02PreProcessing

March 18, 2019

1 前處理-資料清理

1. missing data
   - 平均值、標準差、屆在平均值與標準差之間的亂數
2. range 差異過大的資料
   - 偵測 (identity): PCA
   - 處理: 取 log e.g. 10^1 => 1, 10^6 => 6
3. 資料不一致的問題
   - domain knowledge e.g. 年紀為負的
4. 正規化 (Normalize)
   - L1 Norm(穩定: 水平調整較少):
     - $|||_1 = \sum||$
   - L2 Norm(強健: 較能對抗 outlier):
     - $|||_2 = \frac{}{\sqrt{(\sum^2)}}$
5. 類別型資料的處理
   - 自然語言 (NLP): 先轉成類別型資料
   - onehot encoding

0	1	2
[1,0,0]	[0,1,0]	[0,0,1]

7. Feature 產生工具
   - PolynomialFeatures: (_1, _2)=> (1, _1, _2, _1^2, _1 _2, _2^2)
8. 議題:
   - 請問取 log 與 normalize 有什麼差別?

2 IMPORT & DATA

In [3]:
```
import pandas as pd
import numpy as np
from collections import Counter
import re
import numpy as np

from sklearn import preprocessing

import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
from sklearn.decomposition import PCA

import os
import random
import math
```

In [4]:
```
df = pd.read_csv('train.csv')

# 請查看 df.info()
# 並找出共有幾種型別，以及哪一些欄位有 null 值
#=============your works starts===============#
df_info =
#==============your works ends================#
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 891 entries, 0 to 890
Data columns (total 12 columns):
PassengerId    891 non-null int64
Survived       891 non-null int64
Pclass         891 non-null int64
Name           891 non-null object
Sex            891 non-null object
Age            714 non-null float64
SibSp          891 non-null int64
Parch          891 non-null int64
Ticket         891 non-null object
Fare           891 non-null float64
Cabin          204 non-null object
Embarked       889 non-null object
dtypes: float64(2), int64(5), object(5)
memory usage: 83.6+ KB
```

In [5]:
```
# 請查看 df.describe()
# 請透過 mean 關注每一個變數的 scale
#=============your works starts===============#
df_describe =
```

```
        #==============your works ends================#
        df_describe
```

Out[5]:

	PassengerId	Survived	Pclass	Age	SibSp	\
count	891.000000	891.000000	891.000000	714.000000	891.000000	
mean	446.000000	0.383838	2.308642	29.699118	0.523008	
std	257.353842	0.486592	0.836071	14.526497	1.102743	
min	1.000000	0.000000	1.000000	0.420000	0.000000	
25%	223.500000	0.000000	2.000000	20.125000	0.000000	
50%	446.000000	0.000000	3.000000	28.000000	0.000000	
75%	668.500000	1.000000	3.000000	38.000000	1.000000	
max	891.000000	1.000000	3.000000	80.000000	8.000000	

	Parch	Fare
count	891.000000	891.000000
mean	0.381594	32.204208
std	0.806057	49.693429
min	0.000000	0.000000
25%	0.000000	7.910400
50%	0.000000	14.454200
75%	0.000000	31.000000
max	6.000000	512.329200

In [6]:
```
        # 請透過 head() 查看 df 的頭 5 行
        #==============your works starts===============#
        df_head =
        #==============your works ends================#

        df_head
```

Out[6]:

	PassengerId	Survived	Pclass	\
0	1	0	3	
1	2	1	1	
2	3	1	3	
3	4	1	1	
4	5	0	3	

	Name	Sex	Age	SibSp	\
0	Braund, Mr. Owen Harris	male	22.0	1	
1	Cumings, Mrs. John Bradley (Florence Briggs Th...	female	38.0	1	
2	Heikkinen, Miss. Laina	female	26.0	0	
3	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	35.0	1	
4	Allen, Mr. William Henry	male	35.0	0	

