105-2: EE4052

計算機程式設計

Computer Programming

Unit 13: 資料間的相關性

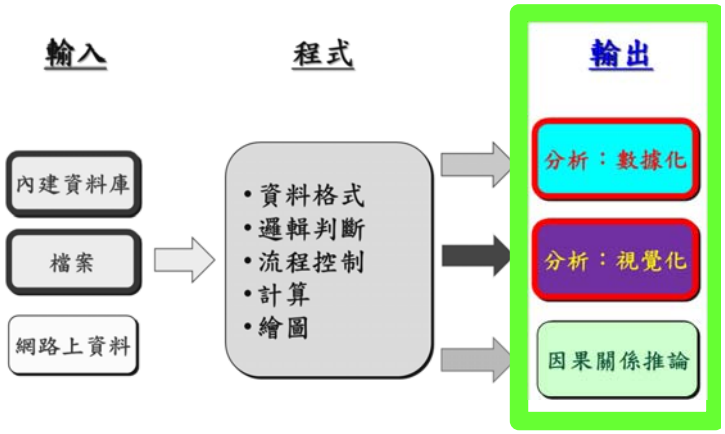
連 豐 力

臺 大 電 機 系

Feb 2017 - Jun 2017

課程主題進度

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



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- 資料間的線性關係
- lm: Linear Model
- nhanes2, cars, iris 的線性回歸模型
- 資料間的相關性
- 多維關係繪圖

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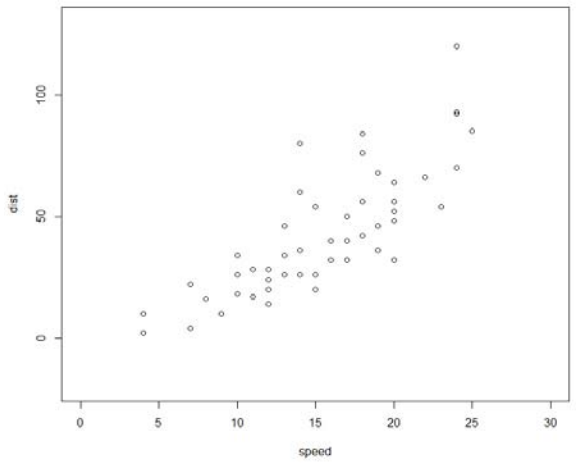
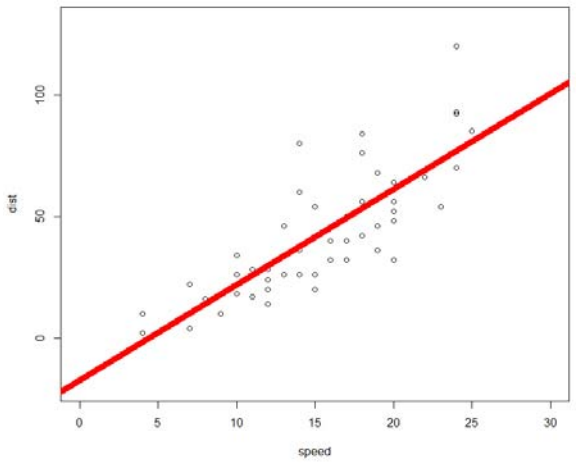
資料間的線性關係

資料庫：cars

- cars
- plot(cars, xlim = c(0, 30), ylim = c(-20, 130))

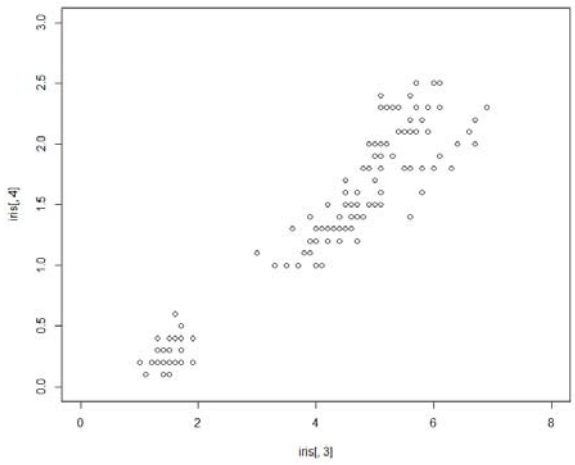


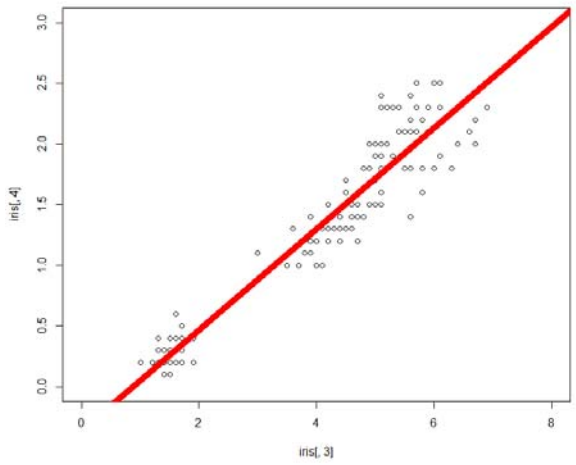


- abline(a = -17.579, b = 3.932, col = "red", lwd = 8)

資料庫： iris

- iris
- plot(iris[, 3], iris[, 4], xlim = c(0, 8), ylim = c(0, 3))





- abline(a = -0.3631, b = 0.4158, col = "red", lwd = 8)

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lm: Linear Model

Least Squares Approximation

Least Squares Approximation

- 參考資料：http://www.ms.uky.edu/~ma138/Spring15/Curve_fitting.pdf

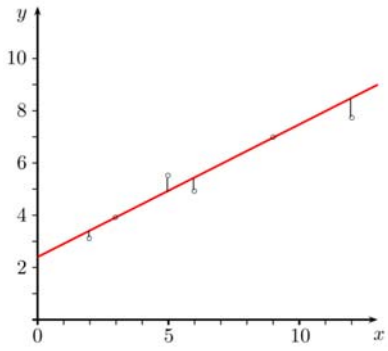

FIGURE 1: Fitting a straight line to data by the method of least squares

$$y = ax + b$$

$$\begin{cases} ax_1 + b &= y_1 \\ ax_2 + b &= y_2 \\ &\vdots \\ ax_n + b &= y_n \end{cases} \quad \rightsquigarrow \quad \begin{bmatrix} x_1 & 1 \\ x_2 & 1 \\ \vdots & \vdots \\ x_n & 1 \end{bmatrix} \begin{bmatrix} a \\ b \end{bmatrix} = \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{bmatrix}$$

$$\delta_1 = (ax_1 + b) - y_1, \quad \delta_2 = (ax_2 + b) - y_2, \quad \ldots, \quad \delta_n = (ax_n + b) - y_n.$$

$\sqrt{\delta_1^2 + \delta_2^2 + \ldots + \delta_n^2}$ is as small as possible.

