Fraud Detection

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The Problem

Fraud in online transactions:

- Loss of revenue
- Decreased customer satisfaction

The Solution

Fraud detection system:

- Accurate fraud prediction
- Less false alarms

Data

- IEEE Computational Intelligence Society Fraud Detection
- Vesta Corporation's real-world e-commerce transactions

Data Overview

- Two datasets: transaction and identity data
- 590540 observations, 434 variables

Workflow

I. Data Preparation:

- Data Cleaning
- Exploratory Data Analysis
- Feature Engineering

II. Modeling:

- Class Imbalance
- Model Optimization
- Model Evaluation

Data Preparation

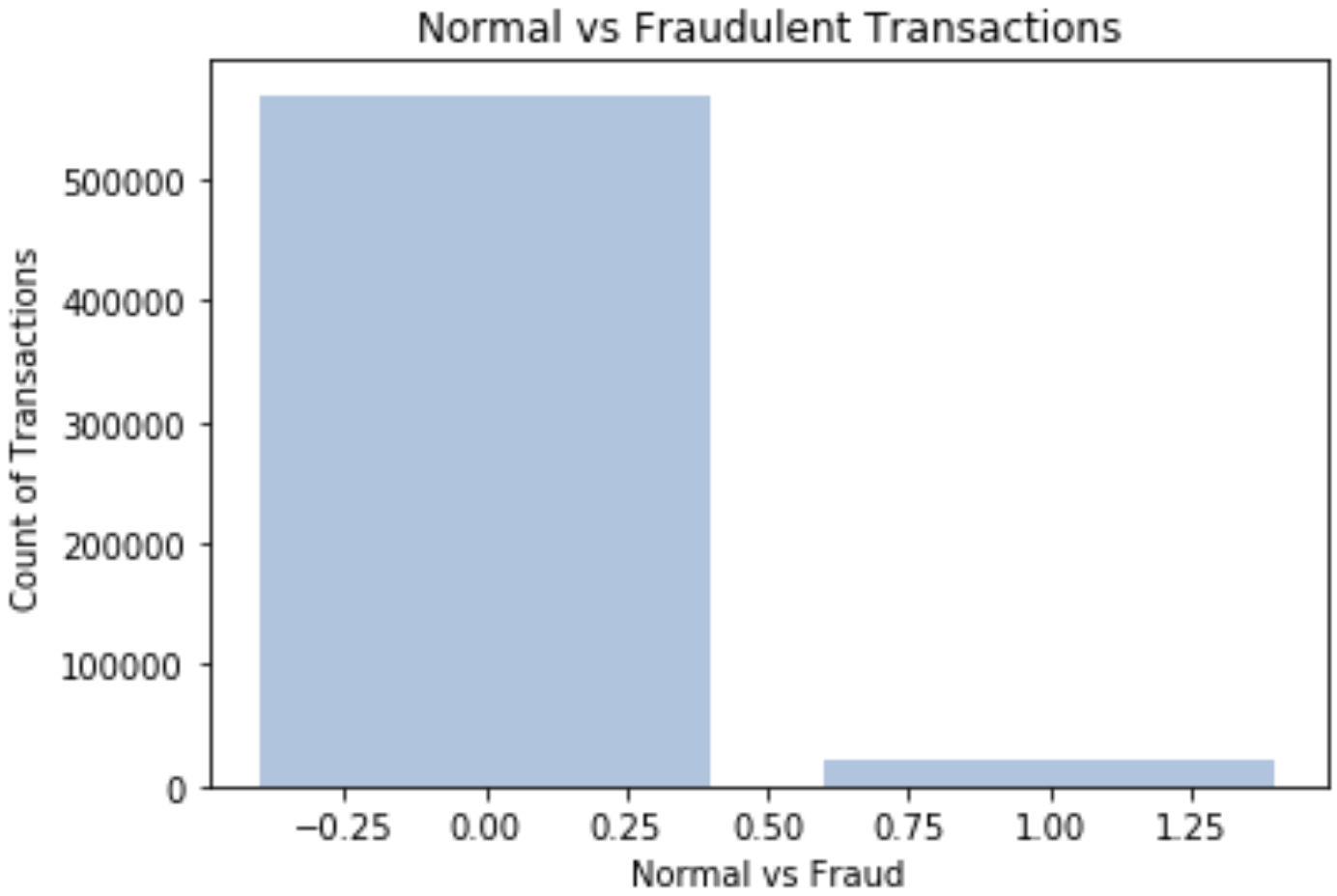
- Address missing data
- Limit values of outliers
- Transform variables
- Reduce dimensionality

Data Preparation

- Continuous variables:
  - Transaction time deltas
  - Transaction amount
  - Distance
  - Vesta engineered features
- Categorical variables:
  - Product codes
  - Payment card information
  - Address
  - Email domains
  - Identity information

