DOI: http://dx.doi.org/10.26483/ijarcs.v9i1.5319

ISSN No. 0976-5697

Volume 9, No. 1, January-February 2018

International Journal of Advanced Research in Computer Science

RESEARCH PAPER

Available Online at www.ijarcs.info

A NOVEL INITIAL BASIC FEASIBLE SOLUTION METHOD FOR TRANSPORTATION PROBLEM

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Abstract: One of the popular operation research problems is transportation problem. Its solution is basically divided into two parts. Initially Initial Basic Feasible Solution (IBFS) is obtained then the result is used to calculate the optimal solution. The popular methods to find IBFS of transportation problem are North West Corner Method (NWCM), Least Cost Method (LCM), and Vogel's Approximation Method (VAM). In this paper, a novel approximation method is proposed to find out the IBFS of the transportation problem. There are five different examples used for which the IBFS are calculated using NWCR, LCM, VAM, and our proposed method. The results show that the proposed method provides the best result among them.

Keywords: Transportation problem, IBFS, NWCM, LCM, VAM.

I. INTRODUCTION

There are many problems discussed in operations research and Transportation problem is one of the widely used problems discussed in linear programming problem of operation research which is directly used in our day to day logistics and supply chain activities. It helps to solve problems related to distribution and transportation of resources from various sources to destinations so that the cost of transportation should be optimal for the commodity. The units of resources to be supplied from source to destination are the primary objective so that the cost of transportation should be minimal and profit should be maximum.

Let x_{ij} be the quantity transported from the source i to the destination j. The problem is mathematically formulated as follows:

$$\text{Minimize } Z= \qquad C_{ij}x_{ij}$$

Subject to,

$$_{ij} = a_i$$

$$_{ij} = b_j$$

And,

$$x_{ij} \geq 0 \text{ for all i and j.}$$

Where,

Z : Objective function is minimize the total transportation cost.

C_{ij}: Transportation cost per unit from source i to destination j.

x_{ij}: Units of commodity sent from source i to destination j.

a_i : Quantity supplied from source i.

b_j : Quantity demanded at destination j.

Transportation problem is balanced if Supply $_i$ = Demand $_i$

Otherwise unbalanced if Supply $_i$ $\neq$ Demand $_i$

When number of rows are multiplied with number of columns then total number of variables are used in the transportation problem is obtained i.e. mn. The total number of constraints for the transportation problem is m+n. For feasible solution the total number of allocations should be (m+n–1).

The organization of the paper is as follows: section II deals with literature review; section III deals the proposed approximation method; section IV deals with results analysis and finally section V concludes the paper.

II. LITERATURE REVIEW

One of the most important problems discussed in operations research is the transportation problem. It deals with the transportation of some products from source to destination so that cost of transportation should be minimal and also satisfy the constraints related to demand and the supply. Transportation problem can be utilized in inventory, assignment, traffic, and so on. Transportation problems are required for analyzing and formulating such models [1-2]. Therefore primary objective of transportation problem is to find out the IBFS [3-4]. To obtain optimal solution requires start from the IBFS. Therefore IBFS affects the optimal solution of the transportation problem. In fact, we can say that finding IBFS would be significant to obtain optimal solution. There are only few methods available which can be used to find IBFS of the transportation problem [5-7]. The names of the methods are as follows: NWCM [8, 9], LCM [8, 9], and VAM [8-10]. In NWCM, the process begins from the northwest corner cell in the transportation table. In LCM, a cell having lower cost is selected sooner than a cell with higher cost. In fact, the process starts with the cell having the least cost of the transportation table. Most of the cases the LCM find IBFS better than NWCM because algorithm uses costs during the allocation unlike LCM. In LCM, all processes used in NWCM are repeated the only difference is that cell having minimum cost is selected first instead the northwest cell. VAM [11] is based on rows and column penalty where difference between two lowest cell costs for each rows and columns is considered as penalty to initiate the process. It is the best among LCM and NWCM.

