中級術科考題

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提醒

- 不同題型於 R 與 Python 中，難度可能有異，若兩個語言皆有基礎將使答題更容易
- 需具備文字資料探勘基礎能力及常用中文斷詞套件「結巴」
- 熟悉常見機器學習演算法及套件操作
  - 演算法：k-means, 簡單線性迴歸, 決策樹, 隨機森林分類樹與迴歸樹
  - 套件：
    - R：jiebaR、dplyr、jsonlite、randomForest
    - Python：jieba、pandas、sklearn.cluster、sklearn.ensemble.RandomForestRegressor、sklearn.ensemble.RandomForestClassifier、sklearn.preprocessing.LabelEncoder、matplotlib

考試前需安裝

- R：3.5.0
- R 套件：
  - jiebaR (0.9.99)
  - dplyr (0.7.6)
  - jsonlite (1.5)
  - randomForest (4.6-14)
- Python： Anaconda Python 3.6
- Python 套件：
  - jieba (0.39)

題目一：文字資料處理

網頁資料擷取為資料科學常見之資料蒐集手段，而字串處理技巧為網頁資料擷取之關鍵技術之一。此題以某知名電商之商品資料進行相關技能之模擬，主要考核考生於字串處理、流程控制及文字資料探勘之基礎操作。

- 相關套件提示
    - R 套件：jiebaR, dplyr, jsonlite
    - Python 套件：jieba, pandas, json

20% 小題一：透過程式產生重複資料

題目說明

- 有時我們會從網址中發現切換頁面的規則，例如以下網址包含 page=1。假設我們需要擷取 1 到 10 頁之資料，請透過迴圈或向量方式產出網址。
    - 第 1 頁之網址：https://iii-bid.com?page=1&q=iphone

答案示意

- (R) 輸出應如下：

```
##  [1] "https://iii-bid.com?page=1&q=iphone"
##  [2] "https://iii-bid.com?page=2&q=iphone"
##  [3] "https://iii-bid.com?page=3&q=iphone"
##  [4] "https://iii-bid.com?page=4&q=iphone"
##  [5] "https://iii-bid.com?page=5&q=iphone"
##  [6] "https://iii-bid.com?page=6&q=iphone"
##  [7] "https://iii-bid.com?page=7&q=iphone"
##  [8] "https://iii-bid.com?page=8&q=iphone"
##  [9] "https://iii-bid.com?page=9&q=iphone"
## [10] "https://iii-bid.com?page=10&q=iphone"
```

- (Python) 輸出應如下：

```
## ['https://iii-bid.com?page=1&q=iphone', 'https://iii-bid.com?page=2&q=iphone', 'https://iii-bid.com?page=3&q=iphone', 'https://iii-bid.com?page=4&q=iphone', 'https://iii-bid.com?page=5&q=iphone', 'https://iii-bid.com?page=6&q=iphone', 'https://iii-bid.com?page=7&q=iphone', 'https://iii-bid.com?page=8&q=iphone', 'https://iii-bid.com?page=9&q=iphone', 'https://iii-bid.com?page=10&q=iphone']
```

20% 小題二：JSON 格式之載入與轉換

題目說明

1. (10%) 載入網拍資料集「1_bid.json」
2. (10%) 取得其中 key 為 prods 資料並轉為資料框架(Data Frame)格式

答案示意

- 共十九筆資料，以下提供前五筆輸出作為參考：
- (R) 輸出應如下：

	Id	cateId	describe	name	picB	price
0	DYAF13-A9007Z1GM	DYAF13	2 in 1 bamboo charging base Apple Watch+iPhone...	2 in 1 bamboo charging base Apple Watch+iPhone...	000001_1489735402.jpg	399
1	DYAJDR-19009JGT8	DYAJDT	Gold send glass to protect Apple iPhone Xs Max...	Apple iPhone Xs Max (256G)-Gold (MT552TA/A)	000001_1555383734.jpg	41999
2	DYAJDN-A9009N87T	DYAJDN	Daily strongmad kill sale red send wireless ...	Apple iPhone XR (64G) - Red (MRY62TA/A)	000001_1555379017.jpg	25288
3	DYAJ8H-A9008TS5F	DYAJ8I	Welfare Products Limited Edition Apple iPhone...	Welfare Products - Apple iPhone 7 128GB	000001_1546576470.jpg	11900
4	DYAJCX-A9009UFV0	DYAJ9Y	Space Gray mad down $1501 Apple iPhone 8 (64G...	Apple iPhone 8 (64G) - Space Gray	000001_1554781348.jpg	19999

- (Python) 輸出應如下：因頁面寬度，答案示意會將超過 11 字元之後以 ... 表示

```
##           Id cateId       picB     name     describe  price
## 0  DYAF13-A90...  DYAF13  000001_148...  2 in 1 bam...  2 in 1 bam...    399
## 1  DYAJDR-190...  DYAJDT  000001_155...  Apple iPho...  Gold send ...  41999
## 2  DYAJDN-A90...  DYAJDN  000001_155...  Apple iPho...  Daily stro...  25288
## 3  DYAJ8H-A90...  DYAJ8I  000001_154...  Welfare Pr...  Welfare Pr...  11900
## 4  DYAJCX-A90...  DYAJ9Y  000001_155...  Apple iPho...  Space Gray...  19999
```

補充：

- 若此題無法完成者，請讀取資料 1_bid_for_help.csv 以便後續題目作答。

20% 小題三：取出描述內容包含字串「Limited」之商品資料

題目說明

- (20%) 篩選出網拍資料集的描述(describe)欄位內容包含「Limited」之商品

答案示意

- (R) 輸出應如下：

	Id	cateId	picB	name	describe	price
0	DYAJ8H-A9008TS5F	DYAJ8I	000001_1546576470.jpg	Welfare Products - Apple iPhone 7 128GB	Welfare Products Limited Edit...	11900
1	DYAJDN-A9009N878	DYAJDN	000001_1555379070.jpg	Apple iPhone XR (64G)-White (MRY52TA/A)	White send wireless charging ...	25288

- (Python) 輸出應如下：因頁面寬度，答案示意會將超過 11 字元之後以 ... 表示

```
##           Id cateId       picB     name     describe  price
## 3   DYAJ8H-A90...  DYAJ8I  000001_154...  Welfare Pr...  Welfare Pr...  11900
## 13  DYAJDN-A90...  DYAJDN  000001_155...  Apple iPho...  White  sen...  25288
```

20% 小題四：字串處理技巧

題目說明

網頁資料擷取過程中，字串處理為常見技巧，請回答下列各題：

1. (10%) 取出商品圖(picB)欄位中的 ID 部分 - 例如 picB 欄位的其中一筆資料為 000001_1494933718.jpg，取出 1494933718

2. (10%) 承上題，請將最後一碼為 9 的取出

答案示意

- (R) 輸出應如下：
  1.

```
##  [1] "1489735402" "1555383734" "1555379017" "1546576470" "1554781348"
##  [6] "1554948610" "1553652419" "1553479796" "1546938527" "1554691189"
## [11] "1554948220" "1547024213" "1554890673" "1555379070" "1555399157"
## [16] "1551924378" "1554688741" "1536049459" "1554691692" "1555294039"
```

  2.

```
## [1] "1553652419" "1554691189" "1536049459" "1555294039"
```

- (Python) 輸出應如下：
  - 建議輸出之物件類型為 Series，如下。若您使用 List 或 Array 也沒問題。
  1.

```
## 0     1489735402
## 1     1555383734
## 2     1555379017
## 3     1546576470
## 4     1554781348
## 5     1554948610
## 6     1553652419
## 7     1553479796
## 8     1546938527
## 9     1554691189
## 10    1554948220
## 11    1547024213
## 12    1554890673
## 13    1555379070
## 14    1555399157
## 15    1551924378
## 16    1554688741
## 17    1536049459
## 18    1554691692
## 19    1555294039
## Name: picB, dtype: object
```

  2.

```
## 6     1553652419
## 9     1554691189
## 17    1536049459
## 19    1555294039
## Name: picB, dtype: object
```

20% 小題五：將商品描述(describe)透過結巴斷詞並計算詞頻排行

題目說明

此題主要考斷詞套件的應用，R 與 Python 皆已安裝好套件並可用內建的查詢文件方式查看文件。若第一題無法回答，可自己創造模擬資料進行第二題的回答。

- (10%) 請透過結巴套件將商品描述(describe)欄位之內容進行斷詞作業：
  - 於 R 之名稱為 `jiebaR`
  - 於 Python 之名稱為 `jieba`
- (10%) 請將斷詞後之結果，計算詞頻並由多到少排序

答案示意

- (R) 觀察前五筆資料，輸出應如下：

```
##  .
##     the      to     and      is product
##     379     213     192     134     117
```

- (Python) 觀察前五筆資料，輸出應如下：

```
##          6024
## =         605
## the       379
## \r\n      334
## .         295
## dtype: int64
```

題目二：集群與視覺化

k-means 是最常見的集群法之一，請以 2_iris.csv 資料中的數值欄位進行 k-means 集群，並將其繪製視覺化圖形

- 相關套件提示
  - R 套件：使用內建函數即可
  - Python 套件：pandas, sklearn.cluster, matplotlib.pyplot

15% 小題一：讀取資料

題目說明

- 請讀取 2_iris.csv 資料集
  - 資料集說明請參考 iris 資料說明.pdf

答案示意

- (R) 以下提供前五筆輸出作為參考：

```
  Sepal.Length  Sepal.Width  Petal.Length  Petal.Width Species
0          5.1          3.5           1.4          0.2  setosa
1          4.9          3.0           1.4          0.2  setosa
2          4.7          3.2           1.3          0.2  setosa
3          4.6          3.1           1.5          0.2  setosa
4          5.0          3.6           1.4          0.2  setosa
```

- (Python) 以下提供前五筆輸出作為參考：

```
##    Sepal.Length  Sepal.Width  Petal.Length  Petal.Width Species
## 0           5.1          3.5           1.4          0.2  setosa
## 1           4.9          3.0           1.4          0.2  setosa
## 2           4.7          3.2           1.3          0.2  setosa
## 3           4.6          3.1           1.5          0.2  setosa
## 4           5.0          3.6           1.4          0.2  setosa
```

15% 小題二：次數分配表

題目說明

- 請計算 Species 欄位之次數分配表

答案示意

- (R) 輸出應如下：

```
##
##     setosa versicolor  virginica
##         50         50         50
```

- (Python) 輸出應如下：

```
## setosa       50
## virginica    50
## versicolor   50
## Name: Species, dtype: int64
```

30% 小題三：k-means 集群

題目說明

- 使用 k-means 進行集群，群數為 3，並將各元素之集群結果輸出
- 因集群結果具隨機性質，有集群差異屬正常
  - 若想驗證結果可以透過隨機種子的設定來達成 (此部分非必要執行)
    - R: set.seed(1)
    - Python: random_state=1
- 提示：
  - R 使用 kmeans 函數
  - Python 使用 KMeans 函數 (透過 from sklearn.cluster import KMeans 載入)

答案示意

- (R) 輸出應如下：

```
##   [1] 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3
##  [36] 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##  [71] 1 1 1 1 1 1 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 1 2 2 2
## [106] 2 1 2 2 2 2 2 2 1 1 2 2 2 2 1 2 1 2 1 2 2 1 1 2 2 2 2 2 1 2 2 2 2 1 2
## [141] 2 2 1 2 2 2 1 2 2 1
```

