Fraud Detection
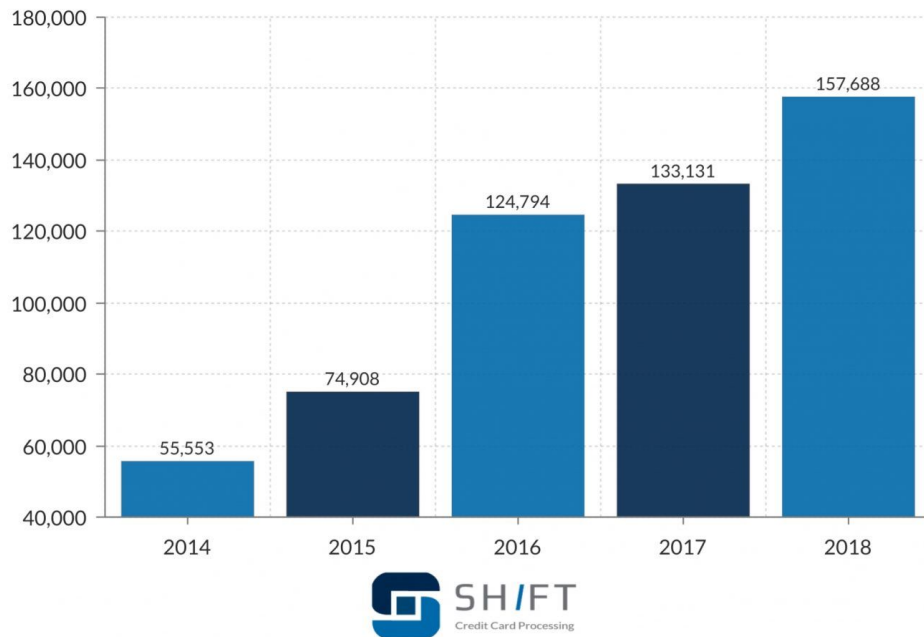## With Supervised Learning

Project 3
Benjamin Lu

Credit Card Fraud Statistics

- Worldwide losses of $24.26 Billion in 2018

- Credit card fraud increased by 18.4 percent over 2017

- USA is the global leader as the most credit card fraud prone country with 38.6 percent of reported fraud losses in 2018