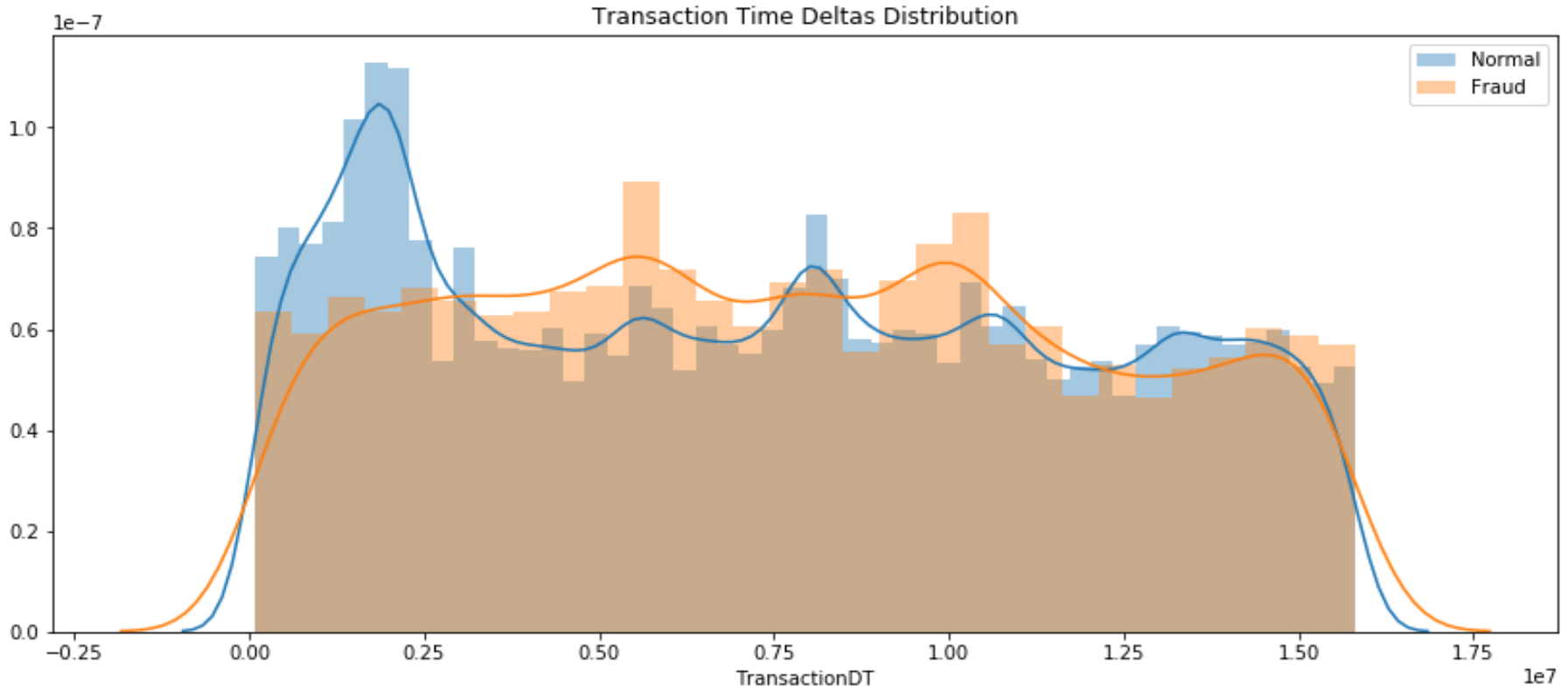
Data Preparation

- Target: isFraud
- 3.6%
- Class Imbalance



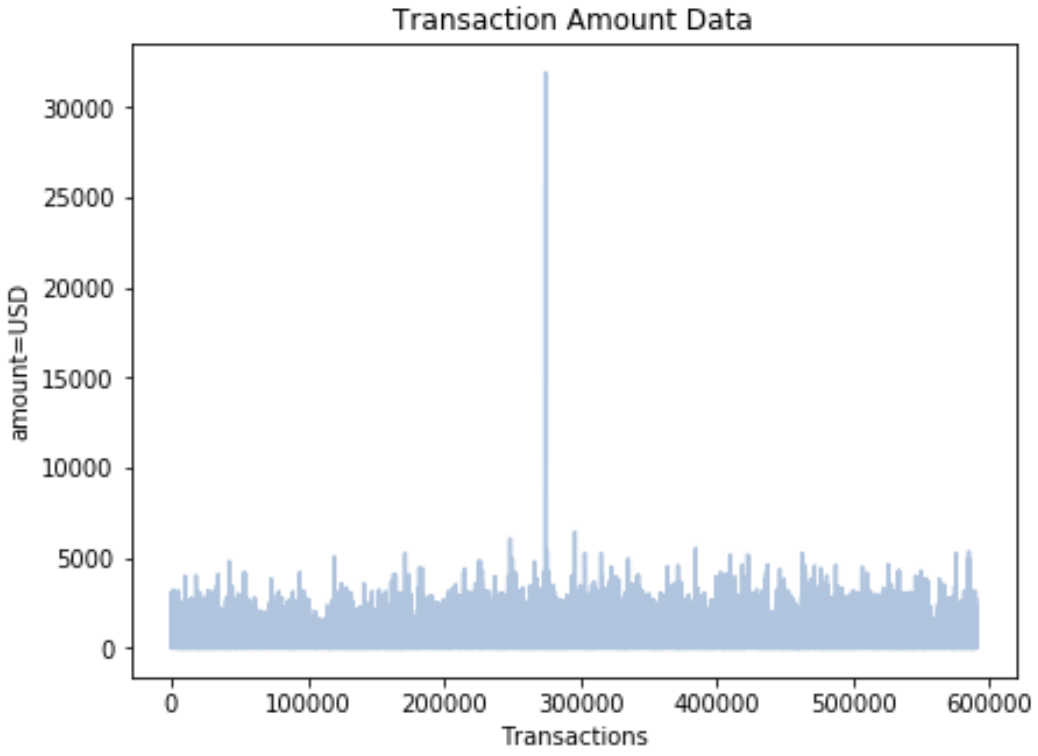
Data Preparation

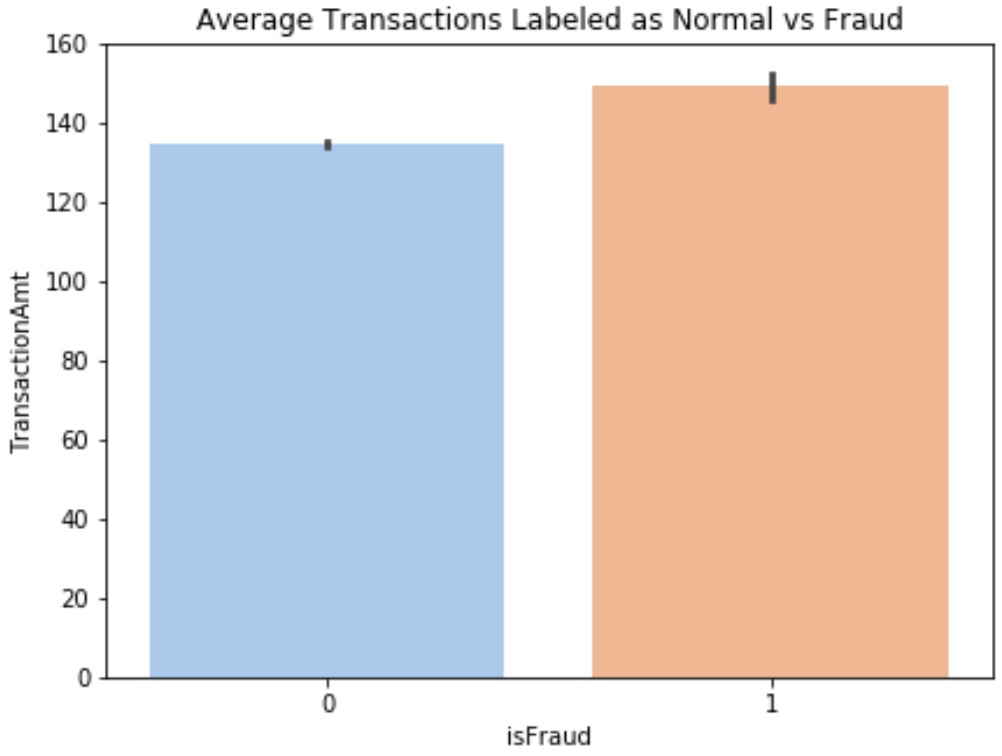
Transaction Time Deltas



Data Preparation

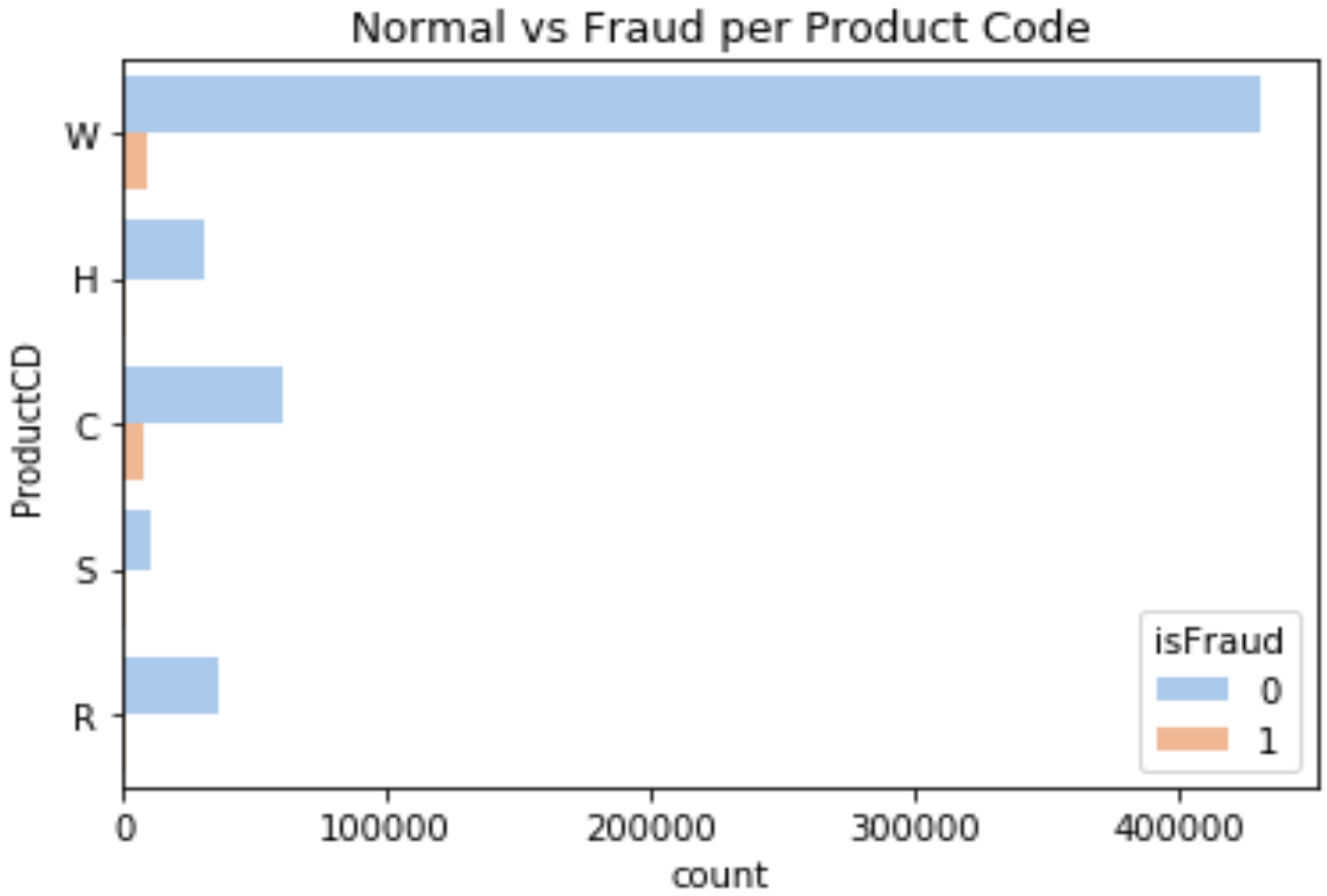
