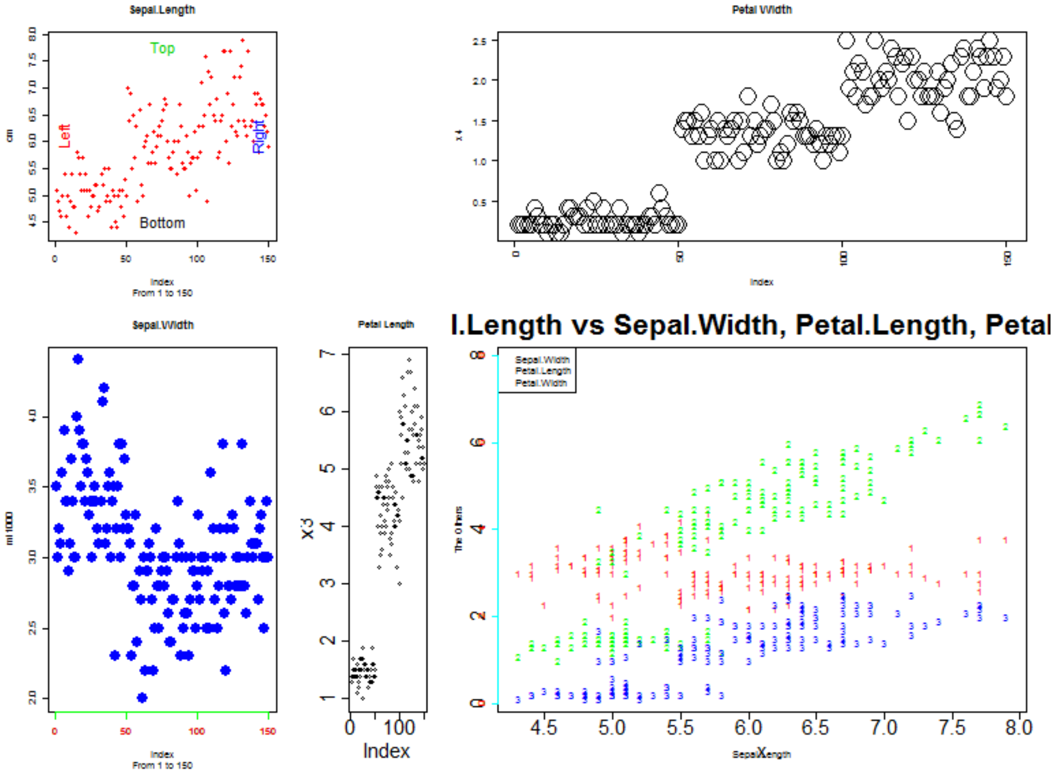
- U01: 課程介紹：討論主題，作業，報告，進行方式
- U02: 主題，案例，程式，演算法，資源
- U03: 設定軟體 R 與 Rstudio
- U04: 數據處理與繪圖指令功能
- U05: 資料類別與基本運算
- U06: 邏輯判斷與流程控制
- U07: 函數：計算與排序
- U08: 多維度資料格式
- U09: 檔案資料輸入與輸出
- **U10: 繪圖功能與文字**
- **U11: 多重繪圖與顏色**
- **U12: 影像與動畫**
- U13: 資料間的相關性
- U14: 探索性資料分析
- U15: 資料連結分析



Unit 11: 多重繪圖與顏色

- 一頁之中，至少放了多張的圖
- 每張圖的長寬或大小，不一樣
- 主標題，軸標題，字體要有變化
- 數據點的顏色要有變化
- 數據點的形式要有變化
- 不同數據加上不同註解





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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

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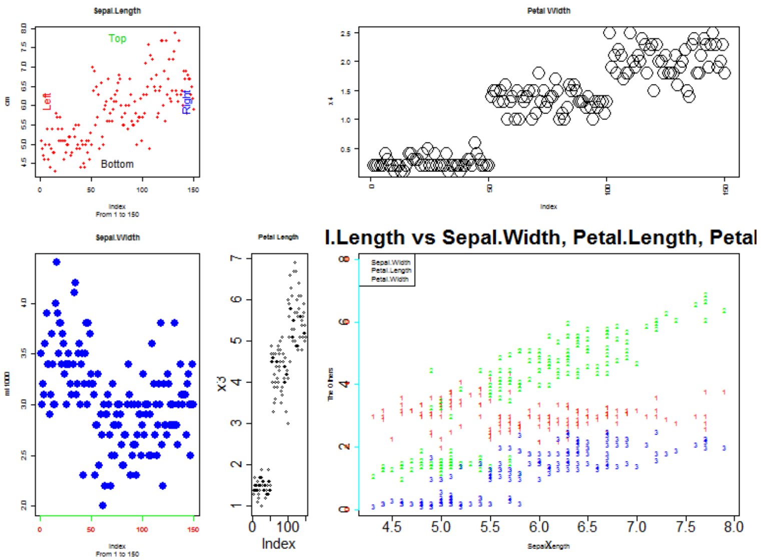
作業

HW09：多重繪圖與顏色

On 12/2, 2020

- 右下角的圖是使用 iris 的數據，所繪製一組圖。
- 程式為：HW09_PlotManyFigures.R（請從課程網站下載到工作目錄）
- 此程式主要的功能為：
  - 一頁之中，擺設多張的圖
  - 每張圖的長寬或大小，要不一樣
  - 主標題，軸標題，字體要有變化
  - 數據點的顏色要有變化
  - 數據點的形式要有變化
  - 試著給不同數據加上註解



- 在本次作業中，
  - 請任意挑選**五個**，您覺得比要醜或不喜歡的地方，
  - 改變原始程式對應的參數數值或設定，
  - 在對應的下面加上註解，說明所改變的內容，
  - 然後，再重新執行一次，
  - 將所產生的新的圖，複製到報告之中。

HW09：多重繪圖與顏色

On 12/2, 2020

- 繳交下面檔案，檔案名稱：HW09_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： HW09_B01921001_PlotManyFigures.R
  - 程式與結果檔： HW09_B01921001_PlotManyFigures.Rmd
    - 或轉成： HW09_B01921001_PlotManyFigures.html
  - 報告檔案： HW09_B01921001_PlotManyFigures.pdf

- 繳交方式與期限：
  - 上傳檔案到：https://cool.ntu.edu.tw
  - 繳交期限：12/7 (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

HW09++：進階視覺化數據

On 12/2, 2020

- 請挑選下面任一個數據：
  1. 課程學習時間：https://goo.gl/u7qdtN
  2. 餐廳小費金額：https://raw.githubusercontent.com/mwaskom/seaborn-data/master/tips.csv
  3. 您的期末專題所處理的數據！
- 然後，參考下面幾個網站的說明：
  - A Compendium of Clean Graphs in R
    http://shinyapps.org/apps/RGraphCompendium/index.php
  - R Base Graphics: An Idiot's Guide
    http://rstudio-pubs-static.s3.amazonaws.com/7953_4e3efd5b9415444ca065b1167862c349.html
  - R 的視覺化之一：風格美學篇
    https://badala2164.blogspot.tw/2018/05/r.html
  - 10 Questions R Users always ask while using ggplot2 package
    https://www.analyticsvidhya.com/blog/2016/03/questions-ggplot2-package-r/
- 最後，試著完成下面工作：
  - 挑選四到六個繪製圖形的功能，
    以便於能夠展現出該組數據比較性或者趨勢性的特性。
  - 請所有的圖，放置在同一個頁面中，排列的方式能夠展現數據間的關聯性。
- 繳交任何一種格式的檔案： .R or .Rmd or .html or .pdf。

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多張圖形

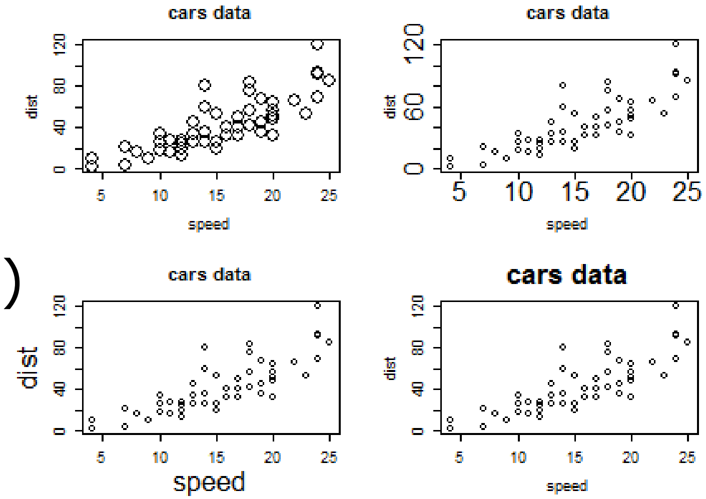
多張圖形 – mfrow, mfcol

- mfrow( )　　# 依照橫列 (by row) 順序畫出
- mfcol( )　　# 依照直行 (by column) 順序畫出

- cex.axis:　　# 座標軸數字，文字及符號相對於內定值之縮放比
- cex.lab:　　# 座標軸標記文字及符號相對於內定值之縮放比
- cex.main:　　# 主標題（上標題）文字及符號相對於內定值之縮放比
- cex.sub:　　# 副標題（下標題）文字及符號相對於內定值之縮放比

多張圖形 – mfrow, mfcol

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



- plot(cars, main = "cars data", cex = 2)
- plot(cars, main = "cars data", cex.axis = 2)
- plot(cars, main = "cars data", cex.lab = 2)
- plot (cars, main = "cars data", cex.main = 2)

- par(old.par)

多張圖形 – las

- las: # 座標軸數字，文字之展現方式

- las = 0 # 0: always parallel to the axis [default]
- las = 1 # 1: always horizontal
- las = 2 # 2: always perpendicular to the axis
- las = 3 # 3: always vertical

多張圖形 – las

- windows(width = 4.5, height = 3.3, pointsize = 8)
- old.par <- par(mfrow = c(2, 2), mex = 0.8, mar = c(5, 5, 4, 4) + 0.1)
- plot(cars, main = "las = 0", las = 0)