- (Python)輸出應如下：

```
## KMeans(algorithm='auto', copy_x=True, init='k-means++', max_iter=300,
##        n_clusters=3, n_init=10, n_jobs=None, precompute_distances='auto',
##        random_state=1, tol=0.0001, verbose=0)
```

```
## [1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
##  1 1 1 1 1 1 1 1 1 1 1 1 1 0 0 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
##  0 0 0 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 2 0 2 2 2 2 0 2 2 2 2
##  2 2 0 0 2 2 2 2 0 2 0 2 0 2 2 0 0 2 2 2 2 2 0 2 2 2 2 0 2 2 2 0 2 2 2 0 2
##  2 0]
```

20% 小題四：分組計算

題目說明

- 請計算每個 Species 種類的集群結果

- 若無法取得集群結果，可自行產生模擬結果並作答此題

答案示意

- 因作答方式可能不同，輸出之物件類型不需完全相同

- (R) 輸出示意如下：
  - 原 setosa 種類之集群結果，皆分至第 1 群
  - 原 versicolor 種類之集群結果，分至第 2 群的有 48 個樣本、分至第 3 群的有 2 個樣本
  - 原 virginica 種類之集群結果，分至第 2 群的有 14 個樣本、分至第 3 群的有 36 個樣本

```
## $setosa
##
##  1
## 50
##
## $versicolor
##
##  2  3
##  2 48
##
## $virginica
##
##  2  3
## 36 14
```

- (Python) 輸出示意如下：
  - 原 setosa 種類之集群結果，皆分至第 1 群
  - 原 versicolor 種類之集群結果，分至第 0 群的有 48 個樣本、分至第 3 群的有 2 個樣本
  - 原 virginica 種類之集群結果，分至第 2 群的有 36 個樣本、分至第 0 群的有 14 個樣本

```
## KMeans(algorithm='auto', copy_x=True, init='k-means++', max_iter=300,
##        n_clusters=3, n_init=10, n_jobs=None, precompute_distances='auto',
##        random_state=None, tol=0.0001, verbose=0)

## Species     cluster
## setosa      0          50
## versicolor  1          48
##             2           2
## virginica   2          36
##             1          14
## Name: cluster, dtype: int64
```

20% 小題五：資料視覺化

題目說明

- 請將集群結果以散點圖(scatter diagram)進行視覺化：
  - (10%) 點的位置：

- X 軸使用 Sepal.Length
- Y 軸使用 Sepal.Width
  - (5%) 點的顏色使用原始分類(Species)
    - R 可參閱 points 之說明
  - (5%) 點的形狀使用集群結果(cluster)
    - R 可參閱 points 之說明
- 若無法取得集群結果，可自行產生模擬結果並作答此題

答案示意

- (R)視覺化結果示意圖：
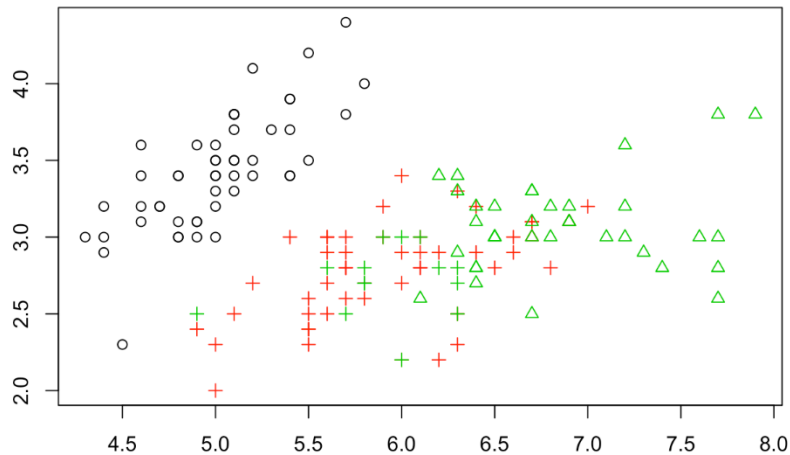
- (Python) 視覺化結果示意圖：
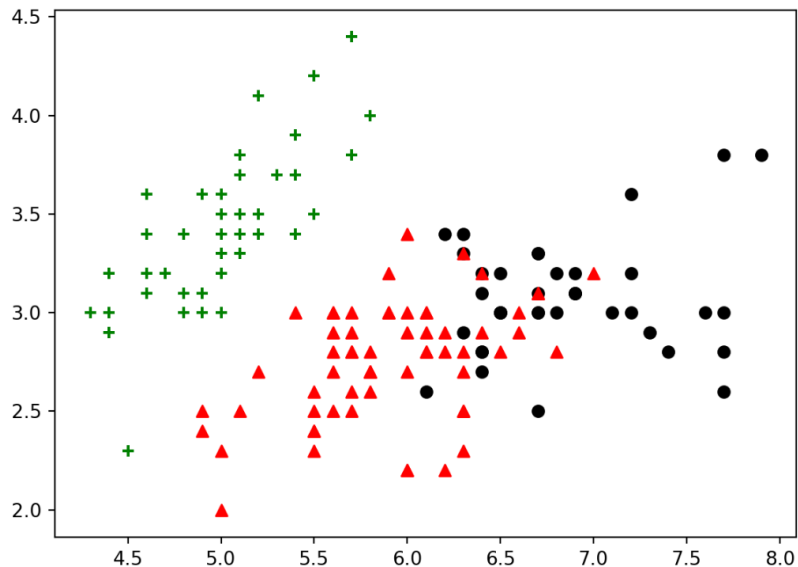
題目三：隨機森林迴歸預測模型

隨機森林是經典的監督式學習算法之一，請透過該算法進行 cars 資料之迴歸數值預測。

- 相關套件提示
  - R 套件：randomForest
  - Python 套件：pandas, from sklearn.ensemble import RandomForestRegressor

10% 小題一：讀取資料

題目說明

- 請讀取 3_cars.csv 資料集
  - 相關說明請參考 3_cars 資料說明.pdf

答案示意

- (R)前五筆資料的輸出應如下：

```
   speed  dist
0      4     2
1      4    10
2      7     4
3      7    22
4      8    16
```

- (Python)前五筆資料的輸出應如下：

```
##     speed  dist
## 0      4     2
## 1      4    10
## 2      7     4
## 3      7    22
## 4      8    16
```

20% 小題二：切分訓練集與測試集

題目說明

- 請以資料筆數的 70%和 30%將 cars 資料隨機抽樣分為兩份，訓練集與測試集
  - 因具有隨機性質，抽樣結果可能不同，這部分不硬性規定，但若希望與答案示意結果相同可參考下方設定：
    - R: set.seed(1)
    - Python: random_state=1 (此部分非必要執行)

答案示意

- (R)輸出應如下：

```
## [1] "訓練集"

##    speed dist
## 4      7   22
## 39    20   32
## 1      4    2
## 34    18   76
## 23    14   80
## 43    20   64
## 14    12   24
## 18    13   34
## 33    18   56
## 21    14   36
## 41    20   52
## 10    11   17
## 7     10   18
## 9     10   34
## 15    12   28
## 40    20   48
## 25    15   26
## 47    24   92
## 12    12   14
## 36    19   36
## 48    24   93
## 20    14   26
## 3      7    4
## 6      9   10
## 49    24  120
## 26    15   54
## 27    16   32
## 31    17   50
## 29    17   32
## 22    14   60
## 32    18   42
## 24    15   20
## 8     10   26
## 35    18   84
## 37    19   46

## [1] "測試集"

##    speed dist
## 2      4   10
## 5      8   16
## 11    11   28
## 13    12   20
## 16    13   26
## 17    13   34
## 19    13   46
## 28    16   40
## 30    17   40
## 38    19   68
## 42    20   56
## 44    22   66
## 45    23   54
## 46    24   70
## 50    25   85
```

答案示意

- (Python) 輸出應如下：

```
## 訓練集

##      speed  dist
## 27      16    40
## 35      19    36
## 40      20    52
## 38      20    32
## 2        7     4
## 3        7    22
## 48      24   120
## 29      17    40
## 46      24    92
## 31      18    42
## 32      18    56
## 39      20    48
## 21      14    60
## 36      19    46
## 19      14    26
## 42      20    64
## 49      25    85
## 26      16    32
## 22      14    80
## 13      12    24
## 41      20    56
## 17      13    34
## 45      24    70
## 24      15    26
## 23      15    20
## 4        8    16
## 33      18    76
## 14      12    28
## 30      17    50
## 10      11    28
## 28      17    32
## 44      23    54
## 34      18    84
## 18      13    46
## 20      14    36

## 測試集

##      speed  dist
## 0        4     2
## 1        4    10
## 5        9    10
## 6       10    18
## 7       10    26
## 8       10    34
## 9       11    17
## 11      12    14
## 12      12    20
## 15      13    26
## 16      13    34
## 25      15    54
## 37      19    68
## 43      22    66
## 47      24    93
```

補充：

- 若此題無法完成者，請讀取資料以便後續題目作答
  - 3_cars_train_for_helper.csv
  - 3_cars_test_for_helper.csv

30% 小題三：模型配適

題目說明

- 使用訓練集進行隨機森林模型配適
  - speed 為自變數(x)，dist 為應變數(y)

答案示意

- (R) 配適後模型的輸出應如下：
  - 因為抽樣與訓練過程是隨機，數值僅供參考

```
## 
## Call:
##  randomForest(formula = dist ~ speed, data = train_set)
##                Type of random forest: regression
##                      Number of trees: 500
## No. of variables tried at each split: 1
## 
##           Mean of squared residuals: 292.7432
##                     % Var explained: 60.02
```

- (Python) 配適後模型的輸出應如下：
  - 僅僅示意於 Python 中直接將模型輸出的結果，主要會看過程是否正確

```
## RandomForestRegressor(bootstrap=True, criterion='mse', max_depth=None,
##                       max_features='auto', max_leaf_nodes=None,
##                       min_impurity_decrease=0.0, min_impurity_split=None,
##                       min_samples_leaf=1, min_samples_split=2,
##                       min_weight_fraction_leaf=0.0, n_estimators=10,
##                       n_jobs=None, oob_score=False, random_state=None,
##                       verbose=0, warm_start=False)
## 
```

20% 小題四：預測

題目說明

- 以配適後模型進行測試集資料之預測
  - 放入模型的應為測試集資料的 speed 欄位，並得到相同數量的預測結果

答案示意

- (R) 配適後模型的輸出應如下：
  - 因為抽樣與訓練過程是隨機，數值僅供參考，主要會看過程是否正確

```
##        1        7       10       11       13       17       18       19
## 11.62840 27.03792 27.81006 27.81006 23.48877 25.01437 25.01437 25.01437
```

```
##       23       25       27       33       36       43       45
## 39.46086 37.79642 39.18347 64.81688 58.51836 48.58718 74.96116
```

- (Python) 預測結果應如下：
  - 因為抽樣與訓練過程是隨機，<mark>數值僅供參考</mark>，主要會看過程是否正確

```
## RandomForestRegressor(bootstrap=True, criterion='mse', max_depth=None,
##                       max_features='auto', max_leaf_nodes=None,
##                       min_impurity_decrease=0.0, min_impurity_split=None,
##                       min_samples_leaf=1, min_samples_split=2,
##                       min_weight_fraction_leaf=0.0, n_estimators=10,
##                       n_jobs=None, oob_score=False, random_state=None,
##                       verbose=0, warm_start=False)
##

## [18.25       18.25       17.2        26.8        26.8        26.8
##  27.6        25.93333333 25.93333333 37.53333333 37.53333333 28.21666667
##  41.68571429 52.3         86.93666667]
```