Transaction Amount





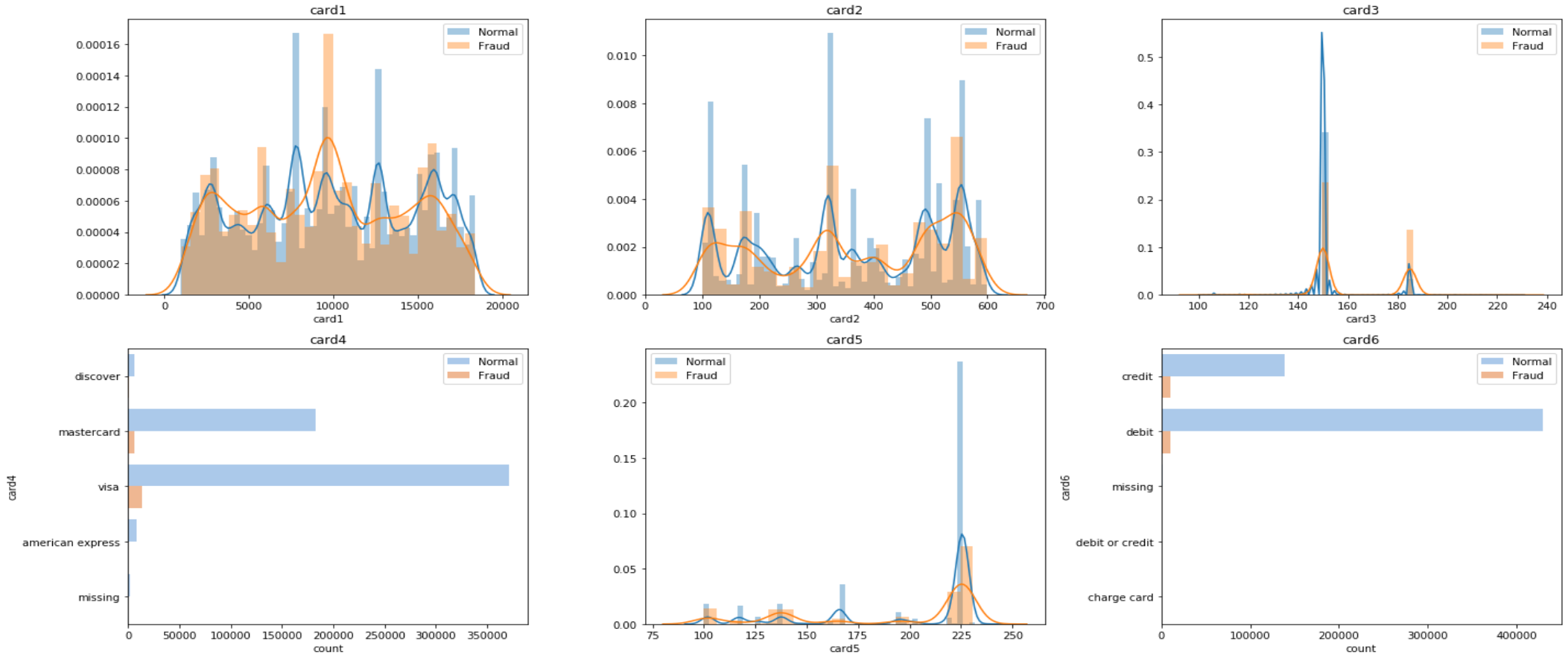
Data Preparation: Product Code

Product Codes



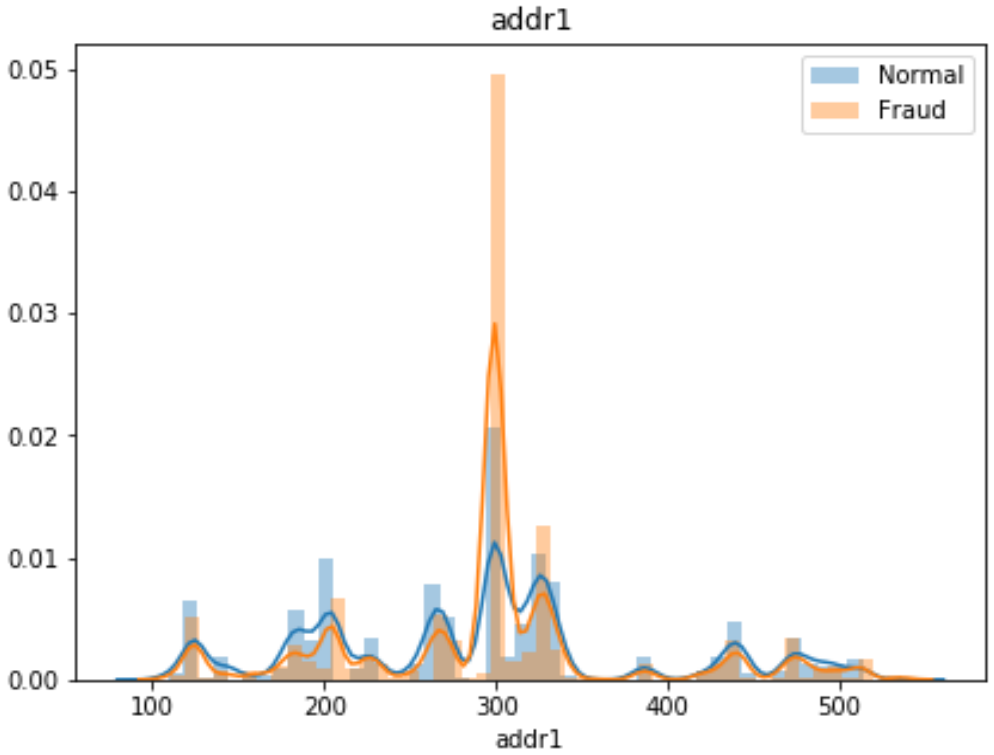
Data Preparation

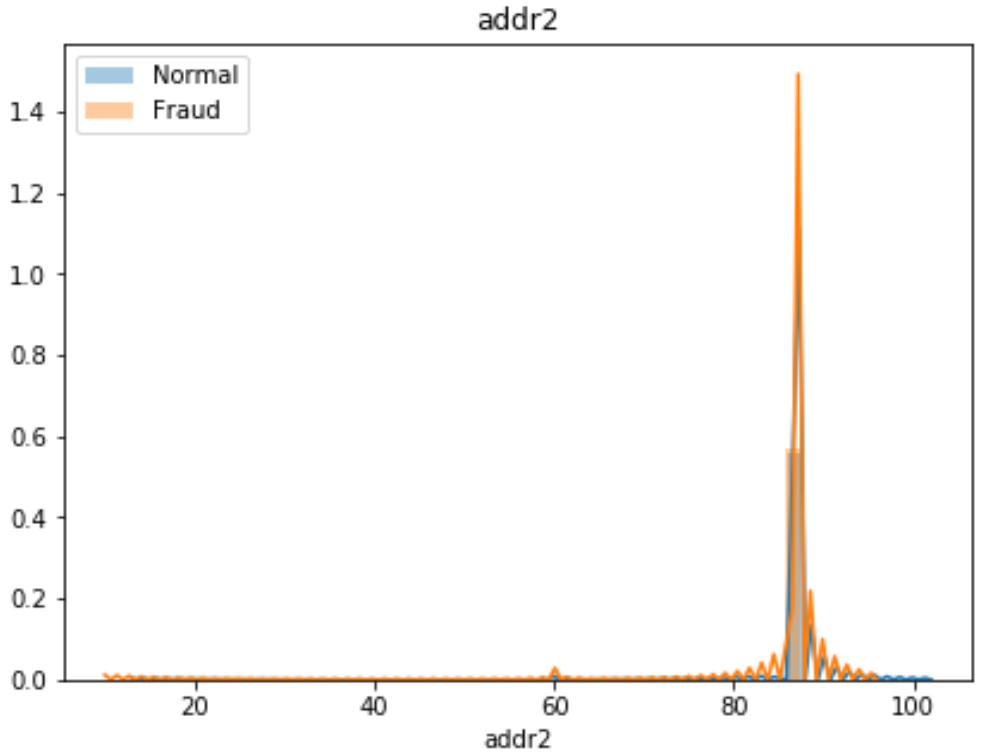
Payment Card Information



Data Preparation

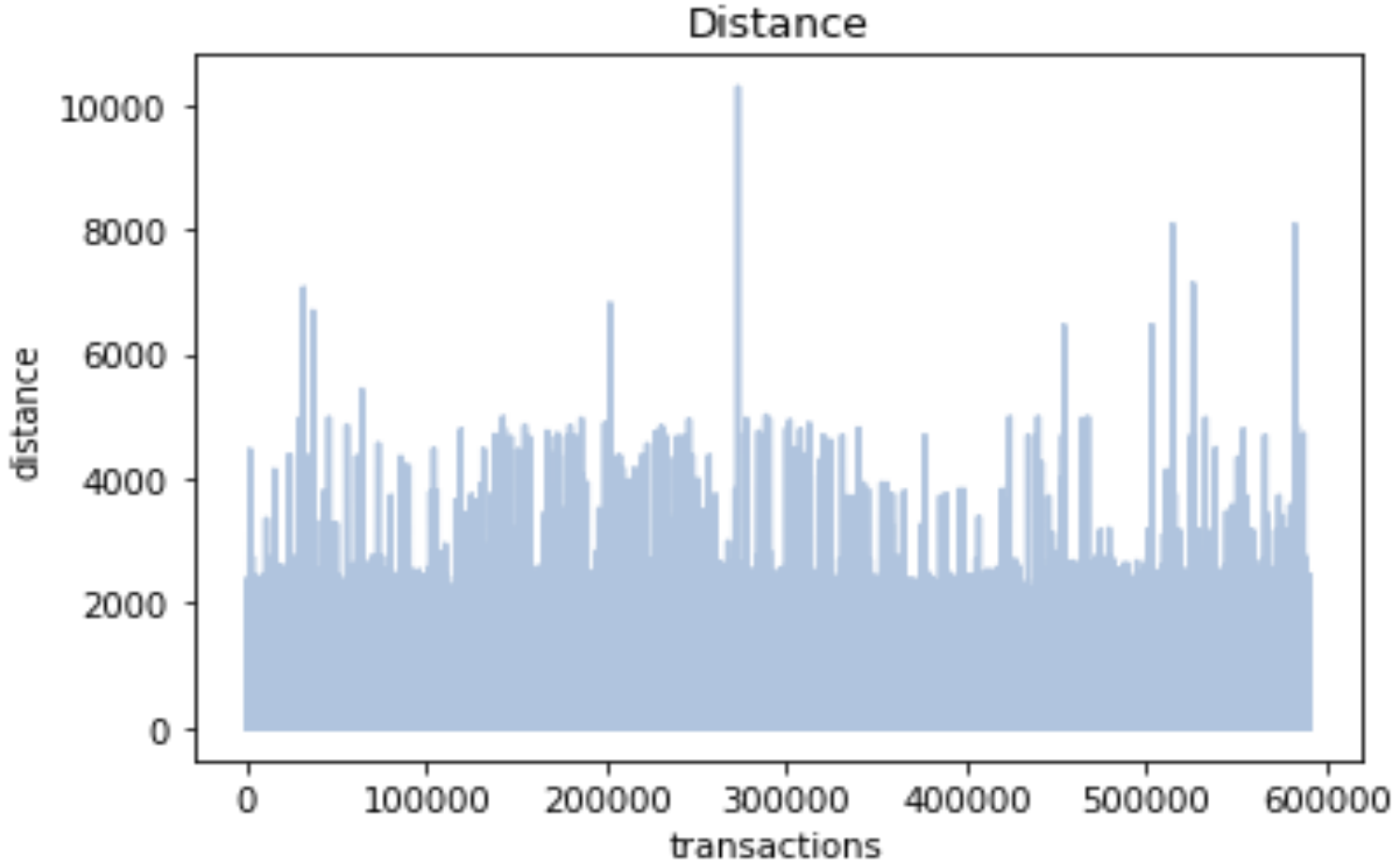