  # 0: always parallel to the axis [default]
- plot(cars, main = "las = 1", las = 1)

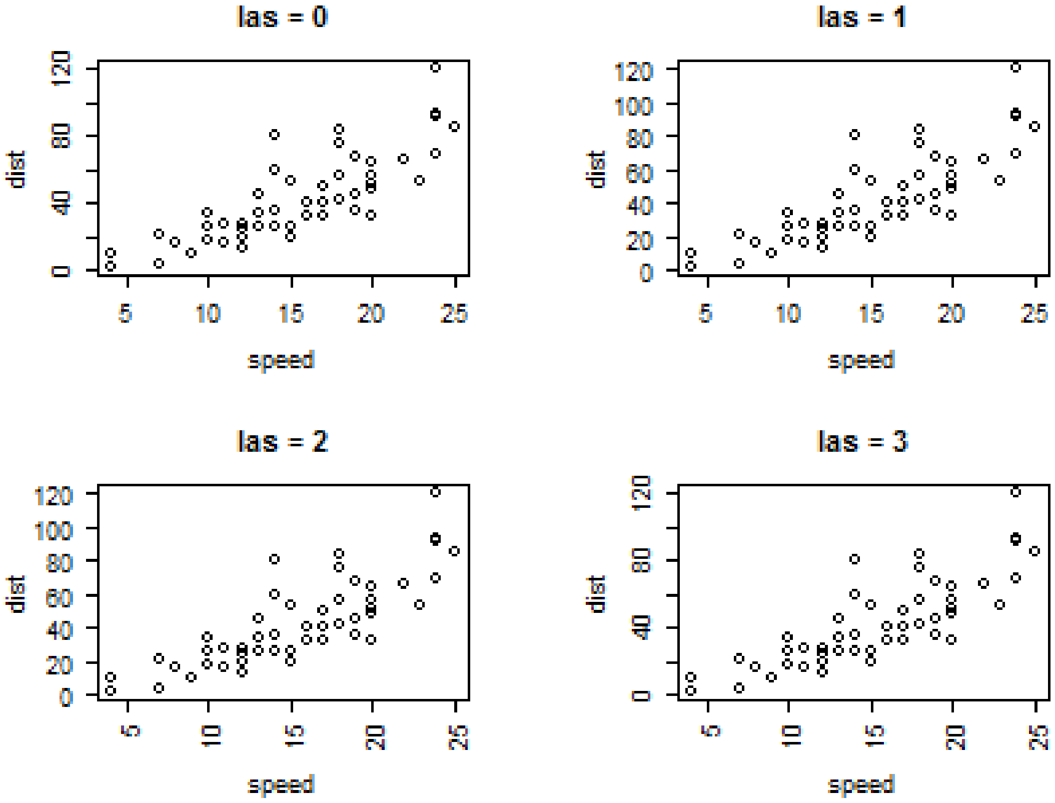
  # 1: always horizontal
- plot(cars, main = "las = 2", las = 2)

  # 2: always perpendicular to the axis
- plot(cars, main = "las = 3", las = 3)

  # 3: always vertical
- par(old.par)

多張圖形 – las

- plot(cars, main = "las = 0", las = 0) # 0: always parallel to the axis [default]
- plot(cars, main = "las = 1", las = 1) # 1: always horizontal
- plot(cars, main = "las = 2", las = 2) # 2: always perpendicular to the axis
- plot(cars, main = "las = 3", las = 3) # 3: always vertical



las = 0

las = 1

las = 2

las = 3

多張圖形 – type

- type: # 點跟點之間的展現方式
- type = "p" # "p" for points
- type = "l" # "l" for lines
- type = "b" # "b" for both
- type = "o" # "o" for both ‘overplotted’
- type = "h" # "h" for histogram-like vertical lines
- type = "n" # "n" for no plotting

多張圖形 – type

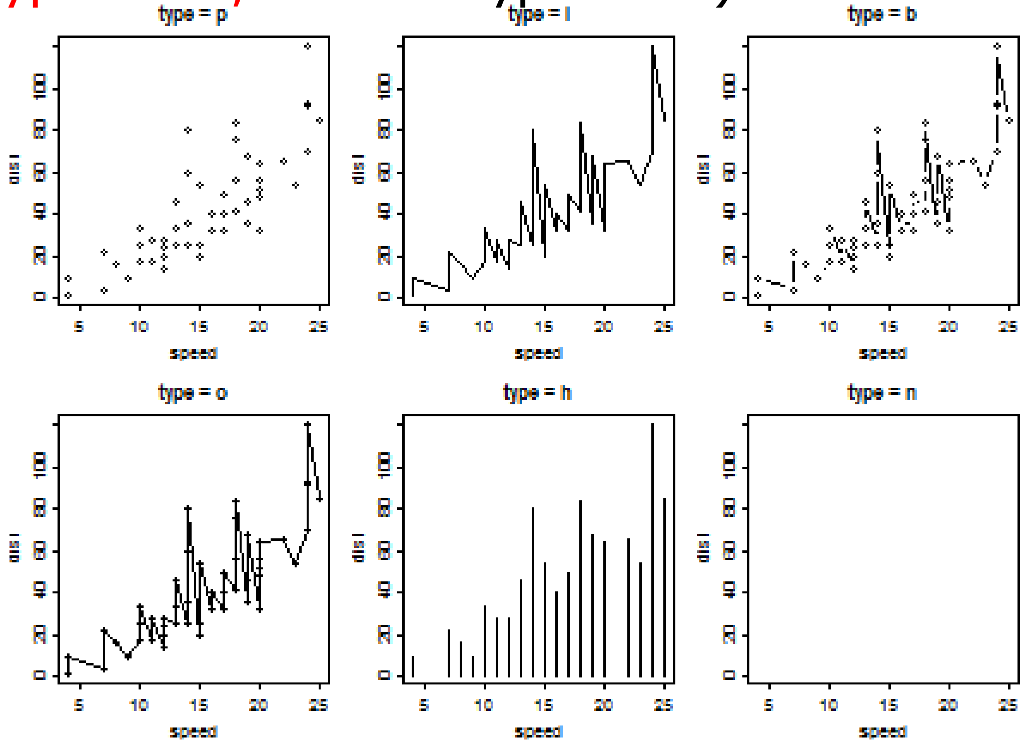
- windows(width = 4.5, height = 3.3, pointsize = 8)
- old.par <- par(mfrow = c(2, 3), mex = 0.6, mar = c(5, 4, 4, 2) + 0.1)

- plot(cars, type = "p", main = "type = p")   # "p" for points
- plot(cars, type = "l", main = "type = l")   # "l" for lines
- plot(cars, type = "b", main = "type = b")   # "b" for both
- plot(cars, type = "o", main = "type = o")   # "o" for both ‘overplotted’
- plot(cars, type = "h", main = "type = h")   # "h" for histogram-like vertical lines
- plot(cars, type = "n", main = "type = n")   # "n" for no plotting

- par(old.par)

多張圖形 – type

- plot(cars, type = "p", main = "type = p") # "p" for points
- plot(cars, type = "l", main = "type = l") # "l" for lines
- plot(cars, type = "b", main = "type = b") # "b" for both
- plot(cars, type = "o", main = "type = o") # "o" for both ‘overplotted’
- plot(cars, type = "h", main = "type = h") # "h" for histogram-like vertical lines
- plot(cars, type = "n", main = "type = n") # "n" for no plotting



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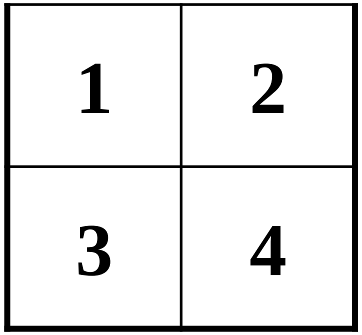
多張圖形之位置安排

繪圖 – 圖形位置安排

- layout(M, widths, heights)
- M 是圖形分佈的矩陣，
- widths、heights 各是設定 M 矩陣長、寬的比例，其基準點是左上角

matrix(c(1, 2, 3, 4) , 2, 2, byrow = T)

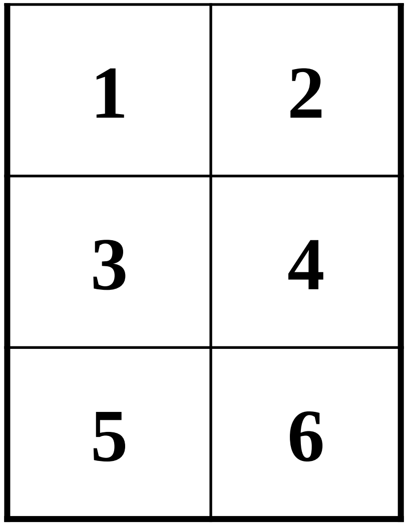
```
     [,1] [,2]
[1,]    1    2
[2,]    3    4
```

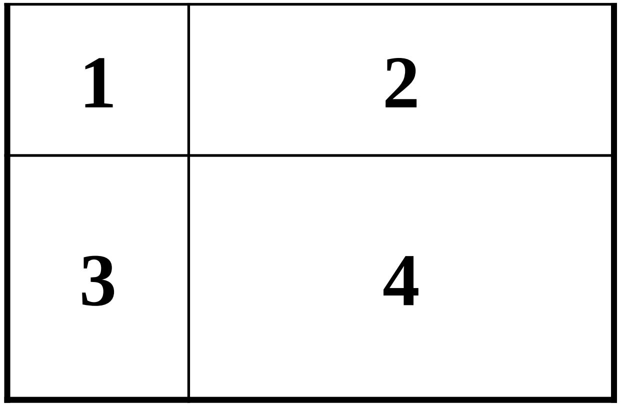


widths = c(1,1), heights = c(1,1))

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

matrix(c(1, 2, 3, 4, 5, 6) , 3, 2, byrow = T)





widths = c(1,3), heights = c(1,2))