$$\widehat{a} = \frac{n\left(\sum_{i=1}^{n} x_i y_i\right) - \left(\sum_{i=1}^{n} x_i\right)\left(\sum_{i=1}^{n} y_i\right)}{n\left(\sum_{i=1}^{n} x_i^2\right) - \left(\sum_{i=1}^{n} x_i\right)^2} \qquad \widehat{b} = \frac{1}{n}\left(\sum_{i=1}^{n} y_i - \widehat{a}\sum_{i=1}^{n} x_i\right),$$

$$y = \widehat{a}\,x + \widehat{b}$$

Least Squares Approximation

- 參考資料：http://www.ms.uky.edu/~ma138/Spring15/Curve_fitting.pdf

t (sec)	0.5	1.1	1.5	2.1	2.3
T (°C)	32.0	33.0	34.2	35.1	35.7

$T = at + b,$

$$\begin{cases} 0.5a+b &= 32.0 \\ 1.1a+b &= 33.0 \\ 1.5a+b &= 34.2 \\ 2.1a+b &= 35.1 \\ 2.3a+b &= 35.7 \end{cases} \rightsquigarrow \begin{bmatrix} 0.5 & 1 \\ 1.1 & 1 \\ 1.5 & 1 \\ 2.1 & 1 \\ 2.3 & 1 \end{bmatrix} \begin{bmatrix} a \\ b \end{bmatrix} = \begin{bmatrix} 32.0 \\ 33.0 \\ 34.2 \\ 35.1 \\ 35.7 \end{bmatrix}.$$

$$A^TA = \begin{bmatrix} 0.5 & 1.1 & 1.5 & 2.1 & 2.3 \\ 1 & 1 & 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} 0.5 & 1 \\ 1.1 & 1 \\ 1.5 & 1 \\ 2.1 & 1 \\ 2.3 & 1 \end{bmatrix} = \begin{bmatrix} 13.41 & 7.5 \\ 7.5 & 5 \end{bmatrix}$$

$$A^T\mathbf{b} = \begin{bmatrix} 0.5 & 1.1 & 1.5 & 2.1 & 2.3 \\ 1 & 1 & 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} 32.0 \\ 33.0 \\ 34.2 \\ 35.1 \\ 35.7 \end{bmatrix} = \begin{bmatrix} 259.42 \\ 170 \end{bmatrix}$$

$$\begin{bmatrix} 13.41 & 7.5 \\ 7.5 & 5 \end{bmatrix} \begin{bmatrix} a \\ b \end{bmatrix} = \begin{bmatrix} 259.42 \\ 170 \end{bmatrix}$$

$$\left[\begin{array}{cc|c} 13.41 & 7.5 & 259.42 \\ 7.5 & 5 & 170 \end{array}\right] \text{ is equivalent to } \left[\begin{array}{cc|c} 1 & 0 & 2.0463 \\ 0 & 1 & 30.93 \end{array}\right]$$

$\widehat{a} = 2.0463$ and $\widehat{b} = 30.93.$

$T(t) = 2.0463\,t + 30.93$

year	1980	1985	1990	1995
population	227	237	249	262

$P(t) = at + b.$

$$\begin{bmatrix} 0 & 1 \\ 5 & 1 \\ 10 & 1 \\ 15 & 1 \end{bmatrix} \begin{bmatrix} a \\ b \end{bmatrix} = \begin{bmatrix} 227 \\ 237 \\ 249 \\ 262 \end{bmatrix}$$

$$A^TA = \begin{bmatrix} 0 & 5 & 10 & 15 \\ 1 & 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} 0 & 1 \\ 5 & 1 \\ 10 & 1 \\ 15 & 1 \end{bmatrix} = \begin{bmatrix} 350 & 30 \\ 30 & 4 \end{bmatrix}$$

$$A^T\mathbf{b} = \begin{bmatrix} 0 & 5 & 10 & 15 \\ 1 & 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} 227 \\ 237 \\ 249 \\ 262 \end{bmatrix} = \begin{bmatrix} 7605 \\ 975 \end{bmatrix}$$

$$\begin{bmatrix} 350 & 30 \\ 30 & 4 \end{bmatrix} \begin{bmatrix} a \\ b \end{bmatrix} = \begin{bmatrix} 7605 \\ 975 \end{bmatrix}$$

$$\left[\begin{array}{cc|c} 350 & 30 & 7605 \\ 30 & 4 & 975 \end{array}\right] \text{ is equivalent to } \left[\begin{array}{cc|c} 1 & 0 & 117/50 \\ 0 & 1 & 1131/5 \end{array}\right]$$

$P(t) = 117/50 \cdot t + 1131/5.$

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三個資料庫

nhanes2, cars, iris

資料庫

- install.packages("mice") # 安裝 mice 軟體套件
- library(mice) # 載入 mice 軟體套件
- data(nhanes2)
- nrow(nhanes2) # nhanes2 資料集的橫列數
- ncol(nhanes2) # nhanes2 資料集的直行數
- summary(nhanes2) # nhanes2 資料集的概括資訊
- head(nhanes2)

```
> head( nhanes2 )
    age  bmi  hyp chl
1 20-39   NA <NA>  NA
2 40-59 22.7   no 187
3 20-39   NA   no 187
4 60-99   NA <NA>  NA
5 20-39 20.4   no 113
6 60-99   NA <NA> 184
```

```
> summary( nhanes2 )
    age          bmi          hyp          chl
 20-39:12   Min.   :20.40   no  :13   Min.   :113.0
 40-59: 7   1st Qu.:22.65   yes : 4   1st Qu.:185.0
 60-99: 6   Median :26.75   NA's: 8   Median :187.0
            Mean   :26.56             Mean   :191.4
            3rd Qu.:28.93             3rd Qu.:212.0
            Max.   :35.30             Max.   :284.0
            NA's   :9                 NA's   :10
```


線性回歸模型預測數值

- data0 <- nhanes2 # 針對第2, 4組數據
- subNA <- which(is.na(nhanes2[, 4]) == TRUE | is.na(nhanes2[, 2]) == TRUE)
- dataOK <- nhanes2[-subNA,]
- dataOK
- dataNA <- nhanes2[subNA,]
- dataNA

```
> lm_chl_bmi

Call:
lm(formula = chl ~ bmi, data = dataOK)

Coefficients:
(Intercept)          bmi
     87.130        3.963
```

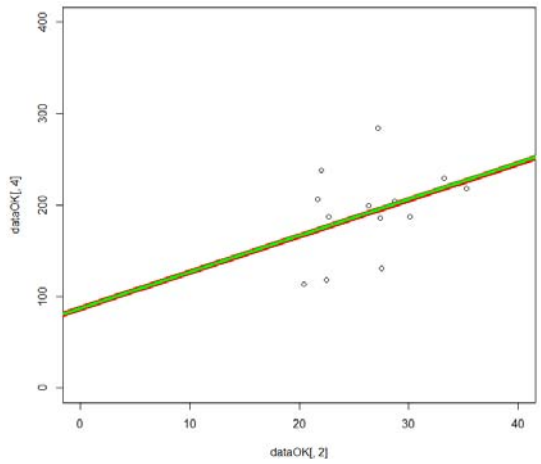
chl = 3.963 * bmi + 87.130

- lm_chl_bmi <- lm(chl ~ bmi, data = dataOK)
  - # 利用 dataOK 中 bmi 為引數，chl 為因變數，建構線性回歸模型

