Avaliacao_ensemble_test

November 4, 2019

[1]:

```
import pandas as pd
import numpy as np
import seaborn as sns
from datetime import datetime
import matplotlib.pyplot as plt
%matplotlib inline
from sklearn.model_selection import StratifiedKFold, GridSearchCV
from sklearn.ensemble import RandomForestClassifier,␣
 ↪GradientBoostingClassifier, AdaBoostClassifier, VotingClassifier
from sklearn.metrics import roc_auc_score, roc_curve, auc,␣
 ↪precision_recall_curve
from sklearn.metrics import classification_report, confusion_matrix
from xgboost import XGBClassifier
from mlxtend.plotting import plot_learning_curves
from yellowbrick.model_selection import LearningCurve
import matplotlib.gridspec as gridspec
import itertools
from sklearn.model_selection import cross_val_score, train_test_split
from sklearn.tree import DecisionTreeClassifier
from sklearn.metrics import accuracy_score
from sklearn.linear_model import LogisticRegression
from sklearn import tree
from sklearn.naive_bayes import MultinomialNB
from sklearn.utils import shuffle
from sklearn.preprocessing import LabelEncoder, OrdinalEncoder
```

[2]:

```
def timer(start_time=None):
    if not start_time:
        start_time = datetime.now()
        return start_time
    elif start_time:
        tmin, tsec = divmod((datetime.now() - start_time).total_seconds(), 60)
        print('\n Tempo Necessário: %i minutos and %s segundos.' % (tmin,␣
 ↪round(tsec, 2)))
```

[3]:

```
train = pd.read_csv('trainLR.csv')
train = shuffle(train)
```

```
X_train = train.iloc[:,1:25]
Y_train = train.loc[:, train.columns == 'Y']
test = pd.read_csv('testLR.csv')
test = shuffle(test)
X_test = test.iloc[:,1:25]
Y_test = test.loc[:, test.columns == 'Y']
```

[4]:
```
print(X_train.shape)
```

```
(109992, 24)
```

[5]:
```
print(X_test.shape)
```

```
(65995, 24)
```

[6]:
```
X_train.head()
```

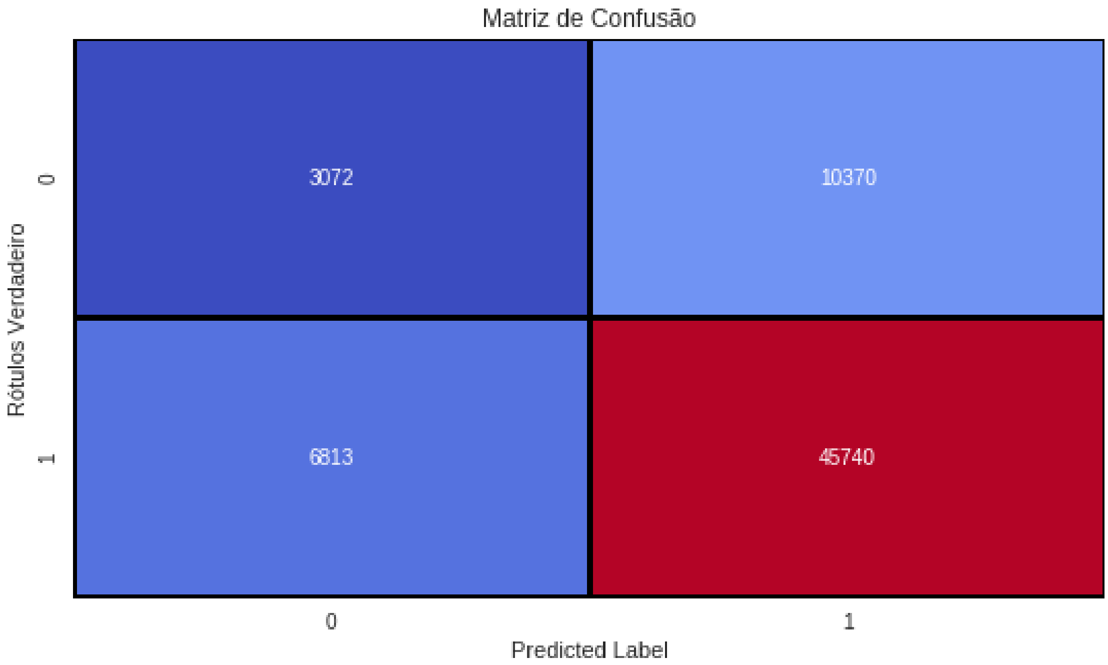
[6]:
```
        v1  v10  v29  v87  v111      v277  v279      v280      v281      v282  \
95975    0    0    0    0     0  0.758621   0.0  0.866667  0.740741  0.636364
21840    0    0    0    0     0  0.000000  -1.0  0.000000  0.000000 -1.000000
68686    0    0    0    0     0  1.000000  -1.0  1.000000  1.000000 -1.000000
107302   0    0    0    0     0  0.857143  -1.0  0.857143  0.857143 -1.000000
1795     0    0    0    2     2  0.958333   0.0  1.000000  0.950000  1.000000

        …      v605      v606      v607  v608  v609  v610  v681  v683  v684  \
95975   …  0.833333  0.833333  0.866667   0.7   0.7   0.7     1     0     0
21840   …  0.000000  0.000000  0.000000  -1.0  -1.0  -1.0     0     0     0
68686   …  1.000000  1.000000  1.000000  -1.0  -1.0  -1.0     0     0     0
107302  …  1.000000  1.000000  1.000000  -1.0  -1.0  -1.0     0     0     0
1795    …  0.950000  0.950000  0.950000   1.0   1.0   1.0     0     0     0

            v691
95975   0.400000
21840   0.500000
68686   0.500000
107302  0.363636
1795    0.000000

[5 rows x 24 columns]
```