繪圖 – 圖形位置安排

- layout(M, widths, heights)
- M是圖形分佈的矩陣，
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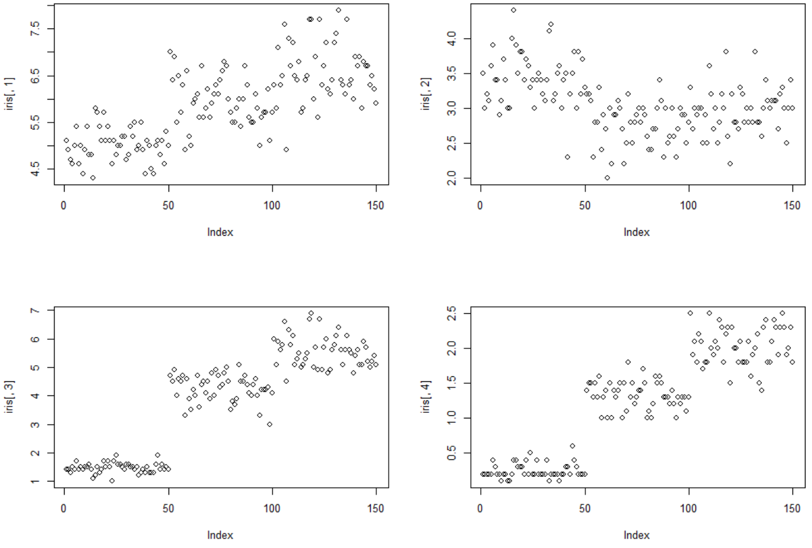
- # 幾張圖繪製在一起
- layout(matrix(c(1, 2, 3, 4) , 2, 2, byrow = T), widths = c(1,1), heights = c(1,1))
- plot(iris[, 1])
- plot(iris[, 2])
- plot(iris[, 3])
- plot(iris[, 4])



繪圖 – 圖形位置安排

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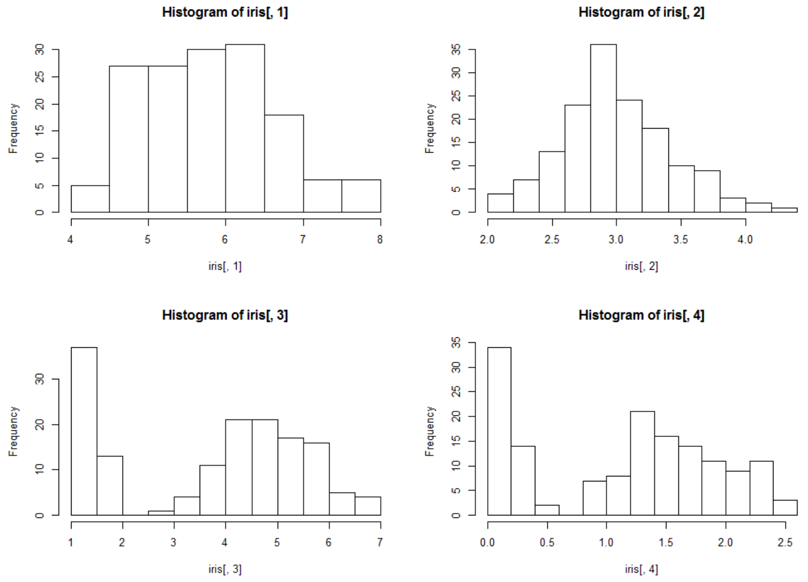
- # 幾張圖繪製在一起
- layout(matrix(c(1, 2, 3, 4) , 2, 2, byrow = T), widths = c(1,1), heights = c(1,1))
- hist(iris[, 1])
- hist(iris[, 2])
- hist(iris[, 3])
- hist(iris[, 4])



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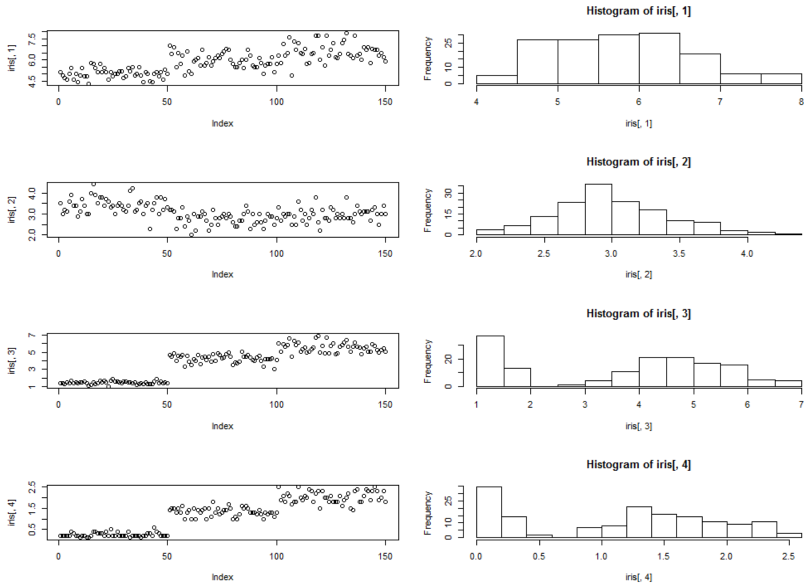
- # 幾張圖繪製在一起
- layout(matrix(c(1, 2, 3, 4, 5, 6, 7, 8) , 4, 2, byrow = T), widths = c(1,1), heights = c(1,1,1,1))
- plot(iris[, 1])
- hist(iris[, 1])
- plot(iris[, 2])
- hist(iris[, 2])
- plot(iris[, 3])
- hist(iris[, 3])
- plot(iris[, 4])
- hist(iris[, 4])



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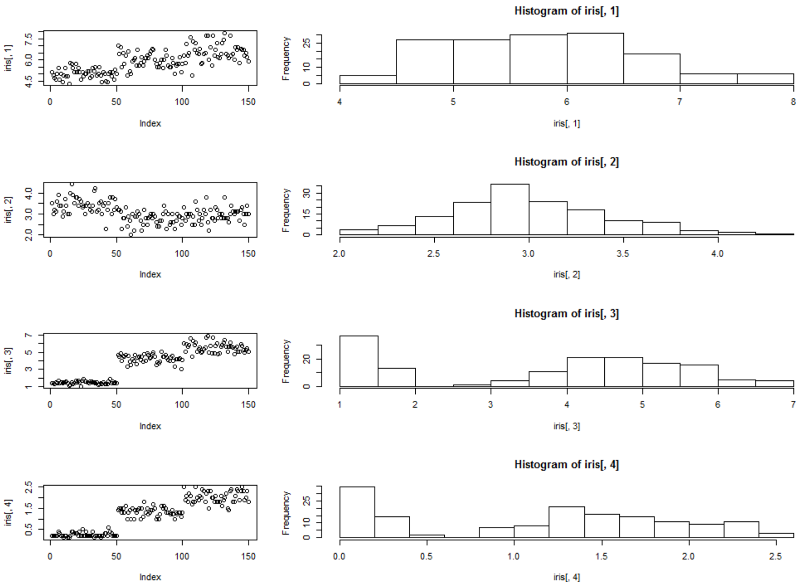
- # 幾張圖繪製在一起
- layout(matrix(c(1, 2, 3, 4, 5, 6, 7, 8) , 4, 2, byrow = T), widths = c(1,2), heights = c(1,1,1,1))
- plot(iris[, 1])
- hist(iris[, 1])
- plot(iris[, 2])
- hist(iris[, 2])
- plot(iris[, 3])
- hist(iris[, 3])
- plot(iris[, 4])
- hist(iris[, 4])



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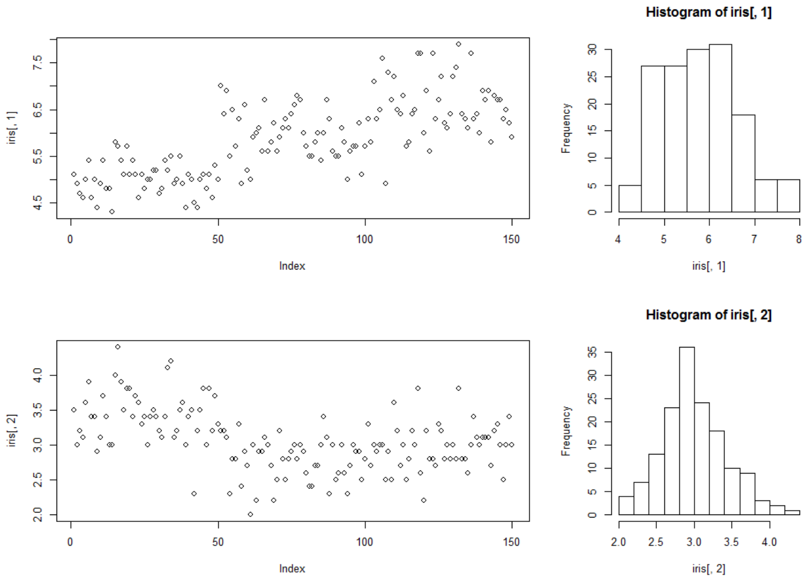
- # 幾張圖繪製在一起
- layout(matrix(c(1, 2, 3, 4) , 2, 2, byrow = T), widths = c(2,1), heights = c(1,1))
- plot(iris[, 1])
- hist(iris[, 1])
- plot(iris[, 2])
- hist(iris[, 2])



