

## Accuracy Analysis for Logistic Regression Algorithm and Random Forest Algorithm to Detect Frauds in Mobile Money Transaction

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### Abstract

**Aim:** The main motto of the study is to detect the frauds in mobile money transactions using logistic regression and random forest algorithms and comparing their accuracy. **Materials and Methods:** Logistic regression ( $N=10$ ) and random forest algorithm ( $N=10$ ) was iterated 20 times and detected the frauds. **Results and Discussion:** Random forest has significantly better accuracy (99.6%) compared to logistic regression (92.6%). The statistical significance of random forest algorithm ( $p < 0.018$  Independent sample T-test) is high. **Conclusion:** Within the limits of this study, random forest algorithm offers better accuracy to detect frauds in mobile money transactions.

**Key-words:** Logistic Regression (LR), Random Forest (RF), Novel Money Transactions Fraud Detection, Machine Learning.

### 1. Introduction

The purpose of this study is to detect the accuracy percentage of frauds in the money transaction process. According to the researchers, the fraud was determined as 5% of total income from every person (Boztepe and Usul 2019). Since the growth of e-commerce the fraudulent transactions also increased. In online the frauds are defined as click fraud and ad-fraud. Click fraud is a fraud when the user clicks on the link it will generate the fraud. Ad-fraud is transferring false information about something to do a fraud. It can be used in many applications like in the banking sector, stock market, anomaly detection for recognizing inconsistencies or inaccuracies in payment

and application information. (Sadineni 2020; “Detection of Fraud in Mobile Advertising Using Machine Learning” 2020)

The data for fraud detection is enormous. So, the outliers and null values are removed in data preprocessing. The huge data helps to get the knowledge about the data and gives the accurate values (Ayeb et al. 2020). There are 173 papers published on mobile money fraud detection in sciencedirect and 250 papers on google scholar and 3 papers were published in ieeexplore for fraud detection. Sadineni et al. proposed a machine learning algorithm that uses deep learning algorithms to detect the frauds that show the better significance (Sadineni 2020). Mubalalike et al. uses deep learning algorithms. It is a time taken process and obtained accuracy is also low (Mubalalike and Adali 2018).

Previously our team has a rich experience in working on various research projects across multiple disciplines (Sathish and Karthick 2020; Varghese, Ramesh, and Veeraiyan 2019; S.R. Samuel, Acharya, and Rao 2020; Venu, Raju, and Subramani 2019; M. S. Samuel et al. 2019; Venu, Subramani, and Raju 2019; Mehta et al. 2019; Sharma et al. 2019; Malli Sureshbabu et al. 2019; Krishnaswamy et al. 2020; Muthukrishnan et al. 2020; Gheena and Ezhilarasan 2019; Vignesh et al. 2019; Ke et al. 2019; Vijayakumar Jain et al. 2019; Jose, Ajitha, and Subbaiyan 2020). Now the growing trend in this area motivated us to pursue this project.

The methods which are used before have less accuracy and detection rate in frauds. Sadineni et al. implemented a new framework to find the frauds manually with the help of deep learning algorithms and achieve less accuracy (Sadineni 2020). The main purpose of this study is to develop an novel mobile money transaction fraud detection using Random forest algorithm and logistic regression algorithm. The main aim of this study is to detect mobile money transaction frauds using logistic regression and random forest algorithms.

## **2. Materials and Methods**

The study setting of the proposed work is done in Saveetha School of Engineering. The number of groups identified for the study are two. The group-1 is a logistic regression algorithm and group-2 is a random forest algorithm. Sample size for each group was calculated by using previous study results in clinical.com by keeping g power as 80 %, threshold 0.05 and confidence interval as 95%(Yu and Pan 2016; Liu et al. 2019)(Apostolopoulos and Mpesiana 2020). According to that, the sample size of logistic regression algorithm (N=10) and random forest algorithm (N=10) were calculated.