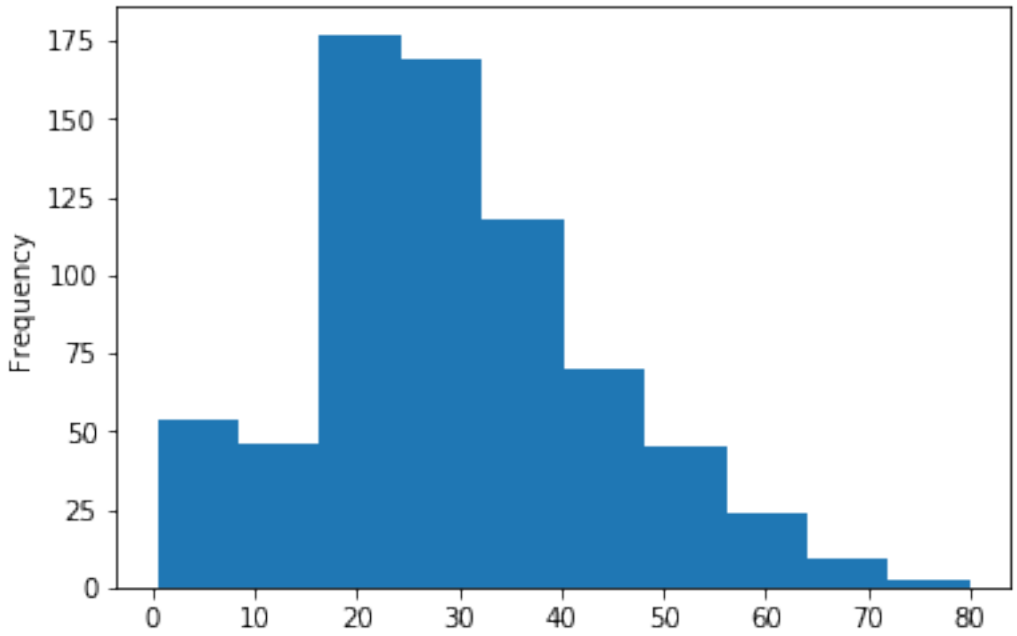
	Parch	Ticket	Fare	Cabin	Embarked
0	0	A/5 21171	7.2500	NaN	S
1	0	PC 17599	71.2833	C85	C
2	0	STON/O2. 3101282	7.9250	NaN	S

```
3      0            113803  53.1000  C123        S
4      0            373450   8.0500   NaN        S
```

3 PREPROCESSING

3.1 Age - Fill in missing values

In [7]:
```
# 查看 Age 的分布狀況 (hint: df['Age'].plot('hist'))
#=============your works starts===============#
age_ax =
#==============your works ends================#

plt.show()
```



In [8]:
```
# 作法一: 取平均值
#=============your works starts===============#
avg_age =
#==============your works ends================#


print("avg_age", avg_age)
# avg_age 29.69911764705882
```

```
avg_age 29.69911764705882
```

```
In [9]: # 作法二: 取中位數
        #=============your works starts===============#
        median_age =
        #==============your works ends================#


        print("median_age", median_age)
        # median_age 28.0
```

```
median_age 28.0
```

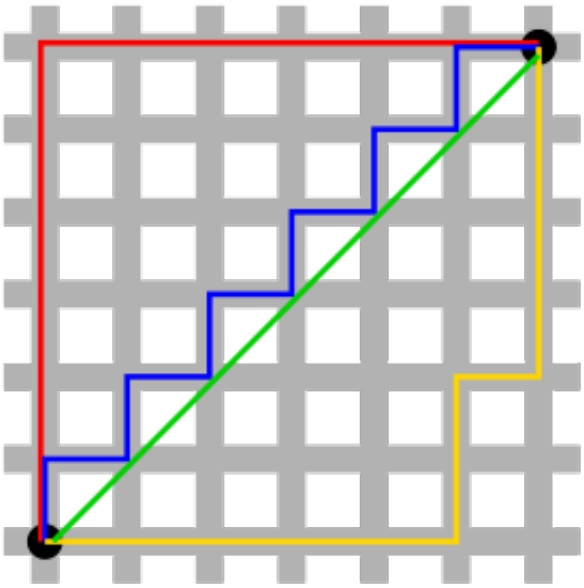
```
In [10]: # 作法三: 用相同的分布產生亂數塞入 (hint: 使用 np.random.randint, min: mean - std, max:
         std = df['Age'].std()
         mean = df['Age'].mean()
         size = len(df[pd.isnull(df['Age'])])
         np.random.seed(1212)
         #=============your works starts===============#
         random_age =
         #==============your works ends================#


         print("random_age", random_age)
         print("len(random_age)", len(random_age))
         # random_age [23 41 37 17 31 20 28 24 16 42 33 19 22 20 29 15 32 16 35 40 35 34 26 27
         # len(random_age) 177
```

```
random_age [23 41 37 17 31 20 28 24 16 42 33 19 22 20 29 15 32 16 35 40 35 34 26 27
 37 28 30 23 31 33 42 30 25 21 29 15 21 16 39 39 21 31 31 37 31 30 23 41
 30 35 33 21 31 28 39 37 31 29 29 40 16 43 20 29 36 22 27 41 32 24 35 23
 29 43 33 43 31 34 34 28 27 40 29 35 27 20 40 37 16 29 29 39 20 17 20 35
 24 42 34 33 26 38 42 31 30 40 34 16 35 16 34 24 43 29 22 29 20 43 29 38
 37 39 35 42 40 19 32 17 25 36 15 26 31 23 19 24 34 39 39 19 17 28 16 35
 20 16 29 18 34 43 16 28 30 42 27 25 36 19 22 43 37 38 30 15 32 38 41 21
 26 33 20 19 21 29 40 30 28]
len(random_age) 177
```

```
In [11]: df['avg_age'] = df['Age']
         df.loc[pd.isnull(df['Age']), 'avg_age'] = avg_age
         df['median_age'] = df['Age']
         df.loc[pd.isnull(df['Age']), 'median_age'] = median_age
         df['random_age'] = df['Age']
         df.loc[pd.isnull(df['Age']), 'random_age'] = random_age

         df.loc[pd.isnull(df['Age']), ['avg_age', 'median_age', 'random_age']].head()
```

