hart pals prediction

October 3, 2021

[1]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import scipy.stats as stat
import warnings
warnings.filterwarnings('ignore')
```

```
C:\Users\Chandra Sekhar\Anaconda3\lib\site-
packages\statsmodels\tools\_testing.py:19: FutureWarning: pandas.util.testing is
deprecated. Use the functions in the public API at pandas.testing instead.
  import pandas.util.testing as tm
```

[2]:

```
df=pd.read_csv('heart.csv')
```

[3]:

```
df.head()
```

[3]:

```
   age  sex  cp  trestbps  chol  fbs  restecg  thalach  exang  oldpeak  slope  \
0   63    1   3       145   233    1        0      150      0      2.3      0
1   37    1   2       130   250    0        1      187      0      3.5      0
2   41    0   1       130   204    0        0      172      0      1.4      2
3   56    1   1       120   236    0        1      178      0      0.8      2
4   57    0   0       120   354    0        1      163      1      0.6      2

   ca  thal  target
0   0     1       1
1   0     2       1
2   0     2       1
3   0     2       1
4   0     2       1
```

[4]:

```
df.isnull().sum()
```

[4]:

```
age         0
sex         0
cp          0
trestbps    0
chol        0
```

```
fbs         0
restecg     0
thalach     0
exang       0
oldpeak     0
slope       0
ca          0
thal        0
target      0
dtype: int64
```

[17]:
```
x=df.drop('target',axis=1)
```

[7]:
```
y=df['target']
```

[8]:
```
df['target'].value_counts()
```

[8]:
```
1    165
0    138
Name: target, dtype: int64
```

[12]:
```
from sklearn.preprocessing import StandardScaler,RobustScaler
```

[15]:
```
std=StandardScaler()
```

[18]:
```
scale=std.fit_transform(x)
```

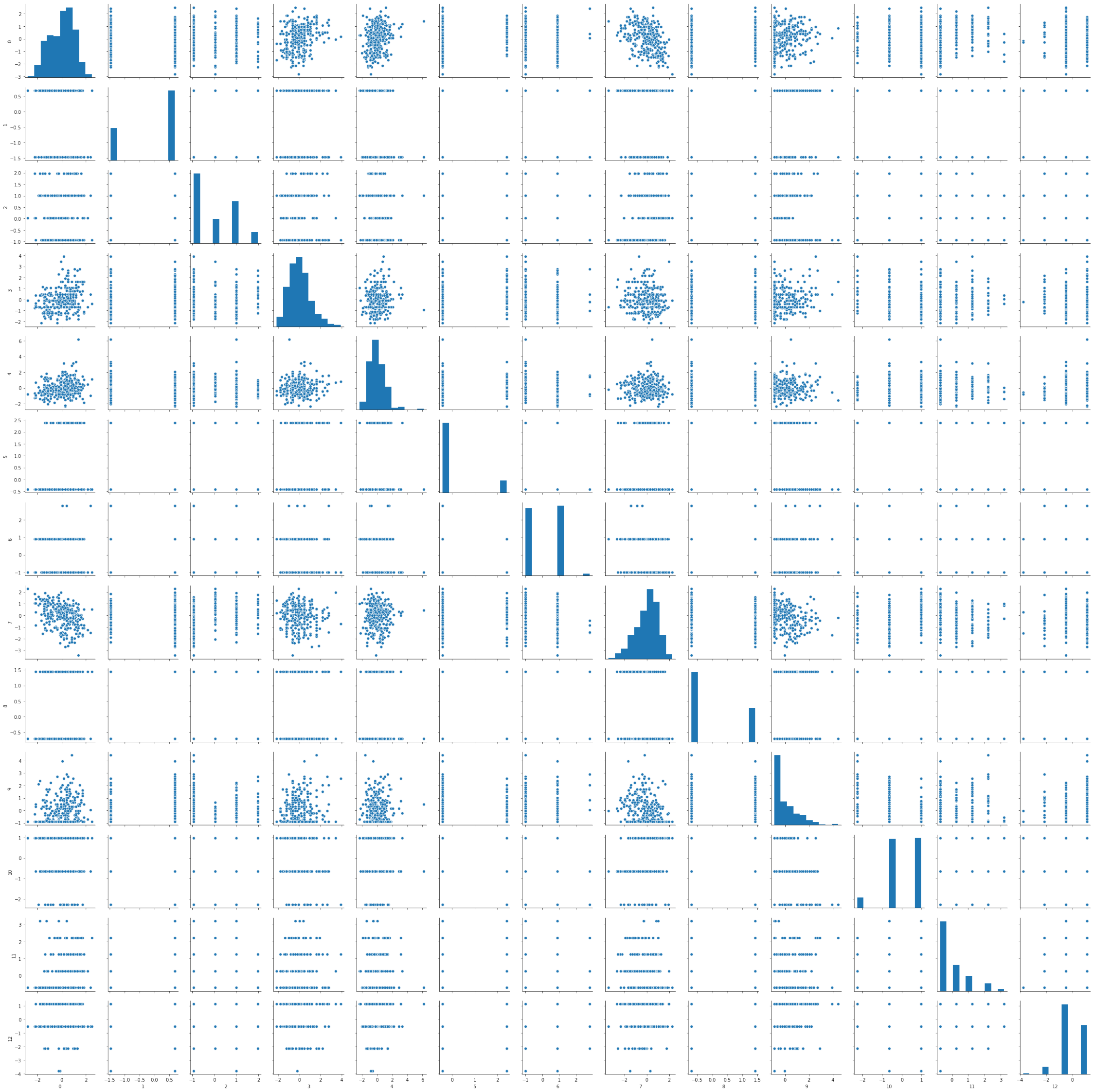
[19]:
```
scale
```

[19]:
```
array([[ 0.9521966 ,  0.68100522,  1.97312292, ..., -2.27457861,
