Metrics comparing DecisionTreeClassifier resampling and other models

| *Configuration* | *Precision* | | *Recall* | | *Accuracy* | *F1 Score* | *ROC-AUD* | *CGC* |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *Resampling* | 0 | 1 | 0 | 1 |  |  |  |  |
| Baseline (for sklearn DecisionTreeClassifier) | 1.00 | 0.05 | 0.99 | 0.06 | 0.99 | 0.05 | 0.52 | ✔ |
| Baseline (tuned) | 0.99 | 0.22 | 1.00 | 0.02 | 0.99 | 0.044 | 0.81 | ✔ |
| Undersampling (org) | 1.00 | 0.02 | 0.74 | 0.75 | 0.74 | 0.03 | 0.74 |  |
| Undersampling (tuned) | 1.00 | 0.02 | 0.75 | 0.80 | 0.75 | 0.03 | 0.82 | ✔ |
| SMOTE | 1.00 | 0.06 | 0.99 | 0.14 | 0.98 | 0.08 | 0.56 | ✔ |
| SMOTEEN | 1.00 | 0.06 | 0.98 | 0.19 | 0.98 | 0.09 | 0.59 | ✔ |
| Tomek (from 10Tech) | 1.00 | 0.05 | .99 | .06 | 0.99 | 0.05 | 0.52 |  |
| NearMiss (from 10Tech | 0.99 | .01 | 0.02 | 0.94 | 0.03 | 0.01 | 0.48 |  |
| *Different models* |  |  |  |  |  |  |  |  |
| BalancedBaggingClassifier | 1.00 | 0.03 | 0.88 | 0.74 | 0.88 | 0.06 | 0.90 | ✔ |
| RandomForestClassifier with Class Weights (‘balanced’) | 0.99 | 0.60 | 1.00 | 0.01 | 0.99 | 0.01 | 0.81 | ✔ |
| XGBoost (see below) | 1.00 | 0.04 | 0.93 | 0.58 | 0.93 | 0.08 | 0.88 | ✔ |

Notes: CGC = Cumulative Gains Chart available

Original model: DecisionTreeClassifier(random\_state=42)  
 Tuned model: DecisionTreeClassifier(random\_state=42, max\_depth=10, min\_samples\_split=10, min\_samples\_leaf=5)

[XGBoost](https://chatgpt.com/c/558b9bd6-6a0d-4d85-b783-f0072f70dbcc) (3.4 sec.) [Analytics Vidhya paper](https://www.analyticsvidhya.com/blog/2018/09/an-end-to-end-guide-to-understand-the-math-behind-xgboost/#:~:text=XGBoost%2C%20or%20eXtreme%20Gradient%20Boosting,trees%2C%20in%20an%20iterative%20manner.) [XGBoost documentation](https://xgboost.readthedocs.io/en/stable/)

XGBoost results:

precision recall f1-score support

0 1.00 0.93 0.96 75077

1 0.04 0.58 0.08 397

accuracy 0.93 75474

macro avg 0.52 0.76 0.52 75474

weighted avg 0.99 0.93 0.96 75474

F1 Score: 0.08

ROC-AUC Score: 0.88

[10 Techniques to Solve Imbalanced Classes](https://www.analyticsvidhya.com/blog/2020/07/10-techniques-to-deal-with-class-imbalance-in-machine-learning/)

NearMiss (2.8 sec.): under-samples major class to 3172 observations, 50/50 0/1

Tomek (from 10Tech) (88 sec.): Does minimal resampling, so not good for this dataset.

RandomForestClassifier results: (49.9 seconds)

precision recall f1-score support

0 0.99 1.00 1.00 75077

1 0.60 0.01 0.01 397

accuracy 0.99 75474

macro avg 0.80 0.50 0.51 75474

weighted avg 0.99 0.99 0.99 75474

F1 Score: 0.01

ROC-AUC Score: 0.81

BalancedBaggingClassifier results: (5.4 seconds)

precision recall f1-score support

0 1.00 0.88 0.94 75077

1 0.03 0.74 0.06 397

accuracy 0.88 75474

macro avg 0.52 0.81 0.50 75474

weighted avg 0.99 0.88 0.93 75474

F1 Score: 0.06

ROC-AUC Score: 0.90

SMOTEENN results: (339.4 seconds)

precision recall f1-score support

0 1.00 0.98 0.99 75077

1 0.06 0.19 0.09 397

accuracy 0.98 75474

macro avg 0.53 0.59 0.54 75474

weighted avg 0.99 0.98 0.98 75474

F1 Score: 0.09

ROC-AUC Score: 0.59

SMOTE results: (17.1 seconds)

precision recall f1-score support

0 1.00 0.99 0.99 75077

1 0.06 0.14 0.08 397

accuracy 0.98 75474

macro avg 0.53 0.56 0.54 75474

weighted avg 0.99 0.98 0.99 75474

F1 Score: 0.08

ROC-AUC Score: 0.56

Undersampling results: (1.9 seconds)

y\_test (dependent variable) value counts

0 300309

1 1586

Name: flag\_request\_closure, dtype: int64

X\_train shape : (301895, 34) y\_train shape: (301895,)

X\_res shape : (3172, 34) y\_res shape: (3172,)

Note: y\_res (y\_train resampled) 0 and 1 count = 1586

Undersampling results:

precision recall f1-score support

0 1.00 0.74 0.85 75077

1 0.02 0.75 0.03 397

accuracy 0.74 75474

macro avg 0.51 0.74 0.44 75474

weighted avg 0.99 0.74 0.85 75474

F1 Score: 0.03

ROC-AUC Score: 0.74

Baseline results: (~9 sec.)

y\_test (dependent variable) value counts

0 75077

1 397

Name: flag\_request\_closure, dtype: int64

Test accuracy: 98.9%

Confusion table

Truth 0 1

Predicted

0 74643 375

1 434 22

Classification\_report

precision recall f1-score support

0 1.00 0.99 0.99 75077

1 0.05 0.06 0.05 397

accuracy 0.99 75474

macro avg 0.52 0.52 0.52 75474

weighted avg 0.99 0.99 0.99 75474

F1 Score: 0.05

ROC-AUC Score: 0.52

Precision: [0.00526009 0.04824561 1. ]

Recall: [1. 0.05541562 0. ]