

# Incognia Case

Douglas Winston

[https://github.com/douglaswinstonr/case\\_incognia](https://github.com/douglaswinstonr/case_incognia)

# Methodology

1. Problem
2. Literature
3. Data
4. Exploration
5. Data Product
6. Naive Solution
7. Data-driven Approach
8. Next Steps

Problem

# Chargeback Fraud Detection

## Definition

**Chargeback fraud** occurs when consumers fraudulently attempt to **secure a refund** using the chargeback process. Instead of contacting the merchant directly for a refund, consumers dispute the transaction with their bank, thus initiating the chargeback process. Consumers will falsely complain that the product they ordered was delivered defective or not at all, that they did not authorize the transaction, or that they had requested the cancellation of a recurring transaction and were charged anyway. Whatever reason they give, chargeback fraud is when the real reason is something else entirely (<https://www.cardinalcommerce.com/fraud/chargebacks/what-is-chargeback-fraud>)

## Example

A consumer uses the iFood's app for a delivery in a different location than where he/she lives at the moment. Lets say for an example that this consumer order 2 sushi combos (\$200) to be delivered to a friends house. However, a little after the delivery is concluded with success the same consumer ask its cardholder for a refund claiming that someone took over its account and ordered in his place. Depending on the consumers's cardholder, the \$200 will be refunded, eventhough it was a chargeback fraud. It would be really important for the iFood's app to know the consumer's location during its daily journey to be able to detect such chargeback frauds.

If such data was available at the time of the order and the same consumer have already been many times in the order locations then a detector (model or specialist) would be able to label dispute such chargeback fraud.

Literature

## Rare Event Detection (Temporal)

### Types:

- **full length supervised time series classification:** detect if a rare event occurred in a fixed period of time.
- **early supervised time-series classification:** detect if a rare event will occur in the next period of time to be able to fixed or countermeasure.
- **unbalanced non-temporal classification:** in some rare event detection applications, instances are transformed without considering the time dimension (similar to anomaly detection).

**Objective:** classify the rare class

**Metric:** AUC, Recall of the rare class

### Techniques:

- Rare event logistic regression
- Kullback-Leibler divergence
- LSTMs
- SVMs

## Anomaly Detection (Non-Temporal)

**Types:** highly unbalanced supervised classification

**Objective:** classify the anomaly classes

**Metric:** AUC, recall of the rare class

**Classification Techniques:** popular supervised classifiers

Data

## Payments

| coluna                         | tipo   | descrição  |
|--------------------------------|--------|--|
| id                             | string | identificador da transação   |
| account_id                     | string | identificador da conta   |
| device_id                      | string | identificador do dispositivo   |
| installation_id                | string | identificador da instalação  |
| timestamp                      | long   | timestamp (unixtime - em ms)   |
| device_age_ms                  | long   | idade do dispositivo (em ms)   |
| n_accounts_by_device_30d       | int    | número de contas acessadas pelo dispositivo nos últimos 30 dias                                |
| sum_values_by_device_30d       | float  | soma dos valores das transações realizadas pelo dispositivo nos últimos 30 dias                |
| sum_values_by_device_3d        | float  | soma dos valores das transações realizadas pelo dispositivo nos últimos 3 dias                 |
| sum_values_by_installation_30d | float  | soma dos valores das transações realizadas pela instalação nos últimos 30 dias                 |
| sum_values_by_installation_3d  | float  | soma dos valores das transações realizadas pela instalação nos últimos 3 dias                  |
| low_geo_chargeback_rate_30d    | float  | taxa de chargeback rate da região geográfica associada à transação (precisão geográfica baixa) |
| medium_geo_chargeback_rate_30d | float  | taxa de chargeback rate da região geográfica associada à transação (precisão geográfica média) |
| high_geo_chargeback_rate_30d   | float  | taxa de chargeback rate da região geográfica associada à transação (precisão geográfica alta)  |
| value                          | float  | valor da transação   |
| chargedback                    | float  | se a transação ocasionou um chargeback   |





Streamlit

# Exploration

# Data Exploration

## Resume

Observation's Begin

2021-04-30 21:01:20

~5 months

Observation's End

2021-09-21 02:50:43

Table Size

648173

Number of Payments

648173

Payments per Accounts

5.62

Accounts per Devices

1.37

Installation per Device

1.42

Max Payments by Account

572

Max Account by Device

31281

Max Installation by Device

31976

Number of Chargedbacks

3249

Chargedback Rate

0.501

Outlier ?

