

Budget Planning in E-banking Services

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Abstract

This paper explores the use of budget planning features as an E-banking service for monthly income earners who make use of electronic banking (E-banking) platform for their monthly expenditure transactions. In order to investigate the underlying need for incorporating budget planning as an E-banking service, a Google online survey on 155 University staff was carried out. Results show that 29% of them live above their monthly income and in dire need of a budget planner. Based on this, the monthly income and monthly expenditure were modeled using Binary Logistic regression. A computational algorithm for classifying previous transaction data of a salary earner was developed. Implementation architecture for deployment of the E-banking budget planner was also presented. A simulation carried out on 10 years classified data from bank transaction details of a salaried earner was used to train and test the model in python (spyder platform). Results show 82% accuracy in prediction of salary earner's budget for each month. The P-values for both the income (x1) and expenditure (x2) independent variables were both significant at 0.0494 and 0.0001 ($P < 0.05$) respectively affirming a linear relationship between the variables.

Keywords: Algorithm, E-banking, budget, income, expenditure, regression, simulation.

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I. Introduction

The Internet has brought a lot of innovations in the banking sector. One of such innovations is the introduction of E-banking. Internet banking allows clients to engage in banking transactions at the comfort of their homes, offices or any other place at any time of the day, regardless of physical location [1]. Some of the services provided under E-banking include; online purchases, fund transfers, bill payments, checking of account balances, checking of previous transactions, checking of statement of accounts and several others. The Internet has indeed improved the banking sector and has brought banking to our door step [2]. E-banking is fast becoming the preferred banking approach in several countries. Nigeria is not an exception. According to Statista in [3], the percentage of Internet users amounted to 47.1 percent in 2018 and is expected to rise further by 2023. A report according to KPMG Consulting firm reveals that 42 percent of Nigerians use E-banking as their preferred banking approach. Notwithstanding the rising numbers, a critical question to be addressed is whether the available E-banking and internet services are meeting the needs of their clients.

Satisfaction of clients is usually of paramount importance to host banks. One major way of ensuring client satisfaction is by improving the security of E-banking channels. Research has shown that security is a major threat to E-banking as revealed in [4],[5],[6],[7]. According to [8], the volume of deposits has increased as well as the fraudulent practices experienced by Nigerian banks since the adoption of E-banking in the economy. The persistent E-banking security challenge has necessitated increased efforts solely directed at improving the security in E-banking channels. Some of these efforts range from data mining of account holder spending behavior [9],[10] to introduction of more sophisticated hardware tools.

Apart from improved security, another way to ensure clients satisfaction in the use of E-banking channels is by identifying the needs of clients and providing satisfaction to that effect as observed by the authors in [11],[12]. The satisfaction derived from the use of E-banking is dependent on the services that are provided by hosting banks. In other words, each bank usually determines the nature of E-banking services which they can offer to their clients for their satisfaction. However, most of the hosting banks offer only the basic E-banking services which aid their clients in their transactions. The author in [13] enumerates the services available in E-banking banking to include: account enquiry, funds transfer, recharging of phones, changing of passwords and bill payment. Similar services are also provided by other E-banking platforms.

Indeed, the nature of E-banking services provided by hosting banks could go a long way in boosting their clients satisfaction. According to the authors in [14], today's E-banking require more personalised banking products and services aimed at attracting clients. Similarly, the authors in [15] recommends that hosting banks should pay more attention to the E-banking products they offer as this will attract more clients and enhance E-banking penetration. E-banking satisfaction has also been linked to the quality of service and initiative of

hosting banks [16]. It is therefore pertinent for hosting banks to introduce new and exciting services that will further enhance their client's satisfaction and improve banking experience.

Salary earners are one category of people who patronize E-banking due to their timely fixed income. According to the authors in [17],[18], E-banking saves a lot of time and is encouraged among paid employees. The authors in [19], see E-banking as an advantage in financial service deliveries. The author in [16] stipulates that E-banking channels provide the needed services for salary earners. However, one major service which seems to be missing in the available E-banking services which will certainly improve clients' satisfaction is the provision of advisory budget planning for salary earners.

E-banking services such as withdrawals, transfers, purchases and bill payment are mostly expenditure inclined. The authors in [20] also enumerate other expenditure geared E-banking services as; payment orders in lieu, scheduled payment in lieu, global payment orders used for the employees' salaries, intra-banking transfers between accounts, intern or extern currency payments and exchanges. For this reason, it is pertinent to incorporate budget planning services that will improve client satisfaction. E-banking if not controlled, could lead to unnecessary expenditure especially for fixed income earners who need to plan based on their monthly salary. The need for a control measure cannot be over emphasized as expenditure continue to outgrow income as seen in The Pew Charitable reports, which states that average expenditure for American household increased by about \$10,000 between 1996 and 2014.

One major reason why clients need an E-budget service is to control excessive expenditure. E-banking expenditure transactions for salary earners in particular seem to peak at the end or beginning of the month when their fixed monthly income (salary) arrives. During such period, cash transfers, online purchases and cash withdrawal are on the increase. As it approaches the mid month, traffic to Internet banking channels begin to reduce as most employees seem to suddenly realize that they are cash hamstrung. As soon as salaries are paid again for the new month, the spending frenzy resumes. This repeating and infectious cycle continue to deprive salary earners the ability to plan and live under their income. A major consequence of this uncontrolled spending frenzy is that salary earner who access credit facilities from host banks for investment purposes could end up using it for house hold expenditure. The authors in [21] attest to this as they attribute the increase in bad debt to customers' poor utilization of the received credit facilities. This attitude negates the recommendations of the authors in [22],[23] which stipulates that loans and credit facilities should be assessed purely for investment purposes and not to be used for routine house hold expenditure.