補充：

- 若此題無法完成者，請讀取資料 3_cars_rf_for_helper.csv 以便後續題目作答。

20% 小題五：評估

題目說明

- 計算每個預測結果與實際結果之誤差，因為誤差可能有正有負，請將其各別平方後平均，即 MSE(Mean Squared Error)。

答案示意

- (R) 評估結果如下：
  - 因為抽樣與訓練過程是隨機，<mark>數值僅供參考</mark>，主要會看過程是否正確

```
## [1] 266.7502
```

- (Python) 評估結果如下：
  - 因為抽樣與訓練過程是隨機，<mark>數值僅供參考</mark>，主要會看過程是否正確

```
## RandomForestRegressor(bootstrap=True, criterion='mse', max_depth=None,
##                       max_features='auto', max_leaf_nodes=None,
##                       min_impurity_decrease=0.0, min_impurity_split=None,
##                       min_samples_leaf=1, min_samples_split=2,
##                       min_weight_fraction_leaf=0.0, n_estimators=10,
##                       n_jobs=None, oob_score=False, random_state=None,
##                       verbose=0, warm_start=False)

## 120.30138595616027
```

題目四：隨機森林分類預測模型

隨機森林是經典的監督式學習算法之一，請透過該算法進行 `4_titanic_data.csv` 資料之分類預測。

- 相關套件提示
  - R 套件：randomForest
  - Python 套件：pandas, `from sklearn.ensemble import RandomForestClassifier`, `from sklearn.preprocessing import LabelEncoder`

10% 小題一：讀取資料

題目說明

- 請讀取 `4_titanic_data.csv` 資料集
  - 資料集說明請參考 `4_titanic_data` 資料說明.pdf

答案示意

- 前五筆資料的輸出應如下：

```
   pclass survived     sex  age  sibsp  parch  fare embarked
0  Upper       Yes  female   39      0      0    79        S
1  Upper       Yes    male    8      1      2    58        S
2  Upper        No  female   23      1      2    58        S
3  Upper        No    male   41      1      2    58        S
4  Upper        No  female   33      1      2    58        S
```

20% 小題二：切分訓練集與測試集

題目說明

- 請以資料筆數的 70%和 30%將 iris 資料隨機抽樣分為兩份，訓練集與測試集
  - 因具有隨機性質，抽樣結果可能不同，這部分不硬性規定，但若希望與答案示意結果相同可參考下方設定：
    - R: `set.seed(1)`
    - Python: `random_state=1` (此部分非必要執行)

