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RESEARCH ARTICLE

STUDY OF TRANSPORTATION PROBLEM BY MCD METHOD.

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Abstract

Obtaining an initial basic feasible solution is the prime requirement of obtaining an optimal solution for the transportation problem. In this paper, a new approach is proposed to find an initial basic initial feasible solution for the transportation problems. The method is also illustrated with numerical examples.

Introduction:-

The very interesting class of “allocation Methods” which is applied to a lot of very practical problems generally called ‘Transportation Problems’. Transportation model was first introduced by F.L. Hitchcock I 1941. Later on, it was further improved by T.C. koopman in 1949 and G.B. Dantzig in 1951.

Definition: The transportation problem is to transport various amounts of single homogeneous commodities that are initially stored at various sources, to different destinations in such a way that the total transportation cost is minimum.

Requirements Assumption:-
Each source has a fixed supply of units where this entire supply must be distributed to the destination (we let a_i denote the number of units being supplied by the source $i, i = 1 to m$)
Similarly, each destination has a fixed demand for units, where this entire demand must be received from the source.(We let b_j denote the number of units being received by destination j, $j = 1\ to n$).

Cost Assumption:-
The cost of distributing units from any particular source to any particular destination is directly proportional to the number of units distributed.
The Necessary and Sufficient condition for a Transportation problem to have feasible solution is$\sum_{i=1}^{m} a_i = \sum_{j=1}^{n} b_j$.

Mathematical Formation of Transportation problem:
Let a_i = Quantity of product available at source i
b_j = quantity of product required at destination j
c_{ij} = Cost of transporting one unit of product from source i to destination j
x_{ij} =Quantity of product transported from source i to destination j
Then the transportation model would be in the form as follows:

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Minimize $Z = \sum_{j=1}^{n} \sum_{i=1}^{m} c_{ij} x_{ij}$
Subject to $\sum_{j=1}^{n} x_{ij} = a_i i = 1 \, to m$

$$\sum_{i=1}^{m} x_{ij} = b_j \quad j = 1 \, to n$$

$$x_{ij} \geq 0 , \forall i, j$$

Formation of Transportation Table:

S_i/D_j	D_1	D_2	……….	D_n	Availability
S_1	$c_{11}(x_{11})$	$c_{12}(x_{12})$	………	$c_{1n}(x_{1n})$	a_1
S_2	$c_{21}(x_{21})$	$c_{22}(x_{22})$	……….	$c_{2n}(x_{2n})$	a_2
………	……….	……….	……..	……….	………
S_m	$c_{m1}(x_{m1})$	$c_{m2}(x_{m2})$	……	$c_{mn}(x_{mn})$	a_m
Demand	b_1	b_2	……..	b_n	$\sum_{i=1}^{m} a_i = \sum_{j=1}^{n} b_j$

Algorithm for Transportation Method:-
The Transportation Problem can be solved by the following steps:
Step1: Formulate the given problem in the matrix form.
Step 2: Obtain an Initial feasible solution.
Step3: Test the optimality of Initial solution.
Step4: Update the solution accordingly and repeat Step 3 until the most feasible solution is reached.

There are several methods for solving transportation problems which arebased on different of special linear programming methods, among these are:

1. Northwest Corner method
2. Least cost method
3. Vogel's approximation method
4. Row Minimum Method
5. Column Minimum Method

Basically, these methods are different in term of the quality for the produced basic starting solution and the best starting solution that yields smaller objective value.

The proposed approach to find the initial feasible solution is:
Step 1: construct the transportation table from the given Transportation Problem.
Step2:Check whether the Transportation Problem is balanced or not, if not make it balance.
Step3:Select the minimum cost from all the cost cells of Transportation table.
Step4: Subtract the selected minimum cost from each cost by keeping the minimum cost in the respective cost cell/cells as it was/were. Let the table be known as minimum costdifference table(MCDT).
Step5: Now allocate the minimum of (a_i, b_j) to the minimum 'cost difference cell' in the MCDT.If demand is satisfied delete the column,if it is supply delete the row.
Step6: If the minimum 'cost difference' is repeated in MCDT then select the difference cell which has minimum cost in the Transportation Table and then allocate the minimum of (a_i, b_j) to the minimum 'cost difference cell'in the MCDT. If demand is satisfied delete the column, if it is supply delete the row.
Step7: Repeat the step 5 for the remaining rows and columns until all the supplies are exhausted and the demands are satisfied.
Step8: Now transfer this minimum difference table to the original transportationtable.
Step9: finally calculate the total transportation cost of the transportation problem.

Numerical Example

S_i/D_j	D_1	D_2	D_3	D_4	source
S_1	3	1	7	4	300
S_2	2	6	5	9	400
S_3	8	3	3	2	500
Destination	250	350	400	200	

Solution:-

Step2: the Given Transportation table is balanced.

Step3: The minimum cost of the Transportation table is 1. Subtract 1 from the each cost of the Transportation table. Then Construct the following minimum cost difference table(MCDT).

Table 1:-

S_i/D_j	D_1	D_2	D_3	D_4	source
S_1	2	1	6	3	300
S_2	1	5	4	8	400
S_3	7	2	2	1	500
Destination	250	350	400	200	

Step4: In MCDT the minimum 'difference cost' 1 is repeated in the cells (1,2),(2,1) and (3,4).among these cells, (3,4) has minimum allocation 200. So allocate to (3, 4) in the table the minimum of (200,500)=200.the demand is satisfied .cross the D_4 column, by repeating the allocation process for the next minimum costs unit all supplies and demands are satisfied. Then transform MCDT into original Transportation Table with allocations. Hence find total transportation cost.

Table 2:-

S_i/D_j	D_1	D_2	D_3	D_4
S_1	3	1(300)	7	4
S_1	2(250)	6	5(150)	9
S_1	8	3(50)	3(250)	2(200)

The total Transportation cost is

$1 \times 300 + 2 \times 250 + 5 \times 150 + 3 \times 50 + 3 \times 250 + 2 \times 200$ =2850

Result Analysis:-

Table 7:-

Method	Total Transportation cost
North-West corner Rule	4400
Row Minimum Method	2850
Column Minimum Method	3600
Least Cost Method	2900
Vogel's approximation Method	2850
Proposed MCDT Method	2850
Optimum solution	2850

As observed from Table 2 The proposed MCDT method provides comparatively a better initial basic feasible solution than the result obtained by the traditional algorithms which are either optimal or near to optimal.

Conclusion:-

The MCD method is very simple, easy to understand and to apply to the transportation problems.Computationally it will take less number of iterations.

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