People tend to spend lavishly when there is money at hand. Obviously, as stated in [24], weekly-paid workers who use Prepaid Cards tend to indulge in weekend spending frenzy just like the biweekly-paid whose expenditure peaks in the weekend after the payday. Similar patterns also appear in the monthly-paid workers, though the spending pattern may peak gradually due to longer duration. It is therefore vital that advisory services are integrated into the E-banking services of host banks. This will assist salary earners in planning monthly expenditures. Carefully planned monthly expenditure on paid salary also encourages savings for the future. The authors in [25],[26] avows that proper economic planning and expenditure can positively increase both personal national income while the authors in [27] affirm that savings encourages financial growth of an individual. On the contrary, poor financial management and expenditure planning on the part of the salary earners could lead to emotional stress, marriage separation, family disputes and loss of job, among others. The aim of this paper therefore is to explore the use of budget planning features as an E-banking service for monthly income earners. The associated objectives include:

- i. To examine the relevance of having a budget planner as an E-banking service by looking at the financial status of selected salary earners.
- ii. To develop a classification algorithm for modeling previous E-banking data transactions of a salary earner in order to predict what their monthly budget could be
- iii. To simulate the behaviour of the proposed algorithm in predicting a salary earner's monthly budget in real time using classified bank statement of account data of the salary earner
- iv. To infer from the simulation the relationship between a salary earner's income and expenditure.

The rest of the paper is presented in the subsequent sections. In Section 2, we review the limitations of existing financial management and planning tools according to literature. Section 3 reviews the current E-banking services provided by top leading banks in Nigeria. Section 4 presents the architecture of the proposed system and how it could be implemented as an E-banking service. Section 5 introduces the methodology and the methods applied. The data collection procedure, application of the binary Logistic regression model used for prediction and the procedure for training the model are also presented in section 5. Section 6 presents the results while Section 7 discusses the findings on the results. Sections 8 and 9 discuss the research contributions and the recommendations for further work respectively.

II. Related Work

Every individual, corporate body, institution firm or business endeavour usually keep in place well articulated plans for tomorrow's success. Budget is often seen as an attribute of planning for financial growth especially for tomorrow. Without a budget, it is usually difficult to make tangible plans as well as assessment of the financial growth of a company or an individual. The work of [28] states clearly that planning begins with budgeting. Budget itself comes with assumptions upon which to build a future expectation. The assumptions which form the foundation of budgeting may come to pass or it may not [29]. Notwithstanding the uncertainty associated with budget projection, a plan for the future is still a welcome development in any successful venture. Budgeting can also be seen as a financial plan that includes calculating the revenues and expenses of the state, a social or economic organization for a determined period of time [30]. The essence of budgeting is for reevaluation or reassessment of the current financial situation with a view of improvement. Budgeting naturally pinpoints the basic needs as well as mere frivolities and allocates funds to achieve desired outcomes [31]. A company that ignores proper budgeting does so to its peril. A survey carried out in [32] on micro sized firms in Nigeria shows that budgets are not given the required attention by small scale business, hence they continue to experience stagnated growth. A budget planned and not implemented is also as good as no budget at all. According to the survey carried out in [33] on five construction companies in Nigeria, it was discovered that budgeting is not taken seriously and its implementation is not also monitored as it should.

Salary earners are one category of people who have the privilege of enjoying the full benefits of budgeting. The monthly salaries are usually paid as a post service rendered, hence the monthly stipend is a combination of expenditure and savings for the upcoming month. However, most E-banking services do not provide budgeting as a service. Hence, salary earners lack the tool to control over expenditure. They tend to exceed their monthly expenditure budget without knowing when they do so. Due to the limited and unpredictable income challenge as well as lack of appropriate financial tools to plan for tomorrow reported in IRP [34] working paper, it is pertinent for fixed income earners to rely on a monthly budget as an E-service coming from their host banks. The author in [35] agrees that expenditure is influenced by income emphasising the need to control excessive expenditure through budgeting.

Due to the influence of unbudgeted expenditure on the family, a study was carried out by the authors in [35] to identify the crucial variables associated with families' income and expenditure. The identified variables which include housing loan, automobile loan and educational expenditure showed high correlation with the total expenditure of a family. Notwithstanding their findings, a missing aspect of their research still emphasizes the need to explore possible ways that curtails and forestalls excessive family expenditure.

In order to curtail expenditure and improve welfare conditions, a new method of estimating household income and predicting the expenditure was introduced by the authors in [36]. The method combines the mean prediction model and was applied to a survey which is based on subsample information, to estimate the unconditional income distribution as well as the expenditure for households. However, the study does not make provision for reducing expenditure through budgeting.

Another attempt at curtailing expenditure is seen in the work of [37] which predicts household expenditure and poverty level. Neural network was employed in the work to analyse the relationship between household expenditure, income and living standard measures using the case of Iran. A unique neural network was developed to forecast and estimate household expenditures. It was observed that the application of artificial neural network (ANN) produced better prediction results. However, no attention was paid towards controlling household expenditure. Other attempts such as seen in [38] and several others also focused in predicting household income and expenditure distribution but paid no attention to budgeting on the limited income for expenditure.