答案示意

- (R) 輸出應如下：

```
## [1] "訓練集"

##       pclass survived     sex age sibsp parch fare embarked
## 1017  Lower        No    male  46     0     0  273        S
## 679   Lower        No    male  62     0     1   61        S
## 129   Upper       Yes  female  33     1     0  164        C
## 930   Lower       Yes    male  33     1     0  214        S
## 471   Middle       No    male  37     0     0   28        S
```

```
## 299   Middle   Yes female  22   1   0   98    S
## 270   Upper    No   male    74   0   1  235    S
## 597   Lower    No   male    41   0   0  195    C
## 330   Middle   No female    39   1   0   98    S
## 37    Upper    No   male    59   0   0  120    S
## 729   Lower    No   male    58   0   0   49    S
## 878   Lower    Yes female   17   0   0  195    C
## 485   Middle   Yes female   44   0   0   26    S
## 874   Lower    No   male    47   0   0  242    S
## 382   Middle   No   male    41   0   0   26    S
## 975   Lower    No female    99   3   2  110    S
## 801   Lower    No   male    68   0   0    2    S
## 852   Lower    Yes  male    36   0   0  253    S
## 931   Lower    No   male    31   0   0  242    S
## 326   Middle   No female    62   1   0   98    S
## 1038  Lower    No   male    36   0   0  253    S
## 554   Lower    No   male    41   0   0  197    S
## 422   Middle   No   male    44   0   0    5    S
## 111   Upper    Yes female   67   1   1  239    C
## 404   Middle   Yes female   24   2   1   86    S
## 924   Lower    No   male     6   1   1   29    S
## 532   Middle   Yes female   45   0   0   26    S
## 506   Middle   Yes female   33   0   1   98    S
## 556   Lower    No female    57   1   0  271    S
## 889   Lower    No   male    26   0   0  222    S
## 343   Middle   No   male    26   0   0   12    S
## 582   Lower    No female    20   1   0   65    S
## 121   Upper    Yes  male    73   0   0  111    C
## 40    Upper    Yes female   80   2   0  157    S
## 684   Lower    No   male    22   0   0    3    S
## 537   Middle   Yes female   39   0   2   86    S
## 375   Middle   No   male    34   0   0    5    S
## 248   Upper    Yes female   61   1   0  164    C
## 198   Upper    No   male    64   0   0  111    S
## 378   Middle   No   male    26   1   0   12    S
## 39    Upper    Yes female   62   0   0  108    C
## 435   Middle   No   male    33   1   2  146    C
## 810   Lower    Yes  male    44   0   0  227    S
## 390   Middle   Yes  male    85   0   0    5    S
## 280   Upper    No   male    71   0   1  182    C
## 672   Lower    No   male    41   0   0  242    S
## 526   Middle   Yes female   43   0   0   76    S
## 642   Lower    No   male    19   0   0  253    S
## 45    Upper    Yes female   73   0   0  107    C
## 402   Middle   No   male    26   2   0  230    S
## 22    Upper    Yes  male    34   0   0  118    C
## 718   Lower    Yes  male    31   0   0  202    S
## 742   Lower    No   male    46   1   1   74    S
## 193   Upper    No   male    87   0   0   98    S
## 371   Middle   No   male    53   1   0   76    S
## 499   Middle   Yes female   31   2   3   67    S
## 104   Upper    No   male    87   1   4  105    S
## 1027  Lower    No female    15   0   0  222    S
## 983   Lower    Yes female   29   0   0  202    S
## 767   Lower    No   male    34   1   0  222    S
## 492   Middle   No   male    50   0   0    5    S
## 838   Lower    No   male    44   0   0  227    S
## 616   Lower    No   male    34   0   0  214    S
## 615   Lower    No   male    22   0   0  242    S
## 843   Lower    No female    33   0   0  214    S
## 465   Middle   Yes female   15   1   0  119    C
```

```
## 525  Middle   No   male  57  0  0   26  S
## 808  Lower    No female  24  1  0  276  S
## 1036 Lower    No   male  38  0  0   61  S
## 176  Upper   Yes female  31  0  0  153  C
## 345  Middle   No   male  20  0  0  230  S
## 791  Lower    No   male  67  0  0  222  S
## 110  Upper   Yes   male  82  1  1  239  C
## 84   Upper   Yes female  19  1  0  168  S
## 871  Lower    No   male  33  0  0  206  S
## 29   Upper   Yes   male  37  0  0  103  S
## 141  Upper   Yes female  18  0  1  170  C
## 252  Upper    No female  86  1  0   84  S
## 918  Lower    No   male  18  4  1  143  S
## 733  Lower    No female  26  2  2  133  S
## 1021 Lower    No female  20  2  0   66  S
## 620  Lower    No   male  26  0  0  214  S
## 304  Middle  Yes female  50  0  3  140  S
## 545  Middle   No female  31  0  0   26  S
## 557  Lower   Yes   male   7  0  1  270  S
## 661  Lower    No   male  50  0  0  200  S
## 287  Middle   No   male  41  0  0   26  S
## 614  Lower    No   male  27  0  0  242  S
## 145  Upper   Yes female  49  1  0  160  S
## 329  Middle   No   male  52  1  0   98  S
## 487  Middle  Yes   male  41  0  0   23  C
## 855  Lower   Yes   male  44  0  0  204  S
## 851  Lower    No   male  25  0  0  197  S
## 630  Lower    No   male  39  1  0  190  S
## 498  Middle  Yes   male  40  1  1   67  S
## 858  Lower    No   male  39  0  0  227  S
## 816  Lower    No   male  27  0  0  201  S
## 619  Lower   Yes   male  44  0  0  166  S
## 576  Lower   Yes   male  36  0  0  217  S
## 490  Middle  Yes female  97  1  1   98  S
## 736  Lower    No   male  18  1  3  133  S
## 103  Upper    No   male  22  3  2  105  S
## 316  Middle   No   male  33  1  0   98  S
## 51   Upper   Yes   male  11  1  2   25  S
## 967  Lower    No   male  32  0  0  242  S
## 290  Middle   No   male  47  1  0   98  S
## 650  Lower    No female  52  0  0  213  Q
## 1044 Lower    No   male  35  0  0  195  C
## 811  Lower    No   male  19  0  0  193  S
## 282  Upper   Yes female  43  0  0   35  C
## 143  Upper   Yes female  71  1  0  236  S
## 442  Middle   No   male  70  1  0   98  S
## 285  Middle   No   male  41  1  0   89  C
## 920  Lower    No female  59  0  5  143  S
## 682  Lower   Yes   male  63  0  0  242  S
## 48   Upper    No   male  46  0  0  154  S
## 501  Middle   No   male  22  0  0    5  S
## 716  Lower    No   male  46  0  0  226  C
## 511  Middle  Yes female  41  0  0   19  Q
## 295  Middle  Yes female  50  0  0   26  S
## 536  Middle  Yes female  56  1  1   86  S
## 693  Lower    No   male  27  0  0  242  S
## 214  Upper    No   male  65  0  0  239  C
## 979  Lower    No   male  22  0  0  206  S
## 737  Lower    No female  67  1  3  133  S
## 339  Middle   No   male  43  1  1   99  S
## 346  Middle  Yes female  67  0  2  137  S
```

```
## 675   Lower    Yes female 50  0  2   57  S
## 43    Upper     No   male 63  0  0  103  S
## 1     Upper    Yes female 39  0  0   79  S
## 971   Lower     No   male 26  0  0  227  S
## 590   Lower     No   male 57  1  5  124  S
## 985   Lower     No   male 83  0  0    1  S
## 796   Lower     No   male 46  0  0  252  S
## 628   Lower    Yes female 27  0  0  208  Q
## 233   Upper    Yes   male 77  0  0  136  C
## 293   Middle    No   male 20  0  0   12  S
## 573   Lower     No female 99  4  2  123  S
## 369   Middle    No female 53  0  0   26  S
## 451   Middle    No   male 41  0  0   26  S
## 86    Upper    Yes   male 56  0  2  259  S
## 483   Middle   Yes female 22  0  0   98  S
## 327   Middle    No   male 74  1  0   98  S
## 622   Lower     No   male 34  0  0  226  S
## 355   Middle   Yes female 47  0  1   86  S
## 819   Lower     No   male 21  0  0  196  C
## 812   Lower     No   male 26  0  0  249  S
## 49    Upper     No   male 37  0  0  151  S
## 361   Middle   Yes female 41  1  0   31  C
## 944   Lower     No   male 23  4  1  115  Q
## 242   Upper    Yes   male 63  1  1   35  C
## 440   Middle    No   male 31  0  0    5  S
## 758   Lower     No   male 37  2  0  227  S
## 817   Lower    Yes female 56  0  1   27  C
## 818   Lower    Yes   male 55  0  1   27  C
## 247   Upper    Yes   male 74  1  0  164  C
## 751   Lower     No   male 15  5  2  150  S
## 219   Upper     No   male 46  0  0  103  S
## 135   Upper    Yes   male 36  0  0  234  C
## 1023  Lower     No   male 18  2  0   66  S
## 1020  Lower     No   male 66  0  0  266  S
## 377   Middle    No   male 26  1  0   12  S
## 408   Middle    No   male 70  0  0   26  S
## 943   Lower     No   male 91  4  1  115  Q
## 565   Lower     No   male 20  0  0  246  S
## 467   Middle   Yes   male 40  1  1   98  S
## 356   Middle    No   male 74  0  0   98  S
## 130   Upper    Yes   male 67  1  0  234  C
## 950   Lower     No female 66  1  0   43  S
## 65    Upper     No   male 36  1  0   37  C
## 900   Lower     No   male 60  0  1  248  S
## 359   Middle   Yes female 47  1  1  129  S
## 105   Upper    Yes female 82  1  4  105  S
## 124   Upper    Yes female 79  0  1   59  S
## 77    Upper    Yes female 53  1  0  229  C
## 218   Upper    Yes female 74  1  0  171  C
## 610   Lower    Yes   male 24  0  0  196  C
## 194   Upper    Yes female 55  0  0    9  C
## 19    Upper     No   male 50  0  0  231  C
## 273   Upper    Yes female 43  0  2   63  S
## 418   Middle   Yes female 31  2  1  106  S
## 543   Middle   Yes   male 43  0  0   26  S
## 419   Middle    No   male 66  0  0   45  S
## 686   Lower    Yes   male 39  0  0  213  Q
## 403   Middle    No female 20  1  1   26  S
## 749   Lower     No female 10  5  2  150  S
## 587   Lower    Yes   male 40  4  2  124  S
## 16    Upper     No   male 31  0  1   91  C
```

```
## 1013  Lower   No    male   58  0  2   43  S
## 777   Lower   No    male   37  0  0  226  S
## 892   Lower   No    male   26  0  0  218  S
## 604   Lower   Yes female    6  2  1   69  C
## 634   Lower   No  female   21  0  0  198  Q
## 664   Lower   No    male   43  0  0  213  Q
## 138   Upper   Yes female   72  1  1  282  S
## 719   Lower   No    male   29  1  0   33  S
## 500   Middle  Yes female   70  0  0    5  S
## 761   Lower   No  female   19  0  0  210  Q
## 1001  Lower   Yes female   18  1  1  251  C
## 229   Upper   Yes female   57  0  0   59  S
## 423   Middle  Yes female   29  0  0   30  C
## 421   Middle  No    male   27  2  0  125  S
## 140   Upper   No    male   75  0  0  155  S
## 126   Upper   Yes female   63  0  1  184  C
## 1000  Lower   Yes   male    4  0  1  251  C
## 508   Middle  Yes female   24  0  0  137  S
## 912   Lower   No  female   40  3  1   77  S
## 859   Lower   No  female   42  0  0  213  Q
## 271   Upper   No    male   26  0  1  235  S
## 879   Lower   Yes female    9  0  2   54  C
## 577   Lower   No    male   34  0  0  214  S
## 512   Middle  No    male   49  0  0    5  S
## 907   Lower   No    male   24  0  0  253  S
## 504   Middle  No    male   33  0  0   26  S
## 457   Middle  No    male   67  0  0   26  S
## 358   Middle  No    male   60  1  1  129  S
## 785   Lower   No    male   41  0  0  196  C
## 724   Lower   No    male   55  0  2  196  C
## 127   Upper   No    male   65  0  0  239  C
## 645   Lower   No    male   26  0  0  213  Q
## 41    Upper   Yes female   82  0  0  233  C
## 548   Lower   No    male   18  1  1   73  S
## 305   Middle  Yes   male   47  0  0   26  S
## 809   Lower   No  female   26  1  0  276  S
## 413   Middle  No    male   86  1  0   98  S
## 948   Lower   No    male   49  0  0  193  S
## 939   Lower   No    male   53  0  0  226  S
## 309   Middle  No    male   60  0  0   26  S
## 829   Lower   No  female   50  0  2   16  S
## 441   Middle  No    male   84  0  0   19  Q
## 117   Upper   Yes female   63  0  1  171  C
## 901   Lower   No  female   43  0  0  222  S
## 470   Middle  No    male   22  1  1  137  S
## 959   Lower   No    male   31  0  0  269  S
## 562   Lower   No    male   31  0  0  191  S
## 336   Middle  No    male   37  0  0   26  S
## 798   Lower   No    male   39  0  0  222  S
## 766   Lower   No    male   59  2  0   39  S
## 349   Middle  No    male   19  0  0  230  S
## 72    Upper   Yes female   75  2  0   94  S
## 915   Lower   No    male    9  4  1  143  S
## 474   Middle  No    male   55  0  0   26  S
## 168   Upper   Yes female   26  0  0  236  S
## 1043  Lower   No  female   16  1  0   41  C
## 845   Lower   No    male   50  1  0   52  S
## 455   Middle  Yes   male   22  0  0    5  S
## 840   Lower   No    male   50  0  0    2  S
## 880   Lower   Yes   male   24  1  1   54  C
## 625   Lower   No    male   57  1  1   51  Q
```

```
## 234   Upper    Yes   male   37   0   0   136      S
## 484   Middle   No    male   61   0   1    76      S
## 1014  Lower    No  female   10   0   2    90      S
## 73    Upper    No    male   92   1   1   228      S
## 539   Middle   Yes female   69   1   2   109      S
## 553   Lower    Yes female   20   0   0   196      C
## 15    Upper    Yes   male   98   0   0   118      S
## 893   Lower    No    male   38   0   0   196      C
## 294   Middle   No    male   29   0   0     5      S
## 62    Upper    Yes female   50   0   0   104      C
## 1003  Lower    No    male   42   0   0   242      S
## 644   Lower    No  female   26   0   0   213      Q
## 35    Upper    Yes female   63   0   0   104      C
## 381   Middle   No    male   47   0   0    26      S
## 872   Lower    Yes   male   81   0   1    20      S
## 1033  Lower    No    male   20   1   0   175      S
## 697   Lower    Yes female   50   1   0    64      S
## 904   Lower    No    male   24   0   0   268      S
## 665   Lower    Yes female   27   0   0   213      Q
## 31    Upper    Yes   male   57   0   0   122      C
## 549   Lower    Yes female   49   1   1    73      S
## 987   Lower    No  female   27   0   0   277      S
## 743   Lower    No    male   59   0   0   221      S
## 28    Upper    Yes female   49   0   0    36      S
## 788   Lower    Yes   male   39   0   0   226      C
## 148   Upper    Yes female   49   1   0   280      S
## 828   Lower    No    male   20   1   1   222      S
## 572   Lower    No  female   53   4   2   214      S
## 284   Upper    Yes female   50   0   0    36      C
## 334   Middle   Yes female   37   1   0    98      S
## 778   Lower    No  female   37   0   0   214      S
## 268   Upper    Yes female   82   1   0   232      C
## 93    Upper    No    male   55   0   0   116      C
## 938   Lower    No    male   31   0   0   253      S
## 300   Middle   No    male   37   0   0    98      S
## 714   Lower    No  female   31   0   0   213      Q
## 870   Lower    No    male   37   0   0   226      S
## 937   Lower    No    male   19   0   0   253      S
## 241   Upper    Yes   male   81   0   2    35      C
## 33    Upper    Yes female   79   0   0   103      S
## 786   Lower    No  female   36   1   0   227      S
## 437   Middle   Yes female   19   0   0    15      C
## 1035  Lower    Yes female   66   1   0   189      S
## 906   Lower    No  female   24   0   0   253      S
## 217   Upper    No    male   75   1   0   171      C
## 108   Upper    Yes   male   61   1   0   108      C
## 914   Lower    No  female   39   0   4    77      S
## 1040  Lower    No    male   36   1   0    41      C
## 209   Upper    No    male   27   0   0    36      C
## 338   Middle   Yes female   97   0   2    99      S
## 609   Lower    No    male   34   0   0   226      S
## 946   Lower    No  female   55   0   5   115      Q
## 584   Lower    No    male   49   0   0   191      S
## 882   Lower    No    male   46   0   0   242      S
## 568   Lower    No    male   56   4   2   123      S
## 711   Lower    No    male   44   0   0   213      Q
## 434   Middle   Yes female   40   1   2   146      C
## 201   Upper    Yes female   27   1   0   186      S
## 354   Middle   Yes female   20   0   1    86      S
## 357   Middle   Yes   male   97   0   2   129      S
## 923   Lower    No    male   44   0   0   226      S
```

```
## 860   Lower    No   male  49  0  0  226  C
## 514  Middle    No   male  33  0  0   26  S
## 116  Upper   Yes female  27  0  1  171  C
## 643   Lower    No   male  19  0  0  253  S
## 1024  Lower    No female  43  1  0   66  S
## 911   Lower    No   male  81  3  1   77  S
## 890   Lower    No   male  59  0  0  193  S
## 668   Lower    No   male  61  0  0  242  S
## 439  Middle    No   male  50  0  0   24  C
## 197  Upper    No   male  38  0  0  108  C
## 220  Upper   Yes   male  14  2  2  104  C
## 462  Middle    No   male  18  0  0    5  S
## 1041  Lower   Yes female  17  1  0   41  C
## 235  Upper    No   male  77  0  0  103  S
## 513  Middle  Yes female  57  0  0   26  S
## 805   Lower    No   male  29  0  0  226  S
## 173  Upper   Yes female  18  0  0  264  S
## 83   Upper   Yes   male  43  1  0  168  S
## 721   Lower    No   male  20  0  0  214  S
## 407  Middle  Yes female  74  1  3   86  S
## 324  Middle  Yes female  49  0  0   76  S
## 185  Upper   Yes   male  41  1  0  169  C
## 988   Lower   Yes   male  43  0  0  227  S
## 180  Upper    No   male  37  1  0  260  C
## 464  Middle    No   male  45  1  0  119  C
## 674   Lower   Yes   male  40  1  1   57  S
## 493  Middle    No   male  47  1  0   76  S
## 919   Lower    No   male  15  4  1  143  S
## 444  Middle    No female  78  0  0    5  S
## 167  Upper    No   male  39  0  0  118  S
## 899   Lower    No   male  37  0  0   83  S
## 1042  Lower    No   male  64  0  0  195  C
## 702   Lower    No   male  34  1  2   75  S
## 673   Lower   Yes   male  99  1  1   57  S
## 291  Middle  Yes female  50  1  0   98  S
## 653   Lower    No   male  26  0  0  210  Q
## 891   Lower   Yes   male  55  0  0  227  S
## 741   Lower   Yes   male  99  0  2   74  S
## 897   Lower   Yes female  27  0  0  214  S
## 933   Lower    No   male  22  0  0  226  S
## 781   Lower    No   male  61  0  0  174  S
## 994   Lower    No   male  33  0  0  191  S
## 56   Upper    No   male  50  1  0  238  S
## 25   Upper    No   male  33  0  0   98  C
## 81   Upper    No   male  43  1  0  160  S
## 472  Middle  Yes   male  24  0  0   32  C
## 957   Lower    No   male  54  0  0  197  S
## 494  Middle  Yes female  41  3  0   76  S
## 690   Lower    No   male  36  0  0  226  S
## 480  Middle    No   male  22  0  0    5  S
## 990   Lower    No female  23  0  1    4  S
## 3    Upper    No female  23  1  2   58  S
## 179  Upper   Yes   male  50  0  0  101  S
## 659   Lower   Yes   male  20  0  0  242  S
## 161  Upper   Yes female  41  0  0    8  C
## 384  Middle    No   male  41  0  0   26  S
## 436  Middle  Yes female  27  1  2  146  C
## 771   Lower    No   male  11  0  0   68  C
## 260  Upper   Yes   male  19  0  2   13  C
## 60   Upper   Yes   male  36  1  0  162  S
## 448  Middle    No   male  41  0  0   26  S
```

