Blood clot prediction

July 8, 2025

[3]:
```
#install scikit-learn
!pip install scikit-learn
```

```
Requirement already satisfied: scikit-learn in
c:\users\admin\anaconda3\lib\site-packages (1.4.2)
Requirement already satisfied: numpy>=1.19.5 in
c:\users\admin\anaconda3\lib\site-packages (from scikit-learn) (1.26.4)
Requirement already satisfied: scipy>=1.6.0 in
c:\users\admin\anaconda3\lib\site-packages (from scikit-learn) (1.13.1)
Requirement already satisfied: joblib>=1.2.0 in
c:\users\admin\anaconda3\lib\site-packages (from scikit-learn) (1.4.2)
Requirement already satisfied: threadpoolctl>=2.0.0 in
c:\users\admin\anaconda3\lib\site-packages (from scikit-learn) (2.2.0)
```

[71]:
```
#import the required libraries
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import classification_report, confusion_matrix,␣
 ↪accuracy_score
from imblearn.over_sampling import SMOTE
```

[73]:
```
df=pd.read_csv("blood_clot_data.csv")
df
```

[73]:

	Age	D_dimer	Platelet_Count	Blood_Pressure	Cholesterol	Smoking	\
0	69	228.155578	218113.000787	109.496820	238.778288	0	
1	32	278.655285	223450.152250	126.628519	217.087774	1	
2	89	331.090757	218842.973679	112.448305	174.150908	0	
3	78	447.535622	222226.144042	102.970293	271.012436	1	
4	38	385.765962	218130.643635	138.121941	152.254527	0	
..	…	…	…	…	…	…	
495	34	338.240975	309532.313739	131.392674	178.958606	1	
496	88	316.645221	297477.706772	132.397846	113.866283	0	
497	62	349.245126	175755.101578	114.584873	243.886108	0	
498	21	328.916864	122303.943255	148.985618	180.846502	1	

```
499   53  545.530014   296715.995562      117.007377   165.488969        1

     Diabetes  Clot_Present
0           0             0
1           0             0
2           0             0
3           1             1
4           1             0
..        …           …
495         0             0
496         0             0
497         0             0
498         0             1
499         0             0

[500 rows x 8 columns]
```

[75]:
```
#display the first 10 rows
df.head(10)
```

[75]:
```
   Age     D_dimer  Platelet_Count  Blood_Pressure  Cholesterol  Smoking  \
0   69  228.155578   218113.000787      109.496820   238.778288        0
1   32  278.655285   223450.152250      126.628519   217.087774        1
2   89  331.090757   218842.973679      112.448305   174.150908        0
3   78  447.535622   222226.144042      102.970293   271.012436        1
4   38  385.765962   218130.643635      138.121941   152.254527        0
5   41  284.006147   309450.826555      141.387327   236.766167        0
6   20  298.098379   321025.212399      121.352344   240.023293        0
7   39  199.747064   221462.685313       91.134366   173.175192        1
8   70  298.148686   208382.221345      121.806333   255.698612        1
9   19  271.134136   273570.777819      135.877060   189.998139        0

   Diabetes  Clot_Present
0         0             0
1         0             0
2         0             0
3         1             1
4         1             0
5         0             0
6         1             0
7         0             0
8         1             0
9         0             0
```

[77]:
```
#display the features of the dataset
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
```

```
RangeIndex: 500 entries, 0 to 499
Data columns (total 8 columns):
 #   Column          Non-Null Count  Dtype
---  ------          --------------  -----
 0   Age             500 non-null    int64
 1   D_dimer         500 non-null    float64
 2   Platelet_Count  500 non-null    float64
 3   Blood_Pressure  500 non-null    float64
 4   Cholesterol     500 non-null    float64
 5   Smoking         500 non-null    int64
 6   Diabetes        500 non-null    int64
 7   Clot_Present    500 non-null    int64
dtypes: float64(4), int64(4)
memory usage: 31.4 KB
```

[79]:
```
#look for any null values
df.any().isnull()
```

[79]:
```
Age               False
D_dimer           False
Platelet_Count    False
Blood_Pressure    False
Cholesterol       False
Smoking           False
Diabetes          False
Clot_Present      False
dtype: bool
```

[81]:
```
#display the descriptive statistics
df.describe()
```

[81]:

	Age	D_dimer	Platelet_Count	Blood_Pressure	Cholesterol	\
count	500.000000	500.000000	500.000000	500.000000	500.000000	
mean	52.930000	300.011222	254931.431765	130.812426	200.811921	
std	21.009519	99.759627	49522.416610	14.924935	39.314721	
min	18.000000	30.311336	105187.231090	86.179743	79.219514	
25%	34.000000	229.653176	221457.276612	120.820958	175.336626	
50%	52.000000	298.123533	255635.170822	130.341483	200.264442	
75%	71.000000	364.028833	285683.010205	140.797155	226.767056	
max	89.000000	607.888081	378985.466883	177.896614	325.509941	

	Smoking	Diabetes	Clot_Present
count	500.000000	500.000000	500.0000
mean	0.280000	0.212000	0.1000
std	0.449449	0.409134	0.3003
min	0.000000	0.000000	0.0000
25%	0.000000	0.000000	0.0000
50%	0.000000	0.000000	0.0000

```
75%       1.000000    0.000000         0.0000
max       1.000000    1.000000         1.0000
```

[83]:
```
df['Clot_Present'].value_counts()#check for balance
```

[83]:
```
Clot_Present
0    450
1     50
Name: count, dtype: int64
```

[85]:
```
# Features and target
X = df.drop('Clot_Present', axis=1)
y = df['Clot_Present']
```

[87]:
```
X_train,X_test,y_train,y_test=train_test_split(X,y,test_size=0.3,␣
↪random_state=42)#split data
```

[137]:
```
#train the model


smote = SMOTE()
X_resampled, y_resampled = smote.fit_resample(X_train, y_train)

from sklearn.ensemble import RandomForestClassifier
model = RandomForestClassifier()
model.fit(X_resampled,y_resampled)
```

[137]:
```
RandomForestClassifier()
```

[139]:
```
#make predictions
y_pred=model.predict(X_test)
```

[141]:
```
#evaluate model
print(confusion_matrix(y_test,y_pred))
print(classification_report(y_test,y_pred))
print("Accuracy:",accuracy_score(y_test,y_pred))
```

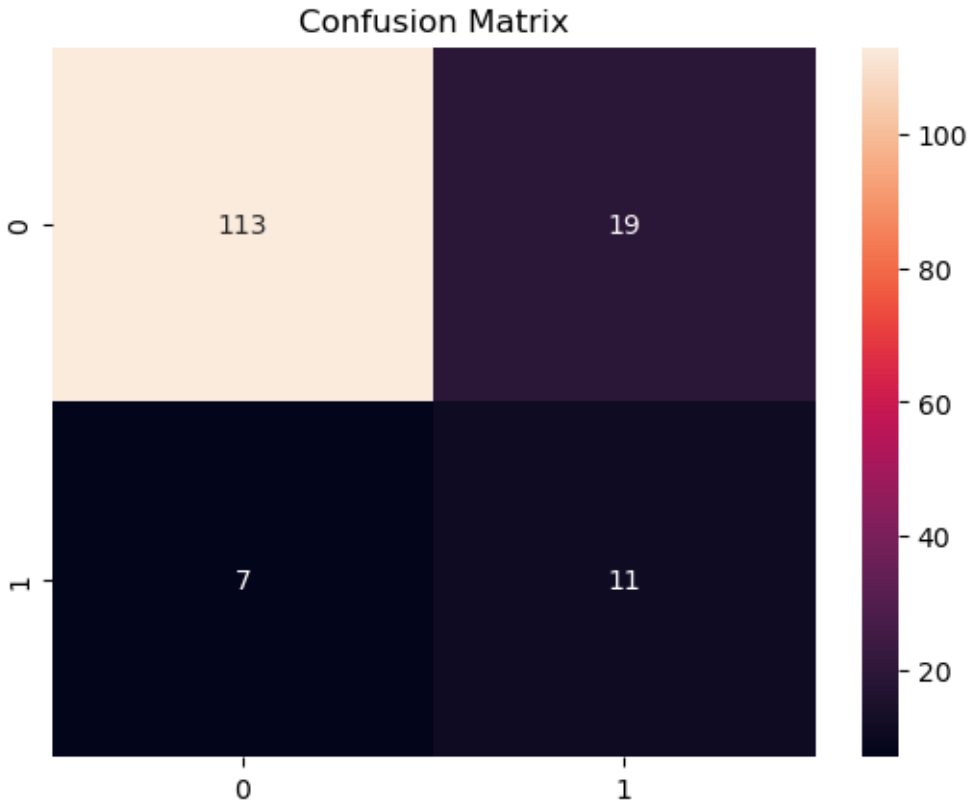
```
[[113  19]
 [  7  11]]
              precision    recall  f1-score   support

           0       0.94      0.86      0.90       132
           1       0.37      0.61      0.46        18

    accuracy                           0.83       150
   macro avg       0.65      0.73      0.68       150
weighted avg       0.87      0.83      0.84       150
```

```
Accuracy: 0.8266666666666667
```