Highly unbalanced

# Temporal Dimesion

Hour

Choose an option

Day of The Week

Choose an option

Week of The Month

Choose an option

Month

Choose an option

Date

2021-04-30

2021-09-21

2021-04-30

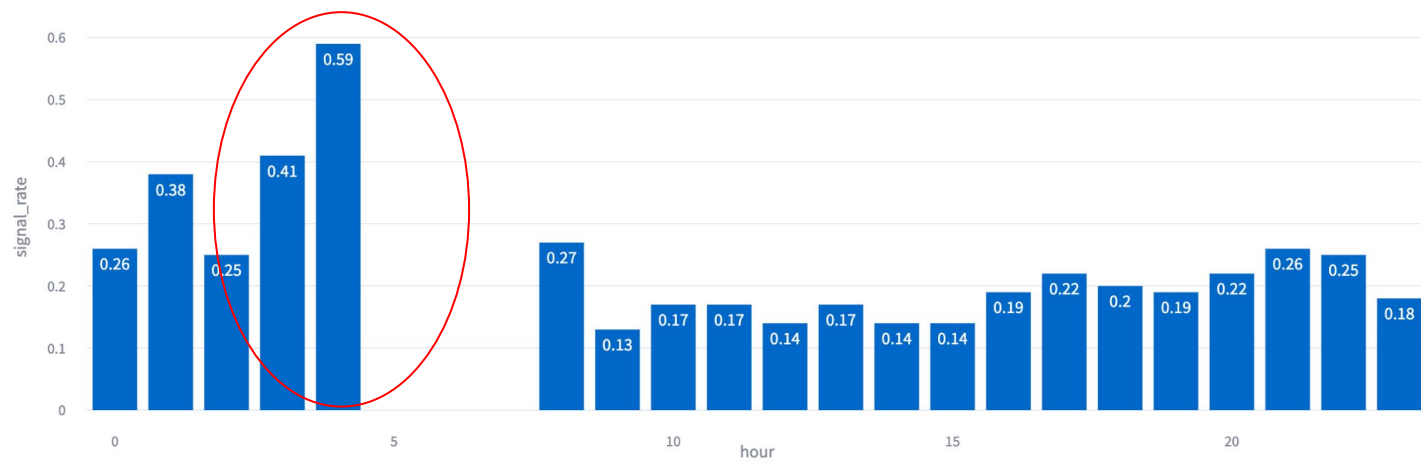
2021-09-21

Temporal Dimesion

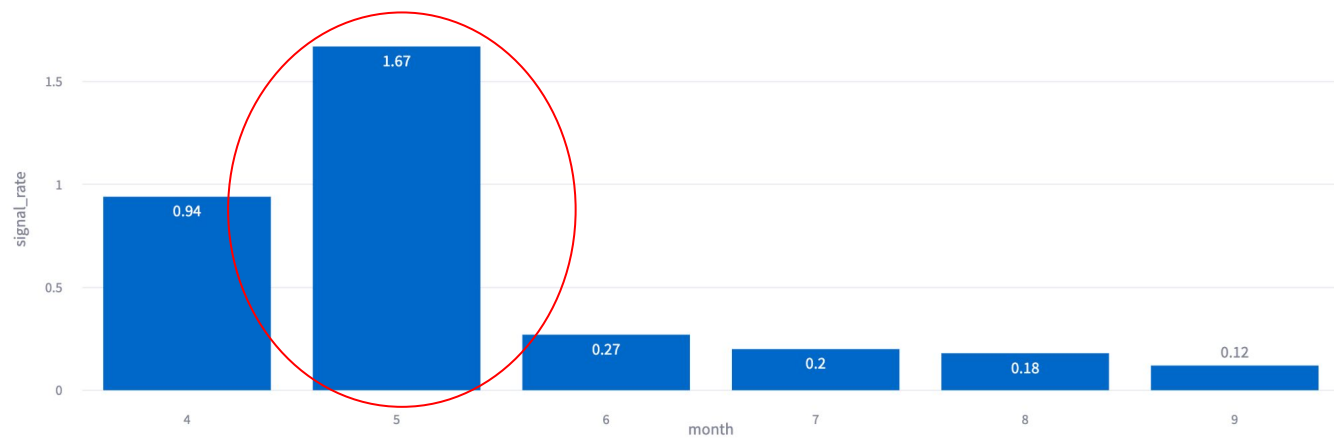
## Date



## Hour



## Month



# Non-Temporal Dimesion

Min Payments by Account

0 - +

Min Accounts by Device

0 - +

Min Installations by Device

0 - +

Min Transaction Value

0 - +

Max Payments by Account

572 - +

Max Accounts by Device

31281 - +

Max Installations by Device

31976 - +

Max Transaction Value

429831.08 - +

Payments by Account

Choose an option ▾

Accounts by Device

Choose an option ▾

Installations by Device

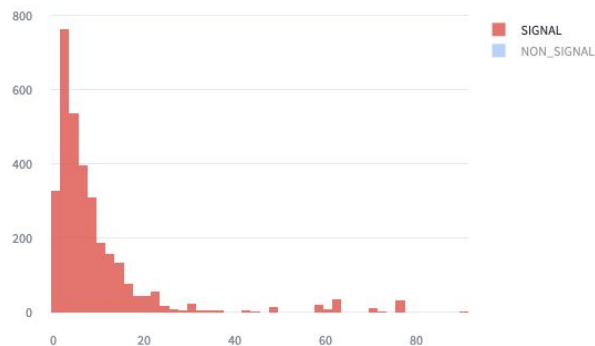
Choose an option ▾

Transaction Value

Choose an option ▾

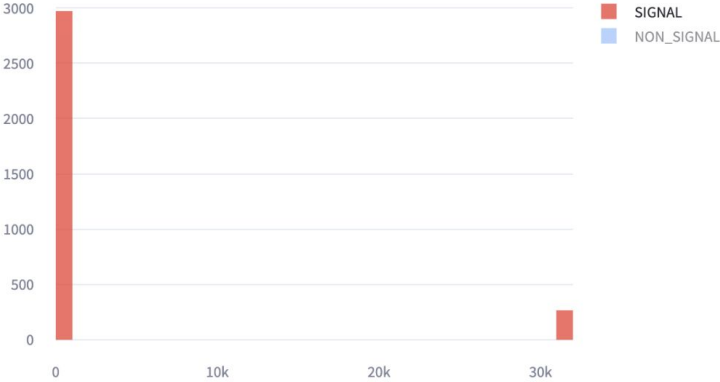
Non-Temporal Dimesion

## Transaction By Account



|             | NON_SIGNAL | SIGNAL | signal_rate |
|-------------|------------|--------|-------------|
| 00-0_1      | 52747      | 327    | 0.6200      |
| 01-1_2      | 35006      | 426    | 1.2200      |
| 02-2_4      | 51847      | 646    | 1.2500      |
| 03-4_8      | 70896      | 766    | 1.0800      |
| 04-8_16     | 98787      | 699    | 0.7100      |
| 05-16_32    | 126605     | 239    | 0.1900      |
| 06-32_64    | 120606     | 97     | 0.0800      |
| 07-64_128   | 62262      | 49     | 0.0800      |
| 08-128-256  | 19969      | 0      | 0.0000      |
| 09-256-512  | 5627       | 0      | 0.0000      |
| 10-512-1024 | 572        | 0      | 0.0000      |
| 11-1024-Inf | 0          | 0      | 0.0000      |

# Accounts By Device



|             | NON_SIGNAL | SIGNAL | signal_rate |
|-------------|------------|--------|-------------|
| 00-0_1      | 446138     | 1509   | 0.3400      |
| 01-1_2      | 29892      | 451    | 1.5100      |
| 02-2_4      | 13360      | 336    | 2.5100      |
| 03-4_8      | 4082       | 338    | 8.2800      |
| 04-8_16     | 2092       | 99     | 4.7300      |
| 05-16_32    | 768        | 76     | 9.9000      |
| 06-32_64    | 396        | 169    | 42.6800     |
| 07-64_128   | 0          | 0      | 0.0000      |
| 08-128-256  | 0          | 0      | 0.0000      |
| 09-256-512  | 0          | 0      | 0.0000      |
| 10-512-1024 | 0          | 0      | 0.0000      |
| 11-1024-Inf | 148196     | 271    | 0.1800      |

