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Research Paper

An Alternative Method to Minimize the Transportation Cost

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ABSTRACT

The main objective of transportation problem (TP) solution methods is to minimize the cost / time of transportation. Most of the currently used methods for solving transportation problems are trying to reach the optimal solution and most of those methods are considered complex. In this paper a new method is proposed for finding initial basic feasible solution (IBFS) also optimal or near to optimal cost for transportation directly. Here a moderate table called least entry table (LET) is formed by subtracting smallest odd cost from other odd cost and then divide all entries by common factors, Later the Decision Making Indicators (DMI) are calculated from the difference of the greatest unit cost and the nearest-to-the-greatest unit cost. The least entry of the DMI along the highest DMI is taken as the basic cell. Finally, loads have been imposed on the original TT corresponding to the basic cells of the DMI. So, it performs faster than the existing methods with a minimal computation time. Also this method will be very lucrative for those decision makers who are dealing with logistics and supply chain related issues.

Keywords: TP, VAM, LET, IBFS, LPP.DMI.

INTRODUCTION

The transportation problem is one of the fundamental problems of network flow problem which is usually used to minimize the transportation cost for industries to transport goods, which deals with shipping commodities from sources to destinations. This problem is one of the earliest and most important applications of linear programming problem (LPP).Transportation problem was firstly presented by Hichcock [5] as the basic transportation problem along with the constructive method of solution. However it cannot be used to solve optimization problems in complex business situations until when George B. Dantzig [4] applied the concept of Linear programming in solving the transportation models and then Charnes et al. [3] There are many authors developed the algorithms to find IBFS such as P. Pandian et al. [10] Sudhakar et al, [11] N.M. Deshmukh, [9] Aminur Rahman Khan, [1] Amirul Islam, [2] Main Uddin, [7] M.A. Hakim, [8] Mollah Mesbahuddin Ahmed et al [8] etc. In 2016 Md. Mizanur Rahman et al [6] added an innovative method for minimization of transportation cost by subtract the smallest entry from each of the element of every row and column and place them on the right top and bottom respectively. Then form the CMST by the average of right top and bottom of the corresponding elements. To find IBFS the available methods are North West Corner, Row minima, Column minima, Matrix minima, Vogel's Approximation Method (VAM). The objective of this study is to determine the best methods of minimizing transportation cost using the following models of transportation algorithms.

(i)North-west Corner method (ii) Vogel's Approximation method,(iii) Also Verify the optimality by MODI method.

Algorithm of the Method Presented Herein: To find the minimum cost it is constructed a moderate table called least entry table (LET). Now it is presented propose developed algorithm in finding the initial basic feasible solutions of transportation problems.

Here, Algorithm is applied in order to find the transportation cost needed 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 LET.
- Step 5 Place the row and the column Decision Making Indicators (DMI) 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 Choose the highest Decision Making Indicators. If a tie occurs, 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. And make maximum possible allocation to the lowest cost cell corresponding to selected row or column.
- Step 7 Adjust the supply and demand requirements in the respective rows and columns
- Step 8 Repeat step 5 to 7,for remaining sources and showrooms till (m + n - 1) cells are allocated.
- Step 9 Finally total minimum cost is calculated as sum of the product of cost and corresponding allocated value of supply/demand.

Example-1: A company produces cement and it has three factories F_1, F_2 and F_3 whose weekly production capacities are 7, 9 and 18 tons respectively. The company supplies cement to its four showrooms located at S_1, S_2, S_3 and S_4 whose weekly demands are 5, 8, 7 and 14 tons respectively. The transportation costs per ton cements are given below in the TT:

Factories	Products				Supply
	S_1	S_2	S_3	S_4	
F_1	20	30	50	10	7
F_2	70	30	40	60	9
F_3	40	20	70	20	18
Demand	5	8	7	14	34

Table: 1.1

We want to schedule the shifting of cement from factories to showrooms with minimum cost.

Here the common factor of the cost entries is 10. So we divide all the cost entries by 10.

Factories	Products				Supply
	S_1	S_2	S_3	S_4	
F_1	2	3	5	1	7
F_2	7	3	4	6	9
F_3	4	2	7	2	18
Demand	5	8	7	14	34

Table: 1.2

The minimum odd cost value is 1.Subtract 1 from all odd cost, which shown in Table 1.3

Factories	Products				Supply
	S_1	S_2	S_3	S_4	
F_1	2	2	4	0	7
F_2	6	2	4	6	9
F_3	4	2	6	2	18
Demand	5	8	7	14	34

Table:1.3

Here the common factor of the cost entries is 2. So we multiplied all the cost entries by 2, we get LET

Factories	Products				Supply
	S_1	S_2	S_3	S_4	
F_1	1	1	2	0	7
F_2	3	1	2	3	9
F_3	2	1	3	1	18
Demand	5	8	7	14	34

Table: 1.4

Allocate the cell (F1, S_4), min (7,14) =7, we get $x_{1,4} = 7$ and delete row F_1, as for demand exhausted supply as (14-7) =7, which shown in Table 1.5

Factories	Product				supply	Row DMI
	S_1	S_2	S_3	S_4		
F_1	1	1	2	$^{7}0$	0	(1)
F_2	3	1	2	3	9	(1)
F_3	2	1	3	1	18	(1)
Demand	5	8	7	7	27	
Column DMI	(1)	(0)	(1)	(2)		