A study carried out by the author in [39] reveals that most income earners do not engage in prior budgeting and planning. As a result, poverty abounds. Based on this, a research carried out by the author in [40] successfully applied Markov Chain Model to predict what could likely be the next expenditure amount of a customer using the previous expenditure. However, in their research, the monthly expenditure rate of a salary earner was seen as a fixed amount which is unlikely in real life situation as expenditure is strictly a function of income and needs. The authors in [41] also predicted customer's spending pattern using data obtained from social media. In the work, time series and machine learning models were employed to predict a customer's spending pattern up to eleven to eighteen (11% to 18%) percent accuracy. Notwithstanding their efforts, the model does not take into cognizance the fact that apart from online purchases, there are other expenditure associated transactions that customers embark on. Bank transfers, withdrawals and bill payments are also important expenditure related transactions that defines the spending pattern of a customer. Similarly, the author in [42] predicted the next month expenditure of an individual based on previous expenses. The approach used was simple linear regression which did not consider the persons income as a factor that influences expenditure. The main aim of the research carried out in [42] was to develop a system that helps in managing personal finances of the user. The output from the developed system was however limited to a specific spending amount

which a customer is bound not to exceed. In real life, salary earners are not bound to definite income or expenditure, rather they decide their expenditure based on need and their income. The authors in [43] also predicted patients' medical expenses using their previous medical expenditure. They successfully showed that medical expenditures are significantly correlated over multiple periods. However, their study is also limited to offline analysis of medical expenditure which does not provide real time results.

There are existing financial management and planning tools available to be used by salary earners to plan their budget. Unfortunately, these tools do not address the individual need of salary earners. The Popular ones include:

- Zoho Finance Plus:- This offers an end-to-end integrated platform for all your back-office operations in accounting, invoicing, inventory, expense management, and tax compliance. The Zoho suite serves especially for office and small business ventures.
- Kissflow Finance & Ops Cloud:- This gives a step by step guide to financial processes. It has a lot of pre-inbuilt modules for purchases, expenditure, invoices and purchase orders. Unfortunately, it is also designed for existing business ventures.
- QuickBoots:- This is a comprehensive financial management tool especially for small and medium businesses and accountants who need to manage their daily transactions.
- Sage Intacct:- Designed to assist small and midsize companies, in managing their ledger, expenditure accounts as well as income accounts.

Other financial management tools include Oracle financials cloud and Xero which are however specifically designed to be used by small scale business ventures. The shortcoming of the existing tools is that they are not specifically designed for individuals to use in planning their personal expenditure. It is therefore pertinent to develop a recommendation system that will advise a salary earner to know when an estimated expenditure amount for a new month is safe based on the person's previous income and expenditure. This will enable the salary earner to plan his/her expenditure and spend wisely.

III. Existing Internet service banking in Nigeria

A careful review of the E-banking services offered by nine (9) major banks in Nigeria reveals that there are no budgetary services offered by the E-banking platforms. More so, most of the E-banking services are expenditure inclined transactions which rather encourages more spending. A summary of the Mobile expenditure related E-banking services offered by these banks is shown in Table 1.

Table 1: Expenditure inclined E-banking services

S/No	Bank	USSD Code	Transfer	Airtime	Data	Wallet Pay	Pay Bills	Sports	Withdrawals	AccessPay	Promo
1	First Bank	*894#	Yes	Yes	Yes	Yes	Yes	No	No	No	No
2	GTB	*737#	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No
3	Access Bank	*901#	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
4	Fidelity Bank	*701#	Yes	Yes	Yes	No	Yes	No	Yes	No	No
5	Zenith Bank	*966#	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
6	UBA Bank	*919#	Yes	Yes	Yes	No	Yes	No	Yes	No	No
7	IBTC Bank	*909#	Yes	Yes	No	Yes	No	No	No	No	No
8	Sterlin Bank	*822#	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
9	WEMA Bank	*945#	Yes	Yes	Yes	No	Yes	No	Yes	No	No

Key: Yes = Service available, No = Service unavailable

Table 1 shows the status of E-banking services in major Nigerian banks. It can be seen that all the banks offer cash transfer as an E-banking service. Transfer is regarded as expenditure inclined service because the service usually debits initiator's account. Similarly, all the other represented services are also expenditure inclined because they will necessarily debit the initiator. The information in Table 1 is further presented as a chart in Figure 1 to illustrate the nature of E-banking services available in Nigerian banks.

