Falak_Jain_HW2

March 20, 2022

HW2 - Falak Jain

[10]:
```
import pandas as pd
import numpy as np
from sklearn.preprocessing import MinMaxScaler
from sklearn.linear_model import LinearRegression
import statsmodels.api as sm
from sklearn.model_selection import train_test_split
from sklearn.discriminant_analysis import LinearDiscriminantAnalysis
```

1.

(i) Yes

(ii) about 8-10 hours

2. Sampling balls in a box with replacement

[36]:
```
np.random.seed(2)
color = ['red', 'black','blue','yellow']
for _ in range(3):
    print(np.random.choice(color, size = 5, p=[0.25, 0.25, 0.25, 0.25],replace␣
 ↪= True))
```

```
['black' 'red' 'blue' 'black' 'black']
['black' 'red' 'blue' 'black' 'black']
['blue' 'blue' 'red' 'blue' 'red']
```

3. Mean and Variance of X_bar

It is given that X_i's are independant and identically distributed

Mean X_bar = (X_1 + X_2 + … X_n)/n where n is the number of records in the dataset

Var(X_bar) = Var((X_1 + X_2 + … X_n)/n) / n = 1/n^2 * Var(X1 + X2 + … X_n)

Given that X_i's are independant, we can say that the variance of the sum of all X_i = sum of variances of X_i

= 1/n^2 * (Var(X_1) + Var(X_2) + …. + Var(X_n))

= 1/n^2 * n * sigma^2

= **sigma^2 / n**

4. LDA Model for Spam Detection

[21]:
```python
df_spam = pd.read_csv("spambase.data", header = None)
```

[22]:
```python
X,y = df_spam.iloc[:,0:57].values, df_spam.iloc[:,57].values

X_train, X_test, y_train, y_test = train_test_split(X,y,
                                                    test_size = 0.2,
                                                    random_state = 5,
                                                    stratify = y)
```

[23]:
```python
lda = LinearDiscriminantAnalysis().fit(X_train,y_train)
y_pred = lda.predict(X_test)
classification_error = np.mean(y_pred != y_test)
print(f'The classification error on the test set:␣
 ↪{round(classification_error*100,2)}%')
```

```
The classification error on the test set: 12.05%
```

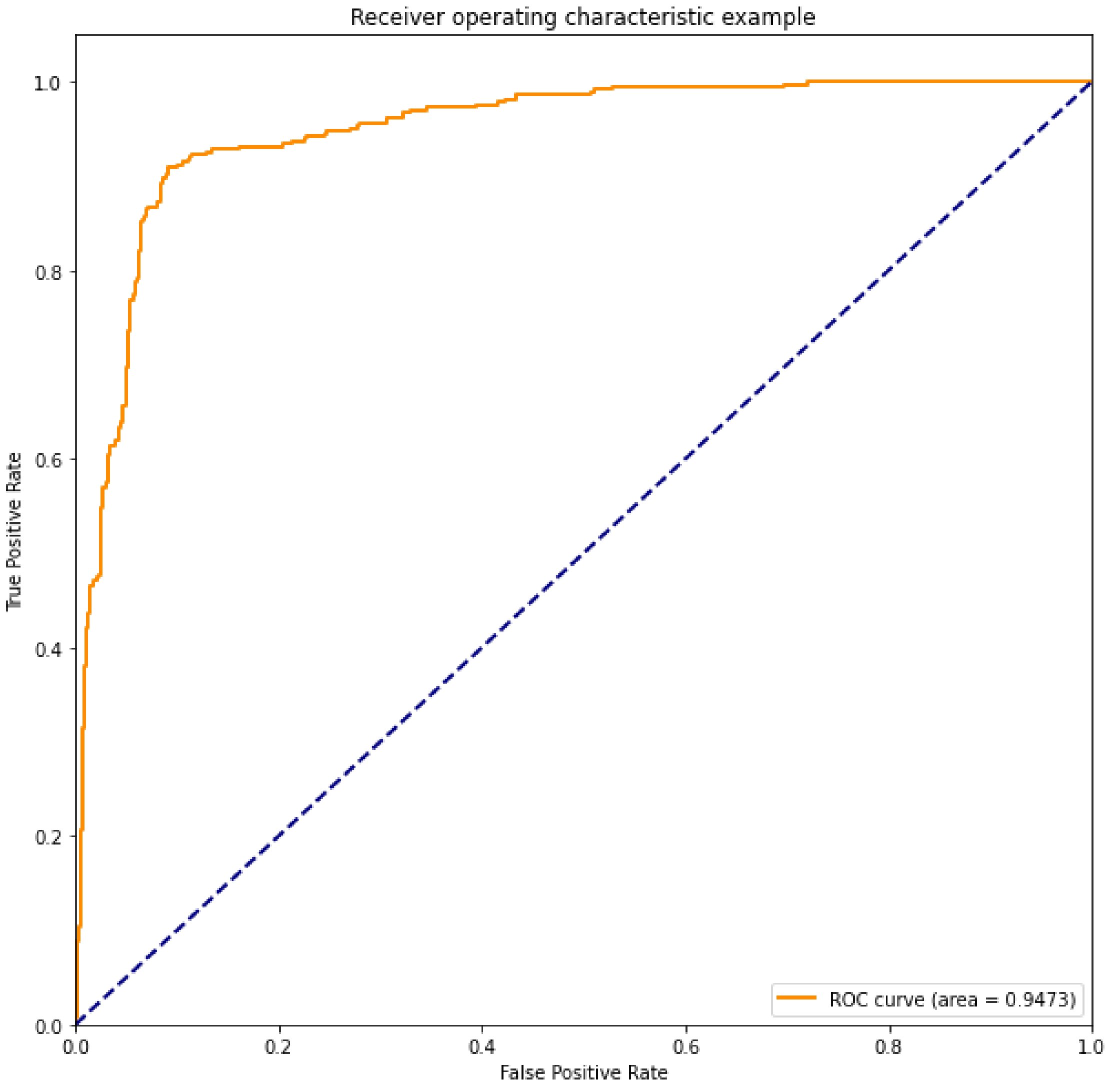
5. Plotting ROC curve and finding AUC for LDA Model

[30]:
```python
from sklearn.metrics import roc_curve
import matplotlib.pyplot as plt
from sklearn.metrics import auc
fpr,tpr,threshold = roc_curve(y_test,lda.predict_proba(X_test)[:,1])
roc_auc = auc(fpr,tpr)
print(f'AUC of the LDA Model: {roc_auc}')
```

```
AUC of the LDA Model: 0.9472782566624208
```

[27]:
```python
plt.figure()
plt.figure(figsize=(10,10))
plt.plot(fpr, tpr, color='darkorange',
lw=2, label='ROC curve (area = {0:.4f})'.format(roc_auc))
plt.plot([0, 1], [0, 1], color='navy', lw=2, linestyle='--') # lw is linewidth
plt.xlim([0.0, 1.0])
plt.ylim([0.0, 1.05])
plt.xlabel('False Positive Rate')
plt.ylabel('True Positive Rate')
plt.title('Receiver operating characteristic example')
plt.legend(loc="lower right")
plt.show()
```

```
<Figure size 432x288 with 0 Axes>
```


Receiver operating characteristic example
True Positive Rate
False Positive Rate
0.0
0.2
0.4
0.6
0.8
1.0
0.0
0.2
0.4
0.6
0.8
1.0
ROC curve (area = 0.9473)