Address





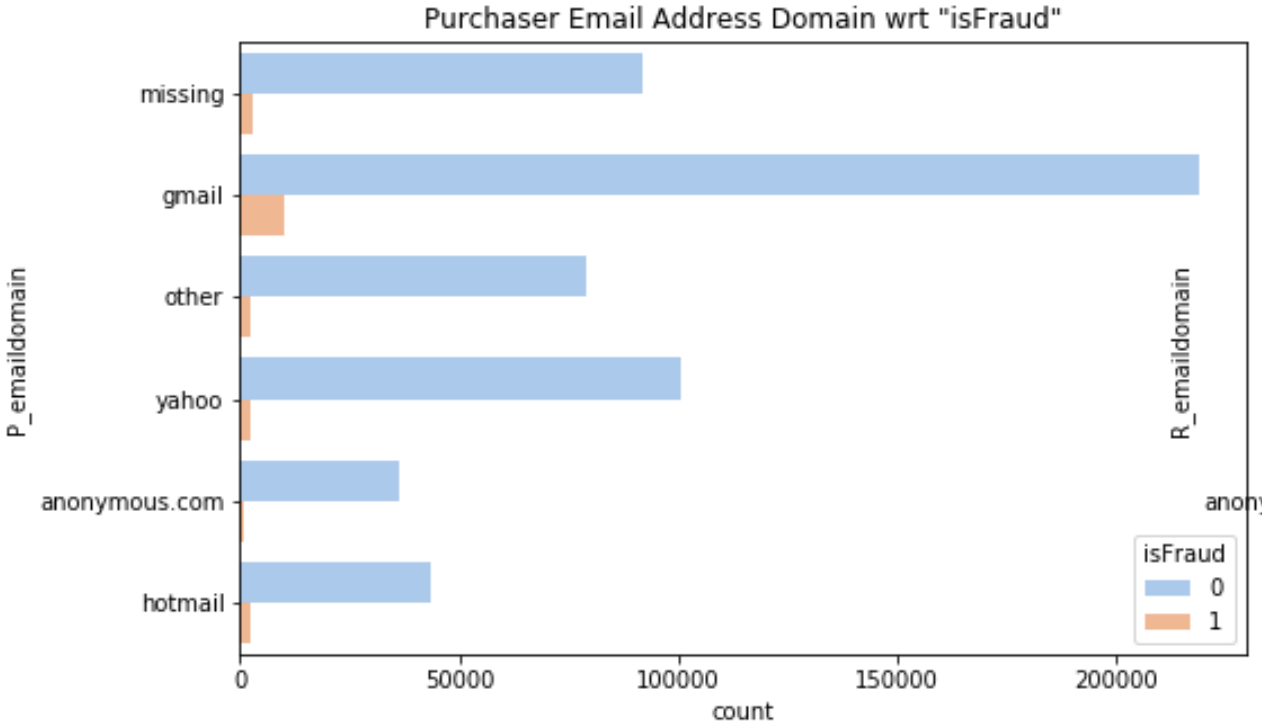
Data Preparation

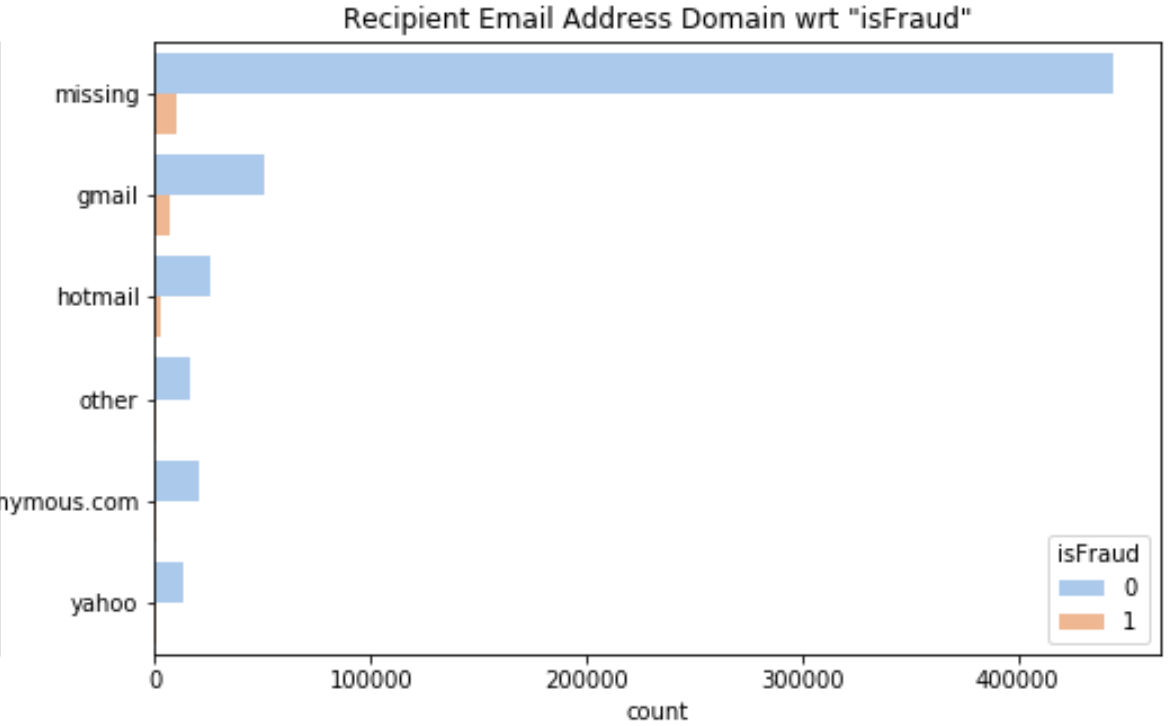
Distance



Data Preparation

Email domains





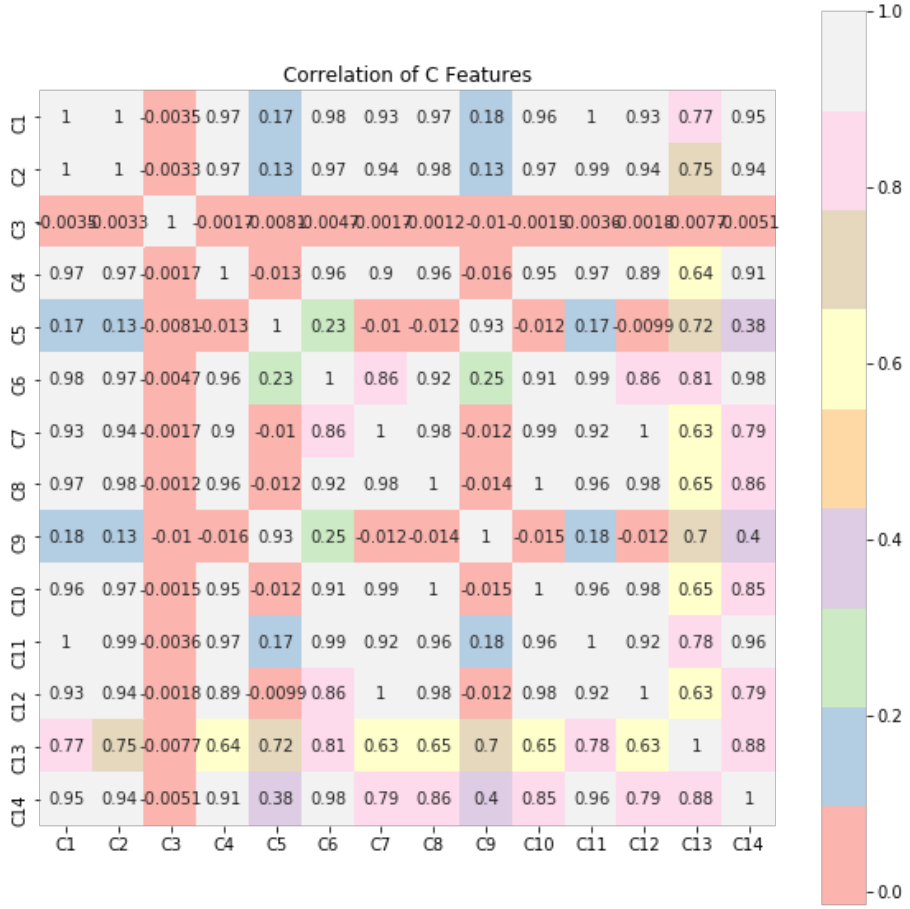
Data Preparation

Vesta-engineered features:

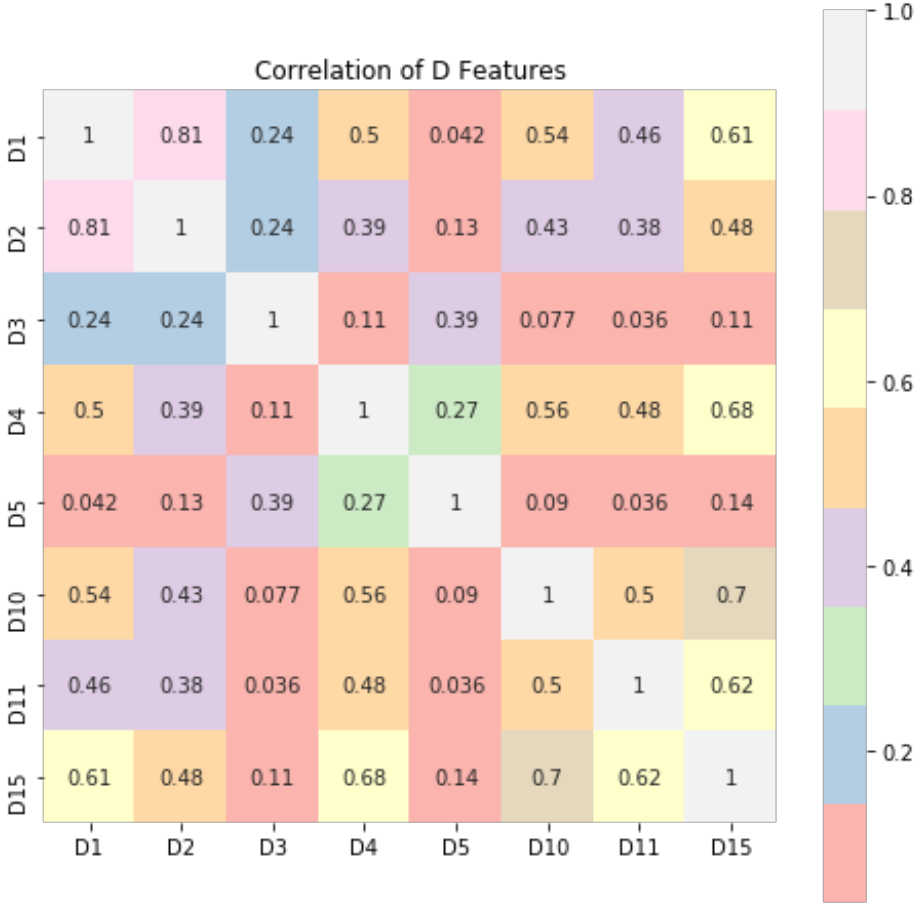
- C variables