畫 y = b x + a 的直線

- abline( )　　# 畫 y = b x + a 的直線

- plot(dataOK[, 2], dataOK[, 4], xlim = c(0, 40), ylim = c(0, 400))
- abline(a = 87.130, b = 3.963, col = "red", lwd = 8)
- abline(lm_chl_bmi, col = "green", lwd = 4)



chl = 3.963 * bmi + 87.130

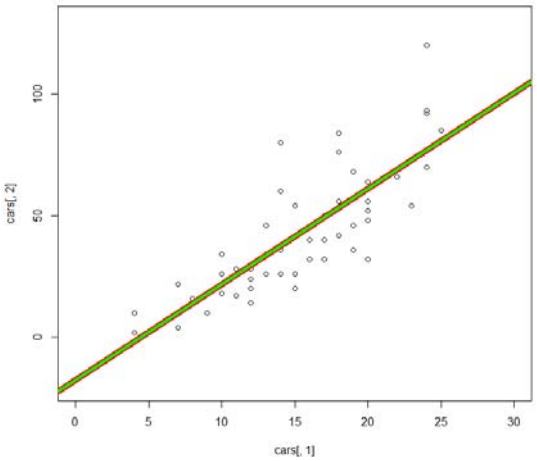
```
> lm_chl_bmi

Call:
lm(formula = chl ~ bmi, data = dataOK)

Coefficients:
(Intercept)          bmi
     87.130        3.963
```


另一個資料：cars

- cars
- plot(cars[, 1], cars[, 2], xlim = c(0, 30), ylim = c(-20, 130))
- lm_cars <- lm(dist ~ speed, data = cars)
- lm_cars
- abline(a = -17.579, b = 3.932, col = "red", lwd = 8)
- abline(lm_cars, col = "green", lwd = 4)



chl = 3.932 * speed – 17.579

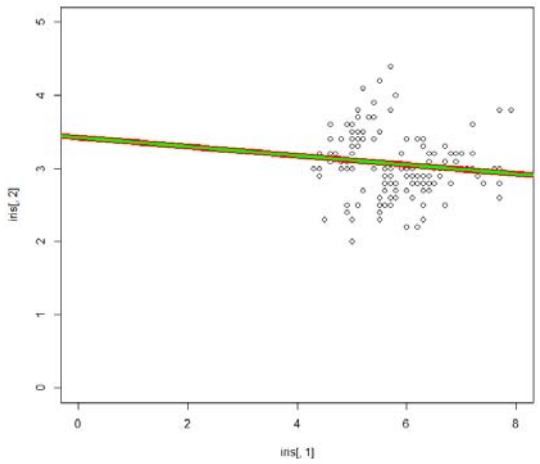
```
> lm_cars

Call:
lm(formula = dist ~ speed, data = cars)

Coefficients:
(Intercept)        speed
    -17.579        3.932
```

另一個資料：iris

- iris
- plot(iris[, 1], iris[, 2], xlim = c(0, 8), ylim = c(0, 5))
- lm_iris_1 <- lm(Sepal.Width ~ Sepal.Length, data = iris)
- lm_iris_1
- abline(a = 3.41895, b = -0.06188 , col = "red", lwd = 8)
- abline(lm_iris_1, col = "green", lwd = 4)




```
Sepal.Width = -0.06188 * Sepal.Length + 3.41895
```

```
> lm_iris_1

Call:
lm(formula = Sepal.Width ~ Sepal.Length,
data = iris)

Coefficients:
 (Intercept)  Sepal.Length
     3.41895       -0.06188
```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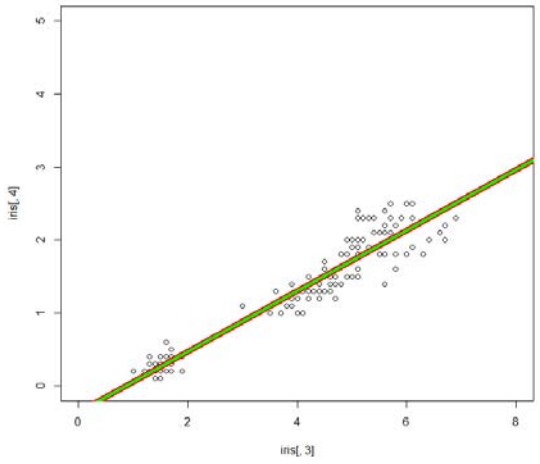
另一個資料：iris

- iris
- plot(iris[, 3], iris[, 4], xlim = c(0, 8), ylim = c(0, 5))
- lm_iris_2 <- lm(Petal.Width ~ Petal.Length, data = iris)
- lm_iris_2
- abline(a = -0.3631, b = 0.4158, col = "red", lwd = 8)
- abline(lm_iris_2, col = "green", lwd = 4)




```
Petal.Width = 0.4158 * Petal.Length - 0.3631
```

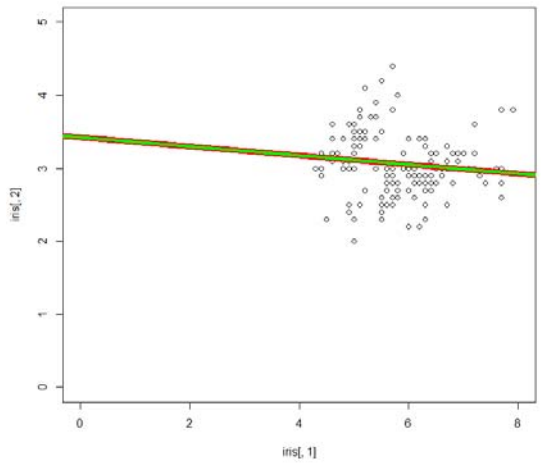
```
> lm_iris_2

Call:
lm(formula = Petal.Width ~ Petal.Length,
data = iris)

Coefficients:
 (Intercept)  Petal.Length
     -0.3631        0.4158
```

另一個資料：iris

- iris

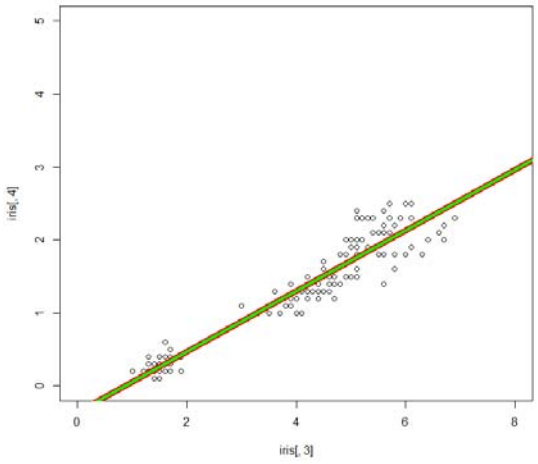
```
> lm_iris_1

Call:
lm(formula = Sepal.Width ~ Sepal.Length,
data = iris)

Coefficients:
 (Intercept)  Sepal.Length
     3.41895       -0.06188
```