The Dataset was collected from kaggle. The dataset contains 1048576 rows and 11 columns. The dataset contains the information about the transactions and full data about the amount deducted and credited. The percentage compared to frauds and non frauds are 0.000536. Based on the payments new balance and old balance, detect the frauds by applying the algorithms. <https://www.kaggle.com/ntnu-testimon/paysim1>

## **Logistic Regression Algorithm**

Logistic regression is a supervised learning model. It takes the only discrete values for a given set of features, it uses sigmoid function to get the output. Logistic regression is a regression model. It predicts the output of a categorical dependent variable. It is similar to linear regression. The ROC curve approach, which is a rationale. (Boztepe and Usul 2019)

Input: Trained dataset

Output: Classifier Trained accuracy

#Feature Scaling

```
from sklearn.preprocessing import StandardScaler
```

```
sc_X = StandardScaler()
```

```
X_train = sc_X.fit_transform(X_train)
```

```
X_test = sc_X.transform(X_test)
```

#Fitting Logistic Regression to dataset

```
from sklearn.linear_model import LogisticRegression
```

```
classifier = LogisticRegression()
```

```
classifier.fit(X_train, y_train)
```

#Predicting the test set result

```
y_pred = classifier.predict(X_test)
```

#Making the confusion matrix

```
from sklearn.metrics import confusion_matrix
```

```
cm = confusion_matrix(y_test, y_pred)
```

## **Random Forest Algorithm**

Random forest comes under the type of supervised machine learning algorithm. It is easy, and flexible to use, which produces a greater and better accuracy. Random forest has its diversity to use

both in classification and regression problems. Random forest is the superset of trained model trees, where decision trees are subsets of the random forest. It gives best results through integration of decision trees and by reduction of error due to bias and variance. (Gawas 2019)

Input: Trained dataset

Output: Classifier trained accuracy.

```
RF_classifier=RandomForestClassifier(n_estimators=100,max_depth=15,random_state=1)
```

```
RF_classifier.fit(train_data,train_target)
```

```
train_score=Rf_classifier.score(train_data,train_target_data)
```

```
print("Training accuracy:"train_score)
```

```
test_score=RF_classifier.score(test_data,test_target_data)
```

```
print("Testing accuracy:"test_score)
```

```
RF_pred=RF_classifier.predict(test_data)
```

```
precision_RF=precision_score(RF_pred,test_target_data)
```

The software tool used to evaluate the Logistic regression algorithm and Random Forest Algorithm was google colab with python programming language. The hardware configuration was intel core i5 processor with a RAM size of 12GB. The system type used was 64-bit, OS, X64 based processor with HDD of 917 GB. The software configuration includes windows 10 operating system.

In the proposed model train the dataset and implement the classification algorithm based on the dataset. After collecting the dataset, the outliers and null values were removed. By this the data preprocessing were done. After data preprocessing the dataset is split into two parts one for training and other for testing. In the dataset 33% is split for training and the remaining 77% given to the testing process. By evaluating the algorithm with train and test sets the accuracy percentage was predicted.

The analysis was done using IBM SPSS version 21. It is a statistical software tool used for data analysis. For both proposed and existing algorithms 10 iterations was done with a maximum of 10-20 samples and for each iteration the predicted accuracy was noted for analysing accuracy. In this research transaction name, step, type of transaction and name origin are the independent variables because they are inputs and remain constant even after changing other parameters, whereas new balance origin, old balance difference and new balance difference are dependent variables because they depend on the inputs and vary for every change in the input. The analysis of the research work is done using Independent T-Test which is used to compare random forest algorithm and logistic regression algorithm to detect frauds in mobile money transactions.

### 3. Results

Sample test data to differentiate normal transactions and fraud transactions. (Fig-1). True positive rate and false positive rate is heading to top that indicates predicting levels are improving based on the number of iterations (Fig 2). The transaction history clearly detected the frauds in the mobile money transaction using logistic regression 92.6% accuracy (Fig-3). The transaction history clearly detected the frauds in the mobile money transaction using random forest algorithm 99.6% accuracy (Fig-4). Results clearly show that the Random forest algorithm got better significance than the logistic regression algorithm. The random forest model achieved precision 23.35%, recall 73.40%, accuracy 99.6% and 35.43% F1-score. Finally the proposed classifier achieved an accuracy of 99.6%. Thus, the model is able to work efficiently in detecting frauds in mobile money transactions (Table 1). The mean, standard deviation and standard error mean of random forest based mobile money fraud detection and logistic regression based mobile money fraud detection is tabulated (Table 2) which shows that Logistic regression has an accuracy mean of 97.25%, Std.Deviation.15128 for the sample size of N=10 where the Random Forest has an accuracy mean of 99.3%, Std.Deviation of.26717 for the sample size of N=10, based on the above results the statistical significance of Random Forest Algorithm is high. The mean, standard deviation and significant difference of random forest based mobile money fraud detection and logistic regression based mobile money fraud detection is tabulated (Table 3) which shows there is a significant difference between the two groups since  $p < 0.018$  (Independent Sample T Test). Bar graph is comparing the mean accuracy of a random forest algorithm based mobile money transaction fraud detection and logistic regression based mobile money transaction fraud detection (Fig 5).

