Research Paper
Impact Factor - **2.262**
Peer Reviewed Journal

IJMDRR
E- ISSN –2395-1885
ISSN -2395-1877

A NEW APPROACH TO SOLVE A TRANSPORTATION PROBLEM

S.Saranya*   Dr. G. Michael Rosario* *
**Research Scholar of Jayaraj Annapackiam College for Women (Autonomous) Periyakulam, Tamilnadu, India.*
***Associate Professor in Mathematics, Jayaraj Annapackiam College Women (Autonomous) Periyakulam, Tamilnadu, India.*

Abstract
A new algorithm for a Transportation Problem (TP) is proposed for finding an optimal solution. The result is close to the optimal solution or nearest to the optimal solution obtained from various methods - NWCM, LCM, VAM, and MODI method. The feasible solutions and optimal solution derived from NWCM, LCM, VAM, MODI method and proposed method are compared. The proposed method is applied for finding an optimal solution for a TP directly and it avoids the degeneracy condition. The procedure to find the solution is illustrated with numerical examples.

Keywords: Transportation Problem (TP), NWCM, LCM, VAM, MODI Method, Proposed Method, Initial Basic Feasible Solution.

1. Introduction

The Transportation Problem (TP) is a special type of Linear Programming Problem and important part of logistics and supply chains. The problem basically deals with the determination of a cost plan for transporting a single commodity from a number of sources to a number of destinations. We are assuming that the total demand is equal to total supply. The basic Transportation Problem along with the constructive method of solution was originally developed by Hitchcock [7] in 1941. In the year 1947 T.C.Koopmans [9] made an independent study on “Optimum utilization of transportation system”. Again in 1963 Dantzig [3] formulated the transportation problem as linear programming problem and also provided the solution method. The TP is applied in factories, warehouses, pipe line system and in projects which send water, oil or gas from supply stations to demanding customers.

Transportation problems are generally concerned with the distribution of a certain product from several sources to numerous localities at minimum cost. For obtaining an optimal solution for Transportation Problem it is required to solve the problem in two stages. In the first stage the Initial Basic Feasible Solution (IBFS) is obtained by using any one of the available methods such as North West Corner Method (NWCM), Matrix Minima Method or Least Cost Method (LCM) and Vogel’s Approximation Method (VAM). Then in the second stage MODI method (Modified Distribution) is used to get an optimal solution.

In last few years P.Pandian et.al [16] and sudhaker et.al [15] proposed two different methods in 2010 and 2012 respectively, for finding an optimal solution directly. Recently, In 2012 Shweta singh, G.C.Dubey, Rajesh Shrivastava [14] followed by given various methods to find optimality of transportation problems. Reena G.patel and P.H.Bhathawala [11] have given a new global approach for solved Transportation Problem.

In this paper, a different approach using simple calculations is proposed to find IBFS of a Transportation Problem. The proposed method is illustrated with examples and results are compared with the solutions obtained by various methods .The paper is organized as follows. Algorithm of the Proposed Method (PM) is given Section 2. Proposed Method is illustrated in Section 3. Analysis and conclusion is given in section 4.

2. Algorithm for Proposed Method

Step 1: Construct the transportation table from give transportation problem.
Step 2: Select the minimum odd cost from the transportation table.
Step 3: Subtract selected least odd cost only from odd cost in matrix. Now there will be at least one zero and remaining all cost become even. Allocate maximum possible supply or demand at the place of zero, and delete the row or column where supply or demand zero.
Step 4: Determine the penalty cost for each row and column by subtracting the lowest cell cost in the row or column from the next lowest cell cost in the same row or column. Select the row or column with the highest Penalty cost (breaking tie choosing the lowest-cost cell). Allocate as much as possible to the feasible cell with the lowest transportation cost in the row or column with the highest penalty cost.
Step5: Repeat steps 4, 5 and 6 until all requirements have been meet.

Step6: Compute total transportation cost for the feasible allocations using the original balanced transportation cost matrix.

