Journal of Information Engineering and Applications
ISSN 2224-5782 (print) ISSN 2225-0506 (online)
Vol.3, No.1, 2013 

# Cash-lite Economy Policy Enforcement: Using Bayes' Theorem to Prevent Multiple Opening of Bank Accounts

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**Abstract**
This paper is on preventing multiple opening of bank account as a security measure, to enforce the Nigeria apex bank cash-lite policy on raw cash transaction limits and the associated penalties. The paper therefore presents a remedy to stabilise and achieve the purpose of the new cash-lite policy in Nigeria economy. The Nigeria apex bank on January 1, 2012 kicked off Nigeria's cash-lite policy using Lagos as pilot city. As a result, companies registered with the Corporate Affairs Commission (CAC), who before now operated two accounts namely, corporate current account and an individual savings account, opened accounts in virtually all the banks in Nigeria. The account users see the multiple opening of bank account as the remedy to circumvent the charges attached to exceeding daily cash transaction on both individual and cooperate bank accounts. This informed the proposition of Bayes' theorem, to centrally monitor, control and checkmate the customers' multiple opening of bank account at account opening desk. The Bayes' theorem is used to check each account items/particulars submitted by the account owner/user at the account opening desk, to check if it is existing already, using each items' given value stored in the database to calculate the probability of existence of such an account. The result which is probability of 'X' (P(X)) calculated where less than 0.5 ((that is if P(X) < 0.5)) would allow the continuation of the account opening process, otherwise (if P(X) >= 0.5) it will alert that the account is already existing and would prevent further opening of such an account. Results generated using Bayes' theorem shows that customers having high number of particulars equivalent with the existing customers' stored information will have high chances of existence, while those with less particulars will have low chances.

**Keywords:** Cash-lite, Cash-less, Multiple account, Bayes' theorem, Apex Bank, Central Bank of Nigeria (CBN).

## 1.0 Introduction

A Cash-lite economy is an economy whereby there is reduction in the high usage/volume of cash in circulation, thereby encouraging the use of electronic payment channels and reducing the cost of cash production and transportation. A Cash-lite society is a Society where most of the purchases of goods or services are made by credit card or electronic funds transfer rather than with cash or cheques, it is an environment where money is spent without being physically carried from one person to the other. Money is any object or record that is generally accepted as a means payment for goods and services and repayment of debts in a given socio-economic context or country (Mishkin, 2007). Money is often described as having three functions: (i) a unit-of-account function, (ii) a medium-of-exchange function, and (iii) a store-of-value function (Neil, 2004), all of which can be done in electronic mode rather than using physical cash.

## 1.1 Cash-lite Policy

The Nigeria Apex Bank has introduced a new policy on cash-based transactions which stipulates daily 'cash handling' limit and penalty. The new policy on cash-based transactions (withdrawals and deposits) in banks, aims at reducing (NOT ELIMINATING) the amount of physical cash (coins and notes) circulating in the economy, and encouraging more electronic-based transactions (payments for goods, services, transfers, etc.) (Central Bank of Nigeria, 2011).

### 1.1.1 Nigeria Cash-lite policy transaction limits and associated penalties

**Table 1: Individual accounts**

| | DAILY CASH TRANSACTION LIMIT | FEES |
|---|---|---|
| **CASH DEPOSITS** | ₦500,000.00 (Five Hundred Thousand Naira ) | 2% of excess amount over the set limit |
| **CASH WITHDRAWALS** | ₦500,000.00 (Five Hundred Thousand Naira ) | 3% of excess amount over the set limit |

**Table 2: Corporate accounts**

| | CASH TRANSACTION LIMITs | FEES |
|---|---|---|
| **CASH DEPOSITS** | ₦3,000,000.00 (Three Million Naira ) | 3% of excess amount over the set limit |
| **CASH WITHDRAWALS** | ₦3,000,000.00 (Three Million Naira ) | 5% of excess amount over the set limit |

Table 1 and Table 2 present the total daily cumulative cash deposits/cash withdrawals (including ATM withdrawals) across all accounts owned by an individual or a corporate entity (WEMA Bank, 2012).