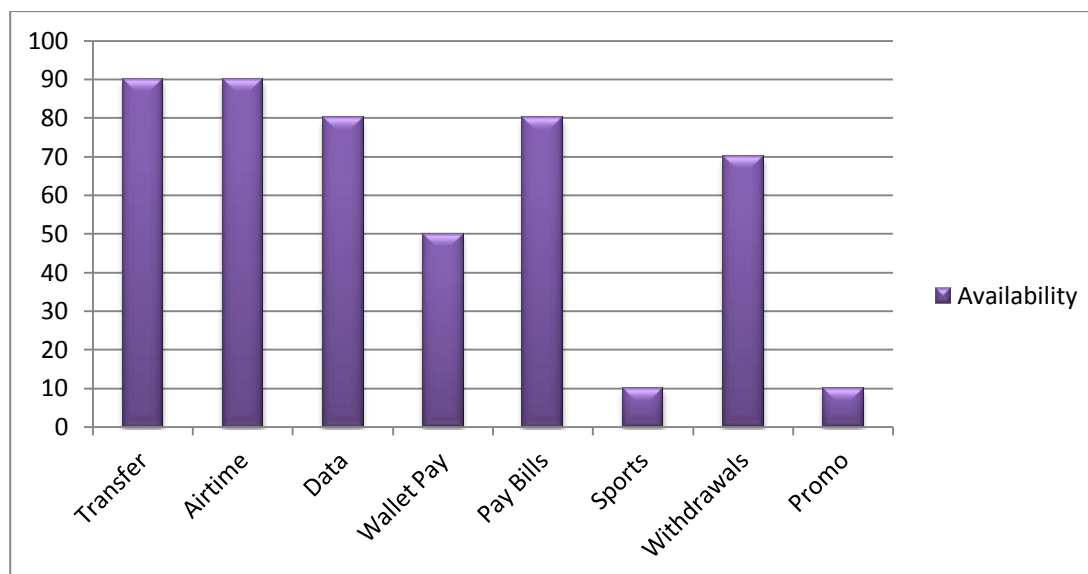


Figure 1 clearly shows the expenditure related E-banking services that exist in major Nigerian banks. It can be seen that the most common expenditure inclined mobile E-banking services are Transfer and Airtime services which every bank seem to offer. Other expenditure services such as purchasing of data, payment of bills and the use of mobile withdrawal code on ATM were also noticed to be common among these banks

A remarkable thing is that the available E-banking services seem to encourage expenditure without providing financial advice for salary earners. Sadly, some salary earners are lured into a reckless spending frenzy by these expenditure inclined E-banking services as soon as they receive their salary. There is therefore need to include an advisory E-banking service that will help such earners to live within their income and have some savings as well.

IV. Conceptualization

The transactions of every salary earner are in the custody of the host bank where the salary is domiciled. Real time access to such historical data can predict the behaviour of the salary earner in terms of what is earned and what is spent over some years. As soon as salary for a given month is paid, the budget planning E-banking service becomes available for salary earners to plan their expenditure budget for the month. A salary earner sends a tentative expenditure amount as query through the mobile or online banking platform to the host bank server through the internet. The request is sent to confirm if the planned expenditure amount is appropriate for the month considering the average income and average expenditure of previous years. The server responds to the query by providing previous transactions on income and expenditure and sends the data to the budget model which uses the data to compute a single predictive output (Safe or Unsafe) using Binary logistic regression. The predicted output is sent back as response to the salary earner who made the request. The conceptualized framework model of the E-banking budget service is given in Figure 2.

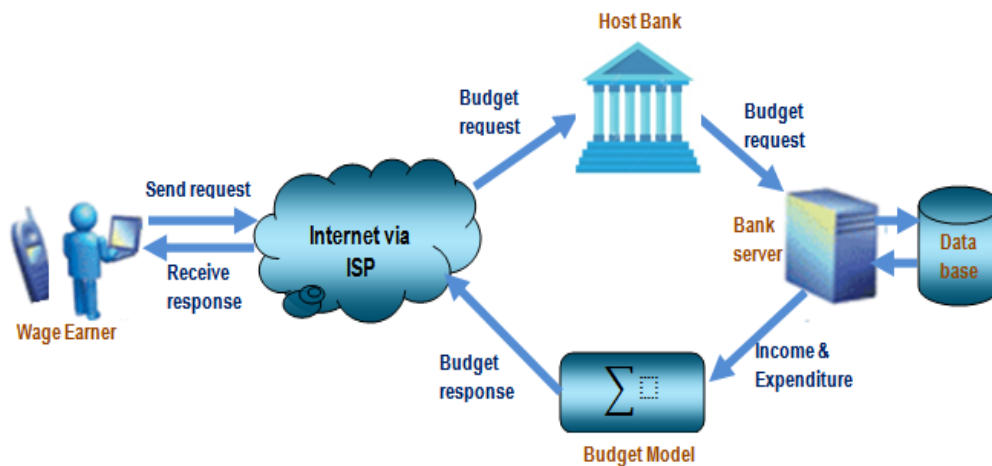


Figure 2 Conceptual framework

From Figure 2, as soon as salary is received for the month, a salary/wage earner makes a tentative and intended list of his/her expenditure for the month. The total expenditure amount will need to be verified using the E-budget service to determine if the tentative amount is a safe or unsafe expenditure for that month. Hence, the total intended expenditure amount is then sent as a query via the internet to the bank host server. The server responds by extracting the transaction history of the salary earner over the years. The monthly expenditure as well as the monthly income for a period of years not less than five (5) years is extracted from the salary earner's bank transaction history. The extracted data is then classified for each month using the proposed algorithm. After the classification, the budget logistic model is then employed and used in predicting whether the intended expenditure amount is a safe budget or not. The response is sent back to the user. If the amount returns as unsafe, the user can make modifications on the expenditure list and resend again until a safe budget is obtained.

V. Methodology

This paper adopts a mixed research approach. It combines descriptive qualitative methods with simulation quantitative method in search of solutions. The descriptive method was employed on a selected population of salary earner in order to ascertain the relevance of having a budget planner as an E-banking service. For this purpose, a Google online survey was carried out on University of Nigeria staff members who are monthly income earners and the responses of the participants were analysed. The survey questions borders on family experiences and were specifically designed to achieve the intended objective. The respondents were asked questions on issues such as; Knowledge on existence of E-banking, use of E-banking in transactions, nature of available E-banking services, existence of advisory E-banking services, transaction types, transaction rate and others. A total of 155 respondents made up of 39 academic staff, 34 technical staff, 41 administrative staff, 21 security personnel participated in the survey. A copy of the Google sheet containing the responses of the participants of the survey is available at (<https://docs.google.com/spreadsheets/d/1VZt5JZiT40EmQBxJrrMqEW6O6unH0Tuh14yhHKQpskg/edit?usp=sharing>).