Pertinent and Growing Problem that Banks want to Address

Fraud Detection Dataset

Transaction Counts
Non-Fraud: 0 - Fraud: 1

99.83%

0.173%
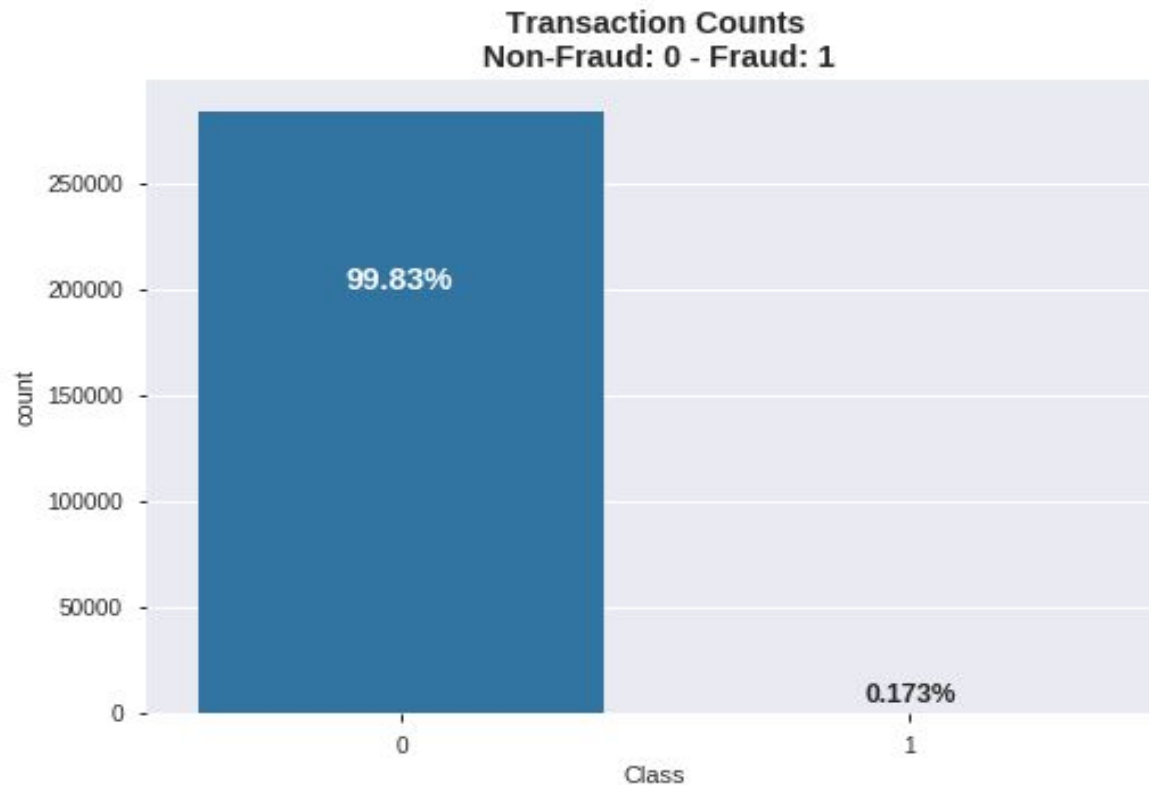
High Class Imbalance Problem

Methodology Adopted for Imbalanced Data

Data Preparation
- stratified test splits
- Standard scaling

Data Resampling
- RUS - Random Under Sampling for 50:50 dataframe
- SMOTE - Synthetic minority oversampling
- ADASYN - Oversampling near decision boundaries

Modelling & Testing
- Logistic regression, Random forests, SVC, KNN, XGBoost
- Hyper parameter tuning and cross validation

RUS - Training Results

- Dataset size: ~700

	Precision	Recall	F1-Score	AUC ROC
Logistic Reg	0.914	0.97	0.941	0.944
Random Forest	0.888	0.972	0.928	0.935
SVC	0.911	0.968	0.939	0.942
KNN	0.886	0.969	0.926	0.932
XGBoost	0.997	1	0.999	0.999

May Result in Significant Information Loss

ADASYN + RUS - Training Results
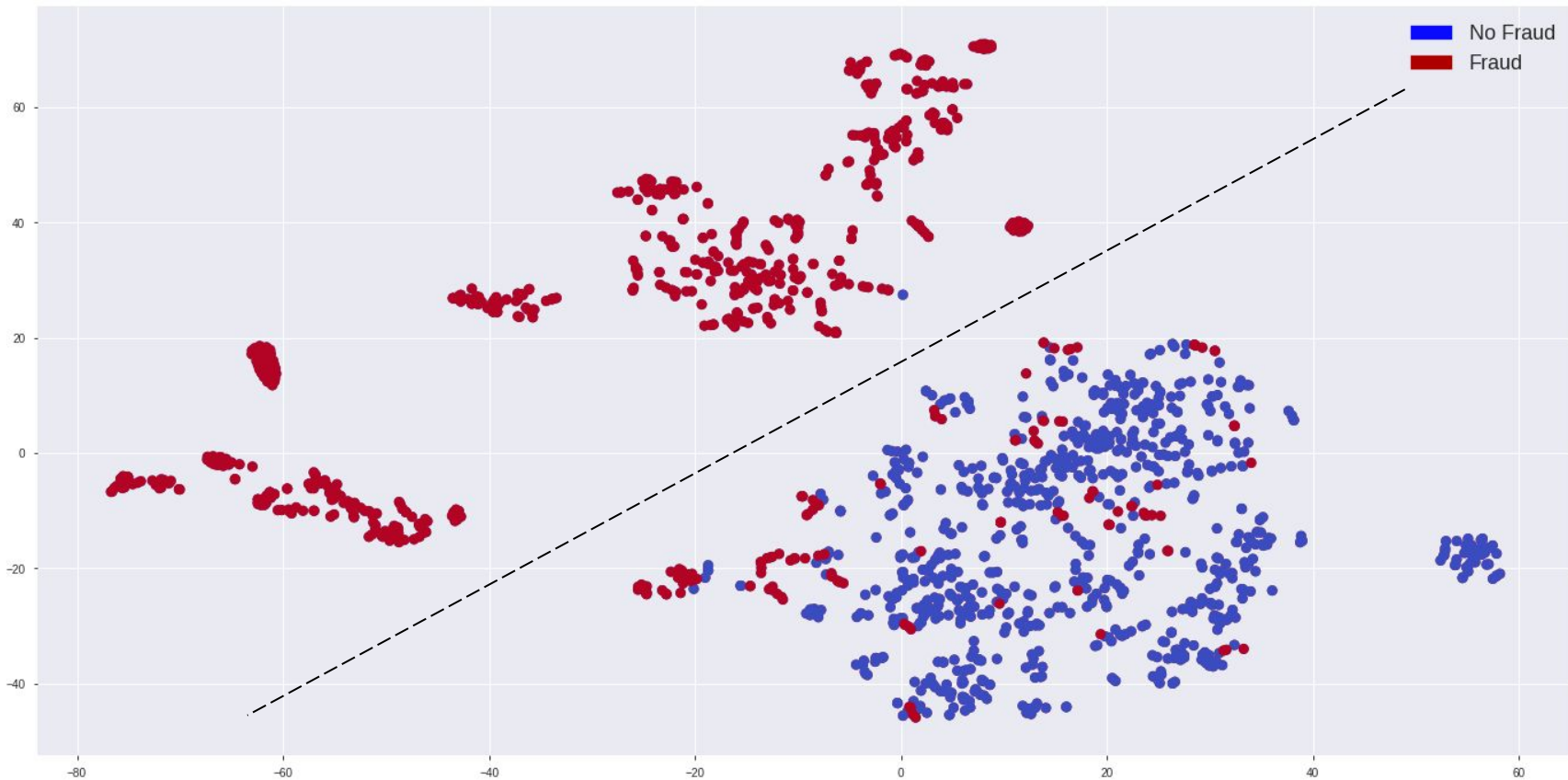
- Dataset size: ~1500