Out[11]:

	avg_age	median_age	random_age
5	29.699118	28.0	23.0



l1_l2_norm

```
17  29.699118       28.0        41.0
19  29.699118       28.0        37.0
26  29.699118       28.0        17.0
28  29.699118       28.0        31.0
```

3.2 Age - Normalize

- L1 Normalization: $||x||_2 = \sqrt{(\sum_i x_i^2)} = \sqrt{x_1^2 + x_2^2 + \ldots + x_i^2}$
- L2 Normalization: $||x||_1 = \sum_i |x_i| = |x_1| + |x_2| + \ldots + |x_i|$
- difference

```
In [12]: # 請寫出 L1 Normaliaze 的 function
         def normalize_l1(X):
             """if type(X) == np.array, and X has two dimensiions"""
             #=============your works starts===============#
             l1_x =
             X =
             #==============your works ends================#
             return X

         X = [[ 1., -1.,  2.],
              [ 2.,  0.,  0.],
              [ 0.,  1., -1.]]
         X_normalized = normalize_l1(X)
         print(X_normalized)
         # [[ 0.125 -0.125  0.25 ]
```

```
        #  [ 0.25   0.     0.   ]
        #  [ 0.     0.125 -0.125]]
```

```
[[ 0.125 -0.125  0.25 ]
 [ 0.25   0.     0.   ]
 [ 0.     0.125 -0.125]]
```

```
In [13]: # 請寫出 L2 Normaliaze 的 function
         def normalize_l2(X):
             """if type(X) == np.array, and X has two dimensiions"""
             #=============your works starts===============#
             l2_x =
             X =
             #==============your works ends================#
             return X

         X_normalized = normalize_l2(X)
         print(X_normalized)
         # [[ 0.28867513 -0.28867513  0.57735027]
         #  [ 0.57735027  0.          0.        ]
         #  [ 0.          0.28867513 -0.28867513]]
```

```
[[ 0.28867513 -0.28867513  0.57735027]
 [ 0.57735027  0.          0.        ]
 [ 0.          0.28867513 -0.28867513]]
```

```
In [14]: X = [[ 1., -1.,  2.],
              [ 2.,  0.,  0.],
              [ 0.,  1., -1.]]

         # 請使用 preprocessing.normalize(X, norm='l1') 比較，與我們自己寫的 normalize function
         #=============your works starts===============#
         X_normalized =
         #==============your works ends================#

         print(X_normalized)
         # sklearn l1_norm
         # [[ 0.25 -0.25  0.5 ]
         #  [ 1.    0.    0.  ]
         #  [ 0.    0.5  -0.5 ]]
```

```
[[ 0.25 -0.25  0.5 ]
 [ 1.    0.    0.  ]
 [ 0.    0.5  -0.5 ]]
```

```
In [15]: avg_age_l1 = normalize_l1(df['avg_age'].values)
         avg_age_l2 = normalize_l2(df['avg_age'].values)
```

```
df['avg_age_l1'] = avg_age_l1
df['avg_age_l2'] = avg_age_l2

df[['avg_age', 'avg_age_l1', 'avg_age_l2']].head()
```

Out[15]:

	avg_age	avg_age_l1	avg_age_l2
0	22.0	0.000831	0.022735
1	38.0	0.001436	0.039270
2	26.0	0.000983	0.026869
3	35.0	0.001323	0.036170
4	35.0	0.001323	0.036170