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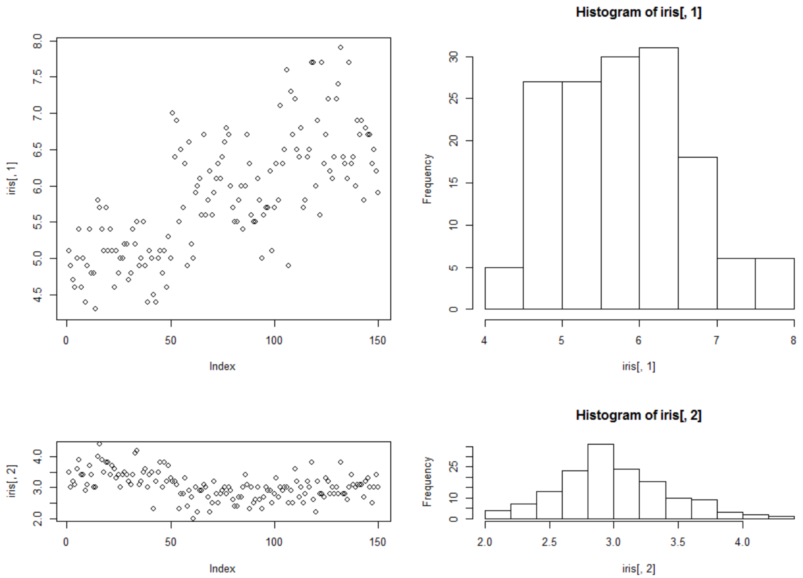
- # 幾張圖繪製在一起
- layout(matrix(c(1, 2, 3, 4) , 2, 2, byrow = T), widths = c(1,1), heights = c(2,1))
- plot(iris[, 1])
- hist(iris[, 1])
- plot(iris[, 2])
- hist(iris[, 2])



繪圖 – 圖形位置安排

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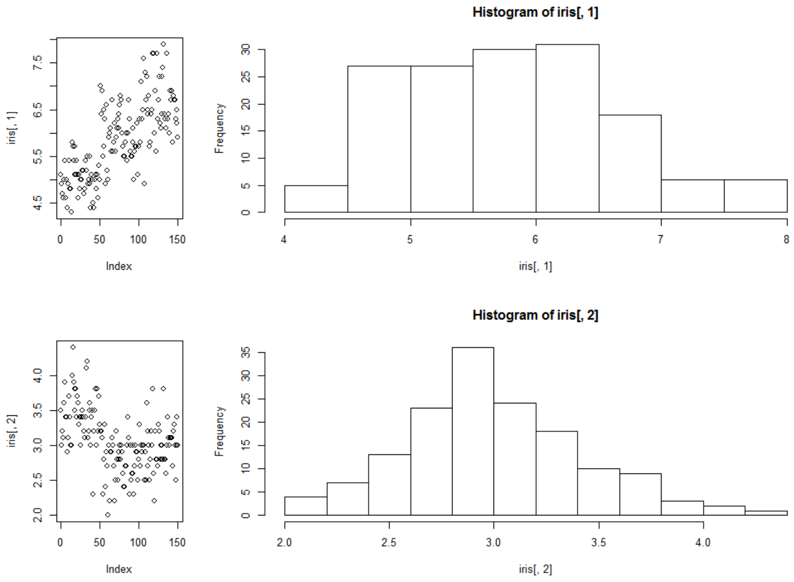
- # 幾張圖繪製在一起
- layout(matrix(c(1, 2, 3, 4) , 2, 2, byrow = T), widths = c(1,3), heights = c(1,1))
- plot(iris[, 1])
- hist(iris[, 1])
- plot(iris[, 2])
- hist(iris[, 2])



繪圖 – 圖形位置安排

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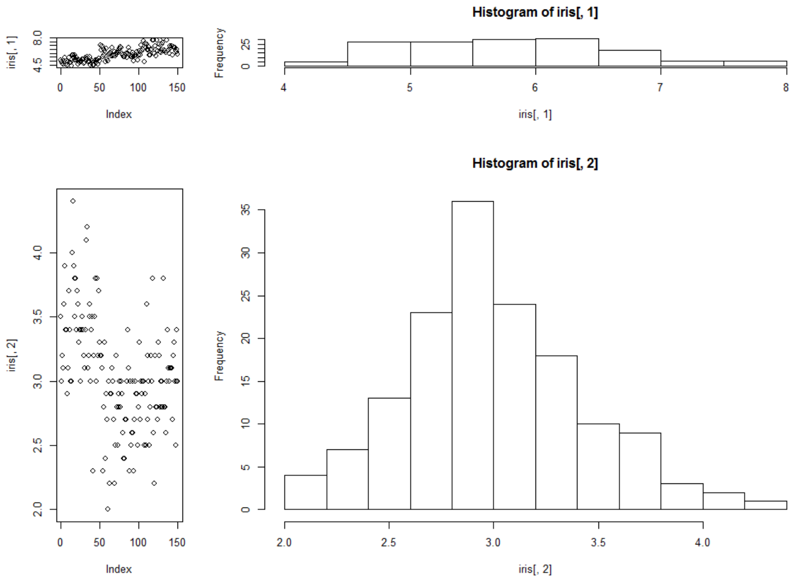
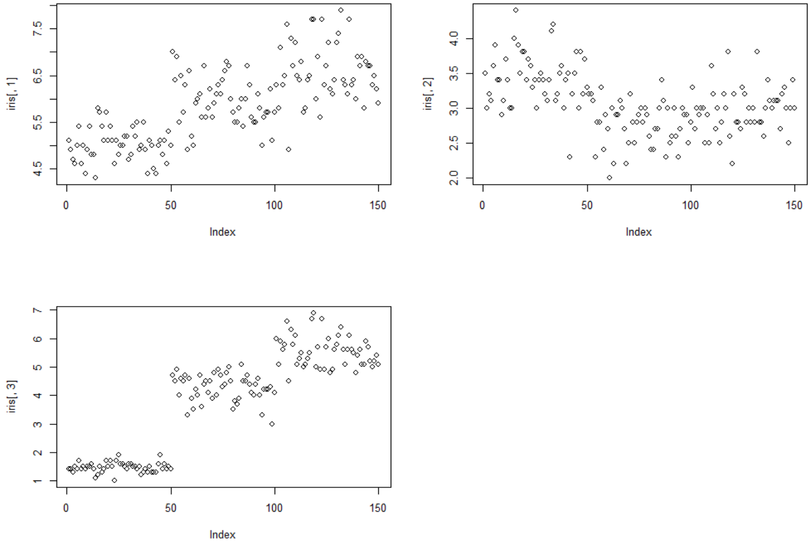
- # 幾張圖繪製在一起
- layout(matrix(c(1, 2, 3, 4) , 2, 2, byrow = T), widths = c(1,3), heights = c(1,3))
- plot(iris[, 1])
- hist(iris[, 1])
- plot(iris[, 2])
- hist(iris[, 2])



繪圖 – 圖形位置安排

- layout(M, widths, heights)
- M是圖形分佈的矩陣，
- widths、heights各是設定M矩陣長、寬的比例，其基準點是左上角

- # 幾張圖繪製在一起
- layout(matrix(c(1, 2, 3, 0) , 2, 2, byrow = T), widths = c(1,1), heights = c(1,1))
- plot(iris[, 1])
- plot(iris[, 2])
- plot(iris[, 3])



繪圖 – 圖形位置安排

- layout(M, widths, heights)
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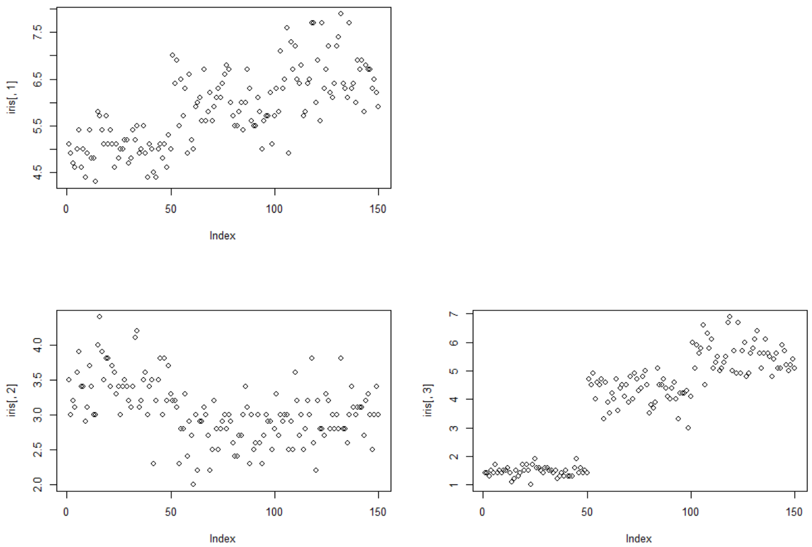
- widths、heights各是設定M矩陣長、寬的比例，其基準點是左上角

- # 幾張圖繪製在一起
- layout(matrix(c(1, 0, 2, 3) , 2, 2, byrow = T), widths = c(1,1), heights = c(1,1))
- plot(iris[, 1])
- plot(iris[, 2])
- plot(iris[, 3])



繪圖 – 圖形位置安排

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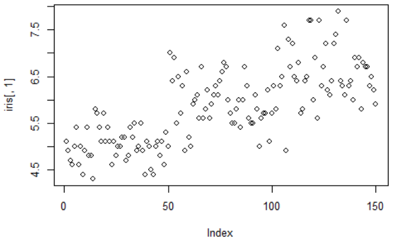
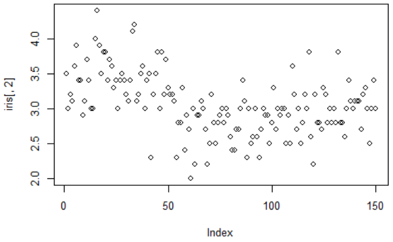
- widths、heights各是設定M矩陣長、寬的比例，其基準點是左上角

- # 幾張圖繪製在一起
- layout(matrix(c(1, 0, 0, 2) , 2, 2, byrow = T), widths = c(1,1), heights = c(1,1))
- plot(iris[, 1])
- plot(iris[, 2])