**1.2 Cash-lite Benefits to Economy**

Through the system, users can pay utility bills, school fees, hotel bookings, and house rents, among other transactions, using a mobile phone device. One important thing about mobile money is the fact that it thrives on agency network, thereby taking traditional banking and its cumbersome processes in the cities to the streets in sub-urban areas where accredited mobile money agents also operate (This Day, 2012). A Cash-lite economy enforces law, prevents corruption, promotes literacy, reduces crime committed with cash, promotes e-business, creates jobs, enhances banking ethics and so on

A cashless or mixed economy reduces risk level in lending transactions. This allows the lender to place more priority on the viability of the transaction; furthermore, the domiciliation clause in lending transactions will have better security value. This is because it will be easier for the lender to know when the business proceeds are not being routed through the transaction account. It is an obvious improvement on the status quo, as at today a significant percentage of the bad loans in our banks are fallouts of borrowers default on domiciliation clauses in contracts, the policy will enhance the efficacy of monetary policy operations and economic stabilisation measures and balance genuine currency transaction demands and speculative market behaviours, as at March 2011, currency in circulation stood at ₦1.42 trillion, while that outside banks' vaults, stood at ₦1.025 trillion as at February, 2011. Cashless banking is the route to financial inclusiveness and inclusive development (Business Day, 2012).

On individual basis, corporate and natural actors in the system would be more rational in their planning and implementation of management policies. It would further curb cheating and economic sabotage within the system, in such sectors as the electricity energy sector, Petroleum and so on; people will actually be made to pay for what they consume. Cash-based transaction indulges people to live beyond their means and also encourages dishonesty in transactions. A cashless regime on the other hand encourages people to work harder to enable them earn more. Where this is the case the impact of the policy on the country's GDP and GNP is better imagined. Using the Ghana-must-go-bags to carry money during the business transactions, particularly in public places will be totally eliminated. Coming down to the Nigerian context the target, is getting the cost reduced by 30 per cent in three years through enforcement of four-pronged initiatives namely reduction in cash management cost, enhanced electronic payment system, Information Technology and centralised back-office systems. The proposal is not to place limit on cash transactions, but to ensure that customers who make high volume cash transactions bear the associated cost, if they choose to ignore electronic payment channels.

The policy is commendable given the fact that transactions in goods and services in the Nigerian economy are heavily cash-based. This imposes enormous costs on the banking system and customers in form of high rates and other charges. According to the CBN, the direct cost of cash management to the banking industry in 2009 was ₦114.5 billion, with an estimated cost of ₦192 billion by 2012. The spiralling cash management cost, most of

which is passed to customers in the form of bank charges and lending rates, is as a result of the country's cash dominant economy (Business Day, 2012).

### 1.3 Disadvantages of Cash economy

In Nigeria, almost everything is paid for in cash. In supermarkets, cheques are hardly accepted, and when applied, delivery of goods and services is only completed when the beneficiary gets value from the bank. Therefore, Nigeria has remained a cash-based economy, despite the growth in the country's banking sector, the billions of naira invested in electronic banking over the years, and the cost of handling cash which is eating into banks' profits and liquidity on which banks will be spending ₦192 billion on cash handling by this year, noting that this would be passed on to customers in terms of fees and interest charges. The Nigeria Apex bank then adopted the measure of cash-lite economy to curb dominance of cash in the economy, with its attendant implication for cost, security and money laundering, among others. According to This Day live (2012), "it is estimated that over 70 per cent of cash in circulation in the Nigerian economy exists outside the formal banking system". This means government spends a lot of money replacing cash with new ones; this has cost implications for the economy. Moreover physical cash has life span; it gets destroyed easily. If cash is not in the formal system it cannot be used for lending, but if you know an aggregate that is how much money is available to kick-start the economy, it makes lending and production easier (BusinessDay, 2012). And, the disadvantages of transacting businesses with cash, outweighs its advantages, noting that in 2009, the total cost spent on cash-in-transit was ₦27.3 billion, while cash processing stood at ₦69 billion. The high cost of processing cash, revenue leakages, and inefficient treasury management, among others, are some of the negative side of a cash-based economic system (Michael, 2011).