3.3 Cabin - NLP category

In [16]:
```
# 整理出每一個 Cabin 的個數並排序 (hint:Counter(), sorted())
#=============your works starts===============#
sorted_cabin_counter =
#==============your works ends================#


print(sorted_cabin_counter[:10])
# [('nan', 687), ('G6', 4), ('C23 C25 C27', 4), ('B96 B98', 4), ('F33', 3), ('E101', 
```

```
[('nan', 687), ('G6', 4), ('C23 C25 C27', 4), ('B96 B98', 4), ('F33', 3), ('E101', 3), ('F2', 3
```

In [17]:
```
test_arr = ["A", "B", "C"]

# enumerate 的用法: 替 test_arr 寫上編號，並轉換成 dict 型別
#=============your works starts===============#
enumerate_res =
#==============your works ends================#

print(enumerate_res)
```

```
{0: 'A', 1: 'B', 2: 'C'}
```

In [18]:
```
# 抓出第一個 char 出來分類，並轉成 int 類別 (hint: enumerate)
# new_Cabin: 抓出第一個 char，轉 str，轉小寫
# mapping_dict: 找到每個開頭 char 所屬的編號
# new_Cabin_int: 將 char 轉換成編號
#=============your works starts===============#
new_Cabin =
mapping_dict =
new_Cabin_int =
#==============your works ends================#
```

```
        print(new_Cabin.values[:10])
        print(mapping_dict)
        print(new_Cabin_int[:10])
        # ['n' 'c' 'n' 'c' 'n' 'n' 'e' 'n' 'n' 'n']
        # {'e': 0, 'f': 1, 'd': 2, 't': 3, 'c': 4, 'n': 5, 'b': 6, 'g': 7, 'a': 8}
        # [5 4 5 4 5 5 0 5 5 5]
```

```
['n' 'c' 'n' 'c' 'n' 'n' 'e' 'n' 'n' 'n']
{'d': 0, 't': 1, 'b': 2, 'n': 3, 'f': 4, 'e': 5, 'g': 6, 'c': 7, 'a': 8}
[3 7 3 7 3 3 5 3 3 3]
```

```
In [19]: df['cabin_cat'] = new_Cabin_int
         df[['Cabin', 'cabin_cat']].head()
```

```
Out[19]:   Cabin  cabin_cat
         0   NaN          3
         1   C85          7
         2   NaN          3
         3  C123          7
         4   NaN          3
```

3.4 Sex - Category

```
In [20]: # 請算出 Sex 共有幾個類別，每一個類別共出現幾次 (hint:Counter)
         #=============your works starts===============#
         counter =
         #==============your works ends================#


         print(counter)
         #Counter({'male': 577, 'female': 314})
```

```
Counter({'male': 577, 'female': 314})
```

```
In [21]: # 創造出一個與 df['Sex'] 等長的 array，並將 df['Sex'] 中的 male 換成 1，female 換成 0
         #=============your works starts===============#
         sex_mapping =
         sex_cat =
         #==============your works ends================#


         print("Counter(sex_cat)", Counter(sex_cat))
         #Counter(sex_cat) Counter({1: 577, 0: 314})
```

```
Counter(sex_cat) Counter({1: 577, 0: 314})
```

```
In [22]: df['sex_cat'] = sex_cat
         Counter(df['sex_cat'])

Out[22]: Counter({1: 577, 0: 314})
```

3.5 Ticket - Category

```
In [23]: # 整理出每一個 Ticket 的個數並排序 (hint:Counter(), sorted())
         #=============your works starts===============#
         sorted_ticket_counter =
         #==============your works ends================#

         print(sorted_ticket_counter)
         # [('110152', 3), ('110413', 3), ('110465', 2), ('110564', 1), ('110813', 1), ('11124
```

```
[('110152', 3), ('110413', 3), ('110465', 2), ('110564', 1), ('110813', 1), ('111240', 1), ('1
```

```
In [24]: # ticket
         ticket_cat = {}
         for ticket in df['Ticket']:
             if ticket.isdigit():
                 ticket_cat[ticket] = 1
             elif ticket.startswith('A'):
                 ticket_cat[ticket] = 2
             elif ticket.startswith('C'):
                 ticket_cat[ticket] = 3
             elif ticket.startswith('F'):
                 ticket_cat[ticket] = 4
             elif ticket.startswith('P'):
                 ticket_cat[ticket] = 5
             elif ticket.startswith('SOTON'):
                 ticket_cat[ticket] = 6
             elif ticket.startswith('STON'):
                 ticket_cat[ticket] = 7
             elif ticket.startswith('S'):
                 ticket_cat[ticket] = 8
             elif ticket.startswith('W'):
                 ticket_cat[ticket] = 9
             else:
                 ticket_cat[ticket] = 0
         df['ticket_cat'] = df['Ticket'].apply(ticket_cat.get)
         print(Counter(df['ticket_cat']))
```

```
Counter({1: 661, 5: 65, 3: 47, 8: 30, 2: 29, 7: 18, 6: 17, 9: 13, 4: 7, 0: 4})
```

