Scientia Africana, Vol. 11 (No.2), December 2012. Pp74- 80
 ISSN 1118 – 1931

APPLICATION OF GOAL PROGRAMMING TECHNIQUE IN GOVERNMENT STATUTORY BUDGET IN ANAMBRA STATE

C. R. Chikwendu[a], M. N. Umeh[b], I. U. Mbeledogu[c], E. O. Nwachukwu[d], N. N. Mbeledogu[e]

[a]Department of Mathematics,
Nnamdi Azikiwe University, Awka, Nigeria

[b&e] Department of Computer Science ,
Nnamdi Azikiwe University, Awka, Nigeria

[c]Department of Applied Mathematics,
University of Port Harcourt,
Rivers State, Nigeria

[d]Department of Computer Science,
University of Port Harcourt,
River State, Nigeria

Email:rosecc2k2@yahoo.com,rose1chi@yahoo.com,iumbeledogu@yahoo.com,
enoblesciences@yahoo.com, njidembeledogu@yahoo.com
Corresponding Author: M. N. Umeh, rose1chi@yahoo.com

Received: 11-07-12
Accepted: 22-08-12

ABSTRACT

The problem with the current system of budgeting in most states in Nigeria is the little or no involvement of the masses in making budget decisions. In addition the use of the manual system of budget allocation is characterized by delays in overall administrative operations and unavoidable human error. Decision makers allocate resources to various services without seeking the opinion of the general public. With this problem there is need for an efficient budget allocation method that will take input from the general public before allocation. This paper therefore uses goal programming method to implement the allocation of various capital budgets (Education, Water Resources and Supply, Rural Electricity, Road Maintenance, Finance and Investment, Commerce and industry, Health, Environment Development and management, and Community Development) with input taken from the budget allocation for the past six years. The pair-wise comparison method is used to assign weights to prioritize the project/ goals data obtained from the 15 communities of Orumba South Local Government Area of Anambra State.

INTRODUCTION

The Local government being the smallest arm of the three tier government of Nigeria is the closest to the people for which budget is made and for the government to fulfill their mandate and obligation to the people, there is need for efficient utilization of the available scarce resources in order to meet the peoples' needs. A measure of the success of any well meaning government is the meeting of the needs of the people at their moment of value i.e. when the people need it (Time), where the people need it (location), how the people need it (form) and in the manner that is satisfying to the people, Williams and Sawyer (2001). The implementation of any development should be made to touch the lives of the people and it is only then that one could say that democracy is fully effective, Ezeorah *et. al.* (2008).

Governance entails proper and efficient management of available resources of the state to meet various demands of the people Okoye and Ani (2004). Budget, according to Oxford Advanced dictionary, is the money that is available to a person or an organization and a plan on how it will be spent over a period of time. Budgeting is a term commonly used in our society where there are limited resources meant to satisfy enormous needs. The governments as well as individuals, families, societies, associations and organizations are continually faced with the problem of optimizing the utilization of funds available to them at any given period.

Goal programming (GP) is a multi-objective optimization (or multi-objective programming) technigue which is also known as multi-criteria or multi-attribute optimization. It is the process of simultaneously optimizing two or more conflicting objectives subject to certain constraints Barichard (2009). It is a form of decision analysis that seeks to analyze complex decision problems by dividing the problem into smaller understandable parts. These Individual parts are then worked upon and later integrated in a logical manner to produce a meaningful solution. Goal programming (GP) technique can be used to allocate scarce resources to conflicting goals. Goal programming was first used by Charnes and Cooper in a discussion which appeared in 1961, Frederic and Gerald (2001). In essence, they proposed a model and approach for dealing with linear programming problems in which complexity goals of management were included as constraints. Since it might be impossible to satisfy exactly all such goals, one attempts to minimize the sum of the absolute values of the deviations from such goals. Handy Taha (2006) equally stated that goal programming is an ideal methodology in dealing with multiple objective problems. In Goal programming, several methodologies or variants could be employed; including Lexicographic, weighted or Non-preemptive, Chebyshev and Fuzzy goal programming.