High usage of cash results in a number of challenges across the whole banking system. Some of them include robberies and cash-related crimes; high cost of processing borne by every entity across the value chain (that is, from Apex Bank, to banks, to the operating entities as well example, staff required to process cash transactions will manual operate the process); revenue leakage arising from significant handling of cash; inefficient treasury management due to nature of cash processing; limitations of monetary policy due to high volumes of cash outside the formal economy, and this encourages money-laundering, terrorist funding, among related acts. To address these challenges, the cash policy was introduced to encourage cash-lite payments.

### 1.4 Factors militating against the development of the cashless policy

Among the factors militating against the development of the cashless policy are Issues instituted from infrastructural and technology instability (Guardian, 2012), Multiple opening of Bank account to boycott over limit daily cash transaction policy penalty and the Security issue, specific needs of the consumers is that they want low-risk, maximum security payments services that preserve the confidentiality of any private information (Nick, 2008).

### 1.5 Cashless policy

Over the course of history, there have been many different forms of payment systems.
Originally, barter was quite common. Eventually, various forms of money were introduced. In the mid-twentieth century, charge cards debuted. Ever since then, pundits have been predicting the demise of paper instruments and the emergence of a "cashless society." Today, we still pay with cash and checks, but several other payment instruments, such as credit and debit cards, are widely used. The use of paper money is declining, but at a slow pace.

As more payment systems have been introduced, researchers have begun to critically examine their costs from both a private and social perspective. From a private perspective, researchers have examined the incentives payers have for choosing a given type of payment instrument, the incentives retailers may have for accepting such instruments, and why various payment methods are used in different settings. From a social perspective, researchers have examined whether economic welfare would increase if certain payment instruments displaced others such as, if electronic instruments displaced paper-based instruments (Daniel, Robert and Anne, 2004).

### 1.6 Electronic mode of payment in use

According to the research conducted by Business Day (2012), for the lower segment, 61.2% said they have ATM cards and use them. Only 10% said they don't have and do not want. It was discovered also that it is more likely for the Top/middle segment individuals to have more than one account (70% of those in this segment have at least three account) than for a low segment individual. The Top/middle segment refers to highly educated individuals who have

a minimum of HND (Higher National Diploma) education. In most cases these individuals are acquainted with and use the internet. The lower class is made up of those with lower educational qualifications.

### 1.7 Offsite ATMs return

The Nigeria Apex bank has also reversed its earlier directive to banks to withdraw their offsite ATMs in airports, hotels and eateries. Citing the new cash limit policy, it said banks can now deploy ATMs outside their premises. Findings have shown that banks have started deploying ATMs and PoS terminals in strategic points, like shopping malls, airports, higher institutions of learning and busy markets to make cash readily available to customers. Managing Director/CEO of one of the Nigeria commercial bank, said the bank is putting in place everything needed to achieve a 'Cashless Lagos'.

## 2.0 Problem statement

In the last three months, about 20 companies that have registered with the Corporate Affairs Commission (CAC) and who before now, operated only two accounts, a corporate current account and an individual savings account, have now opened accounts in virtually all the banks in Nigeria in order to circumvent the cash-lite policy the Central Bank just introduced (The Nation, 2012). Individuals and corporate organisations have found an alternative to the Nigeria Apex bank policy on cash-lite economy by opening multiple bank accounts and now spread their money across those multiple opened banks account to avoid the cash-lite economy daily cash transaction limit and penalty. Hence, the result is a gap between the Nigeria Apex bank policy on cash-lite economy and what is operating in the society, and limited studies have been conducted to address this problem. Therefore, the study reported proper solution to multiple opening of bank account.