The simulation approach on the other hand was used to simulate the behaviour of the proposed classification algorithm and budget planning model on a specific salary earner. Being that it is necessary to test the efficacy of the proposed algorithm that classifies a salary earner's historical transaction data before the logistic model is applied, the simulation approach was employed as a suitable approach. In addition, the simulation approach was used in order to make up for the limitation associated with acquiring classified bank transaction data. The use of the budget advisory E-banking service is individual based and depends on the previous bank transaction history of the individual. The output from the advisory model for a particular month is therefore localised to a specific individual and justifies the single simulation carried out. Based on these, a replica of a real E-budget service was simulated according to the authors in [44] using 10 years bank transaction data obtained from the statement of account of a salary earner.

VI. Data analysis

The Google survey data was specifically used to ascertain the relevance of having an E-banking budget planner for salary earners. In order to achieve the desired objectives, particular attention was given to specific questions and responses from the survey using the layout in Table 2.

Table 2: Survey Response Layout

Designation (D_i)	Bread winner (B_i)	Alternative income (A_i)	Monthly Expenditure (TME)			Monthly Income (TMI)	On loan (L_i)	ATM usage (A_i)	E-banking services (E)
			Accommodation fee (AF)	School fees (SF)	Other expenses (OE)				
D_i	B_i	A_i	AF	SF	OE	TMI	L_i	A_i	E
$\sum D_i$'s	$\sum B_i$'s	$\sum A_i$'s	AF	SF/12	OE	TMI	$\sum L_i$'s	$\sum A_i$'s	E
	A_i 's $\in B_i$'s		$TME = \frac{AF}{12} + \frac{SF}{12} + OE$						

The notation i 's represent responses that could be either "Yes" or "No" for an individual respondent.

Firstly, in order to compute the percentage of respondents who have single income source, respondents who are bread winners and who also do not have alternative income source were aggregated. This was done in order to strictly determine those who depend on their salary as a major source of income.

Secondly, in order to compute the percentage respondents who live above their income, respondents who have single income source and who are *on-loan* and who also make use of E-banking were aggregated putting into consideration the average expenditure which includes the annual accommodation fee, annual school fees and other monthly expenditure. The percentage of those who live above their income was used to determine the relevance of having an E-budget service for salary earners.

Finally, the percentage of respondents that make use of E-banking services was also computed. The results of the analysis are shown in Section 6.

For the simulation, data obtained from a salary earner's statement of account for ten (10) years (2010-2019) was used. This is in accordance with principles of budget planning advocated by [45] which stipulate that planning for revenues and expenditures require at least a five (5) year financial report. The data was classified using the proposed algorithm in Section 5.4 and the Binary logistic model was employed and coded in Spyder platform using python machine learning language. The word "Budget" in this context is used as a nomenclature that explains the outcome of both the previous monthly expenditure and the current month being predicted. A budget outcome can be either "Safe" or "Unsafe". The simulation data was used to test the proposed budget planning system. The budget planning prediction is specific to a salary earner as such the bank transaction data must also be personalised. The simulation data therefore was used to test the system on a salary earner's bank transaction data. The results are also shown in Section 6.

Similarly, data were extracted from the bank statement account of a salary earner and used for simulating the behaviour of the proposed algorithm. In order to study the expenditure pattern of a salary earner in particular, data was obtained from a salary earners account domiciled with one of the leading banks in Nigeria and used to simulate the budget planning system using python programming. The account is a salary account of more than 10 years old. The layout of the extracted data is shown in Table 3.

Table 3 Data extraction layout of bank transactions from statement of account

Trans. Date	Ref. No	Transactio Details	Value Date	Withdrwal (DR)	Deposit (CR)	Account Balance
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From Table 3, Transaction Date, Withdrawal (DR), and Deposit (CR) were extracted as fields from the account statement and used for the simulation. The data was cleaned to remove bank transaction withdrawals such as VAT (Value added tax), SMS charge, account maintenance charge and others. Care was taken to extract only withdrawal expenses initiated by the account owner. The grand total income and expenditure were obtained as (GTI) and (GTE) respectively for the ten years under consideration. The total monthly income and expenditure were also obtained as (TMI) and (TME) respectively. Finally, the grand average income and grand average expenditure were obtained as (GAI) and (GAE) respectively and used as classifier to determine safe and unsafe budget for all the transactions within the ten years under study. Using the duo classification criteria, If the monthly expenditure is less than or equal to the average expenditure and the monthly expenditure is also less than or equal to the monthly income, then the budget is classified as "Safe" otherwise, it was classified as "Unsafe". The details of the classification algorithm are discussed in Section 5.2.

VII. Algorithm for classifying bank transaction data

For the E-banking budget planning system to make any meaningful budget prediction for a specific customer, previous bank transaction details from the bank account statement is required. The bank transaction records are classified using an algorithm developed for the purpose. The algorithm is based on the fact that a salary earner should at least have some savings. This means that no monthly expenditure should exceed the average income and no expenditure should also exceed the monthly income. The condition for a “Safe” budget classification is therefore given in the Boolean equation as follows:

$$\text{Budget}_{\text{safe}} = \begin{cases} \text{Total Monthly expenditure} \leq \text{Grand Average Expenditure} \\ \text{Total Monthly expenditure} \leq \text{Total Monthly Income} \end{cases}$$

The algorithm for the classification is presented as follows:

```
i. For (i = 1; i ≤ ten_years; i++){
  Compute grand_total_income(GTI);
  Compute grand_total_expenditure (GTE);
}
Compute grand_average_income (GAI);
Compute average_grand_expenditure (GAE);
ii. For (i = 1; i ≤ month_end; i++){
  Compute monthly_income (TMI);
  Compute monthly_expenditure (TME);
}
iii. if (TME ≤ GAE and TME ≤ TMI){
  Monthly_budget_classification = "Safe"; }
Else{
  Monthly_budget_classification = "Unsafe"; }
```