```
## 488  Middle   No    male   36   0   0   46   C
## 181  Upper    No    male   88   0   0  103   S
## 510  Middle   No    male   80   0   0   28   S
## 133  Upper    Yes female   49   1   0  263   S
## 618  Lower    No    male   24   0   0  144   C
## 428  Middle   Yes female   63   0   0   28   S
## 547  Lower    No    male   14   0   2   73   S
## 885  Lower    No  female   39   0   0  227   S
## 279  Upper    Yes female   26   0   0  103   S
## 704  Lower    No    male   33   0   0  226   S
## 1010 Lower    Yes female   20   0   0  278   S
## 611  Lower    No  female   20   0   1   41   C
## 772  Lower    Yes   male   36   0   0  179   S
## 150  Upper    No  female   70   0   0  113   C
## 795  Lower    No    male   27   0   0  217   S
## 169  Upper    No    male   41   0   0  149   S
## 598  Lower    No    male   29   0   0  222   S
## 881  Lower    Yes female   22   1   1   54   C
## 752  Lower    No    male   57   1   6  150   S
## 530  Middle   Yes female   13   0   0   55   S
## 1018 Lower    No    male   37   0   0  273   S
## 846  Lower    No  female   41   1   0   52   S
## 91   Upper    Yes female   67   1   0  142   C
## 164  Upper    Yes female   75   0   0  108   C
## 544  Middle   Yes female   34   0   0   28   S
## 479  Middle   Yes female   70   0   1   98   S
## 883  Lower    Yes   male   13   1   0   11   C
## 119  Upper    Yes   male   68   1   0  265   C
## 981  Lower    No    male   44   0   0  242   S
## 847  Lower    Yes   male   24   1   0  227   S
## 649  Lower    Yes female   18   0   0  213   Q
## 784  Lower    No    male   60   0   0  206   S
## 680  Lower    No    male   19   0   0  253   S
## 89   Upper    Yes female   36   1   1   91   C
## 533  Middle   No    male   36   1   0   98   S
## 591  Lower    Yes   male   29   0   0  217   S
## 738  Lower    No    male   33   0   0  212   Q
## 691  Lower    No    male   33   0   0  226   S
## 71   Upper    Yes female   87   0   2  262   C
## 681  Lower    No    male   28   0   0  195   C
## 315  Middle   Yes female   24   1   0   98   S
## 1046 Lower    No    male   39   0   0  223   S
## 414  Middle   No  female   82   1   0   98   S
## 710  Lower    No    male   61   0   0  226   S
## 570  Lower    No  female   23   4   2  123   S
## 730  Lower    No    male   58   0   0  213   Q
## 626  Lower    No  female   44   1   1   51   Q
## 546  Lower    No    male   60   0   0  202   S
## 722  Lower    No    male   18   0   0  214   S
## 574  Lower    No  female   11   4   2  123   S
## 755  Lower    No    male   44   0   0  247   S
## 995  Lower    No    male   95   0   0  214   S
## 804  Lower    Yes female   36   0   2   10   S
## 826  Lower    Yes female   34   1   1   81   S
## 392  Middle   Yes female   91   0   2   99   S
## 281  Upper    Yes   male   26   0   1  182   C
## 5    Upper    No  female   33   1   2   58   S
## 1026 Lower    No    male   24   0   0  222   S
## 986  Lower    No    male   22   0   0  226   S
## 20   Upper    Yes   male   52   1   1  161   S
## 183  Upper    Yes female   46   1   0  280   Q
```

```
## 775   Lower    No female 29   0    0  227       S
## 79    Upper   Yes   male 36   0    0  120       S
## 735   Lower    No   male 20   2    2  133       S
## 69    Upper   Yes female 55   1    1  262       C
## 631   Lower    No   male 27   1    0  197       S
## 473  Middle   Yes female 39   0    0    5       S
## 646   Lower    No   male 26   0    0  242       S
## 296  Middle    No   male 37   0    0    5       S
## 970   Lower    No   male 57   0    0  226       S
## 132   Upper    No   male 63   1    0  263       S
## 42    Upper   Yes female 59   0    0   35       C
## 848   Lower    No   male 37   0    0  166       S
## 993   Lower   Yes   male 62   0    0  227       S
## 789   Lower   Yes   male 26   0    0  217       S
## 397  Middle    No   male 68   1    2  185       S
## 264   Upper    No   male 84   0    0  131       S
## 177   Upper    No   male 65   0    0  231       C
## 595   Lower    No   male 29   0    0  191       S
## 368  Middle    No   male 50   0    0   26       S
## 433  Middle   Yes female  9   1    2  146       C
## 563   Lower    No   male 33   0    0  191       S
## 139   Upper    No   male 60   0    0  148       S
## 520  Middle    No   male 29   0    0   26       S
## 320  Middle   Yes female 60   0    0   26       S
## 115   Upper   Yes female 49   0    0   80       C
## 453  Middle   Yes female 14   0    1   70       S
## 450  Middle    No   male 44   0    0   28       S
## 589   Lower   Yes female 69   4    2  124       S
## 396  Middle   Yes female 31   1    2  185       S
## 834   Lower    No   male 39   0    0  272       S
## 972   Lower   Yes female 20   0    0  200       S
## 159   Upper   Yes female 55   0    0   79       S
## 648   Lower    No   male 31   0    0  222       S
## 495  Middle   Yes female 37   0    0   26       S
## 109   Upper   Yes female 27   0    2  152       C
## 519  Middle   Yes female 70   0    0    5       S
## 793   Lower    No   male 47   0    0  175       S
## 393  Middle    No   male 61   1    1   99       S
## 754   Lower    No   male 71   0    0  242       S
## 998   Lower   Yes   male 33   0    0  217       S
## 112   Upper    No   male 52   1    0  162       S
## 27    Upper   Yes female 22   1    0  281       C
## 222   Upper   Yes female 26   2    2  104       C
## 266   Upper   Yes female 49   0    0  159       C
## 158   Upper   Yes female 63   1    0  161       S
## 820   Lower    No   male 48   0    0  220       Q
## 698   Lower   Yes   male 41   0    0  273       S
## 386  Middle   Yes female 31   0    2   43       S
## 175   Upper   Yes female 20   1    0  162       S
## 763   Lower   Yes female 31   1    0   56       S
## 261   Upper   Yes female 55   1    1   13       C
## 166   Upper   Yes female 71   0    1  141       S
## 806   Lower   Yes   male 44   0    0  222       S
## 340  Middle   Yes female 43   1    1   99       S
## 92    Upper   Yes   male 68   1    0  167       C
## 412  Middle   Yes   male 60   0    0   26       S
## 99    Upper    No   male 41   0    0  109       C
## 516  Middle    No   male 33   0    0    5       S
## 128   Upper   Yes   male 33   1    0  164       C
## 689   Lower    No female 37   1    1   40       S
## 594   Lower    No   male 26   0    0  195       C
```

```
## 1005  Lower   Yes   male  33  0  0    2  S
## 734   Lower    No female  99  2  2  133  S
## 192   Upper   Yes female  22  0  2  100  S
## 85    Upper   Yes   male  73  1  1  259  S
## 302  Middle   Yes female  56  2  1  140  S
## 208   Upper    No   male  53  0  0    2  S
## 608   Lower    No   male  57  0  0  195  C
## 383  Middle    No   male  72  0  0   26  S
## 277   Upper    No   male  36  0  2   80  C
## 87    Upper   Yes female  74  1  1  259  S
## 913   Lower    No female  97  3  1   77  S
## 503  Middle    No   male  34  0  0   26  S
## 824   Lower   Yes female  56  0  2   81  S
## 662   Lower    No   male  31  0  0  200  S
## 515  Middle    No   male  59  0  0   47  C
## 629   Lower    No female  24  0  0  222  S
## 312  Middle   Yes female  17  0  2  140  S
## 962   Lower   Yes female   9  1  1   62  S
## 58    Upper    No   male  65  1  0  181  S
## 308  Middle    No   male  34  0  0   26  S
## 1034  Lower    No   male  26  1  0  175  S
## 887   Lower   Yes female  20  0  0  214  S
## 342  Middle    No female  41  0  0   26  S
## 978   Lower    No female  63  1  4  110  S
## 701   Lower   Yes female   2  1  2   75  S
## 122   Upper   Yes female  22  0  0  118  S
## 44    Upper   Yes   male  60  0  0  101  S
## 787   Lower    No female  33  1  0  227  S
## 1028  Lower    No   male  27  0  0  226  S
## 100   Upper   Yes female  31  3  2  105  S
## 313  Middle    No   male  82  1  1  140  S
## 232   Upper   Yes female  55  1  0  165  S
## 481  Middle    No   male  59  0  0   26  S
## 360  Middle   Yes female  36  1  0   31  C
## 11    Upper    No   male  66  1  0   85  C
## 310  Middle    No   male  36  0  0   26  S
## 550   Lower   Yes female  18  0  0  206  S
## 692   Lower    No   male  31  2  0   90  S
## 256   Upper    No   male  72  1  1  240  S
## 54    Upper   Yes female  50  1  2   25  S
## 146   Upper   Yes   male  49  0  0  103  C
## 876   Lower    No   male  20  0  0  213  S
## 776   Lower   Yes female  27  0  0  257  S
## 236   Upper    No   male  77  0  0  121  C
## 328  Middle    No   male  72  0  0   28  S
## 215   Upper    No   male  50  0  0  145  C
## 6     Upper   Yes   male  67  0  0  103  S
## 656   Lower    No   male  34  1  0   41  C
## 593   Lower   Yes female  63  0  0  195  C
## 792   Lower    No   male  19  1  0  192  S
## 250   Upper   Yes female  85  0  0  258  ?
## 641   Lower    No   male  53  0  0  253  S
## 965   Lower   Yes   male  33  0  0  273  S
## 258   Upper   Yes   male  67  1  0  160  S
## 927   Lower    No   male  26  0  0  227  S
## 542  Middle    No   male  89  0  0    5  S
## 288  Middle    No   male  20  0  0   12  S
## 797   Lower    No   male  43  0  0  214  S
## 607   Lower   Yes female  20  0  0  242  S
## 635   Lower   Yes   male  26  0  0  219  Q
## 531  Middle   Yes female  57  0  0   55  S
```

```
## 864   Lower   No    male  31  1  0   61   S
## 579   Lower   No    male  24  0  0  222   S
## 205   Upper   Yes   male  72  0  0  120   S
## 243   Upper   Yes female  57  1  1   35   C
## 837   Lower   Yes   male  27  0  0  195   C
## 1008  Lower   Yes female  39  0  2   50   C
## 399   Middle  Yes female  75  0  0   60   S
## 55    Upper   No    male  68  0  0   98   S
## 182   Upper   No    male  62  2  0  280   Q
## 903   Lower   Yes   male  44  0  0  214   S
## 61    Upper   Yes female  46  1  0  162   S
## 348   Middle  No    male  44  0  0   26   S
## 677   Lower   No    male  22  0  0  245   S
## 877   Lower   No    male  27  0  0  226   S
## 850   Lower   No  female  34  1  0   61   S
## 137   Upper   No    male  75  1  1  282   S
## 1039  Lower   No    male  50  0  0  273   S
## 325   Middle  No    male  22  0  0   26   S
## 854   Lower   Yes female  29  0  0  222   S
## 362   Middle  No    male  29  0  0   26   S
## 66    Upper   Yes female  34  1  0   37   C
## 101   Upper   Yes female  37  3  2  105   S
## 960   Lower   Yes female  26  0  0  206   S
## 245   Upper   Yes   male  44  0  0  120   C
## 206   Upper   No    male  66  0  0  160   S
## 999   Lower   No    male  47  0  0  242   S
## 213   Upper   Yes female  46  0  0  108   C
## 841   Lower   No    male  55  0  0   90   S
## 956   Lower   No    male  33  0  0  195   C
## 432   Middle  No    male  41  1  1   98   S
## 380   Middle  No    male  31  0  0   26   S
## 466   Middle  Yes   male  23  1  1   98   S
## 746   Lower   No    male  99  5  2  150   S
## 447   Middle  Yes female  31  1  1  138   C
## 153   Upper   No    male  70  0  0   98   S
## 17    Upper   Yes female  70  0  1   91   C
## 190   Upper   Yes female  29  1  0   14   C
## 894   Lower   Yes female  27  0  0  213   S
## 528   Middle  No    male  29  1  0    5   S
## 581   Lower   No    male  33  1  0   65   S
## 861   Lower   No    male  46  0  0  226   S
## 663   Lower   No    male  43  0  0  210   Q
## 551   Lower   Yes   male  33  0  0  206   S
## 1016  Lower   No  female  41  1  1   90   S
## 276   Upper   No    male  70  1  1   80   C
## 538   Middle  Yes female   8  1  2  109   S
## 683   Lower   No  female  27  0  0    6   S
## 928   Lower   No    male  33  0  0  227   S
## 603   Lower   Yes female   6  2  1   69   C
## 283   Upper   No    male  85  0  0  103   S
## 353   Middle  No    male  20  0  0  230   S
## 482   Middle  Yes female  26  0  1   76   S
## 226   Upper   Yes female  49  1  0  169   C
## 184   Upper   Yes female  52  1  0  280   Q
## 36    Upper   Yes female  27  0  1  163   S
## 1022  Lower   No    male  43  3  0   66   S
## 341   Middle  Yes female  27  0  0    5   S
## 52    Upper   Yes female  15  1  2   25   S
## 162   Upper   Yes   male  49  0  0  159   C
## 303   Middle  Yes female  13  2  1  140   S
## 973   Lower   No    male  56  3  2  110   S
```

```
## 67    Upper  Yes female 27 0 0  58 S
## 463  Middle  No   male  85 0 0 275 Q
## 941  Lower   No   male  10 4 1 115 Q
## 952  Lower   No   male  20 1 1  72 S
## 454  Middle  Yes female 59 0 1  70 S
## 335  Middle  No   male  39 0 0   5 S
## 849  Lower   No   male  41 1 0  61 S
## 600  Lower   No   male  24 0 0 195 C
## 725  Lower   No   male  19 1 1 196 C
## 825  Lower   Yes  male  39 3 1  81 S
## 363  Middle  No   male  26 0 0  26 S
## 652  Lower   No   male  31 0 0 242 S
## 459  Middle  No   male  36 0 0  26 S
## 286  Middle  Yes female 37 1 0  89 C
## 367  Middle  No   male  20 0 0   5 S
## 922  Lower   No   male  22 0 0  43 S
## 521  Middle  Yes female 37 0 0  22 S
## 13   Upper   Yes female 31 0 0 187 C
## 489  Middle  Yes female 23 1 1  98 S
## 964  Lower   Yes female 56 1 1  62 S
## 7    Upper   Yes female 86 1 0 236 S
## 82   Upper   Yes female 36 1 2 160 S
## 790  Lower   No   male  24 0 0 222 S
## 257  Upper   Yes female 55 1 1 240 S
## 670  Lower   No   male  36 0 0 226 S
## 475  Middle  Yes  male  27 0 0   5 S
## 456  Middle  No   male  55 0 0  26 S
## 974  Lower   No   male  10 3 2 110 S
## 374  Middle  No   male  18 0 0  98 S
## 438  Middle  Yes female 47 0 0   5 S
## 739  Lower   No   male  27 0 0 242 S
## 760  Lower   No female 31 0 0 256 S
## 225  Upper   Yes female 31 0 0 187 C
## 868  Lower   No   male  31 0 0 226 S
## 992  Lower   Yes  male  18 0 0 242 S
## 306  Middle  Yes female 22 0 0  26 S
## 780  Lower   Yes female 27 1 1  18 S
## 821  Lower   No   male  62 0 0 242 S
## 688  Lower   No   male  47 1 1  40 S
## 352  Middle  No   male  33 0 0 125 S
## 522  Middle  Yes female 36 0 0   5 S
## 833  Lower   Yes  male  34 0 0 166 S
## 97   Upper   No female 50 0 0 126 C
## 823  Lower   No   male  34 2 0 253 S
## 409  Middle  No   male  62 1 0  98 S
## 694  Lower   No   male  26 2 0  90 S
## 830  Lower   Yes  male  33 0 0 196 C
## 896  Lower   No   male  29 0 0 268 S
## 207  Upper   Yes female 77 0 1 262 C
## 707  Lower   Yes female 22 0 0 224 Q
## 651  Lower   No   male  37 0 0 197 S
## 753  Lower   No female 61 1 6 150 S
## 917  Lower   No   male  23 4 1 143 S
## 415  Middle  No   male  46 0 0  17 S
## 477  Middle  Yes  male  39 0 0  31 C
## 552  Lower   Yes  male  24 0 0 227 S
## 351  Middle  Yes female 31 1 0 108 C
## 1009 Lower   No   male  50 0 0 226 S
## 80   Upper   Yes female 46 0 0  58 S
## 527  Middle  No   male  41 1 0  76 S
## 632  Lower   No   male  27 0 0 217 S
```

```
## 977    Lower    No    male    57    1    4    110    S
## 251    Upper    No    male    90    1    0     84    S
## 12     Upper    Yes female    20    1    0     85    C
## 388    Middle   Yes female    81    0    1    130    S
## 458    Middle   No    male    92    0    0      5    S
## 586    Lower    No    male    99    4    2    124    S
## 658    Lower    No    male    24    0    0    191    S
## 8      Upper    No    male    55    0    0      2    S
## 612    Lower    No female    63    0    1     41    C
## 583    Lower    No    male    31    0    0    214    S
## 406    Middle   No    male    50    0    0     26    S
## 844    Lower    No female    63    0    0    213    S
## 30     Upper    No    male    63    0    0    136    S
## 9      Upper    Yes female    73    2    0    157    S
## 869    Lower    No    male    26    0    0    226    S
## 1019   Lower    No    male    37    0    0    273    S
## 655    Lower    No    male    39    0    0    242    S
## 968    Lower    Yes    male    39    0    0    273    S
## 278    Upper    Yes female    70    1    1     80    C
## 955    Lower    No    male    18    0    0    242    S
## 102    Upper    Yes female    29    3    2    105    S
## 687    Lower    No    male     3    0    2     40    S
## 118    Upper    No    male    31    0    0    239    C
## 757    Lower    No    male    52    2    0    227    S
## 323    Middle   Yes female    27    1    1    114    S
## 322    Middle   Yes    male    34    1    1    114    S
## 211    Upper    No    male    43    0    0    156    S
## 1007   Lower    Yes female    99    1    1     50    C
## 782    Lower    No    male    37    0    0     83    S
## 476    Middle   No    male    29    0    0      5    S
## 773    Lower    No female    20    0    0    176    Q
## 633    Lower    No    male    49    0    0    242    S
## 991    Lower    No female    39    1    1      4    S
## 605    Lower    Yes female    69    2    1     69    C
## 70     Upper    No    male    52    1    1    262    C
## 365    Middle   No    male    57    1    0     98    S
## 980    Lower    No    male    41    0    0    242    S
## 540    Middle   No    male    50    1    2    109    S
## 951    Lower    No female    23    1    1     72    S
## 768    Lower    No    male    26    0    0    222    S
## 750    Lower    No female    18    5    2    150    S
## 469    Middle   No    male    34    0    0     26    S
## 262    Upper    Yes    male    43    0    0    112    C
## 747    Lower    No    male     9    5    2    150    S
## 200    Upper    No    male    39    1    0    186    S
## 517    Middle   No    male    21    0    0     26    S
## 1002   Lower    No    male    44    0    0    227    S
## 696    Lower    Yes    male    51    1    0     64    S
## 391    Middle   No    male    41    0    0      5    S
## 910    Lower    No    male    23    3    1     77    S
## 14     Upper    Yes female    34    0    0    238    S
## 909    Lower    Yes female    43    0    0    254    S
## 783    Lower    Yes female    36    0    0    227    S
## 685    Lower    Yes female    41    0    0    178    Q
## 934    Lower    No    male    33    1    0    214    S
## 387    Middle   No    male    62    0    0     26    S

## [1] "測試集"

##      pclass survived   sex age sibsp parch fare embarked
## 2     Upper    Yes    male   8    1    2    58        S
```