3. Illustration

Example: 1

Step1

Consider the following cost minimizing transportation problem

Table: 1

	D1	**D2**	**D3**	**D4**	**Demand**
S1	11	13	17	14	250
S2	16	18	14	10	300
S3	21	24	13	10	400
Supply	200	225	275	250	950

Step 2: The minimum odd cost is **11**

Step 3

Table: 2

	D1	**D2**	**D3**	**D4**	**Demand**
S1	$\boxed{200}$ o	2	6	14	250
S2	16	18	14	10	300
S3	10	24	2	10	400
Supply	200	225	275	250	950

The column **D1** is deleted.

Step 4

Table: 3

	D2	**D3**	**D4**	**Demand**	**Column Penalty**
S1	2	6	14	50	4
S2	18	14	10	300	4
S3	24	2	10	400	8
Supply	225	275	250		
Row Penalty	16	4	0		

Maximum penalty is 16 which correspond to D2.

Table: 4

	D2	**D3**	**D4**	**Demand**
S1	$\boxed{50}$	6	14	50
S2	18	14	10	300
S3	24	2	10	400
Supply	225	275	250	

The row **S1** is deleted.

Step 5 (i)

Table: 5

	D2	**D3**	**D4**	**Demand**	**Column Penalty**
S2	18	14	10	300	4
S3	24	2	10	400	8
Supply	175	275	250		
Row Penalty	6	12	0		

Maximum penalty is 12 which correspond to D3.

Table: 6

	D2	**D3**	**D4**	**Demand**
S2	18	14	10	300
S3	4	$\boxed{275}$ 2	10	400
Supply	175	275	250	

The column D3 is deleted.

Step 5 (ii)

Table: 7

	D2	**D4**	**Demand**	**Penalty cost**
S2	18	10	300	4
S3	24	10	125	14
Supply	225	250		
Penalty cost	6	0		

Maximum penalty is 14 which correspond to S3.

Table: 8

	D2	**D4**	**Demand**
S2	$\boxed{175}$ 18	$\boxed{125}$ 10	300
S3	24	$\boxed{125}$ 10	125
Supply	225	250	

The cost is allocated in S3.The row S3 is deleted and remaining cells are allocated.

Step 6

Table: 9

	D1	**D2**	**D3**	**D4**	**Demand**
S1	$\boxed{200}$ 11	$\boxed{50}$ 13	17	14	250
S2	16	$\boxed{175}$ 18	14	$\boxed{125}$ 10	300
S3	21	24	$\boxed{275}$ 13	$\boxed{125}$ 10	400
Supply	200	225	275	250	950

The total cost =11×200+13×50+18×175+10×125+13×275+10×125
=12075

Example: 2

Consider the following cost minimizing transportation problem

Table: 10

	D1	**D2**	**D3**	**D4**	**Demand**
S1	13	25	12	21	18
S2	18	23	14	9	27
S3	23	15	12	16	21
Supply	14	12	23	17	66

By applying proposed method allocations obtained are given in Table 11.

Table: 11

	D1	**D2**	**D3**	**D4**	**Demand**
S1	$\boxed{14}$ 13	25	$\boxed{4}$ 12	21	18
S2	18	23	$\boxed{10}$ 14	$\boxed{17}$ 9	27
S3	23	$\boxed{12}$ 15	$\boxed{9}$ 12	16	21
Supply	14	12	23	17	66

The total transportation cost is 811

Example: 3

Consider the following cost minimizing transportation problem

Table: 12

	D1	**D2**	**D3**	**Demand**
S1	0	2	1	6
S2	2	1	5	7
S3	2	4	3	7
Supply	5	5	10	20

By applying Proposed Method allocations obtained are given Table 13

Table: 13

	D1	**D2**	**D3**	**Demand**
S1	$\boxed{5}$ 0	2	$\boxed{1}$ 1	6
S2	2	$\boxed{5}$ 1	$\boxed{2}$ 5	7
S3	2	4	$\boxed{7}$ 3	7
Supply	5	5	10	20

