Fraud Detection in Electricity and Gas Consumption

Machine Learning project

Jin-Ho Lee
Veranda Osmani
Franziska Schulze Bockeloh

Outline

- **Introduction**
  - Tunisian Company of Electricity and Gas
  - Our aims
  - Introduction to dataset
  - Exploratory data analysis
- **ML Model**
  - Baseline model
  - Final models
- **Conclusion**
- **Future work**

The Tunisian Company of Electricity and Gas (STEG)

- established 1962
- public, non-administrative
- provider of electricity and gas across whole Tunisia
- second-largest Tunisian company by revenues in 2009

Significant losses of 200 million TND (about **64 million USD**) due to fraudulent manipulations of meters by consumers.

Our aims

1. **Help improve revenues** of the Tunisian Company of Electricity and Gas (STEG)

2. **Reduce the losses** caused by clients involved in fraudulent activities

3. **Detect / predict fraudulent clients** using a data science (machine learning) based model

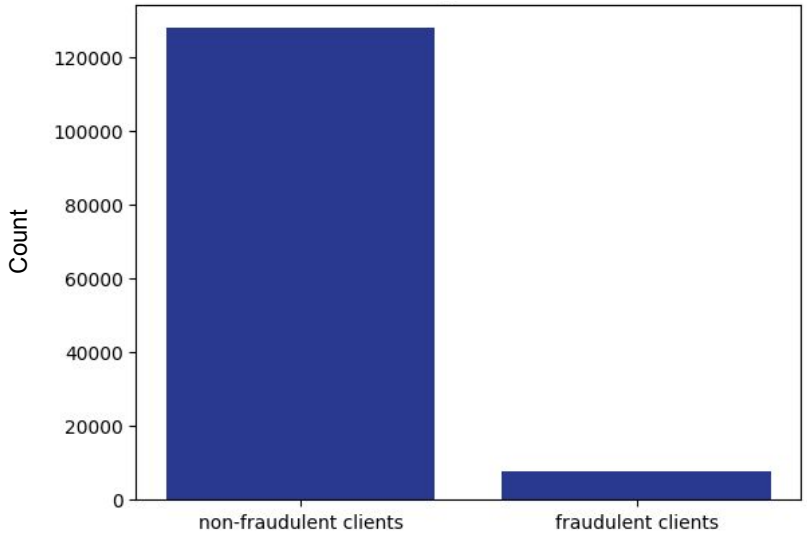
4. Maintain the company's **customer satisfaction**

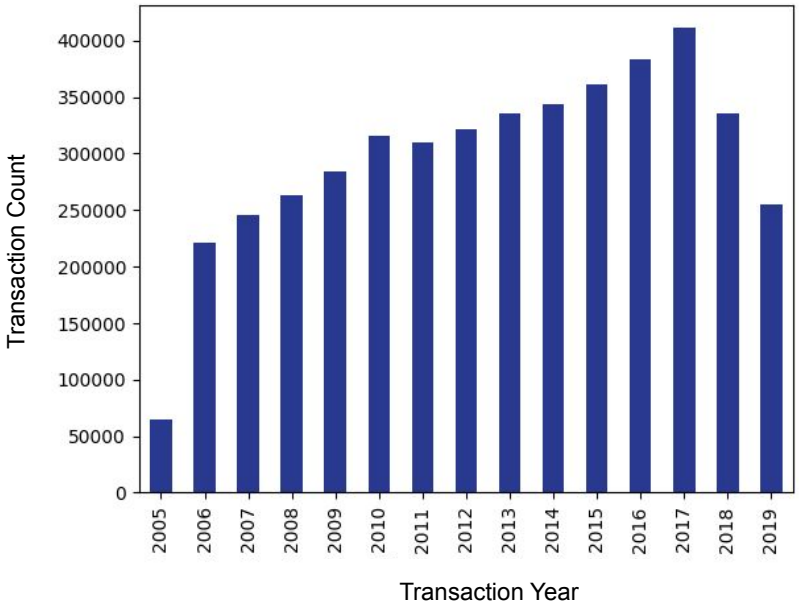
The data set

- **Billing history** of about **4,500,000 transactions** from **136,000 clients** provided in two separate data tables with:
  a. **client data** with 6 features (**fraud labels**, regional details, etc.)
  b. **invoice data** with 16 features (billing amount, payment details, **meter readings**, etc.)

