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Budgetary Resource Allocation and Organizational Survival Strategies: A Revised Simplex Algorithm

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Abstract: This paper, which is based on budgetary provisions in Ejigbo Local Government Area of the State of Osun for a period of three years spanning 2011 to 2013, considered allocation of limited resources on expenditure items from which it was discovered that capital expenditure should be given maximum attention during the preparation of budget. Having applied Revised Simplex Method (RSM) on the formulated Linear Programming Problem (LPP), the results revealed that less emphasis should be placed on recurrent expenditure as well as consolidated revenue fund charges with a view to ensuring optimal budgetary allocation by meeting the demands of the citizenry in the local government area considered.
Keywords: Budgetary Resource Allocation, Expenditure, Linear Programming Problem, Revised Simplex Method.

INTRODUCTION

At the beginning of the financial period of every organization, whether the organization is publicly or privately owned, it needs to develop its budget to guide its operations for the year ahead. Budgeting is therefore an important process of every organization. How effectively the budgeting process is handled in an organization could define success or failure for the organization. Thus, budgeting can be defined as the process of preparing detailed, short-term (usually one year) plans for the functions and activities as well as departments of the organization thus converting the long-term corporate plan into action [3]. It's further explained that plans are developed using physical values, for instance, the number of units to be produced, the number of hours to work, the amount of materials to be consumed, …, when monetary values are attributed to the plan, it becomes a budget. In our own definition, a budget is a financial plan formulated to be implemented within a specified time frame usually one year. This research is considering public budget of Ejigbo Local Government Area of the State of Osun, Nigeria. It is aimed at studying the way in which available resources are being distributed according to the three major sources of expenditure- recurrent expenditure, consolidated revenue fund charges and capital expenditure.

As earlier defined, budgeting is a process which encapsulates a number of phases that include: budget idealization (conceptualization phase); budget formulation (preparation phase); budget authorization phase; budget implementation (execution phase) which includes budget monitoring and control and finally budget evaluation phase. At the budget idealization (conceptualization phase), we are expected to be highly proactive and plan ahead regarding the ensuing budget. Indeed, we are expected to project on what the ensuing budget is likely to do for our people at the grassroot. Budget formulation is the dreaming phase of budgetary process when serious planning is undertaken in view of the fact that 'to fail to plan is to plan to fail'. Also, the budget authorization phase is a very important phase of the budgetary process; it is the phase when each department of the local government is expected to appear before the legislative council to defend its draft budget. Authorization phase gives legal backing to the formulation and implementation of the annual budget. Thereafter, budget implementation (execution phase) follows immediately and finally budget evaluation, which is a post mortem exercise carried out after the formulation and implementation of the annual budget, takes the last leg. This is usually done at the end of the year starting with the Final Quarterly Progress Report.

STATEMENT OF THE PROBLEM

The statement of the problem is in respect of low level of budget success. Despite the fact that budgets are designed to carry out various functions such as planning, evaluating performance, coordinating activities, implementing plans, communicating, motivating and authorizing actions and inspite of the management accounting control techniques, the operations of budgetary control techniques have met with little success. The objective of this study is to assess the budgetary resource allocation at the grassroot level using Revised Simplex Method. Specifically, the study will proffer solution to the low level of budget success.

LITERATURE REVIEW

The Foundation of Budgeting and Budgetary Control:

According to [1], there must be a commitment by the top management to the broad concept of budgeting and budgetary control. Other researchers [2] pointed out that there should be an evaluation of the organization, structure and assignment of managerial responsibilities and implementation of changes deemed necessary for financial planning and control programme that would be effective and practical. Reference to [5], he says that budget represents 'the plan of the dominant individuals in an organization expressed in monetary terms, and subject to the constraints imposed by the participants and the environment indicating how the available resources may be utilized to achieve whatever the dominant individuals agree to organization's priorities'.