	Precision	Recall	F1-Score	AUC ROC
Logistic Reg	0.861	0.936	0.897	0.904
Random Forest	0.884	0.972	0.926	0.933
SVC	0.918	0.937	0.928	0.929
KNN	0.927	0.913	0.92	0.92
XGBoost	0.999	0.994	0.996	0.996

Results Significantly Poorer

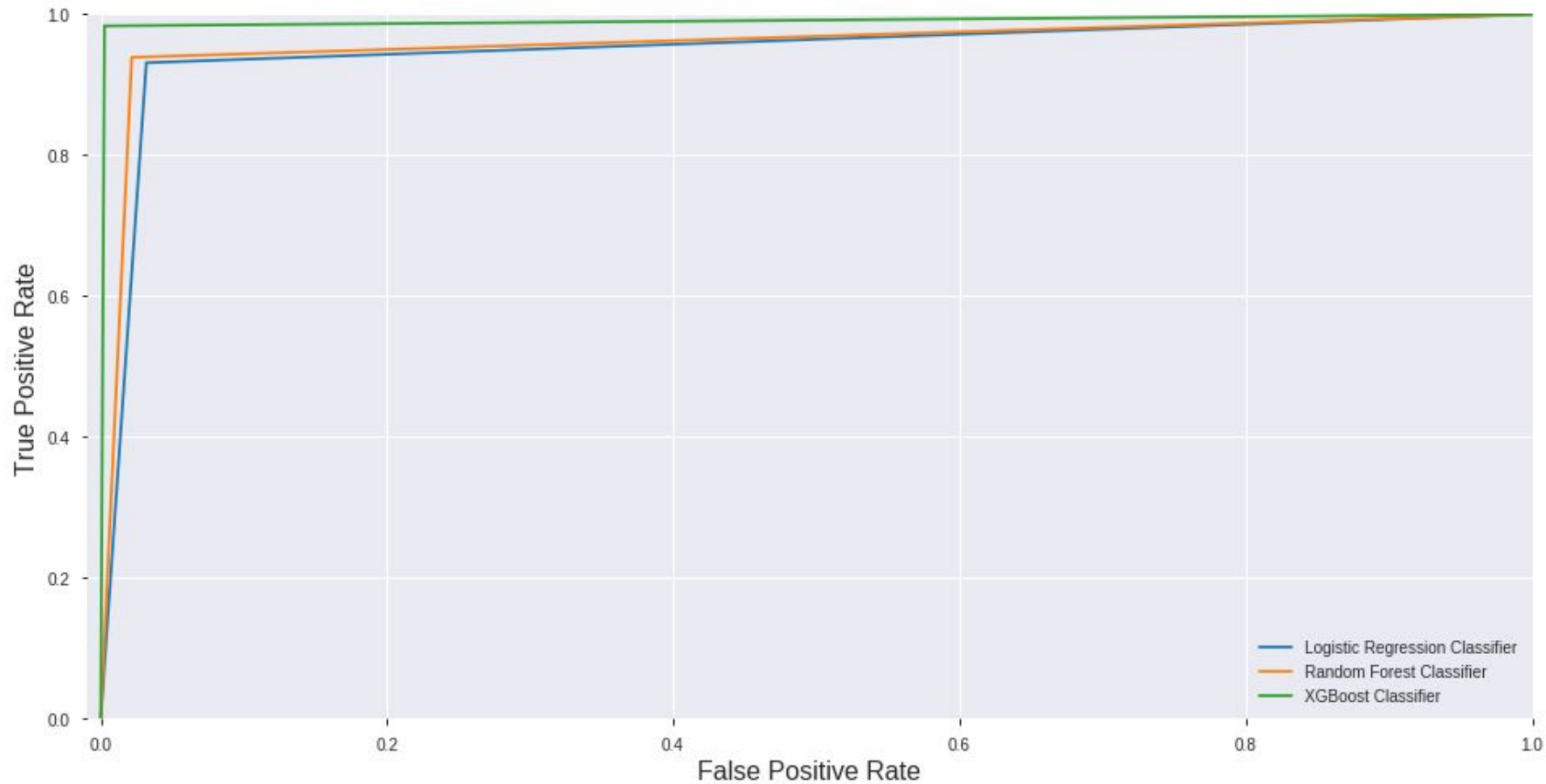# ADASYN + Random Under Sampling
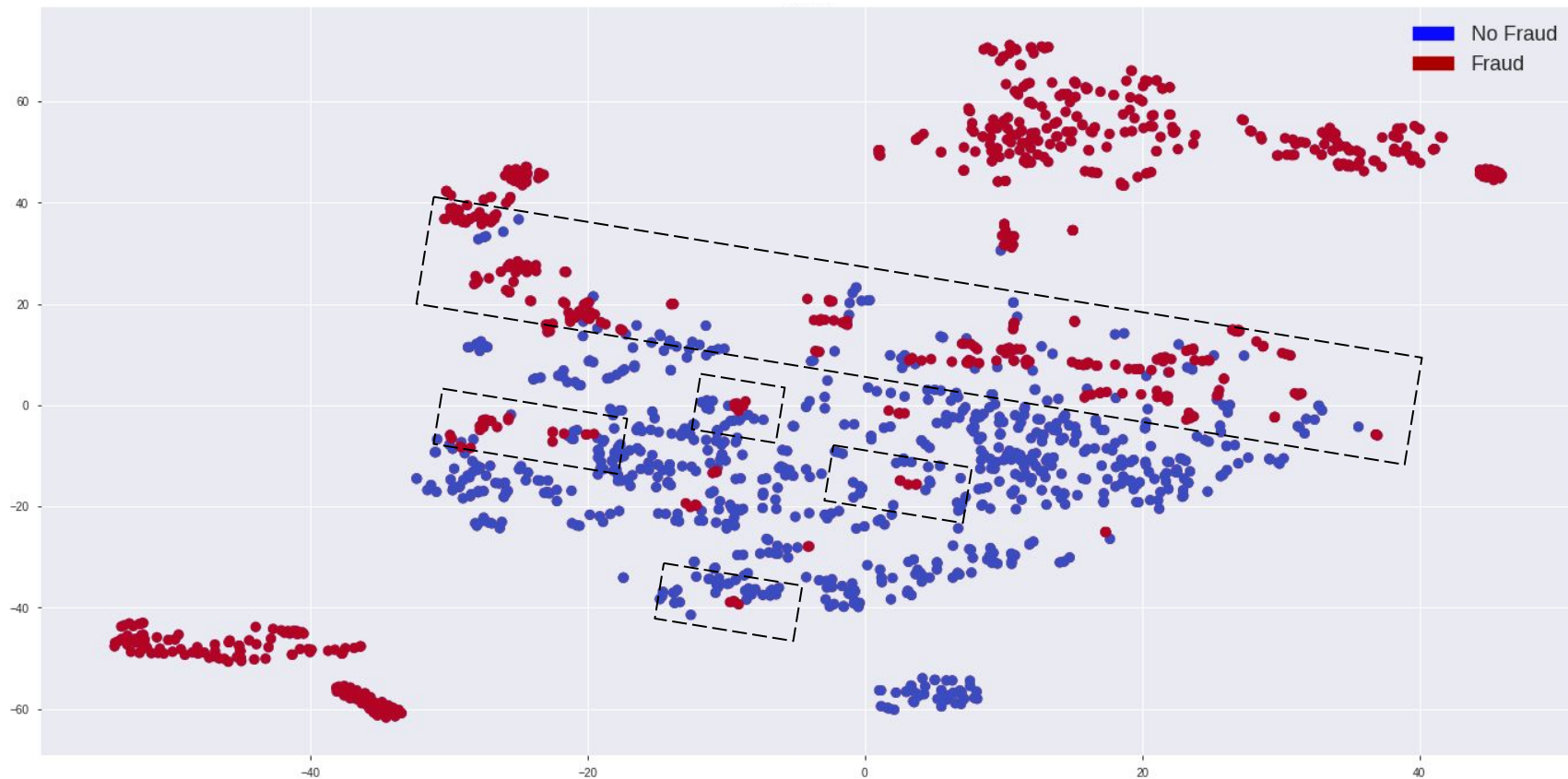
SMOTE + Random Under Sampling

