www.ijemr.net ISSN (ONLINE): 2250-0758, ISSN (PRINT): 2394-6962

Vandana Publications
IJEMR

Volume-8, Issue-3, June 2018
International Journal of Engineering and Management Research
Page Number: 46-48
DOI: doi.org/10.31033/ijemr.8.3.5

A New Approach to Solve Initial Basic Feasible Solution for the Transportation Problem

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ABSTRACT

In transportation problem the main requirement is to find the Initial Basic Feasible Solution for the transportation problem. The objective of the transportation problem is to minimize the cost. In this paper, a new algorithm (i.e.) Row Implied Cost Method(RICM) which is proposed to find an initial basic feasible solution for the transportation problem. This method is illustrated with numerical examples.

Keywords--- Transportation Problem, Transportation Cost, Initial Basic Feasible Solution, Optimal Solution

I. INTRODUCTION

Special type of linear programming problem is known as transportation problem (TP). These kind of problems makes us to decide the minimum charge of transporting goods from one place to another. It plays a vital role in logistics. There are several methods for finding an initial basic feasible solution like North West Corner Rule(NWCR), Least Cost Method(LCM), Vogel's Approximation Method(VAM) and to find the optimality we are using the method MODI. In this paper we are introducing a new method for finding an Initial Basic Feasible Solution. Two numerical examples are provided to prove the claim with stepwise procedure of this new method.

II. MATHEMATICAL REPRESENTATION

The transportation problem was developed and proposed by F.L. Hitchcocksince 1941. This method main aim is to minimize the total transportation cost and maximize the profit. The Hitchcock-Koopmans's transportation problem is expressed as a linear transportation model as follows:

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

$$\text{Subject to, } \sum_{j=1}^{n} \alpha_{ij} \leq X_i,\ i=1,2,\ldots n(\text{supply})$$

$$\sum_{i=1}^{m} \alpha_{ij} \leq Y_{ij},\ j=1,2,\ldots.m\ (\text{demand})$$

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

Where,
α_{ij}- the quantity of goods moved from origin i to destination j.
C_{ij}- per unit cost in transporting goods from origin i to destination j.
X_i - the amount available at each origin i.
Y_j- the demand available at each destination j.
m - total number of origins(source)
n - total number of destinations(sinks)

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Origin(i)	Destination(j)				Supply(ai)
	1	2	…	n	
1	X_{11} C_{11}	X_{12} C_{12}	…	X_{1n} C_{1n}	a_1
2	X_{21} C_{21}	X_{22} C_{22}	…	X_2 C_{2n}	a_2
…	…	…	…	…	…
m	X_{m1} C_{m1}	X_{m2} C_{m2}	…	X_{mn} C_{mn}	a_m
Demand(bj)	b_1	b_2	…	b_n	$\sum a_i=\sum b_j$

III. ALGORITHM

STEP 1
Determine whether the given Transportation Table is balanced, if not make them balanced.
STEP 2
Determine Row Implied Cost for each cell by the product of unit transportation cost and availability of supply amount, then write that cost below to the unit cost.
STEP 3
Now identify the lowest Implied cost (LIC) and allocate the minimum of supply/demand corresponding to the unit cost cell and cross out the corresponding row/column, where the supply/demand is satisfied.
STEP 4
If there is more than one Lowest Implied Cost, then select the one which has minimum sum of supply and demand or select arbitrarily.
STEP 5
If a row and column is satisfied simultaneously only one of them is crossed out and the remaining is assigned as zero.
STEP 6
If the supply and demand are exhausted, then stop the process.
STEP 7
Finally calculate the transportation cost of the Transportation Table. This calculation is the sum of product of unit cost and corresponding allocated value.

IV. NUMERICAL EXAMPLES

EXAMPLE 1: Solve the following Transportation Problem:

	P	Q	R	S	T	Supply
S1	7	6	4	5	9	40
S2	8	5	6	7	8	30
S3	6	8	9	6	5	20
S4	5	7	7	8	6	10
demand	30	30	15	20	5	

SOLUTION
Here we have ∑ai = ∑bj = 100.
The given transportation problem is balanced.
Now let us multiply each unit cost by supply cost corresponding to its row. Then find the Lowest Implied Cost from all the cell and then allocate the min (supply, demand) to that cell then delete the corresponding row/column where the supply/demand is satisfie

7 280	6 240	4 [15] 160	5 [20] 200	9 360	40
8 [0] 240	5 [30] 150	6 180	7 210	8 240	30
6 [15] 120	8 160	9 180	6 120	5 [5] 100	20
5 [10] 50	7 70	7 70	8 80	6 60	10
30	30	15	20	5	

Therefore, we have the allocations as
m+n-1=4+5-1= 8.
Hence this is a non-degeneracy problem.
The initial transportation cost =
7×5+4×15+5×20+8×0+5×30+6×15+5×5+5×10
= 510/-

EXAMPLE 2: Solve the following Transportation Problem:

	A	B	C	D	supply
1	7	5	9	11	30
2	4	3	8	6	25
3	3	8	10	5	20
4	2	6	7	3	15
demand	30	30	20	10	

SOLUTION

Here we have ∑ai = ∑bj = 90.

The given transportation problem is balanced.

Now let us multiply each unit cost by supply cost corresponding to its row. Then find the Lowest Implied Cost from all the cell and then allocate the min (supply, demand) to that cell then delete the corresponding row/column where the supply/demand is satisfied.

7 210	5 5 150	9 20 270	11 5 330	30
4 100	3 25 75	8 200	6 150	25
3 15 60	8 160	10 200	5 5 100	20
2 15 30	6 90	7 105	3 45	15
30	30	20	10	

Therefore, we have the allocations as

m+n-1 = 4+4-4 = 7.

The given problem satisfies the non-degeneracy.

The initial transportation cost =

5×5+9×20+11×5+3×25+15×3+5×5+2×15 = 435/

V. COMPARATIVE STUDY OF THE RESULTS

After obtaining an IBFS by this proposed method, the result is compared with solution obtained by other existing methods.

PROBLEMS	NWCR	LCM	VAM	RICM
EXAMPLE 1	540	510	510	510
EXAMPLE 2	540	435	470	435

VI. CONCLUSION

In this paper we proposed a new algorithm named Row Implied Cost Method (RICM) which is very simple and easy to calculate than other algorithms. This method provides better feasible solution than others and sometimes it is equal to the optimal solution. But it is not always sure that RICM provides least feasible solution but sometimes it gives greater or better approach.

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