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TAIWANESE BANKRUPTCY PREDICTION

Gr5

Taiwanese Bankruptcy Prediction Data Set

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SUPER TEAM

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Data set

Taiwanese Bankruptcy Prediction Data Set

Number of features : 96

Number of Samples: 6819

Class: 0=ไม่ล้มละลาย, 1=ล้มละลาย

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Import

```
[ ] import pandas as pd
    import numpy as np
    import matplotlib.pyplot as plt
    import seaborn as sns
    from sklearn import linear_model
    from sklearn.svm import SVC
    from sklearn.tree import DecisionTreeClassifier
    from sklearn.metrics import confusion_matrix, ConfusionMatrixDisplay
    from sklearn.metrics import make_scorer, f1_score, precision_score, recall_score, accuracy_score
    from sklearn.datasets import make_classification
    from sklearn.pipeline import Pipeline
    from sklearn.ensemble import RandomForestClassifier
    from sklearn.preprocessing import StandardScaler
    from sklearn.model_selection import train_test_split, GridSearchCV, cross_val_score
    from sklearn.utils.class_weight import compute_sample_weight
    from xgboost import XGBClassifier
    from fast_ml.utilities import display_all
    from fast_ml.feature_selection import get_duplicate_features
    from imblearn.over_sampling import SMOTE
```

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Clean Data

01 Duplicate

02 Check Null and Zero

03 Class 0 and 1 balance

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Duplicate Index

ข้อมูลที่มีความสัมพันธ์กัน(ไปในทางเดียวกัน)

	Desc	feature1	feature2
0	Duplicate Index	Debt ratio %	Net worth/Assets
1	Duplicate Index	Total income/Total expense	Net Income to Stockholder's Equity
2	Duplicate Index	Total expense/Assets	Cash Flow to Total Assets
3	Duplicate Index	Total expense/Assets	Current Liability to Equity
4	Duplicate Index	Total expense/Assets	Cash Flow to Sales
5	Duplicate Index	Total expense/Assets	Working capitcal Turnover Rate
6	Duplicate Index	Total income/Total expense	Equity to Liability
7	Duplicate Index	Total income/Total expense	Liability to Equity
8	Duplicate Index	Total income/Total expense	No-credit Interval
9	Duplicate Index	Total income/Total expense	Cash Flow to Sales

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Duplicate Index

```
[ ]  # drop these duplicate features from dataset
     print('Shape of Dataset before dropping the duplicate index features: ', data.shape)
     data.drop(columns = duplicate_index_features_list, inplace=True)
     print('Shape of Dataset after dropping the duplicate index features: ', data.shape)
```

```
Shape of Dataset before dropping the duplicate index features:  (6819, 94)
Shape of Dataset after dropping the duplicate index features:  (6819, 69)
```

จาก 96 เหลือ 69 Feature

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Check Null and Zero

```
[ ]  checkNull = data.isnull().sum()
     for key,value in checkNull.iteritems():
         print(key,",",value)
```

```
Bankrupt? , 0
 ROA(C) before interest and depreciation before interest ,
 ROA(A) before interest and % after tax , 0
 ROA(B) before interest and depreciation after tax , 0
 Operating Gross Margin , 0
 Realized Sales Gross Margin , 0
 Operating Profit Rate , 0
 Pre-tax net Interest Rate , 0
 After-tax net Interest Rate , 0
 Non-industry income and expenditure/revenue , 0
 Continuous interest rate (after tax) , 0
 Operating Expense Rate , 0
 Research and development expense rate , 0
 Cash flow rate , 0
 Interest-bearing debt interest rate , 0
 Tax rate (A) , 0
 Net Value Per Share (B) , 0
 Net Value Per Share (A) , 0
 Net Value Per Share (C) , 0
```

```
checkZero = data.eq(0).sum()
for key,value in checkZero.iteritems():
    print(key,",",value)
```

```
 Research and development expense rate , 1424
 Cash flow rate , 1
 Interest-bearing debt interest rate , 891
 Tax rate (A) , 2568
 Net Value Per Share (B) , 1
 Net Value Per Share (A) , 1
 Net Value Per Share (C) , 1
 Persistent EPS in the Last Four Seasons , 1
 Cash Flow Per Share , 1
 Revenue Per Share (Yuan ¥) , 2
 Operating Profit Per Share (Yuan ¥) , 1
 Per Share Net profit before tax (Yuan ¥) , 1
 Realized Sales Gross Profit Growth Rate , 1
 Operating Profit Growth Rate , 1
 After-tax Net Profit Growth Rate , 1
 Regular Net Profit Growth Rate , 1
 Continuous Net Profit Growth Rate , 1
 Total Asset Growth Rate , 1
 Net Value Growth Rate , 1
 Total Asset Return Growth Rate Ratio , 1
 Cash Reinvestment % , 1
 Current Ratio , 1
 Quick Ratio , 1
 Interest Expense Ratio , 1
 Total debt/Total net worth , 1
 Debt ratio % , 1
 Long-term fund suitability ratio (A) , 1
 Borrowing dependency , 1
 Contingent liabilities/Net worth , 1
 Operating profit/Paid-in capital , 1
 Net profit before tax/Paid-in capital , 1
 Inventory and accounts receivable/Net value , 1
 Total Asset Turnover , 8
```