## 3.0 Research methodology

This study proposes a centralised uniform account controlling by the Apex bank whereby the Bayes' theorem will be used to calculate the probability of existence of an account that is about to open. Based on the account users supplied data/items/particulars, the Bayes' theorem will check for the existence of each users' data/items/particulars supplied at the point of opening an account and if such an account does exist, its stored chance value will be withdrawn from the database where stored and used to calculate the probability of existence of such account using the Bayes' theorem stated below (each of the data items would have been given a chance value that will be used to calculate the probability(P(X)) using Table 3 below). If the result of the probability value calculated (P(X)) < 0.5 the account opening process will continue otherwise (that is if P(X)>=0.5), the opening process will be halted immediately. The 0.5 is being used as value to determine/predict the existence of an account being the significant value.

### 3.1 Bayes' theorem

The formula below is the Bayes' theorem used to calculate the value "P(X)" used in determining the existence of an account at the account opening desk.

$$p(a,b,c...z)=\frac{a*b*c*.....*z}{a*b*c*.....*z+[(1-a)*(1-b)*(1-c)*.....*(1-z)]}$$

Where:

***a*** *= is the first item/particular/data supplied by the customer at the account opening desk and found existing already in the database e.g. first name.*

***b*** *= is the second item/particular/data supplied by the customer at the account opening desk and found existing already in the database e.g. middle name.*

***c*** *= is the third item/particular/data supplied by the customer at the account opening desk and found existing already in the database e.g. last name.*

***z*** *= which is the last item/particular/data supplied by the customer at the account opening desk and found existing already in the database e.g. address.*

The above theorem can be broken into $x_1$ or equation 1, $x_2$ or equation 2, later form up P(X) as shown below:

$\mathbf{x_1}$ = a*b*c*…….*z ……..eqn (1)

