International Journal of Engineering and Advanced Technology (IJEAT)
ISSN: 2249-8958 (Online), Volume-9 Issue-2, December, 2019

A New Method to Obtain an Initial Basic Feasible Solution of Transportation Problem with the Average Opportunity Cost Method

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Abstract: ***In this preset article, we have explained all new method to get Initial Basic Feasible solution (IBFS) of Transportation Problem (TP) with the Average Opportunity Cost Method (AOCM). It is very simple arithmetical and logical calculation. After finding the IBFS we use Modified Distribution Method (MODI) method to optimize the IBFS. Results obtained by using this method we found that IBFS of most of the transportation problem closer to optimal solution than using the other existing methods. We illustrate the same by suitable examples.***

Keyword: AOCM, IBFS, MODI, Optimal Solution, TP.

I. INTRODUCTION

Transportation Problem is a specific part of linear programming problem which is applied in real life. It is helpful for the solving TP on distribution and transportation of resources between places. Main role of TPs is to minimize the total transportation cost of shipping units between places. Some well-known methods to find the minimum transportation cost are North West Corner Method (NWCM), Least Cost Method (LCM) & Vogel's Approximation Method (VAM) are considered to provide the better Initial Basic Feasible Solution (IBFS) and for optimality check we can use MODI method.

In last few years many methods are proposed to find IBFS of TP, Kore B. G. (2008) proposed Row Penalty Method and Column Penalty Method for finding IBFS of TP. M.W Ullah, M. Alhaz Uddin and Rijwaana Kauser (2016) proposed a new method "A Modified Vogel's Approximation method for obtaining a good primal solution of transportation problem". Duraphe S and Raigar S (2017) obtain" A new approach to solve transportation problems with the max-min total opportunity cost method". S.M.Abool Kalaam Aazad,Md. Belleil Hosain,Md .M Rahman (2017)" An Algorithmic Approach to solve Transportation Problems with the Avg Total Opportunity cost method". S.M.Abool Kalaam Aazad, Md. Bellel Hosain (2017) developed a new method for solving transportation problems considering average penalty.A.R.Khaan, Adreian vilcu, Md. sharrif Uddin and florin Ungurenu (2015) proposed a competent Algorithm to find the IBFS of cost minimization transportation problem.

Revised Manuscript Received on December 30, 2019.

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In this paper, we have developed a new method AOCM to obtain IBFS. Using this method we find the IBFS of most of the TP closer to optimal solution than using the other existing method. Results of some examples of TP are same to optimal solution. Which is a very simple and easy to understand.We illustrated the numerical examples for the new method and comparing these result to NWCM, LCM and VAM.

II. MATHEMATICAL FORMULATION

The transportation problem is shown as a linear transportation model as below,

Minimize,

$$Z = \sum_{i=1}^{n}\sum_{j=1}^{m} C_{ij}X_{ij}$$

where,

$$\sum_{j=1}^{m} X_{ij} = a_i, \quad i = 1,2,\ldots\ldots\ldots n \text{ (Supply)}$$

$$\sum_{i=1}^{n} X_{ij} = bj, \quad j = 1,2,\ldots\ldots\ldots\ldots, m \text{ (demand)}$$

And $X_{ij} \geq 0$, for all i and j.

Where,

X_{ij}=The quantity to be shipped from i^{th} origin to j^{th} destination.

C_{ij}=per piece(unit) cost in shipping from i^{th} origin to j^{th} destination.

a_i= The amount available at i^{th} origin.

b_j=The demand available at j^{th} destination.

III. ALGOTITHM OF AOCM

STEP 1. Subtract smallest cost from every element of every row of transportation table and put it on right top of that element.

STEP 2. Subtract the smallest cost from every element of every column of transportation table and put it on right bottom of that element.

STEP 3. Create a new matrix whose elements are average value of right top and right bottom of elements of step 1 and step 2.

STEP 4. Find Row & Column penalties by taking difference between smallest & next smallest value in row & column.

STEP 5. Identify the largest penalty and allocate the maximum possible quantity to that cell having minimum value of element in corresponding row or column. If there is a tie between largest penalties, then tie can be broken by taking difference between smallest and next to smallest element, if tie still not broken then repeat the procedure with next to next smallest and so on, if tie still not broken then select arbitrarily.

STEP 6. Repeat step 5 to step 6 until the rim requirement is satisfied.

