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Capital Budgeting Decision through Goal Programming

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Abstract

The present paper will provide a critical review of capital budgeting and an attempt to scpecifier for consideration nine mutually exclusive projects with given present values of out lays for the periods and given present values of investment proposal of large scale industry. An approach using goal programming is described as a possible practical alternative.

Keywords: Capital Budgeting: Goal Programming

INTRODUCTION:

Optimization techniques are those techniques which seek to maximize or minimize a function of one a more variable when the variable can be independent or related in some way or the other. During the last four decades a large number of optimization techniques have emerged in the field of business, industry and government.

Mathematical programming is a general class of optimization problem to maximize or minimize an objective function dealing with many interrelated variables subject to an set of restraining conditions. Such problems are usually called programming problems. These are classified according to the characteristics of the decision environment.

The theoretical models of capital budgeting 'demonstrate' the advantage of accepting all projects with a positive NPV (Net Present Value) or an IRR (Internal Rate of Return) grater than the cost of capital. Yet the study indicated that 80 percent of the companies imposed some overall capital constraints. This capital rationing was largely self-imposed by the firms rather than by external forces. Since capital rationing practices are imposed by some of the most profitable corporations, this evidence would indicate that financial executives may impose capital rationing to reflect factors other than the 'cost of capital'.

The 163 respondents in the survey were asked to rank their financial objectives in order of importance. By a large margin the firms ranked 'maximization of earning per share' as their primary objective. But frequently the decision rule indicated by a discounted cash flow analysis may be in direct conflict with this particular objective. A short example may serve to illustrate this point.

Assume a firm has two unrelated projects in which it can invest; the capital rationing constraint makes it possible to accept only one of the projects. Project 'A' will generalize relatively higher cash flows, but because of the depreciation and the amortization associated with it, the accounting earning during the first years of its life will be quite small. The IRR on Project 'A' is 20 percent. By way of contrast, project 'B' has an IRR of only 15 percent, but its first-year contribution to accounting income would be significantly greater than project A's. The question facing the financial manager of this form is how to evaluate each of these factors. Should he blindly follow the rules of the theoretical model and accept project A, or should he introduce the 'next year's earnings' objective into the picture? If he should consider earning, how much IRR would he be willing to sacrifice for an additional Rs. 0.25 earnings per share? One percent? Two percent? May be he should accept project B instead. After all, those additional first year earnings may help the firm achieve its budget objectives. For that matter, it may also be in the best interest of stock holders as well, because it is well known that the market often reacts to reported growth (or dective) in earnings.

The difficulty of the decision-making process is further compounded as the number of projects and the size of the capital budget is increased. Imagine the complexity of selecting the 'optimum set' of projects from 150 alternatives.

The preceding discussion illustrates the dilemma financial managers often face in attempting to decide among alternative investment proposals. The lack of confidence in the pure theoretical approach is blatantly apparent when a manager is confronted with a situation where the acceptance of the 'theoretical optimal' solution has a significant adverse effect on other operational goals such as current earnings to return on investment. It is obvious that a pragmatic approach is required to benefit the operational financial manager. Yet, the recently developed and recommended discounted cash flow concepts should not be abandoned because they give the manager information as the 'long-run' effect on objectives. What is needed is a procedure that combines the best features of both theory and practice to give the manager a workable and feasible approach. Further more, this procedure must be flexible so that it can be modified and adapted to meet the specific needs of any individual company.

For a method to be practicable, it must allow the operational manager to state a range of objectives or factors that be considers important for his company. These relevant factors should be integrally included, not excluded from the procedure used in deciding among various investment alternatives. As implied above, these considerations could and probably should, differ from one company to another.

In multiple criteria decision making problems, the satisfaction of some aspiration levels of the criteria seems to be more meaningful. Such problems are tackled by using the Goal Programming model. Changes and cooper[3] have introduced the concept of Goal Programming to solve the unsolvable linear programming problems. It plays an important role in various decision analysis. Ignizio[7] presents a review of the works on Goal Programming in general and gives an overview of some computer codes for Goal Programming.

Previous weeks in multiple and conflicting criterion capital budgeting and for other functions has been considered by Baykasoglu[1], Benjamin[2], Deckro[4], Gao[5], Gary[6], Harish Babu G A[7], Kendall[12], Mirrazavi[13], NG Kyk[14], Parter[15], Romero[16], Tomasz[17] and Vickery[18].

The focus of this paper will be the extension of current Goal Programming models specifies for consideration nine mutually exclusive projects with given present values of outlays for the periods 1 and 2 and given present values of investment proposals of large scale industry in Hyderabad.

DATA OF THE PROBLEM

The data specifies for consideration nine mutually exclusive projects with given present values of outlays for periods I & II and given present values of investment proposals of large - scale industry in Hyderabad.

The required information is given in the following Table - 1.