3.6 Embarked - Category

In [25]:
```
# 整理出每一個 Embarked 的個數並排序 (hint:Counter(), sorted())
#=============your works starts===============#
sorted_embarked_counter =
#=============your works ends================#

print(sorted_embarked_counter)
# [('C', 168), ('Q', 77), ('S', 644), ('nan', 2)]
```

```
[('C', 168), ('Q', 77), ('S', 644), ('nan', 2)]
```

In [26]:
```
# 創造 embarked 的類別對應 dict
#=============your works starts===============#
embarked_cat =
#=============your works ends================#


print(embarked_cat)
#{nan: 0, 'S': 1, 'Q': 2, 'C': 3}
```

```
{nan: 0, 'Q': 1, 'S': 2, 'C': 3}
```

In [27]:
```
# 轉換 embarked 為數字類別
#=============your works starts===============#
df['embarked_cat'] =
#=============your works ends================#

print(Counter(df['embarked_cat']))
#Counter({1: 644, 3: 168, 2: 77, 0: 2})
```

```
Counter({2: 644, 3: 168, 1: 77, 0: 2})
```

3.7 Title - NLP category

In [57]:
```
# re.findall() 的使用方法
test_str = 'Cumings, Mrs. John Bradley (Florence Briggs Thayer)'
test_str1 = 'St. Clumbia (Dother Thier)'

# 請取出「(」、「)」中的文字
#=============your works starts===============#
pattern =
sub_str =
sub_str1 =
#=============your works ends================#
```

```
        print(sub_str)
        print(sub_str1)
        # ['(Florence Briggs Thayer)']
        # ['(Dother Thier)']
```

```
['(Florence Briggs Thayer)']
['(Dother Thier)']
```

```
In [28]: # 請找到位在"," 以及"." 的所有字並將" ", ".", "," 去掉 (hint: re.findall(), str.replace
         def find_call(name):
             #=============your works starts===============#
             name =
             #==============your works ends================#
             return name

         title_cat_series = df['Name'].apply(find_call)
         print(title_cat_series.values[:10])
         #['Mr' 'Mrs' 'Miss' 'Mrs' 'Mr' 'Mr' 'Mr' 'Master' 'Mrs' 'Mrs']
```

```
['Mr' 'Mrs' 'Miss' 'Mrs' 'Mr' 'Mr' 'Mr' 'Master' 'Mrs' 'Mrs']
```

```
In [29]: title_mapping= {
             'Ms':"Miss",
             'Mlle':"Miss",
             'Miss':"Miss",
             'Mrs':"Mrs",
             'Mme':"Mrs",
             'MrsMartin(ElizabethL':"Mrs",
             'Mr':"Mr"
             }

         title_cat = {"Mr": 1, "Miss": 2, "Mrs": 3, "Master": 4, "Rare": 5}

         def process_title(call):
             if title_cat.get(call):
                 return title_cat.get(call)
             else:
                 return title_cat.get(title_mapping.get(call, "Rare"))

         df['title_cat'] = title_cat_series.apply(process_title)
         print(Counter(df['title_cat']))
```

```
Counter({1: 517, 2: 185, 3: 126, 4: 40, 5: 23})
```

