Detecting Anomalous Financial Transactions

Using big data to help FinCEN fight financial fraud and money laundering

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Agenda

1

BUSINESS UNDERSTANDING

The high cost of money laundering

2

DATA UNDERSTANDING

A model is only as good as the data

3

THE MODELS

Can we reliably spot anomalous transactions?

4

ANALYSIS & INFERENCES

What have we learned?

5

CONCLUSION & RECOMMENDATIONS

What are the takeaways?

Business Understanding

"THE ESTIMATED AMOUNT OF MONEY LAUNDERED GLOBALLY IN ONE YEAR IS 2% - 5% OF GLOBAL GDP, OR $800 BILLION - $2 TRILLION USD" — UNITED NATIONS OFFICE ON DRUGS AND CRIME

THEFT AND MAJOR CRIMES
- From stolen pandemic aid to drug dealing and racketeering - criminals go to great lengths to hide the source of their cash

SANCTIONS DIVERSION
- Sanctioned organizations and nation-states will attempt to skirt restrictions through clandestine operations

TERRORIST FINANCING
- Terrorist organizations require capital to carry out their activities

HARMS INDUSTRY AND CONSUMERS
- Banks can suffer reputational damage and face regulatory scrutiny, and costs often pass on to consumers

Data Understanding

A collaboration between NIST and the NSF

```
Transactions dataframe
----------------------
root
|-- MessageId: string
|-- Timestamp: timestamp
|-- UETR: string
|-- Sender: string
|-- Receiver: string
|-- TransactionReference: string
|-- OrderingAccount: string
|-- OrderingName: string
|-- OrderingStreet: string
|-- OrderingCountryCityZip: string
|-- BeneficiaryAccount: string
|-- BeneficiaryName: string
|-- BeneficiaryStreet: string
|-- BeneficiaryCountryCityZip: string
|-- SettlementDate: integer
|-- SettlementCurrency: string
|-- SettlementAmount: double
|-- InstructedCurrency: string
|-- InstructedAmount: double
|-- Label: integer
```
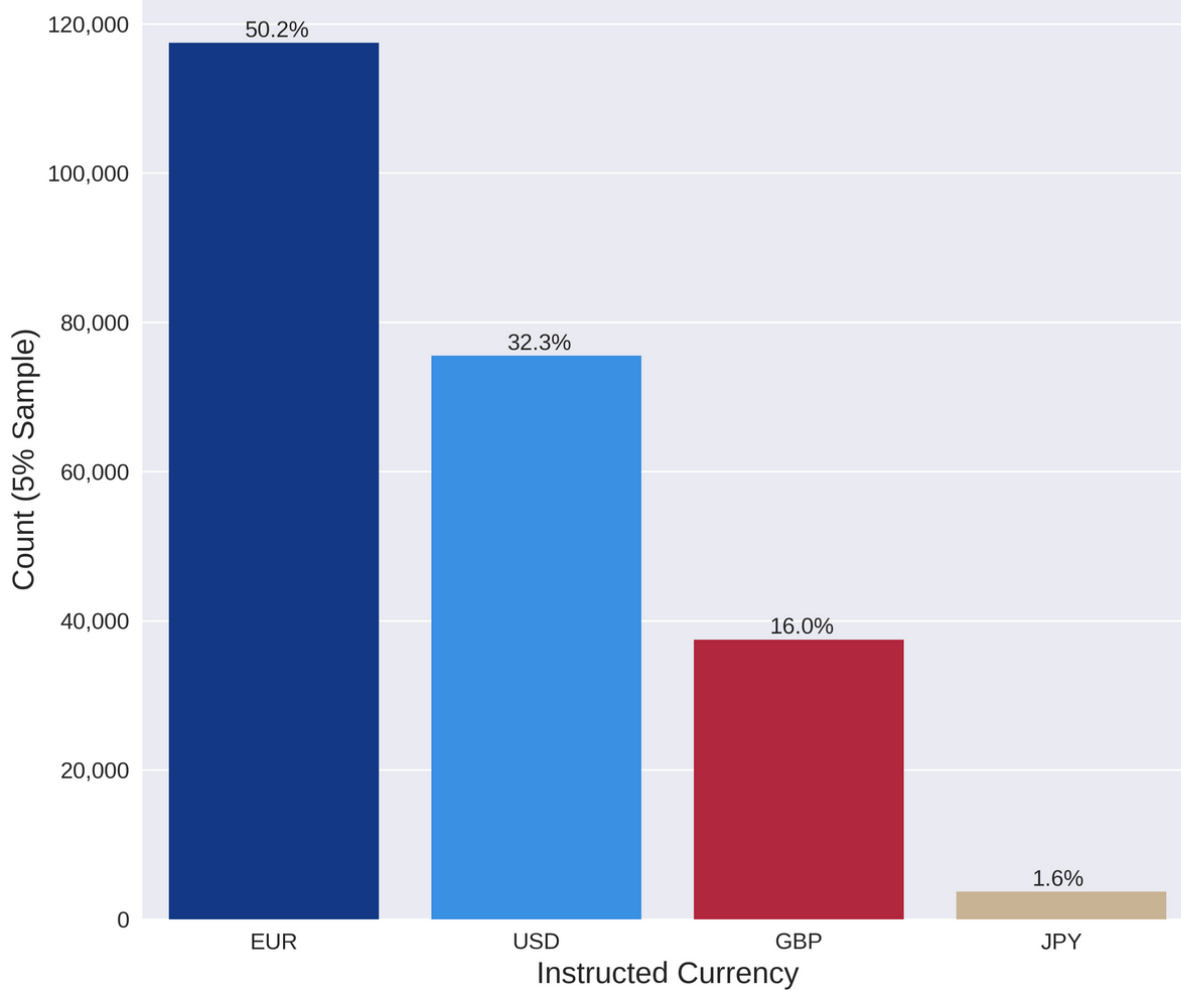
```
Target class distribution
-------------------------
+------------------+---------+----------+
|Label             |count    |percent   |
+------------------+---------+----------+
|Anomalous (1)     |4,900    |0.104%    |
|Non-anomalous (0) |4,686,825|99.895%   |
+------------------+---------+----------+
```