แบ่งข้อมูลเพื่อ train, valid และ test model

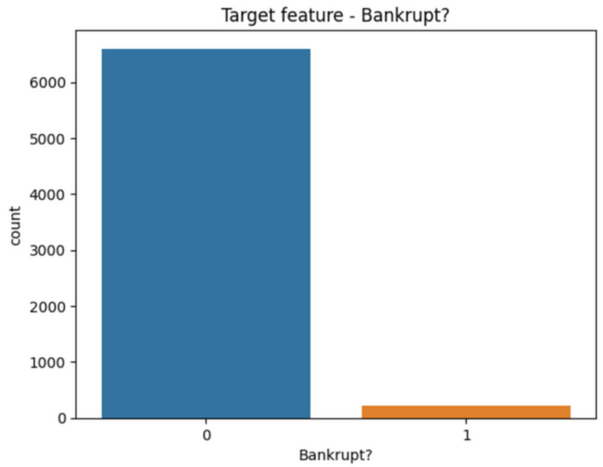
```
X_Will_SM, X_test, y_Will_SM, y_test = train_test_split(X, y, 0test_size=0.4, random_state=1)
X_test, X_valid, y_test, y_valid = train_test_split(X_test, y_test, test_size=0.5, random_state=1)
```

อัตตราส่วน 60 : 20 : 20

Class 0 and 1 balance โดยใช้ smote data

```
sns.countplot(x=data['Bankrupt?'])
plt.title('Target feature - Bankrupt?')
```

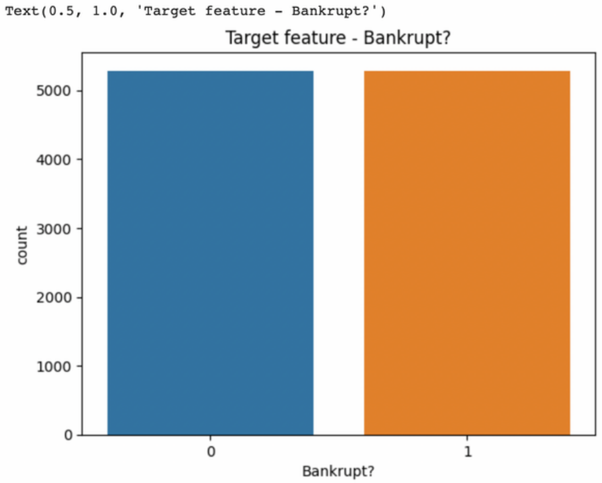
```
Text(0.5, 1.0, 'Target feature - Bankrupt?')
```



@ train data

```
sns.countplot(x=y_sm)
plt.title('Target feature - Bankrupt?')
```

```
Text(0.5, 1.0, 'Target feature - Bankrupt?')
```




```
X_sm, y_sm = sm.fit_resample(X_Will_SM, y_Will_SM)

print('balance of 1 and 0 classes:')
y_sm.value_counts()
```

```
balance of 1 and 0 classes:
0    5285
1    5285
Name: Bankrupt?, dtype: int64
```

