105-1: EE4052

計算機程式設計

Computer Programming

Unit 11: 探索性資料分析

連 豊 力

臺 大 電 機 系

Sep 2016 - Jan 2017

大綱

- 數據化探索
  - 變數概況
  - 變數詳情
  - 分布指標
  - 相關性
- 視覺化探索
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  - 累積分布圖
  - 箱形圖 盒鬚圖
  - 橫條圖
  - 點陣圖
  - 圓形圖

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資料庫

資料庫

- Insurance 資料集：
  記錄了某保險公司在 1973年第三季車險投保人的相關資料
- District: 投保人家庭住址所在區域，
  設定值：1-4
- Group: 所投保汽車的引擎排氣量：
  1升，1-1.5升， 1.5-2升，大於2升，四個等級
- Age: 投保人年齡：
  小於25歲，25-29歲，30-35歲，大於35歲，四組別
- Holders: 投保人數量
- Claims: 要求索賠的投保人數量

資料庫

- install.packages("MASS")
- library(MASS)
- data(Insurance)
- nrow(Insurance)
- ncol(Insurance)
- dim(Insurance)
- head(Insurance)
- tail(Insurance)

```
> head( Insurance )

  District  Group   Age Holders Claims
1        1    <1l   <25     197     38
2        1    <1l 25-29     264     35
3        1    <1l 30-35     246     20
4        1    <1l   >35    1680    156
5        1 1-1.5l   <25     284     63
6        1 1-1.5l 25-29     536     84

> tail( Insurance )

   District  Group   Age Holders Claims
59        4 1.5-2l 30-35      68     16
60        4 1.5-2l   >35     344     63
61        4    >2l   <25       3      0
62        4    >2l 25-29      16      6
63        4    >2l 30-35      25      8
64        4    >2l   >35     114     33
```


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數據化探索 - 變數概況

變數概況

- # variable attribute, 資料集變數屬性
- attributes(Insurance)

```
> attributes( Insurance )

$names
[1] "District" "Group"    "Age"      "Holders"  "Claims"

$class
[1] "data.frame"

$row.names
 [1]  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19
[20] 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38
[39] 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57
[58] 58 59 60 61 62 63 64
```

- # internal structure, 內部結構
- str(Insurance)

```
> str( Insurance )

'data.frame':       64 obs. of  5 variables:
 $ District: Factor w/ 4 levels "1","2","3","4": 1 1 1 1 1 1 1 1 1 1 ...
 $ Group   : Ord.factor w/ 4 levels "<1l"<"1-1.5l"<..: 1 1 1 1 2 2 2 2 3 3 ...
 $ Age     : Ord.factor w/ 4 levels "<25"<"25-29"<..: 1 2 3 4 1 2 3 4 1 2 ...
 $ Holders : int  197 264 246 1680 284 536 696 3582 133 286 ...
 $ Claims  : int  38 35 20 156 63 84 89 400 19 52 ...
```


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變數概況

- # summary, 統計指標值
- summary(Insurance)

```
> summary( Insurance )

 District    Group       Age        Holders           Claims
 1:16     <1l   :16   <25  :16   Min.   :   3.00   Min.   :  0.00
 2:16     1-1.5l:16   25-29:16   1st Qu.:  46.75   1st Qu.:  9.50
 3:16     1.5-2l:16   30-35:16   Median : 136.00   Median : 22.00
 4:16     >2l   :16   >35  :16   Mean   : 364.98   Mean   : 49.23
                                 3rd Qu.: 327.50   3rd Qu.: 55.50
                                 Max.   :3582.00   Max.   :400.00
```

- 定性變數：各水準的設定值的頻數
  - District, Group, Age: 四種的出現頻率都是16個
- 定量變數：統計數字指標
  - 最小值，第一四分位點，中位數（第二四分位點），平均值，第三四分位點，最大值
  - 中位數與平均值的差異：判斷資料的偏倚程度，左偏或右偏

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數據化探索 - 變數詳情

變數詳情

describe( ) in Hmisc, 更詳細的變數情況，使用 Hmisc 軟體套件 describe( )

```
install.packages( "Hmisc" )
library( Hmisc )
describe( Insurance[ , 1:3] )
```

n: 樣本總個數

missing: 缺失樣本數

unique: 水準個數

每一個水準：
設定值，頻數，頻率

```
> describe( Insurance[ , 1:3] )

Insurance[, 1:3]

 3  Variables      64  Observations
---------------------------------------------------------------------
District
       n  missing distinct
      64        0        4

1 (16, 0.25), 2 (16, 0.25), 3 (16, 0.25), 4 (16, 0.25)
---------------------------------------------------------------------
Group
       n  missing distinct
      64        0        4

<1l (16, 0.25), 1-1.5l (16, 0.25), 1.5-2l (16, 0.25), >2l (16, 0.25)
---------------------------------------------------------------------
Age
       n  missing distinct
      64        0        4

<25 (16, 0.25), 25-29 (16, 0.25), 30-35 (16, 0.25), >35 (16, 0.25)
---------------------------------------------------------------------
```

變數詳情

describe( ) in Hmisc, 更詳細的變數情況，使用 Hmisc 軟體套件 describe( )

```
install.packages( "Hmisc" )
library( Hmisc )
describe( Insurance[ , 4:5] )
```

n: 樣本總個數

missing: 缺失樣本數

unique: 水準個數

每一個水準：
設定值，頻數，頻率

```
> describe( Insurance[ , 4:5] )

Insurance[, 4:5]

 2  Variables      64  Observations
---------------------------------------------------------------------------
Holders
       n  missing distinct     Info     Mean      Gmd      .05
      64        0       63        1      365    497.1    16.30
     .10      .25      .50      .75      .90      .95
   24.00    46.75   136.00   327.50   868.90  1639.25

lowest :    3    7    9   16   18, highest: 1635 1640 1680 2443 3582
---------------------------------------------------------------------------
Claims
       n  missing distinct     Info     Mean      Gmd      .05
      64        0       46    0.999    49.23    60.66     3.15
     .10      .25      .50      .75      .90      .95
    4.30     9.50    22.00    55.50   101.70   182.35

lowest :   0   2   3   4   5, highest: 156 187 233 290 400
---------------------------------------------------------------------------
```


變數詳情

basicStats( ) in fBasics, 輸出指標更豐富，使用 fBasics 軟體套件

```
install.packages( "fBasics" )
library( fBasics )
basicStats( Insurance$Holders )
```

```
> basicStats( Insurance$Holders )

            X..Insurance.Holders
nobs                6.400000e+01
NAs                 0.000000e+00
Minimum             3.000000e+00
Maximum             3.582000e+03
1. Quartile         4.675000e+01
3. Quartile         3.275000e+02
Mean                3.649844e+02
Median              1.360000e+02
Sum                 2.335900e+04
SE Mean             7.784632e+01
LCL Mean            2.094209e+02
UCL Mean            5.205478e+02
Variance            3.878432e+05
Stdev               6.227706e+02
Skewness            3.127833e+00
Kurtosis            1.099961e+01
```

