data_processing_lda

May 12, 2021

[1]:

```
import os
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns

from sklearn.discriminant_analysis import LinearDiscriminantAnalysis
from sklearn.metrics import accuracy_score

from sklearn.metrics import confusion_matrix
from sklearn.metrics import accuracy_score
from sklearn.metrics import roc_curve
from sklearn.metrics import auc
```

1 Data Processing

[2]:

```
spotify = pd.read_csv("data.csv")
spotify.head(5)
```

[2]:

```
   acousticness                    artists  danceability  duration_ms  energy  \
0      0.991000            ['Mamie Smith']         0.598       168333   0.224
1      0.643000  ["Screamin' Jay Hawkins"]         0.852       150200   0.517
2      0.993000            ['Mamie Smith']         0.647       163827   0.186
3      0.000173        ['Oscar Velazquez']         0.730       422087   0.798
4      0.295000                   ['Mixe']         0.704       165224   0.707

   explicit                      id  instrumentalness  key  liveness  \
0         0  0cS0A1fUEUd1EW3FcF8AEI          0.000522    5    0.3790
1         0  0hbkKFIJm7Z05H8Zl9w30f          0.026400    5    0.0809
2         0  11m7laMUgmOKqI3oYzuhne          0.000018    0    0.5190
3         0  19Lc5SfJJ5O1oaxY0fpwfh          0.801000    2    0.1280
4         1  2hJjbsLCytGsnAHfdsLejp          0.000246   10    0.4020

   loudness  mode                                               name  \
0   -12.628     0                           Keep A Song In Your Soul
1    -7.261     0                               I Put A Spell On You
```

```
2   -12.098     1                                       Golfing Papa
3    -7.311     1  True House Music - Xavier Santos & Carlos Gomi…
4    -6.036     0                                          Xuniverxe

   popularity release_date  speechiness    tempo  valence  year
0          12         1920       0.0936  149.976   0.6340  1920
1           7   1920-01-05       0.0534   86.889   0.9500  1920
2           4         1920       0.1740   97.600   0.6890  1920
3          17   1920-01-01       0.0425  127.997   0.0422  1920
4           2   1920-10-01       0.0768  122.076   0.2990  1920
```

[3]:

```python
#fix the artists column into the correct format

def artists(x):
    return x.replace("[", "").replace("]", "").replace("'", "").split(", ")

spotify['artists'] = spotify.agg({"artists": [artists]})['artists']
```

[4]:

```python
#make a new column indicating if the song was a collaboration

collab = []
for x in spotify['artists']:
    if len(x) > 1:
        collab.append(1)
    else:
        collab.append(0)

spotify['Collaboration'] = collab
```

[5]:

```python
#make a new column indicating what season the song was published in
season = []

for x in spotify['release_date']:

    split = x.split("-")
    if len(split) == 1:
        season.append("NA")
    else:
        month = int(split[1])
        if month == 12 or month <= 2:
            season.append("Winter")
        if month == 3 or month == 4 or  month == 5:
            season.append("Spring")
        if  month == 6 or  month == 7 or  month == 8:
            season.append("Summer")
        if  month == 9 or  month == 10 or month == 11:
            season.append("Fall")
```

```
spotify["Season"] = season
```

[6]:

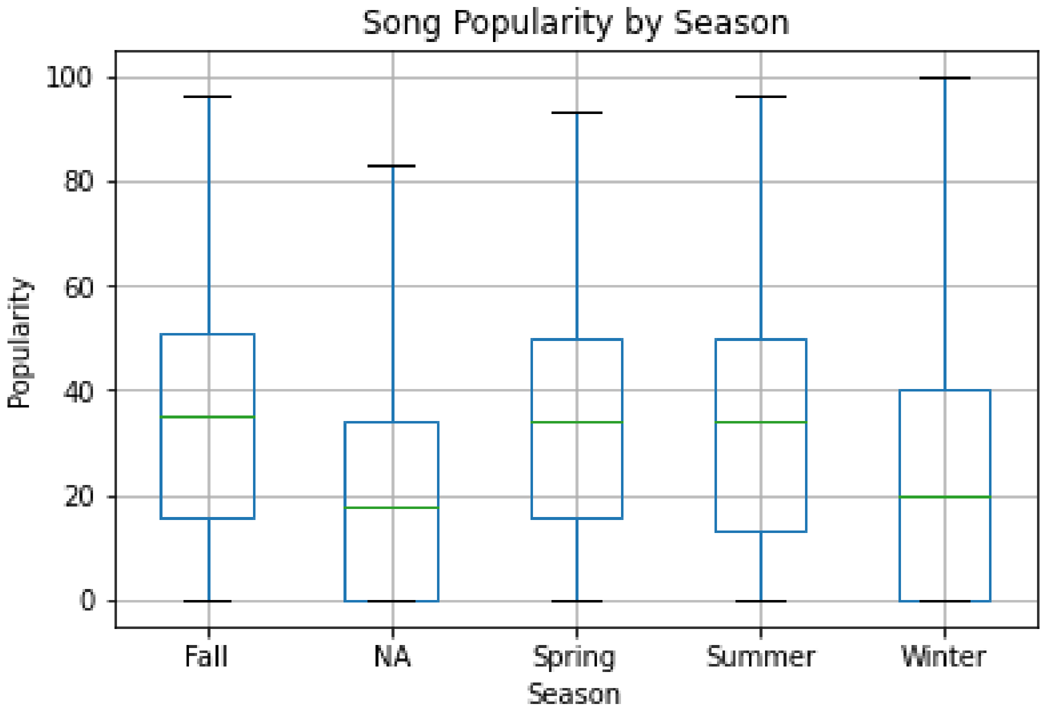
```
spotify.head(3)
```

[6]:

```
   acousticness                   artists  danceability  duration_ms  energy  \
0         0.991             [Mamie Smith]         0.598       168333   0.224
1         0.643  ["Screamin Jay Hawkins"]         0.852       150200   0.517
2         0.993             [Mamie Smith]         0.647       163827   0.186

   explicit                      id  instrumentalness  key  liveness  ...  \
0         0  0cS0A1fUEUd1EW3FcF8AEI          0.000522    5    0.3790  ...
1         0  0hbkKFIJm7Z05H8Zl9w30f          0.026400    5    0.0809  ...
2         0  11m7laMUgmOKqI3oYzuhne          0.000018    0    0.5190  ...

   mode                      name popularity  release_date speechiness  \
0     0  Keep A Song In Your Soul         12          1920      0.0936
1     0      I Put A Spell On You          7    1920-01-05      0.0534
2     1              Golfing Papa          4          1920      0.1740

     tempo  valence  year  Collaboration  Season
0  149.976    0.634  1920              0      NA
1   86.889    0.950  1920              0  Winter
2   97.600    0.689  1920              0      NA

[3 rows x 21 columns]
```

[38]:

```
spotify[["Season", "popularity"]].boxplot(by = "Season")
plt.title('Song Popularity by Season')
plt.suptitle('')
plt.xlabel("Season")
plt.ylabel("Popularity")
plt.savefig("song_popularity.png", bbox_inches='tight', dpi=600)
```



[8]:
```
#add the length of the song title (maybe longer song titles will be less␣
↪effective since less memborable)
name_length = []

for x in spotify["name"]:
    name_length.append(len(x.split(" ")))


spotify['Name Length'] = name_length
```

[9]:
```
#make song names lowercase
spotify['name'] = spotify['name'].str.lower()
```

[10]:
```
#remove stopwords
from nltk.corpus import stopwords

stop_words = set(stopwords.words('english'))

spotify['name'] = spotify['name'].apply(lambda x: " ".join([y for y in x.
↪split() if y not in stop_words]))
```

[11]:
```
from string import punctuation
```

```
def remove_punctuation(document):

    no_punct = ''.join([character for character in document if character not in␣
 ↪punctuation])

    return no_punct

#remove punctuation
spotify['name'] = spotify['name'].apply(remove_punctuation)
```

[12]:

```
#tokenize the text

from nltk.tokenize import word_tokenize

names_tokenized = spotify['name'].apply(word_tokenize)
```

[13]:

```
from nltk.stem import PorterStemmer

porter = PorterStemmer()

def stemmer(document):

    stemmed_document = [porter.stem(word) for word in document]

    return stemmed_document

#apply the stemmer

name_stemmed = names_tokenized.apply(stemmer)
```

[14]:

```
#detokenize

from nltk.tokenize.treebank import TreebankWordDetokenizer

name_detokenized = name_stemmed.apply(TreebankWordDetokenizer().detokenize)
```

[15]:

```
#vectorize the name column

from sklearn.feature_extraction.text import CountVectorizer

countvec = CountVectorizer(min_df = .02)

name = countvec.fit_transform(name_detokenized)
name
```

[15]:

```
<174389x8 sparse matrix of type '<class 'numpy.int64'>'
        with 43801 stored elements in Compressed Sparse Row format>
```

[47]:
```
name_dtm = pd.DataFrame(name.toarray(), columns=countvec.get_feature_names(),␣
 ↪index=spotify.index)
name_dtm.head()
```

[47]:
```
   live  love  mix  no  op  remast  version  year
0     0     0    0   0   0       0        0     0
1     0     0    0   0   0       0        0     0
2     0     0    0   0   0       0        0     0
3     0     0    0   0   0       0        0     0
4     0     0    0   0   0       0        0     0
```

[17]:
```
final = pd.merge(spotify, name_dtm, left_index=True, right_index=True,␣
 ↪how='outer')
final.to_csv("spotify_final.csv")
```

2 Model Building: LDA

[18]:
```
#prepare data for model building

lda_data = pd.get_dummies(final, columns = ["Season"]).drop(columns =␣
 ↪{"artists", "id", "name", \
                                                                        ␣
 ↪"release_date"})

#add binary column indicating if popularity score is above 25
popular = []
for x in lda_data['popularity'].astype('int32'):
    if x >= 25:
        popular.append(1)
    else:
        popular.append(0)
lda_data['popular'] = popular
```