In the lexicographic (LGP) or pre-emptive goal programming, there is a hierarchy of priority levels for the goals, so that the goals of primary importance receive first priority attention, while those of secondary importance receive second priority attention, and so forth Ehrgott, M. (2009). The multi-objective problem could be expressed as;

$$\text{Min } Z = \left\{ P_1 \left[\sum_1^r (Wr^- d_r^- + W_r^+ d_r^+) \right] \; P_2 \left[\sum_1^r (Wr^- d_r^- + W_r^+ d_r^+) \right] \; \ldots \; P_n \left[\sum_1^r (Wr^- d_r^- + W_r^+ d_r^+) \right] \right\}$$

Subject to;

$F_r(x) - G_r = d_r^- - d_r^+$, For r = 1 to k

$d_r^-, d_r^+, Wr \geq 0$, x E X

Where W_r^- & W_r^+ are weights corresponding to several goal deviations and P_n are the priority levels with $P_1 \geq P_2 \geq P_n \geq P_{n+1}$.

The second variant of goal programming is the weighted goal programming or the non-preemptive goal programming. This is possibly the simplest form of goal programming. In this variant, the entire goals are roughly comparable importance. In other words, the decision makers give the relative importance of each objective in regard to the other objectives. In this case, all the unwanted deviations are multiplied by weights,

Scientia Africana, Vol. 11 (No.2), December 2012. Pp74- 80
© Faculty of Science, University of Port Harcourt, Printed in Nigeria *ISSN 1118 – 1931*

reflecting their relative importance, and added together as a single sum to form the achievement function, Chikwendu *et. al.* (2009).

The multi-objective problem could be expressed as;

$$\text{Min} \quad \sum_1^r \quad (Wr^-d_r^- + W_r^+d_r^+)$$

Subject to;

$F_r(x) - G_r = d_r^- - d_r^+$, For r = 1 to k

$$d_r^- , d_r^+ , Wr \geq 0 , x \text{ E } X$$

Where W_r^- & W_r^+ are weights corresponding to several goal deviations.

Another variant of goal programming is the chebyshev goal programming also known as MINMAX. This variant seeks to minimize the maximum unwanted deviations, rather than the sum of deviations.

MATERIALS AND METHODS

We have adopted the structured system analysis and design methodology (SSADM) together with operations research methodology. Data collection has been through a primary source i.e. Interview of the key officers of the budget & planning unit, questionnaires were administered to the 15 communities in the research area. The secondary data was obtained from the study of their procedural manuals and the approved budget proposals for the past six years. The data used to build the model is presented in the Table 1 through to Table 7.

Table 1: Response to Research question (11); Rate the performance of the State Government.

Communities	Excellent	Good	Average	Poor
Agbudu	10	42	68	25
Akpu	15	37	64	29
Eziagu	25	34	58	28
Ezira	20	45	55	25
Enugu-	11	52	63	19
Umuonyia	17	45	53	30
Ihite	11	46	55	33
Isulo	22	37	54	32
Nawfija	8	48	68	21
Nkerehi	10	47	67	21
Ogboji				
Ogbunka	9	52	66	18
Onneh	21	47	48	29
Owere-Ezukala	7	49	67	22
Umuomaku	12	50	62	21
Umunze	8	40	56	41
Total	206	671	904	394

Table 2: Response to Research question (12); Do you think that their level of performance in question (11) above is largely due to poor budgeting?

Communities	Strongly Agree	Agree	Disagree	None of the above
Agbudu	42	30	69	4
Akpu	37	26	65	17
Eziagu	34	36	59	16
Ezira	45	31	56	13
Enugu-Umuonyia	52	22	64	7
Ihite	45	28	54	18
Isulo	46	22	56	21
Nawfija	37	33	55	20
Nkerehi	48	19	67	11
Ogboji	47	21	68	9
Ogbunka	52	20	67	6
Onneh	47	32	49	17
Owere-Ezukala	49	18	68	10
Umuomaku	50	23	63	9
Umunze	41	19	69	16
Total	672	380	929	194

Table 3: Response to Research question (13); Could the level of performance in question (11) above be due to poor funding & finance?