VII. The prediction model

The Binary logistic model is a well known machine learning model which is used to predict the class a particular entity belongs to. Binary logistic regression has only two classification output which could be 1 or 0 (true or false). Logistic regression generally is a special case of linear regression which makes use of the Sigmoid function/curve for prediction. For the proposed Binary Logistic regression model, we first obtain the regression equation using the following definition:

Definition 1:

Let TMI represent the first independent variable which is the total monthly income (previous balance inclusive) and let TME represents the second independent variable which is the total monthly expenditure, then Y (Monthly budget) which is the dependent variable of interest represents the output classification “Safe” or “Unsafe” (1 or 0). When the output is safe, then the total monthly income and the estimated planned total monthly expenditure amount will produce a good budget. Then formally, linear regression equation for the model is given as:

$$Y = \beta_0 + \beta_1 TMI + \beta_2 TME \quad (1)$$

Where

- B_0 is the Y-intercept, which is basically the point on the line which touches the y-axis.
- B_1 is the slope of the line (the slope can be negative or positive depending on the relationship between the dependent variable and the independent variable.)

The Sigmoid function on the other hand is given as: $p = 1 / 1 + e^{-y}$ (2)

Therefore, the logistic regression equation for the model is given as:

$$P = \frac{1}{1 + e^{-(\beta_0 + \beta_1 TMI + \beta_2 TME)}} \quad (3)$$

Where P is the predicted budget for the month.

Training the model

The Binary logistic model was trained using ten (10) years of transactions which is equivalent to one hundred and twenty (120) months. The data extraction layout is shown in Table 4.

Table 4: Data extraction layout

Year/Month	Income Transactions			Expenditure Transactions			TMI	TME	Budget Prediction
M ₁	I ₁	.	I _n	E ₁	.	E _j	TMI ₁	TME ₁	B ₁
M ₂	I ₂	.	I _n	E ₂	.	E _j	TMI ₂	TME ₂	B ₂
.
.
M _n	I _n	.	I _n	E _n	.	E _{j_n}	TMI _{j_n}	TME _{j_n}	B _n
							GTI	GTE	
							GAI	GAE	

Table 4 shows how the training data was extracted from the statement of account. The respective income and expenditure per month were extracted to obtain the total income and expenditure as TMI and TME respectively. The grand total income (GTI) and the grand total expenditure (GTE) were also obtained. Finally, the algorithm in section 5.4 was applied to the layout in order to obtain budget classification for each month.

The 120 records were randomly split in the ratio 75:25 respectively. 75% of the data was used to train and fit the model while the remaining 25% was used for the test.

VIII. Results and Discussion

Firstly, the results of the Google online survey are summarized in Table 5.

Table 5: Summary of Survey Findings

Description	Number	Percentage
Single Income Source	112	72
Alternative Income Source	43	28
Above Income	45	29
Within Income	110	71
Need E-Budgeting	41	26
Doesn't Need E-Budgeting	114	74

From Table 5, it can be seen that the percentage of respondents who depend solely on their salary is 72%. Within this group of respondents, 29% live above their income while 26% represent the percentage of respondents who make use of E-banking, and who are also in dire need of a E-budget planner as an E-banking service.

The survey also reveals the E-banking services which are mostly used by salary earners as shown in Figure 3.

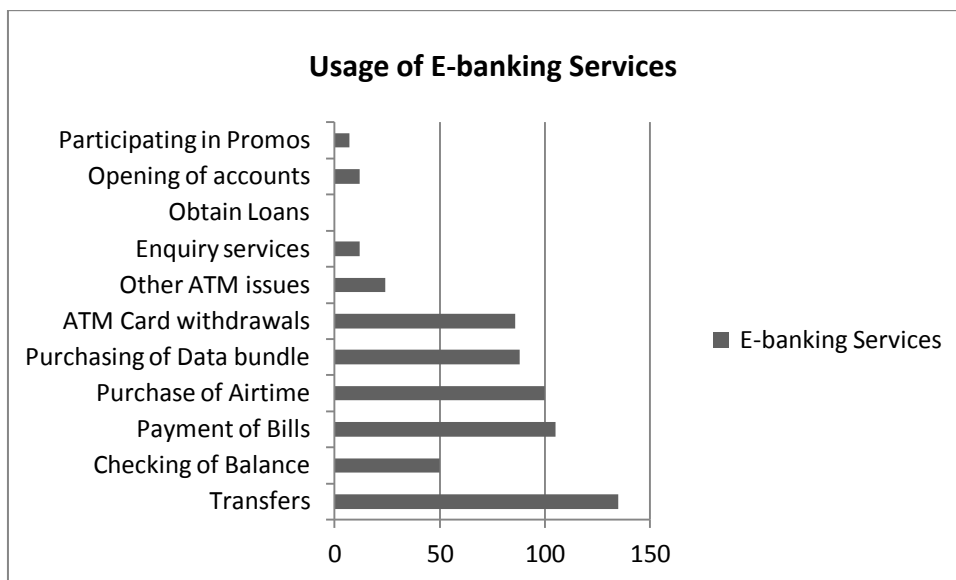


Figure 3 Usage Distribution of E-banking Services

Figure 3 shows that the most used E-banking service is ‘transfers’ and the least is ‘obtain loans’. It could be seen that the expenditure related E-banking services such as ‘Transfers’, ‘Payment of bills’, ‘Purchase of airtime’, ‘ATM card withdrawals’ and ‘Purchasing of data’ seem to take a higher priority than others. Secondly, the Budget planner E-service was simulated in Spyder platform using Python code and the result is shown in Figure 4.

