As per UGC guidelines an electronic bar code is provided to seure your paper

International Journal for Modern Trends in Science and Technology, 7(02): 56-59, 2021

ISSN: 2455-3778 online
DOI: https://doi.org/10.46501/IJMTST0702009
Available online at: http://www.ijmtst.com/vol7issue02.html

An Alternative Technique of Improved Multi Goal Programming

Chandra Sen

Professor (Rtd.), Department of Agricultural Economics, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi-221005, India
Email: chandra_sen@rediffmail.com

To Cite this Article

Chandra Sen, "An Alternative Technique of Improved Multi Goal Programming", *International Journal for Modern Trends in Science and Technology*, Vol. 07, Issue 02, February 2021, pp.-56-59.

Article Info
Received on 15-January-2021, Revised on 31-January-2021, Accepted on 08-February-2021, Published on 12-February-2021.

ABSTRACT

Minimization the sum of deviations between the goals and their achievements was the popular technique of solving multi goal programming (MGP) problems. Few weaknesses in the technique necessitated the need for the new techniques of MGP. Sen's improved MGP technique was found efficient for solving MGP problems. An extension of Sen's improved MGP technique has also achieved multiple conflicting goals simultaneously. An alternative MGP technique is proposed in this study for solving MGP problems.

Keywords: *Goal Programming, Single Goal Programming, Multi Goal Programming, Improved Multi, Goal Programming.*

I. INTRODUCTION

The presence of conflicts amongst goals makes the decision process difficult. A random decision may not be beneficial to any organization. The MGP techniques are helpful in improving the decision making process for achieving multiple goals at a time. The MGP technique was first developed by Charnes and Cooper in the year 1961 [1]. Applications of these MGP techniques have been made in the studies by Ignizio [2] Tamiz, et al. [3], Romero [4], and Lee [5] for solving MGP problems. Recently, few variants of MGP have been proposed by Kanan et al.[6], Qahtani et al.[7], and Ajayi-Daniels [8] for achieving multiple conflicting goals. After observing few weaknesses in the basic formulation of MGP, an improved MGP technique was proposed by Sen [9]. An extension of the improved MGP technique has also been proposed by Sen [10]. Both the above MGP techniques are capable of achieving multiple conflicting goals simultaneously. An alternative technique of improved MGP has been suggested in this study. The alternative improved MGP technique has been used to solve two examples and compared them with previous improved MGP techniques.

II. METHODOLOGIES TO SOLVE MGP PROBLEMS

2.1 Existing MGP Technique

The existing multi goal programming model can be expressed as:

$$Minimize\ Z = \sum_{i=1}^{m}(d_i^+ + d_i^-)$$

Subject to:

Goal Constraints

$$\sum_{j=1}^{n} a_{ij} X_j - d_i^+ + d_i^- = g_i \qquad for\ i = 1 \ldots .m$$

System constraints

$$\sum_{j=1}^{n} a_{ij} X_j = b_i \qquad for\ i = m+1 \ldots \ldots p$$

There are 'm' Goals, 'p' System constraints and 'n' decision variables

Z = Objective function/ Summation of all deviations
a_{ij} = the coefficient associated with j^{th} variable in i^{th} Goal/constraint
X_j= the j^{th} decision variable
g_i = the right hand side value of i^{th} goal
b_i = the right hand side value of i^{th} constraint
d_i^- = negative deviational variation from i^{th} goal (under achievement)
d_i^+ = positive deviational variation from i^{th} goal (over achievement)

2.2 Sen's Improved MGP Technique

The improved technique is formulated as described below:

$$Minimize\ Z = \sum_{i=1}^{m}(d_i^+ + d_i^-)/g_i$$

Subject to:
Goal Constraints

$$\sum_{j=1}^{n} a_{ij}X_j - d_i^+ + d_i^- = g_i \qquad for\ i = 1 \ldots . m$$

System constraints and other details are the same as in the existing MGP technique.

2.3. Sen's Modified Improved MGP technique.

The improved technique is formulated as described below:

$$Minimize\ Z = \sum_{i=1}^{m}(d_i^+ + d_i^-)$$

Subject to:
Goal Constraints

$$\sum_{j=1}^{n} a_{ij}X_j / g_i - d_i^+ + d_i^- = 1 \qquad for\ i = 1 \ldots . m$$

System constraints and other details are the same as in the existing MGP technique.

2.4 Alternative Improved MGP Technique

An alteration in the improved MGP technique is proposed as described below:

$$Minimize\ Z = \sum_{i=1}^{m}(d_i^+ + d_i^-)$$

Subject to:
Goal Constraints

$$\sum_{j=1}^{n} a_{ij}X_j - g_i^+ + g_i^- = g_i \qquad for\ i = 1 \ldots . m$$

System constraints and other details are the same as in the existing MGP technique.

III. EXAMPLES

Following two examples of previous studies by Sen have been solved using alternative improved MGP technique for comparative analysis.