Communities	Strongly Agree	Agree	Disagree	None of the above
Agbudu	33	46	45	21
Akpu	23	46	54	22
Eziagu	16	56	62	11
Ezira	18	58	49	20
Enugu-Umuonyia	15	51	64	15
Ihite	17	44	60	24
Isulo	12	54	63	16
Nawfija	14	46	74	11
Nkerehi	10	61	69	5
Ogboji	24	46	63	12
Ogbunka	16	60	46	23
Onneh	15	46	71	13
Owere-Ezukala	17	63	57	8
Umuomaku	16	48	58	23
Umunze	18	45	67	15
Total	264	770	902	239

Scientia Africana, Vol. 11 (No.2), December 2012. Pp74- 80
© Faculty of Science, University of Port Harcourt, Printed in Nigeria *ISSN 1118 – 1931*

Table 4: The estimated budget allocation for the period of 2003 – 2008

Basic Variables (Rev. All $_i$)	Services/goals G_i	Rev_All$_i$ /Total Budget Size(in million naira)of Goals G_i					
		2003	2004	2005	2006	2007	2008
x_1	Transport and Road Maintenance	19.9	25	25	21.3	27.3	92.7
x_2	Education	3.7	2	2	5	18	20.5
x_3	Health	20	20	20	29.9	23	30
x_4	Water Resources and Supply	17	14	14	20	42.5	65
x_5	Rural Electrification	5	5	5	5	12	20
x_6	Environmental Development and Management.	2	2	2	3	4	4.1
x_7	Finance and Investment	20	20	20	20	4	17
x_8	Commerce and Industry	14.1	9.5	9.5	22.4	38.4	49.6
x_9	Community Development	3	2	2	5	8	9
TOTAL		104.7	99.5	99.5	131.6	177.2	307.9

Table 5: Priority needs of the 15 communities

Global Goals G_i	Points of Priority								
	1	2	3	4	5	6	7	8	9
Transport and Road Maintenance.	446	422	290	302	253	184	98	99	81
Education	394	372	418	410	172	111	101	94	103
Health	331	343	349	350	184	209	113	175	121
Water Resources & Supply	233	237	336	275	243	294	238	223	96
Rural Electrification	341	300	325	198	307	311	137	171	85
Environment Development and Management	36	92	85	49	369	330	366	351	497
Finance and investment	35	103	78	45	157	287	387	478	605
Commerce and industry	231	243	159	356	314	151	284	233	204
Community Development.	128	63	135	190	176	298	451	351	383

Table 6: Normalized weight

Goals	Weights allocated (Wr)
X_1	0.14
x_2	0.14
x_3	0.13
x_4	0.12
x_5	0.13
x_6	0.08
x_7	0.07
x_8	0.11
x_9	0.08

Table 7: Estimated actual cost of services in the selected years

Goals	Estimated Cost (in millions of Naira)
Year 1	150
Year 2	101
Year 3	110
Year 4	140
Year 5	200
Year 6	400

The formulation of our model is thus derived from data obtained in Table 4 to 7

Maximize $Z = 0.14\ x_1 + 0.14\ x_2 + 0.13\ x_3 + 0.12\ x_4 + 0.13\ x_5 + 0.08\ x_6 + 0.07\ x_7 + 0.11\ x_8 + 0.08\ x_9$

Subject to:

F_1: $19.9x_1 + 3.7x_2 + 20x_3 + 17x_4 + 5x_5 + 2x_6 + 20x_7 + 14.1x_8 + 3x_9 \leq 150$ (1)

F_2: $25x_1 + 2x_2 + 20x_3 + 14x_4 + 5x_5 + 2x_6 + 20x_7 + 9.5x_8 + 2x_9 \leq 101$ (2)

F3: $25x_1 + 2x_2 + 20x_3 + 14x_4 + 5x_5 + 2x_6 + 20x_7 + 9.5x_8 + 2x_9 \leq 110$ (3)

F4: $21.3x_1 + 5x_2 + 29.9x_3 + 20x_4 + 5x_5 + 3x_6 + 20x_7 + 22.4x_8 + 5x_9 \leq 140$ (4)

F5: $27.3x_1 + 18x_2 + 23x_3 + 42.5x_4 + 12x_5 + 4x_6 + 4x_7 + 38.4x_8 + 8x_9 \leq 200$ (5)

F6: $92.7x_1 + 20.5x_2 + 30x_3 + 65x_4 + 20x_5 + 4.1x_6 + 17x_7 + 49.6x_8 + 9x_9 \leq 400$ (6)

$dr-, dr+, Xi \geq 0, \quad \forall\ r = 1,2,\ldots,k$

This model is further transformed into a goal model as shown below;

Minimize $Z = d_1^+ + d_2^+ + d_3^+ + d_4^+ + d_5^+ + d_6^+ + d_7^+ + d_8^+ + d_9^+$

Subject to:

F1: $-0.14\ x_1 - 0.14\ x_2 - 0.13\ x_3 - 0.12\ x_4 - 0.13\ x_5 - 0.08\ x_6 - 0.07\ x_7 - 0.11\ x_8 - 0.08\ x_9 = 400$ (1)