Sepal.Width = -0.06188 * Sepal.Length + 3.41895



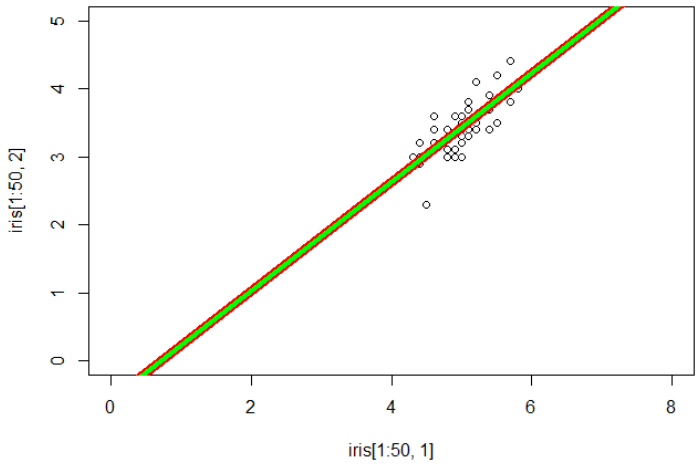

```
> lm_iris_2

Call:
lm(formula = Petal.Width ~ Petal.Length,
data = iris)

Coefficients:
 (Intercept)  Petal.Length
     -0.3631        0.4158
```

Petal.Width = 0.4158 * Petal.Length - 0.3631



另一個資料：iris, 依照種類

- iris
- plot(iris[1:50, 1], iris[1:50, 2], xlim = c(0, 8), ylim = c(0, 5))
- lm_iris_11 <- lm(Sepal.Width ~ Sepal.Length, data = iris[1:50,])
- abline(a = -0.5694, b = 0.7985, col = "red", lwd = 8)
- abline(lm_iris_11, col = "green", lwd = 4)

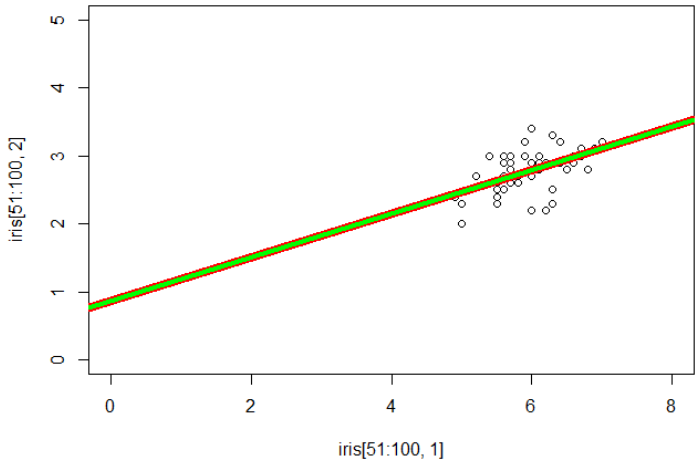


Sepal.Width = 0.7985 * Sepal.Length - 0.5694

```
> lm_iris_11

Call:
lm(formula = Sepal.Width ~ Sepal.Length,
data = iris[1:50, ] )

Coefficients:
 (Intercept)  Sepal.Length
     -0.5694        0.7985
```

另一個資料：iris, 依照種類

- iris
- plot(iris[51:100, 1], iris[51:100, 2], xlim = c(0, 8), ylim = c(0, 5))
- lm_iris_12 <- lm(Sepal.Width ~ Sepal.Length, data = iris[51:100,])
- abline(a = 0.8721, b = 0.3197, col = "red", lwd = 8)
- abline(lm_iris_12, col = "green", lwd = 4)




```
Sepal.Width = 0.3197 * Sepal.Length + 0.8721
```

```
> lm_iris_12

Call:
lm(formula = Sepal.Width ~ Sepal.Length,
data = iris[51:100, ] )

Coefficients:
 (Intercept)  Sepal.Length
      0.8721        0.3197
```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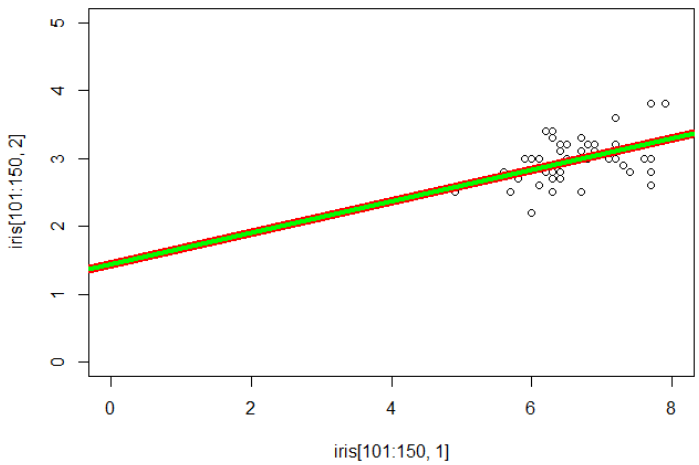
另一個資料：iris, 依照種類

- iris
- plot(iris[101:150, 1], iris[101:150, 2], xlim = c(0,8), ylim = c(0,5))
- lm_iris_13 <- lm(Sepal.Width ~ Sepal.Length, data = iris[101:150,])
- abline(a = 1.4463, b = 0.2319, col = "red", lwd = 8)
- abline(lm_iris_13, col = "green", lwd = 4)




```
Sepal.Width = 0.3197 * Sepal.Length + 1.4463
```

```
> lm_iris_13

Call:
lm(formula = Sepal.Width ~ Sepal.Length,
data = iris[101:150, ] )

Coefficients:
 (Intercept)  Sepal.Length
      1.4463        0.2319
```

另一個資料：iris, 依照種類

- lm_iris_11 <- lm(Sepal.Width ~ Sepal.Length, data = iris[1:50,])
- lm_iris_12 <- lm(Sepal.Width ~ Sepal.Length, data = iris[51:100,])
- lm_iris_13 <- lm(Sepal.Width ~ Sepal.Length, data = iris[101:150,])
- lm_iris_21 <- lm(Petal.Width ~ Petal.Length, data = iris[1:50,])
- lm_iris_22 <- lm(Petal.Width ~ Petal.Length, data = iris[51:100,])
- lm_iris_23 <- lm(Petal.Width ~ Petal.Length, data = iris[101:150,])