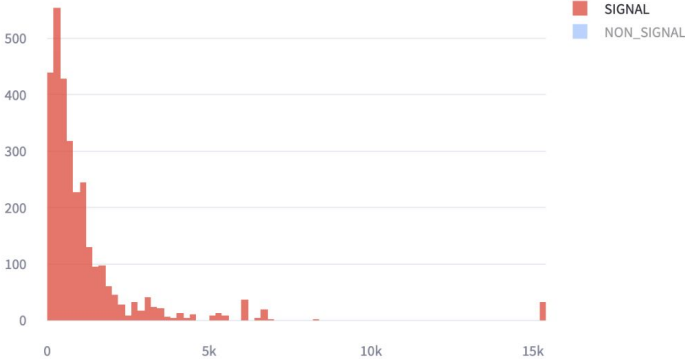
# Installation By Device



|             | NON_SIGNAL | SIGNAL | signal_rate |
|-------------|------------|--------|-------------|
| 00-0_1      | 439238     | 1643   | 0.3700      |
| 01-1_2      | 40158      | 502    | 1.2500      |
| 02-2_4      | 11500      | 279    | 2.4300      |
| 03-4_8      | 3601       | 292    | 8.1100      |
| 04-8_16     | 1255       | 98     | 7.8100      |
| 05-16_32    | 938        | 133    | 14.1800     |
| 06-32_64    | 38         | 31     | 81.5800     |
| 07-64_128   | 0          | 0      | 0.0000      |
| 08-128-256  | 0          | 0      | 0.0000      |
| 09-256-512  | 0          | 0      | 0.0000      |
| 10-512-1024 | 0          | 0      | 0.0000      |
| 11-1024-Inf | 0          | 0      | 0.0000      |



# Value By Account



|                 | NON_SIGNAL | SIGNAL | signal_rate |
|-----------------|------------|--------|-------------|
| 00-0_50         | 24283      | 43     | 0.1800      |
| 01-50_100       | 22698      | 107    | 0.4700      |
| 02-100_250      | 42487      | 431    | 1.0100      |
| 03-250_500      | 43030      | 634    | 1.4700      |
| 04-500_1000     | 56330      | 756    | 1.3400      |
| 05-1000_2500    | 97674      | 707    | 0.7200      |
| 06-2500_5000    | 99859      | 176    | 0.1800      |
| 07-5000_10000   | 72969      | 91     | 0.1200      |
| 08-10000-25000  | 29931      | 33     | 0.1100      |
| 09-25000-50000  | 5534       | 0      | 0.0000      |
| 10-50000-100000 | 1695       | 0      | 0.0000      |
| 11-100000-Inf   | 160        | 0      | 0.0000      |