Table: 1.5

Proceeding in this way we get the Table 1.6

Factories	Product				supply	Row DMI			
	S_1	S_2	S_3	S_4					
F_1	1	1	2	$^{7}0$	0	(1)	-	-	-
F_2	$^{2}3$	1	$^{7}2$	3	0	(1)	(1)	(1)	(1)
F_3	$^{3}2$	$^{8}1$	3	$^{7}1$	0	(1)	(1)	(1)	(1)
Demand	0	0	0	0	0				
Column DMI	(1)	(0)	(1)	(2)					
	(1)	(0)	(1)	(2)					
	(1)	(0)	(1)	-					
	(1)	-	(1)	-					

Table : 1.6

Therefore, the final allocations to cells of original TT corresponding to the cells of LET are as below:

Factories	Products				Supply
	S_1	S_2	S_3	S_4	
F_1	20	30	50	$^{7}10$	7
F_2	$^{2}70$	30	$^{7}40$	60	9
F_3	$^{3}40$	$^{8}20$	70	$^{7}20$	18
Demand	5	8	7	14	34

Table: 1.7

We see that the number of basic variables is 6 (3 + 4 -1) and the basic cells do not contain any loop. Therefore, the obtained solution is Initial Basic Feasible Solution.

Thus the minimum cost is $= 7\times10+2\times70+7\times40+3\times40+8\times20+7\times20$ = 70 + 140 + 280 + 120 + 160 + 140 = 910 units

Example-2: A company manufactures motor cars and it has three factories F_1, F_2 and F_3 whose weekly production capacities are 9, 8 and 10 pieces respectively. The company supplies motor cars to its three showrooms located at S_1, S_2 and S_3 whose weekly demands are 7, 12 and 8 pieces respectively. The transportation costs per piece of motor cars are given in the next TT:

Factory	Showroom			Supply
	F_1	F_2	F_3	
S_1	6	6	10	9
S_2	12	10	8	8
S_3	12	20	14	10
Demand	7	12	8	27

Table: 2.1

We want to schedule the shifting of motor cars from factories to showrooms with minimum cost.

Factory	Showroom			Supply	Row DMI		
	F_1	F_2	F_3				
S_1	0	$^{9}0$	1	0	(1)	-	-
S_2	3	$^{3}1$	$^{5}2$	0	(1)	(1)	(1)
S_3	$^{7}3$	5	$^{3}2$	0	(2)	(2)	(1)
Demand	0	0	0	0			
Column DMI	(3)	(4)	(1)				
	(3)	(4)	(1)				
	(0)	-	(0)				

Factory	Showroom			Supply
	F_1	F_2	F_3	
S_1	6	$^{9}6$	10	9
S_2	12	$^{3}10$	$^{5}8$	8
S_3	$^{7}12$	20	$^{3}14$	10
Demand	7	12	8	27

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

Therefore, the minimum transportation cost is $z = 9\times6+3\times10+5\times8+7\times12+3\times14$ = 250 units.

Example-3:

Factories	Showrooms					Supply
	F_1	F_2	F_3	F_4	F_5	
W_1	12	3	6	12	12	60
W_2	6	9	6	6	9	35
W_3	9	15	6	12	12	40
Demand	22	45	20	18	30	135

Table : 3.1

Factories	Showrooms					Supply
	F_1	F_2	F_3	F_4	F_5	
W_1	12	$^{45}3$	$^{15}6$	12	12	60
W_2	$^{22}6$	9	6	$^{13}6$	9	35
W_3	9	15	$^{5}6$	$^{5}12$	$^{30}12$	40
Demand	22	45	20	18	30	135

The minimum cost $z = 45\times3+15\times6+22\times6+13\times6+5\times6+5\times12+30\times12 = 885$

Example:4

Factories	Products				Supply
	S_1	S_2	S_3	S_4	
F_1	7	5	9	11	30
F_2	4	3	8	6	25
F_3	3	8	10	5	20
F_4	2	6	7	3	15
Demand	30	30	20	10	90

IBFS is shown according to the proposed algorithm in the final allocation bellow:

Factories	Products				Supply
	S_1	S_2	S_3	S_4	
F_1	$^{5}7$	$^{5}5$	$^{20}9$	11	30
F_2	4	$^{25}3$	8	6	25
F_3	$^{20}3$	8	10	5	20
F_4	$^{5}2$	6	7	$^{10}3$	15
Demand	30	30	20	10	90

The minimum cost $z = 5\times7+5\times5+20\times9+25\times3+20\times3+5\times2+10\times3 = 415$

Comparison of Result Obtained in Different Methods

Example	Problem size	Propose Method	VAM	NWC Method	Optimal Solution
1	3×4	910	1000	1020	870
2	3×3	125	143	159	125
3	3×5	885	945	1089	860
4	4×4	415	470	540	415

CONCLUSION

It is showed that the above presented and discussed method which gives us an initial basic feasible solution of the transportation problem in minimization of transportation cost. The proposed method is easy to be understood and applied. Vogel`s Approximation Method is one of the well-known transportation methods for getting initial basic feasible solution. But from the example it is seen that by the proposed method it is obtained more efficient initial basic feasible solution compared to other two presented methods above. Also it is given optimum solution or near to optimum solution.

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