STEP 7. Put these allocated values in original TT in corresponding cell.

STEP 8. Calculate the transportation cost of TT. This calculation is the sum of product of unit transportation cost and allocated quantity.

IV. NUMERICAL EXAMPLES

4.1 Solve Following TP:

	D_1	D_2	D_3	D_4	Supply
W_1	9	8	5	7	12
W_2	4	6	8	7	14
W_3	5	8	9	5	16
Demand	8	18	13	3	42

Solution:

	D_1	D_2	D_3	D_4	Supply
W_1	9^{4}_{5}	8^{3}_{2}	5^{0}_{0}	7^{2}_{2}	12
W_2	4^{0}_{0}	6^{2}_{0}	8^{4}_{3}	7^{3}_{2}	14
W_3	5^{0}_{1}	8^{3}_{2}	9^{4}_{4}	5^{0}_{0}	16
Demand	8	18	13	3	42

Prepare reduced Matrix and calculate penalties

	D_1	D_2	D_3	D_4	a_i	P_1	P_2	P_3	P_4	P_5
W_1	4.5	2.5	12 0	2	12,0	2	–	–	–	–
W_2	0	14 1	3.5	2.5	14,0	1	1	1	2.5	
W_3	8 0.5	4 2.5	1 4	3 0	16,13,5,4,0	0.5	0.5	2	1.5	1.5
b_j	8,0	18,4,0	13,1,0	3,0	**42**					
P_1	0.5	1.5	3.5	2						
P_2	0.5	1.5	0.5	2.5						
P_3	0.5	1.5	0.5	_						
P_4	_	1.5	0.5	_						
P_5	_	2.5	4	_						

Now put allocation values in original matrix

	D_1	D_2	D_3	D_4	a_i
W_1	9	8	12 5	7	12,0
W_2	4	14 6	8	7	14,0

W_3	8 5	4 8	1 9	3 5	16,13,5,4,0
b_j	8,0	18,4,0	13,1,0	3,0	**42**

The transportation cost is Z=12*5+14*6+8*5+4*8+1*9+3*5 = 240

4.2 Solve Following TP:

	W_1	W_2	W_3	Supply
F_1	16	20	12	200
F_2	14	8	18	160
F_3	26	24	16	90
Demand	180	120	150	450

Solution:

	W_1	W_2	W_3	Supply
F_1	16_{2}^{4}	20_{12}^{8}	12_{0}^{0}	200
F_2	14_{0}^{6}	8_{0}^{0}	18_{6}^{10}	160
F_3	26_{12}^{10}	24_{16}^{8}	16_{4}^{0}	90
Demand	180	120	150	450

Prepare reduced Matrix & calculate penalties

	W_1	W_2	W_3	a_i	P_1	P_2	P_3	P_4
F_1	140 3	10	60 0	200,140,0	3	3	3	3
F_2	40 3	120 0	8	160,40,0	3	5	5	3
F_3	11	12	90 2	90,0	9	9	–	–
b_j	180,40,0	120,0	150,60,0	**450**				
P_1	0	10	2					
P_2	0	-	2					
P_3	0	-	8					
P_4	0	-	-					

Now put allocation values in original Matrix.

	W_1	W_2	W_3	a_i
F_1	140 16	20	60 12	200,140,0
F_2	40 14	120 8	18	160,40,0
F_3	26	24	90 16	90,0
b_j	180,40,0	120,0	150,60,0	**450**

The transportation cost is Z=140*16+60*12+40*14+120*8+90*16
= 5920

V. COMPARISON BETWEEN RESULTS OF EXISTING METHODS AND PROPOSED METHOD

Method	Example 1	Example 2
Proposed Method (AOCM)	240	5920
NWCM	320	6600
LCM	248	6460
VAM	248	5920
Optimal Solution	240	5920

VI. CONCLUSION

From comparison table we can see that this new developed (AOCM) method is more effective than other existing and established methods wiz NWCM,LCM and VAM.The AOCM method which is totally new concept & result oriented for both the bigger & smaller size TP. The solution derived by this method is very close to optimal solution or same as optimal solution.

ACKNOWLEDGMENTS

I express my deepest sense of gratitude to Principal Dr. B. G. Kore, Research Guide, Associate Professor of Statistics, Adarsh College, Vita – 415311,Dist. Sangli(M.S.), for his invaluable guidance and continuous encouragement.

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