5.5M Transactions
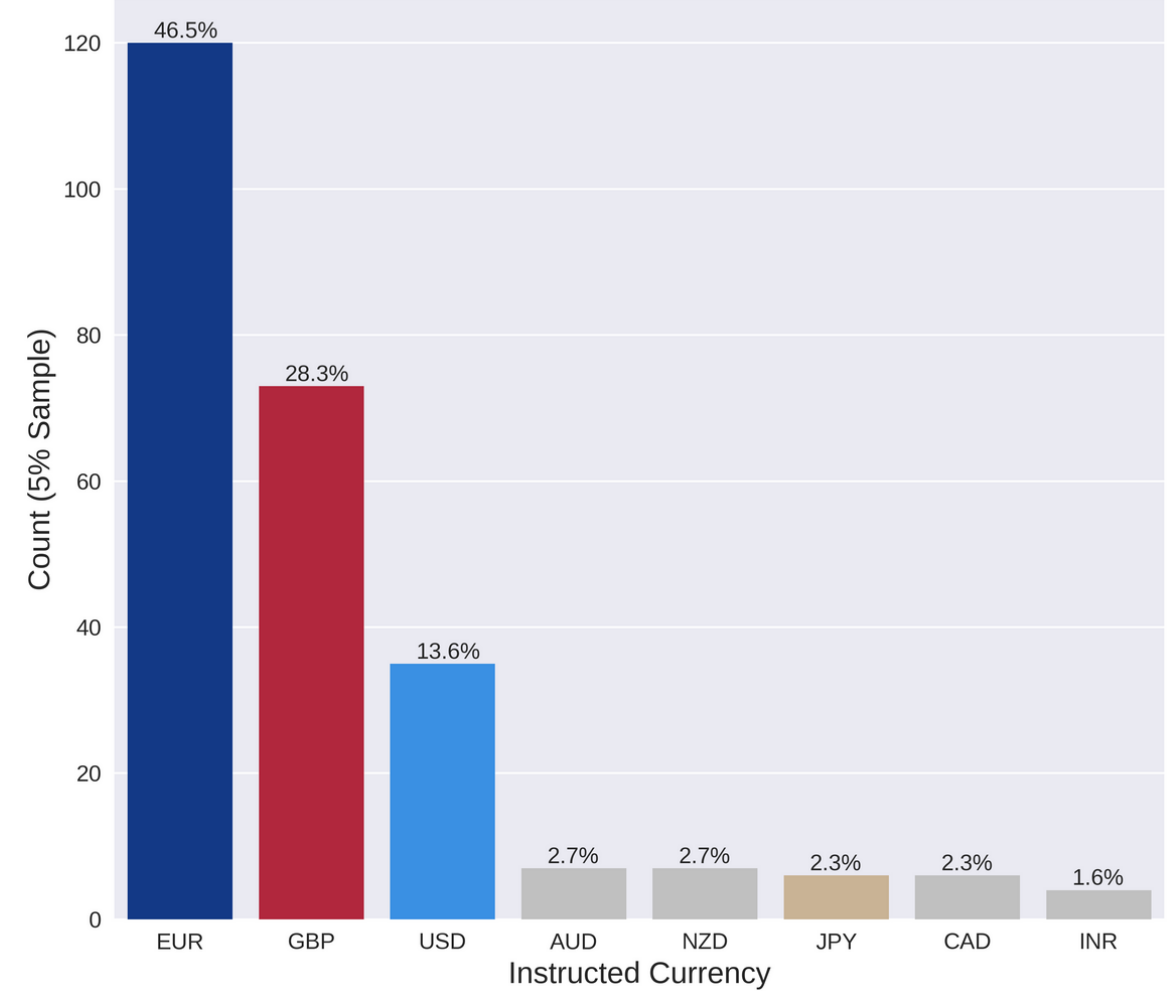530k Matching Accounts
91 Features

```
Bank accounts dataframe