觀測樣本數
遺漏數
最小
最大
第一四分位點
第三四分位點
平均值
中位數
總和
標準誤差平均值
95%置信水準平均值之置信下限
95%置信水準平均值之置信上限
變異量
標準誤差
偏度
峰度

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數據化探索 - 分布指標

分布指標 – Insurance

skewness( ), kurtosis( ), in timeDate, 更詳細的分布指標

```
install.packages( "timeDate" )

library( timeDate )

skewness( Insurance[ , 4:5] )

kurtosis( Insurance[ , 4:5] )
```

```
> skewness( Insurance[ , 4:5] )

 Holders   Claims
3.127833 2.877292

> kurtosis( Insurance[ , 4:5] )

  Holders    Claims
10.999610  9.377258
```

分布指標 – Insurance

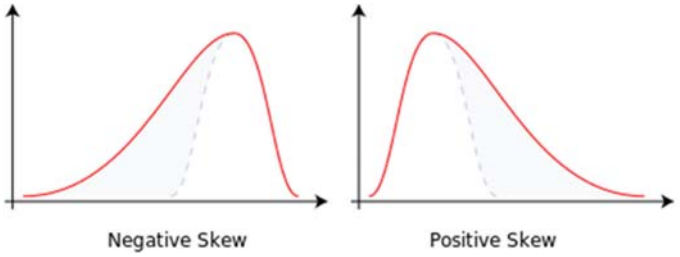
skewness( ), kurtosis( ), in timeDate, 更詳細的分布指標

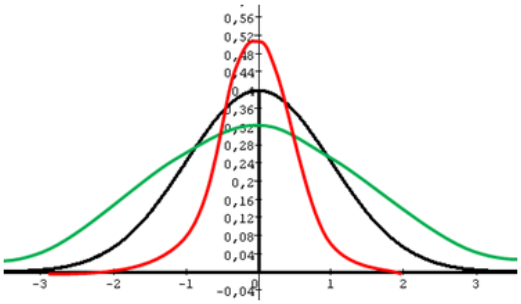
偏度： 衡量資料的偏倚程度或對稱程度

= 0: 正態分布，完全對稱
[-1, 1]: 對稱性較強，不存在左偏或右偏
> 1: 右偏
< -1: 左偏

峰度： 衡量資料的分布型態的陡緩程度，集中或分散

= 0: 集散程度與正態分布相同，為標準峰度
> 0: 比正態分布較為陡峭，為尖頂峰度
< 0: 比正態分布較為平坦，為平頂峰度





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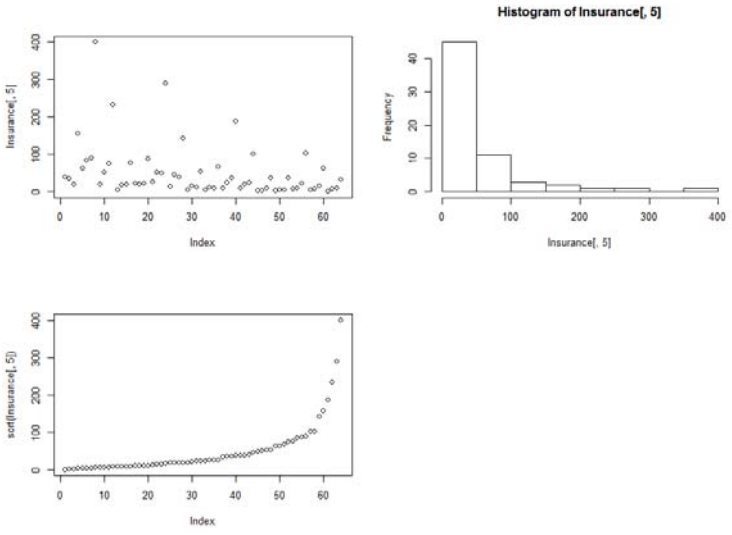
分布指標 – Insurance

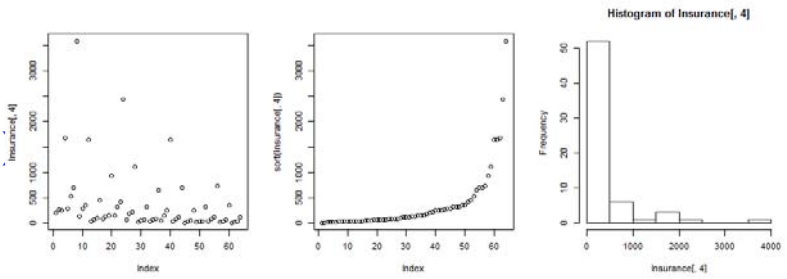
skewness( ), kurtosis( ), in timeDate, 更詳細的分布指標

```
set.seed(1)

s1 <- .Random.seed

y <- rnorm( 100 )

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

plot( y )

plot( sort( y ) )

hist( y )
```

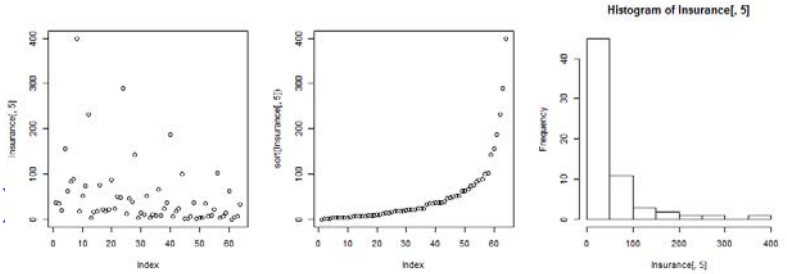


分布指標 – Insurance

```
# skewness( ), kurtosis( ), in timeDate, 更詳細的分布指標

layout( matrix( 1:6, nrow=2, byrow=T) )

plot( Insurance[ , 4] )

plot( sort( Insurance[ , 4] ) )

hist( Insurance[ , 4] )
```




```
plot( Insurance[ , 5] )

plot( sort( Insurance[ , 5] ) )

hist( Insurance[ , 5] )
```



分布指標 – Insurance

```
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```

偏度： 衡量資料的偏倚程度或對稱程度

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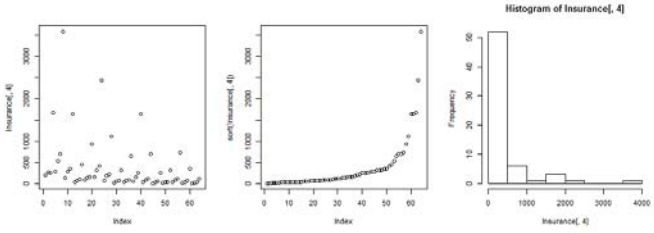
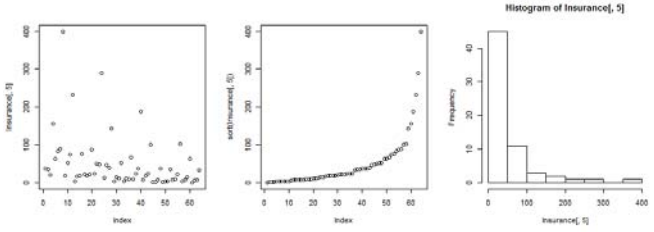
```
> skewness( Insurance[ , 4:5] )