[7]:
```
# Fit a Decision Tree model as comparison
starttime = timer(None)
start_time = timer(None)
clf_DecisionTreeClassifier = DecisionTreeClassifier()
clf_DecisionTreeClassifier.fit(X_train, Y_train.values.ravel())
DecisionTreeClassifier_pred = clf_DecisionTreeClassifier.predict(X_test)
timer(start_time)
```

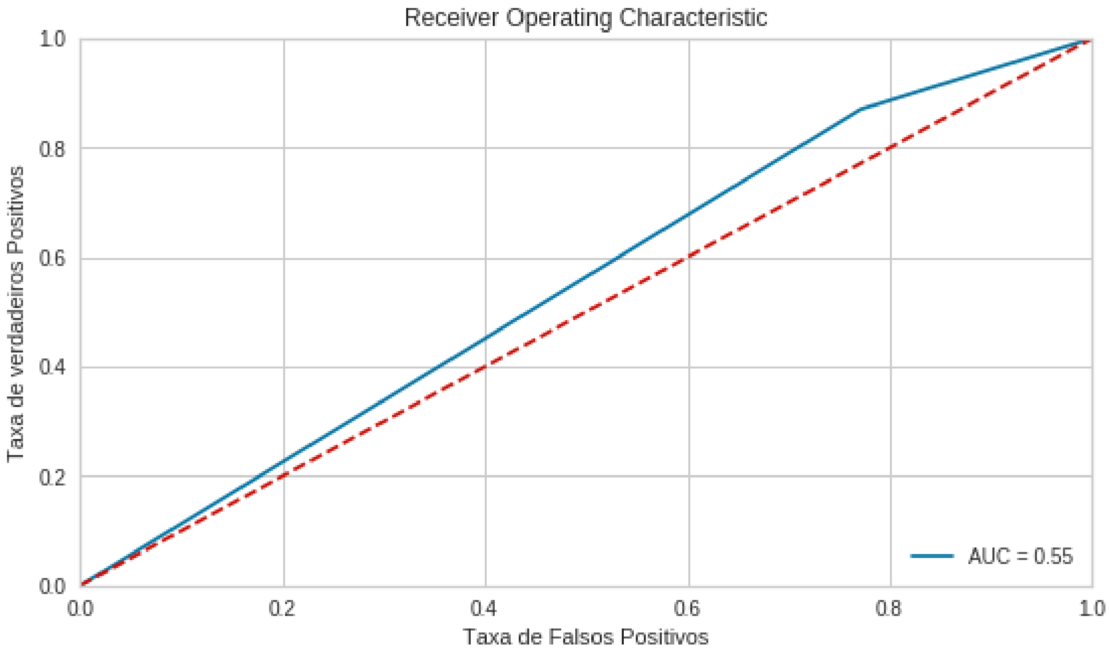
```
accuracy_score(Y_test, DecisionTreeClassifier_pred)
false_positive_rate, true_positive_rate, thresholds = roc_curve(Y_test␣
 ↪,DecisionTreeClassifier_pred)
roc_auc = auc(false_positive_rate, true_positive_rate)

plt.figure(1)
matrix_DecisionTreeClassifier = confusion_matrix(Y_test,␣
 ↪DecisionTreeClassifier_pred)
plt.figure(figsize=(9,5))
DecisionTreeClassifier = sns.heatmap(matrix_DecisionTreeClassifier, annot=True,␣
 ↪cbar=False, fmt="d", cmap ='coolwarm', linecolor ='black', linewidths = 2)
bottom, top = DecisionTreeClassifier.get_ylim()
DecisionTreeClassifier.set_ylim(bottom + 0.5, top - 0.5)
plt.ylabel('Rótulos Verdadeiro')
plt.xlabel('Predicted Label')
plt.title('Matriz de Confusão')
plt.show()



plt.figure(2)
plt.figure(figsize=(9,5))
plt.title('Receiver Operating Characteristic')
plt.plot(false_positive_rate, true_positive_rate, 'b',
label='AUC = %0.2f'% roc_auc)
plt.legend(loc='lower right')
plt.plot([0,1],[0,1],'r--')
plt.xlim([-0.0,1.0])
plt.ylim([-0.0,1.0])
plt.ylabel('Taxa de verdadeiros Positivos')
plt.xlabel('Taxa de Falsos Positivos')
plt.show()



print("Relatório de Classificação")
print(classification_report(Y_test, DecisionTreeClassifier_pred))

print("Acurácia do Modelo")
accuracy_score(Y_test, DecisionTreeClassifier_pred)
```

```
 Tempo Necessário: 0 minutos and 0.73 segundos.
```

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



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



```
Relatório de Classificação
```

```
              precision    recall  f1-score   support

           0       0.31      0.23      0.26     13442
           1       0.82      0.87      0.84     52553

    accuracy                           0.74     65995
   macro avg       0.56      0.55      0.55     65995
weighted avg       0.71      0.74      0.72     65995

Acurácia do Modelo
```