Table 1-Predicted accuracy to detect frauds (random forest accuracy of 99.6% and logistic regression accuracy of 92.6%)

Algorithm	Accuracy	F1 score	Recall	Precision
Logistic Regression	92.6%	3.18%	90.42%	1.61%
Random Forest	99.6%	35.43%	73.40%	23.35%

Table 2 - Group statistics results (Mean of random forest 99.33 is more compared with logistic regression 97.25 and Std. Error mean of random forest is.0844 and logistic regression is.04784)

Accuracy	Algorithm	N	Mean	Std. Deviation	Std. Error mean
	Logistic regression	10	97.2520	.15128	.04784
	Random Forest	10	99.3370	.26717	.08449

Table 3 -Independent sample T-test result is applied for dataset fixing confidence interval as 95% and level of significance as 0.05 (random forest appears to perform significantly better than logistic regression with the value of p=0.018)

		Levene's Test for Equality of Variance		t-test for Equality of Means						
		F	Sig.	t	df	Sig.(2-tailed)	Mean difference	Std.Error difference	95% confidence interval of the differences	
									Lower	Upper
Accuracy	Equal variance assumed	6.774	.018	-21.475	18	<.0001	-2.08500	.09709	-2.28898	-1.88102
	Equal variance not assumed			-21.475	14.233	<.0001	-2.08500	.09709	-2.29292	-1.87708

Fig. 1 - Sample entities and attributes of the dataset to detect the frauds in the transaction process

step	type	amount	nameOrig	oldbalance	newbalanc	nameDest	oldbalance	newbalanc
1	PAYMENT	9839.64	C12310068	170136	160296.4	M1979787	0	0
1	PAYMENT	1864.28	C16665442	21249	19384.72	M2044282	0	0
1	TRANSFER	181	C13054861	181	0	C55326406	0	0
1	CASH_OUT	181	C84008367	181	0	C38997010	21182	0
1	PAYMENT	11668.14	C20485377	41554	29885.86	M1230701	0	0
1	PAYMENT	7817.71	C90045638	53860	46042.29	M5734872	0	0
1	PAYMENT	7107.77	C15498889	183195	176087.2	M4080691	0	0
1	PAYMENT	7861.64	C19128504	176087.2	168225.6	M6333263	0	0
1	PAYMENT	4024.36	C12650129	2671	0	M1176932	0	0
1	DEBIT	5337.77	C71241012	41720	36382.23	C19560086	41898	40348.79
1	DEBIT	9644.94	C19003667	4465	0	C99760839	10845	157982.1
1	PAYMENT	3099.97	C24917757	20771	17671.03	M2096539	0	0
1	PAYMENT	2560.74	C16482325	5070	2509.26	M9728652	0	0
1	PAYMENT	11633.76	C17169328	10127	0	M8015691	0	0
1	PAYMENT	4098.78	C10264838	503264	499165.2	M1635378	0	0
1	CASH_OUT	229133.9	C90508043	15325	0	C47640220	5083	51513.44
1	PAYMENT	1563.82	C76175070	450	0	M1731217	0	0
1	PAYMENT	1157.86	C12377626	21156	19998.14	M1877062	0	0
1	PAYMENT	671.64	C20335245	15123	14451.36	M4730532	0	0
1	TRANSFER	215310.3	C16709931	705	0	C11004390	22425	0
1	PAYMENT	1373.43	C20804602	13854	12480.57	M1344519	0	0
1	DEBIT	9302.79	C15665112	11299	1996.21	C19735381	29832	16896.7
1	DEBIT	1065.41	C19592395	1817	751.59	C51513299	10330	0
1	PAYMENT	3876.41	C50433648	67852	63975.59	M1404932	0	0
1	TRANSFER	311685.9	C19840940	10835	0	C93258385	6267	2719173
1	PAYMENT	6061.13	C10433588	443	0	M1558079	0	0
1	PAYMENT	9478.39	C16715900	116494	107015.6	M5848821	0	0
1	PAYMENT	8009.09	C10539670	10968	2958.91	M2953048	0	0
1	PAYMENT	8901.99	C16324978	2958.91	0	M3341971	0	0
1	PAYMENT	9920.52	C76482668	0	0	M1940055	0	0