 Holders   Claims
3.127833 2.877292
```



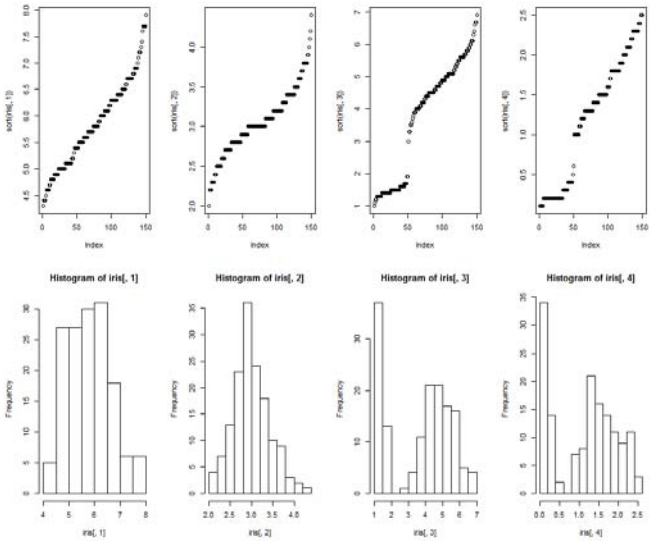

```
> kurtosis( Insurance[ , 4:5] )

  Holders    Claims
10.999610  9.377258
```



分布指標 – iris

```
# skewness( ), kurtosis( ), in timeDate, 更詳細的分布指標
layout( matrix( 1:8, nrow=2, byrow=F ) )
plot( sort( iris[ , 1 ] ) )
hist( iris[ , 1 ] )
plot( sort( iris[ , 2 ] ) )
hist( iris[ , 2 ] )
plot( sort( iris[ , 3 ] ) )
hist( iris[ , 3 ] )
plot( sort( iris[ , 4 ] ) )
hist( iris[ , 4 ] )
```



分布指標 – iris

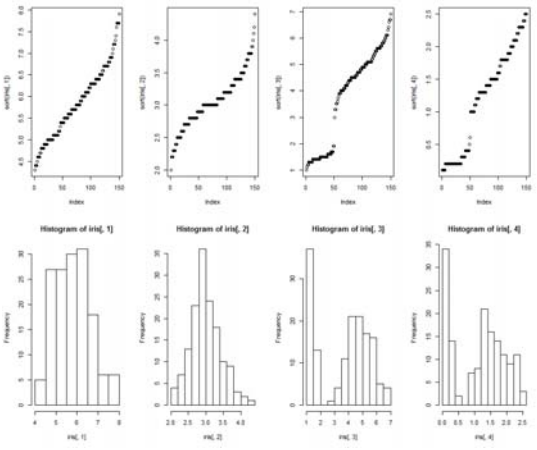
```
# skewness( ), kurtosis( ), in timeDate, 更詳細的分布指標
install.packages( "timeDate" )
library( timeDate )
skewness( iris[ , 1:4] )
kurtosis( iris[ , 1:4] )
```

```
> skewness( iris[ , 1:4] )

Sepal.Length  Sepal.Width Petal.Length  Petal.Width
   0.3086407    0.3126147   -0.2694109   -0.1009166

> kurtosis( iris[ , 1:4] )

Sepal.Length  Sepal.Width Petal.Length  Petal.Width
  -0.6058125    0.1387047   -1.4168574   -1.3581792
```



偏度：衡量資料的偏倚程度或對稱程度
- = 0: 正態分布，完全對稱
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- > 1: 右偏
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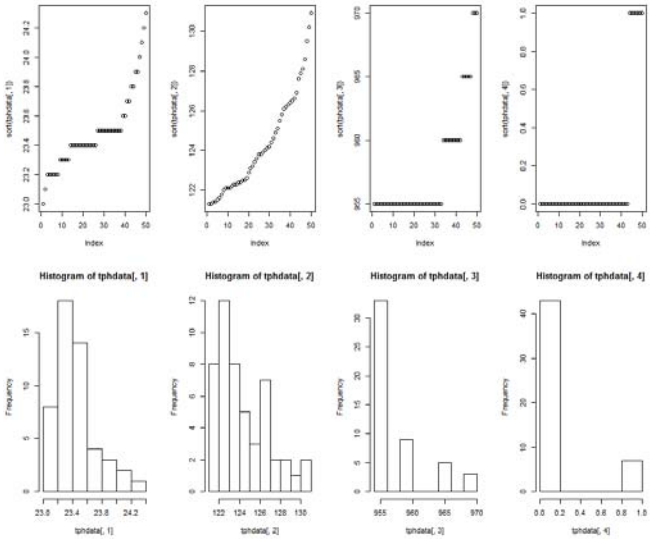
- < 0: 比正態分布較為平坦，為平頂峰度

分布指標 – Typhoon-01

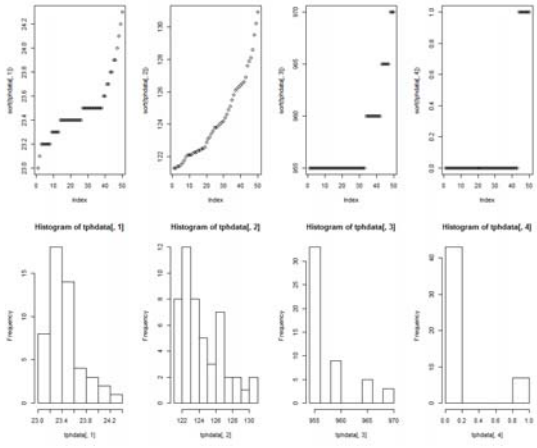
```
# skewness( ), kurtosis( ), in timeDate, 更詳細的分布指標
tphdata <- read.table( "L:/DataWD/Typhoon-01.txt", header = TRUE )
layout( matrix( 1:8, nrow=2, byrow=F ) )
plot( sort( tphdata[ , 1 ] ) )
hist( tphdata[ , 1 ] )
plot( sort( tphdata[ , 2 ] ) )
hist( tphdata[ , 2 ] )
plot( sort( tphdata[ , 3 ] ) )
hist( tphdata[ , 3 ] )
plot( sort( tphdata[ , 4 ] ) )
hist( tphdata[ , 4 ] )
```



分布指標 – Typhoon-01

```
# skewness( ), kurtosis( ), in timeDate, 更詳細的分布指標
install.packages( "timeDate" )
library( timeDate )
skewness( tphdata[ , 1:4] )
kurtosis( tphdata[ , 1:4] )
```