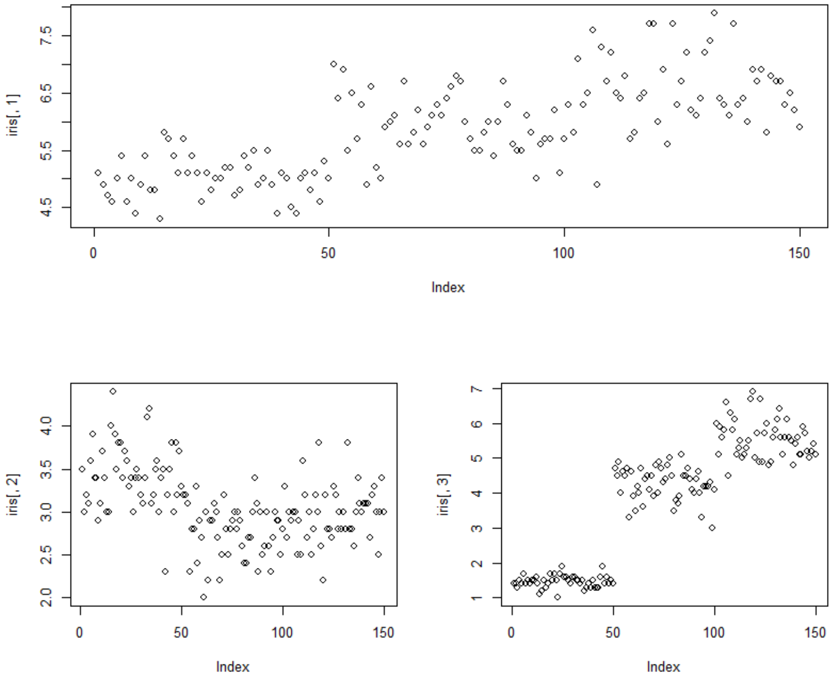




繪圖 – 圖形位置安排

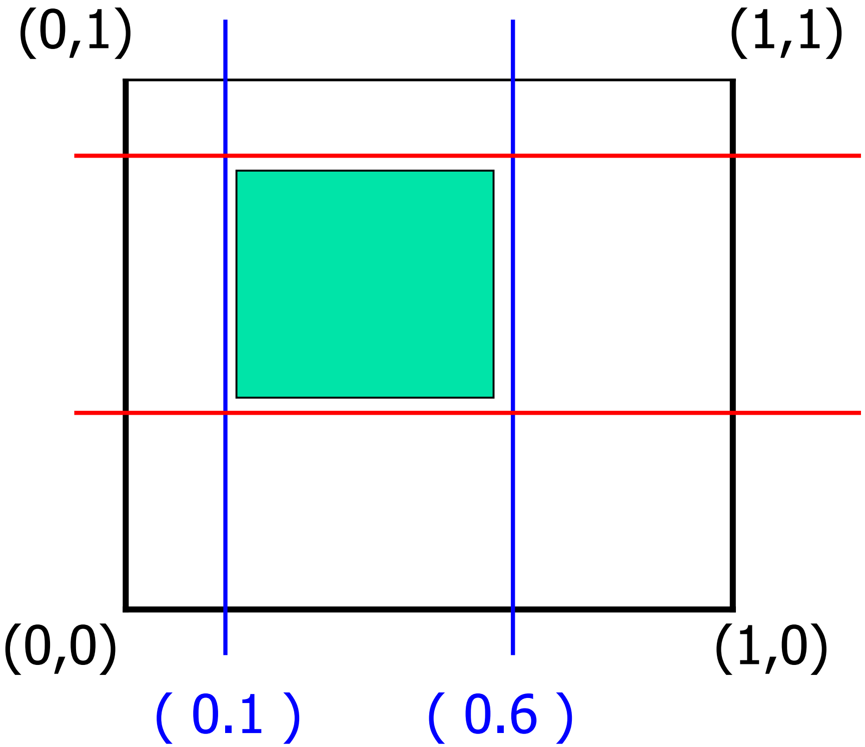
- layout(M, widths, heights)
- M是圖形分佈的矩陣，
- widths、heights各是設定M矩陣長、寬的比例，其基準點是左上角

- # 幾張圖繪製在一起
- layout(matrix(c(1, 1, 2, 3) , 2, 2, byrow = T), widths = c(1,1), heights = c(1,1))
- plot(iris[, 1])
- plot(iris[, 2])
- plot(iris[, 3])



繪圖 – 圖形位置安排

- par(fig = c(x1, x2, y1, y2))
- par(fig = c(0.1, 0.6, 0.3, 0.9))
  圖1 的 左下角座標 (x1,y1) 是 (0.1, 0.3) ,
  圖1 的 右上角座標 (x2,y2) 是 (0.6, 0.9)

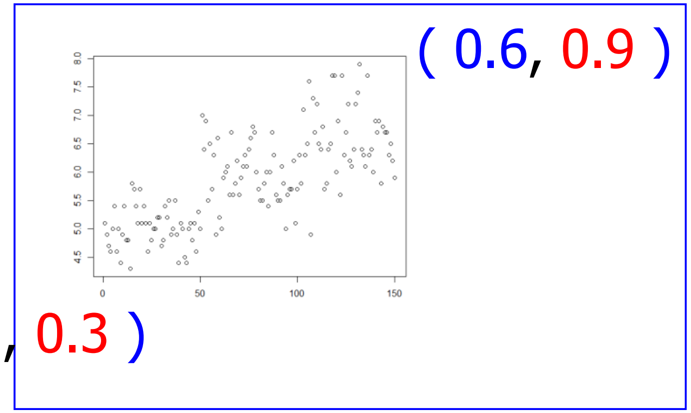


繪圖 – 圖形位置安排

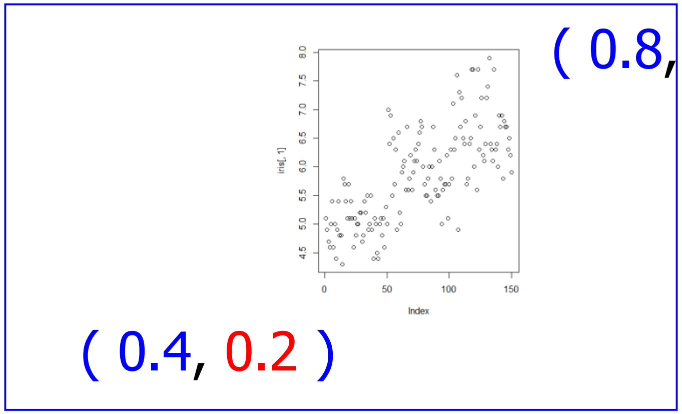
- par(fig = c(x1, x2, y1, y2))
- par(fig = c(0.1, 0.6, 0.3, 0.9))
  圖1 的 左下角座標 (x1,y1) 是 (0.1, 0.3) ,
  圖1 的 右上角座標 (x2,y2) 是 (0.6, 0.9)

- # 幾張圖繪製在一起

- par(fig=c(0.1, 0.6, 0.3, 0.9))
- plot(iris[, 1])

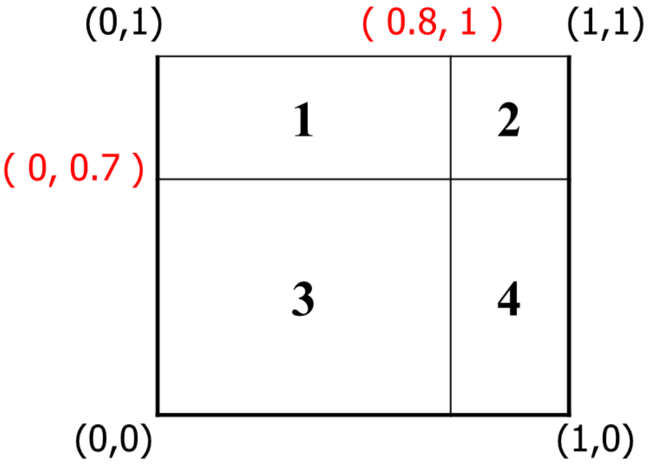


- par(fig=c(0.4, 0.8, 0.2, 0.9))
- plot(iris[, 1])

