TOWARD TAX FRAUD DETECTION AND PRREDICTION IN EAST AFRICAN COMMUNITY USING ANALYTICS BASED ON DATA MINING TECHNIQUES

Nadine NIBIGIRA-University of Burundi,Ramadhani Ally & John Esterique ITANGISHAKA-International University of Equator, Pr Vincent HAVYARIMANA-Ecole Normale Superieure

ABSTRACT

The Revenues Authorities are the bank of confidential information from taxpayer and businesses in a digital format. They usually exchange that information with other governmental bodies. In East African Community (EAC), Revenues Authorities (RA) have put a lot of work into developing the updated systems with standards enabling the automatic exchange of information under multilateral or bilateral agreements. Much of the recent works in tax evasion detection relies on supervised machine learning techniques that leverage labelled or audit-assisted data. Unfortunately, auditing tax returns is a slow and expensive process, so access to tagged historical information is extremely limited. This paper shows that data mining methods could help the RA to fight against tax fraud. Indeed, it investigates how RA are undertaking to monitor data of their Information Technology systems and countering potential threats involving fraudulent communications aiming to steal identity and fraudulently claim tax refunds. The investigation results prove that 72% of revenues authorities already have the ability of data mining to identify tax fraud. An estimated 80% of RA will not attend the annual target if they don't well manage data and follow their income. It was evident that data mining methods have impact on existing and potential data economy. Ultimately, this study finds KNN as the best model to be used in RA to detect and predict fraud.

Keywords Data mining, analytics, advanced analytics, predictive analytics, Revenues Authorities

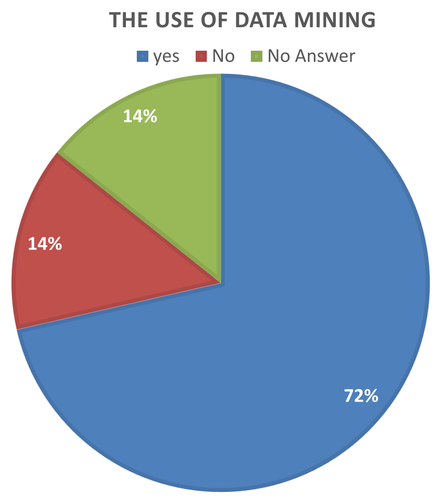
DATA GOUVERNANCE IN EAST AFRICAN COMMUNITY

African countries have started with digital growth, at the continental and regional levels, there are identifiable institutions that create or make data governance related laws, regulations or policies in Africa. This permit the deployment of data-driven technologies to transform most aspects of the daily lives and work into quantifiable data that can be tracked, monitored, analysed and monetised has become such a phenomenon that the term 'datafication' has been coined to describe it. The data governance ecosystem in Africa involves institutions that can ensure the availability, usability, integrity, security and quality of data shaped by functional regulations, contextual ethical principles and technical infrastructure.

RA across the East African Community adopt and implement the data governance and analytics policy [2]. They establish the right ability to collect, analyse, and protect data helping to increase the annual revenue. However, data governance and data analytics play an important role in the economy of data in revenue collection despite the fact that most African countries have been found to lack reliable institutions and resources to support a secure and functional data governance environment (Osakwe and Adeniran, 2021). The data governance landscape is an ever-changing ecosystem that continually needs to align with societal expectations, regulatory provisions, technical requirements and organisational objectives.
A strong data protection implementation and enforcement help foster citizens' trust and increased the use of digital tools, which in turn can lead to more investment, competition, and innovation in the digital economy. It was evident that identified gaps and needs can have impact on existing and potential data economy.

Recently, the governments of Republics of Burundi, Kenya, Rwanda, Uganda and United Republic of Tanzania desired to conclude an agreement for avoidance of double taxation and the prevention of fiscal evasion with respect to taxes on income [5]. Revenue collection from the *East African Community* (*EAC*) is under threat from increased *fraudulent* practices, commissioner-generals from the regional bloc.

This study shows that 72% of RA in EAC are using data mining, and the estimation come with the confirmation that 80% have the ability to use data mining methods for fraud detection. However, the RA are finding fraud cases by using old way. Indeed, on they define threshold values using common statistics, to split fraud and non-fraud. Those thresholds are then used on the features to detect fraud. This is common practice within fraud analytics teams. Statistical thresholds are often determined by looking at the mean values of observations.



TOWARD TAX FRAUD DETECTION AND PRREDICTION IN EAST AFRICAN COMMUNITY USING ANALYTICS BASED ON DATA MINING TECHNIQUES

Nadine NIBIGIRA-University of Burundi,Ramadhani Ally & John Esterique ITANGISHAKA-International University of Equator, Pr Vincent HAVYARIMANA-Ecole Normale Superieure

DATA PREPROCESSING

The data used covers a period of one year. It was found that ARs in EAC have already started using data analysis techniques. Clustering is performed using k-clusters based on similarities between clusters and a simple K-mean algorithm with K=2 is used. Based on the values of the attributes grouped in the clusters, it was suggested to make two groups of which **group** constitutes taxpayers who do not engage in tax cheating (Fraud) and **group 2** of taxpayers who engage in tax cheating (Zero Fraud).

The database comprises data of six RA of EAC from 2205 taxpayers, with 1.565. 089 lines (entries) and 12 columns (features).
From the database, we train 1803 taxpayers and data are labelled as “Zero Fraud” or “Fraud”, so that and we use the supervised learning.

Label	Number of Taxpayers	Entries
Zero-Fraud	1051	504.125
Fraud	752	180.383

Table1: Labelled dataset

In this data set fraudulent taxes are rare compared to normal taxes.