        -0.71442887, -2.14887271],
       [-1.91531289,  0.68100522,  1.00257707, ..., -2.27457861,
        -0.71442887, -0.51292188],
       [-1.47415758, -1.46841752,  0.03203122, ...,  0.97635214,
        -0.71442887, -0.51292188],
       ...,
       [ 1.50364073,  0.68100522, -0.93851463, ..., -0.64911323,
         1.24459328,  1.12302895],
       [ 0.29046364,  0.68100522, -0.93851463, ..., -0.64911323,
         0.26508221,  1.12302895],
       [ 0.29046364, -1.46841752,  0.03203122, ..., -0.64911323,
         0.26508221, -0.51292188]])
```

[22]:
```
data=pd.DataFrame(scale)
```

[24]:
```
sns.pairplot(data)
```

[24]:
```
<seaborn.axisgrid.PairGrid at 0x257d8253a58>
```



[25]:
```
df.corr()
```

[25]:
```
               age       sex        cp  trestbps      chol       fbs  \
age       1.000000 -0.098447 -0.068653  0.279351  0.213678  0.121308
sex      -0.098447  1.000000 -0.049353 -0.056769 -0.197912  0.045032
cp       -0.068653 -0.049353  1.000000  0.047608 -0.076904  0.094444
trestbps  0.279351 -0.056769  0.047608  1.000000  0.123174  0.177531
chol      0.213678 -0.197912 -0.076904  0.123174  1.000000  0.013294
fbs       0.121308  0.045032  0.094444  0.177531  0.013294  1.000000
restecg  -0.116211 -0.058196  0.044421 -0.114103 -0.151040 -0.084189
thalach  -0.398522 -0.044020  0.295762 -0.046698 -0.009940 -0.008567
exang     0.096801  0.141664 -0.394280  0.067616  0.067023  0.025665
oldpeak   0.210013  0.096093 -0.149230  0.193216  0.053952  0.005747
slope    -0.168814 -0.030711  0.119717 -0.121475 -0.004038 -0.059894
```

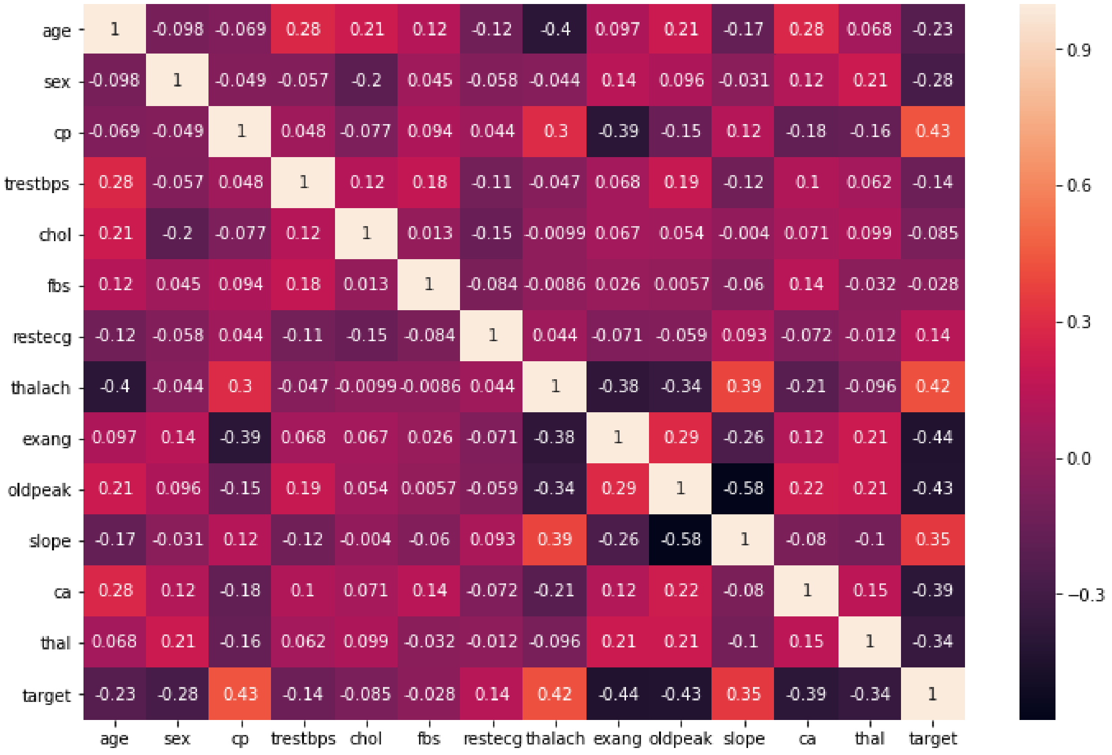
```
ca        0.276326  0.118261 -0.181053  0.101389  0.070511  0.137979
thal      0.068001  0.210041 -0.161736  0.062210  0.098803 -0.032019
target   -0.225439 -0.280937  0.433798 -0.144931 -0.085239 -0.028046