# Data Product

Demo

# Naive Approach

Supervised Classification

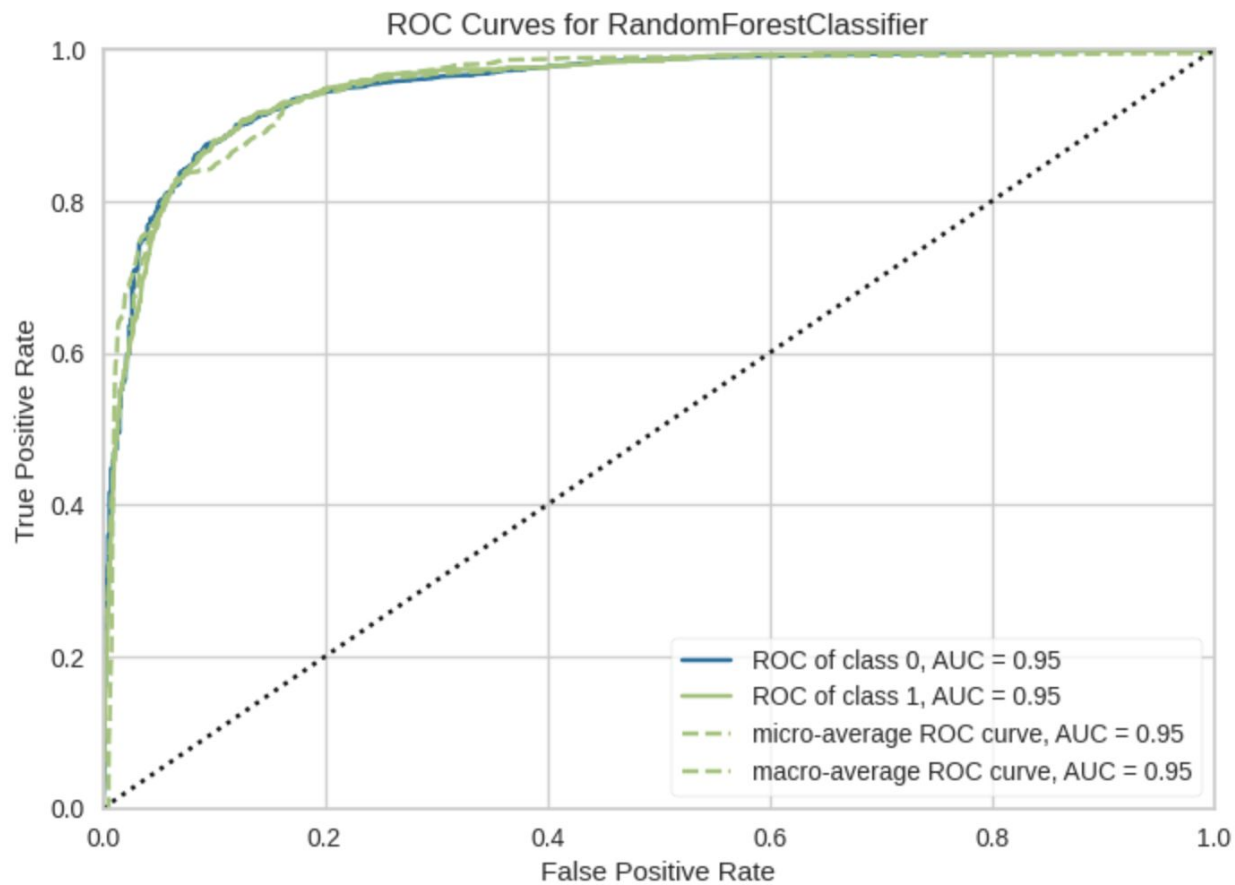
|          | Model                           | Accuracy | AUC    | Recall | Prec.  | F1     | Kappa  | MCC    | TT (Sec) |
|----------|---------------------------------|----------|--------|--------|--------|--------|--------|--------|----------|
| qda      | Quadratic Discriminant Analysis | 0.9698   | 0.8976 | 0.5035 | 0.0852 | 0.1457 | 0.1381 | 0.1982 | 0.3000   |
| lda      | Linear Discriminant Analysis    | 0.9868   | 0.9216 | 0.3923 | 0.1659 | 0.2332 | 0.2276 | 0.2494 | 0.5290   |
| dt       | Decision Tree Classifier        | 0.9920   | 0.6260 | 0.2563 | 0.2363 | 0.2457 | 0.2417 | 0.2420 | 2.7500   |
| et       | Extra Trees Classifier          | 0.9949   | 0.8783 | 0.2142 | 0.5111 | 0.3017 | 0.2996 | 0.3287 | 3.2990   |
| rf       | Random Forest Classifier        | 0.9951   | 0.9100 | 0.1408 | 0.5686 | 0.2253 | 0.2237 | 0.2809 | 6.1780   |
| xgboost  | Extreme Gradient Boosting       | 0.9950   | 0.9532 | 0.1004 | 0.5427 | 0.1688 | 0.1674 | 0.2311 | 0.7860   |
| lightgbm | Light Gradient Boosting Machine | 0.9932   | 0.9375 | 0.0848 | 0.1703 | 0.1126 | 0.1096 | 0.1166 | 18.6980  |
| ada      | Ada Boost Classifier            | 0.9944   | 0.9446 | 0.0631 | 0.2811 | 0.1026 | 0.1008 | 0.1306 | 12.4760  |
| catboost | CatBoost Classifier             | 0.9950   | 0.9519 | 0.0534 | 0.5729 | 0.0975 | 0.0967 | 0.1732 | 4.0950   |
| gbc      | Gradient Boosting Classifier    | 0.9948   | 0.9418 | 0.0275 | 0.4313 | 0.0513 | 0.0507 | 0.1056 | 58.6310  |
| svm      | SVM - Linear Kernel             | 0.9899   | 0.0000 | 0.0173 | 0.0175 | 0.0174 | 0.0123 | 0.0123 | 5.7750   |
| knn      | K Neighbors Classifier          | 0.9948   | 0.5450 | 0.0016 | 0.1333 | 0.0032 | 0.0031 | 0.0141 | 1.5990   |
| lr       | Logistic Regression             | 0.9949   | 0.8580 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.5740   |
| nb       | Naive Bayes                     | 0.9949   | 0.8584 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.1500   |
| ridge    | Ridge Classifier                | 0.9949   | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.1610   |
| dummy    | Dummy Classifier                | 0.9949   | 0.5000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.1300   |

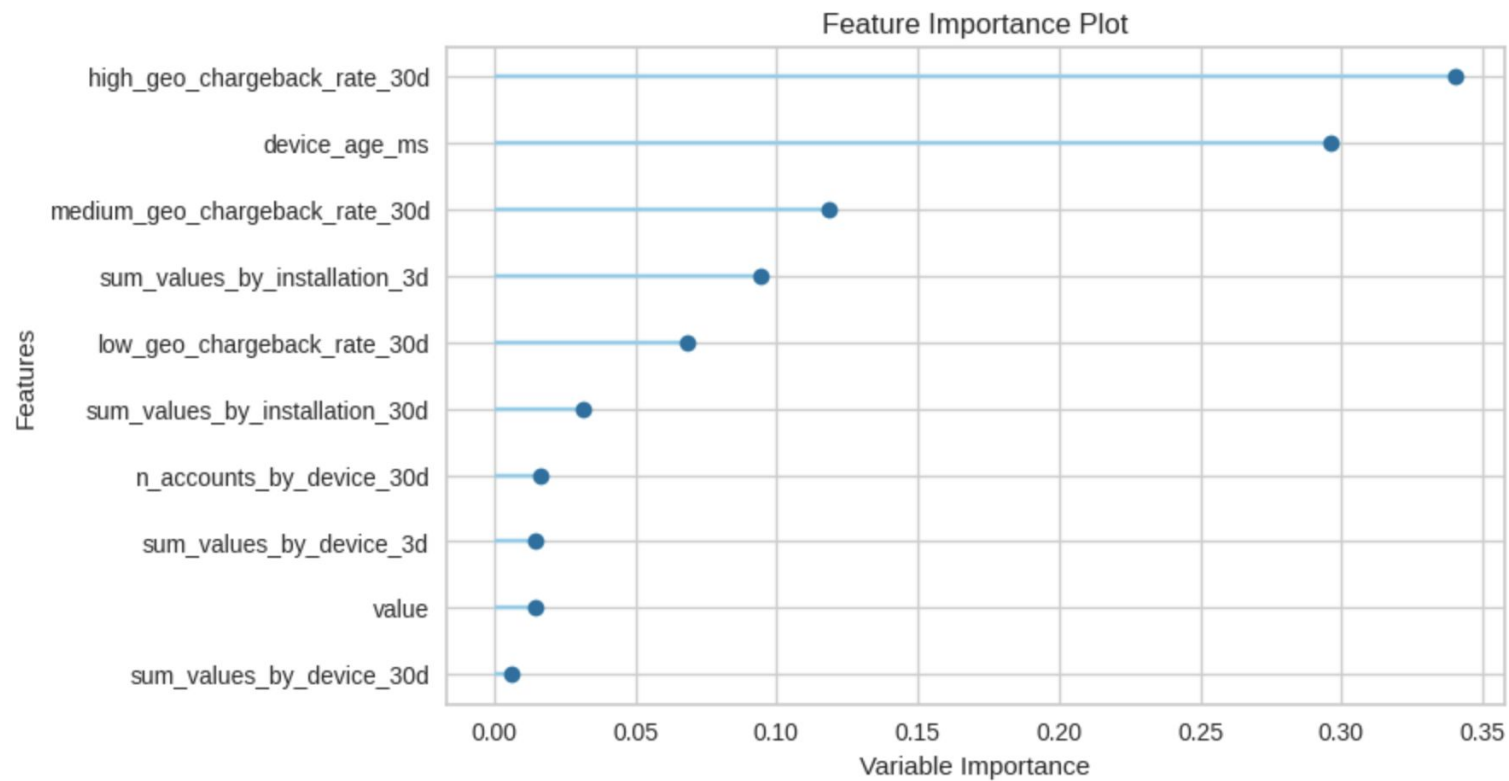
## Random Forest (Naive)