3.8 Title - Length

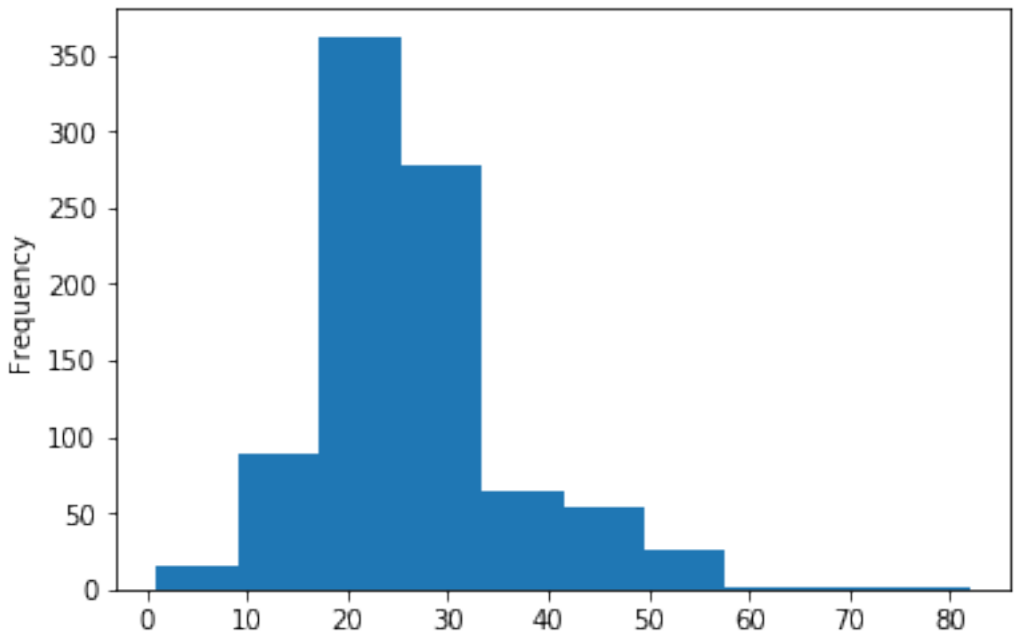
```
In [30]: # 算出 df['Name'] 中每一個名字的長度並放進一個 array
         #=============your works starts===============#
```

```
        name_length =
        #==============your works ends================#


        print(Counter(pd.cut(name_length, bins=10, labels=range(10))))
        # Counter({1: 303, 2: 237, 0: 204, 3: 57, 4: 53, 5: 26, 6: 8, 7: 2, 9: 1})
```

```
Counter({1: 303, 2: 237, 0: 204, 3: 57, 4: 53, 5: 26, 6: 8, 7: 2, 9: 1})
```

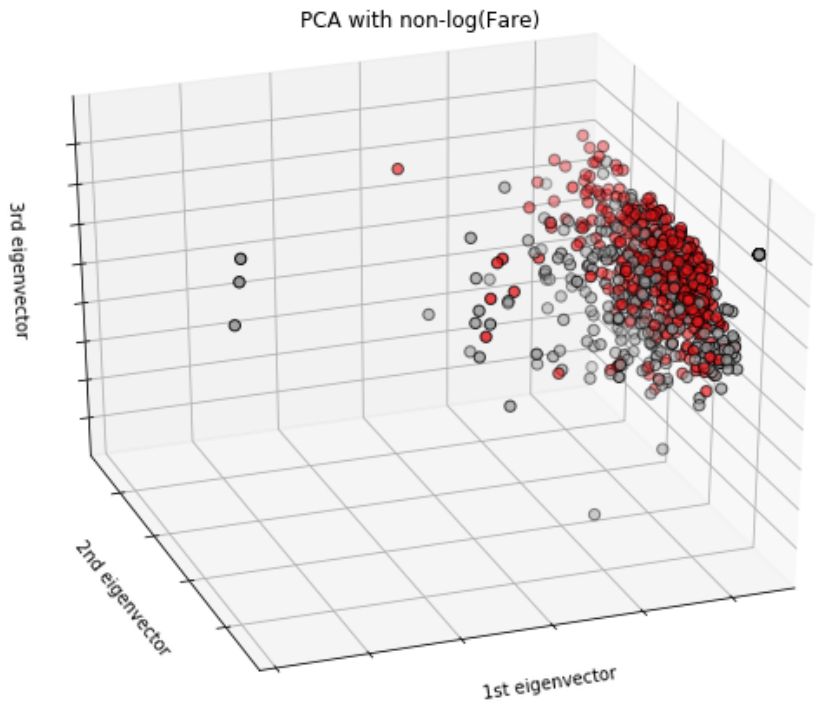
```
In [31]: df['name_length'] = name_length
```

```
In [58]: # 劃出每一長度區間次數的長條分布圖 (如長度界在 10~20 之間的有出現約 150 次)(hint: df[col
         #!=============your works starts===============!#

         #!=============your works ends================!#

         plt.show()
```



3.9 Fare - PCA, smooth noisy data, feature generation

```
In [33]: # 請找出 dtype 是 np.int64 或 np.float64 且名稱不以'_cat' 結尾的欄位。
         #==============your works starts===============#
         number_cols =
         #==============your works ends================#
```