Example 1

Goal-I: $16500X_1 + 18100X_2 + 15800X_3 + 17400X_4 + 14800X_5 = 73000$

Goal-II: $41X_1 + 35X_2 + 32X_3 + 39X_4 + 31X_5 = 165$

Goal-III: $430X_1 + 470X_2 + 380X_3 + 410X_4 + 440X_5 = 1500$

Goal-IV : $2300X_1 + 2400X_2 + 2100X_3 + 1900X_4 + 1800X_5 = 7000$

Subject to:

$X_1 + X_2 + X_3 + X_4 + X_5 = 4$

$2X_3 \geq 1$

$X_1, X_2, X_3, X_4, X_5 \geq 0$

Example 2

Goal-I: $6X_1 + 5X_2 + 3X_3 + 4X_4 = 55$

Goal-II: $700X_1 + 800X_2 + 900X_3 + 500X_4 = 9000$

Goal-III: $50X_1 + 55X_2 + 40X_3 + 60X_4 = 600$

Subject to:

$X_1 + X_2 + X_3 + X_4 = 11$

$X_1 \geq 1$

$2X_3 \geq 1$

$X_1, X_2, X_3, X_4 \geq 0$

IV. SOLUTION

The examples have been solved using single and multi goal programming techniques. The results of example 1 are presented in table 1. The single goal programming has achieved one goal only ignoring the remaining three goals. The first goal has been achieved with its value 71250 which is closest to its aspiration value of 73000. However, the values of second, third and fourth goals were 138.5, 1835 and 9450 respectively which are highly under achieved. Similar results have also been obtained in the single achievements of second, third and fourth goals. Four MGP techniques have been used for achieving all the goals simultaneously. The existing MGP has achieved first goal only and ignored the remaining three goals. However, the improved, modified and alternative improved MGP techniques have achieved first, second, third and fourth goals with their values 68800, 152.5, 1625 and 7700 respectively. These achievements are very close to the respective goals.

Table 1: Goal Achievements in Single and Multi-Goal Programming.

Goals		Single Goal Programming				Multi Goal Programming			
		I	II	III	IV	Existing MGP	Improved MGP	Modified MGP	**Alternative MGP**
Xi		0, 3.5, 0.5, 0, 0	3.5, 0, 0.5, 0, 0	0, 0, 4, 0, 0	0,0,0.5, 0, 3.5	0, 3.5, 0.5, 0,0	0, 0, 0.5, 3.5, 0	0, 0, 0.5, 3.5, 0	0, 0, 0.5, 3.5, 0
I	73000	71250	65650	63200	59700	71250	68800	68800	68800
II	165	138.5	159.5	128	124.5	138.5	152.5	152.5	152.5
III	1500	1835	1695	1520	1730	1835	1625	1625	1625
IV	7000	9450	9100	8400	7350	9450	7700	7700	7700

The solution of example 2 has been presented in table 2. There were three goals to be achieved. Like the first example, the single goal programming technique has achieved one goal only, ignoring the other two goals. All three goals have been achieved perfectly with the values of 55, 9000, and 600 in the single goal achievements of first, second and third goals respectively. The remaining two goals in every single goal achievement have been ignored. The achievements of goals with the existing MGP technique were not satisfactory. It has achieved the second goal only ignoring the first and third goal. However, the alternative improved MGP technique has achieved all three goals simultaneously. The achievements of goals are matching with the results of improved and modified MGP techniques. This reveals the suitability of the alternative improved technique for solving MGP problems.

Table 2: Goal Achievements in Single and Multi-Goal Programming.

Goals		Single Goal Programming			Multi Goal Programming			
		I	II	III	Existing MGP	Improved MGP	Modified MGP	**Alternative MGP**
X_i		5.75, 0, 0.5, 4.75	1, 7, 3, 0	5, 0, 0.5, 5.5	1, 7, 3, 0	1, 9.5, 0.5, 0	1, 9.5, 0.5, 0	1, 9.5, 0.5, 0
I	55	55	50	53.5	50	55	55	55
II	9000	6850	9000	6700	9000	8750	8750	8750
III	600	592.50	555	600	555	592.50	592.50	592.50

V. CONCLUSION

It is clear from the above results that multiple conflicting goals could not be achieved with the single MGP technique. The existing MGP technique has also been found inefficient in providing the desired solution. However, the alternative MGP technique has achieved multiple conflicting goals efficiently, similar to improved and modified MGP techniques.

Compliance with ethical standards

Conflict of interest: The author declares that there is no conflict of interest.

REFERENCES:

[1] Charnes, A., & Cooper, W. W. (1961). Management model and industrial application of linear programming. New York: Wiley.

[2] Ignizio, J. P. (1985). Introduction to linear goal programming. Beverly: Hills, CA: Sage.

[3] Tamiz, M., Jones, D., & Romero, C. (1998). Goal programming for decision making: an overview of the current state-of-the-art. European Journal of Operational Research, 111, 567-581.

[4] Romero, C. (2001). Extended lexicographic goal programming: a unifying approach. Omega, 29, 63-71.

[5] Lee SM. (1972) Goal programming for Decision Analysis, Auerbach, Philadelphia.

[6] Kanan K. Patro, M. M. Acharya & S. Acharya (2018) Multi-choice goal programming approach to \solve multi-objective probabilistic programming problem, Journal of Information and Optimization Sciences, 39:3, 607-629.

[7] Qahtani, H. Al., El–Hefnawy, A., El–Ashram,M. M., and Fayomi, A. (2019).A Goal Programming Approach to Multichoice Multiobjective Stochastic Transportation Problems with Extreme Value Distribution. Advances in Operations Research. Vol. 2019, 1-6.

[8] Ajayi-Daniels, E. E.(2019). Resource Optimization in a Fashion Firm: A Goal Programming Approach. International Journal of Management and Fuzzy Systems, 5 (1), 14-20.
[9] Sen, Chandra (2020). Improved Multi Goal Programming Technique. American Journal of Operational Research, Vol. 10 (3), 45-48.
[10] Sen, Chandra (2020). Sen's Improved Multi Goal Programming Technique- An Extension. American Journal of Operational Research, Vol. 10 (3), 49- 52.