|      | Accuracy | AUC    | Recall | Prec.  | F1     | Kappa  | MCC    |
|------|----------|--------|--------|--------|--------|--------|--------|
| Fold |          |        |        |        |        |        |        |
| 0    | 0.9953   | 0.9164 | 0.1676 | 0.6739 | 0.2684 | 0.2669 | 0.3346 |
| 1    | 0.9947   | 0.8979 | 0.1027 | 0.4130 | 0.1645 | 0.1628 | 0.2041 |
| 2    | 0.9948   | 0.8966 | 0.0973 | 0.4615 | 0.1607 | 0.1592 | 0.2102 |
| 3    | 0.9950   | 0.8976 | 0.1075 | 0.5556 | 0.1802 | 0.1788 | 0.2429 |
| 4    | 0.9951   | 0.9263 | 0.1667 | 0.5849 | 0.2594 | 0.2577 | 0.3105 |
| 5    | 0.9952   | 0.8877 | 0.1667 | 0.5962 | 0.2605 | 0.2588 | 0.3135 |
| 6    | 0.9951   | 0.9262 | 0.1297 | 0.5854 | 0.2124 | 0.2109 | 0.2740 |
| 7    | 0.9953   | 0.9188 | 0.1568 | 0.6444 | 0.2522 | 0.2507 | 0.3163 |
| 8    | 0.9952   | 0.9243 | 0.1622 | 0.5882 | 0.2542 | 0.2526 | 0.3072 |
| 9    | 0.9951   | 0.9082 | 0.1514 | 0.5833 | 0.2403 | 0.2387 | 0.2955 |
| Mean | 0.9951   | 0.9100 | 0.1408 | 0.5686 | 0.2253 | 0.2237 | 0.2809 |
| Std  | 0.0002   | 0.0135 | 0.0273 | 0.0739 | 0.0401 | 0.0401 | 0.0440 |

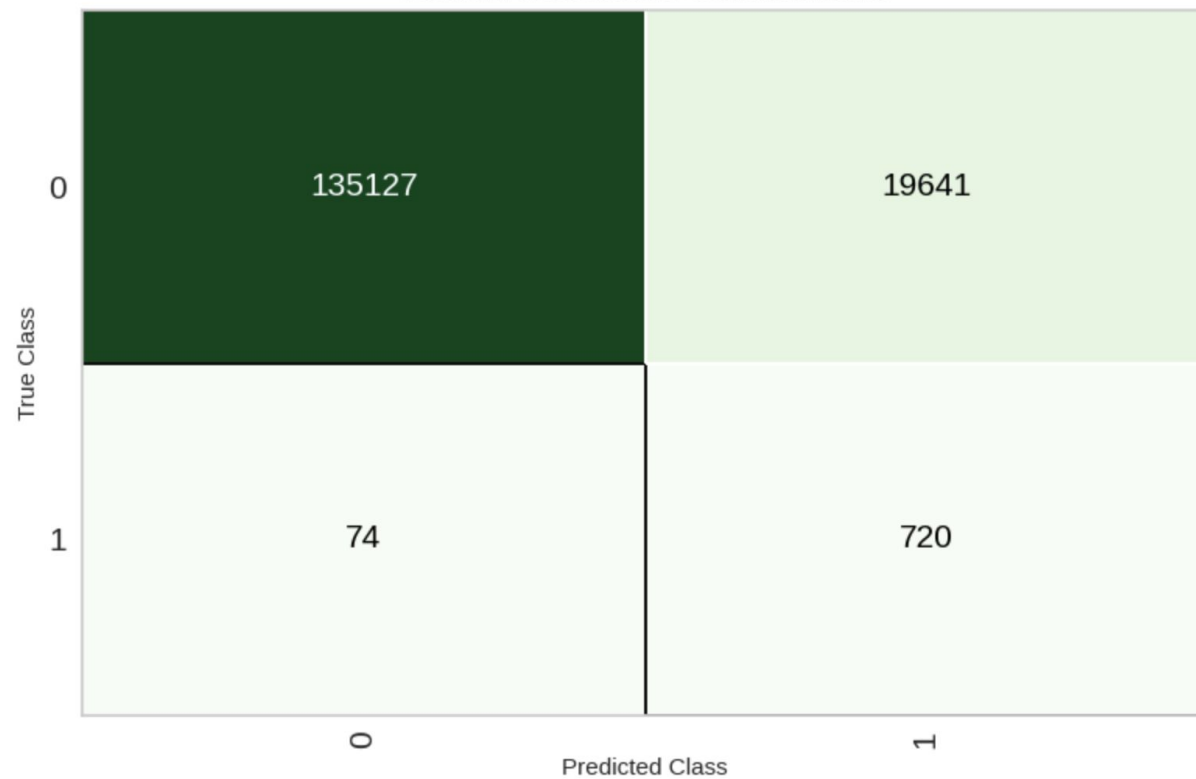
## Random Forest (Tuned for Recall)