```
> skewness( tphdata[ , 1:4] )
       x1        x2        x3        x4
1.0759446 0.8048285 1.4330051 2.0130676
> kurtosis( tphdata[ , 1:4] )
        x1         x2         x3         x4
1.0076500 -0.2838985  0.8818208  2.0955442
```



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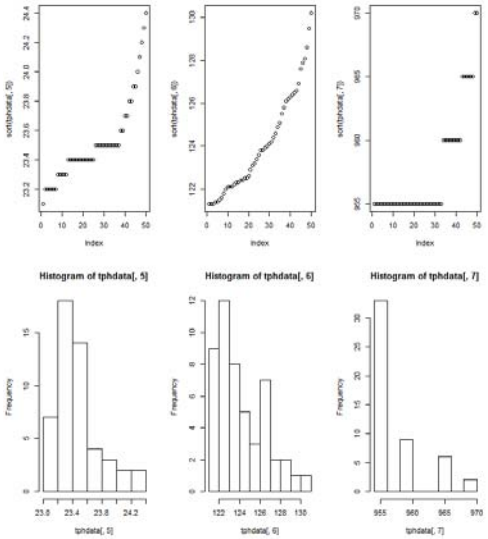
- < 0: 比正態分布較為平坦，為平頂峰度

分布指標 – Typhoon-01

```
# skewness( ), kurtosis( ), in timeDate, 更詳細的分布指標
tphdata <- read.table( "L:/DataWD/Typhoon-01.txt", header = TRUE )
layout( matrix( 1:8, nrow=2, byrow=F ) )
plot( sort( tphdata[ , 5 ] ) )
hist( tphdata[ , 5 ] )
plot( sort( tphdata[ , 6 ] ) )
hist( tphdata[ , 6 ] )
plot( sort( tphdata[ , 7 ] ) )
hist( tphdata[ , 7 ] )
```



分布指標 – Typhoon-01

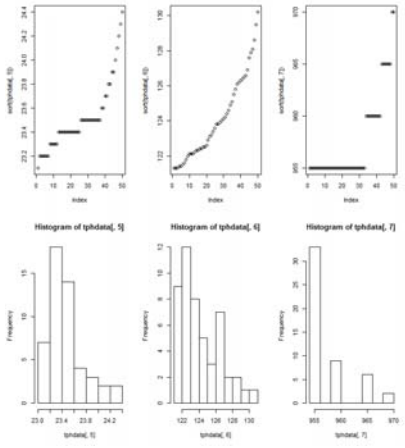
```
# skewness( ), kurtosis( ), in timeDate, 更詳細的分布指標
install.packages( "timeDate" )
library( timeDate )
skewness( tphdata[ , 5:7] )
kurtosis( tphdata[ , 5:7] )
```

```
> skewness( tphdata[ , 5:7] )

       d1        d2        d3
1.2903782 0.7363766 1.3772497

> kurtosis( tphdata[ , 5:7] )

        d1         d2         d3
1.2025491 -0.4650986  0.7547749
```



偏度：衡量資料的偏倚程度或對稱程度

= 0:	正態分布，完全對稱
[-1, 1]:	對稱性較強，不存在左偏或右偏
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峰度：衡量資料的分布型態的陡緩程度，集中或分散

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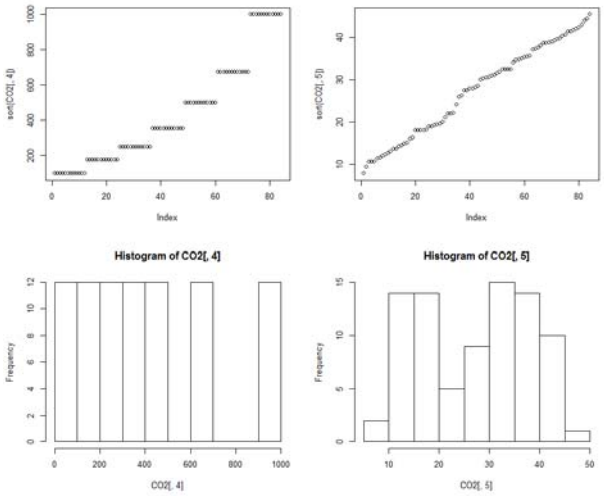
< 0:	比正態分布較為平坦，為平頂峰度

分布指標 – CO2

```
# skewness( ), kurtosis( ), in timeDate, 更詳細的分布指標
CO2
layout( matrix( 1:4, nrow=2, byrow=F ) )
plot( sort( CO2[ , 4 ] ) )
hist( CO2[ , 4 ] )
plot( sort( CO2[ , 5 ] ) )
hist( CO2[ , 5 ] )
```



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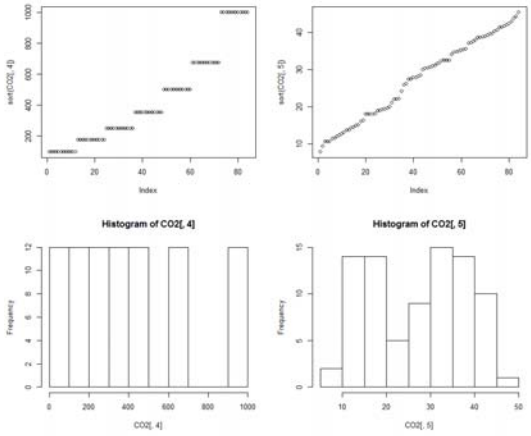
分布指標 – CO2

```
# skewness( ), kurtosis( ), in timeDate, 更詳細的分布指標
install.packages( "timeDate" )
library( timeDate )
skewness( CO2[ , 4:5] )
kurtosis( CO2[ , 4:5] )
```

```
> skewness( CO2[ , 4:5] )
      conc     uptake
 0.7201458 -0.1040551
> kurtosis( CO2[ , 4:5] )
      conc     uptake
-0.6826587 -1.3482674
```

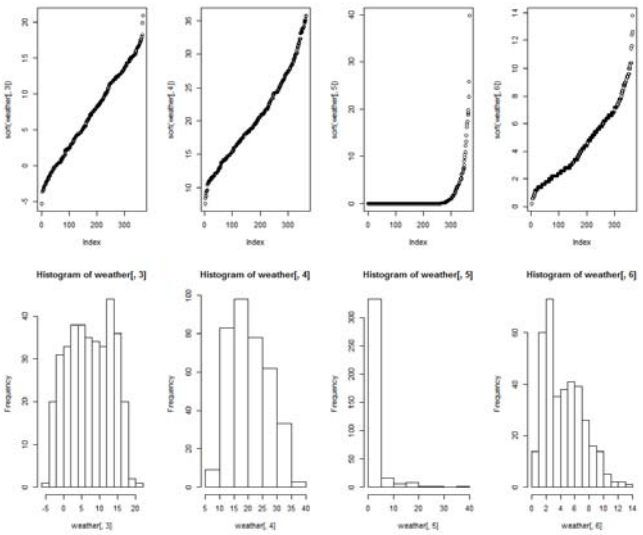
偏度：衡量資料的偏倚程度或對稱程度
- = 0: 正態分布，完全對稱
- [-1, 1]: 對稱性較強，不存在左偏或右偏
- > 1: 右偏
- < -1: 左偏

峰度：衡量資料的分布型態的陡緩程度，集中或分散
- = 0: 集散程度與正態分布相同，為標準峰度
- > 0: 比正態分布較為陡峭，為尖頂峰度
- < 0: 比正態分布較為平坦，為平頂峰度



分布指標 – weather