Correlation

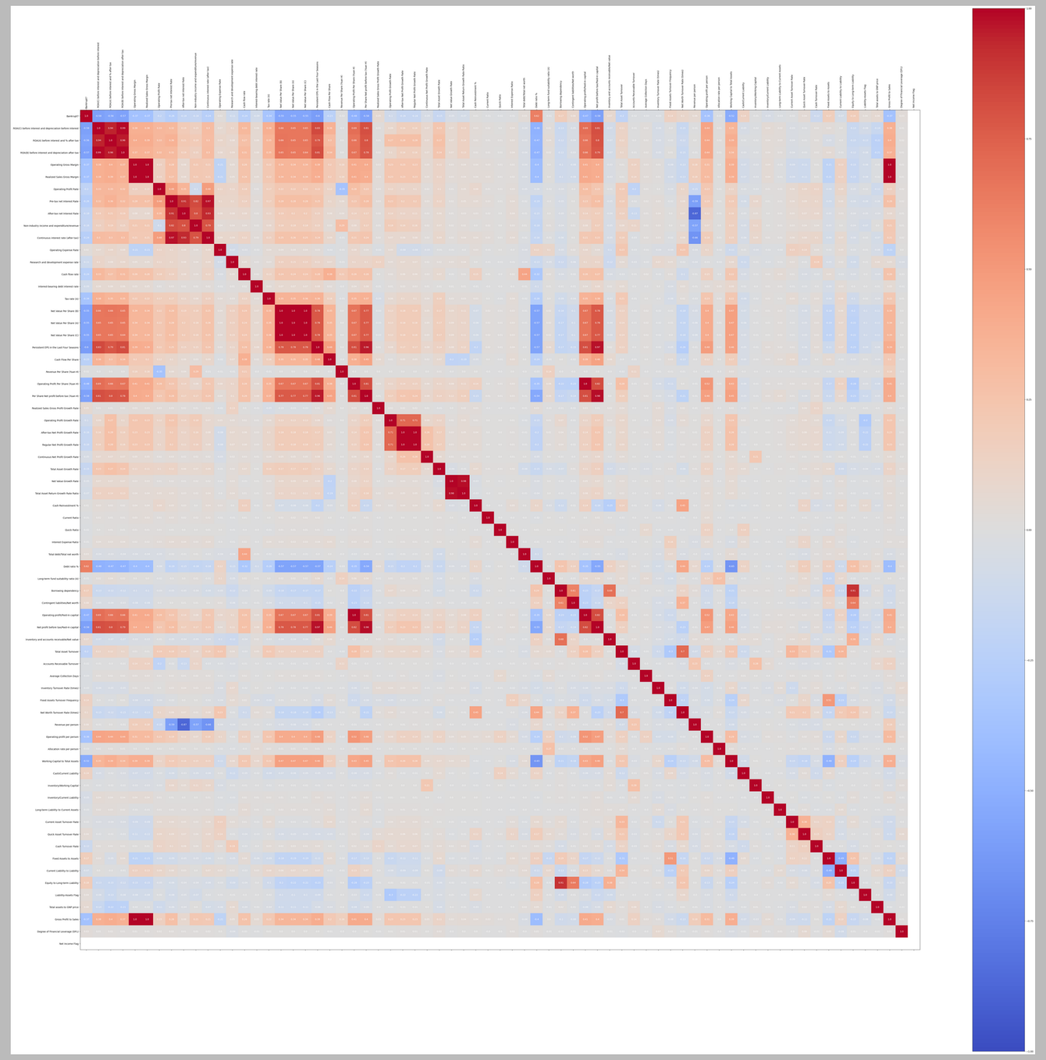
Use Correlation Coefficient to select feature

```
corr = X_sm.corr()
print(corr)
```

```
                                                 Bankrupt  \
Bankrupt                                         1.000000
 ROA(C) before interest and depreciation before... -0.585940
 ROA(A) before interest and % after tax          -0.569592
 ROA(B) before interest and depreciation after tax -0.580041
 Operating Gross Margin                          -0.332981
...                                                    ...
 Liability-Assets Flag                            0.024618
 Total assets to GNP price                        0.053761
 Gross Profit to Sales                           -0.332987
 Degree of Financial Leverage (DFL)               0.028264
 Net Income Flag                                       NaN

                                                  ROA(C) before interest and depreciation before interest  \
Bankrupt                                                                                         -0.585940
 ROA(C) before interest and depreciation before...                                                1.000000
 ROA(A) before interest and % after tax                                                           0.939364
 ROA(B) before interest and depreciation after tax                                                0.989079
 Operating Gross Margin                                                                           0.377527
...                                                                                                    ...
 Liability-Assets Flag                                                                           -0.071774
 Total assets to GNP price                                                                       -0.132407
 Gross Profit to Sales                                                                            0.377533
 Degree of Financial Leverage (DFL)                                                               0.000964
 Net Income Flag                                                                                       NaN

                                                  ROA(A) before interest and % after tax  \
```