|      | Accuracy | AUC    | Recall | Prec.  | F1     | Kappa  | MCC    |
|------|----------|--------|--------|--------|--------|--------|--------|
| Fold |          |        |        |        |        |        |        |
| 0    | 0.8705   | 0.9501 | 0.8865 | 0.0339 | 0.0652 | 0.0560 | 0.1585 |
| 1    | 0.8728   | 0.9393 | 0.8865 | 0.0345 | 0.0663 | 0.0571 | 0.1602 |
| 2    | 0.8769   | 0.9436 | 0.8757 | 0.0351 | 0.0676 | 0.0584 | 0.1609 |
| 3    | 0.8768   | 0.9516 | 0.8925 | 0.0359 | 0.0691 | 0.0598 | 0.1648 |
| 4    | 0.8739   | 0.9376 | 0.8656 | 0.0342 | 0.0657 | 0.0564 | 0.1571 |
| 5    | 0.8732   | 0.9463 | 0.8978 | 0.0351 | 0.0676 | 0.0584 | 0.1632 |
| 6    | 0.8777   | 0.9292 | 0.8541 | 0.0346 | 0.0665 | 0.0572 | 0.1571 |
| 7    | 0.8708   | 0.9411 | 0.8865 | 0.0339 | 0.0654 | 0.0561 | 0.1587 |
| 8    | 0.8784   | 0.9552 | 0.8865 | 0.0360 | 0.0692 | 0.0600 | 0.1644 |
| 9    | 0.8698   | 0.9538 | 0.8973 | 0.0341 | 0.0657 | 0.0564 | 0.1602 |
| Mean | 0.8741   | 0.9448 | 0.8829 | 0.0347 | 0.0668 | 0.0576 | 0.1605 |
| Std  | 0.0030   | 0.0078 | 0.0133 | 0.0008 | 0.0014 | 0.0014 | 0.0027 |





RandomForestClassifier Confusion Matrix





# Data-Driven Approach

Supervised Classification + More Features

## Device

sum\_obs\_values\_by\_device\_30d  
n\_obs\_transaction\_by\_device\_30d  
n\_obs\_installation\_by\_device\_30d  
n\_obs\_accounts\_by\_device\_30d  
sum\_obs\_values\_by\_device\_15d  
n\_obs\_transaction\_by\_device\_15d  
n\_obs\_installation\_by\_device\_15d  
n\_obs\_accounts\_by\_device\_15d  
sum\_obs\_values\_by\_device\_7d  
n\_obs\_transaction\_by\_device\_7d  
n\_obs\_installation\_by\_device\_7d  
n\_obs\_accounts\_by\_device\_7d

## Installation

sum\_obs\_values\_by\_installation\_30d  
n\_obs\_transaction\_by\_installation\_30d  
sum\_obs\_values\_by\_installation\_15d  
n\_obs\_transaction\_by\_installation\_15d  
sum\_obs\_values\_by\_installation\_7d  
n\_obs\_transaction\_by\_installation\_7d

## Account

sum\_obs\_values\_by\_account\_30d  
n\_obs\_transaction\_by\_account\_30d  
n\_obs\_devices\_by\_account\_30d  
n\_obs\_installation\_by\_account\_30d  
sum\_obs\_values\_by\_account\_15d  
n\_obs\_transaction\_by\_account\_15d  
n\_obs\_devices\_by\_account\_15d  
n\_obs\_installation\_by\_account\_15d  
sum\_obs\_values\_by\_account\_7d  
n\_obs\_transaction\_by\_account\_7d  
n\_obs\_devices\_by\_account\_7d  
n\_obs\_installation\_by\_account\_7d

### Random Forest (Tuned for Recall)

|      | Accuracy | AUC    | Recall | Prec.  | F1     | Kappa  | MCC    |
|------|----------|--------|--------|--------|--------|--------|--------|
| Fold |          |        |        |        |        |        |        |
| 0    | 0.8705   | 0.9501 | 0.8865 | 0.0339 | 0.0652 | 0.0560 | 0.1585 |
| 1    | 0.8728   | 0.9393 | 0.8865 | 0.0345 | 0.0663 | 0.0571 | 0.1602 |
| 2    | 0.8769   | 0.9436 | 0.8757 | 0.0351 | 0.0676 | 0.0584 | 0.1609 |
| 3    | 0.8768   | 0.9516 | 0.8925 | 0.0359 | 0.0691 | 0.0598 | 0.1648 |
| 4    | 0.8739   | 0.9376 | 0.8656 | 0.0342 | 0.0657 | 0.0564 | 0.1571 |
| 5    | 0.8732   | 0.9463 | 0.8978 | 0.0351 | 0.0676 | 0.0584 | 0.1632 |
| 6    | 0.8777   | 0.9292 | 0.8541 | 0.0346 | 0.0665 | 0.0572 | 0.1571 |
| 7    | 0.8708   | 0.9411 | 0.8865 | 0.0339 | 0.0654 | 0.0561 | 0.1587 |
| 8    | 0.8784   | 0.9552 | 0.8865 | 0.0360 | 0.0692 | 0.0600 | 0.1644 |
| 9    | 0.8698   | 0.9538 | 0.8973 | 0.0341 | 0.0657 | 0.0564 | 0.1602 |
| Mean | 0.8741   | 0.9448 | 0.8829 | 0.0347 | 0.0668 | 0.0576 | 0.1605 |
| Std  | 0.0030   | 0.0078 | 0.0133 | 0.0008 | 0.0014 | 0.0014 | 0.0027 |