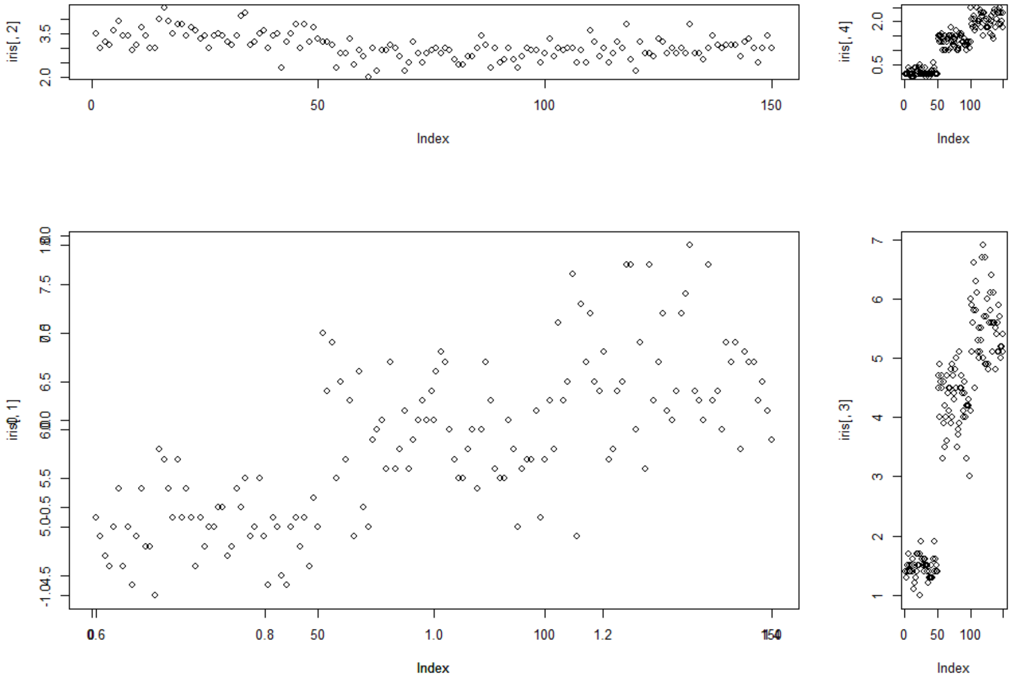


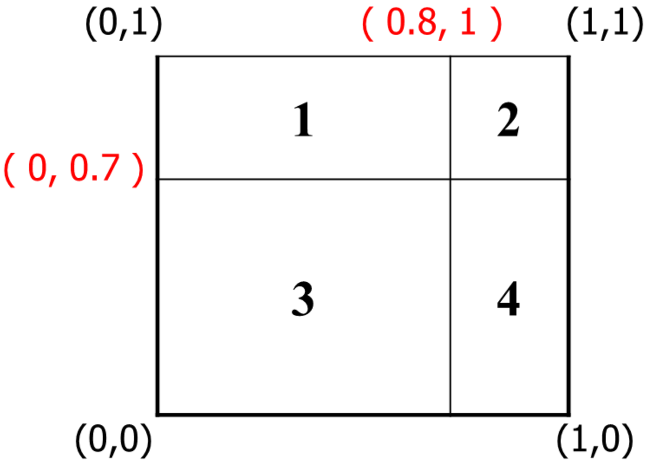
繪圖 – 圖形位置安排

- par(fig = c(x1, x2, y1, y2))
- par(fig = c(0.1, 0.6, 0.3, 0.9))
  圖1 的 左下角座標 (x1,y1) 是 (0.1, 0.3) ,
  圖1 的 右上角座標 (x2,y2) 是 (0.6, 0.9)
- # 幾張圖繪製在一起
- par(fig=c(0, 0.8, 0, 0.7), new=TRUE)
- plot(iris[, 1])
- par(fig=c(0, 0.8, 0.7, 1), new=TRUE)
- plot(iris[, 2])
- par(fig=c(0.8, 1, 0, 0.7), new=TRUE)
- plot(iris[, 3])
- par(fig=c(0.8, 1, 0.7, 1), new=TRUE)
- plot(iris[, 4])



繪圖 – 圖形位置安排


iris[, 2]
2.0
3.5
0
50
100
150
Index
iris[, 4]
0.5
2.0
0
50
100
Index
iris[, 1]
4.5
5.0
5.5
6.0
6.5
7.0
7.5
0.6
0.8
1.0
1.2
0
50
100
150
Index
iris[, 3]
1
2
3
4
5
6
7
0
50
100
Index


(0,1)
(0.8, 1)
(1,1)
1
2
(0, 0.7)
3
4
(0,0)
(1,0)

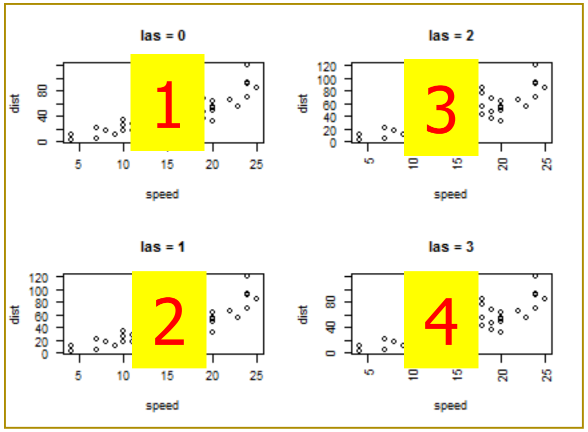
多張圖形 – layout

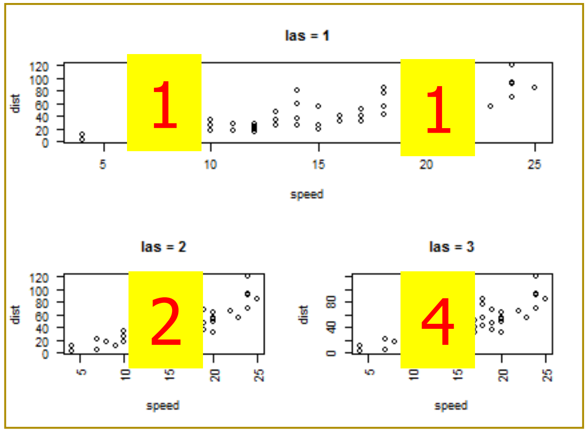
- layout(matrix(1:4, nrow = 2))

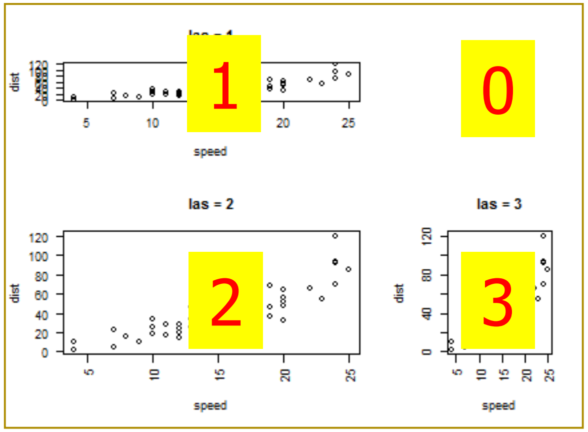
  # 2x2 的圖形矩陣，依照指定的位置

- layout(matrix(c(1, 2, 1, 3), nrow = 2, ncol = 2))

- layout(matrix(c(1, 2, 0, 3), nrow = 2, ncol = 2), width = c(2, 1), height = c(1, 1.5))





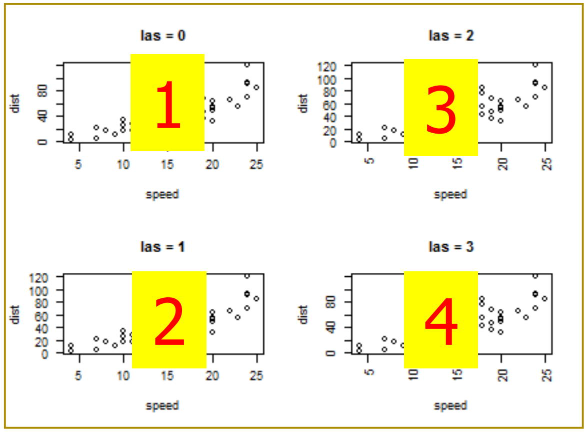


多張圖形 – layout

- windows(width = 4.5, height = 3.3, pointsize = 8)
- old.par <- par(mex = 0.8, mar = c(5, 4, 4, 2) + 0.1)
- layout(matrix(1:4, nrow = 2))

- plot(cars, las = 0, main = "las = 0")
- plot(cars, las = 1, main = "las = 1")
- plot(cars, las = 2, main = "las = 2")
- plot(cars, las = 3, main = "las = 3")

- layout(1)
- par(old.par)

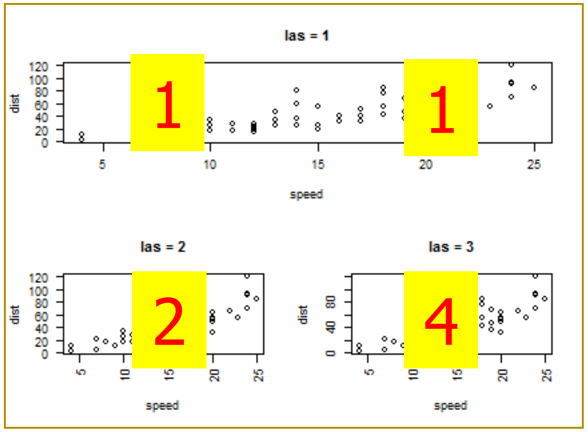


多張圖形 – layout

- windows(width = 4.5, height = 3.3, pointsize = 8)
- old.par <- par(mex = 0.8, mar = c(5, 4, 4, 2) + 0.1)
- layout(matrix(c(1, 2, 1, 3), nrow = 2, ncol = 2))

- plot(cars, las = 1, main = "las = 1")
- plot(cars, las = 2, main = "las = 2")
- plot(cars, las = 3, main = "las = 3")

- layout(1)
- par(old.par)

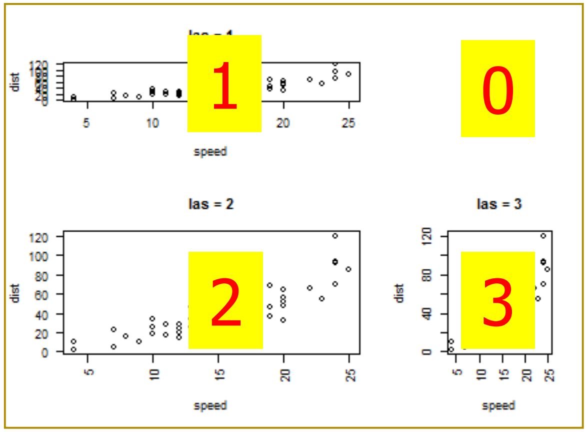


多張圖形 – layout

- windows(width = 4.5, height = 3.3, pointsize = 8)
- old.par <- par(mex = 0.8, mar = c(5, 4, 4, 2) + 0.1)
- layout(matrix(c(1, 2, 0, 3), nrow = 2, ncol = 2), width = c(2, 1), height = c(1, 1.5))

- plot(cars, las = 1, main = "las = 1")
- plot(cars, las = 2, main = "las = 2")
- plot(cars, las = 3, main = "las = 3")

- layout(1)
- par(old.par)