另一個資料：iris, 依照種類

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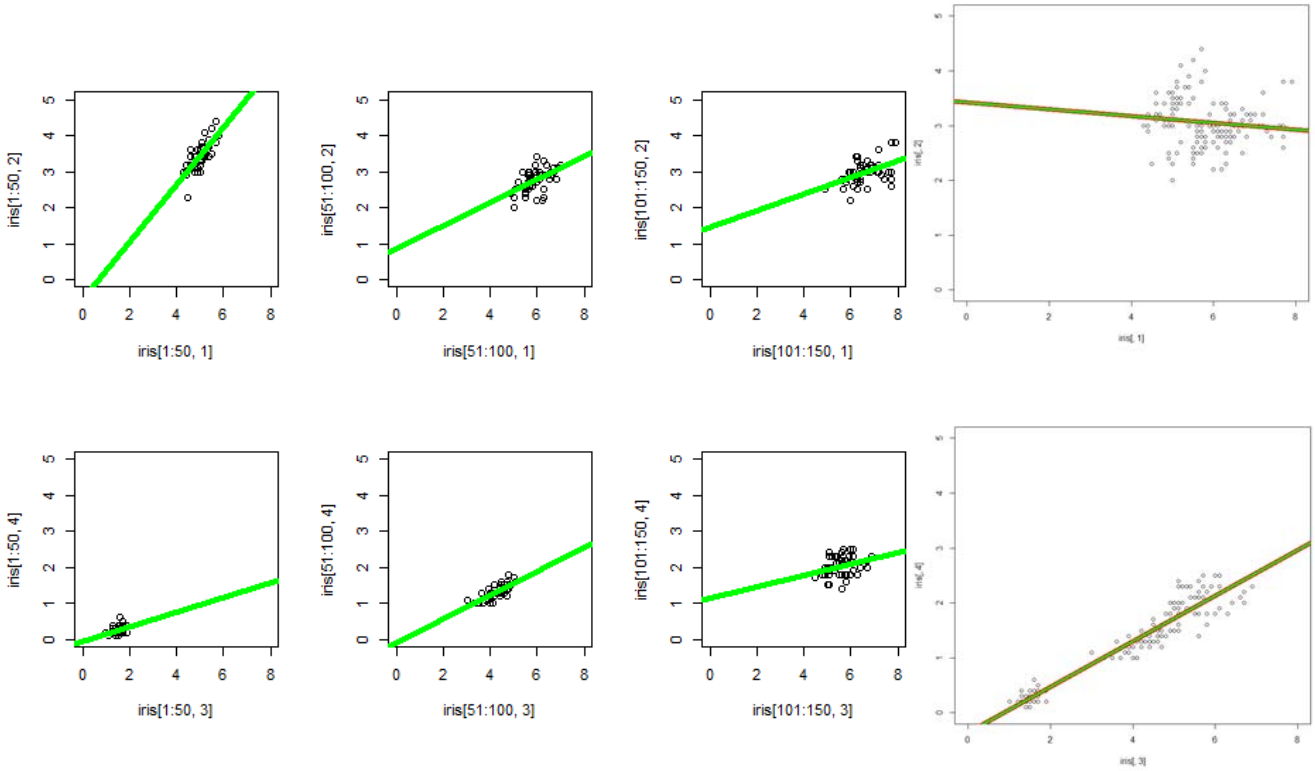
- layout(matrix(1:6, nrow = 2, byrow = T))
- plot(iris[1:50, 1], iris[1:50, 2], xlim = c(0, 8), ylim = c(0, 5))
- abline(lm_iris_11, col = "green", lwd = 4)
- plot(iris[51:100, 1], iris[51:100, 2], xlim = c(0, 8), ylim = c(0, 5))
- abline(lm_iris_12, col = "green", lwd = 4)
- plot(iris[101:150, 1], iris[101:150, 2], xlim = c(0,8), ylim = c(0,5))
- abline(lm_iris_13, col = "green", lwd = 4)
- plot(iris[1:50, 3], iris[1:50, 4], xlim = c(0, 8), ylim = c(0, 5))
- abline(lm_iris_21, col = "green", lwd = 4)
- plot(iris[51:100, 3], iris[51:100, 4], xlim = c(0, 8), ylim = c(0, 5))
- abline(lm_iris_22, col = "green", lwd = 4)
- plot(iris[101:150, 3], iris[101:150, 4], xlim = c(0,8), ylim = c(0,5))
- abline(lm_iris_23, col = "green", lwd = 4)

另一個資料：iris, 依照種類



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資料間的相關性

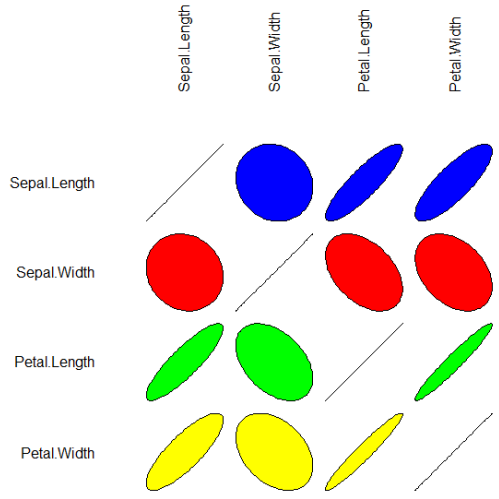
相關性

```
# cor( ), correlation 相關係數

cor( x, y )

cor_matrix <- cor( data_all, use = "pairwise" )


cor_iris <- cor( iris[, 1:4], use = "pairwise")

cor_iris
```

```
> cor_iris

             Sepal.Length Sepal.Width Petal.Length Petal.Width
Sepal.Length    1.0000000  -0.1175698    0.8717538   0.8179411
Sepal.Width    -0.1175698   1.0000000   -0.4284401  -0.3661259
Petal.Length    0.8717538  -0.4284401    1.0000000   0.9628654
Petal.Width     0.8179411  -0.3661259    0.9628654   1.0000000
```


相關性

```
# plotcoor( ), 繪製相關圖

install.packages( "ellipse" )

library( ellipse )

plotcorr( cor_iris, col = c( "blue", "red", "green", "yellow" ) )
```




```
> cor_iris

             Sepal.Length Sepal.Width Petal.Length Petal.Width
Sepal.Length    1.0000000  -0.1175698    0.8717538   0.8179411
Sepal.Width    -0.1175698   1.0000000   -0.4284401  -0.3661259
Petal.Length    0.8717538  -0.4284401    1.0000000   0.9628654
Petal.Width     0.8179411  -0.3661259    0.9628654   1.0000000
```

相關性

```
# use weather dataset

install.packages( "rattle" )

library( rattle )

data( weather )

head( weather[ , 12:21] )          # 12 to 21 variable names, values
```

```
> head( weather[ , 12:21] )
  WindSpeed9am WindSpeed3pm Humidity9am Humidity3pm Pressure9am Pressure3pm Cloud9am Cloud3pm Temp9am Temp3pm
1            6           20          68          29      1019.7      1015.0        7        7    14.4    23.6
2            4           17          80          36      1012.4      1008.4        5        3    17.5    25.7
3            6            6          82          69      1009.5      1007.2        8        7    15.4    20.2
4           30           24          62          56      1005.5      1007.0        2        7    13.5    14.1
5           20           28          68          49      1018.3      1018.5        7        7    11.1    15.4
6           20           24          70          57      1023.8      1021.7        7        5    10.9    14.8
```