- D variables
- M variables
- V variables

Data Preparation

Correlation of C Features



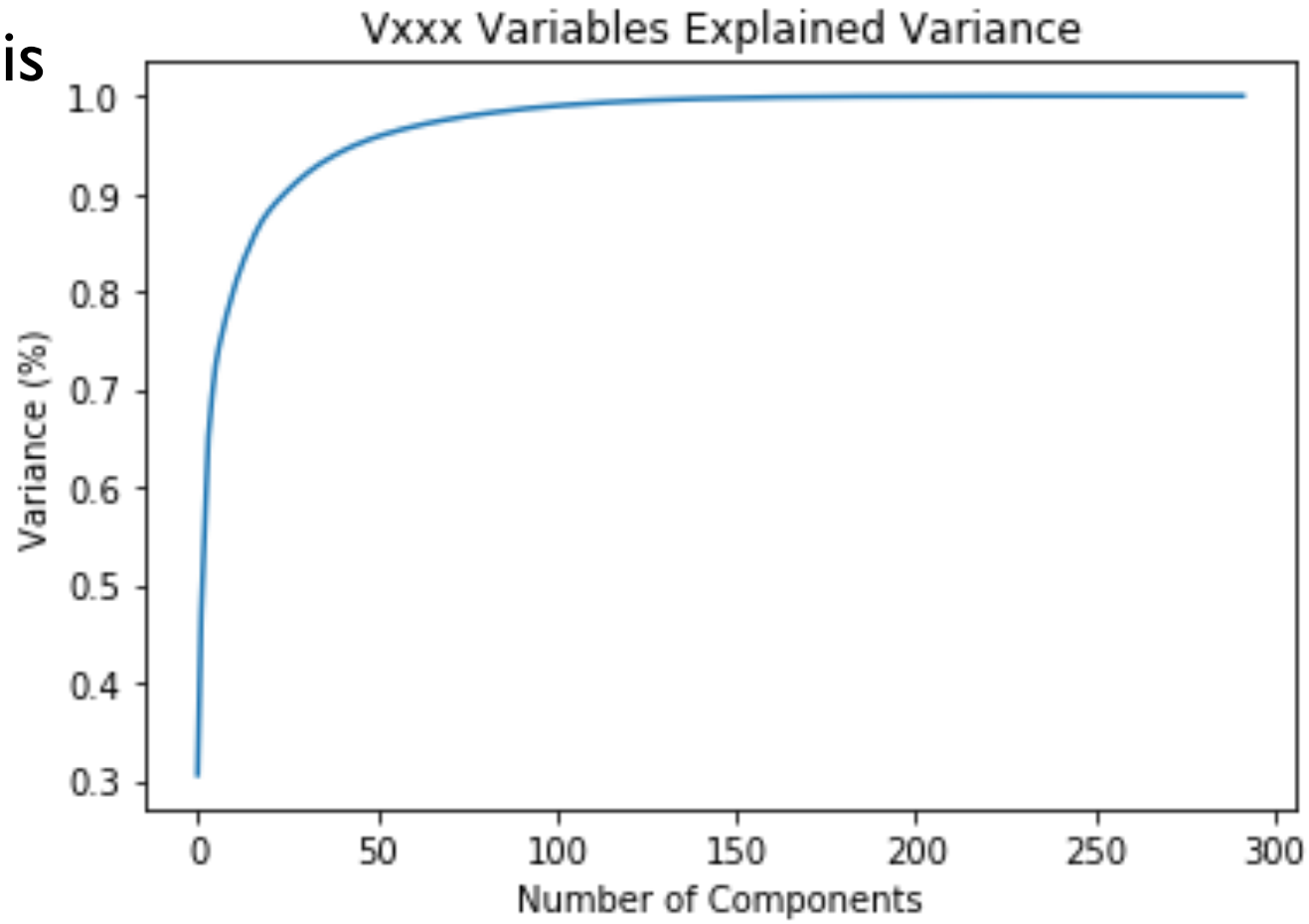
Correlation of D Features



Data Preparation

Principal Component Analysis

- 292 variables
- reduced to 25 features



Data Preparation

Identity/Device Information:

