A new approach for finding the initial solution of the transportation problem

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Introduction

The transportation problem is one of the subclasses of linear programming problem where the objective is to transport various quantities of a homogeneous product that are initially stored at various origins, to different destinations in such a way that the total transportation cost is at its minimum [2]. The main objective of transportation problem is to decide the amounts transported from each origin to each destination to minimize the total transportation cost while fulfilling the supply and demand restrictions. In this research, we have considered to get initial basic feasible solutions for the transportation problem. There are several heuristics methods to find an initial basic feasible solution for a transportation problem. Such as North West corner method, least cost method and Vogel's approximation method. In this study, we calculate the penalty costs by taking addition of highest cost and next smaller to the highest cost for each row and each column, then makes allocation as much as possible to the minimum cost cell in the row or column with the largest penalty cost.

Methodology

Mathematical formulation

Table 1. Transportation Problem Model.

Destination / Source	D_1	D_2	D_3	…. Dj….	D_n	SUPPLY a_i
S_1	x_{11} c_{11}	x_{12} c_{12}	x_{13} c_{13}		x_{1n} c_{1n}	a_1
S_2	x_{21} c_{21}	x_{22} c_{22}	x_{23} c_{23}		x_{2n} c_{2n}	a_2
…S_i…				.... xij….		a_i
S_m	x_{m1} c_{m1}	x_{m2} c_{m2}	x_{m3} c_{m3}		x_{mn} c_{mn}	a_m
DEMAND b_j	b_1	b_2	b_3	b_j	b_n	

Suppose there are n destinations and m sources. Let a_i be the number of supply units presented at sources i and let b_j be the number of demand units required at destination j, c_{ij} represents the cost of transporting one unit of commodity from source i to destination j. If x_{ij} ($x_{ij} \geq 0$) is the number of units transported from source i to destination j [5].

$\sum_{j=1}^{n} x_{ij} \leq ai$, (i=1, 2…………..,m) (Supply constraints).

$\sum_{i=1}^{m} x_{ij} \geq b_j$, (j=1,2,…………..,n) (Demand constraints).

A necessary and sufficient condition for the existence of a feasible solution to the transportation problem is that

$\sum_{i=1}^{m} a_i = \sum_{j=1}^{n} b_j$

Algorithm of proposed method.

Step 1: If the transportation problem is unbalanced (i.e either total supply > total demand or total supply < total demand), balance the transportation problem.

Step 2: Determine the penalty cost for each row by taking addition of highest cell cost in the row and next to highest cell cost in the same row and put in front of the row on the right. Likewise, compute the penalty cost for every column and write them in the bottom of the cost matrix below corresponding columns.

Step 3: Pick the highest penalty costs and notice the row or column to which this corresponds. In the event that a tie happens, pick any one of them randomly.

Step 4: Make allocation min(s_i,d_j) to the cell having lowest unit transportation cost in the selected row or column.

Step 5: No further consideration is needed for the row or column which is satisfied.

If both the row and column are satisfied at a time, delete only one of the two, and the remaining row or column is assigned zero supply (or demand).

Step 6: Calculate fresh penalty costs for the remaining sub-matrix as in step 2 and allocate following the procedure of steps3, 4 and 5. Continue the process until all rows and columns are satisfied.

Step 7: Compute total transportation cost for the feasible allocations using the original balanced transportation cost matrix.

Numerical Illustration. The proposed method and the well-known methods (i.e., NWCM, LCM, VAM) for finding initial basic feasible solutions are illustrated by the secondary data.

Results and Discussion

Table 2. A comparative study of different solutions.

Example Number	Total transportation Cost				
	Proposed Method	NWCM	LCM	VAM	Optimum Solution
1 [3]	457	712	457	457	457
2 [3]	999	1021	944	944	944
3 [3]	760	1490	960	760	760
4 [4]	1039	1015	814	779	743
5 [4]	305	363	305	290	290
6 [2]	1972000	2336000	4160900	2331800	1972000
7 [1]	1720	1815	1885	1745	1650

The initial basic feasible solutions are calculated by using TORA software when we use well known methods (NWCM, LCM and VAM). The optimal solutions are calculated by using TORA software and also by LINGO software.In above table 1, we see that initial basic feasible solution varies for different solution procedure and also for different examples. A comparative study among the solution obtained by proposed method and the well-known methods (NWCM, LCM and VAM) are also presented by means of

examples and it is seen that in all the cases except only one case, the initial basic feasible solution is better than north west corner method, sometimes it is better than least cost method. Most often the presented method gives solution same as least cost method. Sometimes, proposed method is the same as Vogel's approximation method and better than Vogel's approximation method. Sometimes, the presented method gives directly the optimal solution.

Conclusion

In the present highly competitive market, various organizations need to deliver products to the customers in a cost-effective way, so that the market becomes competitive. To address this difficulty, transportation model gives a powerful structure to decide the best ways to deliver merchandise to the customer. In this dissertation, a new approach for finding an initial basic feasible solution of a transportation problem is introduced. We also illustrate this method numerically. By above discussion, finally we claim that our proposed method is approximately equivalent to the well-known heuristics North West Corner Method and Least Cost Method.

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