The total transportation cost associated with this allocation is 37

Example: 4
Consider the following cost minimizing transportation problem

Table: 14

	D1	D2	D3	D4	Demand
S1	13	18	30	8	8
S2	55	20	25	40	10
S3	30	6	50	10	11
supply	4	7	6	12	29

By applying Proposed Method allocations obtained are given in Table 15

Table: 15

	D1	D2	D3	D4	Demand
S1	$\boxed{4}$ 13	18	30	$\boxed{4}$ 8	8
S2	55	$\boxed{4}$ 20	$\boxed{6}$ 25	40	10
S3	30	$\boxed{3}$ 6	50	$\boxed{8}$ 10	11
Supply	4	7	6	12	29

The total transportation cost associated with this allocation is 412.

4. Analysis and Conclusion
Initial Basic Feasible Solution for the above four problems given in section 3 using North West Corner Method (NWCM) ,Least Cost Method (LCM) and Vogel's Approximation Method (VAM) and Optimal solution using Modified Distribution (MODI) are calculated and given in the following **Table 16**

Table: 16

Problem	Problem Dimension	Proposed method	NWCM	LCM	VAM	MODI Method
1	3x4	12075	12200	12825	12075	12075
2	3x4	811	1052	881	811	811
3	3x3	37	42	37	37	33
4	3x4	412	484	516	476	412

Conclusion
Comparing the values of Transportation cost in the above Table (16) the Proposed Method provides a feasible solution which is equal to the optimal solution or nearest to the optimum solution and it is obtained in fewer iterations. The proposed algorithm is easy to understand and apply. It will be very useful for the decision makers who are dealing with logistic and supply chain problems.

References
1. Arsham.H and Khan AB (1989). A Simplex- type, Algorithm for General Transportation problems; An alternative to stepping-stone. *Journal of Operational Research Society* 40(6)581- 590.
2. Charnes, Cooper (1954). The Stepping-Stone Method for explaining linear programming. Calculation in Transportation Problems. *Management Science* 1(1)49-69.
3. Dantzig GB (1963). Linear Programming and Extensions, New Jersey: Princeton University press.
4. Goyal SK (1984). Improving VAM for unbalanced Transportation Problem, *Journal of* Operational *Research*

Society 35(12) 1113-1114.

5. Gass S (1964). Linear Programming, Mc-Graw-Hill New York.
6. Garvin WW (1960). Introduction to Linear Programming, Mc-.Graw-Hill, New York.
7. Hitchcock FL (1941). The distribution of a product from several sources to numerous localities, *Journal Of Mathematical Physics* 20 1941 224-230.
8. Kirca and Statir (1990). A heuristic for obtaining an initial solution for the Transportation Problem, Journal of operational Research Society 41(9) 865-867.
9. Koopmans TC (1947). Optimum Utilization of the Transportation system proceeding of the international statically conference, Washington D.C.
10. Ping Ji, Chu KF(2002). A dual-Matrix approach to the Transportation Problem. *Asia- PacificJournal of Operation Research* 19(1) 35-45.
11. Reena, G.patel and P.H.Bhathawala (2014). A New Global Approach to a Transportation problem. International journal of Engineering Technology, Management and Applied science.vol.2.Issue 3, ISSN 2349- 4476.
12. Reinfeld N.V,Vogel WR (1958)., Mathematical Programming New Jersey Prentice- Hall, Englewood Cliffs.
13. Shore H.H (1970). The Transportation Problem and the Vogel Approximation Method, Decision Sciences 1(3-4) 441-457.
14. Shweta Singh,G .C.Dubey and Rajesh shrivastava (2012).A Various Method to solve the optimality for the transportation problem. International Journal of Mathematical Engineering and science.vol 1.Issue 4.ISSN:2277-6982.
15. Sudhakar VJ, Arunnsankar N, Karpagam T (2012). A new approach for find an Optimal Solution for Trasportation Problems, *European Journal of Scientific Research* 68 254-257.
16. P.Pandian and G. Natarajan, A New Method for Finding an Optimal Solution for Transportation Problems, *International J. of Math. Sci & Engg. Appls*, vol 4, p. 59-65 (2010).