- Whole time period of documented transactions: **2005 - 2019**

Exploring the data





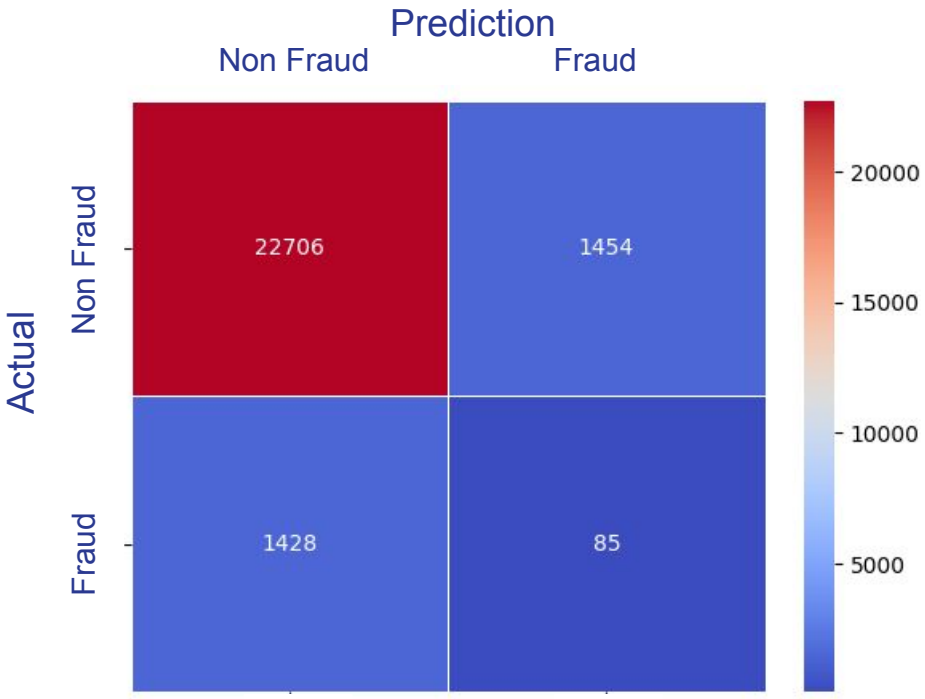
The trend of transaction count over the years.

Due to the
1. **high imbalance** in our prediction target and
2. requirement to maintain **customer satisfaction**

we decided to focus on the **harmonic mean between sensitivity and precision** (F1-score).