```
# skewness( ), kurtosis( ), in timeDate, 更詳細的分布指標
install.packages( "rattle" )
library( rattle )
layout( matrix( 1:8, nrow=2, byrow=F ) )
plot( sort( weather[ , 3 ] ) )
hist( weather[ , 3 ] )
plot( sort( weather[ , 4 ] ) )
hist( weather[ , 4 ] )
plot( sort( weather[ , 5 ] ) )
hist( weather[ , 5 ] )
plot( sort( weather[ , 6 ] ) )
hist( weather[ , 6 ] )
```

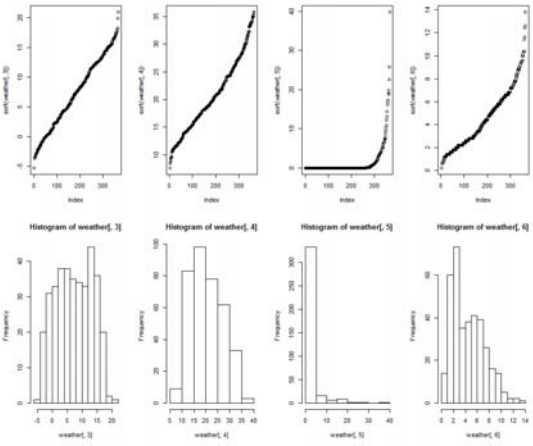


計算機程式設計 – 2016F
Chap 11:探索性資料分析
Feng-Li Lian @ NTU-EE

分布指標 – weather

```
# skewness( ), kurtosis( ), in timeDate, 更詳細的分布指標
install.packages( "timeDate" )
library( timeDate )
skewness( weather[ , 3:6] )
kurtosis( weather [ , 3:6] )
```

```
> skewness( weather[ , 3:6] )

     MinTemp      MaxTemp     Rainfall  Evaporation
-0.003779725  0.347510625  4.552606775  0.658228261

> kurtosis( weather [ , 3:6] )

    MinTemp     MaxTemp    Rainfall Evaporation
-1.1256902  -0.7636094  26.2397007  -0.2087607
```



偏度：衡量資料的偏倚程度或對稱程度
- = 0: 正態分布，完全對稱
- [-1, 1]: 對稱性較強，不存在左偏或右偏
- > 1: 右偏
- < -1: 左偏

峰度：衡量資料的分布型態的陡緩程度，集中或分散
- = 0: 集散程度與正態分布相同，為標準峰度
- > 0: 比正態分布較為陡峭，為尖頂峰度
- < 0: 比正態分布較為平坦，為平頂峰度

大綱

數據化探索 - 相關性

相關性

```
# cor( ), correlation 相關係數

cor( Insurance$Holders, Insurance$Claims )

# 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
```

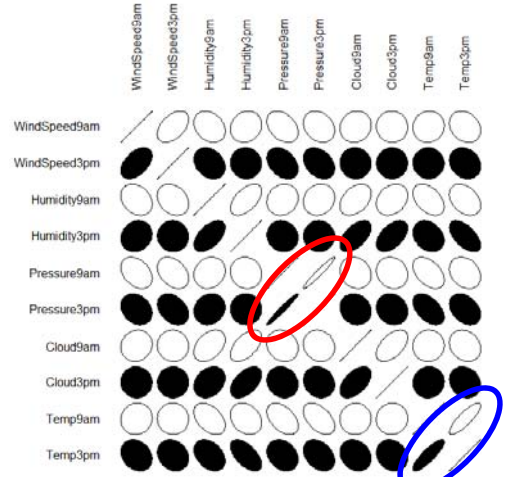
相關性

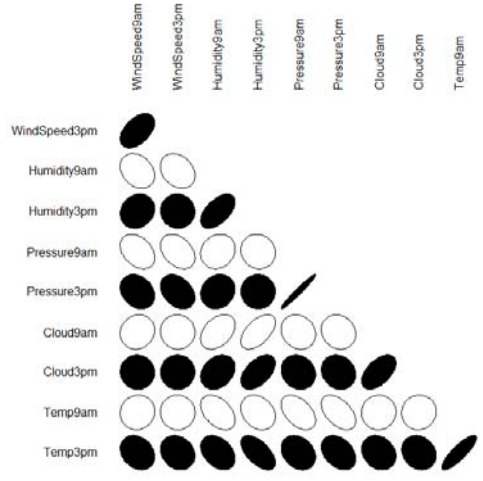
```
# correlation matrix 相關係數矩陣

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  0.84449581  1.0000000
```


相關性

```
# plotcoor( ), 繪製相關圖

install.packages( "ellipse" )

library( ellipse )

plotcorr( cor_matrix, col = rep( c( "white", "black" ), 5 ))

plotcorr( cor_matrix, type = "lower", col = rep( c( "white", "black" ), 5 ))
```





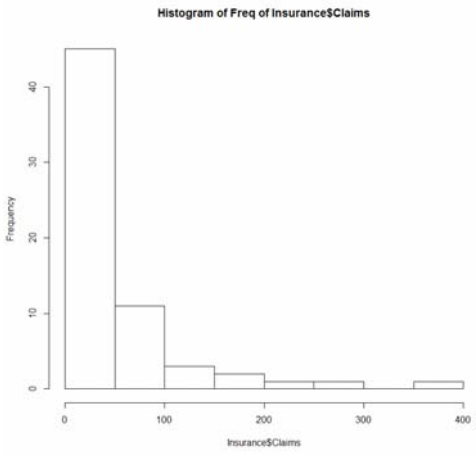
大綱

視覺化探索 - 長條圖

長條圖

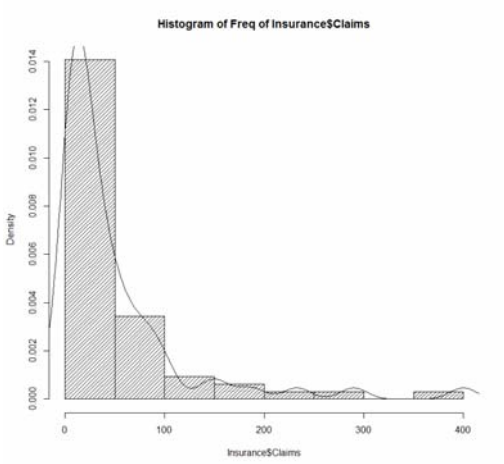
- 長條圖：一種簡單快速探索資料分布的方法
  - 將連續類型的資料分成幾個等間距的組，
    以矩形的高低來顯示資料的頻數或頻率
  - 有時可同時顯示出資料的密度曲線