METHODOLOGY

In the present study, we considered Revised Simplex Method (RSM) of Linear Programming Problem (LPP) with a view to determining optimal allocation of limited resources to meet some specified objective functions. We have considered three important sources of expenditure at the local government level: Recurrent Expenditure, which is peculiar to expenses incurred on administration such as payment of salaries and wages as well as maintaining capital projects and so on; Consolidated Revenue Fund Charges, which are the expenditure items that must take the first charge on the available revenue of the local government, they are mandatory expenditure items that are not subject to the whims and caprices of the local government, examples are contribution to training funds, teachers' salaries, five percent deduction to traditional councils' accounts, etc. [4]. Another source of expenditure at the grassroot level is Capital Expenditure, which are the expenses incurred on physical/capital projects such as construction of roads and buildings, rural electrification, purchase of machinery and tractors, establishment of livestock firms, and the likes.

The study is geared towards using Revised Simplex Method of Linear Programming to analyze available data on expenditure of Ejigbo Local Government, State of Osun for a period of three years spanning 2011 to 2013 inclusive with a view to determining budgetary allocation of resources at the grassroot. This can be achieved by optimizing amount expended in the current year subject to accumulated budgetary provision to individual heads and subheads of the source of expenditure considered within the years covered.

In the formulation of Linear Programming Problem, identifications of variables, objective functions and the constraints are very essential. In the present study, we optimize (maximize or minimize) current accumulated expenditure on individual sources as mentioned above subject to the amount allocated to these sources on yearly basis. Having done this, then Revised Simplex Method was used to obtain optimal solutions with a view to calculating efficient amount expected to be incurred on each head of expenditure estimates.

Revised Simplex Method explicitly uses matrix manipulations so that it is necessary to describe problem in matrix notation. Three steps are involved in a number of iterations before optimal solutions are obtained: First is to determine entering vector, after that we shall determine leaving vector while the third step is to determine new solution; all these three steps must be considered in each of the iterations involved in obtaining optimal solution to a Linear Programming Problem.

DATA PRESENTATION AND ANALYSIS

The data in the following table were collected from Finance and Supplies Department via Budget, Planning, Research and Statistics Department of Ejigbo Local Government, Ejigbo, Osun State, Nigeria and it's collected in million naira.

Table-I: Budget Allocation and Amount Expended for a 3-Year Duration (N'000,000:00)

Variables of Interest (Heads of Expenditure Estimates)	Budgetary Years			Amount expended in the last budgetary year
	2011	2012	2013	
Recurrent Expenditure (x_1)	724	835	900	826
CRFC (x_2)	648	659	702	698
Capital Expenditure (x_3)	1,402	1,556	2,399	2,144
Total Allocation	2,774	3,050	4,001	-

Thus, we formulate Linear Programming Problem as follows:

$$Optimize\ \ Z = 826x_1 + 698x_2 + 2144x_3$$

Subject to the following constraints:

$$724x_1 + 648x_2 + 1402x_3 \le 2774$$
$$835x_1 + 659x_2 + 1556x_3 \le 3050$$
$$900x_1 + 702x_2 + 2399x_3 \le 4001$$
$$(x_1, x_2, x_3 \ge 0)$$

<u>1st Iteration</u>- Step I: Determination of the entering Vector $(\vec{P}_j)$

$$Z_j - C_j = (1\ \ 0\ \ 0\ \ 0).\begin{bmatrix} -826 & -698 & -2144 \\ 724 & 648 & 1402 \\ 835 & 659 & 1556 \\ 900 & 702 & 2399 \end{bmatrix} = (\overset{P_1}{-826}\ \ \overset{P_2}{-698}\ \ \overset{P_3}{-2144})$$

Select the most negative, which corresponds to P_3, as the entering vector.

<u>1st Iteration</u>- Step II: Determination of the leaving Vector $(\vec{P}_r)$

$$\vec{\alpha}_k = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}.\begin{bmatrix} 1402 \\ 1556 \\ 2399 \end{bmatrix} = \begin{bmatrix} 1402 \\ 1556 \\ 2399 \end{bmatrix}$$

$$\theta = \min\left(\frac{B^{-1}.\vec{P}_j}{\vec{\alpha}_k}\right) \equiv \min\left(\frac{2774}{1402}, \frac{3050}{1556}, \frac{4001}{2399}\right) \equiv \min\ (\overset{P_4}{1.9786}\ \ \overset{P_5}{1.9602}\ \ \overset{P_6}{1.6678})$$

Select the least value, which corresponds to P_6, as the leaving vector.