----------------------
root
|-- Bank: string
|-- Account: string
|-- Name: string
|-- Street: string
|-- CountryCityZip: string
|-- Flags: integer
```
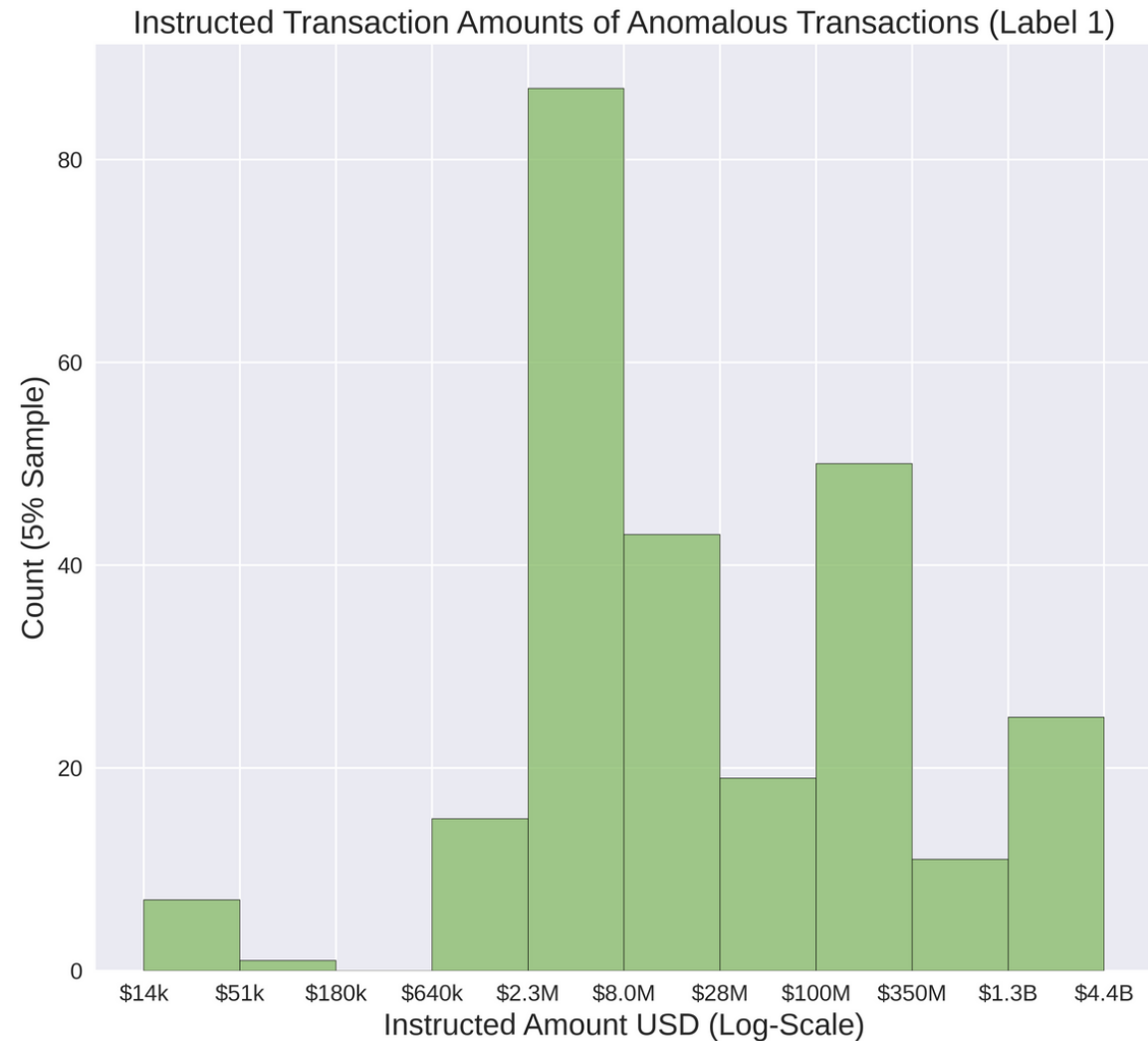
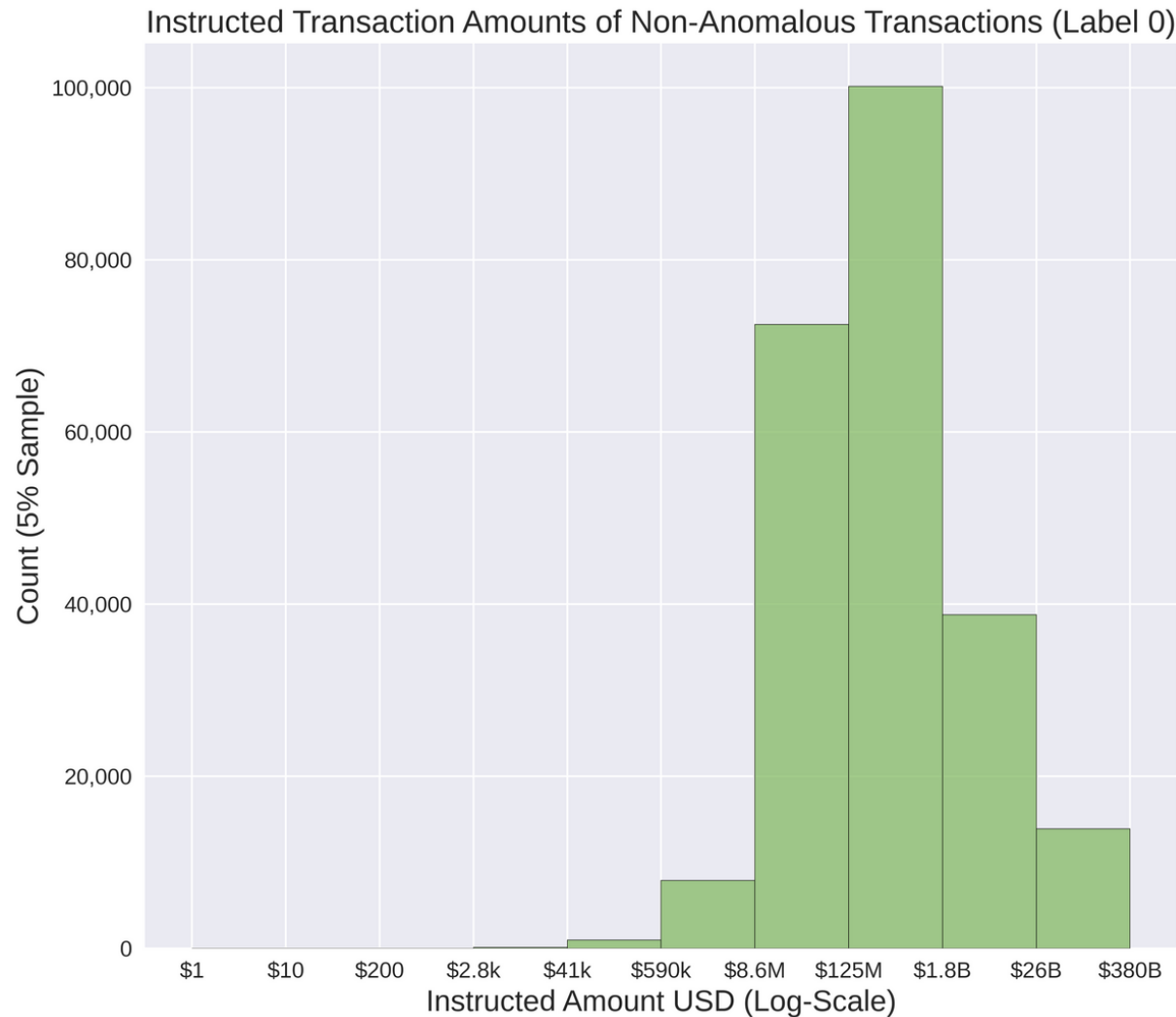**INSTRUCTED TRANSACTION CURRENCIES**