III. NOVEL APPROXIMATION METHOD

The step by step process of the proposed method is given below:

Step1. Subtract elements of each row with the least element of each row.
Step2. Subtract elements of each column with the least element of each column.
Step3. Calculate the distribution indicators by subtracting the smallest and next-to smallest element of each row and each column of the reduced matrix and write them just after and below of the supply and demand amount respectively.
Step4. Identify the highest distribution indicator, if there are two or highest indicators then choose the highest indicator along which the smallest value presents in the cell. If there are two or more smallest elements present in the cells, choose any one of them arbitrarily.
Step5. Allocate X_{ij} = min (a_i, b_j) on the left bottom of the largest element in the (i, j)*th* cell of the reduced matrix.
Step6. If $a_i < b_j$, leave the i*th* row and readjust b_j as $b_j^{'} = b_j - a_i$. If $a_i > b_j$, leave the *jth* column and readjust a_i as $a_i^{'} = a_i - b_j$. If $a_i = b_j$, then leave both the *ith* row and *jth* column.
Step7. Repeat step 4 to step 6 until the demand and supply requirement are exhausted.
Step8. Put all the allocations of the positive allocated cells of the reduced matrix to the original transportation table and calculate the total transportation cost.

$$\text{Minimize } Z = \sum_{i=1}^{m} \sum_{j=1}^{n} C_{ij}x_{ij}$$

Where,

x_{ij} is the total allocation of the $(i, j)th$ cell and C_{ij} is the corresponding unit transportation cost.

IV. RESULTS ANALYSIS

For verifying results of the proposed algorithm five examples are considered. The IBFS for each of the five examples are calculated using NWCR, LCM, VAM, and the proposed method.

Example1:

Source		Destination				
		D1	D2	D3	D4	Supply
	S1	20	22	17	4	120
	S2	24	37	9	7	70
	S3	32	37	20	15	50
Demand		60	40	30	110	240

NWCR=3680 LCM=3670 VAM=3520 Proposed Method=3460

Example2:

Source		Destination				
		D1	D2	D3	D4	Supply
	S1	10	22	15	4	120
	S2	18	27	5	9	70
	S3	32	37	24	15	50
Demand		60	40	30	110	240

NWCR=3120 LCM=3210 VAM=2820 Proposed Method=2820

Example3:

Source		Destination				
		D1	D2	D3	D4	Supply
	S1	4	19	22	11	100
	S2	1	9	14	14	30
	S3	6	6	16	14	70
Demand		40	20	60	80	200

NWCR=2820 LCM=2090 VAM=2170 Proposed Method=2090

Example4:

		Destination					
Source		D1	D2	D3	D4	D5	Supply
	S1	10	8	9	5	13	100
	S2	7	9	8	10	4	80
	S3	9	3	7	10	6	70
	S4	11	4	8	3	9	90
Demand		60	40	100	50	90	340

NWCR=3010 LCM=2070 VAM=2130 Proposed Method=2150

Example5:

		Destination				
Source		D1	D2	D3	D4	Supply
	S1	7	5	9	11	30
	S2	4	3	8	6	25
	S3	3	8	10	5	20
	S4	2	6	7	3	15
Demand		30	30	20	10	90

NWCR=540 LCM=435 VAM=470 Proposed Method=410

The Figure 1 shows the comparative graph of IBFS results using NWCR, LCM, VAM, and the proposed method of the five examples considered for the evaluation. From Figure1, it can be depicted that the proposed method outperforms than NWCR, LCM, and VAM. The transportation cost of the proposed method is minimum.

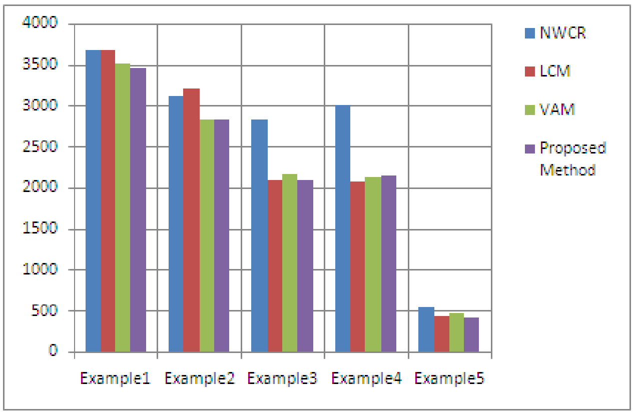

Figure 1 Comparison among NWCR, LCM, VAM, and Proposed Method

V. CONCLUSION

The proposed novel method for finding IBFS provides the best solution among NWCR, LCM and VAM in most of the cases. Also the algorithm complexity is reasonable due of fewer calculations in the algorithm; only rows and column operations have to be done like minimize assignment problem. Therefore, we may say that this method may be used in future works in real transportation problems. Finally, this method only evaluate the IBFS but finding optimal solution better than Modified Distribution Method (MODI) is not found in the literature. In future, a novel algorithm will be proposed for obtaining optimal solution.

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