Fig. 2 - Comparison of accuracy percentage (true positive rate accuracy of.98 than false positive rate accuracy of.97)

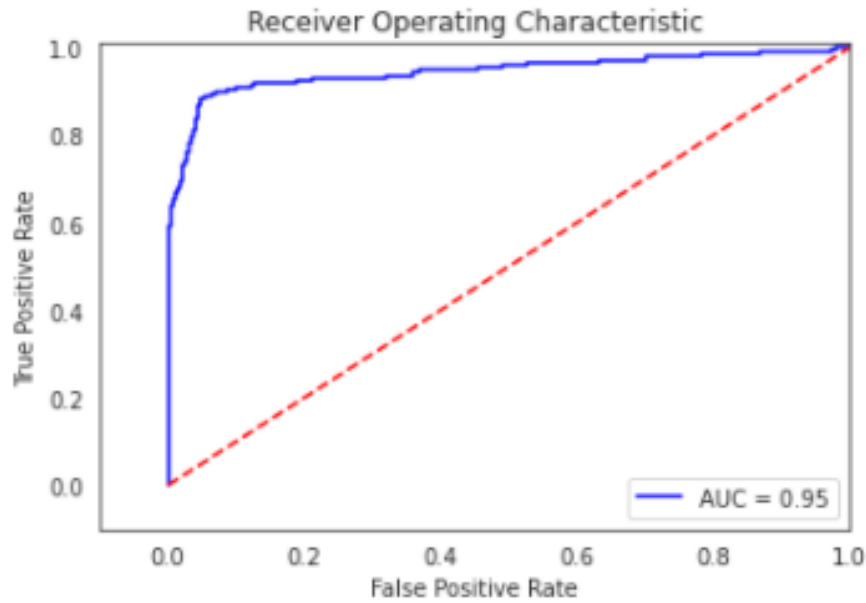


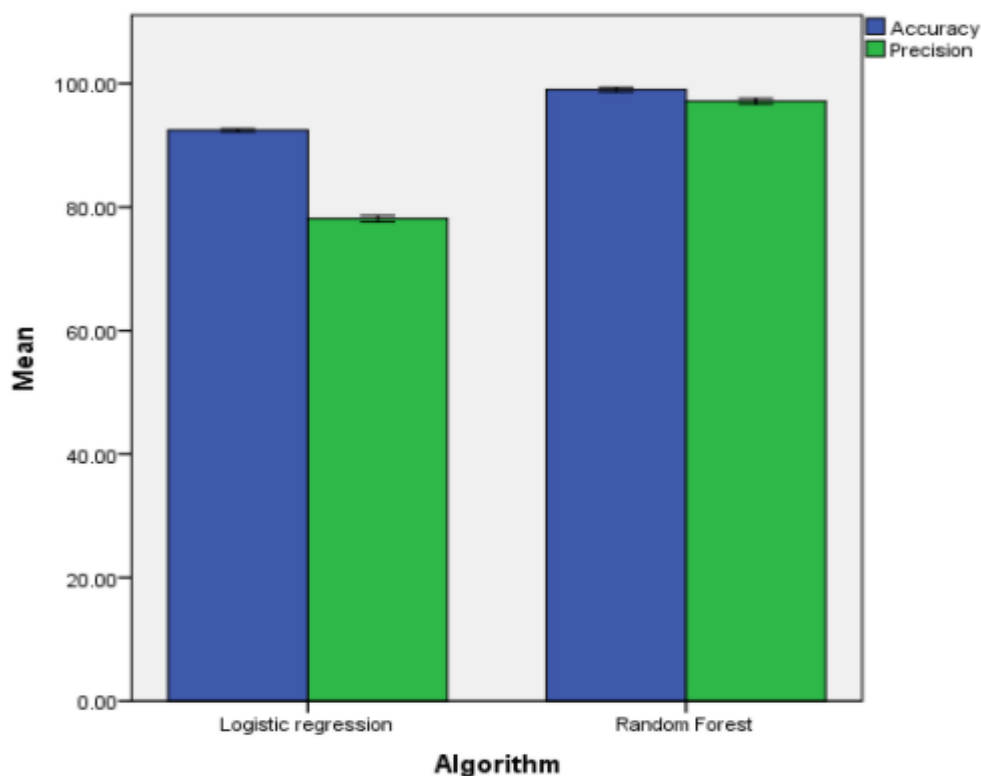
Fig. 3 - Results of logistic regression algorithm to detect the frauds in mobile money transaction process

```
Logistic Regression without applying SMOTE-  
Accuracy: 99.93097657473031 %  
Recall: 66.48936170212765 %  
Precision: 78.61635220125787 %  
F1 score: 72.04610951008645 %  
Logistic Regression with SMOTE-  
Accuracy: 92.63939885577662 %  
Recall: 90.42553191489363 %  
Precision: 1.6196646341463414 %  
F1 score: 3.182328715836765 %
```