PCA_chart

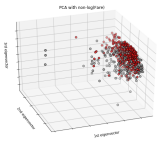
```
        print(number_cols)
        # ['PassengerId', 'Survived', 'Pclass', 'Age', 'SibSp', 'Parch', 'Fare', 'avg_age', '
```

```
['PassengerId', 'Survived', 'Pclass', 'Age', 'SibSp', 'Parch', 'Fare', 'avg_age', 'median_age'
```

請參照這個連結，劃出以下這張 PCA 圖

```
In [34]: X = df[['Pclass', 'Parch', 'SibSp', 'Fare', 'avg_age', 'name_length']].values
         Y = np.array(df['Survived'])

         #!=============your works starts===============!#
```

```
        #!==============your works ends================!#

        plt.show()
```



```
In [35]: # 請找出標準差最大的欄位 ['Pclass', 'Parch', 'SibSp', 'Fare', 'avg_age', 'name_length'
         #!=============your works starts==============!#

         #!==============your works ends================!#
```

Out[35]:

	Pclass	Parch	SibSp	Fare	avg_age	name_length
count	891.000000	891.000000	891.000000	891.000000	891.000000	891.000000
mean	2.308642	0.381594	0.523008	32.204208	29.699118	26.965208
std	0.836071	0.806057	1.102743	49.693429	13.002015	9.281607
min	1.000000	0.000000	0.000000	0.000000	0.420000	12.000000
25%	2.000000	0.000000	0.000000	7.910400	22.000000	20.000000
50%	3.000000	0.000000	0.000000	14.454200	29.699118	25.000000
75%	3.000000	0.000000	1.000000	31.000000	35.000000	30.000000
max	3.000000	6.000000	8.000000	512.329200	80.000000	82.000000

```
In [36]: # 請找出 Fare 的平均值 (mean)，並填入 df['Fare'] 中
         #=============your works starts==============#
         avg_fare =
         df[pd.isnull(df['Fare'])] =
         #==============your works ends===============#
         # df['Fare'].fillna(avg_fare)


         print("avg_fare", avg_fare)
         # 32.204207968574636
         print("number of null of Fare:", len(df[pd.isnull(df['Fare'])]))
         # number of null of Fare: 0
```

```
avg_fare 32.204207968574636
number of null of Fare: 0
```

```
In [37]: df['Fare'].describe()
```

Out[37]:

```
count    891.000000
mean      32.204208
```

```
std       49.693429
min        0.000000
25%        7.910400
50%       14.454200
75%       31.000000
max      512.329200
Name: Fare, dtype: float64
```

```
In [38]: # 找出 Fare==0 的 row，補上 Fare=1
         #=============your works starts===============#
         df[df['Fare']=
         #==============your works ends================#

         print("number of Fare equals zero:", len(df[df['Fare']==0]))
         # number of Fare equals zero: 0
```

```
number of Fare equals zero: 0
```

```
In [39]: # 請算出 Fare 以 10 為底的 log 值
         #=============your works starts===============#
         fare_log10 =
         #==============your works ends================#


         print(fare_log10[:5])
         # [0.86033801 1.8529878  0.89899927 1.72509452 0.90579588]
```

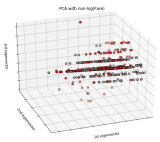
```
[0.86033801 1.8529878  0.89899927 1.72509452 0.90579588]
```

```
In [40]: df['fare_log10'] = fare_log10
         df[['Fare', 'fare_log10']].head()
```

```
Out[40]:      Fare  fare_log10
         0   7.2500    0.860338
         1  71.2833    1.852988
         2   7.9250    0.898999
         3  53.1000    1.725095
         4   8.0500    0.905796
```

```
In [41]: X = np.matrix(df[['Parch', 'SibSp', 'avg_age', 'fare_log10']])
         Y = np.array(df['Survived'])

         fig = plt.figure(1, figsize=(8, 6))
         ax = Axes3D(fig, elev=-150, azim=110)

         X_reduced = PCA(n_components=3).fit_transform(X)
         ax.scatter(X_reduced[:, 0], X_reduced[:, 1], X_reduced[:, 2], c=Y,
```

```
                cmap=plt.cm.Set1, edgecolor='k', s=40)
        ax.set_title("PCA with non-log(Fare)")
        ax.set_xlabel("1st eigenvector")
        ax.w_xaxis.set_ticklabels([])
        ax.set_ylabel("2nd eigenvector")
        ax.w_yaxis.set_ticklabels([])
        ax.set_zlabel("3rd eigenvector")
        ax.w_zaxis.set_ticklabels([])

        plt.show()
```