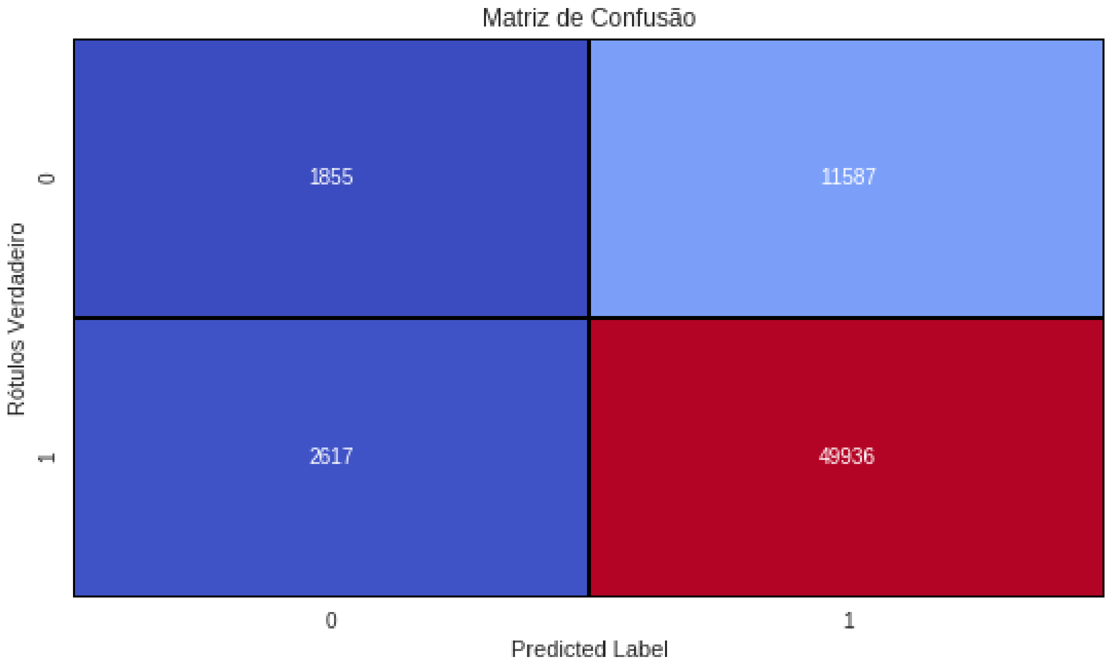
```
[7]: 0.739631790287143
```

Fit a Simple Random Forest model

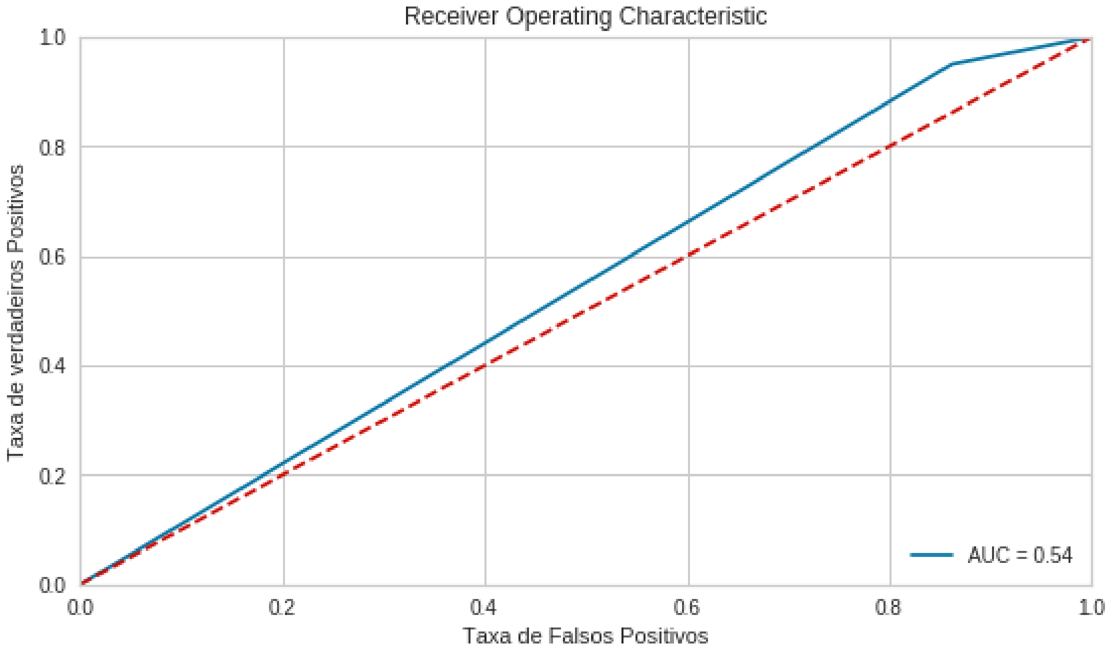
```
[8]: starttime = timer(None)
start_time = timer(None)
clf = RandomForestClassifier(n_estimators=100,␣
 ↪max_features="auto",random_state=0)
clf.fit(X_train, Y_train.values.ravel())
scores = cross_val_score(clf, X_train, Y_train.values.ravel(), cv=3)
RandomForestClassifier_pred = clf.predict(X_test)
timer(start_time)
accuracy_score(Y_test, RandomForestClassifier_pred)
false_positive_rate, true_positive_rate, thresholds = roc_curve(Y_test,␣
 ↪RandomForestClassifier_pred)
roc_auc = auc(false_positive_rate, true_positive_rate)


plt.figure(1)
matrix_RandomForestClassifier = confusion_matrix(Y_test,␣
 ↪RandomForestClassifier_pred)
plt.figure(figsize=(9,5))
map_RandomForestClassifier = sns.heatmap(matrix_RandomForestClassifier,␣
 ↪annot=True, cbar=False, fmt="d", cmap ='coolwarm', linecolor ='black',␣
 ↪linewidths = 1)
bottom, top = map_RandomForestClassifier.get_ylim()
map_RandomForestClassifier.set_ylim(bottom + 0.5, top - 0.5)
plt.ylabel('Rótulos Verdadeiro')
plt.xlabel('Predicted Label')
plt.title('Matriz de Confusão')
plt.show()

plt.figure(2)
plt.figure(figsize=(9,5))
plt.title('Receiver Operating Characteristic')
plt.plot(false_positive_rate, true_positive_rate, 'b',
label='AUC = %0.2f'% roc_auc)
plt.legend(loc='lower right')
plt.plot([0,1],[0,1],'r--')
plt.xlim([-0.0,1.0])
plt.ylim([-0.0,1.0])
plt.ylabel('Taxa de verdadeiros Positivos')
plt.xlabel('Taxa de Falsos Positivos')
plt.show()



print("Relatório de Classificação")
print(classification_report(Y_test, RandomForestClassifier_pred))

print("Acurácia do Modelo")
accuracy_score(Y_test, RandomForestClassifier_pred)

print("Acurácia do Modelo Cross Validation")
print(scores.mean())
```

```
 Tempo Necessário: 0 minutos and 36.27 segundos.
```