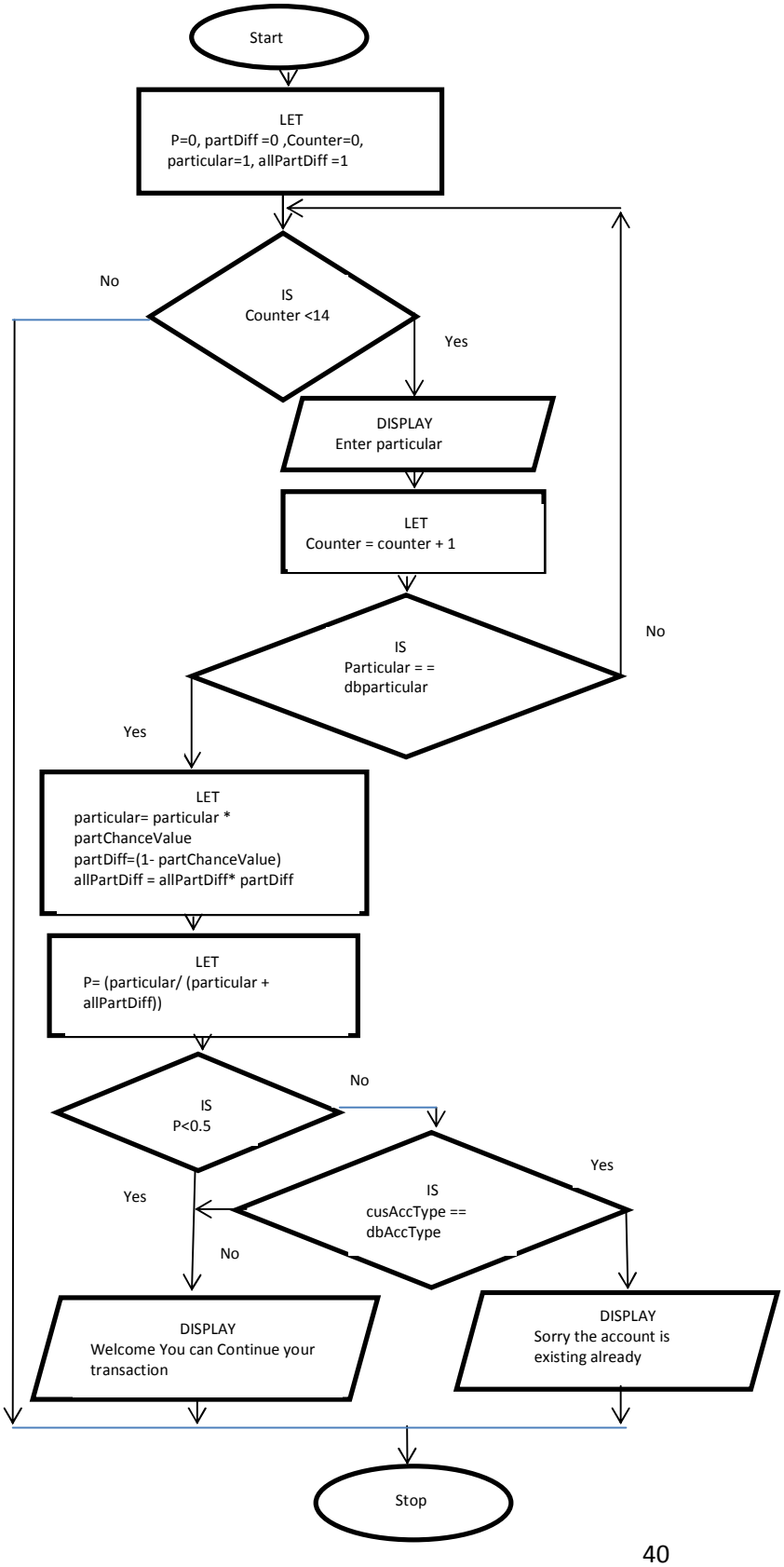
$\mathbf{x_2}$ = (1-a) * (1-b) * (1-c) * ……* (1-z) …….. eqn (2)

Then form up the P(X) shown below from both $x_1$ and $x_2$ or equation (1) and equation (2) above

**P(x)** = ($X_1$ / ($X_1$ + $X_2$ )) or **P(x)** = (eqn1/ (eqn1+ eqn 2))

### 3.2 Research Flowchart Algorithm




### 3.3 Bayes' theorem Experiment

**Step 1**
LET
P=0, partDiff =0, Counter=0
particular=1, allPartDiff =1
End
**Step 2**
Input: enter customers particular
End
**Step 3**
If particular entered = database stored particulars
particular = particular * partChanceValue
partDiff = (1- partChanceValue)
allPartDiff = allPartDiff * artDiff
P = (particular / (particular+allPartDiff))
End
**Step 4**
If P < 0.5, then
Display: Welcome, You can continue your opening transaction
End
**Step 5**
Else if cusAccType = = dbAccType, then
Display: Sorry the account is existing already
End
**Step 6**
Else
Display: Welcome, You can continue your opening transaction
End.
Source: Field work

### 4.0 Discussion

Table 3 below was used to calculate the chance value based on the suggested possible combination of six particular set of account users outcome.