Training Results SMOTE + RUS

- Dataset size: ~1500

	Precision	Recall	F1-Score	AUC ROC
Logistic Reg	**0.926**	**0.972**	**0.948**	**0.951**
Random Forest	**0.93**	**0.979**	**0.954**	**0.956**
SVC	**0.934**	**0.964**	**0.949**	**0.95**
KNN	0.938	0.951	0.944	0.945
XGBoost	0.991	1	0.996	0.996

Best Training Performance Achieved

ROC - Area Under Curve (Training)

Validating

Confusion Matrix

Prob Threshold: 0.5

	Non Fraud	Fraud
Non Fraud	5.6e+04	5.3e+02
Fraud	15	83

Prob Threshold: 0.95

	Non Fraud	Fraud
Non Fraud	5.7e+04	23
Fraud	22	76
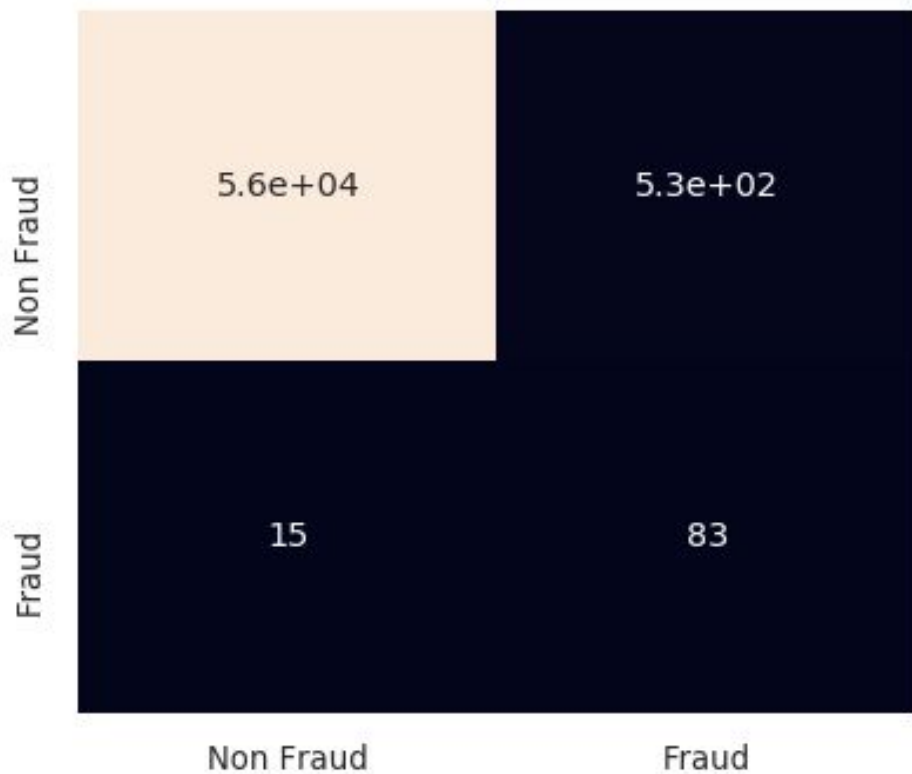
Recommendations

- Able to achieve balance between precision and recall by adjusting threshold

- Necessary to balance fraud detection as well as customer satisfaction

Further Study

More Feature Engineering
- currently model is blind to value - weight decisions by transaction value
- Outlier removal

Comparison Over Time and Variables
- Looking at Customer Profiles and determine outliers

Testing of Different Models
- Ensembling
- Artificial Neural Networks

Questions?