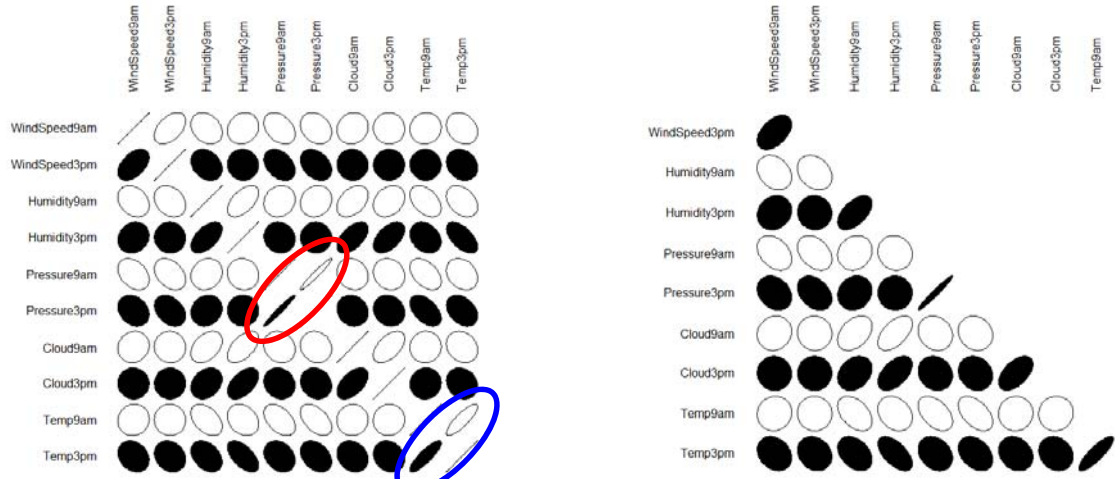

相關性

```
# correlation matrix 相關係數矩陣

var <- c( 12:21 )

cor_matrix <- cor( weather[ var ], use = "pairwise" )
```

```
> cor_matrix
              WindSpeed9am WindSpeed3pm Humidity9am Humidity3pm Pressure9am Pressure3pm    Cloud9am    Cloud3pm     Temp9am    Temp3pm
WindSpeed9am    1.00000000   0.47296617  -0.2706229  0.14665712 -0.35633183 -0.24795238  0.10184246 -0.02247149  0.06407405 -0.2351864
WindSpeed3pm    0.47296617   1.00000000  -0.2660925 -0.02636775 -0.35980011 -0.33732535 -0.02642642  0.00720724 -0.01776636 -0.1875697
Humidity9am    -0.27062286  -0.26609247   1.0000000  0.54671844  0.13572697  0.13442050  0.39284158  0.27193809 -0.43655057 -0.3551186
Humidity3pm     0.14665712  -0.02636775   0.5467184  1.00000000 -0.08794614 -0.01005189  0.55163264  0.51010790 -0.25568147 -0.5816761
Pressure9am    -0.35633183  -0.35980011   0.1357270 -0.08794614  1.00000000  0.96789496 -0.15755279 -0.14100043 -0.46041819 -0.2536738
Pressure3pm    -0.24795238  -0.33732535   0.1344205 -0.01005189  0.96789496  1.00000000 -0.12894408 -0.14383718 -0.49263629 -0.3454853
Cloud9am        0.10184246  -0.02642642   0.3928416  0.55163264 -0.15755279 -0.12894408  1.00000000  0.52521793  0.02104135 -0.2023440
Cloud3pm       -0.02247149   0.00720724   0.2719381  0.51010790 -0.14100043 -0.14383718  0.52521793  1.00000000  0.04094519 -0.1728142
Temp9am         0.06407405  -0.01776636  -0.4365506 -0.25568147 -0.46041819 -0.49263629  0.02104135  0.04094519  1.00000000  0.8444058
Temp3pm        -0.23518635  -0.18756965  -0.3551186 -0.58167615 -0.25367375 -0.34548531 -0.20234405 -0.17281423  0.84440581  1.0000000
```

相關性

```
# plotcoor( ), 繪製相關圖
install.packages( "ellipse" )
library( ellipse )
plotcorr( cor_matrix, col = rep( c( "white", "black" ) ))
plotcorr( cor_matrix, type = "lower", col = rep( c( "white", "black" ) ))
```



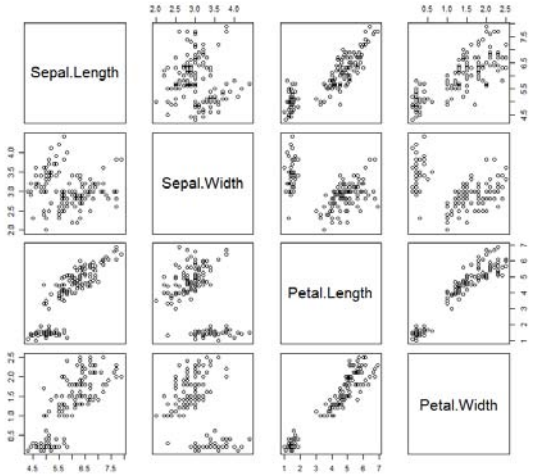
大綱

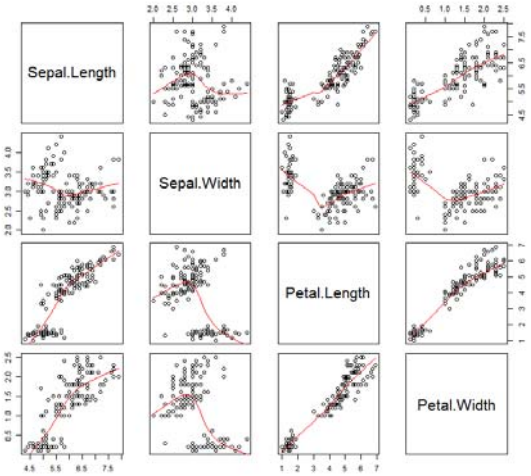
多維關係繪圖

資料庫：iris

- iris
- x <- iris[, 1:4]

- plot(x)
- pairs(x)
- pairs(x, panel = panel.smooth)