```
## 4     Upper    No    male   41   1   2    58        S
## 10    Upper    No    male   94   0   0   153        C
## 18    Upper   Yes  female   44   0   0   233        C
## 21    Upper   Yes  female   66   1   1   161        S
## 23    Upper   Yes  female   60   0   0    85        C
## 24    Upper   Yes  female   39   0   0    84        S
## 26    Upper   Yes    male   33   1   0   281        C
## 32    Upper   Yes  female   41   0   0    63        S
## 34    Upper    No    male   60   0   0   103        S
## 38    Upper    No    male   67   0   0   156        C
## 46    Upper   Yes    male   50   0   1   159        C
## 47    Upper   Yes  female   79   0   1   159        C
## 50    Upper    No    male   19   0   0   151        S
## 53    Upper   Yes    male   50   1   2    25        S
## 57    Upper   Yes  female   96   1   0   238        S
## 59    Upper   Yes  female   66   1   0   181        S
## 63    Upper   Yes  female   41   0   0   264        S
## 64    Upper   Yes    male   63   0   0   116        C
## 68    Upper    No    male   66   0   0    93        S
## 74    Upper   Yes  female   50   0   2   228        S
## 75    Upper   Yes  female   87   1   1   103        S
## 76    Upper    No    male   55   1   0   229        C
## 78    Upper   Yes    male   71   0   0   103        S
## 88    Upper    No    male   70   1   0     8        C
## 90    Upper   Yes  female   67   1   0     8        C
## 94    Upper   Yes  female   29   0   1   262        C
## 95    Upper   Yes  female   53   0   0    85        C
## 96    Upper   Yes  female   74   1   0   237        C
## 98    Upper   Yes    male   50   0   0   102        S
## 106   Upper   Yes  female   41   0   0   167        C
## 107   Upper   Yes    male   70   2   0    34        S
## 113   Upper   Yes  female   49   1   0   162        S
## 114   Upper    No    male   66   0   0   139        S
## 120   Upper    No    male   94   0   0   134        C
## 123   Upper    No    male   53   0   1    59        S
## 125   Upper   Yes    male   29   0   1   184        C
## 131   Upper   Yes  female   68   1   0   234        C
## 134   Upper    No    male   57   0   0     2        S
## 136   Upper   Yes  female   31   0   0   262        C
## 142   Upper   Yes  female   62   0   1   170        C
## 144   Upper    No    male   60   1   0   160        S
## 147   Upper   Yes    male   53   1   0   280        S
## 149   Upper   Yes  female   53   0   0   258        ?
## 151   Upper   Yes    male   68   0   0     2        S
## 152   Upper    No    male   65   0   0    98        S
## 154   Upper    No    male   45   0   0    80        C
## 155   Upper    No    male   79   0   0   116        C
## 156   Upper    No    male   59   1   0   158        S
## 157   Upper   Yes    male   60   1   0   161        S
## 160   Upper   Yes  female   68   0   0    97        S
## 163   Upper    No    male   60   0   0   103        S
## 165   Upper   Yes  female   18   0   1   141        S
## 170   Upper   Yes  female   79   0   0    44        C
## 171   Upper   Yes  female   17   0   1    79        S
## 172   Upper    No    male   41   0   0    98        S
## 174   Upper    No    male   22   1   0   162        S
## 178   Upper    No    male   74   0   0   158        S
## 186   Upper    No    male   75   0   0   120        S
## 187   Upper    No    male   66   0   0   147        S
## 188   Upper    No    male   52   0   1   116        C
## 189   Upper   Yes  female   43   1   0    14        C
```

```
## 191   Upper   No    male  79   0   2    14      C
## 195   Upper   Yes female  27   0   1   183      C
## 196   Upper   No    male  88   0   1   183      C
## 199   Upper   No    male  29   0   0   282      S
## 202   Upper   No    male  20   1   0     9      C
## 203   Upper   Yes female  19   1   0     9      C
## 204   Upper   Yes female  41   0   0   282      S
## 210   Upper   Yes female  61   0   1    79      S
## 212   Upper   Yes   male  63   0   0   103      S
## 216   Upper   Yes female  46   0   0   264      S
## 221   Upper   Yes female  20   2   2   104      C
## 223   Upper   No    male  84   1   3   104      C
## 224   Upper   Yes female  67   1   3   104      C
## 227   Upper   Yes female  41   0   0   122      C
## 228   Upper   Yes   male  47   0   0   103      S
## 230   Upper   Yes   male  49   0   0   101      S
## 231   Upper   No    male  70   1   0   165      S
## 237   Upper   No    male  31   1   0   180      S
## 238   Upper   Yes female  20   1   0   180      S
## 239   Upper   Yes   male  31   1   0   261      S
## 240   Upper   Yes female  29   1   0   261      S
## 244   Upper   No    male  78   1   0    44      C
## 246   Upper   No    male  85   0   0   103      S
## 249   Upper   Yes female  72   1   0   237      C
## 253   Upper   No    male  84   0   0   128      S
## 254   Upper   Yes female  67   0   0    97      S
## 255   Upper   Yes female  20   0   2   240      S
## 259   Upper   No    male  68   1   1    13      C
## 263   Upper   No    male  57   0   0   108      C
## 265   Upper   No    male  66   0   0   132      S
## 267   Upper   No    male  87   1   0   232      C
## 269   Upper   No    male  82   0   0   103      S
## 272   Upper   Yes female  75   0   0    36      C
## 274   Upper   No    male  78   1   1    63      S
## 275   Upper   Yes female  63   1   1    63      S
## 289   Middle  No    male  33   0   0     5      S
## 292   Middle  No    male  78   0   0    26      S
## 297   Middle  No    male  71   0   0    21      S
## 298   Middle  Yes   male  44   1   0    98      S
## 301   Middle  Yes   male   9   2   1   140      S
## 307   Middle  No    male  29   0   0    26      S
## 311   Middle  Yes female  31   0   0    26      S
## 314   Middle  Yes female  57   1   1   140      S
## 317   Middle  Yes female  50   0   0    26      S
## 318   Middle  No    male  33   0   0    26      S
## 319   Middle  No    male  60   0   0    26      S
## 321   Middle  Yes   male   7   0   2   114      S
## 331   Middle  Yes female  33   1   1   118      S
## 332   Middle  Yes female  63   0   2   118      S
## 333   Middle  No    male  39   1   0    98      S
## 337   Middle  Yes   male  31   0   0     5      S
## 344   Middle  Yes   male  97   1   1   137      S
## 347   Middle  Yes female  37   0   0    26      S
## 350   Middle  No    male  39   1   0   108      C
## 364   Middle  No    male  20   0   0    26      S
## 366   Middle  Yes female  39   1   0    98      S
## 370   Middle  No    male  49   0   0    98      S
## 372   Middle  No    male  47   1   0    76      S
## 373   Middle  Yes female  47   0   0    26      S
## 376   Middle  No    male  66   0   0     5      S
## 379   Middle  No    male  31   0   0    28      S
```

```
## 385   Middle   Yes   male     5     1   1    43      S
## 389   Middle    No   male    37     0   1   130      S
## 394   Middle   Yes female    63     1   1    99      S
## 395   Middle   Yes female    31     1   2   185      S
## 398   Middle   Yes female    67     1   2   185      S
## 400   Middle    No   male    31     2   0   230      S
## 401   Middle    No   male    44     2   0   230      S
## 405   Middle    No   male    29     2   1    12      S
## 410   Middle   Yes female    39     1   0    98      S
## 411   Middle    No   male    26     0   0   230      S
## 416   Middle   Yes female    19     0   0     5      S
## 417   Middle    No   male    60     1   0   106      S
## 420   Middle    No   male    31     2   0   125      S
## 424   Middle    No   male    47     1   0    98      S
## 425   Middle   Yes female    31     1   0    98      S
## 426   Middle    No female    27     0   0    76      S
## 427   Middle    No   male    49     0   0    19      Q
## 429   Middle    No   male    78     0   0    19      Q
## 430   Middle    No   male    43     0   0     5      S
## 431   Middle    No female    34     1   1    98      S
## 443   Middle   Yes female    60     1   0    98      S
## 445   Middle   Yes   male     9     0   2   138      C
## 446   Middle    No   male    43     1   1   138      C
## 449   Middle    No   male    57     0   0    60      S
## 452   Middle    No   male    65     0   0    98      S
## 460   Middle    No   male    74     0   0    38      S
## 461   Middle    No   male    55     0   0    98      S
## 468   Middle    No   male    51     0   2    98      S
## 478   Middle    No   male    37     0   0     5      S
## 486   Middle    No   male    47     0   0    26      S
## 491   Middle   Yes female    46     0   2    98      S
## 496   Middle    No   male    29     0   0    47      C
## 497   Middle   Yes   male     7     1   1    67      S
## 502   Middle   Yes female    26     0   0     5      S
## 505   Middle    No   male    36     0   0    98      S
## 507   Middle   Yes female    20     0   2    26      S
## 509   Middle   Yes female    41     0   0    26      S
## 518   Middle    No   male    15     0   0   185      S
## 523   Middle    No   male    39     1   0    76      S
## 524   Middle    No female    36     1   0    76      S
## 529   Middle   Yes female    43     0   0    76      S
## 534   Middle   Yes female    39     1   0    98      S
## 535   Middle   Yes   male    23     1   1    86      S
## 541   Middle   Yes female    46     1   2   109      S
## 555   Lower     No   male    34     0   0   242      S
## 558   Lower    Yes female    20     0   1   270      S
## 559   Lower    Yes   male    34     0   0    68      C
## 560   Lower     No   male    34     0   0   225      S
## 561   Lower     No   male    24     0   0   227      S
## 564   Lower     No   male    49     0   0   242      S
## 566   Lower     No   male    44     0   0    83      S
## 567   Lower    Yes female    22     1   0   222      S
## 569   Lower     No female    81     4   2   123      S
## 571   Lower    Yes female    19     4   2   227      S
## 575   Lower     No   male    55     1   5   123      S
## 578   Lower     No female    55     1   5   123      S
## 580   Lower     No   male    34     0   0   226      S
## 585   Lower     No   male    69     4   2   124      S
## 588   Lower     No   male    14     4   2   124      S
## 592   Lower    Yes female    53     1   5   124      S
## 596   Lower     No female    19     0   0    42      C
```

```
## 599   Lower   Yes female  14   0   0   196   C
## 601   Lower    No   male   44   1   0    56   S
## 602   Lower   Yes female  46   3   0    56   S
## 606   Lower   Yes female  31   0   3    69   C
## 613   Lower    No female  36   0   0   224   Q
## 617   Lower    No   male   27   0   0   270   S
## 621   Lower    No   male   20   0   0   213   S
## 623   Lower    No   male   81   1   1    50   C
## 624   Lower    No female  99   1   1    50   C
## 627   Lower    No   male   26   0   0    61   S
## 636   Lower    No   male   22   0   0   176   Q
## 637   Lower    No female  20   0   0   224   Q
## 638   Lower    No female  26   0   0   253   S
## 639   Lower    No female  41   0   0   253   S
## 640   Lower    No   male   20   0   0   253   S
## 647   Lower    No   male   37   0   0   217   S
## 654   Lower   Yes   male   44   0   0   166   S
## 657   Lower    No   male   20   1   0    41   C
## 660   Lower    No   male   31   0   0   197   Q
## 666   Lower    No female  41   0   0   205   Q
## 667   Lower    No   male   93   0   0   213   Q
## 669   Lower    No   male   49   0   0   226   S
## 671   Lower    No   male   22   0   0   226   S
## 676   Lower    No   male   80   0   0   197   S
## 678   Lower   Yes female  19   0   1    61   S
## 695   Lower    No   male   19   2   0   242   S
## 699   Lower    No   male   18   0   0   273   S
## 700   Lower   Yes   male    9   1   2    75   S
## 703   Lower   Yes female  46   1   2    75   S
## 705   Lower    No   male   27   0   0   197   S
## 706   Lower    No   male   50   0   0   197   S
## 708   Lower    No   male   19   0   0   226   S
## 709   Lower    No   male   60   0   0   253   S
## 712   Lower   Yes   male   22   0   0   242   S
## 713   Lower   Yes female  41   0   0    20   S
## 715   Lower   Yes female  29   0   0   242   S
## 717   Lower    No   male   88   0   0   213   Q
## 720   Lower   Yes female  27   1   0    33   S
## 723   Lower    No   male   63   0   0   179   S
## 726   Lower    No   male   17   1   1   196   C
## 727   Lower    No   male   66   0   0   197   S
## 728   Lower   Yes female  69   0   0    20   S
## 731   Lower    No   male   20   0   0   217   S
## 732   Lower    No   male   34   0   0   224   Q
## 740   Lower   Yes female  18   0   0   210   Q
## 744   Lower   Yes female  43   1   1    74   S
## 745   Lower    No   male   53   0   0   191   S
## 748   Lower    No   male   11   5   2   150   S
## 756   Lower    No   male   24   0   0   279   S
## 759   Lower    No   male   22   0   0   214   S
## 762   Lower    No   male   37   1   0    56   S
## 764   Lower    No   male   24   0   0   273   S
## 765   Lower    No   male   30   0   0   196   C
## 769   Lower   Yes female  63   1   0    39   S
## 770   Lower    No   male   33   0   0   197   S
## 774   Lower   Yes female  34   0   0   227   S
## 779   Lower   Yes female  23   0   1    18   S
## 794   Lower   Yes   male   34   0   0   214   S
## 799   Lower   Yes   male   56   1   1    10   S
## 800   Lower   Yes female   9   1   1    10   S
## 802   Lower    No   male   46   0   0   214   S
```

```
## 803  Lower   No   male  22  0  0    2  S
## 807  Lower   No   male  36  0  0  222  S
## 813  Lower   No   male  41  0  0  226  S
## 814  Lower  Yes   male  26  0  0  217  S
## 815  Lower   No   male  46  0  0  222  S
## 822  Lower   No female  27  2  0  253  S
## 827  Lower   No female   9  1  1   16  S
## 831  Lower   No female  52  0  0  274  S
## 832  Lower  Yes female  27  0  0  197  S
## 835  Lower   No   male  39  0  0  214  S
## 836  Lower   No   male  27  0  0  214  S
## 839  Lower   No   male  48  0  0  173  C
## 842  Lower   No   male  31  0  0  273  S
## 853  Lower   No   male  71  0  0  192  S
## 856  Lower  Yes   male  31  0  0  194  S
## 857  Lower   No   male  27  0  0  193  S
## 862  Lower  Yes female  17  0  0  241  Q
## 863  Lower   No female  49  0  0  213  Q
## 865  Lower   No female  22  1  0   61  S
## 866  Lower   No   male  76  0  0  242  S
## 867  Lower  Yes   male  26  0  0  214  S
## 873  Lower  Yes female  36  0  1   20  S
## 875  Lower  Yes female  31  0  0  213  Q
## 884  Lower  Yes female  15  1  0   11  C
## 886  Lower   No   male  37  0  0  242  S
## 888  Lower  Yes female  34  0  0  222  S
## 895  Lower   No   male  84  0  0  172  S
## 898  Lower  Yes   male  99  0  1  117  S
## 902  Lower   No   male  37  0  0  222  S
## 905  Lower   No female  29  0  0  253  S
## 908  Lower   No   male  18  0  0  267  S
## 916  Lower   No   male  91  4  1  143  S
## 921  Lower   No   male  26  0  0  253  S
## 925  Lower   No female  40  1  1   29  S
## 926  Lower   No female  34  0  2   29  S
## 929  Lower   No   male  27  0  0  197  S
## 932  Lower   No female  37  0  0  226  S
## 935  Lower   No female  20  0  0  214  S
## 936  Lower  Yes   male  44  0  0  242  S
## 940  Lower   No   male  26  0  0  242  S
## 942  Lower   No   male  56  4  1  115  Q
## 945  Lower   No   male  97  4  1  115  Q
## 947  Lower   No female  27  0  0  143  S
## 949  Lower   No   male  70  1  0   43  S
## 953  Lower   No female  59  0  2   72  S
## 954  Lower   No   male  70  0  0  242  S
## 958  Lower   No   male  16  8  2  188  S
## 961  Lower   No   male  55  0  0  227  S
## 963  Lower  Yes female  31  0  2   62  S
## 966  Lower   No   male  24  0  0  242  S
## 969  Lower   No   male  27  0  0  196  C
## 976  Lower   No female  23  3  2  110  S
## 982  Lower   No   male  46  0  0  253  C
## 984  Lower   No   male  26  0  0  242  S
## 989  Lower   No   male  36  0  0  253  S
## 996  Lower  Yes   male  15  0  0  268  S
## 997  Lower   No   male  31  0  0  217  S
## 1004 Lower   No   male  62  0  0  242  S
## 1006 Lower  Yes   male  91  1  1   50  C
## 1011 Lower  Yes female  86  0  0  274  S
## 1012 Lower   No   male  12  1  1   43  S
```

```
## 1015  Lower      No    male  50    1    1    90          S
## 1025  Lower     Yes    male  27    0    0   195          C
## 1029  Lower      No    male  27    0    0   266          S
## 1030  Lower      No    male  45    0    0   273          S
## 1031  Lower     Yes  female  53    0    0   196          C
## 1032  Lower      No    male  71    0    0   213          S
## 1037  Lower      No    male  26    0    0   197          S
## 1045  Lower      No    male  36    0    0   195          C
```