- Over 75% of missing values

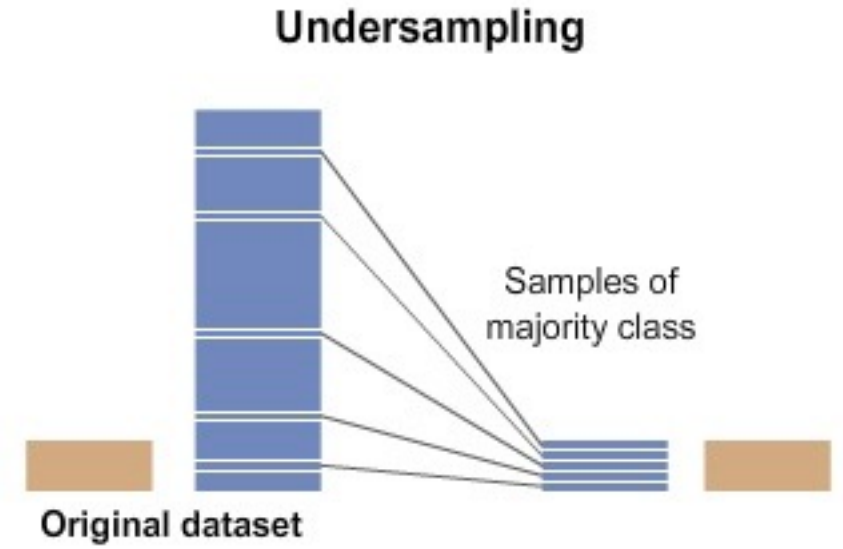
Data Preparation

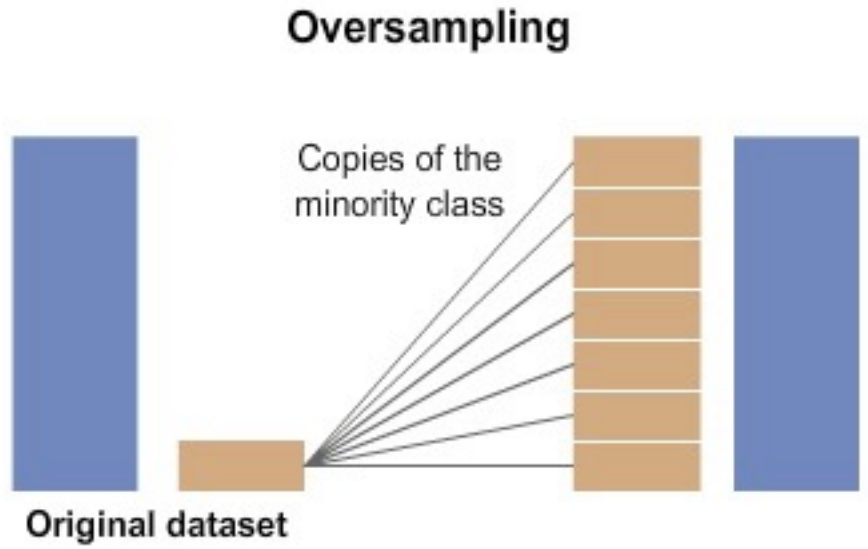
- Data is numeric
- 91 features
- Some features are highly correlated
- Some variables had a lot of missing values

Modeling

Class Imbalance:

- Random Undersampling
- Synthetic Majority Oversampling Technique (SMOTE)





Modeling

Evaluation Metrics:

- Area under Receiver Operating Characteristic curve
- Precision
- Recall

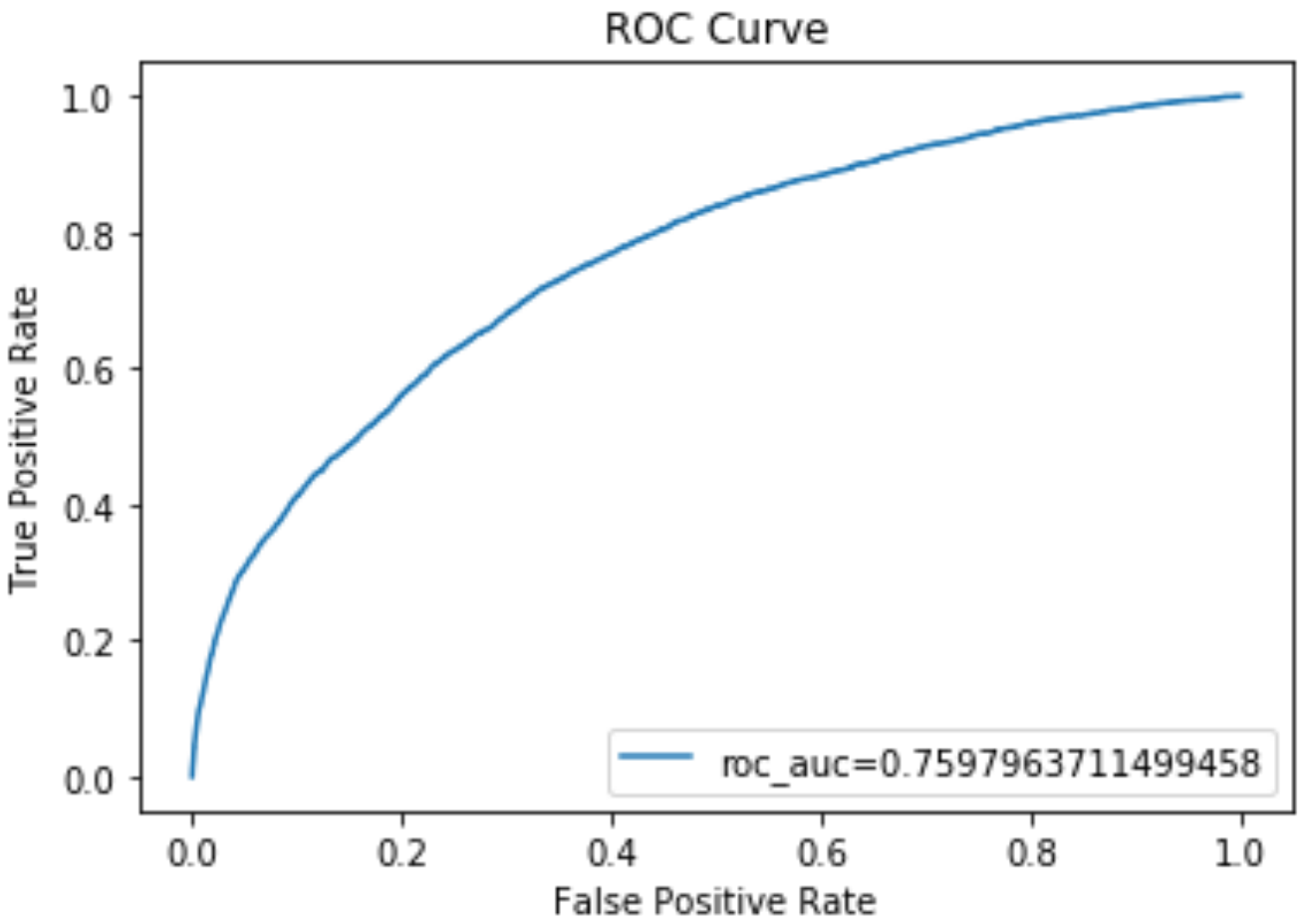
Modeling

- Logistic Regression
- Decision Tree
- Gradient Boosting Classifier
- Random Forest Classifier

