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 3 3
##  [36] 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 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 1 1 2 1 2 2 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 2 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 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 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 2 0 2 2 2 2 0 2 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 0 2 2 2 2 0 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

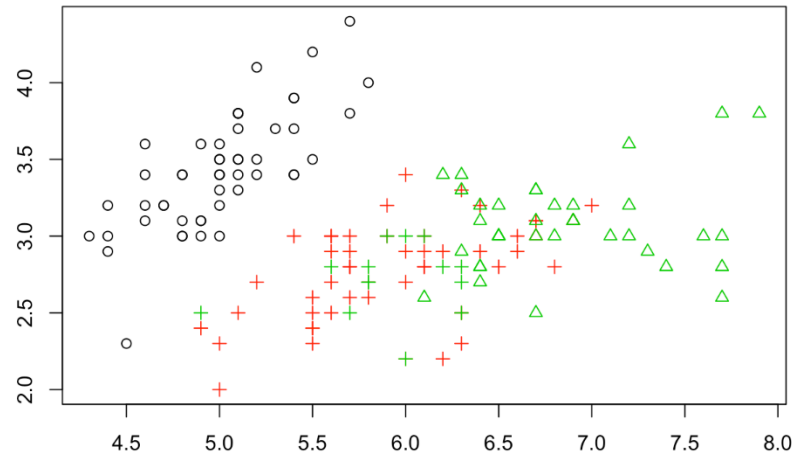
題目說明

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

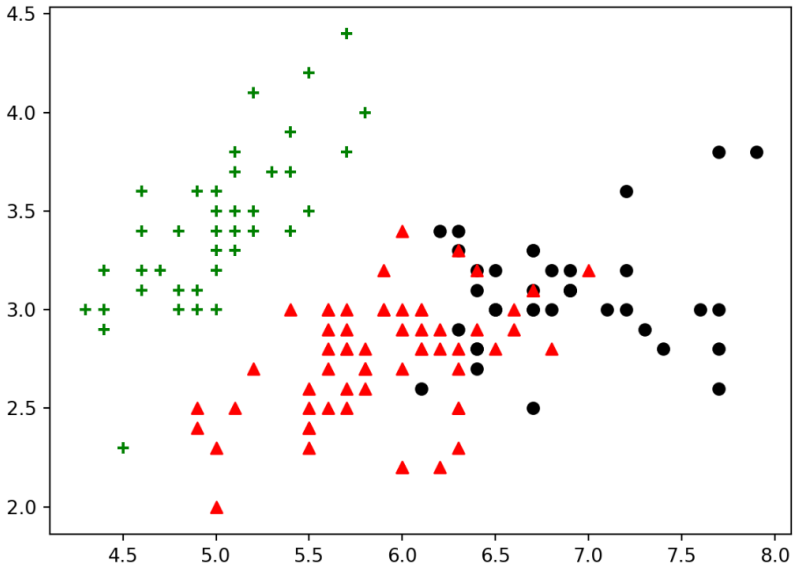
    - X 軸使用 `Sepal.Length`
    - Y 軸使用 `Sepal.Width`
  - (5%) 點的顏色使用原始分類(Species)
    - R 可參閱 points 之說明
  - (5%) 點的形狀使用集群結果(cluster)
    - R 可參閱 points 之說明
- 若無法取得集群結果，可自行產生模擬結果並作答此題

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
```

- (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，**數值僅供參考**，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，**數值僅供參考**，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，**數值僅供參考**，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
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## 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
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## 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
```

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## 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
```

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## 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
```

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## 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
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## 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，**數值僅供參考**

```
##
## 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，**數值僅供參考**，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，**數值僅供參考**，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, 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, 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, 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，**數值僅供參考**，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，**數值僅供參考**，主要會看過程是否正確

```
## 0.732484076433121
```