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



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



```
Relatório de Classificação
              precision    recall  f1-score   support

           0       0.41      0.14      0.21     13442
           1       0.81      0.95      0.88     52553

    accuracy                           0.78     65995
   macro avg       0.61      0.54      0.54     65995
weighted avg       0.73      0.78      0.74     65995

Acurácia do Modelo
Acurácia do Modelo Cross Validation
0.78217505526712
```

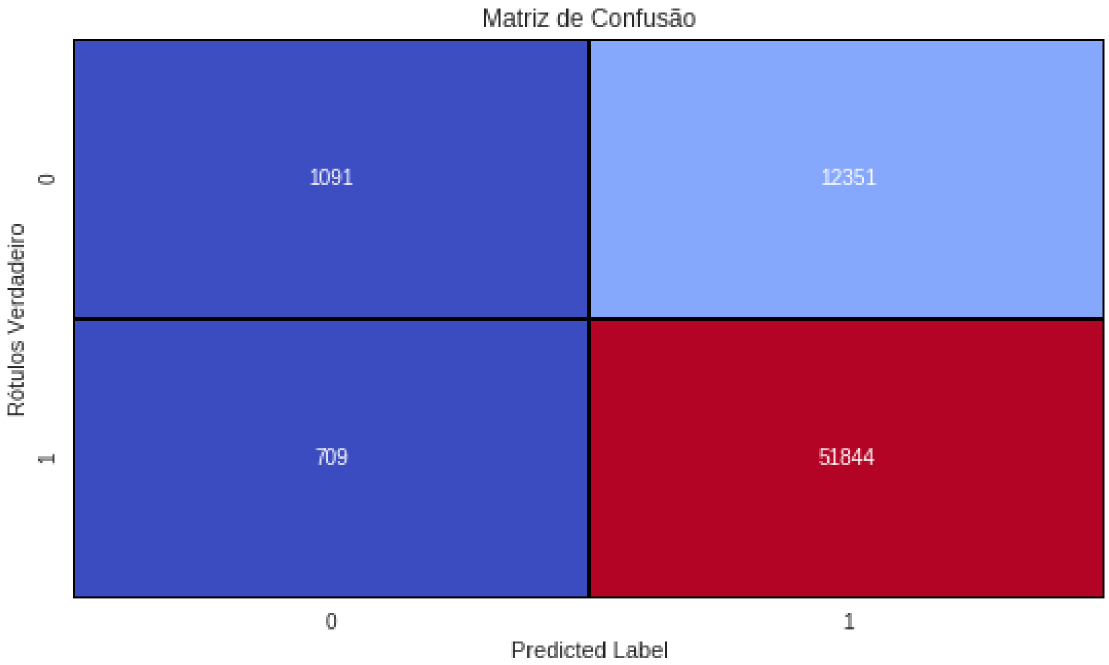
Fit a AdaBoost model

[9]:
```
starttime = timer(None)
start_time = timer(None)
clf = AdaBoostClassifier(n_estimators=100)
clf.fit(X_train, Y_train.values.ravel())
AdaBoostClassifier_pred = clf.predict(X_test)
scores = cross_val_score(clf, X_train, Y_train.values.ravel(), cv=3)
timer(start_time)
accuracy_score(Y_test, AdaBoostClassifier_pred)
```