Instructed Transaction Amounts of Non-Anomalous Transactions (Label 0)
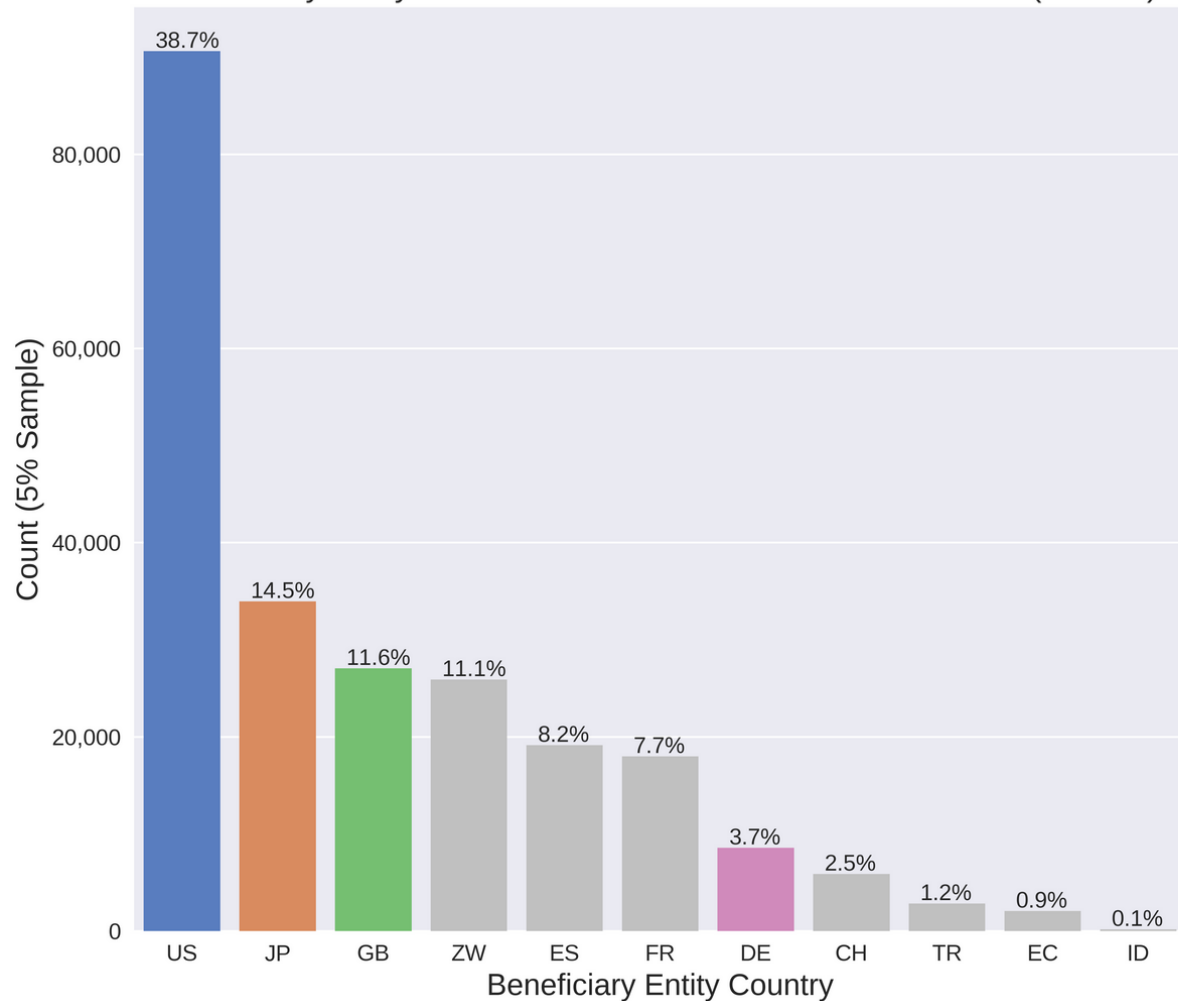
