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S_N Algorithm Involving to Solve the Transportation Problems

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Abstract: In this study, the S-N algorithm has been tried to be solved the transportation problem. In this algorithm, it has been attempted to find the optimal solution directly by using mathematical suffix average, without finding initial basic feasible solution. Even for all types of transportation problems it gives best optimal solution. It gives overall feasibility and optimality with less steps.

Key words: Source, demand, supply, degeneracy, loops, maximization, row, column, minimization and optimal solution

INTRODUCTION

The conventional objective transportation problem consists of finding an optimal solution using one of the classical methods the basic feasible solution can be optimized by using optimization techniques like u-v method and stepping stone method. It has been observed that the classical methods reach the optimal solution with more steps but this S_N algorithm seeks to optimize the transportation problem with less steps and best optimal solution. In this study, we have discussed about the mathematical model of S_N algorithm to solve transportation and also the relevant examples are presented.

THEORETICAL DEVELOPMENT

The transportation problem deals with the transportation of a single product from several sources (origins or supply or capacity centres) to several sinks (destinations or demand or requirements centres). In general, let there be m sources $S_1, S_2, S_3 \ldots\ldots S_m$ with a_i ($i = 1, 2, \ldots.. m$) available supplies or capacity at each source I, to be allocated among n destinations $D_1, D_2, \ldots.. D_n$ with b_j ($j = 1, 2, \ldots. n$) specified requirements at each destination j. Here, we state already existing mathematical model introduced and studied by Kuhn (1995) for such a problem is

$$\text{Min} Z = \sum_{i=1}^{m} \sum_{j=1}^{n} c_{ij} x_{ij}$$

$$\sum_{i=1}^{m} x_{ij} = a_i \,;\; i = 1, 2, \ldots..m$$

$$\sum_{j=1}^{n} x_{ij} = b_j \,;\; j = 1, 2, \ldots..n$$

$$x_{ij} \geq 0, \text{ For i and j}$$

$$\sum_{i=1}^{n} a_i = \sum_{j=1}^{n} b_j \text{ (Rim condition)}$$

Where,

c_{ij} = The cost transporting goods from the ith supply point to the jth destination.

x_{ij} = The amount transporting goods from the ith supply point to the jth destination.

Motivated by earlier works which are stated in this study (Fisk, 1986; Friesz, 1985; Garfinkel and Rao, 1971; Kuhn, 1955; Little *et al*., 1963; Melarkode, 2006; Puri, 1978; Russel and Wsasieni, 1967), in the following study we define new algorithm to solve the transportation problems.

S_N ALGORITHM FOR GETTING OPTIMAL SOLUTION OF TRANSPORTATION PROBLEM

This S_N algorithm gives optimal solution directly without finding initial basic feasible solution. Not only that, there is no need to bother about looping as well as degeneracy. It gives best optimal solution, when compared to the existing method. Also, it works for unbalanced and maximization cases. In maximization case usually, the problem is to be converted to minimization and that can be solved in the regular method.

Step 1: Initially check if the given transportation has equal demand and supply. If not appropriate demand and supply to be adjusted with zero cost.

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To construct a reduced cost matrix for the given transportation problem we required the following Step 1 which was stated by Kuhn (1955).

- Find the row minimum for each row of the original cost matrix

$$\min_{j}\langle \text{ith row cost}; c_{ij}\rangle = \theta, \quad \text{where } i = 1, 2, \ldots m$$

After obtaining the minimum θ, we can construct a new cost matrix. Each new cost in the ith row

$$c'_{ij} = \text{old}\, c_{ij} - \theta, \text{ where } i = 1, 2, \ldots m$$

- Find the column minimum for each column of the new cost matrix

$$\min_{i}\langle j^{th} \text{row cost}; c'_{ij}\rangle = \sigma_j, \text{ where } j = 1, 2, \ldots n$$

- Construct a reduced cost matrix for each new cost in the jth column (c^{n}_{ij})

$$c''_{ij} = \text{old}(c'_{ij}) - \sigma_j, \text{ where } j = 1, 2, \ldots n$$

There are many zeros in the reduced cost matrix, at least one should be in each row and column.

With help of the above step now we define next step of the S_N algorithm.

Step 2: Let

$$s = \frac{1}{4}\left\{c''_{i,j-1} + c''_{i,j+1} + c''_{i-1,j} + c''_{i+1,j}\right\}, \text{where } \left\{\begin{matrix} j = 1, 2, ..n \\ i = 1, 2, ..m \end{matrix}\right\} \quad (1)$$

In the reduced cost matrix by applying the above Eq. 1 in each zero ($c''_{ij} = 0$) from the resultant matrix, write all values of s to the suffix of corresponding c''_{ij}.

Step 3: Select maximum of s, if it has one maximum value then first supply to that demand corresponding to the c''_{ij}. If it has more equal values then select $\{a_i, b_j\}$ and supply to that demand maximum possible. After supplied, the exhausted demand (column) or supply (row) to be trimmed.

Further, the resultant matrix must posses at least one c''_{ij} in each row and column, else repeat the step 1. Repeat the above process until the optimal cost is obtained.

Maximization transportation problems: In maximization transportation problem replace each element of the transportation table by its difference from the maximum element of the table. Then by applying the steps of minimization transportation problem on the revised transportation table.

Numerical example

Example 1:

	Distribution centers				Supply
Plates	2	3	11	7	6
	1	0	6	1	1
	5	8	15	8	10
Requirements	7	5	3	2	

By S-N Algorithm the direct optimal solution is

2	3 (5)	11 (1)	7
1	0	6	1 (1)
5 (7)	8	15 (2)	9 (1)

The Total optimal cost of transportation is Rs.101/=.

Example 2: (Unbalanced problem)

	Destinations				Supply
Sources	6	1	9	3	70
	11	5	2	8	55
	10	12	4	7	70
Demand	85	35	50	45	

By S-N Algorithm the direct optimal solution is

6 (40)	1 (30)	9	3
11	5 (5)	2 (50)	8
10 (25)	12	4	7 (45)

The total optimal cost of transportation is Rs. 960/=.

CONCLUSION

In the present study, we have devised a method to find the solution for the transportation problem by using the above algorithm. The proposed algorithm is simple and there it seems that its execution time is less and this method works effective to provide the desired solution.

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