           restecg   thalach     exang   oldpeak     slope        ca  \
age      -0.116211 -0.398522  0.096801  0.210013 -0.168814  0.276326
sex      -0.058196 -0.044020  0.141664  0.096093 -0.030711  0.118261
cp        0.044421  0.295762 -0.394280 -0.149230  0.119717 -0.181053
trestbps -0.114103 -0.046698  0.067616  0.193216 -0.121475  0.101389
chol     -0.151040 -0.009940  0.067023  0.053952 -0.004038  0.070511
fbs      -0.084189 -0.008567  0.025665  0.005747 -0.059894  0.137979
restecg   1.000000  0.044123 -0.070733 -0.058770  0.093045 -0.072042
thalach   0.044123  1.000000 -0.378812 -0.344187  0.386784 -0.213177
exang    -0.070733 -0.378812  1.000000  0.288223 -0.257748  0.115739
oldpeak  -0.058770 -0.344187  0.288223  1.000000 -0.577537  0.222682
slope     0.093045  0.386784 -0.257748 -0.577537  1.000000 -0.080155
ca       -0.072042 -0.213177  0.115739  0.222682 -0.080155  1.000000
thal     -0.011981 -0.096439  0.206754  0.210244 -0.104764  0.151832
target    0.137230  0.421741 -0.436757 -0.430696  0.345877 -0.391724

