International Journal of Emerging Trends in Engineering and Development
Available online on http://www.rspublication.com/ijeted/ijeted_index.htm
Issue 7, Vol. 3 (May 2017)
ISSN 2249-6149

A Competent Algorithm to Minimize the Transportation Time.

Md. Mizanur Rahman[1], Md.Bellal Hossain[2], Md. Mosharraf Hossain[3],

[1]PhD Student, Department of Mathematics, RUET, Bangladesh.
[2]Professor, Department of Mathematics, RUET, Bangladesh.
[3]Professor, Department of IPE, RUET, Bangladesh.

Abstract: The general transportation problem (TP) is concerned with determining an optimal strategy for distributing a commodity from a group of supply centers, such as factories to various receiving centers, in such a way as to minimize the cost and time. Here a new model to minimize the transportation time has been studied. A new algorithm is developed to determine the initial Basic Feasible Solution (IBFS) to minimize time. Firstly, it is constructed time minimizing least entry table (TMLET) by subtracting least odd cost from other odd cost and divide by common factor. Then Row Decision Making Indicators (RDMI) and Column Decision Making Indicators (CDMI) are calculated by the difference of the greatest time unit and the nearest-to-greatest time unit. Then the least entry of TMLET along the highest RDMI/CDMI is taken as the basic cell. Finally load have been imposed in the original transportation table and the minimum time is calculated as Max unit in to the Original transportation table of allocated cell. In this paper it is compared the time obtained by the propose method with regular methods.

Keywords: TP, IBFS, TMLET, RDMI, CDMI.

Introduction: The transportation problem is one of the most important applications of linear programming problem and time minimizing transportation problem is special case of transportation problem. In a time minimizing transportation problem, it is minimized the time of the transporting goods from stations to destinations. The first algorithm to solve the TP was developed by G.B Dantzig. It was also developed a method for finding an optimal solution by Charnes and Cooper. Transportation problems can be solved by using North West Corner, Row minima, Column minima, Matrix minima, Vogel's Approximation Method (VAM), Shore's application of VAM. Also a good number of researchers such as P. Pandian et al.[15] Kirca and Stair [11], S.K.Goyal [6] Sudhakar et al,[16] N.M. Deshmukh, [5], Juman & Hoque [10], Amirul Islam [1], Main Uddin [13], M.A. Hakim [9], Mollah Mesbahuddin Ahmed et al [14] are available regarding minimization of transportation cost. These research can be used to minimize the transportation time. Also a good number of researchers has been studied the time minimization of transportation problems, such as Hammar [8], M Sharif Uddin [17] Seshan and Tikekar [19], Gaurav Sharma et al [7], Bhatia et al [2], Rahman [12], Sharma and Swarup [18].If it is minimized the transportation time, transportation cost will be come down naturally. Here an easier approach is proposed which gives better IBFS. Also the solution is compared obtain by the propose method with regular method.

Algorithm of the Method Presented Herein: There are constant t_{ij} called unit time, required to transport the products from the factories i to the showrooms, j. To find the minimum time it is constructed a moderate table called time minimizing least entry table (TMLET). Now it is presented propose developed algorithm in finding minimum time to shift a particular product from factories to destinations (Showrooms).

Proposed algorithm is given next:

Step 1 Construct the Transportation matrix / Table from given transportation problems.

Step 2 If there is no odd cost then find the common factor of all cost and divide all the cost by the common factor.

Step 3 Select minimum odd cost from all cost in the matrix

Step 4 Subtract selected least odd cost only from odd cost in matrix/Table. Now there will be at least one zero and remaining all cost become even. Then divide all the cost by the common factor to find TMLET.

Step 5 Place the row and the column Decision Making Indicators (RDMI/CDMI) just after and below the supply and demand amount respectively within first brackets, which are the differences of the greatest and next-to-greatest element of each row and column of DMI. If there are two or more greatest elements, difference has to be taken as zero.

Step 6 Identify the highest Decision Making Indicators, if there are two or more highest indicators; choose the highest indicator along which the smallest cost element is present. If there are two or more smallest elements, choose any one of them arbitrarily.

Allocate x_{ij} = min (supply, demand) in the (i, j) th cell of TMLET along the smallest entry cell.

Step 7 (i).If Supply is less than Demand of ith row, then leave the ith row and readjust new Demand as subtraction supply from demand on the same row & column.

