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A comparative study of ASM and NWCR method in transportation problem

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Abstract

The transportation model is a special class of the linear programming problem. It deals with the situation in which commodity is shipped from sources to destinations. The objective is to minimize the total shipping cost while satisfying both the supply limit and the demand requirements. In this paper, a new method named ASM-method for finding an optimal solution for a transportation problem. The most attractive feature of this method is that it requires very simple arithmetical and logical calculation. So it is very easy to understand and use.

Keywords: Transportation problem, optimal solution , ASM (Assigning Shortest Minimax)-method, NWCR method.

2010 MSC: 90B06, 90C08, 68T27, 68T37.

1 Introduction

A transportation problem is one of the earliest and most important applications of linear programming problem. Description of a classical transportation problem can be given as follows. A certain amount of homogeneous commodity is available at number of sources and a fixed amount is required to meet the demand at each number of destinations. A balanced condition (i.e. Total demand is equal to total supply) is assumed. It deals with the situation in which a commodity is shipped from sources to destinations. The objective is to be determined the amounts shipped from each source to each destination that minimize the total shipping cost while satisfying both the supply limit and the demand requirements. Nowadays transportation problem has become a standard application for industrial organizations having several manufacturing units, warehouses and distribution centers [1–9].

2 Definitions

A set of non-negative values $x_{ij}, i = 1, 2, 3, \cdots$, and $j = 1, 2, 3, \cdots , n$ that satisfies the constraints is called a feasible solution to the transportation problem.

A feasible solution is said to be optimal if it minimizes the total transportation cost.

Optimality test can be performed if the number of allocation cells in an initial basic feasible solution = $m + n - 1\{$ No. of rows + No. of coloums - 1$\}$. Otherwise optimality test cannot be performed.

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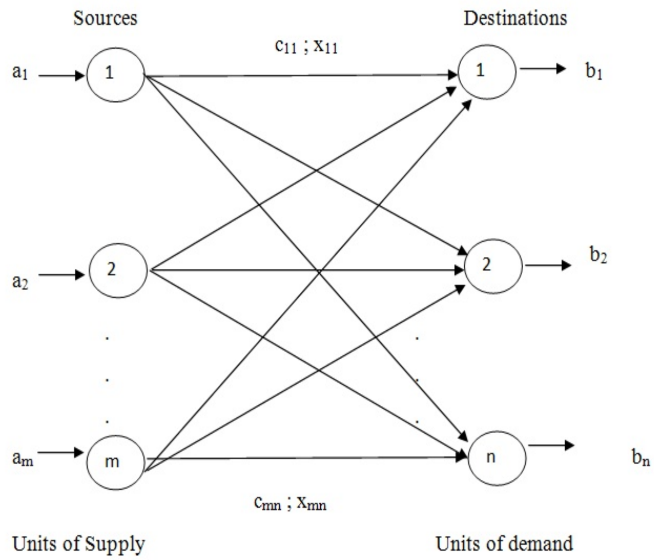
3 General Formation of Transportation Problem



4 Different Methods to Finding Optimal Solution

For finding an optimal solution for transportation problems it was required to solve the problem into two stages.

(1) In first stage Initial basic feasible solution (IBFS) was obtained by opting any of the available methods such as North West Corner, Matrix Minima, Least Cost Method, Row Minima, Column Minima and Vogels Approximation Method etc.

(2) Next and last stage MODI (Modified Distribution) method was adopted to get an optimal solution.

Here a much easier heuristic approach is proposed (ASM-Method) for finding an optimal solution directly with lesser number of iterations and very easy computations. The stepwise procedure of proposed method is carried out as follows.

4.1 ASM Method

Step 1:
Construct the transportation table from given transportation problem.
Step 2:
Subtract each row entries of the transportation table from the respective row minimum and then subtract each column entries of the resulting transportation table from respective column minimum.
Step 3:
Now there will be at least one zero in each row and in each column in the reduced cost matrix. Select the first zero (row-wise) occurring in the cost matrix. Suppose $(i, j)^{th}$ zero is selected, count the total number of zeros (excluding the selected one) in the i^{th} row and j^{th} column. Now select the next zero and count the total number of zeros in the corresponding row and column in the same manner. Continue it for all zeros in the cost matrix.
Step 4:
Now choose a zero for which the number of zeros counted in step 3 is minimum and supply maximum possible amount to that cell. If tie occurs for some zeros in step 3 then choose a $(k.l)^{th}$ zero breaking tie such that the total sum of all the elements in the k^{th} row and l^{th} column is maximum. Allocate maximum possible amount to that cell.

Step 5:

After performing step 4, delete the row or column for further calculation where the supply from a given source is depleted or the demand for a given destination is satisfied.