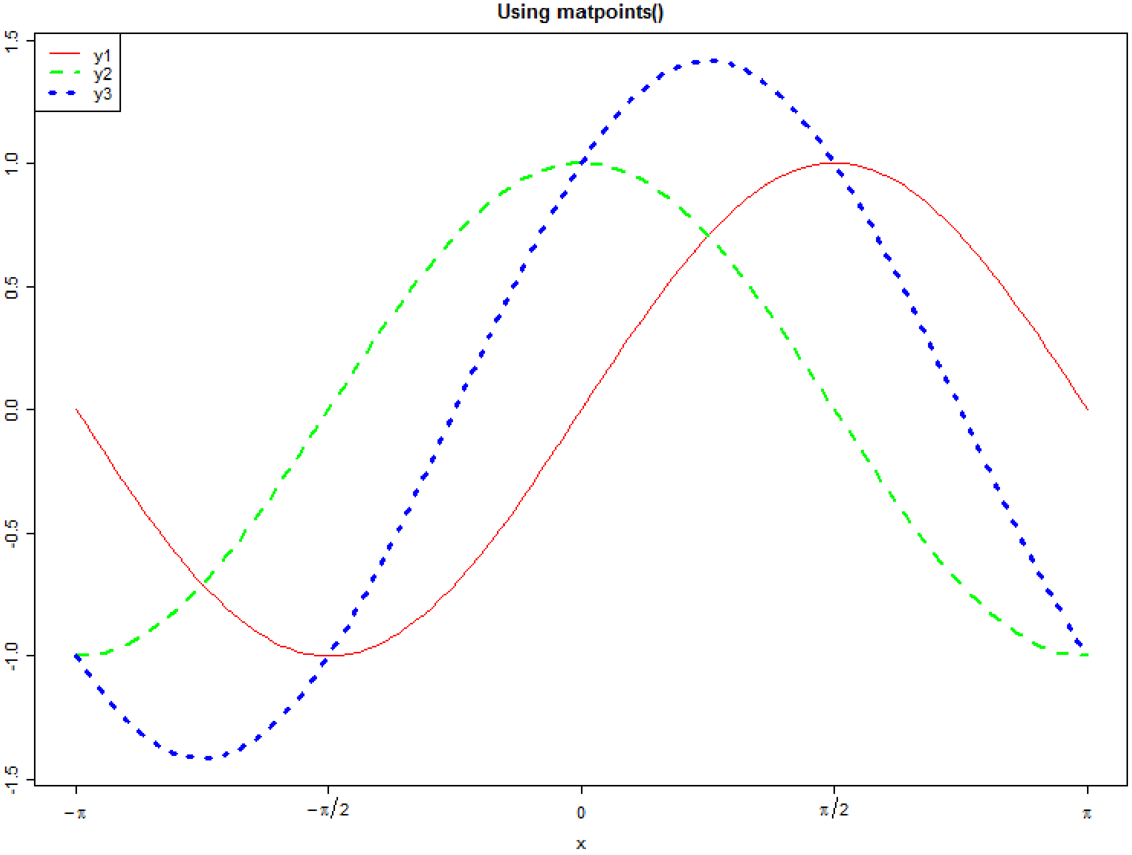


大綱

一張圖多筆數據

呈現多筆數據於一張圖

- matplot( )
- matpoints( )
- matlines( )



呈現多筆數據於一張圖

- x <- seq(from = -pi, to = pi, length = 101)
- y1 <- sin(x)
- y2 <- cos(x)
- y3 <- sin(x) + cos(x)

- ylim <- range(y1, y2, y3)

- win.graph(width = 8, height = 6, pointsize = 8)
- old.par <- par(mex = 0.8, mar = c(5, 4, 3, 1) + 0.1)

呈現多筆數據於一張圖

- plot(x, y1, xlim = range(x), ylim = ylim, type = "n", xaxt = "n", xlab = "x", ylab = "", main = "Using matpoints()")
- matpoints(x, cbind(y1, y2, y3))

- plot(x, y1, xlim = range(x), ylim = ylim, type = "n", xaxt = "n", xlab = "x", ylab = "", main = "Using matpoints()")
- matpoints(x, cbind(y1, y2, y3), col = c("red", "green", "blue"))

- plot(x, y1, xlim = range(x), ylim = ylim, type = "n", xaxt = "n", xlab = "x", ylab = "", main = "Using matpoints()")
- matpoints(x, cbind(y1, y2, y3), type = "l", col = c("red", "green", "blue"), lty = 1:3, lwd = c(1,5,9))

呈現多筆數據於一張圖

- plot(x, y1, xlim = range(x), ylim = ylim, type = "n", xaxt = "n", xlab = "x", ylab = "", main = "Using matpoints()")
- matpoints(x, cbind(y1, y2, y3), type = "l", col = c("red", "green", "blue"), lty = 1:3, lwd = c(1,5,9))
- label <- expression(-pi, -pi / 2, 0, pi / 2, pi)
- axis(side = 1, at = c(-pi, -pi / 2, 0, pi / 2, pi), label = label)
- legend("topleft", legend = c("y1", "y2", "y3"), col = c("red", "green", "blue"), lty = 1:3, lwd = c(1,5,9))

呈現多筆數據於一張圖

- win.graph(width = 8, height = 6, pointsize = 8)
- old.par <- par(mex = 0.8, mar = c(5, 4, 3, 1) + 0.1)

- plot(x, y1, xlim = range(x), ylim = ylim, type = "n", xaxt = "n", xlab = "x", ylab = "", main = "Using matlines()")
- matlines(x, cbind(y1, y2, y3), col = c("red", "green", "blue"), lty = 1:3, lwd = c(1,5,9))

- label <- expression(-pi, -pi / 2, 0, pi / 2, pi)
- axis(side = 1, at = c(-pi, -pi / 2, 0, pi / 2, pi), label = label)

- legend("topleft", legend = c("y1", "y2", "y3"), col = c("red", "green", "blue"), lty = 1:3, lwd = c(1,5,9))

大綱

顏色

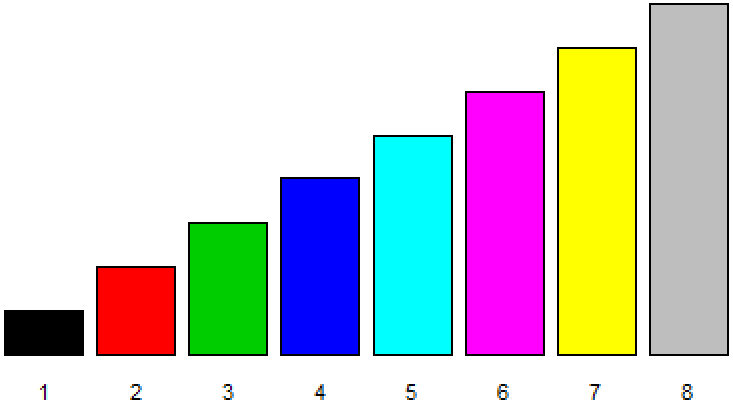
顏色

- palette( )

- windows(width = 4.5, height = 2.5, pointsize = 8)
- old.par <- par(mex = 0.8, mar = c(4, 2, 2, 2) + 0.1)

- barplot(1:8, col = palette(), names.arg = 1:8, yaxt = "n")

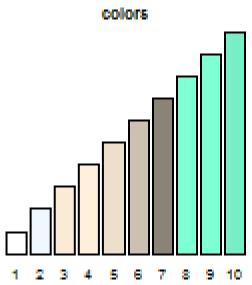
- par(old.par)



顏色 – 調色盤

- n <- 10
- windows(width = 5, height = 3.3, pointsize = 8)
- old.par <- par(mfrow = c(2, 3), mex = 0.6, mar = c(5, 4, 4, 2) + 0.1)

- barplot(1:n, col = colors()[1:n], names.arg = 1:n, yaxt = "n", main = "colors")



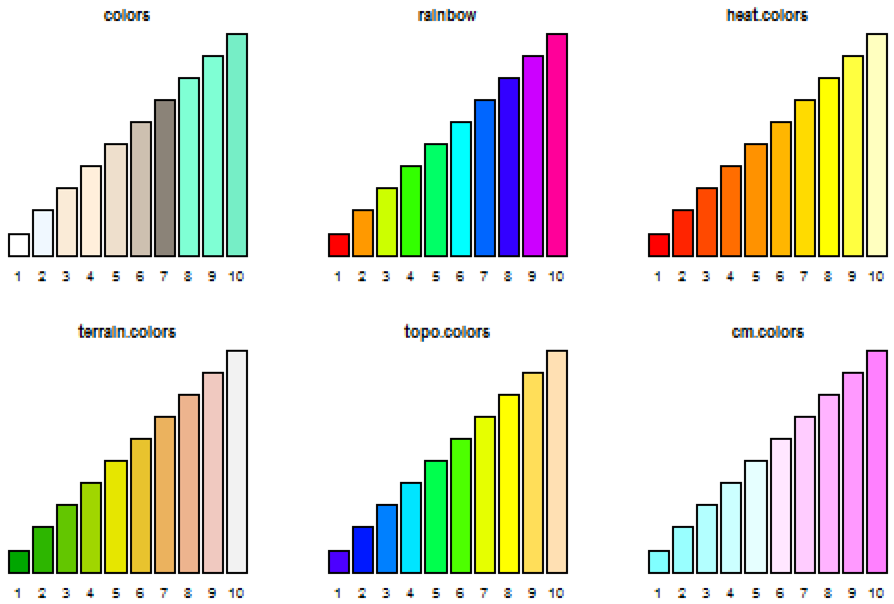
顏色 – 調色盤

- barplot(1:n, col = colors()[1:n], names.arg = 1:n, yaxt = "n", main = "colors")
- barplot(1:n, col = rainbow(n), names.arg = 1:n, yaxt = "n", main = "rainbow")
- barplot(1:n, col = heat.colors(n), names.arg = 1:n, yaxt = "n", main = "heat.colors")
- barplot(1:n, col = terrain.colors(n), names.arg = 1:n, yaxt = "n", main = "terrain.colors")
- barplot(1:n, col = topo.colors(n), names.arg = 1:n, yaxt = "n", main = "topo.colors")
- barplot(1:n, col = cm.colors(n), names.arg = 1:n, yaxt = "n", main = "cm.colors")