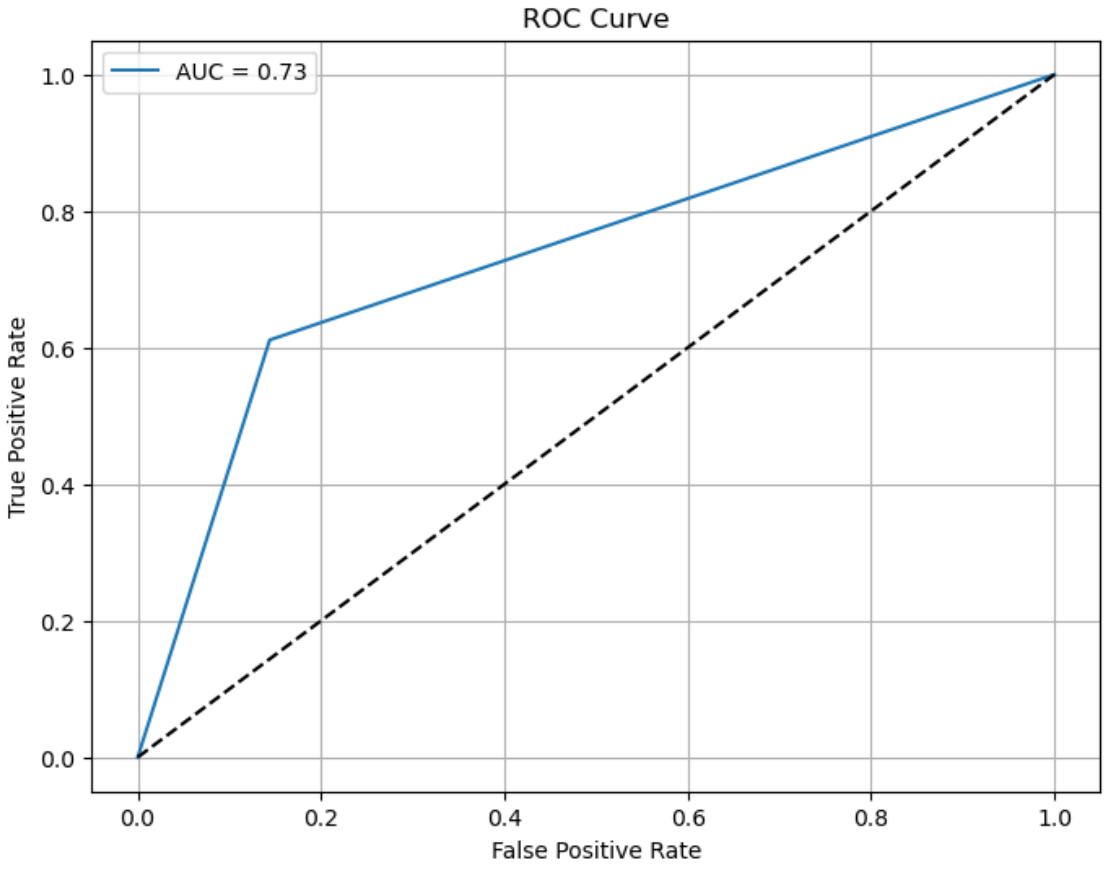
[143]:
```
sns.heatmap(confusion_matrix(y_test, y_pred), annot=True, fmt='d')
plt.title("Confusion Matrix")
plt.show()
```



[144]:
```
from sklearn.metrics import roc_curve, roc_auc_score

fpr, tpr, thresholds = roc_curve(y_test, y_pred)
auc = roc_auc_score(y_test, y_pred)

plt.figure(figsize=(8,6))
plt.plot(fpr, tpr, label="AUC = {:.2f}".format(auc))
plt.plot([0, 1], [0, 1], 'k--')
plt.xlabel("False Positive Rate")
plt.ylabel("True Positive Rate")
plt.title("ROC Curve")
plt.legend()
plt.grid(True)
plt.show()
```



We want to make our model more accurate so lets try and use XGBOOST

[149]:
```
!pip install xgboost
```

```
Collecting xgboost
  Downloading xgboost-3.0.2-py3-none-win_amd64.whl.metadata (2.1 kB)
Requirement already satisfied: numpy in c:\users\admin\anaconda3\lib\site-
packages (from xgboost) (1.26.4)
Requirement already satisfied: scipy in c:\users\admin\anaconda3\lib\site-
packages (from xgboost) (1.13.1)
Downloading xgboost-3.0.2-py3-none-win_amd64.whl (150.0 MB)
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Installing collected packages: xgboost
Successfully installed xgboost-3.0.2
```