Step 6:

Check whether the resultant matrix possesses at least one zero in each row and in each column. If not, repeat step 2, otherwise go to step 7.

Step 7:

Repeat step 3 to step 6 until and unless all the demands are satisfied and all the supplies are exhausted.

4.2 Numerical Example

ASM Method

	1	2	3	4	Supply
A	11	13	17	14	250
B	16	18	14	10	300
C	21	24	13	10	400
Demand	200	225	275	250	

Solution:

Row reduced matrix

	1	2	3	4	Supply
A	0	2	6	3	250
B	6	8	4	0	300
C	11	14	3	0	400
Demand	200	225	275	250	

Column reduced matrix.

	1	2	3	4	Supply
A	0	0	3	3	250
B	6	6	1	0	300
C	11	12	0	0	400
Demand	200	225	275	250	

Using ASM method and final table

	1	2	3	4	Supply
A	11 [200]	13 [50]	17	14	250
B	16	18 [175]	14	10 [125]	300
C	21	24	13 [275]	10 [125]	400
Demand	200	225	275	250	

Transportation Cost

$$= (11 * 200) + (13 * 50) + (18 * 175) + (10 * 125) + (13 * 275) + (10 * 125)$$
$$= 2200 + 650 + 3150 + 1250 + 3575 + 1250$$
$$= Rs.12075$$

4.3 Optimality Check

To find initial basic feasible solution for the above example North West Corner Rule (NWCR) Mmethod is used and allocations are obtained as follows:

	1	2	3	4	Supply
A	11 [200]	13 [50]	17	14	250
B	16	18 [175]	14 [125]	10	300
C	21	24	13 [150]	10 [250]	400
Demand	200	225	275	250	

Transportation cost

$$= (11 * 200) + (13 * 50) + (18 * 175) + (10 * 125) + (14 * 125) + (13 * 150)$$
$$= 2200 + 650 + 3150 + 1750 + 1950 + 2500$$
$$= Rs.12200$$

By applying NWCR (North West Corner Rule) the optimal solution is Rs.12200.

To finding the optimal solution by using NWCR Rs.12200 and ASM method Rs.12075 for transportation problem. From these two methods ASM method provides the minimum transportation cost. Thus the ASM method is optimal.

Problem 2

	1	2	3	Supply
A	5	1	7	10
B	6	4	6	80
C	3	2	5	15
Demand	75	20	50	

Solution:

	1	2	3	Supply
A	5	1	7	10
B	6	4	6	80
C	3	2	5	15
Demand	75	20	50	

Supply $= 10 + 80 + 15 = 105$
Demand $= 75 + 20 + 50 = 145$
Supply $\neq$ Demand
$=>$ Unbalanced transportation problem.

Step:1

Introducing a dummy row with demand 40 units and cost 0.

	1	2	3	
A	5	1	7	10
B	6	4	6	80
C	3	2	5	15
D	0	0	0	40
	75	20	50	

Supply $= 10 + 80 + 15 + 40 = 145$
Demand $= 75 + 20 + 50 = 145$
Supply = Demand
=> Balanced transportation problem.

ASM Method

Row reduced matrix.

	1	2	3	
A	4	0	6	10
B	2	0	2	80
C	1	0	3	15
D	0	0	0	40
	75	20	50	

Column reduced matrix.

	1	2	3	
A	4	0	6	10
B	2	0	2	80
C	1	0	3	15
D	0	0	0	40
	75	20	50	

Using ASM and Final Table

	1	2	3	
A	5	10 1	7	10
B	60 6	10 4	10 6	80
C	15 3	2	5	15
D	0	0	40 0	40
	75	20	50	

Transportation Cost

$$\begin{aligned} &= (1*10) + (6*60) + (4*10) + (6*10) + (3*15) + (0*40) \\ &= 10 + 360 + 40 + 60 + 45 + 0 \\ &= Rs.515. \end{aligned}$$

Optimality Check

	1	2	3	
A	5 [10]	1	7	10
B	6 [65]	4 [15]	6	80
C	3	2 [5]	5 [10]	15
D	0	0	0 [40]	40
	75	20	50	

Transportation Cost

$$\begin{aligned} &= (5*10) + (6*65) + (4*15) + (2*5) + (5*10) + (0*40) \\ &= 50 + 390 + 60 + 10 + 50 + 0 \\ &= Rs.560. \end{aligned}$$

By applying NWCR (North West Corner Rule) the optimal solution is Rs.560.

To finding the optimal solution by using NWCR Rs.560 and ASM method Rs.515 for transportation problem. From these two methods ASM method provides the minimum transportation cost. Thus the ASM method is optimal.

5 Conclusion

In this paper ASM method provides an optimal solution with less iteration for transportation problem. This method provides less time and make easy to understand. So it will be helpful for decision makers who are dealing with this problem.

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