Novel Optimum Solution-Finding Technique for Transport Issues

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Abstract— In this paper a new method named ASM-Method is proposed for finding an optimal solution for a wide range of transportation problems, directly. A numerical illustration is established and the optimality of the result yielded by this method is also checked. The most attractive feature of this method is that it requires very simple arithmetical and logical calculation, that's why it is very easy even for layman to understand and use. This method will be very lucrative for those decision makers who are dealing with logistics and supply chain related issues. Because of the simplicity of this method one can easily adopt it among the existing methods.

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INTRODUCTION

A Transportation problem is one of the earliest and most important applications of linear programming problem. Description of a classical transportation problem can be given as follows. A certain amount of homogeneous commodity is available at number of sources and a fixed amount is required to meet the demand at each number of destinations. A balanced condition (*i.e.* Total demand is equal to total supply) is assumed. Then finding an optimal schedule of shipment of the commodity with the satisfaction of demands at each destination is the main goal of the problem. In 1941 Hitchcock [2] developed the basic transportation problem along with the constructive method of solution and later in 1949 Koopmans [11] discussed the problem in detail. Again in 1951 Dantzig [3] formulated the transportation problem as linear programming problem and also provided the solution method. Now a day's transportation problem has become a standard application for industrial organizations having several manufacturing units, warehouses and distribution centers.

For obtaining an optimal solution for transportation problems it was required to solve the problem into two stages. In first stage the initial basic feasible solution (IBFS) was obtained by opting any of the available methods such as "North West Corner", "Matrix Minima", "Least Cost Method", "Row Minima ", "Column Minima" and "Vogel's Approximation Method " etc. Then in the next and last stage MODI (Modified Distribution) method was adopted to get an optimal solution. Charnes and Cooper [1] also developed a method for finding an optimal solution from IBFS named as "Stepping Stone Method".

Recently, P.Pandian *et al.* [12] and Sudhakar *et al.* [6] proposed two different methods in 2010 and 2012 respectively for finding an optimal solution directly. Here a much easier heuristic approach is proposed for finding an optimal solution directly with lesser number of iterations and very easy computations. The stepwise procedure of proposed method is carried out as follows.

ASM-METHOD

Step 1: Construct the transportation table from given transportation problem.
Step 2: Subtract each row entries of the transportation table from the respective row minimum and then subtract each column entries of the resulting transportation table from respective column minimum.
Step 3: Now there will be at least one zero in each row and in each column in the reduced cost matrix. Select the first zero (row-wise) occurring in the cost matrix. Suppose $(i, j)^{th}$ zero is selected, count the total number of zeros (excluding the selected one) in the i^{th} row and j^{th} column. Now select the next zero and count the total number of zeros in the corresponding row and column in the same manner. Continue it for all zeros in the cost matrix.
Step 4: Now choose a zero for which the number of zeros counted in step 3 is minimum and supply maximum possible amount to that cell. If tie occurs for some zeros in step 3 then choose a $(k,l)^{th}$ zero breaking tie such that the total sum of all the elements in the k^{th} row and l^{th} column is maximum. Allocate maximum possible amount to that cell.

Step 5: After performing step 4, delete the row or column for further calculation where the supply from a given source is depleted or the demand for a given destination is satisfied.

Step 6: Check whether the resultant matrix possesses at least one zero in each row and in each column. If not, repeat step 2, otherwise goto step 7.

Step 7: Repeat step 3 to step 6 until and unless all the demands are satisfied and all the supplies are exhausted.

NUMERICAL EXAMPLE

Consider the following cost minimizing transportation problem with three origins and four destinations.

	D_1	D_2	D_3	D_4	Supply
S_1	13	18	30	8	8
S_2	55	20	25	40	10
S_3	30	6	50	10	11
Demand	4	7	6	12	29 (Total)

By applying ASM-Method allocations are obtained as follows:

	D_1	D_2	D_3	D_4	Supply
S_1	13 [4]	18	30	8 [4]	8
S_2	55	20 [4]	25 [6]	40	10
S_3	30	6 [3]	50	10 [8]	11
Demand	4	7	6	12	29 (Total)

The total cost associated with these allocations is 412.

I. OPTIMALITY CHECK

To find initial basic feasible solution for the above example Vogel's Approximation Method is used and allocations are obtained as follows:

	D_1	D_2	D_3	D_4	Supply
S_1	13 (4)	18	30	8 (4)	8
S_2	55	20	25 (6)	40 (4)	10
S_3	30	6 (7)	50	10 (4)	11
Demand	4	7	6	12	29

The total cost associated with these allocations is 476.

To get optimal solution MODI (Modified Distribution) method is adopted and by applying MODI method the optimal solution is obtained as 412. It can be seen that the value of the objective function obtained by ASM-Method in section 3 is same as the optimal value obtained by MODI method. Thus the value obtained by ASM-Method (i.e. 412) is also optimal.

CONCLUSION

Thus it can be concluded that ASM-Method provides an optimal solution directly, in fewer iterations, for the transportation problems. As this method consumes less time and is very easy to understand and apply, so it willbe very helpful for decision makers who are dealing with logistic and supply chain problems.

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