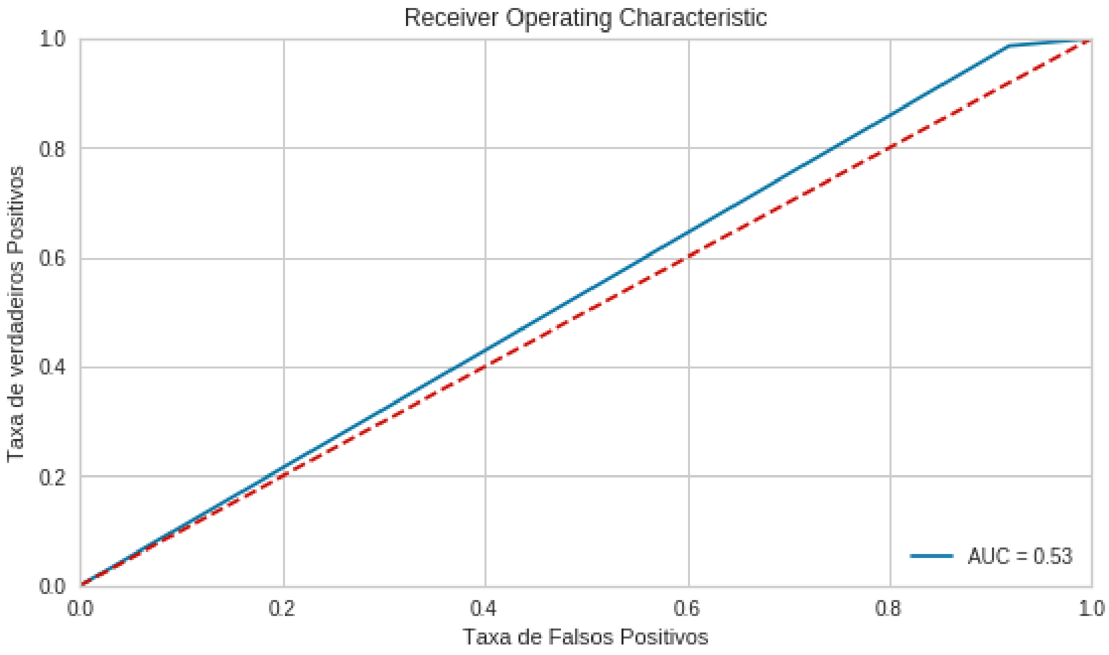
```
false_positive_rate, true_positive_rate, thresholds = roc_curve(Y_test,␣
 ↪AdaBoostClassifier_pred)
roc_auc = auc(false_positive_rate, true_positive_rate)


plt.figure(1)
matrix_AdaBoostClassifier = confusion_matrix(Y_test, AdaBoostClassifier_pred)
plt.figure(figsize=(9,5))
map_matrix_AdaBoostClassifier = sns.heatmap(matrix_AdaBoostClassifier,␣
 ↪annot=True, cbar=False, fmt="d", cmap ='coolwarm', linecolor ='black',␣
 ↪linewidths = 1)
bottom, top = map_matrix_AdaBoostClassifier.get_ylim()
map_matrix_AdaBoostClassifier.set_ylim(bottom + 0.5, top - 0.5)
plt.ylabel('Rótulos Verdadeiro')
plt.xlabel('Predicted Label')
plt.title('Matriz de Confusão')
plt.show()

plt.figure(2)
plt.figure(figsize=(9,5))
plt.title('Receiver Operating Characteristic')
plt.plot(false_positive_rate, true_positive_rate, 'b',
label='AUC = %0.2f'% roc_auc)
plt.legend(loc='lower right')
plt.plot([0,1],[0,1],'r--')
plt.xlim([-0.0,1.0])
plt.ylim([-0.0,1.0])
plt.ylabel('Taxa de verdadeiros Positivos')
plt.xlabel('Taxa de Falsos Positivos')
plt.show()


print("Relatório de Classificação")
print(classification_report(Y_test, AdaBoostClassifier_pred))

print("Acurácia do Modelo")
accuracy_score(Y_test, AdaBoostClassifier_pred)

print("Acurácia do Modelo Cross Validation")
print(scores.mean())
```

```
 Tempo Necessário: 0 minutos and 20.25 segundos.
```

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



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



```
Relatório de Classificação
```

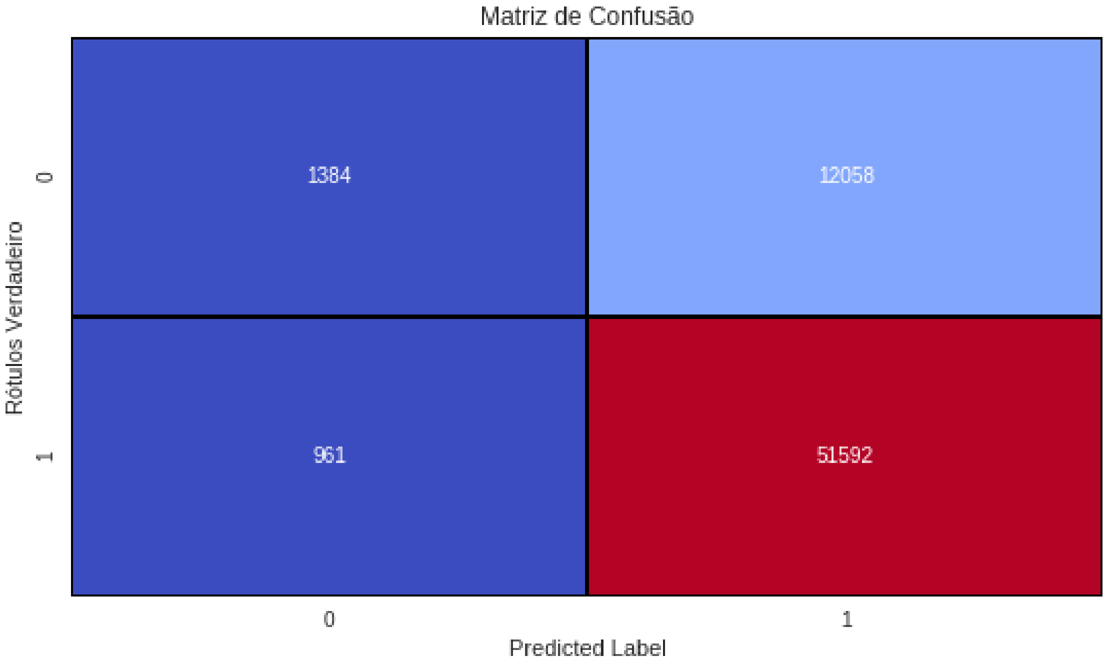
```
              precision    recall  f1-score   support

           0       0.61      0.08      0.14     13442
           1       0.81      0.99      0.89     52553

    accuracy                           0.80     65995
   macro avg       0.71      0.53      0.52     65995
weighted avg       0.77      0.80      0.74     65995

Acurácia do Modelo
Acurácia do Modelo Cross Validation
0.7991672041264524
```

