Comparative study on MDMA method with OFSTF method in Transportation Problem

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Abstract
In this paper comparative study of MDMA method and OFSTF method is discussed concluding this with MDMA is better than OFSTF for proposed pay off matrix

Keywords: *Assignment problem, Transportation problem, Degeneracy, Pay Off Matrix (POM), Quadrants.*

I. INTRODUCTION

The transportation problem constitutes an important part of logistics management.

In addition, logistics problems without shipment of commodities may be formulated as transportation problems [1]. For instance, the decision problem of minimizing dead kilometers (Raghavendra and Maharaja, 1987) [11] can be formulated as a transportation problem (Vasudevan*et al.*,1993; Sridhar an, 1991) [18],[20]. The problem is important in urban transport undertakings, *as* dead kilometers mean additional losses. It is also possible to approximate certain additional linear programming problems by using a transportation formulation (e.g., see Dose and Morrison, 1996) [4].

Various methods are available to solve the transportation problem to obtain an optimal solution [16]. Typical/well-known transportation methods include the stepping stone method [2] (Charnes and Cooper, 1954), the modified distribution method (Dantzig, 1963), the modified stepping-stone method (Shih, 1987), the simplex-type algorithm (Arsham and Kahn, 1989) and the dual-matrix approach (Ji and Chu, 2002). Glover *et al.* (1974) presented a detailed computational comparison of basic solution algorithms for solving the transportation problems [6],[18]. Shafaat and Goyal (1988) proposed a systematic approach for handling the situation of degeneracy encountered in the stepping stone method [7][8][9],[14].

A detailed literature review on the basic solution methods is not presented. All the optimal solution algorithms for solving transportation problems need an initial basic feasible solution to obtain the optimal solution[3],[19]. There are various heuristic methods available to get an initial basic feasible solution, such as "North West Corner" rule, "Best Cell Method," "VAM — Vogel's Approximation Method"[17] (Reinfeld and Vogel, 1958), Shimshak*et* a/.'s version of VAM (Shimshak*et al.*,1981)[13], Coyal's version of VAM (Goyal, 1984), Ramakrishnan's version of VAM (Ramakrishnan, 1988) etc [12]. Further, Kirca and Satir (1990) developed a heuristic, called TOM (Total Opportunity-cost Method), for obtaining an initial basic feasible solution for the transportation problem [10]. Gass (1990) detailed the practical issues for solving transportation problems [5] and offered comments on various aspects of transportation problem methodologies along with discussions on the computational results, by the respective researchers.

Recently, Sharma and Sharma (2000) [15] proposed a new heuristic approach for getting good starting solutions for dual based approaches used for solving transportation problems. Even in the above method needs more iteration to arrive optimal solution. Hence the proposed method helps to get directly optimal solution with less iteration number of the proposed method [21] is given below.

II.Transport Problem through OFSTF (Origin, First, Second, Third, and Fourth quadrants) Method

We now introduce a new method called the Transport Problem through OFSTF method for finding an feasible solution to a transportation problem. The OFSTF method proceeds as follows.

Step 1
Construct the Transportation Table (TT) for the given Pay Off Matrix (POM).

Step 2
Choose the maximum and minimum element in the constructed Transportation Table (TT).

Step 3
Find the difference between the maximum and minimum element from Step 2.
If the Resultant Element (RE) matched with anyone of the element in the POM, then find the difference between each element in the Transportation Table (TT) with the Resultant Element (RE). That is,

Maximum Element – Minimum Element = R.E

If R.E = an element in TT
Every element in TT – R.E.
If R.E ≠ an element in TT
select next minimum element in TT and repeat the Step 2.3.1..
Repeat the process until the condition satisfied.

Step 4
In the Reduced POM, there will be at least one zero in the TT, select a particular zero based on the maximum deviation element from the given zeros.

Step 5
Case 1
Fix zero as origin, and find the maximum deviated element from the selected zero.

Case 2
Fix zero as origin, and find the maximum deviated element in the first quadrant (+, +) from the selected zero.

Case 3
Fix zero as origin, and find the maximum deviated element in the second quadrant (-, +) from the selected zero

Case 4
Fix zero as origin, and find the maximum deviated element in the Third quadrant (-, -) from the selected zero.