Graph

```
crm = corr

fig, ax = plt.subplots(figsize=(80, 80))
cax = ax.matshow(crm,cmap='coolwarm', vmin=-1, vmax=1)
fig.colorbar(cax)
ticks = np.arange(0,len(data.columns),1)
ax.set_xticks(ticks)
ax.set_xticklabels(data.columns)
plt.xticks(rotation = 90)
ax.set_yticklabels(data.columns)
ax.set_yticks(ticks)

for i in range(data.shape[1]):
    for j in range(data.shape[1]):
        text = ax.text(j, i, round(crm.iloc[i][j],2),
        ha="center", va="center", color="w")
plt.show()
```



Use CSV to analyze correlation

```
[ ]  X_sm.corr().to_csv("correlation.csv")
```

top correlation

```
    - " Debt ratio %",
    - " Borrowing dependency",
    - " Equity to Long-term Liability",
    - " Fixed Assets to Assets",
```

```
[ ]  X_sm =X_sm.drop(columns=['Bankrupt'])
```

	Bankrupt
Bankrupt	1
Debt ratio %	0.62
Borrowing dependency	0.19
Equity to Long-term Liability	0.17
Fixed Assets to Assets	0.16
Fixed Assets Turnover Frequency	0.13
Inventory and accounts receivable/Net value	0.13
Cash/Current Liability	0.1
Net Worth Turnover Rate (times)	0.09
Contingent liabilities/Net worth	0.07

Feature

" Debt ratio %"
" Borrowing dependency"
" Equity to Long-term Liability"
" Fixed Assets to Assets"

Model

LogisticRegression

DecisionTreeClassifier

RandomForestClassifier

XGBootClassifier

Support Vector Classification

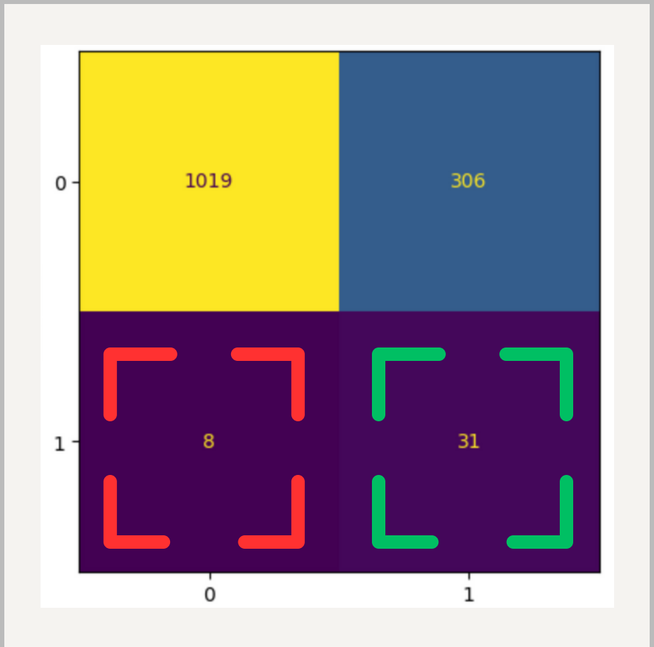
Model

Use GridSearchCV to find hyperparameter

```
param= {
    'n_estimators': [10, 20, 30],
    'max_depth': [None, 1,2,5,6,10,12,15,18,20],
    'min_samples_split': [2, 5, 7],
    'class_weight': ['balanced', None],
    'random_state' :[1]
}

rf = RandomForestClassifier()
model = GridSearchCV(estimator=rf, param_grid=param)
model.fit(X_train, y_train)

print("best parameters: ",model.best_params_)

model = model.best_estimator_
y_pred = model.predict(X_valid)

print("f1 score is %.2f" % f1_score(y_valid, y_pred))
print("Precision: %.2f" % precision_score(y_valid, y_pred))
print("Recall: %.2f" % recall_score(y_valid, y_pred))
acc = accuracy_score(y_valid, y_pred)
print("Accuracy: %.2f%%" % (accuracy * 100.0))
cm = confusion_matrix(y_valid, y_pred, labels=model.classes_)
disp = ConfusionMatrixDisplay(confusion_matrix=cm,
                              display_labels=model.classes_)
disp.plot()

plt.show()
```