              thal    target
age       0.068001 -0.225439
sex       0.210041 -0.280937
cp       -0.161736  0.433798
trestbps  0.062210 -0.144931
chol      0.098803 -0.085239
fbs      -0.032019 -0.028046
restecg  -0.011981  0.137230
thalach  -0.096439  0.421741
exang     0.206754 -0.436757
oldpeak   0.210244 -0.430696
slope    -0.104764  0.345877
ca        0.151832 -0.391724
thal      1.000000 -0.344029
target   -0.344029  1.000000
```

[32]:

```python
plt.figure(figsize=(12,8))
sns.heatmap(df.corr(),annot=True)
```

[32]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x257e4387be0>
```



	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak	slope	ca	thal	target
age	1	-0.098	-0.069	0.28	0.21	0.12	-0.12	-0.4	0.097	0.21	-0.17	0.28	0.068	-0.23
sex	-0.098	1	-0.049	-0.057	-0.2	0.045	-0.058	-0.044	0.14	0.096	-0.031	0.12	0.21	-0.28
cp	-0.069	-0.049	1	0.048	-0.077	0.094	0.044	0.3	-0.39	-0.15	0.12	-0.18	-0.16	0.43
trestbps	0.28	-0.057	0.048	1	0.12	0.18	-0.11	-0.047	0.068	0.19	-0.12	0.1	0.062	-0.14
chol	0.21	-0.2	-0.077	0.12	1	0.013	-0.15	-0.0099	0.067	0.054	-0.004	0.071	0.099	-0.085
fbs	0.12	0.045	0.094	0.18	0.013	1	-0.084	-0.0086	0.026	0.0057	-0.06	0.14	-0.032	-0.028
restecg	-0.12	-0.058	0.044	-0.11	-0.15	-0.084	1	0.044	-0.071	-0.059	0.093	-0.072	-0.012	0.14
thalach	-0.4	-0.044	0.3	-0.047	-0.0099	-0.0086	0.044	1	-0.38	-0.34	0.39	-0.21	-0.096	0.42
exang	0.097	0.14	-0.39	0.068	0.067	0.026	-0.071	-0.38	1	0.29	-0.26	0.12	0.21	-0.44
oldpeak	0.21	0.096	-0.15	0.19	0.054	0.0057	-0.059	-0.34	0.29	1	-0.58	0.22	0.21	-0.43
slope	-0.17	-0.031	0.12	-0.12	-0.004	-0.06	0.093	0.39	-0.26	-0.58	1	-0.08	-0.1	0.35
ca	0.28	0.12	-0.18	0.1	0.071	0.14	-0.072	-0.21	0.12	0.22	-0.08	1	0.15	-0.39
thal	0.068	0.21	-0.16	0.062	0.099	-0.032	-0.012	-0.096	0.21	0.21	-0.1	0.15	1	-0.34
target	-0.23	-0.28	0.43	-0.14	-0.085	-0.028	0.14	0.42	-0.44	-0.43	0.35	-0.39	-0.34	1

[34]:
```python
from sklearn.model_selection import train_test_split
x_train,x_test,y_train,y_test=train_test_split(data,y,test_size=0.3,random_state=0)
```

[36]:
```python
from sklearn.neighbors import KNeighborsClassifier
```

[70]:
```python
knn=KNeighborsClassifier(n_neighbors=3)
```

[71]:
```python
knn.fit(x_train,y_train)
```

[71]:
```
KNeighborsClassifier(n_neighbors=3)
```

[72]:
```python
pred=knn.predict(x_test)
```

[73]:
```python
from sklearn.metrics import confusion_matrix,classification_report,roc_auc_score
```

[74]:
```python
print(confusion_matrix(pred,y_test))
```

```
[[36  5]
 [ 8 42]]
```