Case 5
Fix zero as origin, and find the maximum deviated element in the fourth quadrant (+, -) from the selected zero.

Step 6
Compare and fulfill the demand of the maximum deviated element with the supply in the TT.

Step 7
Calculate the total cost for each cases, the feasible solution is obtained in the origin area for all kind of transportation Problem.
Hence by observation for transportation problem, calculating the cost from origin will lead to a feasible solution through OFSTF from the following example.

III. Example

Consider the following cost minimizing transportation problems.

	D_1	D_2	D_3	D_4	Supply
S_1	6	8	8	5	30
S_2	5	11	9	7	40
S_3	8	9	7	13	50
Demand	35	28	32	25	120

Origin

Step 1

	D_1	D_2	D_3	D_4	Supply
S_1	6	8	8	5	30
S_2	5	11 / 28	9	7	40 / 12
S_3	8	9	7	13	50
Demand	35	28	32	25	120

Step 2

	D_1	D_3	D_4	Supply
S_1	6	8	5 / 25	30 / 5
S_2	5	9	7	12
S_3	8	7	13	50
Demand	35	32	25	92

Step 3

	D_1	D_3	Supply
S_1	6	8	5
S_2	5 / 12	9	12
S_3	8	7	50
Demand	35 / 23	32	67

Step 4

	D_1	D_3	Supply
S_1	6 / 5	8	5
S_3	8	7	50
Demand	23 / 18	32	55

Step 5

	D_1	D_3	Supply
S_3	8 / 18	7 / 32	50
Demand	18	32	50

Total Cost:-

11 x 28 + 28 x 5 + 12 x 5 + 6 x 5 + 8 x 18 + 32x7

308+125+60+30+144+224 = 891

First Quadrant (++)

Step 1

	D_1	D_2	D_3	D_4	Supply
S_1	6	8 / 28	8	5	30 / 2
S_2	5	11	9	7	40
S_3	8	9	7	13	50
Demand	35	28	32	25	120

Step 2

	D_1	D_3	D_4	Supply
S_1	6	8	5 / 2	2
S_2	5	9	7	40
S_3	8	7	13	50
Demand	35	32	25 / 23	92

Step 3

	D_1	D_3	D_4	Supply
S_2	5 / 35	9	7	40 / 5
S_3	8	7	13	50
Demand	35	32	23	90

Step 4

	D_3	D_4	Supply
S_2	9	7 / 5	5
S_3	7	13	50
Demand	32	23 / 18	55

Step 5

	D_3	D_4	Supply
S_3	7 / 32	13 / 18	50
Demand	32	18	50

Total Cost:-

7 x 32 + 13 x 18 + 5 x 7 + 5 x 35 + 5 x 2 + 8 x 28

224 + 234 + 35 + 175 + 10 + 224 = 902

Second Quadrant (-- +)

Step 1

	D_1	D_2	D_3	D_4	Supply
S_1	6 / 30	8	8	5	30
S_2	5	11	9	7	40
S_3	8	9	7	13	50
Demand	35 / 5	28	32	25	120

Step 2

	D_1	D_2	D_3	D_4	Supply
S_2	5 / 5	11	9	7	40 / 35
S_3	8	9	7	13	50
Demand	5	28	32	25	90

Step 3

	D_2	D_3	D_4	Supply
S_2	11	9	7 / 25	35 / 10
S_3	9	7	13	50
Demand	28	32	25	85

Step 4

	D_2	D_3	Supply
S_2	11 / 10	9	10
S_3	9	7	50
Demand	28 / 18	32	60

Step 5

	D_2	D_3	Supply
S_3	9 / 18	7 / 32	50
Demand	18	32	50

Total Cost:-

7 x 32 + 9 x 18 + 11 x 10 + 25 x 7 + 5 x 5 + 6 x 30

224 + 162 + 110 + 175 + 25 + 180 = 876

Third Quadrant (+ --)

Step 1

	D_1	D_2	D_3	D_4	Supply
S_1	6	8	8	5	30
S_2	5	11 / 28	9	7	40 / 12
S_3	8	9	7	13	50
Demand	35	28	32	25	120

Step 2

	D_1	D_3	D_4	Supply
S_1	6	8	5	30
S_2	5 / 12	9	7	12
S_3	8	7	13	50
Demand	35 / 23	32	25	92

Step 3

	D_1	D_3	D_4	Supply
S_1	6	8	5	30
S_3	8 / 23	7	13	50 / 27
Demand	23	32	25	80

Step 4

	D_3	D_4	Supply
S_1	8	5	30
S_3	7 / 27	13	27
Demand	32 / 5	25	57

Step 5

	D_3	D_4	Supply
S_1	8 / 5	5 / 25	30
Demand	5	25	30

Total Cost:-

5 x 25 + 8 x 5 + 7 x 27 + 8 x 23 + 5 x 12 + 11 x 28

125 + 40 + 189 + 184 + 60 + 308 = 906

Fourth Quadrant (-- --)

Step 1

	D_1	D_2	D_3	D_4	Supply
S_1	6	8	8	5	30
S_2	5	11 / 28	9	7	40 / 12
S_3	8	9	7	13	50
Demand	35	28	32	25	120

Step 2

	D_1	D_3	D_4	Supply
S_1	6	8	5 / 25	30 / 5
S_2	5	9	7	12
S_3	8	7	13	50
Demand	35	32	25	92

Step 3

	D_1	D_3	Supply
S_1	6	8	5
S_2	5	9	12
S_3	8	7 / 32	50 / 18
Demand	35	32	67

Step 4

	D_1	Supply
S_1	6 / 5	5
S_2	5 / 12	12
S_3	8 / 18	18
Demand	35	35

Total Cost:-

8 x 18 + 5 x 12 + 6 x 5 + 7 x 32 + 5 x 25 + 11 x 28

144 + 60 + 30 + 224 + 125 + 308 = 891

MDMA Method

	D_1	D_2	D_3	D_4	Supply
S_1	6	8 5	8	5 25	30
S_2	5 35	11 5	9	7	40
S_3	8	9 18	7 32	13	50
Demand	35	28	32	25	120

Step 1

	D_1	D_2	D_3	D_4	Supply
S_1	6/13	8/13	8/13	5/13 25	30 5
S_2	5/13	11/13	9/13	7/13	40
S_3	8/13	9/13	7/13	1	50
Demand	35	28	32	25	120

Step 2

	D_1	D_2	D_3	Supply
S_1	6/13	8/13	8/13	5
S_2	5/13	11/13	9/13	40
S_3	8/13	9/13	7/13	50
Demand	35	28	32	95

	D_1	D_2	D_3	Supply
S_1	6/11	8/11	8/11	5
S_2	5/11 35	1	9/11	40 5
S_3	8/11	9/11	7/11	50
Demand	35	28	32	95

Step 3

	D_2	D_3	Supply
S_1	8/11	8/11	5
S_2	1	9/11	5
S_3	9/11	7/11	50
Demand	28	32	60

	D_2	D_3	Supply
S_1	8/9	8/9	5
S_2	11/9	1	5
S_3	1	7/9 32	50 18
Demand	28	32	60

Step 4

	D_2	Supply
S_1	8/9 5	5
S_2	11/9 5	5
S_3	1 18	18
Demand	28	28

Total Cost:-
8 x 5 + 25 x 5 + 5 x 35 + 11 x 5 + 9 x 18 + 7 x 32
40 + 125 + 175 + 55 + 162 + 224 = 781

Comparative Study

Comparative Study on the same problem with other methods-OFSTF Method, MDMA Method, NORTH WEST CORNER Method has been reduced.

Origin : 891 $\rightarrow$ 18%
First Quadrand : 902 $\rightarrow$ 16%
Second Quadrand : 876 $\rightarrow$ 18%
Third Quadrand : 906 $\rightarrow$ 16%
Fourth Quadrand : 891 $\rightarrow$ 17%
MDMA Method : 781 $\rightarrow$ 28%
North West Corner Method :1076

IV.CONCLUSION AND FUTURE WORK

Thus the OFSTF method provides an feasible value of the objective function for the transportation problem. The proposed algorithm carries systematic procedure, and very easy to understand. It can be extended to assignment problem and travelling salesman problems to get optimal solution. The proposed method is important tool for the decision makers when they are handling various types of logistic problems, to make the decision optimally and from the comparison MDMA leads the optimal solution other than all the methods.

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