(ii) If Supply is greater than Demand of jth column, then leave the jth column and readjust new Supply as subtraction demand from supply on the same row & column.

(iii) If Supply is equal to Demand, leave either ith row or jth column but not both.

Step 8 Repeat step 5 to 7,for remaining sources and showrooms till (m + n - 1) cells are allocated.

Step 9 Finally make the allocations in the original TT and the minimum time is calculated as Max unit in to the Original transportation table of allocated cells.

Example-1: A company manufactures cement and it has three factories F_1, F_2 and F_3 whose weekly production capacities are 10, 9 and 11 thousand bags respectively. The company supplies cement to its three showrooms located at S_1, S_2 and S_3 whose weekly demands are 12, 8 and 10 thousand bags respectively. The transportation time of shipment are given in the next Transportation Table:

Table: 1.1

Factory	Showrooms			Capacity
	S_1	S_2	S_3	
F_1	30	70	100	10
F_2	50	30	70	9
F_3	60	50	30	11
Demand	12	8	10	30

We want to arrange the transportation of cement from factories to showrooms with a minimum time. Here it is applied developed algorithm in order to complete the total transportation work.

Let us now make the allocations according to the proposed algorithm:

Table:1.2

Factory	Showrooms			Capacity	RDMI		
	S_1	S_2	S_3				
F_1	$^{10}0$	2	5	0	(3)	-	-
F_2	$^{2}1$	$^{7}0$	2	0	(1)	(1)	(1)
F_3	3	$^{1}1$	$^{10}0$	0	(2)	(2)	(2)
Demand	0	0	0	0			
CDMI	(2)	(1)	(3)				
	(2)	(1)	(2)				
	(2)	(1)	-				

Now the allocation in the original table is Table:1.3

Factory	Showrooms			Capacity
	S_1	S_2	S_3	
F_1	$^{10}30$	70	100	10
F_2	$^{2}50$	$^{7}30$	70	9
F_3	60	$^{1}50$	$^{10}30$	11
Demand	12	8	10	30

We see that the number of basic variables is 5 (=3+3-1) and the set of basic cells do not contain a loop. Thus the solution obtained is a basic feasible solutions.

Therefore, in order to complete the shipment it takes the time

$$T_1 = \max\{t_{11}, t_{21}, t_{22}, t_{32}, t_{33}\}$$

$$\Rightarrow T_1 = \max\{30, 50, 30, 50, 30\}$$

= 50 units of time.

Here it is applied VAM in order to complete the total transportation work.

Let us now make the allocations according to VAM:

Issue 7, Vol. 3 (May 2017)
ISSN 2249-6149

Table:1.4

Factory	Showrooms			Capacity	RDMI		
	S_1	S_2	S_3				
F_1	$^{10}30$	70	100	0	(40)	-	-
F_2	$^{1}50$	$^{8}30$	70	0	(20)	(20)	(20)
F_3	$^{1}60$	50	$^{10}30$	0	(20)	(20)	(20)
Demand	0	0	0	0			
CDMI	(20)	(20)	(40)				
	(10)	(20)	(40)				
	(10)	(20)	-				

In order to complete the shipment it takes the time

$$T_1 = \max\{t_{11}, t_{21}, t_{22}, t_{31}, t_{33}\}$$

$$\Rightarrow T_1 = \max\{30, 50, 30, 60, 30\}$$ = 60 units of time.

Optimality Test

Since $t_{12} = 70 > T_1, t_{13} = 100 > T_1, t_{23} = 70 > T_1$, we cross off the non-basic cells (1, 2), (1, 3) and (2, 3).

Now let us construct a loop for the basic cells corresponding to the largest time $T_1 = 60$ including the non-basic cell (3, 2).

Table:1.5

Factory	Showrooms			Capacity
	S_1	S_2	S_3	
F_1	$^{10}30$	~~70~~	~~100~~	10
F_2	$^{1}50^{+1}$	$^{8}30^{-1}$	~~70~~	9
F_3	$^{1}60^{-1}$	50^{+1}	$^{3}30^{+1}$	11
Demand	12	8	10	30

Therefore, the new allocation is

Table:1.6

Factory	Showrooms			Capacity
	S_1	S_2	S_3	
F_1	$^{10}30$	~~70~~	~~100~~	10
F_2	$^{2}50$	$^{7}30$	~~70~~	9
F_3	~~60~~	$^{1}50$	$^{10}30$	11

Demand	10	8	12	30

Now we cannot form any loop originating from the cell (2, 1) or (3, 2). Thus the obtained solution $x_{11}=30, x_{21}=50, x_{22}=30, x_{32}=50, x_{33}=30$ is optimum and the optimum shipment time is $\max\{30, 50, 30, 50, 30\} = 50$ units.