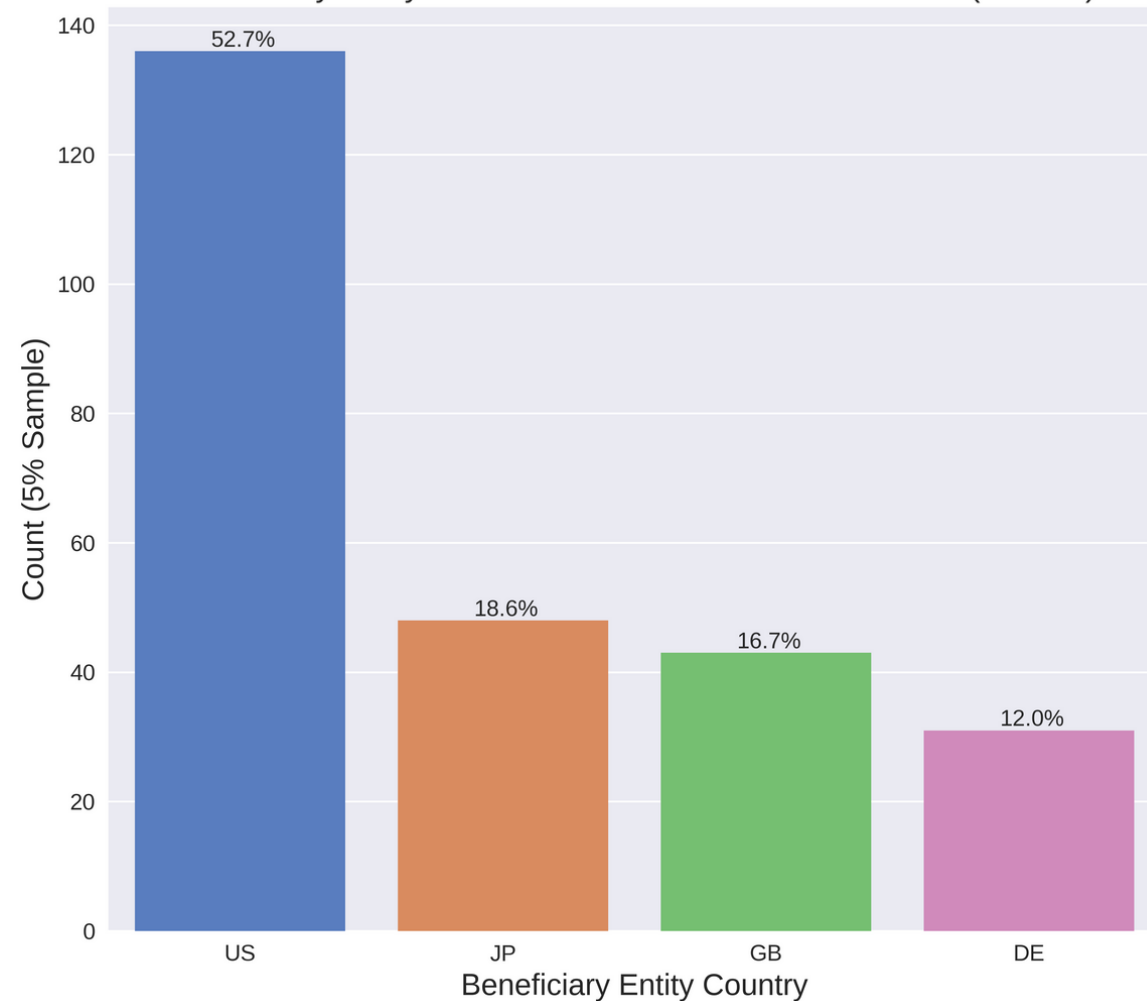Instructed Transaction Amounts of Anomalous Transactions (Label 1)