多維繪圖 – 散點 直方 核密度

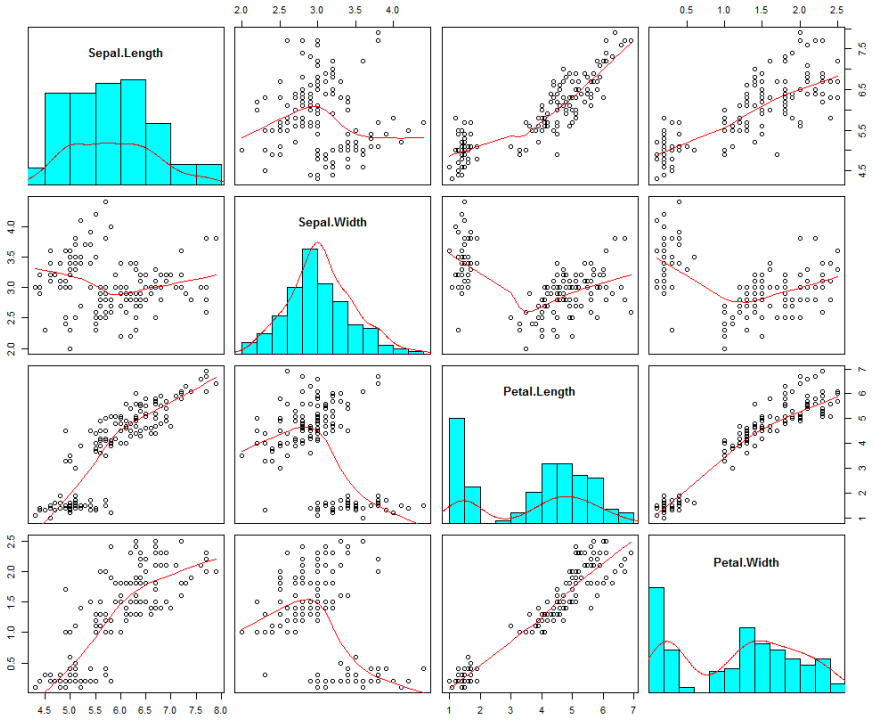
scatterplot

- iris
- x <- iris[, 1:4]

```
panel.hist <- function(x, ...) {
    usr <- par("usr"); on.exit(par(usr))
    par(usr = c(usr[1:2], 0, 1.5) )
    h <- hist(x, plot = FALSE)
    breaks <- h$breaks; nB <- length(breaks)
    y <- h$counts; y <- y / max(y)
    rect(breaks[-nB], 0, breaks[-1], y, col = "cyan", ...)
      lines(density(x, na.rm = TRUE), col = "red")
}

pairs( x, panel = panel.smooth, pch = 1, bg = "lightcyan",
     diag.panel = panel.hist, font.labels = 2, cex.labels = 1.2 )
```

多維繪圖 – 散點 直方 核密度

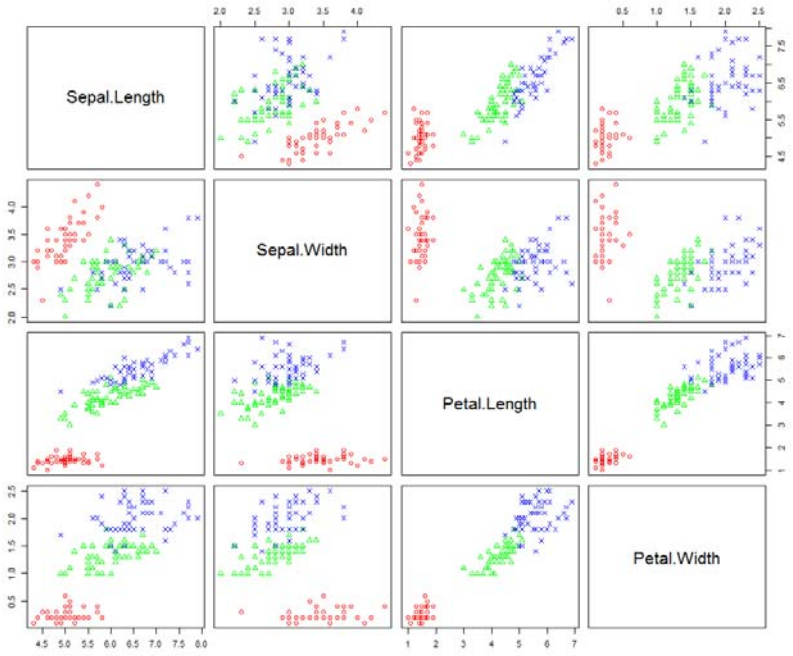
scatterplot



多維繪圖 – 散點 直方 核密度

- iris
- pairs(iris[, 1:4], pch = c(1, 2, 4)[iris$Species], col = c("red", "green", "blue")[iris$Species])

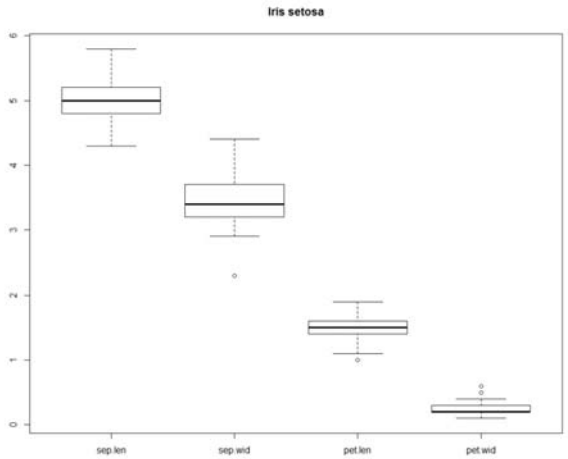
scatterplot
不同品種之
散點圖



多維繪圖 – 多重分布

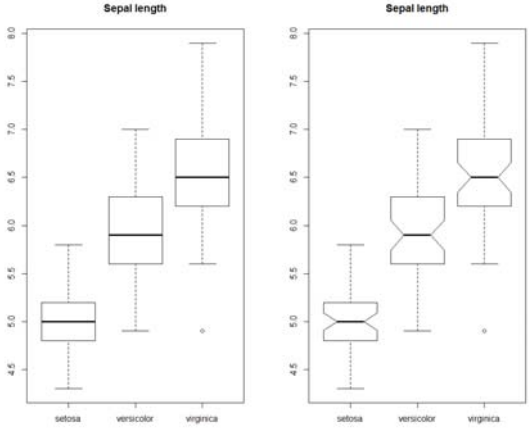
- 第一品種之中，
  花萼長度, 花萼寬度, 花瓣長度, 花瓣寬度，分布情形

- setosa <- iris[iris$Species == "setosa", 1:4]
- boxplot(setosa, names = c("sep.len", "sep.wid", "pet.len", "pet.wid"), main = "Iris setosa")



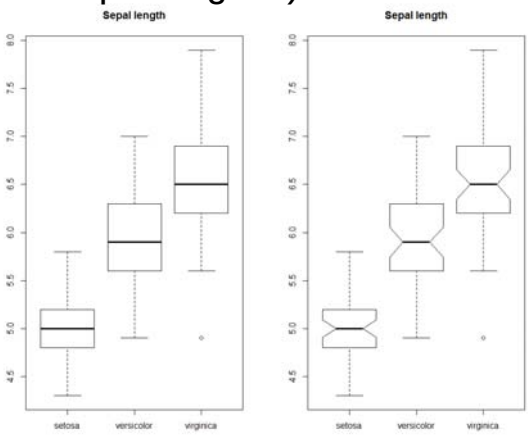
多維繪圖 – 多重分布

- 三個品種，
  花萼長度, 花萼寬度, 花瓣長度, 花瓣寬度，分布情形
- par(mfrow = c(1, 2))
- with(iris, boxplot(Sepal.Length ~ Species, main = "Sepal length"))
- with(iris, boxplot(Sepal.Length ~ Species, notch = TRUE, main = "Sepal length"))



多維繪圖 – 多重分布

- 三個品種，
  花萼長度, 花萼寬度, 花瓣長度, 花瓣寬度，分布情形
- 依照不同種類，先分成三群
- par(mfrow = c(1, 2))
- sx <- with(iris, split(Sepal.Length, Species))
- boxplot(sx, main = "Sepal length")
- boxplot(sx, notch = TRUE, main = "Sepal length")