Fig. 4 - Results of random forest algorithm to detect the frauds in mobile money transaction process

```
Random Forest Method without applying SMOTE-  
Accuracy: 99.94165030028748 %  
Recall: 57.97872340425532 %  
Precision: 97.32142857142857 %  
F1 score: 72.66666666666667 %  
Random Forest Method with SMOTE-  
Accuracy: 99.64207440298296 %  
Recall: 73.40425531914893 %  
Precision: 23.3502538071066 %  
F1 score: 35.43003851091142 %
```

Fig. 5 - Comparison of Logistic Regression algorithm and Random Forest algorithm in terms of mean accuracy and precision. The mean accuracy and precision of Random Forest is better than Logistic Regression. The standard deviation of Random Forest is slightly better than Logistic Regression. X Axis: Random Forest vs Logistic Regression. Y Axis: Mean accuracy of detection  $\pm 1$  SD



#### 4. Discussion

Random forest algorithm based novel mobile money transaction fraud detection have better accuracy compared to logistic regression algorithm based mobile money transactions fraud detection

(Sadineni 2020) et al. have implemented random forest and logistic regression algorithms to detect the frauds in credit card systems and obtained accuracy 98% (Sadineni 2020). (Mouawi et al. 2018) introduced a new framework to implement logistic regression and random forest algorithms to find the types of frauds, they used the transaction history as an ensemble classifier to detect the frauds and obtained accuracy 93% (Mouawi et al. 2018).

The factors that affect fraud detection are computational cost, dataset size, number of data in dataset and null values in data. The identification ability of the model is completely dependent on the data and its attributes; a small size of the datasets with less null values and outliers performs better convergence. Aim of this research is to develop the simple networks to reduce the computational cost (Mouawi et al. 2018; G.s. et al. 2021), these networks produce good results against large datasets. Some simple pre-trained neural networks have found difficulty in learning one class successfully with



high accuracy ((Saha, Sadi, and Islam 2021; Apostolopoulos and Mpesiana 2020). (Mouawi et al. 2018; G.s. et al. 2021; Sadineni 2020)et al have 3000 transaction histories and 7 attributes. This research used LRA and RFA classifiers to achieve accuracy of 93%. The fraud data used in this dataset is collected from various sources. The obtained transaction data may not have the same parameters and might be different from column to column. Therefore, the collected transaction history data should be similar, and maintaining consistency is important in terms of making efficient analysis and consistency (Sadineni 2020). There is no opposite finding related to this proposed algorithm.

Our institution is passionate about high quality evidence based research and has excelled in various fields ((Vijayashree Priyadharsini 2019; Ezhilarasan, Apoorva, and Ashok Vardhan 2019; Ramesh et al. 2018; Mathew et al. 2020; Sridharan et al. 2019; Pc, Marimuthu, and Devadoss 2018; Ramadurai et al. 2019). We hope this study adds to this rich legacy.

Due to the limitations such as threshold, precision and recall. The fraud data used in this dataset is collected from various sources. The evaluation of accuracy cannot provide a better outcome on larger data sets. Moreover in logistic regression, the mean error appears to be higher than random forest algorithms. It would be better if the mean error can be reduced to a considerable extent. However, the work can be enhanced by applying optimization algorithm techniques to automate the novel mobile money transaction fraud detection, to achieve a better accuracy and less mean error. Feature selection algorithms can be used before classification to improve the classification accuracy of classifiers. The feature selection algorithm can be used to reduce the computation time and improve the classification accuracy of classifiers.

## 5. Conclusion

Based on the obtained results the random forest algorithm got the better significance value as compared to the logistic regression algorithm. The accuracy of detecting frauds in mobile money transactions is done by random forest algorithm with better accuracy 99.6% as compared to logistic regression algorithm with accuracy 92.6%.

## Declarations

**Conflict of interests:** No conflict of interest in this manuscript.

## Authors Contributions

Author G.Manoj Kumar was involved in data collection, data analysis, manuscript writing. Author Dr. M. Nalini was involved in conceptualization, guidance and critical review of manuscript.

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