Fit a Gradient Boosting model

[10]:

```python
gb_clf2 = GradientBoostingClassifier(n_estimators=200, learning_rate=0.5, max_features=2, max_depth=2, random_state=1)
gb_clf2.fit(X_train, Y_train.values.ravel())
GradientBoostingClassifier_predictions = gb_clf2.predict(X_test)

matrix_GradientBoostingClassifier2 = confusion_matrix(Y_test, GradientBoostingClassifier_predictions)
scores = cross_val_score(gb_clf2, X_train, Y_train.values.ravel(), cv=3)
plt.figure(figsize=(9,5))
map_matrix_GradientBoostingClassifier2 = sns.heatmap(matrix_GradientBoostingClassifier2, annot=True, cbar=False, fmt="d", cmap ='coolwarm', linecolor ='black', linewidths = 1)
bottom, top = map_matrix_GradientBoostingClassifier2.get_ylim()
map_matrix_GradientBoostingClassifier2.set_ylim(bottom + 0.5, top - 0.5)
plt.ylabel('Rótulos Verdadeiro')
plt.xlabel('Predicted Label')
plt.title('Matriz de Confusão')



print("Relatório de Classificação")
print(classification_report(Y_test, GradientBoostingClassifier_predictions))

print("Acurácia do Modelo")
accuracy_score(Y_test, GradientBoostingClassifier_predictions)

print("Acurácia do Modelo Cross Validation")
print(scores.mean())
```

```
Relatório de Classificação
              precision    recall  f1-score   support

           0       0.59      0.10      0.18     13442
           1       0.81      0.98      0.89     52553

    accuracy                           0.80     65995
   macro avg       0.70      0.54      0.53     65995
weighted avg       0.77      0.80      0.74     65995

Acurácia do Modelo
Acurácia do Modelo Cross Validation
0.8000308936340507
```



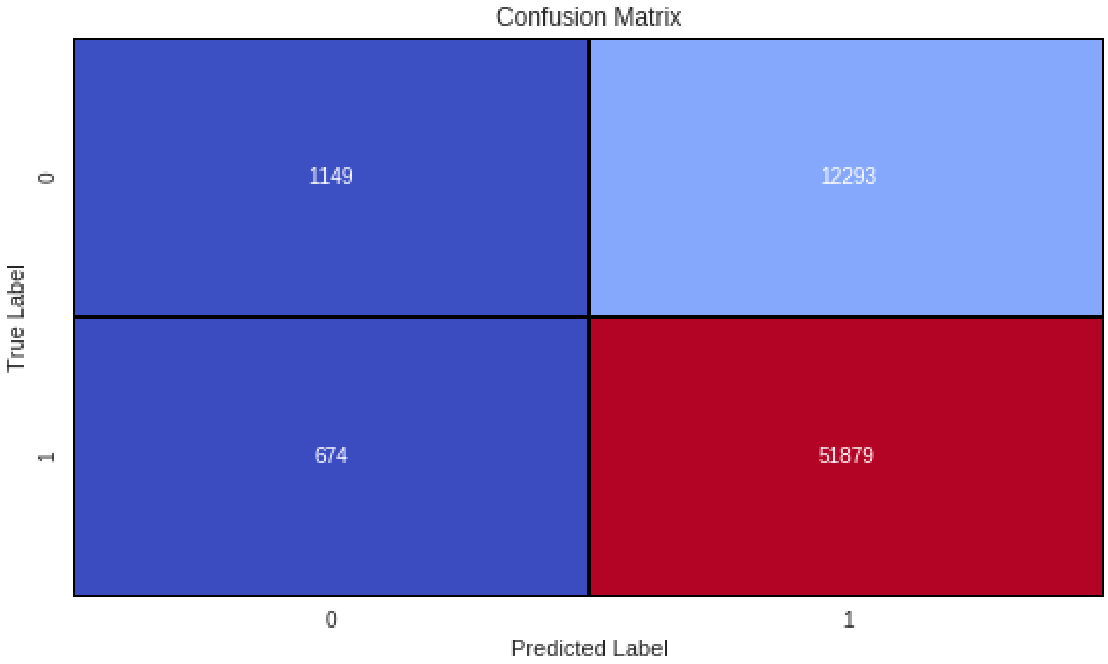
XGboost Classifier

[11]:
```
starttime = timer(None)
start_time = timer(None)
xgb_clf = XGBClassifier(base_score=0.2, booster='gbtree', colsample_bylevel=1,
              colsample_bynode=0.1, colsample_bytree=1, gamma=1,
              learning_rate=0.1, max_delta_step=1, max_depth=3,
              min_child_weight=1, missing=None, n_estimators=300, n_jobs=4,
              nthread=None, objective='reg:squarederror', random_state=1,
              reg_alpha=0, reg_lambda=10, scale_pos_weight=1, seed=None,
              silent=None, subsample=1, verbosity=1)
xgb_clf.fit(X_train, Y_train.values.ravel())
predictions_xgb = xgb_clf.predict(X_test)
scores = cross_val_score(xgb_clf, X_train, Y_train.values.ravel(), cv=3)
timer(start_time)
```

