Fraud Detection using Machine Learning

The goal of this project is to build a machine learning model to detect fraudulent financial transactions and provide actionable insights for fraud prevention.

Project Overview

- **Business Problem:** Financial institutions face huge losses due to fraudulent transactions. The task is to proactively detect fraud using machine learning.

- **Dataset: Fraud.csv**

- **Size:** 6.3M+ rows, 10+ features.

- **Objective:**

    1. Clean and preprocess the dataset.

    2. Build a fraud detection model.

    3. Evaluate the model using reliable metrics.

    4. Identify key predictors of fraud.

    5. Suggest actionable business recommendations.

Technologies Used

- Python

- pandas, NumPy

- scikit-learn

- seaborn, matplotlib

Steps Performed

1. Data Cleaning

- Removed missing values and duplicates.

- Kept high-value outliers (important for fraud detection).

- Checked multicollinearity with a correlation heatmap.

2. Feature Engineering

- Dropped identifiers (nameOrig, nameDest).

- Encoded categorical variable type.

- Scaled numerical features using StandardScaler.

3. Model Building

- Algorithm: **Random Forest Classifier** with class weighting.

- Split: **70% training / 30% testing** with stratification.

4. Model Evaluation

- **Accuracy:** 0.999

- **Precision & Recall:** High, recall is prioritized to catch fraud cases.

- **ROC-AUC:** ~0.994 → excellent model discrimination.

- **Confusion Matrix:** Very few frauds missed.

5. Key Predictors of Fraud

- **Transaction Amount** → Higher amounts more suspicious.

- **Balances (oldbalanceOrg, newbalanceOrig)** → Fraudsters drain accounts to zero.

- **Transaction Type** → TRANSFER and CASH_OUT riskier than PAYMENT.

- **Destination Balances** → Fraud often targets empty accounts.

- **Step (time)** → Certain time clusters show unusual activity.

6. Business Recommendations

- Real-time monitoring of large/unusual transactions.

- Multi-factor authentication for high-value transfers.

- Flagging transactions into empty/new accounts.

- Automated alerts for sudden balance drops.

Results

The Random Forest model achieved:

- **Accuracy:** 99.9%

- **ROC-AUC:** 0.994

- **Strong recall for fraud cases** ensuring minimal false negatives.