Example-2: A company has three factories F_1, F_2 and F_3. The company supplies product to its four Showrooms located at S_1, S_2, S_3 and S_4. The transportation time of shipment are given in the next Transportation Table:

Table:2.1

Factory	Showrooms				Capacity
	S_1	S_2	S_3	S_4	
F_1	7	4	1	5	14
F_2	6	11	2	7	18
F_3	4	3	6	2	7
Demand	6	10	15	8	39

Table:2.2

Factories	Showroom				Supply	Row Decision making Indicators		
	S_1	S_2	S_3	S_4				
F_1	3	$^{3}2$	$^{11}0$	2	0	(1)	(1)	(1)
F_2	$^{6}3$	5	$^{4}1$	$^{8}2$	0	(2)	(2)	(1)
F_3	1	$^{7}1$	3	1	0	(2)	-	-
Demand	0	0	0	0	0			
Column Decision making Indicators	(0)	(3)	(2)	(0)				
	(1)	(3)	(1)	(0)				
	(0)	-	(1)	(0)				

Table:2.3

Factory	Showrooms				Capacity
	S_1	S_2	S_3	S_4	
F_1	7	$^{3}4$	$^{11}1$	5	14
F_2	$^{6}6$	11	$^{4}2$	$^{8}5$	18

F_3	4	$^{7}3$	6	2	7
Demand	6	10	15	8	39

Minimum Time T_1 =Max(4,1,6,2,5,3) = 6 units

Optimality Test

Since $t_{22} = 11 > T_1$ $t_{11} = 7 > T_1$, we cross of the non-basic cells (2,2) and (2,4)

Table:2.4

Factory	Showrooms				Capacity
	S_1	S_2	S_3	S_4	
F_1	7	$^{3}4$	$^{11}1$	5	14
F_2	$^{6}6$	11	$^{4}2$	$^{8}5$	18
F_3	4	$^{7}3$	6	2	7
Demand	6	10	15	8	39

Now we cannot form any loop originating from the cell (2,1) or (3, 3). Thus the obtained solutions x_{12} = 4 , x_{13} = 1 , x_{21} = 6, x_{23} =2, x_{24} =5, x_{32} =3 and the optimum shipment time is max (4, 1, 6, 2, 5, 3) = 6 units

Example-3: A company manufactures cement and it has three factories F_1, F_2 and F_3 whose weekly production capacities are 10, 15 and 5 thousand bags respectively. The company supplies cement to its three Showrooms located at S_1, S_2 and S_3 whose weekly demands are 10, 8 and 12 thousand bags respectively. The transportation time of shipment are given in the next Transportation Table:

Table: 3.1

Factory	Showrooms			Capacity
	S_1	S_2	S_3	
F_1	100	20	200	10
F_2	30	70	90	15
F_3	120	140	110	5
Demand	10	8	12	30

We want to arrange the transportation of cement from factories to Showroom with a minimum time. Here we are going to apply propose developed algorithm in order to complete the total transportation work.
Final allocation according to proposed algorithm-1 is

Table: 3.2

Factory	Showrooms			Capacity
	S_1	S_2	S_3	
F_1	^{2} 100	^{8} 20	200	10
F_2	^{8} 30	70	^{7} 90	15
F_3	120	140	^{5} 110	5
Demand	10	8	12	30

Minimum Time T_1 =Max (100, 20, 30, 90, 110) = 110 unit

Optimality Test

Since $t_{13} = 200 > T_1, t_{31} = 120 > T_1,$ $t_{32} = 140 > T_1$ we cross off the non-basic cells (1, 3) ; (3, 1) and (3, 2).

Table: 3.3

Factory	Warehouse			Capacity
	S_1	S_2	S_3	
F_1	^{2}100	^{8}20	~~200~~	10
F_2	^{8}30	70	^{7}90	15
F_3	~~120~~	~~140~~	^{5} 110	5
Demand	10	8	12	30

Now we cannot form any loop originating from the cell (3, 3). Thus the obtained solution $x_{11} = 100, x_{12} = 20, x_{21} = 30, x_{23} = 90, x_{33} = 110$ is optimum and the optimum shipment time is $\max\{100, 20, 30, 90, 110\} = 110$ units.

Conclusions: It is wanted the different organizations to deliver products to the customers on time. To meet this challenge transportation model provides a powerful framework. In this article a new algorithm is proposed to obtain the minimum transportation time. It is illustrated numerically to test the efficiency of the proposed method. From the given illustration it is seen that optimum solution is obtained directly by the proposed method but VAM is given the optimum solution but it required other supporting method. The proposed algorithm provides a remarkable IBFS by ensuring minimum time, which will be an alternative to the other methods. Also it will be helpful for the decision makers when they are handling various types of logistic supply chain problems.

References

1.Amirul Islam, M. Haque and M. S. Uddin,(2012) 'Extremum Difference Formula on Total Opportunity Cost: A Transportation Cost Minimization Technique', Prime University Journal of Multidisciplinary Quest, Vol.6, No.2,

2. H. Bhatia, K. Saroop and Puri, (1977): A procedure for time minimization transportation problem, Indian Journal of Pure and Applied Mathematics, 8, 29-920.

3. A. Charnes, W.W. Cooper and A. Henderson.(1953): An Introduction to Linear Programming, Wiley,New York,

4. G.B Dantzig,(1963): Linear Programming and Extensions, Princeton University Press, Princeton, N,J.

5. N. M. Deshmukh.(2012) :An Innovative Method for Solving Transportation Problems. International Journal of Physics and Mathematical Science vol. 2(3) July- September, pp. 89 – 91.

6. S. K. Goyal,(1984): Improving VAM for Unbalanced Transportation Problems, Journal of Operational Research Society 35(12), 1113-1114.

7. Gaurav Sharma, S. H. Abbas, Vijay Kumar Gupta(2015): Solving Time Minimizing Transportation Problem by Zero Point Method. International Journal of Engineering and Science vol 5, Issue 7.

8. P. Hammer,(1969) :Time minimizing transportation problems, Naval Research Logistics. 16, 345-357.

9. M.A. Hakim**.**(2012): An Alternative Method to Find Initial Basic Feasible Solution of a Transportation Problems. Annals of Pure and Applied Mathematics. Vol1 No 2. 203- 209 ISSN: 2279- 087 x(p) 2279-0888.

10. Juman Z.A.M.S.Hoque M.A, (2015): An Efficient Heuristic to Obtain a Better Initial Basic Feasible Solution to the Transportation Problem. Applied Soft Computing, 34, 813 – 826.

11. Kirca and Stair,(1990): A Heuristic for Obtaining an Initial Solution for Transportation Problem, Journal of Operational Research Society 41(9) 865-867..

12. Md. Mizanur Rahman, Md. Bellal Hossain & Md. Mosharraf Hossain,(2016): A new approach for minimization of transportation time: An algorithmic approach. Imperial Journal of Interdisciplinary Research, vol-2, issue-7.

13. Md. Main Uddin Md. Azizur Rahman, Faruque Ahmed, M. Sharif Uddin, Md. Rashed Kabir,(2013): Minimization of Transportation Cost on the Basis of Time Allocation: An algorithmic Approach, Jahangirnagar journal of Mathematics & Mathematical Sciences, 28, 47 – 53.

14. Mollah Mesbahuddin Ahmed, Aminur Rahman Khan, MD. Sharif Uddin, Faruque Ahmed(2016): A New Approach to Solve Transportation Problems, Open Journal of Optimization, vol 5 pp. 22 – 30.

15. P. Pandian and G. Natarajan,(2010) A New Method for Finding an Optimal Solution for Transportation Problems, International J. of Math. Sci & Engg. Appls, vol 4, pp.59 – 65.

16. V.J. Sudhakar N. Arusankar and T. Karpagam(2012): A New Approach for Finding an Optimal Solution for Transportation Problems, European Journal of Scientific Research, vol 68, pp.254 – 257,

.17. M Sharif Uddin,(2012): Transportation Time Minimization: An Algorithmic Approach, Journal of Physical Science, vol 16, pp 59-64.

18. J.K. Sharma and K. Swarup,(1978): Transportation fractional programming with respect to time. Ricerca operative, 7, 49-58

19. C.R. Seshan and V. G. Tikekar,(1980): On Sharma Swarup algorithm for time minimizing Transportation Problems, Proc. Indian Acad.Sci., 89(2),101-102.