Table - 1:

Investment Project	PV for outlays for periods		PV of Investments	Sales for Periods		Man-hours for periods	
	I	II		I	II	I	II
1	12	3	14	14	15	10	12
2	54	7	17	30	42	16	16
3	6	6	17	13	16	13	13
4	6	2	15	11	12	9	13
5	30	35	40	53	52	19	16
6	6	6	12	10	14	14	14
7	48	4	14	32	34	7	9
8	36	3	10	21	28	15	22
9	18	3	12	12	21	8	13

GENERAL GOAL PROGRAMMING MODEL

The general form of this model, denoted as the general goal programming is,

find $\bar{x} = (x_1, x_2, \ldots\ldots x_j)$ so as to minimize

$$\bar{a} = \{g_1(\overline{n,p}), \ldots\ldots\ldots\ldots g_k(\overline{n,p})\} \qquad \ldots\ldots\ldots\ldots\ldots\ldots 1$$

such that $f_i(x) + n_i - p_i = b_i$, $i = 1, 2, \ldots\ldots\ldots\ldots m$ $\qquad \ldots\ldots\ldots\ldots\ldots\ldots 2$

and $\bar{x}, \bar{n}, \bar{p} \geq 0$.

Where the equation (1) is our achievement function and the equation (2) is the problem objective.

Subject to:

G1: Present Value of Investment Goal:

$14X_1 + 17X_2 + 17X_3 + 15X_4 + 40X_5 + 12X_6 + 14X_7 + 10X_8 + 12X_9 + d_1^- = 32.4$

G2: Budget Ceiling Goals:

$12X_1 + 54X_2 + 6X_3 + 6X_4 + 30X_5 + 6X_6 + 48X_7 + 36X_8 + 18X_9 + d_2^- = 50.0$

$9X_1 + 7X_2 + 6X_3 + 2X_4 + 35X_5 + 6X_6 + 4X_7 + 3X_8 + 3X_9 + d_3^- = 20.0$

G3: Sales Goals:

$14X_1 + 30X_2 + 13X_3 + 11X_4 + 53X_5 + 10X_6 + 32X_7 + 21X_8 + 12X_9 + d_4^- - d_4^+ = 70.0$

$15X_1 + 42X_2 + 16X_3 + 12X_4 + 52X_5 + 14X_6 + 34X_7 + 28X_8 + 21X_9 + d_5^- = 84.0$

G4: Employment Goals:

$10X_1 + 16X_2 + 13X_3 + 9X_4 + 19X_5 + 14X_6 + 7X_7 + 15X_8 + 8X_9 + d_6^- - d_6^+ = 40.0$

$12X_1 + 16X_2 + 13X_3 + 13X_4 + 16X_5 + 14X_6 + 9X_7 + 22X_8 + 13X_9 + d_7^- - d_7^+ = 40.0$

In the present model, we propose the different priority coefficients (p_i) assigned to different goals are assumed to be as follows:

Goals	**Priority coefficients**
Net present value	1
Budget constraint for period I	2
Budget constraint for period II	3
Negative deviation of sales goal I	2
Negative deviation of sales goal II	3
Negative deviation Employment Goal I	4
Negative deviation Employment Goal II	4
Positive deviation of sales goal I	5
Positive deviation of Employment goal I	6
Positive deviation of Employment goal II	6

OBJECTIVE FUNCTION

Minimize $Z = P_1d_1^- + P_2d_2^- + P_3d_3^- + P_2d_4^- + 4P_3d_5^- + P_4d_6^- + P_4d_7^- + P_5d_4^+ + P_6d_6^+ + P_6d_7^+$

RESULTS AND DISCUSSION

The solution will be obtained by using QSB^+, computer software may be interpreted as follows:

$X_1 = 0.0$, $X_2 = 0.0$, $X_3 = 0.32429$, $X_4 = 3.84716$, $X_5 = 0.20660$, $X_6 = 0.0$, $X_7 = 0.0$, $X_8 = 0.0$, $X_9 = 1.04295$.

Goals	Goal Constraints	Total	Goal Programming solution

			X_3	X_4	X_5	X_9
Net present values	32.4	83.99973	5.51293	57.70740	8.26400	12.51540
Budgeted constraints - I	50.0	49.99980	1.94574	23.08296	6.19800	18.77310
Budgeted constraints - II	20.0	19.99991	1.94574	7.09432	7.23100	3.12885
Sales goal I	70.0	69.99973	4.21577	42.31876	10.94980	12.51540
Sales goal II	84.0	83.99971	5.18864	46.16592	10.74320	21.90925
Employment Goal I	40.0	51.10921	4.21577	34.62444	3.92540	8.34360
Employment Goal II	40.0	71.09280	4.21577	50.01308	3.30560	13.55835

Clearly the solution reveals that 0.32429 units of project X_3, 3.84716 units of project X_4, 0.2066 units of project X_5 and 1.04295 units of project X_9 should be chosen. If the respective units of these projects are chosen four of seven goals. i.e., two budget constraint goals i.e., both for period one and two and two sales goals i.e., both for period one and two would be achieved fully as desired. While the net present value goal would be overachieved as desired. In the formulation yielding a total net present value of 84.0 and the last goals. i.e., two employment goals relating to period one and period two are found to be over achieved requiring total man hours per day to the extent of 51.10921 in period one and 71.09280 in period two. These goals were found to be not achieved as desired since both overachievement and under achievement of these goals were considered to be undesirable in the Goal Programming model 1. the attributing factor to this solution is assignment of lower priority co-efficients to the two employment goals. One of the characteristic features which may be observed from the above is that all goals with higher priority co-efficients are achieved as desired and goals with lower priority were found to be not achieved as desired.

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