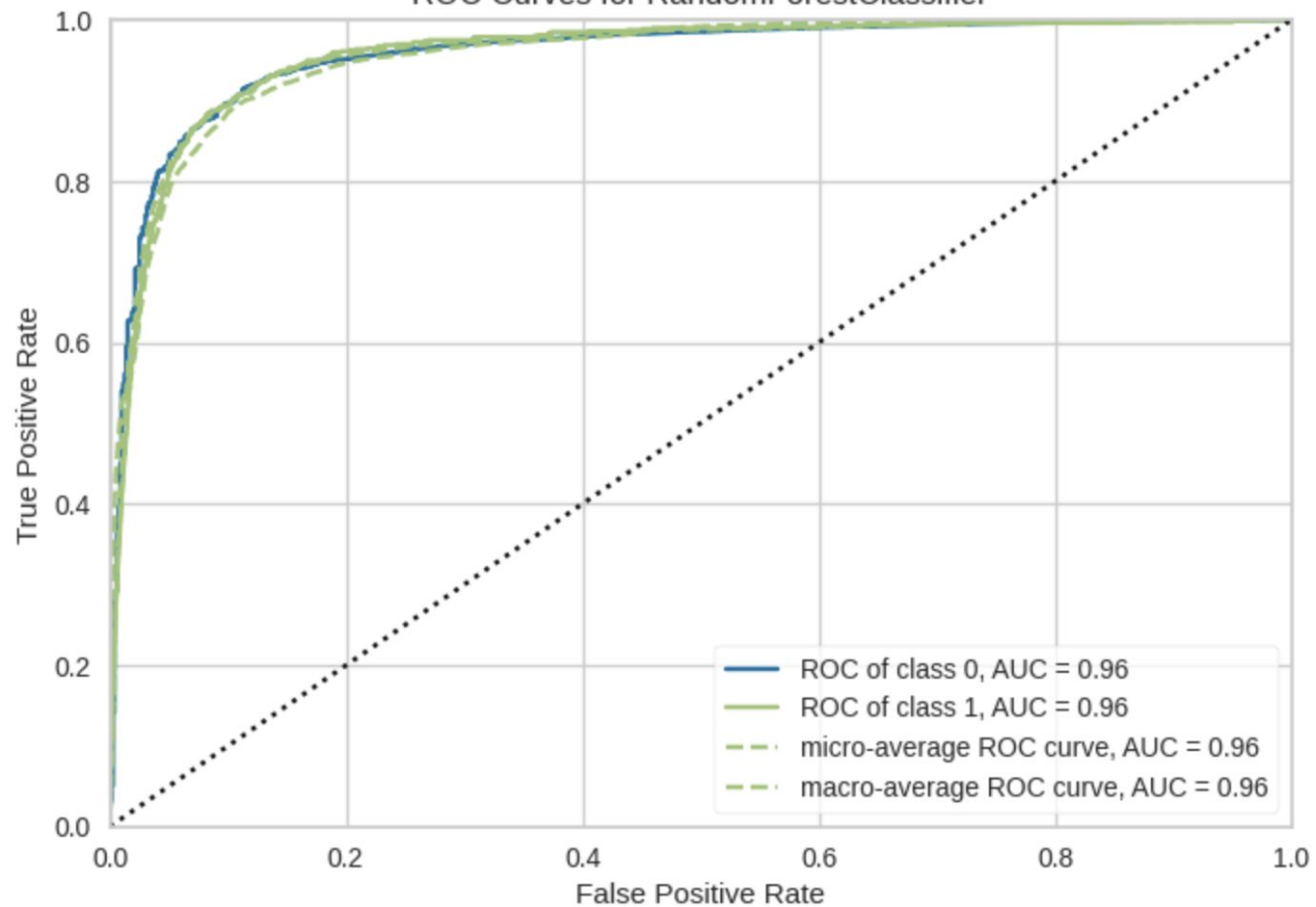


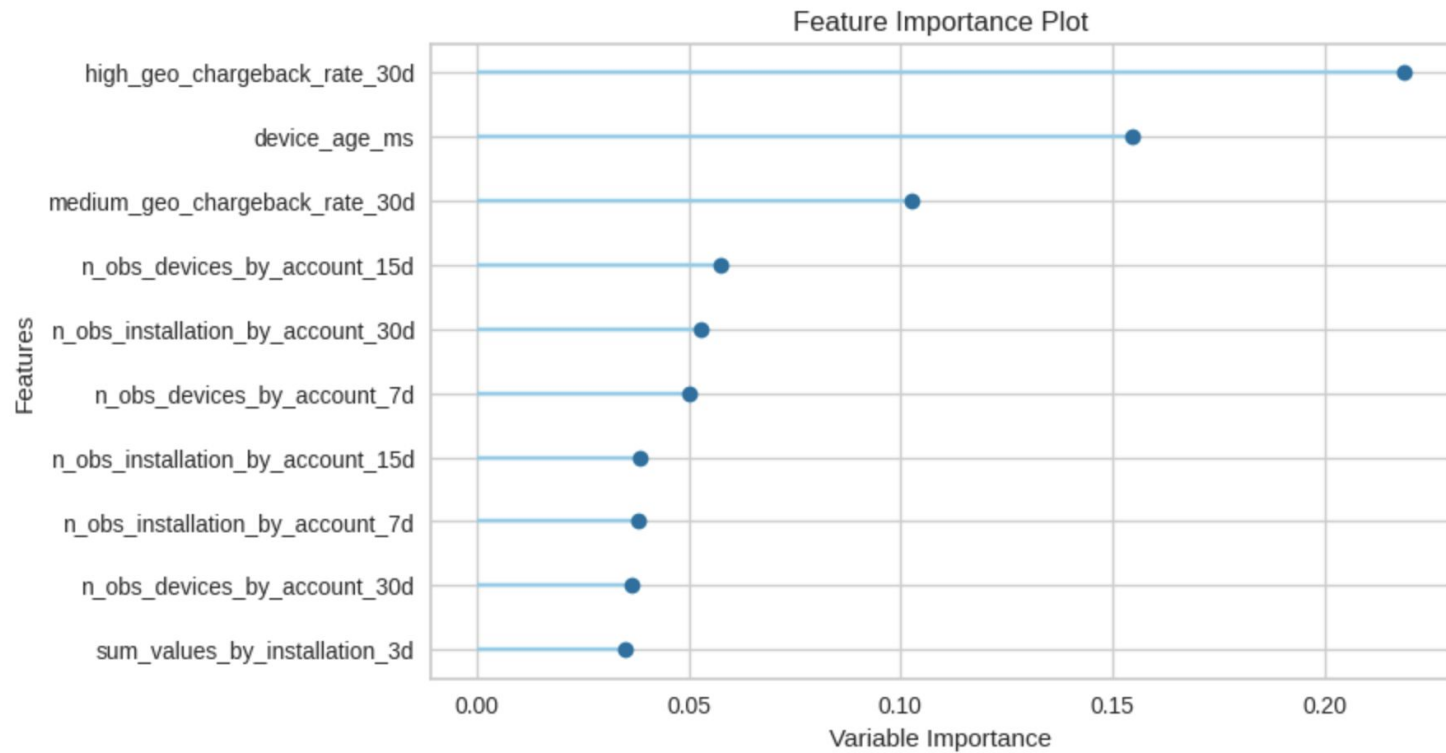
### Random Forest (Tuned for Recall) with more features