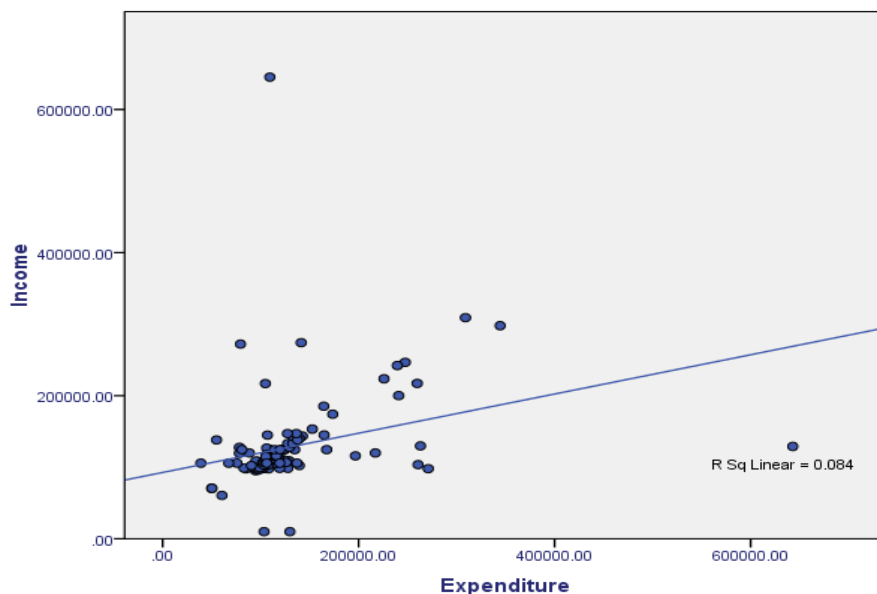
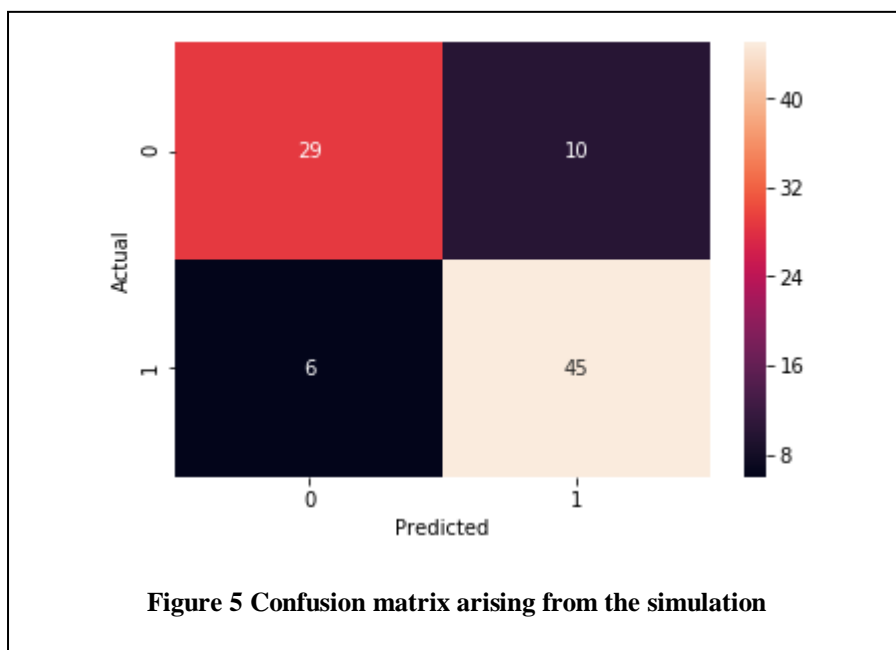


Figure 4: Linear relationships between Income and Expenditure

Figure 4 represents a plot of the dependent and independent variables. The plot shows that there is linear relationship between the variables. It also reveals that the expenditure tends to increase slightly with increased income.

The Binary logistic model applied to the data recorded an accuracy of 82%. The performance of the model was evaluated using the confusion matrix as shown in Figure 5.



From Figure 5, the confusion matrix was used to show the level of trust reposed on the prediction model based on the number of correct predictions and wrong ones. The implication and details of the confusion matrix is shown in Table 6.

Binary Classification	Notation	Meaning	Number
True negatives	TN	Correctly predicted negatives (zeros)	29
False negatives	FN	Incorrectly predicted negatives (zeros)	6
False positives	FP	Incorrectly predicted positives (ones)	10
True positives	TP	Correctly predicted positives (ones)	45

Table 6 shows the details of the prediction results. From Table, it can be seen that the model was able to predict 29 out of 35 previous unsafe budgets correctly while it predicted 6 wrongly. On the other hand, the model was able to predict 45 out of 55 previous safe budgets correctly while 10 were wrongly predicted. The model accuracy is a measure of the number of correct prediction against the incorrect ones. It can be calculated using equation 4 given as:

$$\text{Accuracy} = (TP+TN)/\text{Total} = (45+29)/90 = 0.82 \tag{4}$$

The statistics summary gives the statistical details of the computation as shown in Table 7.