4 類別型變數 onehot encode

```
In [42]: enc = preprocessing.OneHotEncoder()
         # 請使用 enc.fit_transform 兩個步驟，onehot encode title_cat
         #==============your works starts===============#
         title_cat_onehot =
         #==============your works ends================#


         print(title_cat_onehot[:3])
         # [[1. 0. 0. 0. 0.]
         #  [0. 0. 1. 0. 0.]
         #  [0. 1. 0. 0. 0.]]
```

```
[[1. 0. 0. 0. 0.]
 [0. 0. 1. 0. 0.]
 [0. 1. 0. 0. 0.]]
```

```
If you want the future behaviour and silence this warning, you can specify "categories='auto'"
In case you used a LabelEncoder before this OneHotEncoder to convert the categories to integers
  warnings.warn(msg, FutureWarning)
```

```
In [43]: enc = preprocessing.OneHotEncoder()
         # 請使用 enc.fit_transform 兩個步驟，onehot encode embarked_cat
         #==============your works starts===============#
         embarked_cat_onehot =
         #==============your works ends================#
```

```
embarked_cat_onehot[:3]
# array([[0., 0., 1., 0.],
#        [0., 1., 0., 0.],
#        [0., 0., 1., 0.]])
```

```
If you want the future behaviour and silence this warning, you can specify "categories='auto'"
In case you used a LabelEncoder before this OneHotEncoder to convert the categories to integers
  warnings.warn(msg, FutureWarning)
```

```
Out[43]: array([[0., 0., 1., 0.],
                [0., 0., 0., 1.],
                [0., 0., 1., 0.]])
```

5 PolynomialFeatures

```
In [44]: poly = preprocessing.PolynomialFeatures(degree=2)
         # 請利用 poly.fit_transform 製造出 fare_log10 的 0 次項、1 次項、2 次項，並把 0 次項拿掉
         #=============your works starts===============#
         fare_log10_poly =
         #=============your works ends================#

         print(fare_log10_poly[:2])
         # [[1.         0.86033801 0.74018149]
         #  [1.         1.8529878  3.43356378]]
```

```
[[0.86033801 0.74018149]
 [1.8529878  3.43356378]]
```

```
In [45]: # 請利用 poly.fit_transform 製造出'fare_log10', 'random_age' 的二項次及其一次交成項
         #=============your works starts===============#
         age_fare_ploy =
         #=============your works ends================#

         print(age_fare_ploy[:2])
         # [[8.60338007e-01 8.31383556e-04 7.40181486e-01 7.15270871e-04 6.91198616e-07]
         #  [1.85298780e+00 1.43602614e-03 3.43356378e+00 2.66093892e-03 2.06217108e-06]]
```

```
[[8.60338007e-01 8.31383556e-04 7.40181486e-01 7.15270871e-04
  6.91198616e-07]
 [1.85298780e+00 1.43602614e-03 3.43356378e+00 2.66093892e-03
  2.06217108e-06]]
```

5.1 Preprocessing Conclude

```
In [46]: df.columns
```

```
Out[46]: Index(['PassengerId', 'Survived', 'Pclass', 'Name', 'Sex', 'Age', 'SibSp',
                'Parch', 'Ticket', 'Fare', 'Cabin', 'Embarked', 'avg_age', 'median_age',
                'random_age', 'avg_age_l1', 'avg_age_l2', 'cabin_cat', 'sex_cat',
                'ticket_cat', 'embarked_cat', 'title_cat', 'name_length', 'fare_log10'],
               dtype='object')
```

```
In [47]: X = df[['SibSp', 'Parch', 'avg_age_l2', 'sex_cat', 'name_length', 'fare_log10']].value
         X = np.concatenate([X, title_cat_onehot, embarked_cat_onehot, age_fare_ploy], axis=1)
         Y = df[['Survived']].values

         print(X.shape)
         print(Y.shape)
```

```
(891, 20)
(891, 1)
```

```
In [48]: from sklearn import linear_model
         from  sklearn.model_selection import train_test_split


         X_train, X_test, Y_train, Y_test = train_test_split(X, Y, random_state=1212)

         reg = linear_model.LinearRegression()
         reg.fit(X_train, Y_train)
         predict_prob = reg.predict(X_test)

         Y_predict = predict_prob > 0.5
         Y_test = Y_test == 1
         acc = np.sum(Y_predict == Y_test)/ len(Y_test)
         print("Accuracy:", acc)
```

```
Accuracy: 0.8026905829596412
```