<u>1st Iteration</u>- Step III: Determination of the New Solution (Z_{cal})

$$X_B^1 = (x_4\ \ x_5\ \ x_6),\ \ C_B = (0\ \ \ 0\ \ \ 2144)$$

$$\vec{\varepsilon} = \begin{bmatrix} -\alpha_4 / \alpha_k^1 \\ -\alpha_5 / \alpha_k^1 \\ 1 / \alpha_k^1 \end{bmatrix} = \begin{bmatrix} -1402/2399 \\ -1556/2399 \\ 1/2399 \end{bmatrix} = \begin{bmatrix} -0.5844 \\ -0.6486 \\ 0.000416 \end{bmatrix}, \qquad E = \begin{bmatrix} 1 & 0 & -0.5844 \\ 0 & 1 & -0.6486 \\ 0 & 0 & 0.000416 \end{bmatrix}$$

$$B_{next}^{-1} = EB^{-1} = \begin{bmatrix} 1 & 0 & -0.5844 \\ 0 & 1 & -0.6486 \\ 0 & 0 & 0.000416 \end{bmatrix} . \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & -0.5844 \\ 0 & 1 & -0.6486 \\ 0 & 0 & 0.000416 \end{bmatrix}$$

$$C_B B_{next}^{-1} = (0 \quad 0 \quad 2144) . \begin{bmatrix} 1 & 0 & -0.5844 \\ 0 & 1 & -0.6486 \\ 0 & 0 & 0.000416 \end{bmatrix} = (0 \quad 0 \quad 0.8937)$$

$$X_{B-cal} = B_{next}^{-1} .b = \begin{bmatrix} 1 & 0 & -0.5844 \\ 0 & 1 & -0.6486 \\ 0 & 0 & 0.000416 \end{bmatrix} . \begin{bmatrix} 2774 \\ 3050 \\ 4001 \end{bmatrix} = \begin{bmatrix} 435.7749 \\ 454.9370 \\ 1.667778 \end{bmatrix} = \begin{bmatrix} x_4 \\ x_5 \\ x_3 \end{bmatrix}$$

$$Z_{cal} = C_B . B_{next}^{-1} .b = (0 \quad 0 \quad 0.8937) \begin{bmatrix} 2774 \\ 3050 \\ 4001 \end{bmatrix} = 3{,}575.7165$$

2nd Iteration- Step I: Determination of the entering Vector $(\vec{P_j})$

$$Z_j - C_j = (1 \quad 0 \quad 0 \quad 0.8937) . \begin{bmatrix} -826 & -698 & 0 \\ 724 & 648 & 0 \\ 835 & 659 & 0 \\ 900 & 702 & 1 \end{bmatrix} = (\overset{P_1}{-21.6648} \quad \overset{P_2}{-70.6186} \quad \overset{P_3}{0.8937})$$

Select the most negative, which corresponds to P_2, as the entering vector.

2nd Iteration- Step II: Determination of the leaving Vector $(\vec{P_r})$

$$\vec{\alpha_k} = \begin{bmatrix} 1 & 0 & -0.5844 \\ 0 & 1 & -0.6486 \\ 0 & 0 & 0.000416 \end{bmatrix} . \begin{bmatrix} 648 \\ 659 \\ 702 \end{bmatrix} = \begin{bmatrix} 237.74406 \\ 203.68028 \\ 0.2926223 \end{bmatrix}$$

$$\theta = \min \left(\frac{B^{-1} . \vec{P_j}}{\vec{\alpha_k}} \right) \equiv \min \left(\frac{435.7749}{237.74406}, \frac{454.9370}{203.68028}, \frac{1.66778}{0.29262} \right) \equiv \min \, (\overset{P_4}{1.8329} \quad \overset{P_5}{2.23358} \quad \overset{P_6}{5.56946})$$

Select the least value, which corresponds to P_4, as the leaving vector.