	Co.ef	Std.Err.	z	P> z	[0.025 0.975]
Const	11.6025	3.0110	3.8534	0.0001	5.7011 17.5040
x1	0.0000	0.0000	1.9647	0.0494	0.0000 0.0001
x2	-0.0001	0.0000	-3.9227	0.0001	-0.0002 -0.0001

From Table 7, const coefficient is 11.6 which is the value obtained if both the income x1 and expenditure x2 coefficients are both zero. X1 (Income) which is 0.0000 represents the change in the output Y due to a change of one unit in the income (everything else held constant). X2 (expenditure) represents the change in the output Y due to a change of one unit in the expenditure (everything else held constant). The std

err tells us the level of accuracy of the coefficients. The lower it is, the higher is the level of accuracy. The $P > |t|$ is the p -value. Usually a p -value that is less than 0.05 is considered to be statistically significant. The P -values for both the Income (x_1) and expenditure (x_2) independent variables used for the prediction were both significant at 0.0494 and 0.0001 ($P < 0.05$) respectively.

A screen shot showing the python interface simulation is also shown in figure 6.

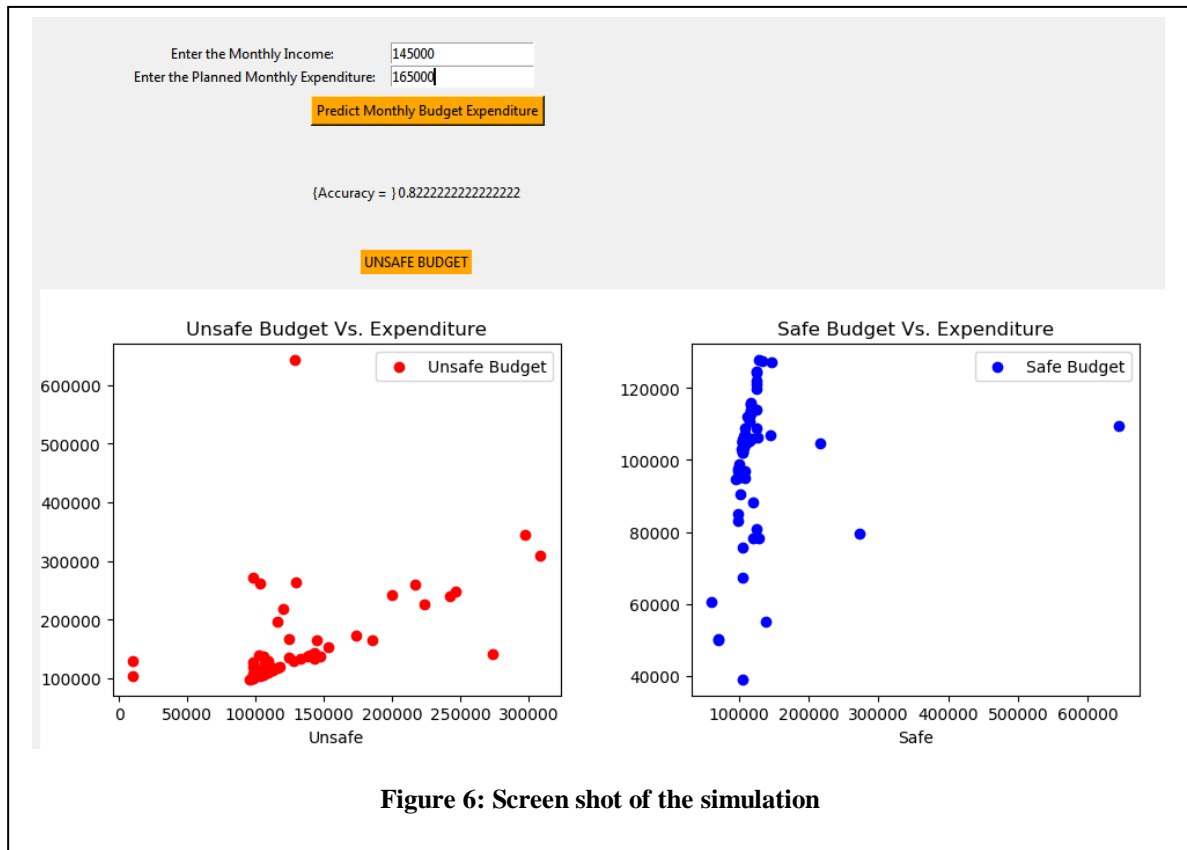


Figure 6: Screen shot of the simulation

Figure 6 shows a screen shot of the python interface where the simulation was carried out. It has two fields to accept the monthly income and the planned monthly expenditure input from the user. The simulation made use of the monthly income field as input although the field can be extracted and used in real time from the user's statement of account.

IX. Conclusion

This paper titled "Budget planning in E-banking service" explores the introduction of budgeting as an E-banking service. Its main objectives are to establish a relevance (if any) in introducing such service especially for salary earners, to propose an algorithm for classifying a salary earner's bank transaction history in real time which then is modeled to determine a safe budget for subsequent monthly expenditure. Results from the research reveal that 29% of salary earners live above their income and 26% of them definitely need an E-budget to plan their expenditure. The proposed algorithm was successfully used to model and simulate an E-budget service of a salary earner. Results of the prediction showed an 82% accuracy confirming that both the classification algorithm and the fitted Binary Logistic model predicts the budget of the said salary earner excellently well. The results from the confusion matrix support the accuracy obtained as it correctly predicted 29 out of 35 and unsafe budgets and 40 out of 50 previous safe budgets. The P -values for both the Income (x_1) and expenditure (x_2) independent variables used for the prediction were both significant at 0.0494 and 0.0001 ($P < 0.05$) respectively. This shows that both variables have significant effect on the budget outcome.

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