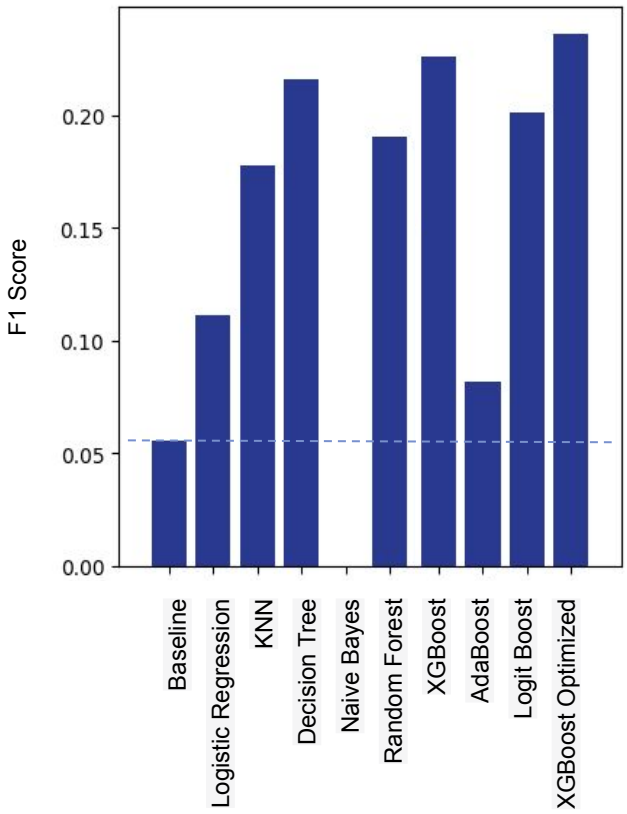
Baseline model

- Simple baseline model as **benchmark** for further machine learning models
- Use **proportion of fraud clients** for baseline
- F1-score of 0.05
- Prediction of baseline
  - **6% of fraud clients**



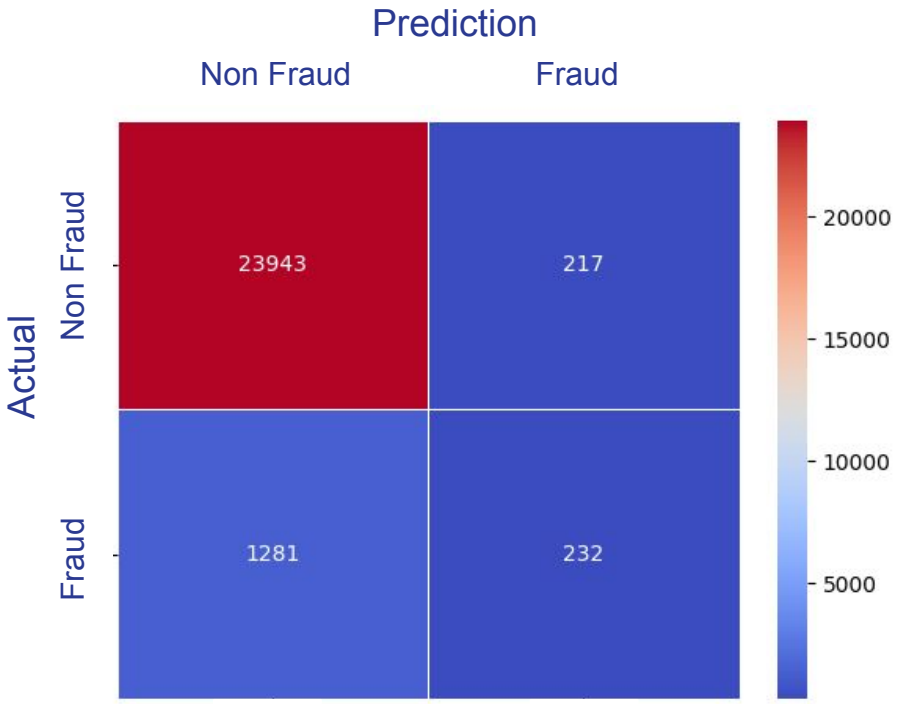
Comparison of models

- All models performed better than baseline model (except Naive Bayes)
- Improvement for **Decision Tree model**
- Further work on **boosting** of tree-based algorithms



Final model

- **XGBoost model** with optimized parameters performed best
- F1 score = 0.233
- Predictions of model
  - **15% of fraud clients** can be detected



Conclusion

- XGBoost is the best performing model for detecting fraudulent clients
- Final model of initial analysis predicts 15% of fraud clients
- Number of wrong accusation (False Positive) is low to maintain customer satisfaction

Future work

1. Extend our domain knowledge to create new variables, or transform existing variables that may be more informative

2. Data augmentation; to overcome with imbalanced data

3. Combining multiple models to make predictions, which can help to improve the f-1 and robustness of the model

Thank you for your attention!

References

1. https://zindi.africa/competitions/fraud-detection-in-electricity-and-gas-consumption-challenge
2. https://towardsdatascience.com/baseline-models-your-guide-for-model-building-1ec3aa244b8d
3. https://scikit-learn.org/stable/supervised_learning.html#supervised-learning

Back-up

Feature Importance