Modeling

Logistic Regression

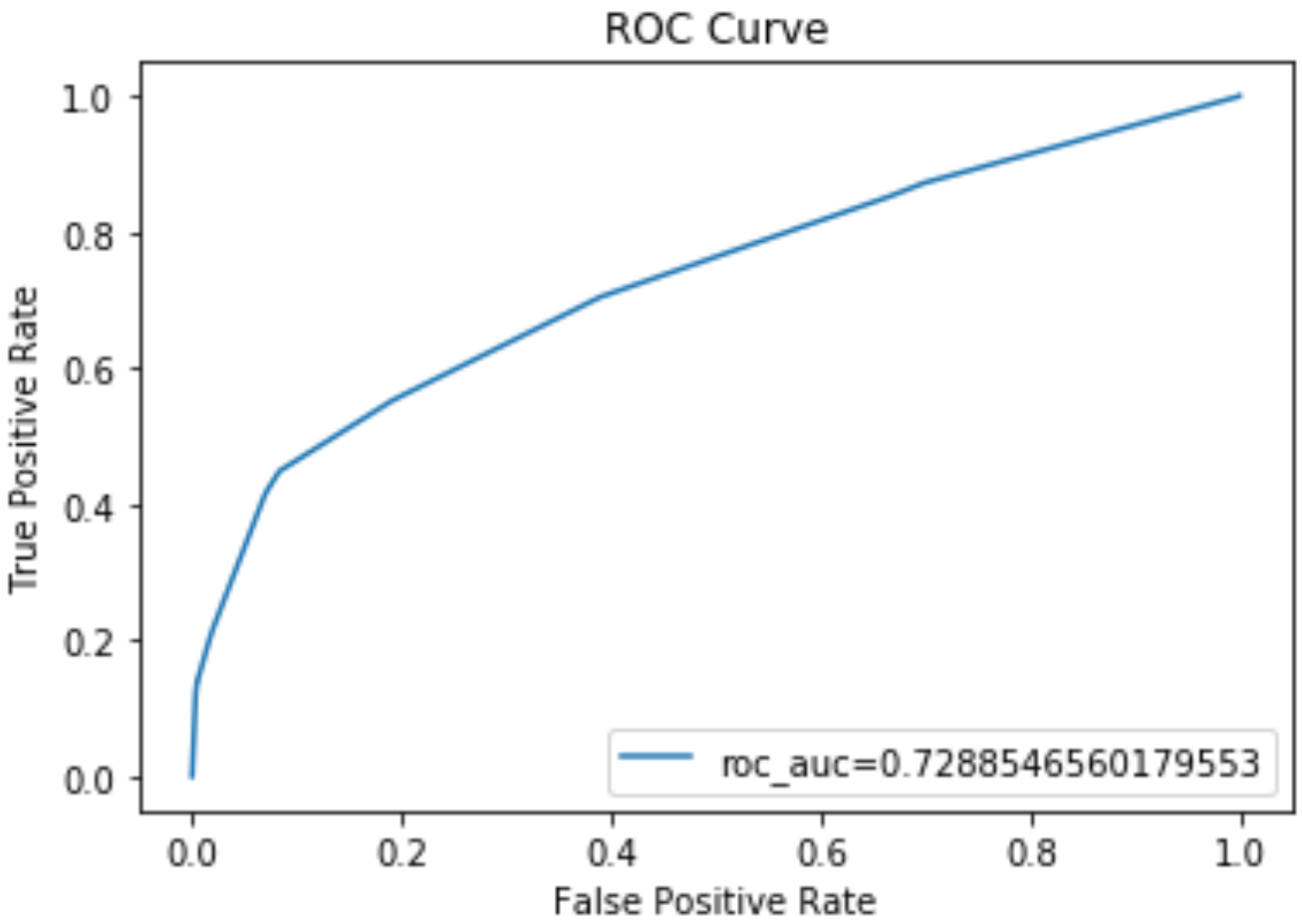
- AUC: 0.7597
- Precision: 0.08
- Recall: 0.64