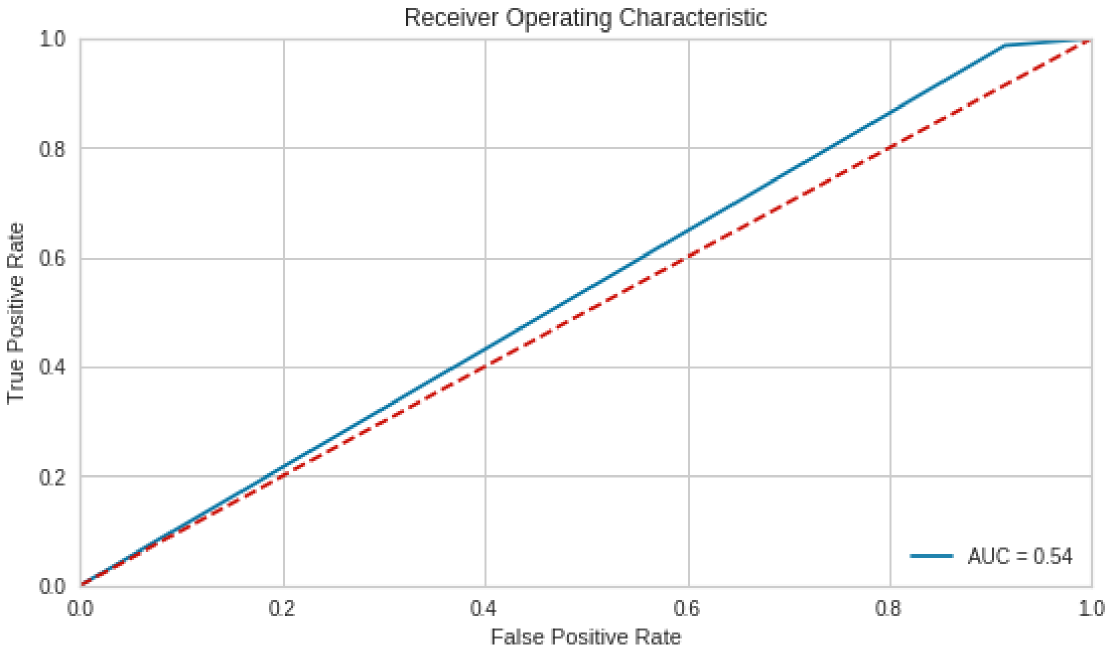
```
false_positive_rate, true_positive_rate, thresholds = roc_curve(Y_test,␣
 ↪predictions_xgb)
roc_auc = auc(false_positive_rate, true_positive_rate)
matrix_xgb_clf = confusion_matrix(Y_test, predictions_xgb)



plt.figure(1)
plt.figure(figsize=(9,5))
xgb_clf_heatmap = sns.heatmap(matrix_xgb_clf,annot=True, cbar=False, fmt="d",␣
 ↪cmap ='coolwarm', linecolor ='black', linewidths = 1)
bottom, top = xgb_clf_heatmap.get_ylim()
xgb_clf_heatmap.set_ylim(bottom + 0.5, top - 0.5)
plt.ylabel('True Label')
plt.xlabel('Predicted Label')
plt.title('Confusion Matrix')
plt.show()

plt.figure(2)
plt.figure(figsize=(9,5))
plt.title('Receiver Operating Characteristic')
plt.plot(false_positive_rate, true_positive_rate, 'b',
label='AUC = %0.2f'% roc_auc)
plt.legend(loc='lower right')
plt.plot([0,1],[0,1],'r--')
plt.xlim([-0.0,1.0])
plt.ylim([-0.0,1.0])
plt.ylabel('True Positive Rate')
plt.xlabel('False Positive Rate')
plt.show()

plt.figure(3)
precision, recall, thresholds = precision_recall_curve(Y_test, predictions_xgb)
plt.figure(figsize = (9,5))
plt.plot(recall, precision)
plt.plot([0, 1], [0.5, 0.5], linestyle = '--')
plt.xlabel('Recall', fontsize = 16)
plt.ylabel('Precision', fontsize = 16)
plt.xticks(size = 18)
plt.yticks(size = 18)
plt.title('Precision-Recall', fontsize = 28)
plt.show();


print("Classification Report")
print(classification_report(Y_test, predictions_xgb))
print("Acurácia do Modelo")
accuracy_score(Y_test, predictions_xgb)

print("Acurácia do Modelo Cross Validation")
print(scores.mean())
```

```
Tempo Necessário: 0 minutos and 8.36 segundos.
```