SUMMARY OF THE RESULT

Looking at the precision metric, the three algorithms used SVM, K-nearest neighbours (KNN) and Neural Network (NN) work very similarly and the precision was at **95.32%.**
Therefore, the recall was at **89.22%** for SVM, **72,18%** for KNN and **82.02%** for NN. And the accuracy was **98.03 %** for SVM, **99.22%** for KNN and **99.11%** for NN. we know accuracy can be misleading in the case of fraud detection. With highly imbalanced fraud data.
To decide which final model is best, we have considered how bad it is not to catch fraudsters, versus how many false positives the fraud analytics team can deal with. Ultimately, this study finds KNN as the best model to be used in RA to detect and predict fraud.

```
ROC Score:

0.9922898952689644467014 7

Classification Report:
              precision    recall  f1-score   support

           0       0.99      1.00      1.00      1051
           1       0.97      0.80      0.88       752

    accuracy                           0.99      0.72      1803
   macro avg       0.98      0.90      0.94      1083
weighted avg       0.99      0.99      0.99      1803


Confusion Matrix:
[[1800    19]
 [51    95]]
```

The model predicts 1803 cases of fraud, of which 650 are actual frauds and a very high accuracy score was found. Recall is therefore not as good as precision.

TOWARD TAX FRAUD DETECTION AND PRREDICTION IN EAST AFRICAN COMMUNITY USING ANALYTICS BASED ON DATA MINING TECHNIQUES

Nadine NIBIGIRA-University of Burundi,Ramadhani Ally & John Esterique ITANGISHAKA-International University of Equator, Pr Vincent HAVYARIMANA-Ecole Normale Superieure

DISCUSSION

The study was conduct to data mining techniques to detect and predict tax fraud practice by taxpayers in different RA of EAC.

As a result of fraud, tax revenues are compromises public investment. The detection of tax fraud has become one of the priorities in the EAC region. This is why the latter is one of the main priorities of the regional tax authorities who are required to develop profitable strategies to solve this problem.

Much of the recent work in tax evasion detection relies on supervised machine learning techniques that leverage labelled or audit-assisted data. Unfortunately, auditing tax returns is a slow and expensive process, so access to tagged historical information is extremely limited.

The fraud detection and prevention through machine learning is a collection of artificial intelligence (AI) algorithms trained with the historical data to suggest risk rules. It can then implement the rules to block or allow certain user actions, such as suspicious logins, identity theft, or fraudulent transactions. Detecting fraud in RA is essential and continuing.

The study suggests KNN algorithm which used to develop a model for predicting the annual revenue collection for RA and their performance has been compared for evaluation so as to get the best performer. According to the results there are high similarities between predicted actual data for both SVR, KNN and NN.

CONCLUSION

Tax compliance here refers to taxpayers fulfilling their registration, filing, reporting, and payment obligations correctly and on time. Intentionally failing to file personal income tax returns or filing an income tax return for natural or legal persons and deliberately understating the amount of income earned during the tax year comes up in cases of fraud. It should be noted however that KNN works very well in the when of the RA of the EAC region.

TOWARD TAX FRAUD DETECTION AND PRREDICTION IN EAST AFRICAN COMMUNITY USING ANALYTICS BASED ON DATA MINING TECHNIQUES

Nadine NIBIGIRA-University of Burundi,Ramadhani Ally & John Esterique ITANGISHAKA-International University of Equator, Pr Vincent HAVYARIMANA-Ecole Normale Superieure

ACKNOWLEDGE

First of all, we would like to thank Almighty God for giving us strength, peace of mind and good health. This study is the result of the symbiotic framework where inspiration found in many directions. We would like to thank everyone from far or near who has contributed, directly or indirectly, to this work. we believe it could not have found better ingredients for it. We hope the results will serve our common goal of improving the fight against tax evasion in the EAC.

REFERENCES

[1] STRENGTHENING DATA GOVERNANCE IN AFRICA, Project Inception Report, Centre for the Study of the economies of Africa. Sone Osakwe (Research Fellow at CSEA) and Adedeji Adeniran (Director of Research at CSEA)

[2] Data governance in EAST AFRICAN COMMUNITY

[3] Data Mining in Tax Administration - Using Analytics to Enhance Tax Compliance, Aalto University school of business, Information Systems Science Master's thesis Jani Martikainen 2012

[4] Credit Card Fraud Detection - Machine Learning methods, Dejan Varmedja, Mirjana Karanovic, Srdjan Sladojevic, Marko Arsenovic, Andras Anderla Faculty of Technical Sciences University of Novi Sad Novi Sad, Serbia

[5] Agreement between the republics of Burundi, Kenya, Rwanda, Uganda and The United Republic of Tanzania,2010

[6] Tax Reforms, Civil Conflicts and Tax Revenue Performance in Burundi, Arcade , AERC Research Paper 469 African Economic Research Consortium, Nairobi September 2021Ndoricimpa

[8] R. Sailusha, V. Gnaneswar, R. Ramesh and G. R. Rao, "Credit Card Fraud Detection Using Machine Learning," 2020 4th International Conference on Intelligent Computing and Control Systems (ICICCS), 2020, pp. 1264- 1270, 2020

[9] D. Varmedja, M. Karanovic, S. Sladojevic, M. Arsenovic and A. Anderla, "Credit Card Fraud Detection - Machine Learning methods," 2019 18th International Symposium INFOTEH-JAHORINA (INFOTEH), pp. 1-5, 2019.