- (Python) 輸出應如下：

```
## 訓練集

##       pclass survived      sex  age  sibsp  parch  fare embarked
## 35     Upper      Yes  female   27      0      1   163         S
## 875    Lower       No    male   20      0      0   213         S
## 604    Lower      Yes  female   69      2      1    69         C
## 133    Upper       No    male   57      0      0     2         S
## 281    Upper      Yes  female   43      0      0    35         C
## ..       ...      ...     ...  ...    ...    ...   ...       ...
## 138    Upper       No    male   60      0      0   148         S
## 51     Upper      Yes  female   15      1      2    25         S
## 624    Lower       No    male   57      1      1    51         Q
## 275    Upper       No    male   70      1      1    80         C
## 503   Middle       No    male   33      0      0    26         S
##
## [732 rows x 8 columns]

## 測試集

##       pclass survived      sex  age  sibsp  parch  fare embarked
## 10     Upper       No    male   66      1      0    85         C
## 15     Upper       No    male   31      0      1    91         C
## 20     Upper      Yes  female   66      1      1   161         S
## 21     Upper      Yes    male   34      0      0   118         C
## 22     Upper      Yes  female   60      0      0    85         C
## ...      ...      ...     ...  ...    ...    ...   ...       ...
## 1034   Lower      Yes  female   66      1      0   189         S
## 1035   Lower       No    male   38      0      0    61         S
## 1037   Lower       No    male   36      0      0   253         S
## 1043   Lower       No    male   35      0      0   195         C
## 1045   Lower       No    male   39      0      0   223         S
##
## [314 rows x 8 columns]
```