[202]:
```python
#import and train the model
from xgboost import XGBClassifier

xgb_model = XGBClassifier( eval_metric='logloss', random_state=42)
xgb_model.fit(X_train, y_train)  # we will use inbalanced data because the␣
 ↪SMOTE-balance data has high False Positive abd False negative
```

[202]:
```
XGBClassifier(base_score=None, booster=None, callbacks=None,
              colsample_bylevel=None, colsample_bynode=None,
              colsample_bytree=None, device=None, early_stopping_rounds=None,
              enable_categorical=False, eval_metric='logloss',
              feature_types=None, feature_weights=None, gamma=None,
              grow_policy=None, importance_type=None,
              interaction_constraints=None, learning_rate=None, max_bin=None,
              max_cat_threshold=None, max_cat_to_onehot=None,
              max_delta_step=None, max_depth=None, max_leaves=None,
              min_child_weight=None, missing=nan, monotone_constraints=None,
              multi_strategy=None, n_estimators=None, n_jobs=None,
              num_parallel_tree=None, …)
```

[178]:
```
#evaluating our model
y_pred_xgb = xgb_model.predict(X_test)
y_prob_xgb = xgb_model.predict_proba(X_test)[:, 1]
```

[180]:
```
from sklearn.metrics import classification_report, confusion_matrix,␣
 ↪accuracy_score

print(confusion_matrix(y_test, y_pred_xgb))
print(classification_report(y_test, y_pred_xgb))
print("Accuracy:", accuracy_score(y_test, y_pred_xgb))
```

```
[[132   0]
 [  8  10]]
              precision    recall  f1-score   support

           0       0.94      1.00      0.97       132
           1       1.00      0.56      0.71        18

    accuracy                           0.95       150
   macro avg       0.97      0.78      0.84       150
weighted avg       0.95      0.95      0.94       150

Accuracy: 0.9466666666666667
```

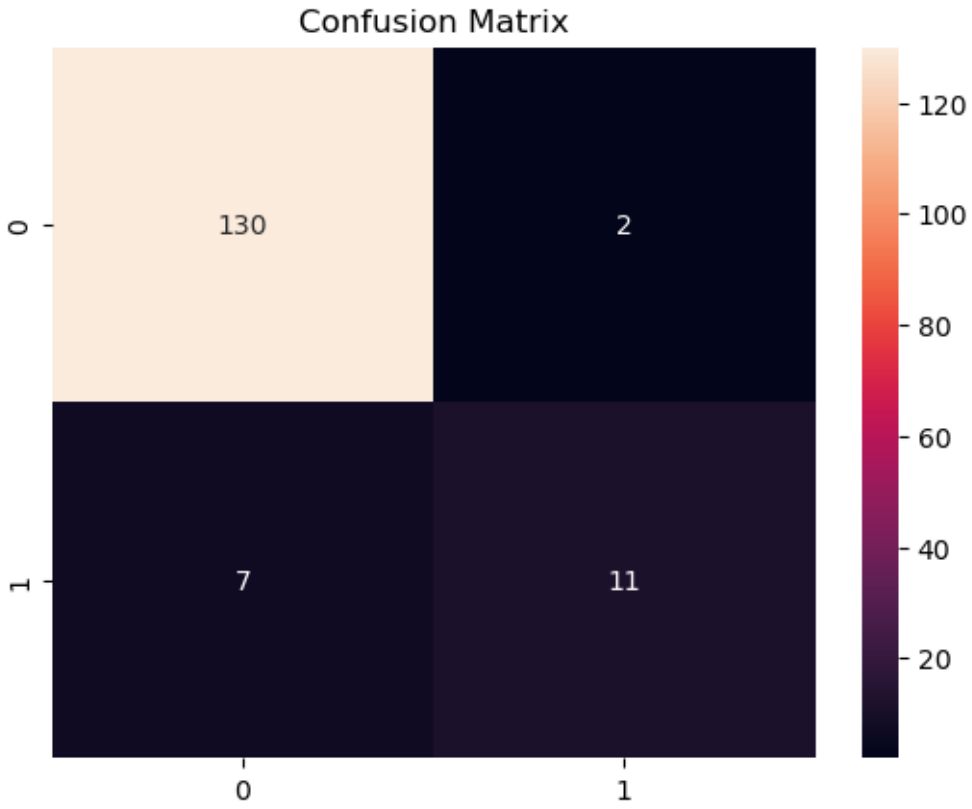
[196]:
```
y_pred_thresh = (y_prob_xgb > 0.4).astype(int)
print(confusion_matrix(y_test, y_pred_thresh))
print(classification_report(y_test, y_pred_thresh))
```

```
[[130   2]
 [  7  11]]
              precision    recall  f1-score   support

           0       0.95      0.98      0.97       132
           1       0.85      0.61      0.71        18
```

```
              accuracy                           0.94       150
             macro avg       0.90      0.80      0.84       150
          weighted avg       0.94      0.94      0.94       150
```