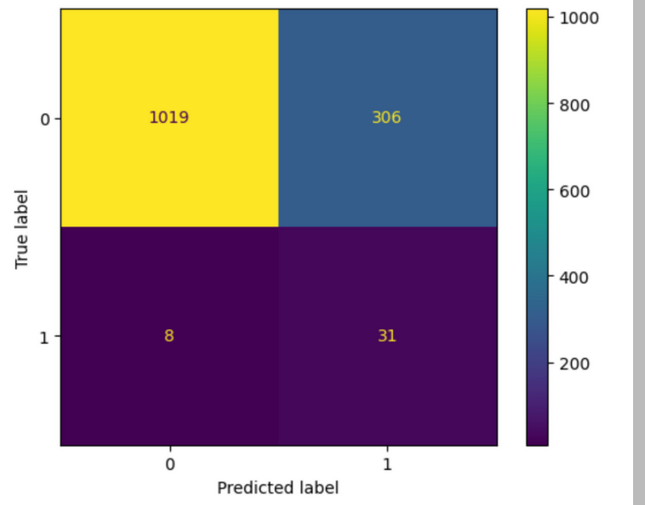
Confusion matrix

Use confusion matrix to measure performance.



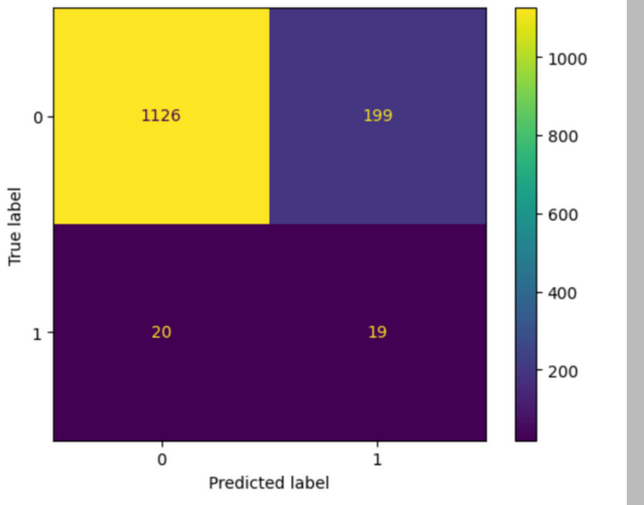
Performance matrix (Recall) and (Accuracy)
good when false positive is less important and classes are aproximately balance