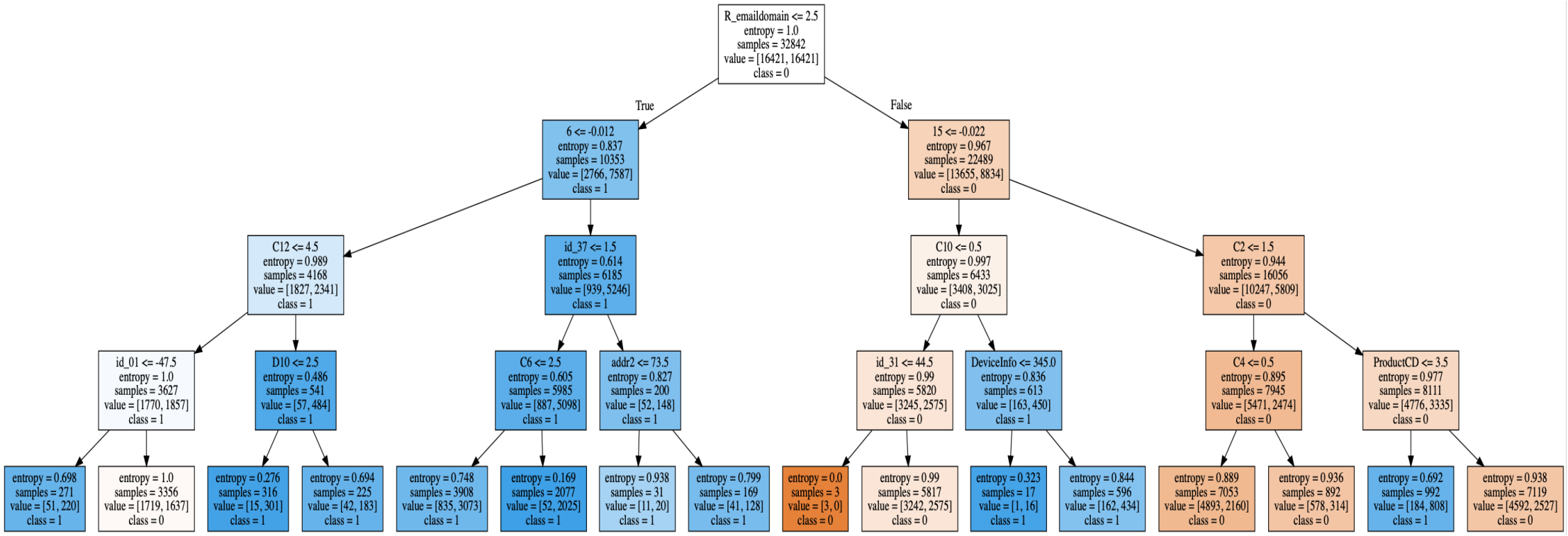
Modeling

Decision Tree

- AUC: 0.7288
- Precision: 0.17
- Recall: 0.45



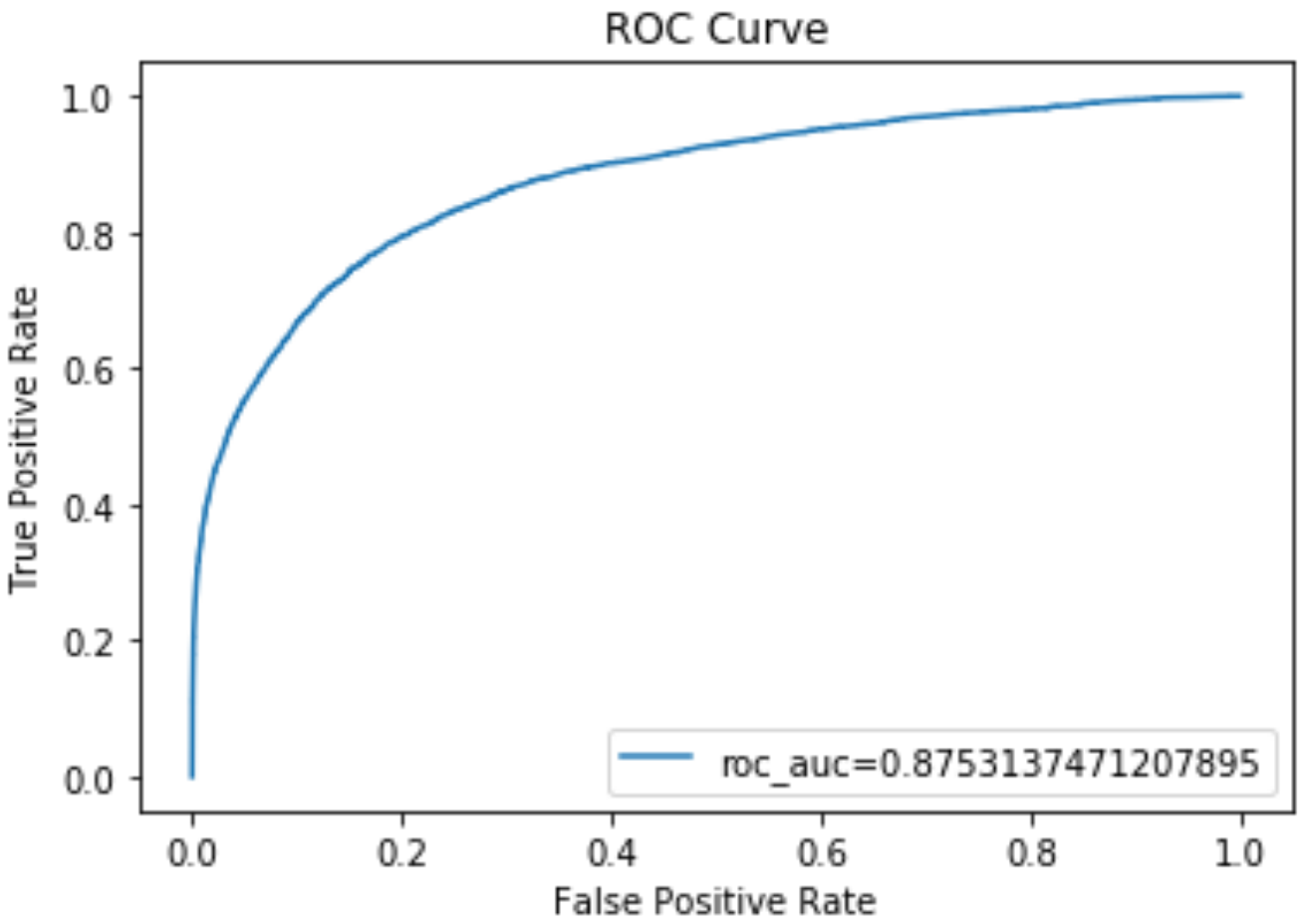
Data Preparation



Modeling

Gradient Boosting Classifier

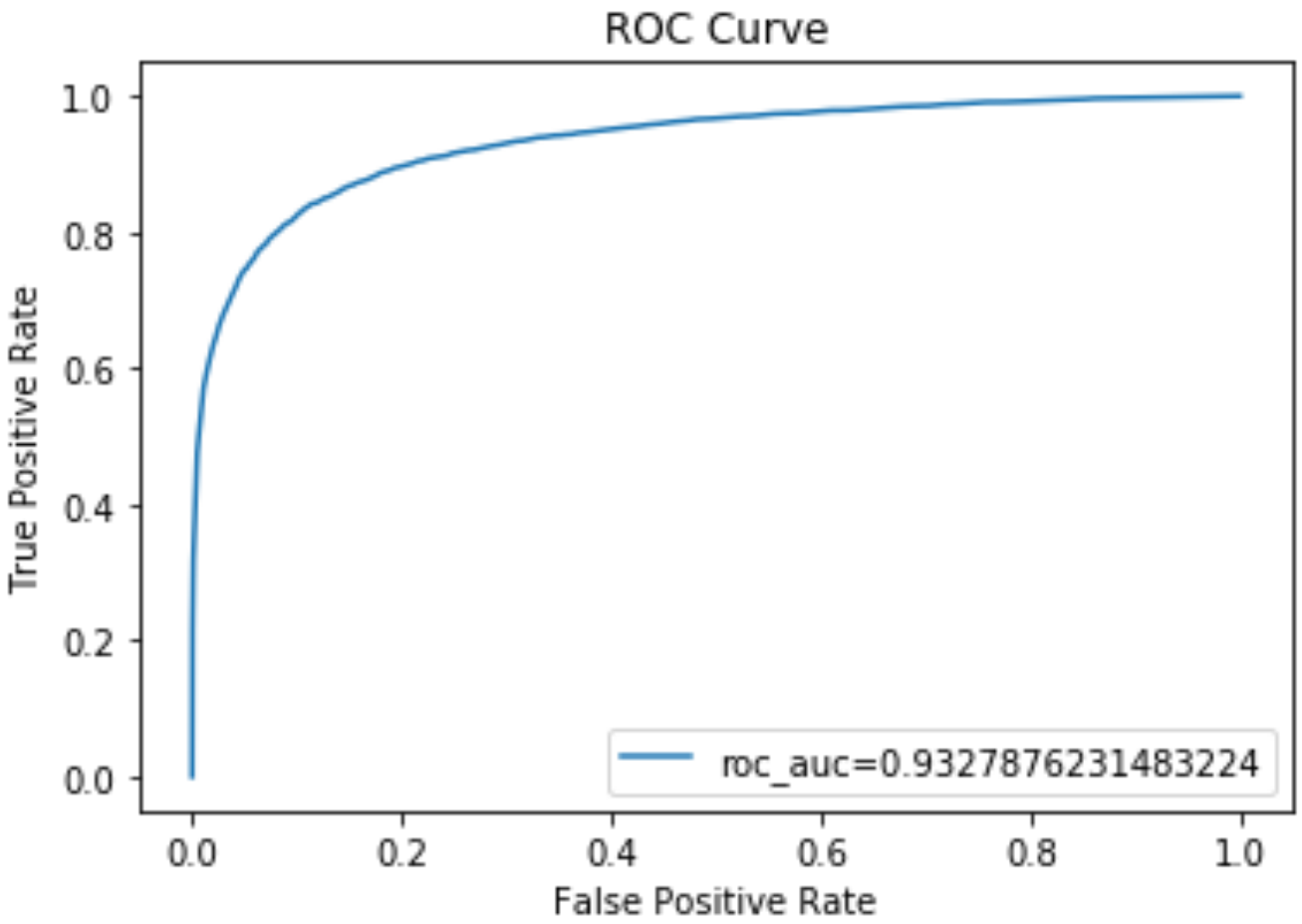
- AUC: 0.8753
- Precision: 0.14
- Recall: 0.77



Modeling

Random Forest (300 trees)

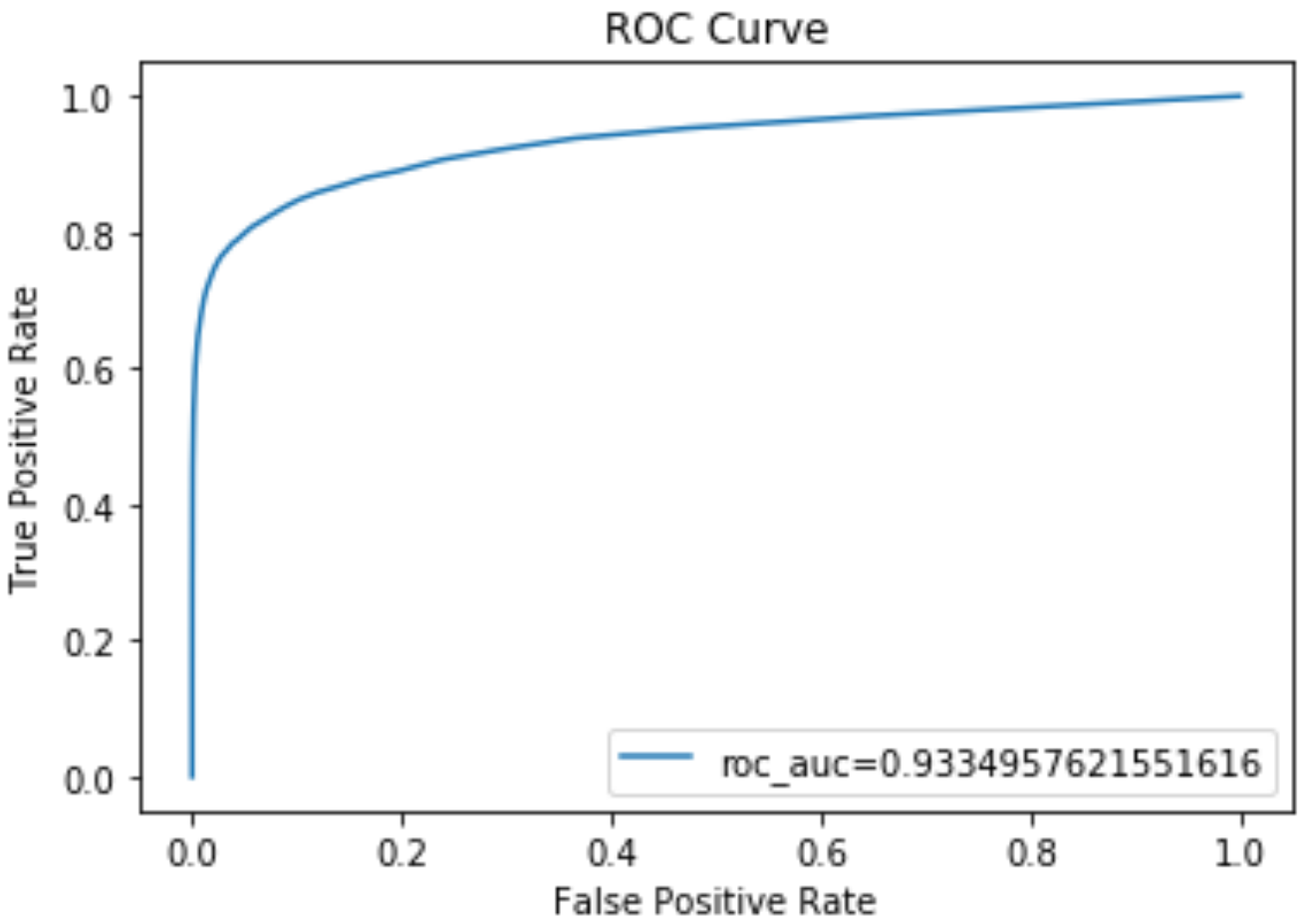
- AUC: 0.9327
- Precision: 0.21
- Recall: 0.84



Modeling

Random Forest (SMOTE)

- AUC: 0.9334
- Precision: 0.92
- Recall: 0.55



Modeling

Important Features (>= 0.03):

- I (V-feature)
- Transaction Time Deltas
- Transaction Amount
- Card1
- C13
- C14
- I0 (V-feature)

Modeling

Model	AUC	Precision	Recall
Random Forest (300)	0.9327	0.21	0.84
Random Forest (SMOTE)	0.9334	0.92	0.55