```
install.packages( "Himsc" )
hist( Insurance$Claims, main = "Histogram of Freq of Insurance$Claims" )
```



長條圖

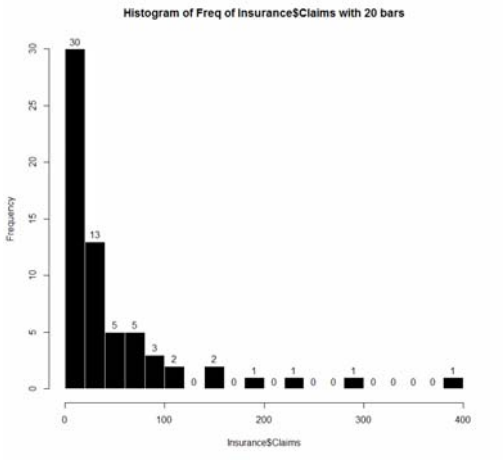
```
hist( Insurance$Claims, freq = FALSE, density = 20, main = "Histogram of Freq of Insurance$Claims" )

lines( density( Insurance$Claims ) )
```



長條圖

```
hist( Insurance$Claims, breaks = 20, labels = TRUE, col = "black", border = "white", main = "Histogram of Freq of Insurance$Claims with 20 bars" )

str(  hist( Insurance$Claims, breaks = 20, labels = TRUE, col = "black", border = "white", main = "Histogram of Freq of Insurance$Claims with 20 bars" )   )
```

```
List of 6
 $ breaks  : num [1:21] 0 20 40 60 80 100 120 140 160 180 ...
 $ counts  : int [1:20] 30 13 5 5 3 2 0 2 0 1 ...
 $ density : num [1:20] 0.02344 0.01016 0.00391 0.00391 0.00234 ...
 $ mids    : num [1:20] 10 30 50 70 90 110 130 150 170 190 ...
 $ xname   : chr "Insurance$Claims"
 $ equidist: logi TRUE

 - attr(*, "class")= chr "histogram"
```



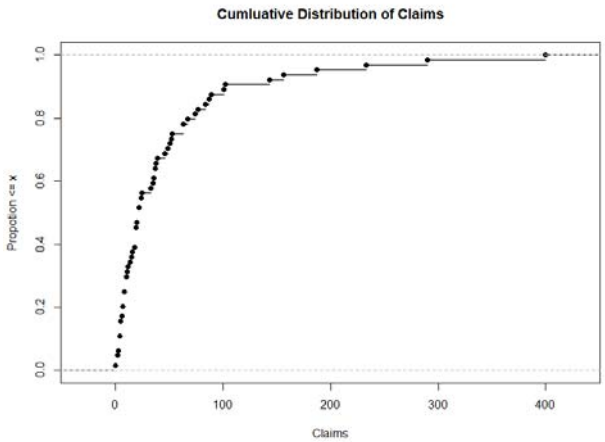
大綱

視覺化探索 -累積分布圖

累積分布圖

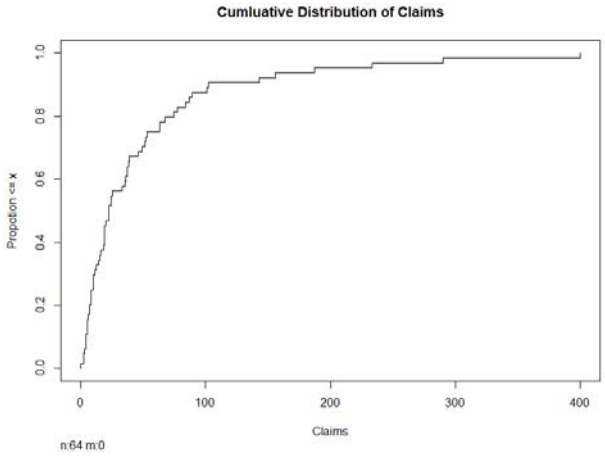
- 累積分布圖：
  - 可以觀察資料分布情形

```
dt <- ecdf( Insurance$Claims )
plot( dt, xlab = "Claims", ylab = "Propotion <= x", main = "Cumluative Distribution of Claims" )
```



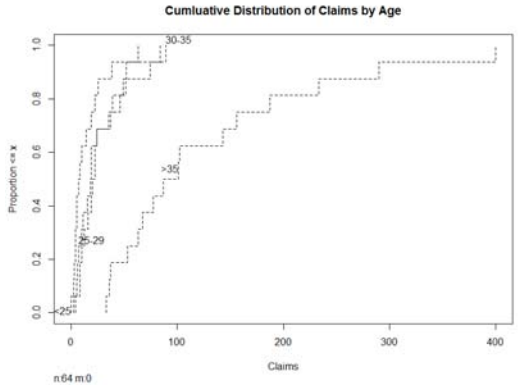
累積分布圖

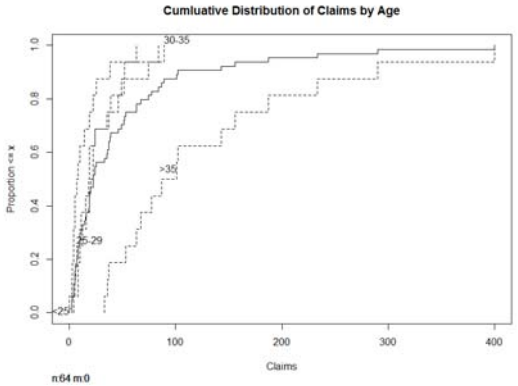
```
install.packages("Hmisc")

library(Hmisc)

Ecdf( Insurance$Claims, xlab = "Claims", ylab = "Propotion <= x", main =
"Cumluative Distribution of Claims" )
```



累積分布圖

```
data_plot <- with( Insurance, rbind(

data.frame( var1 = Claims[ Age == "<25" ], var2 = "<25" ),
data.frame( var1 = Claims[ Age == "25-29" ], var2 = "25-29" ),
data.frame( var1 = Claims[ Age == "30-35" ], var2 = "30-35" ),
data.frame( var1 = Claims[ Age == ">35" ], var2 = ">35" ) )        )

Ecdf( data_plot$var1, group = data_plot$var2, lty = 2, label.curves=1:4,
xlab = "Claims", main = "Cumluative Distribution of Claims by Age"  )

Ecdf( Insurance$Claims, add = TRUE )
```





大綱

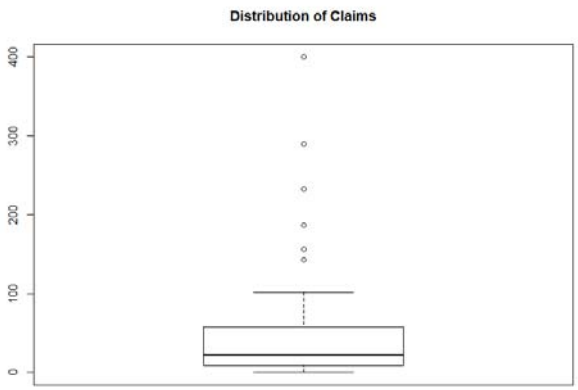
視覺化探索 - 箱形圖

箱形圖 or 盒鬚圖

- 箱形圖 or 盒鬚圖：
  - 可以較深入展現資料分布情況，列出重要分位點，將異數剝離出來