[75]:
```python
print(classification_report(pred,y_test))
```

```
              precision    recall  f1-score   support

           0       0.82      0.88      0.85        41
           1       0.89      0.84      0.87        50

    accuracy                           0.86        91
   macro avg       0.86      0.86      0.86        91
weighted avg       0.86      0.86      0.86        91
```

[49]:

```
from sklearn.metrics import roc_auc_score
```

[50]:

```
print(roc_auc_score(pred,y_test))
```

```
0.8353535353535353
```

[54]:

```
error_rate=[]

for i in range(1,40):

    knn=KNeighborsClassifier(n_neighbors=i)
    knn.fit(x_train,y_train)
    pred=knn.predict(x_test)
    error_rate.append(np.mean(pred !=y_test))
```

[55]:

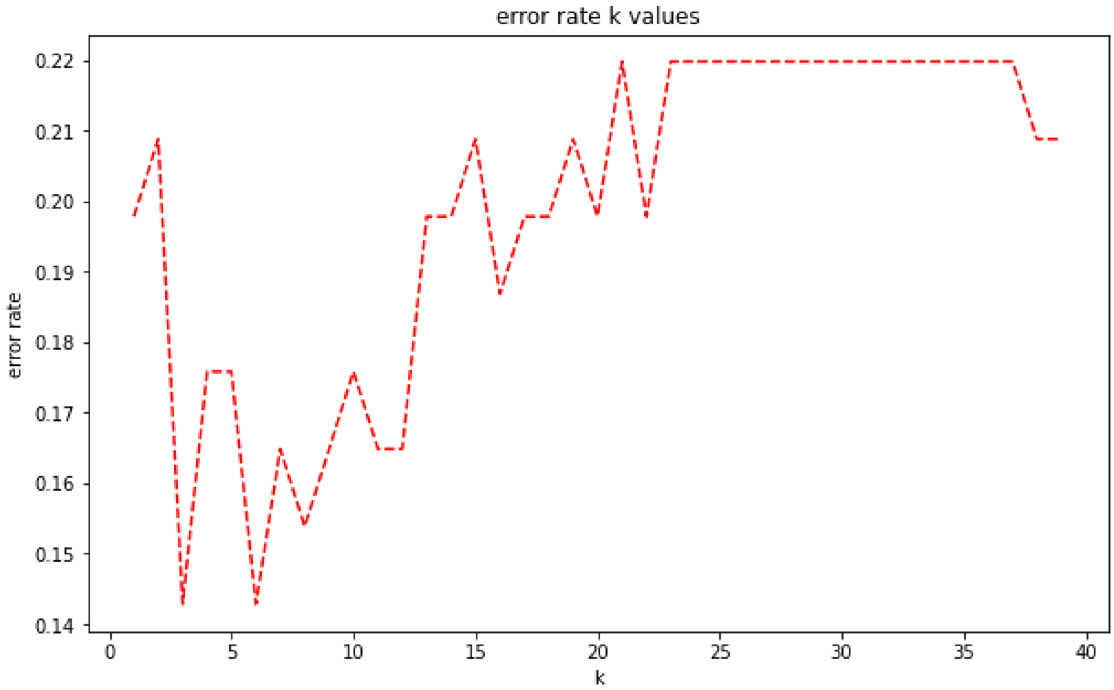
```
error_rate=[]

for i in range(1,40):
    knn=KNeighborsClassifier(n_neighbors=i)
    knn.fit(x_train,y_train)
    pred=knn.predict(x_test)
    error_rate.append(np.mean(pred !=y_test))
```

[56]:

```
plt.figure(figsize=(10,6))
plt.plot(range(1,40),error_rate,color='red',linestyle='dashed')
plt.title('error rate k values')
plt.xlabel('k')
plt.ylabel('error rate')
```

[56]:

```
Text(0, 0.5, 'error rate')
```


error rate k values
error rate
0.22
0.21
0.20
0.19
0.18
0.17
0.16
0.15
0.14
0
5
10
15
20
25
30
35
40
k

[ ]: