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Analysis of the Comments of Dr. Sanjay Jain and Adarsh Mangal on S. Nahar and Md. Abdul Alim (2017) A New Statistical Method to Solve Multiobjective Linear Programming Problem

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Abstract: ***An error in the estimation of multiobjective function has been pointed out by Dr. Sanjay and Dr. Adarsh in a research paper on Multiobjective Optimization (MOO) problems. The calculations should have been checked several times to avoid any such mistakes. There are few more aspects of Multiobjective Optimization (MOO) problems discussed here for improving the MOO methodologies.***

Keywords: New statistical averaging method, Multiobjective optimization, Harmonic average, Sen's multiobjective optimization

1. Introduction

The comments of Dr. Sanjay Jain and Dr. Adarsh Mangal [33] on the paper entitled " A new statistical method to solve multiobjective linear programming" by S. Nahar and Md. Abdul Alim are appreciable. Though, it was a minor error in formulation of multiobjectvie function and there was no methodological or conceptual issues due to this error. Calculations should be checked thoroughly prior to submitting any manuscript for publication. The example used by S. Nahar & Md. Abdul Alim [20]is reproduced here for few methodological issues.

Example 1
Max. $Z_1 = X_1 + 2X_2$
Max. $Z_2 = X_1$
Min. $Z_3 = -2X_1 - 3X_2$
Min. $Z_4 = -X_2$

Subject to:
$6X_1 + 8X_2 \leq 48$
$X_1 + X_2 \geq 3$
$X_1 \leq 4$
$X_2 \leq 3$
$X_1, X_2 \geq 0$

Solution
The problem was solved for achieving all the four objective individually to see the conflicts amongst objectives. The solutions of MOO technique using harmonic mean technique by Nahar & Alim and Sanjay & Adarsh are also mentioned in Table 1:

Table 1: Individual and Multiobjective Optimization

Item	Individual Optimization				Sen's MOO Technique
	Max. Z_1	Max. Z_2	Min. Z_3	Min. Z_4	
X_1, X_2	4, 3	4, 3	4, 3	4, 3	4, 3
Z_1	10	10	10	10	10
Z_2	4	4	4	4	4
Z_3	-17	-17	-17	-17	-17
Z_4	-4	-4	-4	-4	-4
Z^*					9.8593
Z^{**}					9.9164

Z^*= Multiobjective function (Nahar & Alim)
Z^{**} = Multiobjective function (Sanjay & Adarsh)

The solutions of all the individual optimizations are the same and hence there is no conflicts amongst objectives. The solution of MOO is also same with minor error in the value of Z^* due to error in formulation MOO function. The example is not suitable for the application of any MOO technique. There are few relevant issues in the formulation and application of MOO techniques as discussed below.

2. Basic Conceptual Drawbacks

A number of MOO techniques [2], [3] ---------- [28] have been proposed during the past three decades. The efforts were made to formulate multiobjective function using various mathematical equations ignoring the basic nature of th MOO problems as given below:

(i) The objective functions may be non commensurable. The mathematical operations like addition /subtraction of the values of different dimensions seems illogical.
(ii) There may be high deviations in the coefficients of decision variables X_i in the objective functions. The Moo solution may be biased to the dominating objective function.

These problems have been well resolved in several studies [1], [29], [30], [31], [32].

3. Inappropriate Examples

The examples used for validation of MOO techniques by most of the studies [2], [3] ---------- [28] were not appropriate. A MOO technique is supposed to generate a compromise solution for achieving all the conflicting objectives. There was no conflicts amongst objectives in the examples used in these studies. Hence, there was no need of using any MOO technique to solve these examples. This is also true with the present study under review.

4. Misinterpretation of the Results

Most of the studies [2], [3] ---------- [28] considered the value of the combined objective function as the main achievement of the MOO technique. The multiobjective function is optimized to generate a compromising solution. However, the examples of these studies were non conflicting and should not be optimized by any MOO technique.

5. Appropriate Example

The following example has been formulated and solved using Sen's MOO technique [1]

Example 2

Max. $Z_1= 6500X_1 + 5500X_2+ 7000X_3 +7500 X_4+4500 X_5$
Max. $Z_2= 70X_1 + 80X_2+ 90X_3 + 50X_4+ 100X_5$
Min. $Z_3= 90X_1 + 130X_2+ 100X_3 + 160X_4+ 150X_5$
Min. $Z_4= 1200X_1 + 800X_2+ 900X_3 + 1500X_4+ 1400X_5$

Subject to:
$X_1 + X_2+ X_3 + X_4+ X_5= 13$
$X_1 \geq 1.5$
$X_3 \geq 0.5$
$X_1, X_2, X_3, X_4, X_5 \geq 0$

Solution

All the four objectives have been achieved individually to see the presence of conflicts amongst objectives. The results of individual and MOO are presented in Table 2.

Table 2: Individual and Multiobjective Optimization

Item	Individual Optimization				Sen's MOO Technique
	Max. Z_1	Max. Z_2	Min. Z_3	Min. Z_4	
X_i	1.5, 0, 0.5, 10.5, 0	1.5, 0, 0.5, 0, 10.5	12.5, 0, 0.5, 0, 0	1.5,10.5,0.5, 0, 0	1.5, 0, 11.5, 0, 0
Z_1	92000	60500	84750	71000	90250
Z_2	675	1200	920	990	1140
Z_3	2855	1760	1175	1550	1285
Z_4	18000	16950	15450	10650	12150

The results of all the individual optimization are different. When first objective Z_1 was maximized, It achieved the highest value of 92000. However, the remaining three objectives have not achieved. The similar trend was observed in optimization of other three objectives. The solution indicated the presence of high degree of conflicts amongst the objectives. When these objectives were optimized using Sen's MOO technique, all the objectives have been achieved simultaneously. Though, none of the objectives achieved its individual optimal value, but the solution seems more compromising and acceptable.

6. Conclusion

The present analysis suggests that mathematical calculations in the manuscript should be thoroughly checked. It is also suggested to use appropriate examples and suitable methodologies for improving the utility of the research.

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