  # cm: cyan-magenta

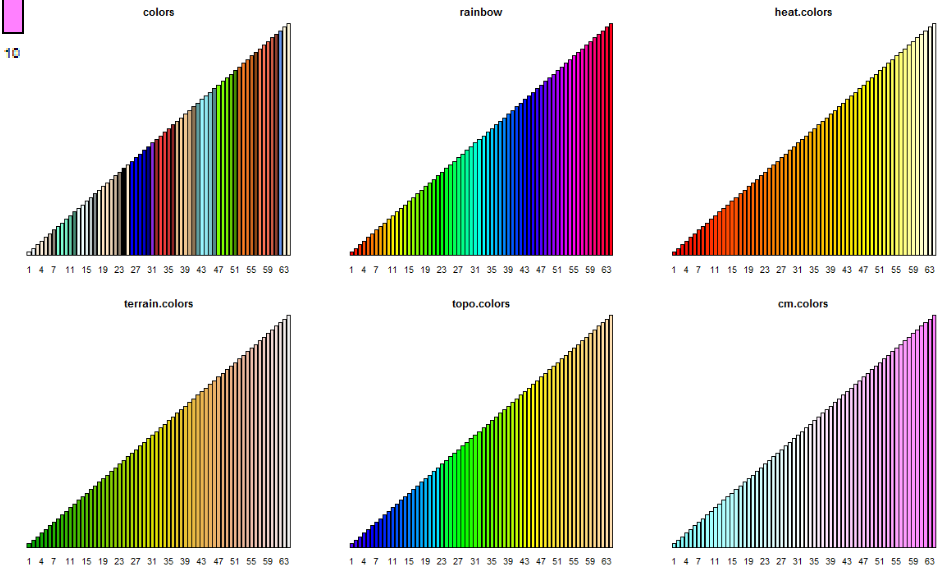
- par(old.par)

顏色 – 調色盤



n <- 10

n <- 64



顏色 – 灰階圖

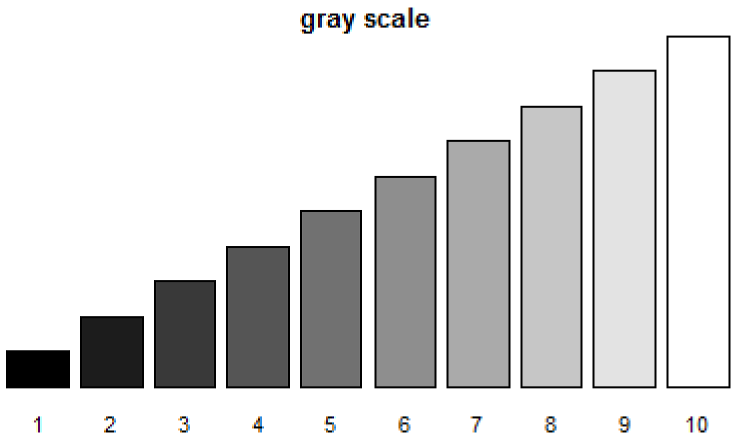
- gray.scale <- seq(from = 0, to = 1, length = 10)

- windows(width = 4.5, height = 2.5, pointsize = 8)
- old.par <- par(mex = 0.8, mar = c(4, 2, 2, 2) + 0.1)

- barplot(1:10, col = gray(gray.scale), names.arg = 1:10, yaxt = "n", main = "gray scale")

# From 0 (black) -> 1 (white)

- par(old.par)



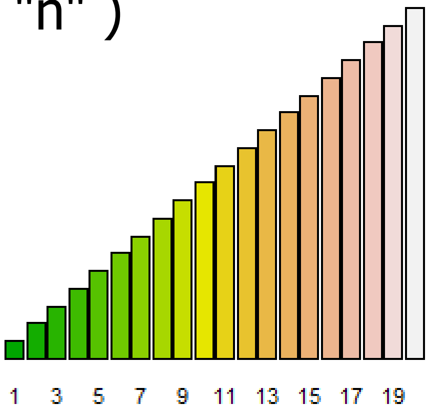
顏色 – 自行定義調色盤

- palette(terrain.colors(20))   # redefine palette
- palette( )

- windows(width = 2.8, height = 2.5, pointsize = 8)
- old.par <- par(mex = 0.8, mar = c(4, 2, 2, 2) + 0.1)

- barplot(1:20, col = 1:20, names.arg = 1:20, yaxt = "n")

- N <- 40
- palette(terrain.colors(N))
- palette( )
- barplot(1:N, col = 1:N, names.arg = 1:N, yaxt = "n")

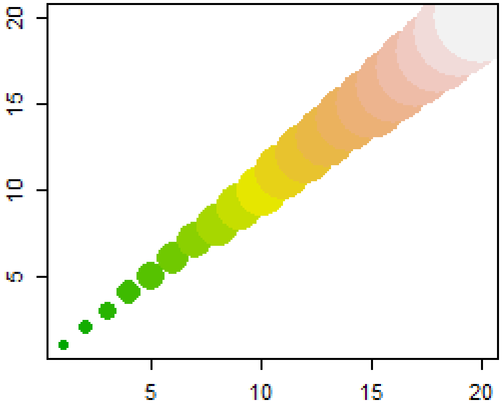


顏色 – 自行定義調色盤

- palette(terrain.colors(20))   # redefine palette
- palette( )

- windows(width = 2.8, height = 2.5, pointsize = 8)
- old.par <- par(mex = 0.8, mar = c(4, 2, 2, 2) + 0.1)

- plot(1:20, pch = 16, cex = seq(from = 1, to = 10, length = 20), col = 1:20, xlab = "")



- par(old.par)

- palette("default")   # using default colors
- palette()

顏色有關的指令

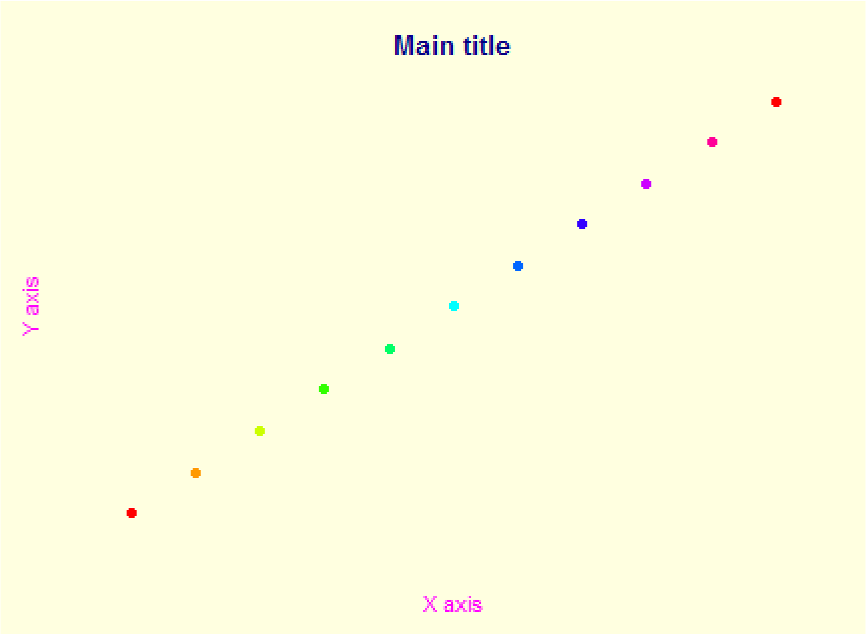
- colors( ) # 所有的內建顏色的指令
- colors()[grep("pink", colors())] # 所有與粉紅色有關的指令
- show.colors( ) # 展現各種內顏色的名稱與顏色
- install.packages("DAAG")
- library(DAAG) # Tools/Install Packages : DAAG
- show.colors(type = "singles", order.cols = TRUE) # single shade
- show.colors(type = "shades", order.cols = TRUE) # multiple shades
- show.colors(type = "gray", order.cols = TRUE) # gray shades

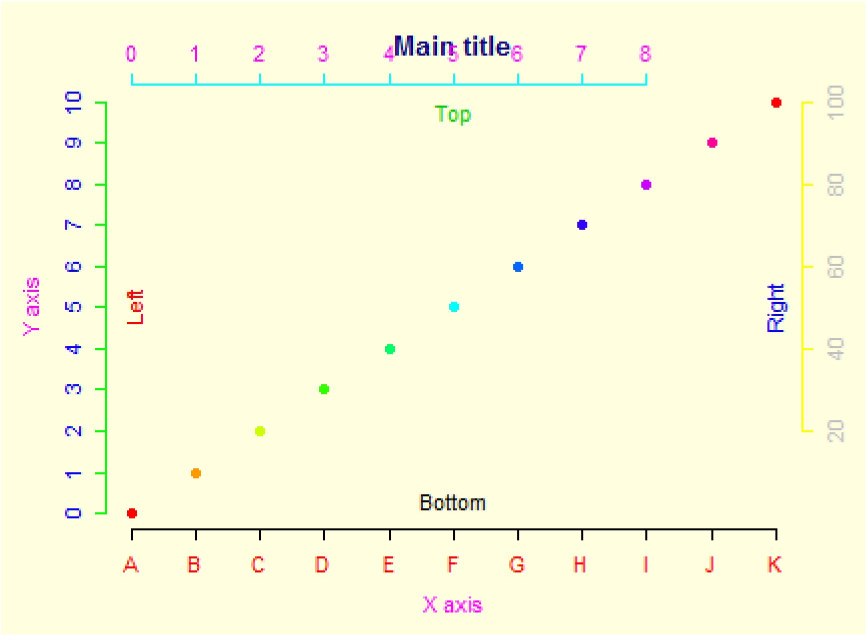
使用顏色圖形參數

col	# 一般狀況之繪圖顏色設定
col.axis	# 座標軸的顏色：內定是黑色
col.lab	# 座標軸標記文字的顏色：內定是黑色
col.main	# 主標題（上標題）的顏色：內定是黑色
col.sub	# 副標題（下標題）的顏色：內定是黑色
bg	# 背景顏色：內定是透明

使用顏色圖形參數

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





使用顏色圖形參數

- # 設定四邊的文字符號
- 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))
- 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))
- mtext(text = c("Bottom", "Left", "Top", "Right"), side = 1:4, col = 1:4, line = -2)
- par(old.par)