補充：

- 若此題無法完成者，請讀取資料以便後續題目作答
  - 4_titanic_train_for_helper.csv
  - 4_titanic_test_for_helper.csv

30% 小題三：模型配適

題目說明

- 使用訓練集進行隨機森林模型配適
  - 自變數(x)：除了 survived 欄位，皆為自變數

– 應變數(y)：survived 欄位

答案示意

- (R) 配適後模型的輸出應如下：
  - 因為抽樣與訓練過程是隨機，<mark>數值僅供參考</mark>

```
## 
## Call:
##  randomForest(formula = survived ~ ., data = train_set)
##                Type of random forest: classification
##                      Number of trees: 500
## No. of variables tried at each split: 2
## 
##         OOB estimate of  error rate: 21.17%
## Confusion matrix:
##      No Yes class.error
## No  397  38  0.08735632
## Yes 117 180  0.39393939
```

- (Python) 配適後模型的輸出應如下：
  - 僅僅示意於 Python 中直接將模型輸出的結果，主要會看過程是否正確

```
## RandomForestClassifier(bootstrap=True, class_weight=None, criterion='gini',
##                        max_depth=None, max_features='auto', max_leaf_nodes=None,
##                        min_impurity_decrease=0.0, min_impurity_split=None,
##                        min_samples_leaf=1, min_samples_split=2,
##                        min_weight_fraction_leaf=0.0, n_estimators=10,
##                        n_jobs=None, oob_score=False, random_state=None,
##                        verbose=0, warm_start=False)
```

20% 小題四：預測

題目說明

- 以配適後模型進行測試集資料之預測
  - 放入模型的應為測試集資料的 speed 欄位，並得到相同數量的預測結果

答案示意

- (R) 預測結果應如下：
  - 因為抽樣與訓練過程是隨機，<mark>數值僅供參考</mark>，主要會看過程是否正確

```
##    2    4   10   18   21   23   24   26   32   34   38   46   47   50   53
##  Yes   No   No  Yes  Yes  Yes  Yes   No  Yes   No   No   No  Yes   No  Yes
##   57   59   63   64   68   74   75   76   78   88   90   94   95   96   98
##  Yes  Yes  Yes   No   No  Yes  Yes   No   No   No  Yes  Yes  Yes  Yes   No
##  106  107  113  114  120  123  125  131  134  136  142  144  147  149  151
##  Yes   No  Yes   No   No   No   No  Yes   No  Yes  Yes   No   No  Yes   No
##  152  154  155  156  157  160  163  165  170  171  172  174  178  186  187
##   No   No   No   No   No  Yes   No  Yes  Yes  Yes   No   No   No   No   No
##  188  189  191  195  196  199  202  203  204  210  212  216  221  223  224
##   No  Yes  Yes  Yes   No   No  Yes  Yes  Yes  Yes   No  Yes  Yes   No  Yes
##  227  228  230  231  237  238  239  240  244  246  249  253  254  255  259
##  Yes   No   No   No   No  Yes   No  Yes   No   No  Yes   No  Yes  Yes  Yes
##  263  265  267  269  272  274  275  289  292  297  298  301  307  311  314
##   No   No  Yes   No  Yes   No  Yes   No   No   No   No   No   No  Yes  Yes
```

```
##  317  318  319  321  331  332  333  337  344  347  350  364  366  370  372
##  Yes   No   No   No  Yes  Yes   No   No   No  Yes   No   No  Yes   No   No
##  373  376  379  385  389  394  395  398  400  401  405  410  411  416  417
##  Yes   No   No   No   No  Yes  Yes  Yes   No   No   No  Yes   No  Yes   No
##  420  424  425  426  427  429  430  431  443  445  446  449  452  460  461
##   No   No  Yes  Yes   No   No   No  Yes  Yes   No   No   No   No   No   No
##  468  478  486  491  496  497  502  505  507  509  518  523  524  529  534
##   No   No   No  Yes   No  Yes  Yes   No  Yes  Yes   No   No  Yes  Yes  Yes
##  535  541  555  558  559  560  561  564  566  567  569  571  575  578  580
##  Yes  Yes   No  Yes   No   No   No   No   No   No   No   No   No   No   No
##  585  588  592  596  599  601  602  606  613  617  621  623  624  627  636
##   No   No   No  Yes  Yes   No   No  Yes   No   No   No   No  Yes   No   No
##  637  638  639  640  647  654  657  660  666  667  669  671  676  678  695
##  Yes   No   No   No   No   No   No   No   No   No   No   No   No   No   No
##  699  700  703  705  706  708  709  712  713  715  717  720  723  726  727
##   No   No   No   No   No   No   No   No   No   No   No   No   No   No   No
##  728  731  732  740  744  745  748  756  759  762  764  765  769  770  774
##   No   No   No   No   No   No   No   No   No   No   No   No   No   No   No
##  779  794  799  800  802  803  807  813  814  815  822  827  831  832  835
##   No   No   No  Yes   No   No   No   No   No   No   No  Yes   No  Yes   No
##  836  839  842  853  856  857  862  863  865  866  867  873  875  884  886
##   No   No   No   No   No   No  Yes   No   No   No   No   No   No  Yes   No
##  888  895  898  902  905  908  916  921  925  926  929  932  935  936  940
##   No   No  Yes   No   No   No   No   No   No  Yes   No   No  Yes   No   No
##  942  945  947  949  953  954  958  961  963  966  969  976  982  984  989
##   No   No   No   No  Yes   No   No   No  Yes   No   No   No   No   No   No
##  996  997 1004 1006 1011 1012 1015 1025 1029 1030 1031 1032 1037 1045
##   No   No   No  Yes   No   No   No   No   No   No  Yes   No   No   No
## Levels: No Yes
```

- (Python) 預測結果應如下：
  - 因為抽樣與訓練過程是隨機，<mark>數值僅供參考</mark>，主要會看過程是否正確

```
## array([0, 0, 1, 1, 1, 0, 1, 1, 0, 1, 0, 1, 0, 1, 0, 0, 0, 1, 1, 1, 1, 1,
##        0, 1, 1, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 0, 1, 0, 0, 0, 1, 1, 1, 1,
##        1, 0, 1, 1, 1, 0, 1, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0, 1, 1, 1, 0, 0,
##        0, 0, 1, 0, 1, 1, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 1, 0, 0, 1, 1, 1,
##        1, 1, 0, 1, 0, 1, 0, 1, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
##        1, 1, 1, 0, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
##        0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1, 0, 1, 0, 0, 0, 0, 1, 0, 0, 1, 0,
##        0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1, 0,
##        0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
##        0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
##        0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0,
##        0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0,
##        1, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 1, 1, 0, 0, 1, 0, 0, 0, 0,
##        0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
##        0, 0, 0, 1, 0, 0])
```

補充：

- 若此題無法完成者，請讀取資料 4_titanic_rf_for_helper.csv 以便後續題目作答。

20% 小題五：評估

題目說明

- 為評估預測結果與實際結果之誤差，請計算其準確度(accuracy)。

答案示意

- (R) 準確度如下：
  - 因為抽樣與訓練過程是隨機，<mark>數值僅供參考</mark>，主要會看過程是否正確

```
## [1] 0.7898089
```

- (Python) 準確度如下：
  - 因為抽樣與訓練過程是隨機，<mark>數值僅供參考</mark>，主要會看過程是否正確

```
## 0.732484076433121
```

答案示意