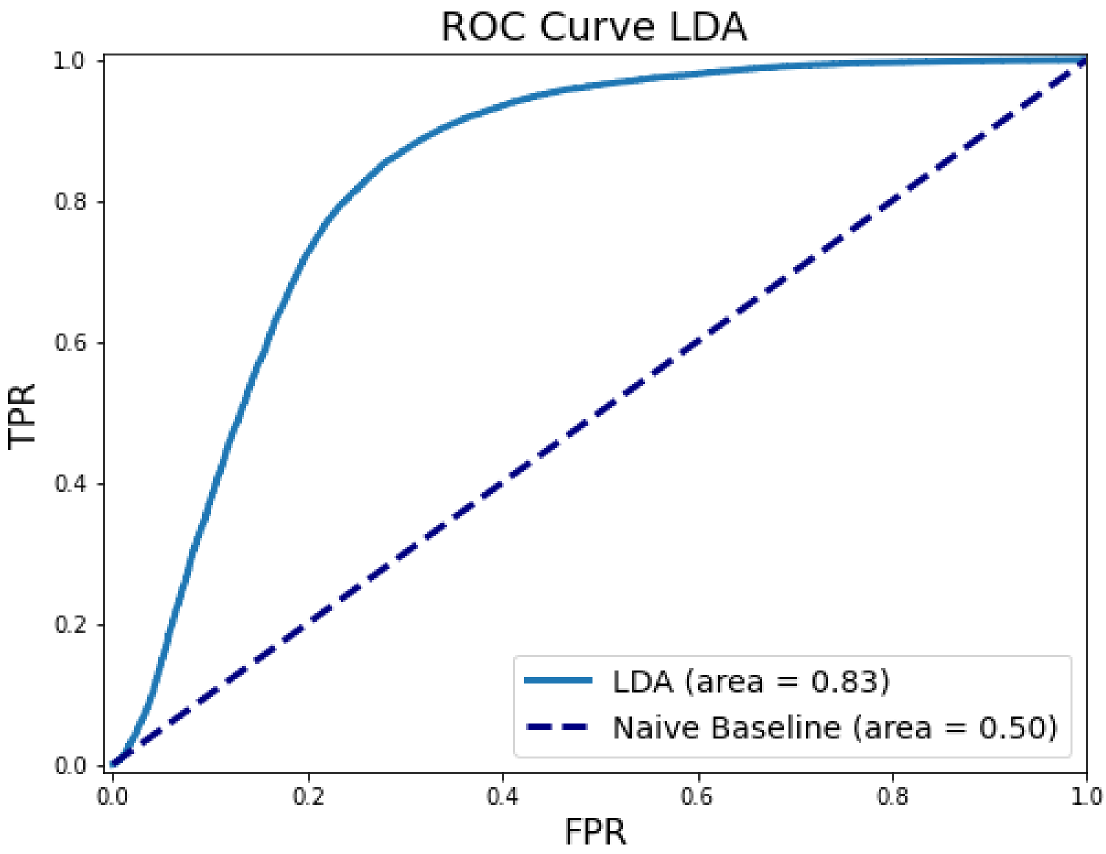
[19]:
```
#train test split

from sklearn.model_selection import train_test_split

y = lda_data['popular'].astype("int64")
x = lda_data.drop(['popular', "popularity"], axis=1)

x_train, x_test, y_train, y_test = train_test_split(x, y,
                                                    test_size=0.3,
                                                   ␣
 ↪stratify=lda_data['popular'],
                                                    random_state=88,)
x_train.shape, x_test.shape
```

[19]: ((122072, 29), (52317, 29))

[20]:
```
#lda model

lda = LinearDiscriminantAnalysis()
lda.fit(x_train, y_train)

y_prob_lda = lda.predict_proba(x_test)
y_pred_lda = pd.Series([1 if x > .5 else 0 for x in y_prob_lda[:,1]])

cm = confusion_matrix(y_test, y_pred_lda)
print ("Confusion Matrix: \n", cm)
print ("\nAccuracy:", accuracy_score(y_test, y_pred_lda))
```

```
Confusion Matrix:
 [[18517  6932]
 [ 4163 22705]]

Accuracy: 0.7879274423227631
```

[41]:
```
fpr_lda, tpr_lda, _ = roc_curve(y_test, y_prob_lda[:,1])
roc_auc_lda = auc(fpr_lda, tpr_lda)

plt.figure(figsize=(8, 6))
plt.title('ROC Curve LDA', fontsize=18)
plt.xlabel('FPR', fontsize=16)
plt.ylabel('TPR', fontsize=16)
plt.xlim([-0.01, 1.00])
plt.ylim([-0.01, 1.01])
plt.plot(fpr_lda, tpr_lda, lw=3, label='LDA (area = {:0.2f})'.
 ↪format(roc_auc_lda))
plt.plot([0, 1], [0, 1], color='navy', lw=3, linestyle='--', label='Naive␣
 ↪Baseline (area = 0.50)')
plt.legend(loc='lower right', fontsize=14)
plt.savefig("roc_lda.png", bbox_inches='tight', dpi=600)
plt.show()
```


ROC Curve LDA
TPR
FPR
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
LDA (area = 0.83)
Naive Baseline (area = 0.50)

```
[ ]:
```