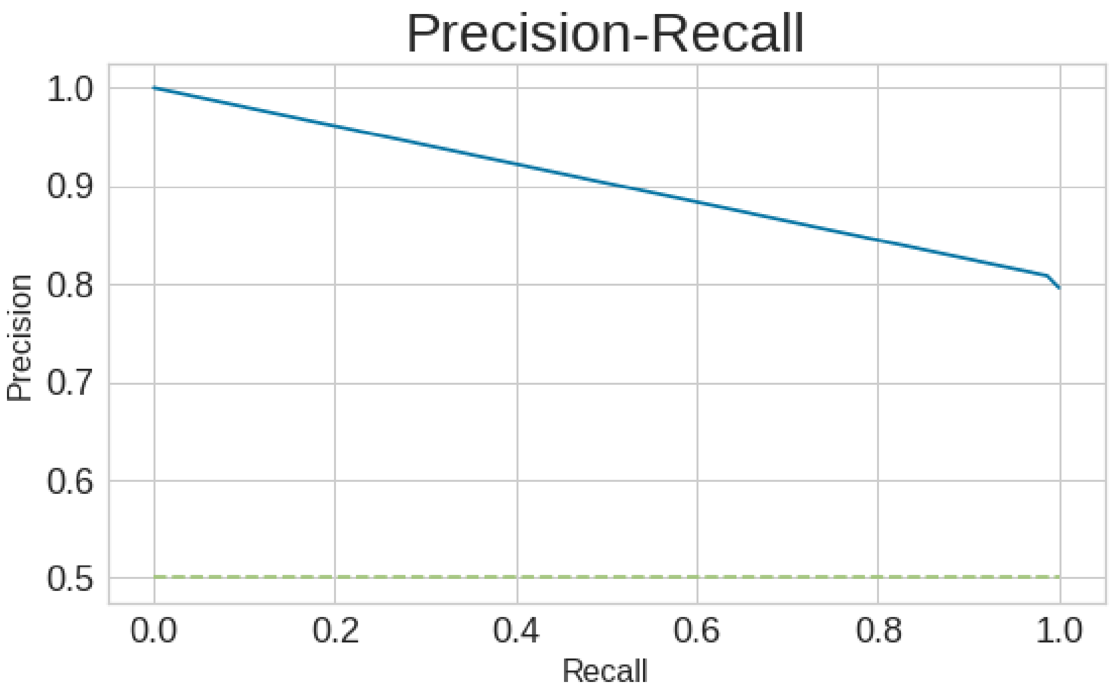
```
<Figure size 432x288 with 0 Axes>
```



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



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

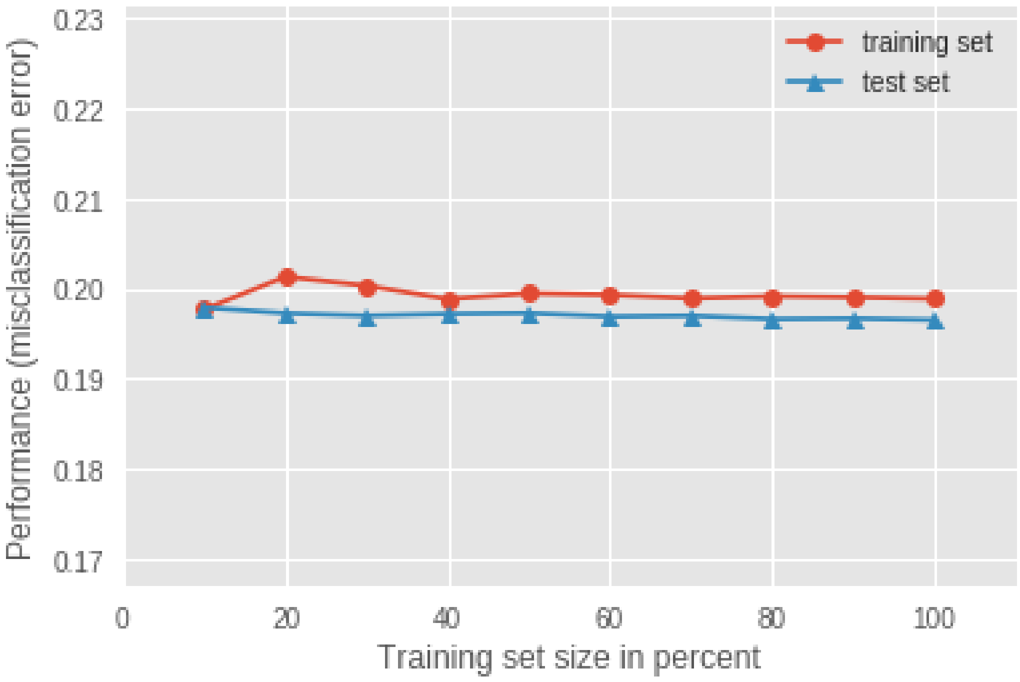


```
Classification Report
```

```
              precision    recall  f1-score   support

           0       0.63      0.09      0.15     13442
           1       0.81      0.99      0.89     52553

    accuracy                           0.80     65995
   macro avg       0.72      0.54      0.52     65995
weighted avg       0.77      0.80      0.74     65995

Acurácia do Modelo
Acurácia do Modelo Cross Validation
0.8002945638030585
```

[12]:

```
plt.figure()
plot_learning_curves(X_train, Y_train.values.ravel(), X_test, Y_test.values.
 ↪ravel(), xgb_clf, print_model=False, style='ggplot')
plt.show()
```


training set
test set
Performance (misclassification error)
Training set size in percent