INSTRUCTED TRANSACTION AMOUNTS (LOG-SCALE USD)

Beneficiary Entity Countries of Non-Anomalous Transactions (Label 0)

Beneficiary Entity Countries of Anomalous Transactions (Label 1)

BENEFICIARY ENTITY COUNTRIES

Modeling Results

As measured by test data F1 scores

0.019
BASELINE
LOGISTIC
REGRESSION

0.019
GBT model 1

Downweighted 10x

0.265
SVC model 1

Downweighted 10x

0.487
Random forest
model 1

Oversampled 10x

0.567
Multilayer perceptron
model 4

Downsampled 50%

0.026
Naive Bayes model 1

Downweighted 100x

0.265
Logistic regression model 1

Unsampled

0.555
Decision tree,
models 1 & 2

Model 1: Unsampled

Model 2: Oversampled 10x

CONFUSION MATRIX

	PREDICTED 0	PREDICTED 1
TRUE 0	704K	22
TRUE 1	451	310

Analysis

Feature Importances - Random Forest Model

| Feature	Importance
Flagged	0.013
BeneficiaryCountry	0.013
OrderingCountryFreq	0.012
SenderCurrencyFreq	0.012
SenderCurrencyAmtAvg	0.011
BeneficiaryCountryFreq	0.01
ReceiverFreq	0.009
InstructedCurrency	0.007
SenderHourFreq	0.005
FinalReceiver	0.005
IntermediaryTransactions	0.004
OriginalSender	0.004
InstructedAmountUSD	0.004
Hour	0.002
OrderingCountry	0.001
SenderReceiverFreq	0.0
SenderFreq	0.0
SettlementCurrency	0.0

Conclusion & Recommendations

IT'S A TRADE OFF

Catching more anomalous transactions = more false positives
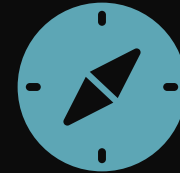
USE MODEL TO FOCUS RESOURCES

Knowing where to look is half the battle

OBTAIN MORE POSITIVE CLASS OBSERVATIONS

Models could be improved with more data

Thank you

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