```
Claims_bp <- boxplot( Insurance$Claims, main = "Distribution of Claims" )
Claims_bp$stats
```

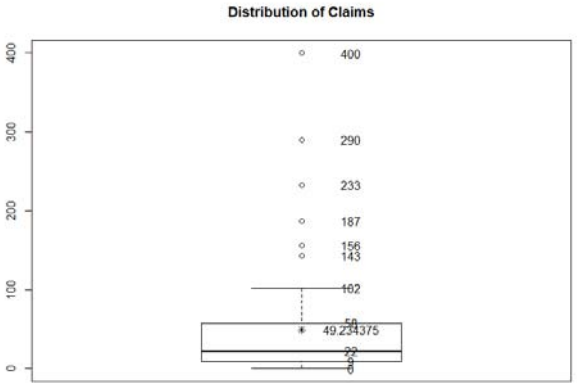
```
> Claims_bp$stats
     [,1]
[1,]    0
[2,]    9
[3,]   22
[4,]   58
[5,]  102
attr(,"class")
"integer"
```



箱形圖 or 盒鬚圖

- 標記資料點

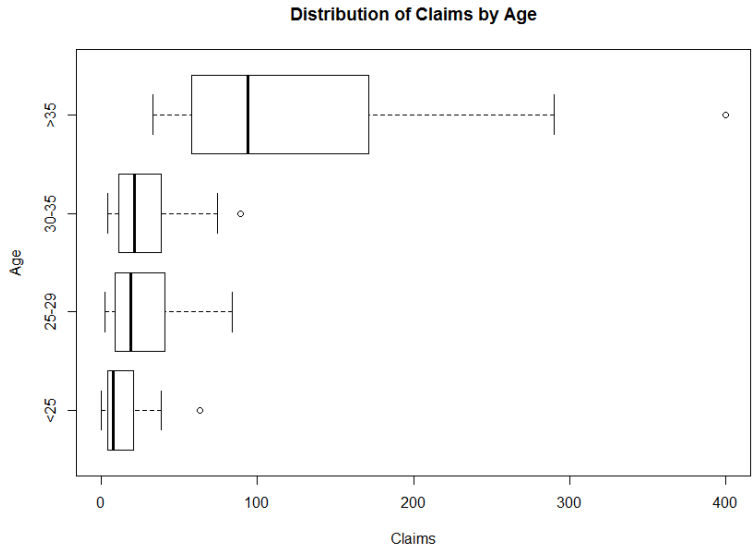
```
points( x=1, y = mean( Insurance$Claims ), pch = 8 )

Claims_points <- as.matrix( Insurance$Claims[ which( Insurance$Claims > 102 ) ], 6, 1 )

Claims_text <- rbind( Claims_bp$stats, mean( Insurance$Claims), Claims_points )

for( i in 1:length( Claims_text ) ) text( x = 1.1, y = Claims_text[ i, ], labels = Claims_text[ i, ] )
```



箱形圖 or 盒鬚圖

- 一張圖容納多個箱形圖

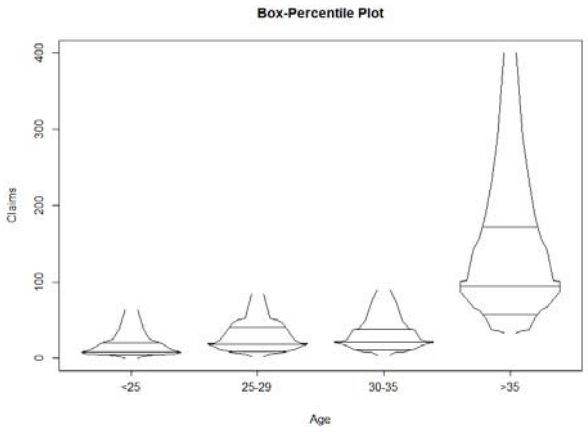
```
boxplot( var1~var2, data = data_plot, horizontal = TRUE, main = "Distribution of Claims by Age", xlab = "Claims", ylab = "Age" )
```



箱形圖 or 盒鬚圖

- 比例箱形圖

```
data_bp <- list(
data_plot$var1[ which( data_plot$var2 == “<25” ) ],
data_plot$var1[ which( data_plot$var2 == “25-29” ) ],
data_plot$var1[ which( data_plot$var2 == “30-35” ) ],
data_plot$var1[ which( data_plot$var2 == “>35” ) ]       )
bpplot( data_bp, name = c(  "<25", "25-29", "30-35", ">35" ),  ylab = "Claims", xlab = "Age"  )
```



大綱

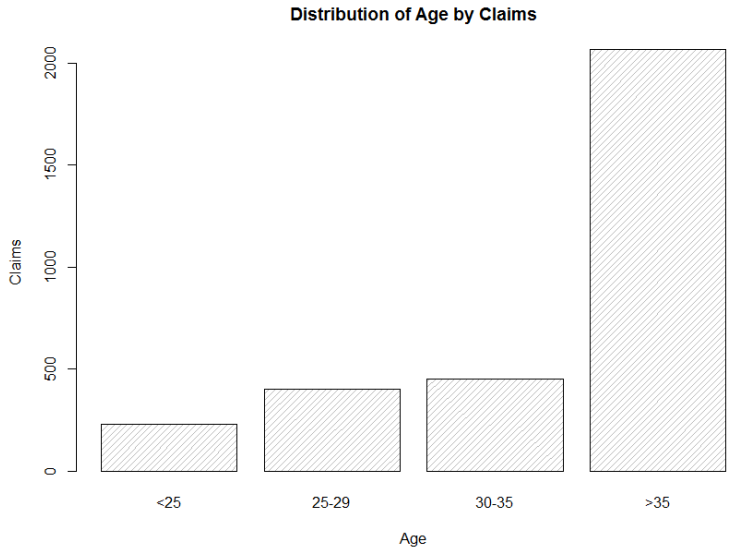
視覺化探索 - 橫條圖

橫條圖

- 橫條圖：
  - 主要針對離散型變數，每一個水準自然成為一個條形來顯示該水準的設定值

```
Claims_Age <- with( Insurance,
c( sum( Claims[ which( Age == "<25" ) ] ),
sum( Claims[ which( Age == "25-29" ) ] ),
sum( Claims[ which( Age == "30-35") ] ),
sum( Claims[ which( Age == ">35"  ) ] )      )   )

barplot( Claims_Age, names.arg = c(  "<25", "25-29", "30-35", ">35" ),
density = rep( 20, 4), main = "Distribution of Age by Claims", ylab =
"Claims", xlab = "Age"   )
```


橫條圖



橫條圖

- 分組 橫條圖：