2nd Iteration- Step III: Determination of the New Solution Z_{cal}

$$X_B^1 = (x_2 \quad x_5 \quad x_4), \quad C_B = (698 \quad 0 \quad 2144)$$

$$\vec{\varepsilon} = \begin{bmatrix} 1/\alpha_k^1 \\ -\alpha_5/\alpha_k^1 \\ -\alpha_6/\alpha_k^1 \end{bmatrix} = \begin{bmatrix} 1/237.4406 \\ -203.68028/237.74406 \\ -0.29262/237.74406 \end{bmatrix} = \begin{bmatrix} 0.0042062 \\ -0.8567223 \\ -0.0012308 \end{bmatrix}, \qquad E = \begin{bmatrix} 0.0042062 & 0 & 0 \\ -0.85672 & 1 & 0 \\ -0.0012308 & 0 & 1 \end{bmatrix}$$

$$B_{next}^{-1} = EB^{-1} = \begin{bmatrix} 0.0042062 & 0 & 0 \\ -0.85672 & 1 & 0 \\ -0.0012308 & 0 & 1 \end{bmatrix} . \begin{bmatrix} 1 & 0 & -0.5844 \\ 0 & 1 & -0.6486 \\ 0 & 0 & 0.000416 \end{bmatrix} = \begin{bmatrix} 0.0042062 & 0 & -0.002458 \\ -0.8567200 & 1 & -0.147930 \\ -0.0012308 & 0 & 0.001136 \end{bmatrix}$$

$$C_B B_{next}^{-1} = (698 \quad 0 \quad 2144). \begin{bmatrix} 0.0042062 & 0 & -0.002458 \\ -0.8567200 & 1 & -0.147930 \\ -0.0012308 & 0 & 0.001136 \end{bmatrix} = (0.29709 \quad 0 \quad 0.72008)$$

$$X_{B-cal} = \begin{bmatrix} 0.9598465 \\ 0.0000039 \\ 1.0000214 \end{bmatrix} = \begin{bmatrix} x_2 \\ x_5 \\ x_3 \end{bmatrix}, \qquad Z_{cal} = 3{,}029.028321$$

3rd Iteration- Step I: Determination of the entering Vector $(\vec{P_j})$

$$Z_j - C_j = (1 \quad 0.29709 \quad 0 \quad 0.72008). \begin{bmatrix} -826 & 0 & 0 \\ 724 & 1 & 0 \\ 835 & 0 & 0 \\ 900 & 0 & 1 \end{bmatrix} = (\overset{P_1}{37.16516} \quad \overset{P_2}{0.29709} \quad \overset{P_3}{0.72008})$$

We have reached the optimal solution since there is no negative value anymore at the end of 1st Step of the 3rd Iteration.

DISCUSSION OF RESULTS

At the initial stage of this study, we set our goal to optimize the available limited resources at the grassroot level by making use of the amount expended on yearly basis on the three major sectors of expenditure at the local government level as objective function and also made use of budgetary approved amount for a period of three years: 2011, 2012 and 2013 respectively to form the constraints. Having put these facts in mathematical form and solved using the Revised Simplex Method, from the figure obtained, a sum of three billion, twenty-nine million, twenty-eight thousand and three hundred and twenty-one naira is expected to project for the next year budget and we advised to distribute the sum accordingly.

SUMMARY AND CONCLUSIONS

From the above results, it is very clear that after the application of Revised Simplex Method (RSM) on the formulated Linear Programming Problem, we were able to arrive at the following optimal solutions: $x_1 = 0$, $x_2 = 0.9598465$, $x_3 = 1.0000214$ and $Z = 3{,}029.028321$ respectively. The implication of these values is such that less emphasis should be placed on recurrent expenditure during the preparation of next budget indicating that approximately 70% of this budget would go to capital expenditure, approximately 20% would go to consolidated revenue fund charges while the remaining 10% is expected to be incurred on recurrent expenditure.

This paper observed that if a sum of N3,029,028,321:00, which is expected to be the total annual budget of the local government for the next budgetary year, is effectively and optimally utilized, some of the major problems confronting these communities would be under control and thereby reduced to the nearest minimum provided that less emphasis is placed on both recurrent expenditure and consolidated revenue fund charges with a view to giving very high attention to capital expenditure in the preparation of the next year estimates.

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