F_2: $19.9x_1 + 3.7x_2 + 20x_3 + 17x_4 + 5x_5 + 2x_6 + 20x_7 + 14.1x_8 + 3x_9 + d_1^+ + d_1^- = 15$ (2)

F_3: $25x_1 + 2x_2 + 20x_3 + 14x_4 + 5x_5 + 2x_6 + 20x_7 + 9.5x_8 + 2x_9 + d_2^+ + d_2^- = 101$ (3)

F_4: $25x_1 + 2x_2 + 20x_3 + 14x_4 + 5x_5 + 2x_6 + 20x_7 + 9.5x_8 + 2x_9 + d_3^+ + d_3^- = 110$ (4)

F_5: $21.3x_1 + 5x_2 + 29.9x_3 + 20x_4 + 5x_5 + 3x_6 + 20x_7 + 22.4x_8 + 5x_9 + d_4^+ + d_4^- = 140$ (5)

F_6: $27.3x_1 + 18x_2 + 23x_3 + 42.5x_4 + 12x_5 + 4x_6 + 4x_7 + 38.4x_8 + 8x_9 + d_5^+ + d_5^- = 200$ (6)

F_7: $92.7x_1 + 20.5x_2 + 30x_3 + 65x_4 + 20x_5 + 4.1x_6 + 17x_7 + 49.6x_8 + 9x_9 + d_6^+ + d_6^- = 400$ (7)

$d_r^-, d_r^+, X_i \geq 0, \quad \forall\ r = 1,2,\ldots,k$

Scientia Africana, Vol. 11 (No.2), December 2012. Pp74- 80
© Faculty of Science, University of Port Harcourt, Printed in Nigeria *ISSN 1118 – 1931*

Note: The right hand side of the first constraint has to take the estimated budget size of 2011 for which the survey was conducted.

RESULTS

The analysis of Table 1 having a mean response of 2.3168 ≅ 2 (Average), which is less than 2.5 implies that there is enough evidence to show that the performance of the state administration is not good. The result from Table 2 having a mean response of 2.7034 ≅ 3 (Agree), shows that the poor performance of the state administration is as a result of poor budgeting. Result from Table 3 having a mean response of 2.4869 ≅ 2 (Disagree), shows that the poor performance of the present administration is not as a result of poor funding and finance. From the analysis of the responses we conclude that the implementation of the budget is not efficient which is evident in the poor performance arrived at and this is as a result of poor budgeting, funding and financing. The budget model developed could guarantee optimum result as per allocating accurately for the needed projects and eliminating the less useful projects. This will eventually save some cost as the issue of abandoned projects will drastically be reduced.

DISCUSSION

The utilization of goal programming model will in no small measure assist in minimizing the strenuous computation involved in budgeting and at the same time optimize government resources allocation. The system is strongly recommended to managers of any business environment that needs to make important decision on the allocation of scarce resources to various goods and services especially as it involves multiple objectives. It is also recommended in the areas of accounting, marketing, banking & finance, investments and inventory management.

REFERENCES

Barichard, V. and Ehrgott M. (2009), *Goal Programming;Theoritical Results & Applications*, Springer-Verlag, Berlin Heidelberg

Chikwendu, C. R., Moore, C.S.,Okonta, S.D. (2009), On the Application of Linear Programming Method to Capital Budgeting in Nigeria, Publications of the International Centre of Mathematical and Computer Sciences.

Ehrgott, M. (2009), *Multicriteria Optimization*, 2nd edition, Springer-Verlag, Berlin Heidelberg

Ezeorah, E. U. ,Ezeano A. N. and Ayatalalumo C. J. C. et al (2008), *Enhancing Local Government Administration through Effective Application of ICT in Budgetary Processes*, Nigeria Computer Society Proceedings, Vol. 19

Williams, B. K. and Sawyer S.C. (2001), *Using Information Technology*, Mc GrawHill Publications, Toronto

Hillier, S. F. and Gerald, J.L. (2001), *Introduction to Operations Research*, McGraw hill Publishers, New-York, USA

Okoye, E.I. and Ani, W. U. (2004), *Annals of Government and Public sector Accounting*, Rex charles and Patrick limited, Nimo-Nigeria

Taha H. A. (2006), *Operations Research, An Introduction*, Pearson Education, Inc, Singapore.