|      | Accuracy | AUC    | Recall | Prec.  | F1     | Kappa  | MCC    |
|------|----------|--------|--------|--------|--------|--------|--------|
| Fold |          |        |        |        |        |        |        |
| 0    | 0.8916   | 0.9608 | 0.9081 | 0.0411 | 0.0787 | 0.0696 | 0.1802 |
| 1    | 0.8895   | 0.9524 | 0.9189 | 0.0408 | 0.0781 | 0.0691 | 0.1806 |
| 2    | 0.8967   | 0.9584 | 0.9027 | 0.0428 | 0.0818 | 0.0728 | 0.1839 |
| 3    | 0.8966   | 0.9594 | 0.9032 | 0.0431 | 0.0822 | 0.0731 | 0.1844 |
| 4    | 0.8832   | 0.9471 | 0.8656 | 0.0368 | 0.0706 | 0.0614 | 0.1642 |
| 5    | 0.8926   | 0.9505 | 0.8925 | 0.0410 | 0.0784 | 0.0693 | 0.1781 |
| 6    | 0.8920   | 0.9407 | 0.8595 | 0.0392 | 0.0750 | 0.0659 | 0.1699 |
| 7    | 0.8914   | 0.9510 | 0.8973 | 0.0406 | 0.0777 | 0.0686 | 0.1776 |
| 8    | 0.8915   | 0.9630 | 0.9459 | 0.0426 | 0.0816 | 0.0726 | 0.1882 |
| 9    | 0.8889   | 0.9568 | 0.8973 | 0.0397 | 0.0760 | 0.0669 | 0.1753 |
| Mean | 0.8914   | 0.9540 | 0.8991 | 0.0408 | 0.0780 | 0.0689 | 0.1782 |
| Std  | 0.0037   | 0.0066 | 0.0233 | 0.0018 | 0.0034 | 0.0034 | 0.0067 |

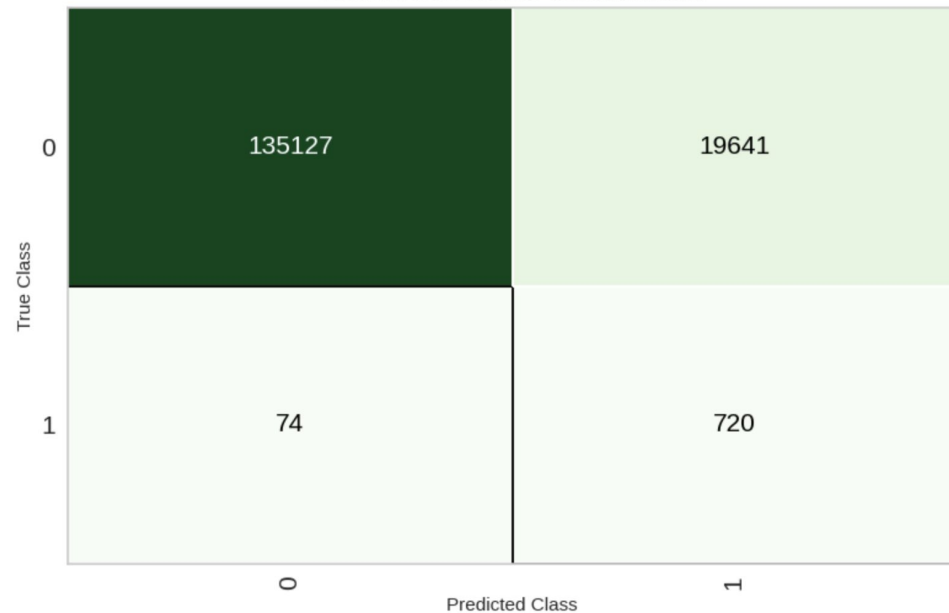
+1% in AUC and Recall

ROC Curves for RandomForestClassifier





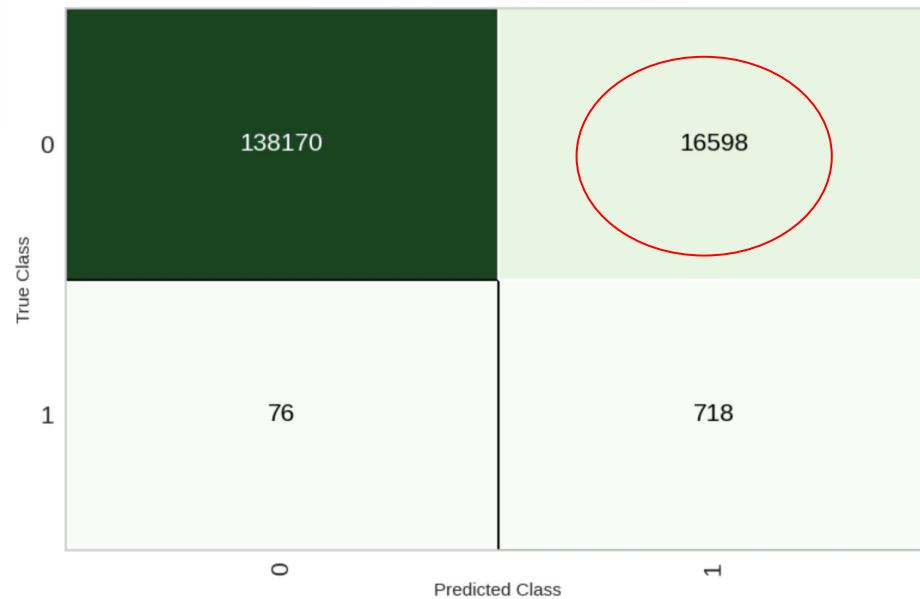
RandomForestClassifier Confusion Matrix



Random Forest (Tuned for Recall)

Random Forest (Tuned for Recall)  
with more features

RandomForestClassifier Confusion Matrix



Next Steps

# Next Steps

- Play with more hyperparameters and data preparation
- Try more robust models using the sequence of transactions (temporal)
  - RNN, LSTM (sequential models)
- Try custom models for anomaly detection
  - Isolation Forest
- Ask for the spatial dimension of the transactions