多維繪圖 – 多重分布

- 花萼長度 與 花萼寬度 之間的關係
- 依照不同種類，先分成三群
- sx <- with(iris, split(Sepal.Length, Species))
- sy <- with(iris, split(Sepal.Width, Species))

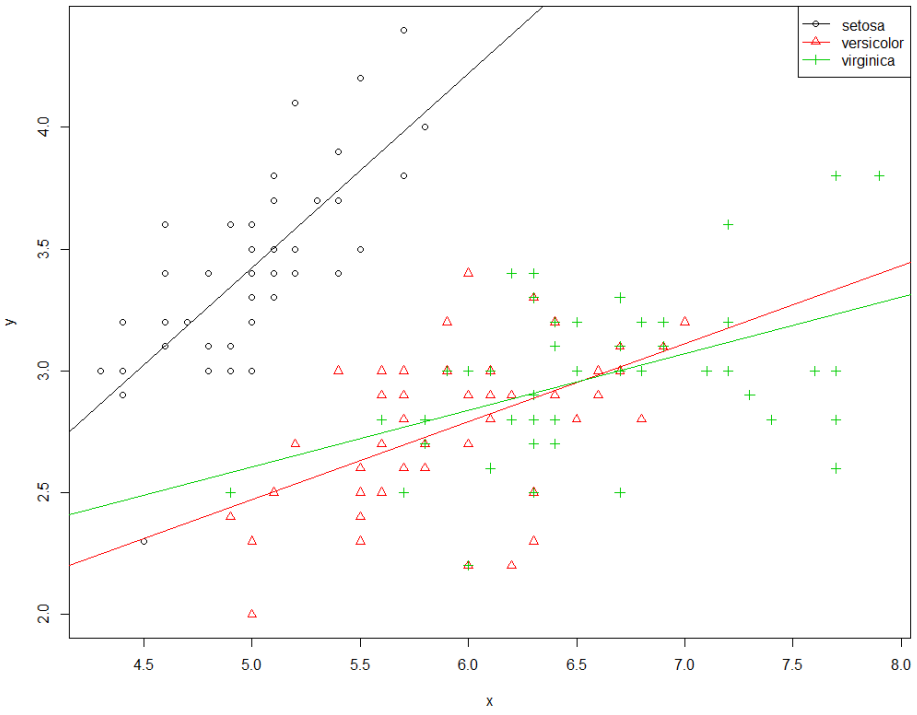
不同品種之散點圖

- par(mfrow = c(1, 1))
- plot(0, xlim = range(sx), ylim = range(sy), type = "n", xlab = "x", ylab = "y")
- points(sx[[1]], sy[[1]], pch = 1, col = 1)
- points(sx[[2]], sy[[2]], pch = 2, col = 2)
- points(sx[[3]], sy[[3]], pch = 3, col = 3)

- for (i in 1:3) abline(lm(sy[[i]] ~ sx[[i]]), col = i)
- legend("topright", legend = c("setosa", "versicolor", "virginica"), lty = 1, pch = 1:3, col = 1:3)

多維繪圖 – 多重分布

不同品種之散點圖

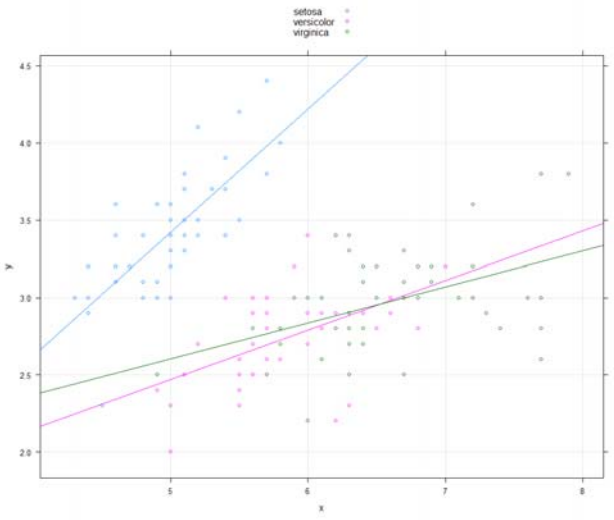


多維繪圖 – 多重分布

不同品種之散點圖

- 花萼長度 與 花萼寬度 之間的關係
- 依照不同種類，先分成三群

- x <- iris[[1]]
- y <- iris[[2]]



- species <- iris[[5]]

- library(lattice)

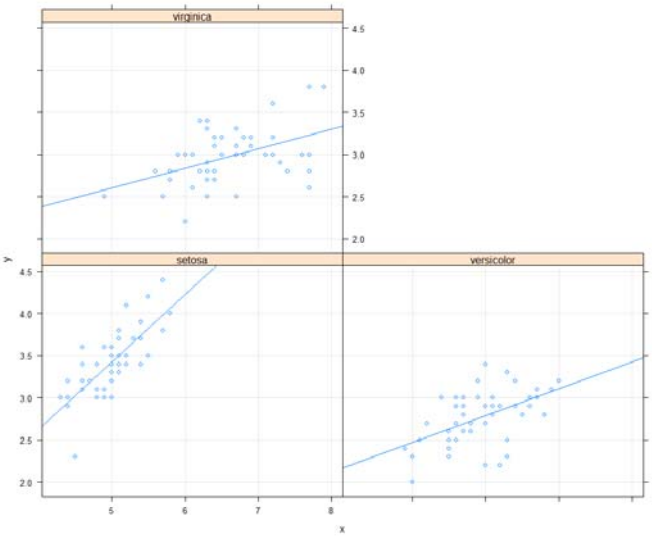
- xyplot(y ~ x, groups = species, type = c("g", "p", "r"), auto.key = TRUE)

多維繪圖 – 多重分布

- 花萼長度 與 花萼寬度 之間的關係
- 依照不同種類，先分成三群

不同品種分開之散點圖

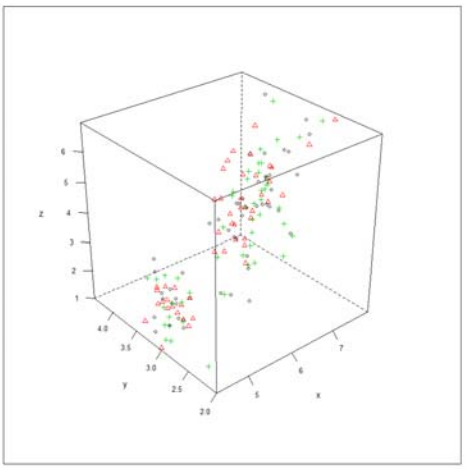
- x <- iris[[1]]
- y <- iris[[2]]
- species <- iris[[5]]
- library(lattice)



- xyplot(y ~ x | species, type = c("g", "p", "r"), auto.key = TRUE)

多維繪圖 – 三維散點圖

- (花萼長度, 花萼寬度, 花瓣長度)
- data(iris)
- x <- iris[, 1]
- y <- iris[, 2]
- z <- iris[, 3]
- library(lattice)



- cloud(z ~ x * y, groups = iris$Spieces, pch = 1:3, col = 1:3,
- scales = list(arrows = FALSE),
- light.source = c(10, 0, 10))