f1 score is 0.16
Precision: 0.09
Recall: 0.79
Accuracy: 76.98%



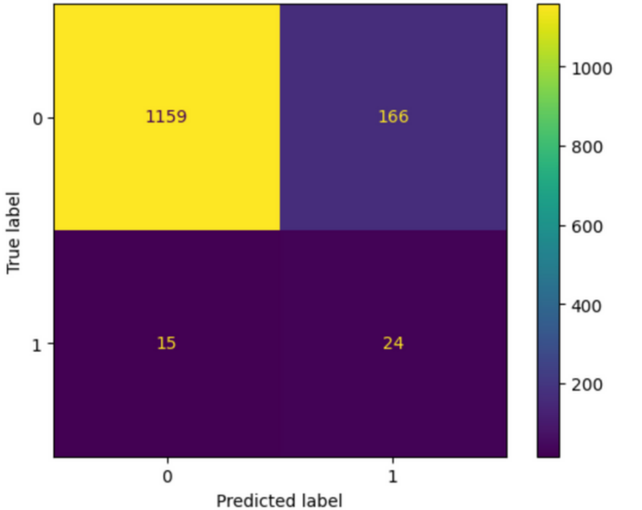
LogisticRegression

f1 score is 0.15
Precision: 0.09
Recall: 0.49
Accuracy: 83.94%



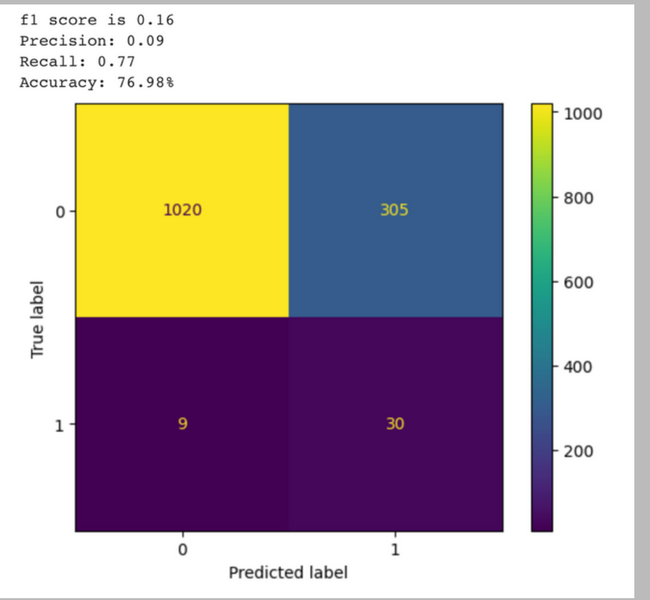
DecisionTreeClassifier

f1 score is 0.21
Precision: 0.13
Recall: 0.62
Accuracy: 86.73%



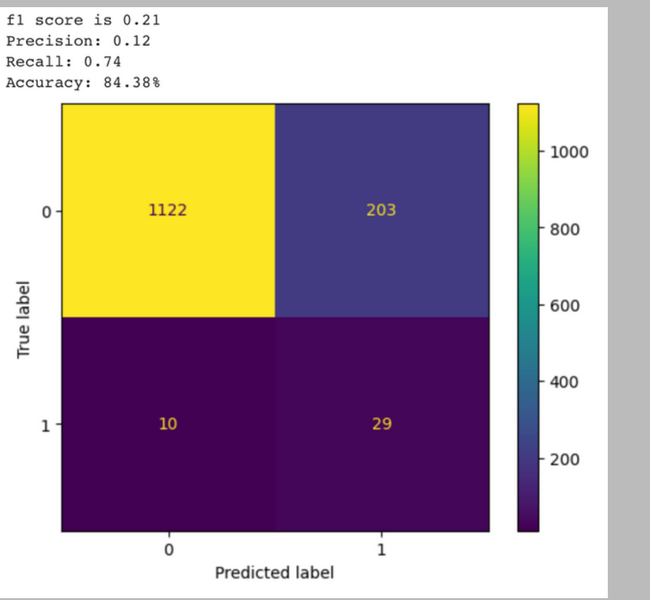
RandomForestClassifier

f1 score is 0.16
Precision: 0.09
Recall: 0.77
Accuracy: 76.98%



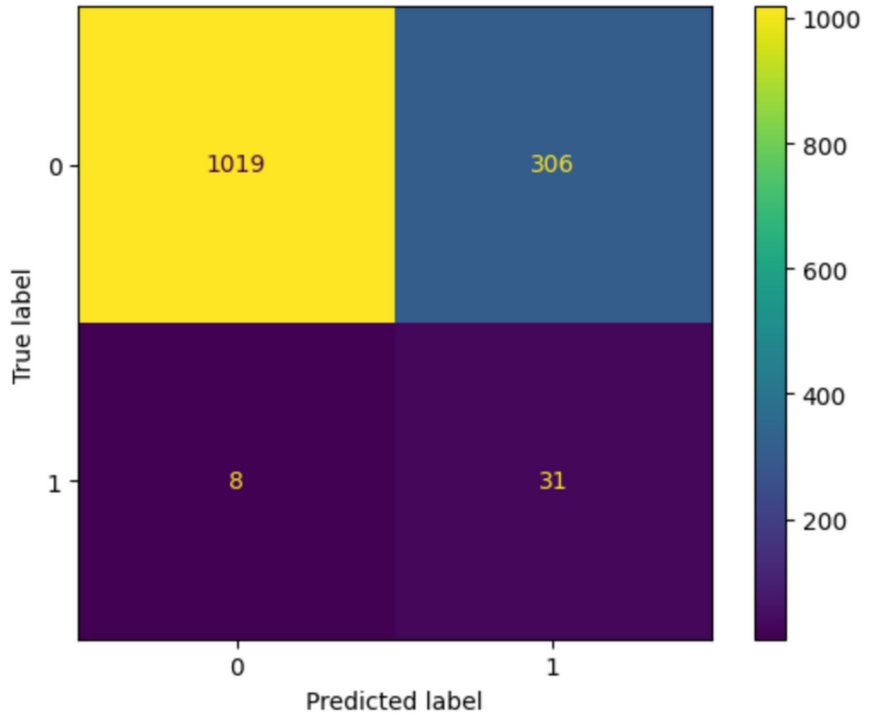
XGBootClassifier

f1 score is 0.21
Precision: 0.12
Recall: 0.74
Accuracy: 84.38%



Support Vector Classification

Recall: 0.79
Accuracy: 76.98%



LogisticRegression

Thank You