Middle-East Journal of Scientific Research 24 (12): 3706-3710, 2016
ISSN 1990-9233

DOI: 10.5829/idosi.mejsr.2016.3706.3710

MDMA Method- An Optimal Solution for Transportation Problem

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Abstract: In this article, proposed method namely MDMA (Maximum Divide Minimum Allotment) method is applied for finding the feasible solution for transportation problem. The proposed algorithm is unique way to reach feasible (or) may be optimal (for some extant) solution without disturbance of degeneracy condition.

Key words: Assignment problem · Transportation problem · Degeneracy · Pay Off Matrix (POM)

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 [2] can be formulated as a transportation problem [3, 4]. The problem is important in urban transport undertakings, *as* dead kilometres mean additional losses. It is also possible to approximate certain additional linear programming problems by using a transportation formulation [5]. Various methods are available to solve the transportation problem to obtain an optimal solution [6]. Typical/well-known transportation methods include the stepping stone method [7] the modified distribution method [8], the modified stepping-stone method [6], the simplex-type algorithm [1] and the dual-matrix approach [9]. Glover *et al.* [10] presented a detailed computational comparison of basic solution algorithms for solving the transportation problems [10, 3]. Shafaat and Goyal [11] proposed a systematic approach for handling the situation of degeneracy encountered in the stepping stone method [12, 13, 9, 11]. 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 [8, 14]. 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" [15, 16], Shimshak *et al*.'s version of VAM [16, 12], Coyal's version of VAM [12], Ramakrishnan's version of VAM etc [17]. Further, Kirca and Satir [18] developed a heuristic, called TOM (Total Opportunity-cost Method), for obtaining an initial basic feasible solution for the transportation problem [18]. Gass [19] detailed the practical issues for solving transportation problems [19] 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 [20] 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.

Transport Problem Through MDMA (Maximum Divide Minimum Allotment) Method: We now introduce a new method called the Transport Problem through MDMA method for finding an feasible solution to a transportation problem. The MDMA method proceeds as follows.

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

Step 2: Choose the maximum element(ME) from POM and divide all elements by the ME in the Constructed Transportation Table (CTT).

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Step 3: Supply the demand for the minimum element newly CTT.

Step 4: Select the next maximum element in CTT and repeat the same procedure for remaining allotments

Example: Consider the following cost minimizing transportation problems.

	D_1	D_2	D_3	D_4	D_5	Supply
S_1	12	4	9	5	9	55
S_2	8	1	6	6	7	45
S_3	1	12	4	7	7	30
S_4	10	15	6	9	1	50
Demand	40	20	50	30	40	180

Step 1: Here the maximum element is 15, Divide all elements by ME = 15

	D_1	D_2	D_3	D_4	D_5	Supply
S_1	12/15	4/15	9/15	5/15	9/15	55
S_2	8/15	1/15 [20]	6/15	6/15	7/15	45 [25]
S_3	1/15	12/15	4/15	7/15	7/15	30
S_4	10/15	15/15	6/15	9/15	1/15	50
Demand	40	20	50	30	40	180

Select the minimum element(1/15) allot the minimum demand and allot [D(20), S(45)] =20 unit in the cell(2, 2)

Step 2: Choose the next maximum element is 12/15, Divide all elements by ME=12/15

	D_1	D_3	D_4	D_5	Supply
S_1	1	9/12	5/12	9/12	55
S_2	8/12	6/12	6/12	7/12	25
S_3	1/12 [30]	4/12	7/12	7/12	30
S_4	10/12	6/12	9/12	1/12	50
Demand	40 [10]	50	30	40	160

Pick the minimum element and assign the minimum demand [D(40), S(30)] =30 unit in the cell(3, 1)

Step 3: Choose the next maximum element is 10/12, Divide all elements by ME= 10/12

	D_1	D_3	D_4	D_5	Supply
S_1	12/10	9/10	5/10	9/10	55
S_2	8/10	6/10	6/10	7/10	25
S_4	1	6/10	9/10	1/10 [40]	50 [10]
Demand	10	50	30	40	130

The minimum element and Assign the minimum demand [D(40), S(50)]=40 unit in the cell(3, 4)

Step 4: Choose the next maximum element is 12/10, Divide all elements by ME=12/10

	D_1	D_3	D_4	Supply
S_1	1	9/12	5/12 [30]	55 [25]
S_2	8/12	6/12	6/12	25
S_4	10/12	6/12	9/12	10
Demand	10	50	30	90

Pick the minimum element and assign the minimum demand [D(30), S(55)]= 30 unit in the cell(1, 3)

Step 5: Choose the next maximum element is 10/12, Divide all elements by ME=10/12

	D_1	D_3	Supply
S_1	12/10	9/10	25
S_2	8/10	6/10	25
S_4	1	6/10 [10]	10
Demand	10	50 [40]	60

Select the minimum element and assign the minimum demand [D(50), S(10)]= 10 unit in the cell(3, 2)

Step 6: Choose the next maximum element is 12/10, Divide all elements by ME=12/10

	D_1	D_3	Supply
S_1	1	9/12	25
S_2	8/12	6/12 [25]	25
Demand	10	40 [15]	50

Select the minimum element and assign the minimum demand [D(40), S(25)]=25 unit in the cell(2, 2)

Step 7:

	D_1	D_3	Supply
S_1	1 [10]	9/12 [15]	25
Demand	10	15	25

Finally Choose the minimum demand and allot 10 unit in cell(1, 1) and 15 unit in cell(1, 2). Which leads to the solution satisfying all the constraints. The resulting initial basic feasible solution is given below.

Sept 8:

	D_1	D_2	D_3	D_4	D_5	Supply
S_1	12 [10]	4	9 [15]	5 [30]	9	55
S_2	8	1 [20]	6 [25]	6	7	45
S_3	1 [30]	12	4	7	7	30
S_4	10	15	6 [10]	9	1 [40]	50
Demand	40	20	50	30	40	180

$S_1 \rightarrow D_1$ 10 units : Cost 10 x 12 = 120
$S_1 \rightarrow D_3$ 15 units : Cost 15 x 9 = 135
$S_1 \rightarrow D_4$ 30 units : Cost 30 x 5 = 150
$S_2 \rightarrow D_2$ 20 units : Cost 20 x 1 = 20
$S_2 \rightarrow D_3$ 25 units : Cost 25 x 6 = 150
$S_3 \rightarrow D_1$ 30 units : Cost 30 x 1 = 30
$S_4 \rightarrow D_3$ 10 units : Cost 10 x 6 = 60
$S_4 \rightarrow D_5$ 40 units : Cost 40 x 1 = 40

Total cost =. 450

Conclusion and Future Work: Thus the MDMA 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.

ACKNOWLEDGEMENT

The authors would like to thank Dr. Ponnammal Natarajan, Former director of Research, Anna University, Chennai, India for her intuitive ideas and fruitful discussions with respect to the paper's contribution and support to complete this paper.

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