Below is the possible combination of items in a particular occurrence:

**Table 3: Possible combination of data items (Chance value)**

| s/n | Item/ Particular | $C_1$ | $C_2$ | $C_3$ | $C_4$ | $C_5$ | $C_6$ | n | Frequency(f) | Mean= $(f/n)$ | 1-$(f/n)$ (Chance value) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | First name | ✓ | | ✓ | | | | 6 | 2 | 0.3 | 0.7 |
| 2 | middle name | ✓ | | | ✓ | | | 6 | 2 | 0.3 | 0.7 |
| 3 | last name | | | ✓ | | | ✓ | 6 | 2 | 0.3 | 0.7 |
| 4 | date of birth | | ✓ | | | | | 6 | 1 | 0.17 | 0.83 |
| 5 | sex | ✓ | ✓ | ✓ | | ✓ | ✓ | 6 | 5 | 0.83 | 0.18 |
| 6 | next of kin | | | | | ✓ | | 6 | 1 | 0.17 | 0.83 |
| 7 | occupation | ✓ | ✓ | | ✓ | | ✓ | 6 | 4 | 0.67 | 0.33 |
| 8 | address | | | | ✓ | | | 6 | 1 | 0.17 | 0.83 |
| 9 | account type | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | 6 | 5 | 0.83 | 0.18 |
| 10 | international passport No | | | ✓ | | | | 6 | 1 | 0.17 | 0.83 |
| 11 | national id no | | | | | ✓ | | 6 | 1 | 0.17 | 0.83 |
| 12 | Passport photograph | | | ✓ | | | | 6 | 1 | 0.17 | 0.83 |
| 13 | biometric | | | | ✓ | | | 6 | 1 | 0.17 | 0.83 |
| 14 | signature | | | | | ✓ | | 6 | 1 | 0.17 | 0.83 |

It is proposed that the result shown in the Table 3 is the possible combination of supplied six sets of account users' particulars/items, that is within a set of six customers/combination. It is possible to have 2 customers having the same first name, 2 customers having the same middle name, 2 customers having the same last name, 1 customer having unique date of birth, 5 customers having the same sex, 1 customer having unique next of kin, 4 customer having the same occupation, 1 customer having unique address, 6 customers having the same account type, 1 customer having unique international passport number, 1 customer having unique national identification number, 1 customer having unique passport photograph, 1 customer having unique biometric identification and 1 customer having unique signature. Table 3 is having the following column:

**S/n**: Means serial number.

**Item/Particular**: List of customers supplied information /particulars.

$C_1$: First customer's particulars, among the six (combination) customers supplied data.

$C_2$: Second customer's particulars, among the six (combination) customers supplied data.

$C_3$: Third customer's particulars, among the six (combination) customers supplied data.

$C_4$: Forth customer's particulars, among the six (combination) customers supplied data.

$C_5$: Fifth customer's particulars, among the six (combination) customers supplied data.

$C_6$: The sixth customer's particulars, among the six (combination) customers supplied data.

**n**: number of the given combination which is "6".

**Frequency (F)**: Number(s) of possible outcome of each particular /item within the six combinations.

**Mean (f/n):** Possible outcome of each particular/item within the six combinations divided by total combinations).

**Chance value**: This is (1-(f/n)), The frequency divided by the number of the testing combination is subtracted from 1 to make the chance value, having discovered that the particulars/item having less frequency are given lower result than those that are having more frequency which are supposed to be in the reverse case because the particulars/item with lower frequency have the higher (increase) chances of such an account to be existing.

## 5.0 Result

Based on the chance value gotten from the Table 3, those results called Chance value are to be applied to calculate the probability of existence of any (new) about to open account. The result of the research is shown in Table 4 which consists of the following columns:

**Table 4: Result**

| s/n | Item/ particular | $C_1$ | $C_2$ | $C_3$ | $C_4$ | $C_5$ | $C_6$ | $C_7$ | $C_8$ | $C_9$ | $C_{10}$ | $C_{11}$ | $C_{12}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | First name | | ✓ | | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 2 | middle name | ✓ | | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 3 | last name | | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 4 | date of birth | | | | | ✓ | | | ✓ | | ✓ | ✓ | ✓ |
| 5 | sex | | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 6 | next of kin | | | | | | | | ✓ | ✓ | ✓ | ✓ | ✓ |
| 7 | occupation | | ✓ | ✓ | | ✓ | | | ✓ | ✓ | ✓ | ✓ | ✓ |
| 8 | address | | | | | | ✓ | | | ✓ | ✓ | ✓ | ✓ |
| 9 | account type | ✓ | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 10 | international passport No | | | | | | | ✓ | | | ✓ | | ✓ |
| 11 | national id no | | | | | | | | | | ✓ | ✓ | ✓ |
| 12 | Passport photograph | | | | | | | ✓ | | | | ✓ | ✓ |
| 13 | biometric | | | | | | | | | | | | ✓ |
| 14 | signature | | | | | ✓ | | | | ✓ | ✓ | ✓ | ✓ |
| 15 | Frequency | 2 | 4 | 4 | 5 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| 16 | **P(x)** | **0.33** | **0.36** | **0.36** | **0.05** | **0.36** | **0.74** | **0.93** | **0.88** | **0.97** | **1.00** | **0.97** | **1.00** |

**S/n**: Serial number.
**Item/Particular**: This is the customer's supplied data at the point of account opening.
**$C_1$, $C_2$, $C_3$**, ……., **$C_{12}$**: These are Customer 1 to Customer 12 particulars used to test the method.
Customer 1 ($C_1$): is a particular/item customer supplied at the account opening point. The particulars/items 1 to 14 shown in the table 4 below, having checked through the data supplied by customer 1 ($C_1$), the method algorithm could find out that only two particulars/items already exist in the centralised database that is the middle name and the account type, the algorithm then retrieve from the database the chance values of those existing particulars/item and use them to calculate the probability (P(X))of such account to find out whether it is existing already or not as follow:

Using the Bayes' Theorem:

$$p(a,b,c...z)=\frac{a*b*c*.....*z}{a*b*c*.....*z+[(1-a)*(1-b)*(1-c)*.....*(1-z)]}$$

Therefore P(0.7, 0.18) = 0.7*0.18 =0.126 ……..…… eqn 1
(1- (0.7))*(1- (0.18)) = 0.246 …….. eqn 2
0.126 + 0.246 = 0.372 (Eqn 1 + eqn 2) . ……. eqn3
0.126/0.372 = 0.338 (Eqn 1 / eqn 3) Answer.
The answer is 0.33 which is less than 0.5 (significant figure).
The algorithm will allow the opening of such an account to continue since the P(0.7, 0.18) = 0.33 if the (Probability of (a,b,c,…z)) or P(a,b,c,..z) < 0.5 the algorithm will allow the continuation of opening of such an account, otherwise if the P(a,b,c,..z) >= 0.5 then the algorithm will check further if such an account type to be opened is

different from the already existing account type. The opening transaction of such an account will continue but if the account type is the same with the already existing account type and having the P(X) >= 0.5 the customer will not be granted access to continue opening such an account. Instead, the algorithm will display that the customer is already having such an account existing.

Table 4 shows that the results (P(X)) obtained for the Customers 1 to 12 (reflecting in black colour) are less than 0.5, which show that the such about to open account is yet to exist therefore the opening process of the account can continue while the results (P(X)) gotten for the Customers 6 to 12 (reflecting in red colour) are greater than 0.5 which show that the such about to open account is already existing and therefore the opening process of such an account should be halted.

## 6.0 Summary and Conclusion

Table 4 shows the results/outcome of twelve (12) sets of customers who supplied their data at the account opening desk with those ones ticked having those particulars/items supplied already existing in the database and then using the Bayesian method to calculate their existence probability (P(X)). The P(X) results shown in red colours signify that those accounts had already been opened, that is they already exist. The method can therefore applied to control and prevent multiple opening of bank account in a cash-lite economy.

## 7.0 Recommendation

The paper recommends the use of centrally control bank account with unified account number by Nigeria Apex bank, and embedded Bayes' theorem in the software program for account opening desk, which serves to control, checkmate and prevent multiple opening of bank accounts that enhance the policy of cash-lite economy in Nigeria.

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