```
Holders_Age <- with( Insurance,
c( sum( Holders[ which( Age == "<25" ) ] ),
sum( Holders[ which( Age == "25-29" ) ] ),
sum( Holders[ which( Age == "30-35") ] ),
sum( Holders[ which( Age == ">35" ) ] ) ) )

data_bar <- rbind( Claims_Age, Holders_Age )

barplot( data_bar, names.arg = c(  "<25", "25-29", "30-35", ">35" ), beside = TRUE, density = rep( 20, 4), main = "Age Distribution by Claims and Holders", ylab = "Claims & Holders", xlab = "Age", col = c( "black", "darkgrey" )  )
legend( x = "topleft", rownames( data  bar ), fill = c( "black", "darkgrey" ) )
```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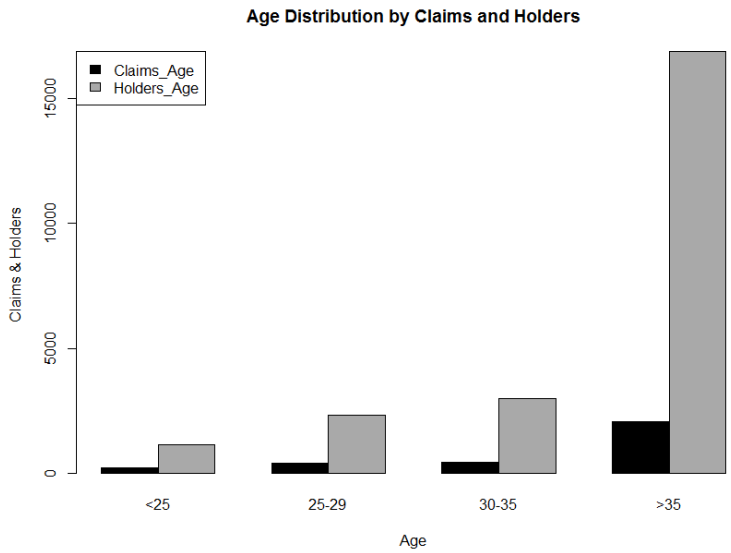
橫條圖

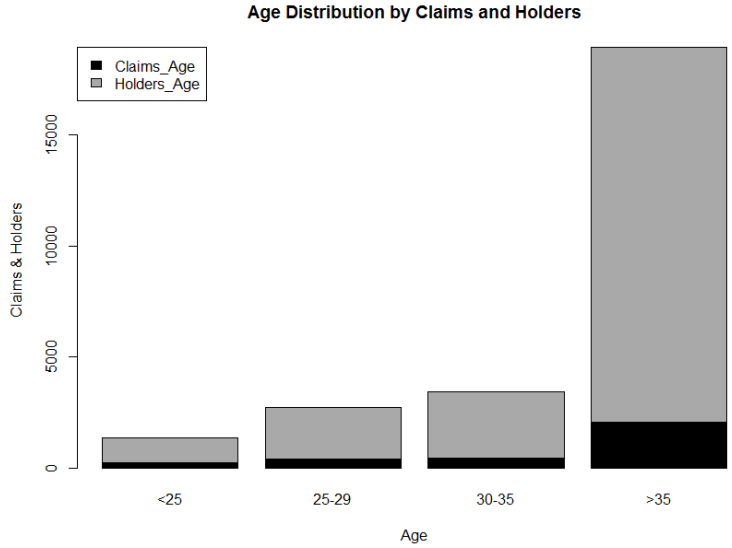


橫條圖

- 堆疊 橫條圖：

```
barplot( data_bar, names.arg = c(  "<25", "25-29", "30-35", ">35" ), main = "Age Distribution by Claims and Holders", ylab = "Claims & Holders", xlab = "Age", col = c( "black", "darkgrey" )  )

legend( x = "topleft", rownames( data_bar ), fill = c( "black", "darkgrey" ) )
```



大綱

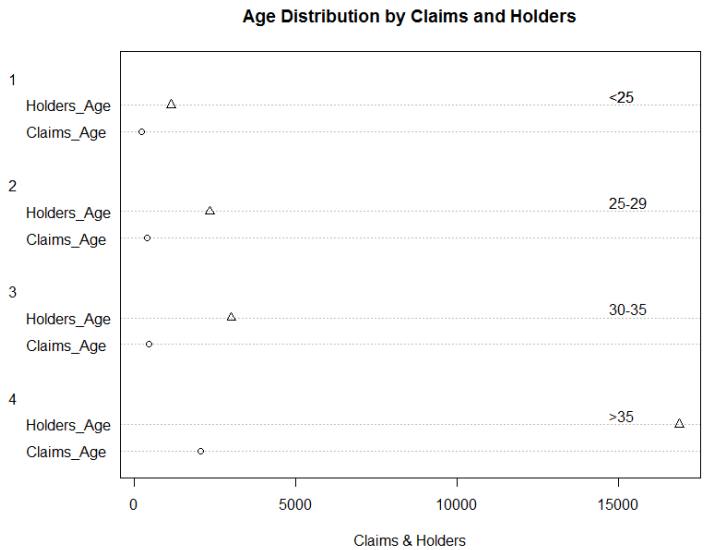
視覺化探索 - 點陣圖

點陣圖

- 點陣圖：
  - 用於呈現離散型變數各取樣水準的分布情形，
    用點與背景格線代替線條

```
dotchart( data_bar, main = "Age Distribution by Claims and Holders", xlab = "Claims & Holders", pch = 1:2  )
legend( x = 14000, y = 15, "<25", bty = "n" )
legend( x = 14000, y = 11, "25-29", bty = "n" )
legend( x = 14000, y = 7, "30-35", bty = "n" )
legend( x = 14000, y = 3, ">35", bty = "n" )
```


橫條圖

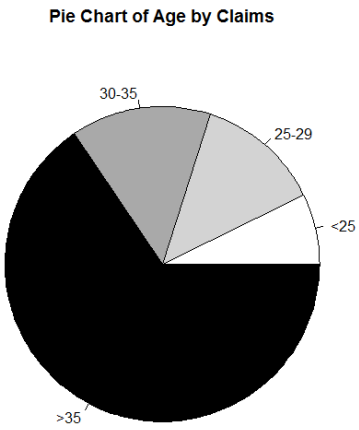


大綱

視覺化探索 - 圓形圖

圓形圖

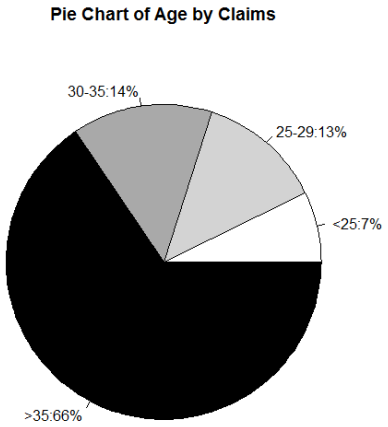
```
pie( Claims_Age, labels = c(  "<25", "25-29", "30-35", ">35" ), main = "Pie Chart of Age by Claims", col = c( "white", "lightgrey", "darkgrey", "black" )     )
```



圓形圖

```
percent <- round( Claims_Age / sum( Claims_Age ) * 100 )
label <- paste( c(  "<25", "25-29", "30-35", ">35" ), ":", percent, "%", sep="" )

pie( Claims_Age, labels = label, main = "Pie Chart of Age by Claims", col = c( "white", "lightgrey", "darkgrey", "black" )    )
```



圓形圖 – 3D

```
install.packages( "plotrix" )
library( plotrix )
pie3D( Claims_Age, labels = c(  "<25", "25-29", "30-35", ">35" ), explode = 0.05, main = "3D Pie Chart of Age by Claims", labelcex = 0.8,  col = c( "white", "lightgrey", "darkgrey", "black" )    )
```