[198]:
```
sns.heatmap(confusion_matrix(y_test, y_pred_thresh), annot=True, fmt='d')
plt.title("Confusion Matrix")
plt.show()
```

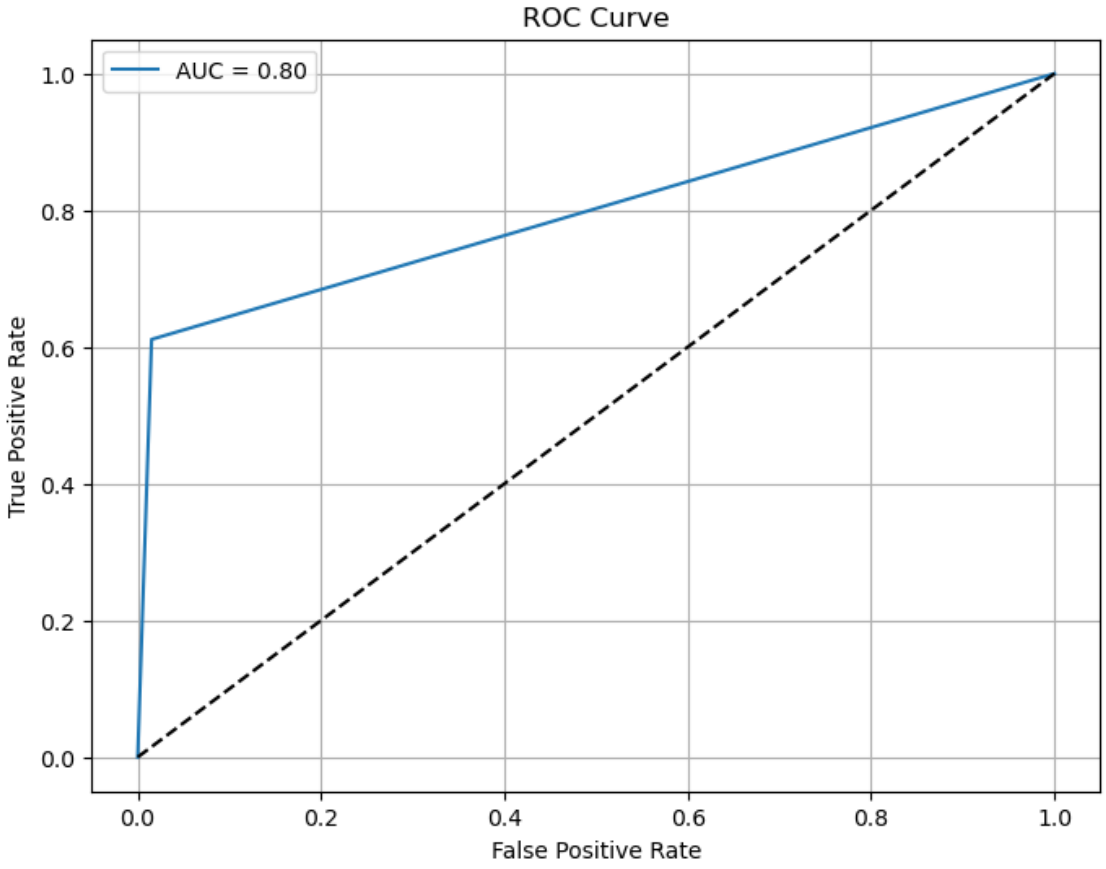


[200]:
```
from sklearn.metrics import roc_curve, roc_auc_score

fpr, tpr, thresholds = roc_curve(y_test, y_pred_thresh)
auc = roc_auc_score(y_test, y_pred_thresh)

plt.figure(figsize=(8,6))
plt.plot(fpr, tpr, label="AUC = {:.2f}".format(auc))
plt.plot([0, 1], [0, 1], 'k--')
plt.xlabel("False Positive Rate")
plt.ylabel("True Positive Rate")
plt.title("ROC Curve")
plt.legend()
```

```
plt.grid(True)
plt.show()
```



[ ]: