Proposed Method for Solving Transportation Problems

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Abstract: - The transportation problem (TP) is a frequently used optimization technique in operations research for studying difficulties involving the transportation of commodities from manufacturing locations to retail outlets. Lowering transportation costs is one possible purpose of the TP, reducing the distance travelled in terms of time, and so on. Solving such issues can be done systematically. We do this by determining the problem's Initial Basic Feasible Solution (IBFS). The usual methods for determining the IBFS are Vogel's Approximation technique, Least Cost technique, and the North-West Corner technique. Several more techniques to handle such difficulties have been proposed in recent years. In this article, we offer a new technique for solving the transportation problem, and its efficacy is compared to that of existing solutions. Calculation of the result shows that it is straightforward and close to the ideal solution to the issue.

Keywords: Modified Vogel’s Approximation Method, Balanced Transportation Problem, Mean Absolute Deviations of Costs.

1. Introduction

The transportation model is a linear programming paradigm that is widely used in the industry, as it is considered an integral part of the process to plant for its purpose of what it needs of production requirements at the specified time and place. This form searches a representative for affiliated actors and actresses for work in a quick response. The least possible time, provided that the processing is found in each source, the demand at each site, and the cost of transporting one unit (or the time taken to transfer units) from each source to each specific information site, The historical roots of the transport model go back to Tolstoi was among the first to conduct a mathematical analysis of the transportation problem in the 1920s A.N, Hitchcock delivered his article Production is distributed among a number of different sources to Various Locations in (1941) at the American Society of Mechanical Engineers. The distribution of a commodity from a number of distinct suppliers to a number of different locations, In (1947) Koopmans presented his research entitled “Usage Optimum Transport System" developed by Dantzig in 1963.

Vogel's Approximation technique (VAM), Least Cost technique (LCM), and The North-West Corner technique (NWCM) are three well-known approaches for determining IBFS of Problem's Transportation . Recently developed heuristic approaches include Modified Vogel's Approximation Method (MVAM), Extremum Difference Method (EDM), and the Maximum Difference Method (MDM) . Keerthi Jain and Smita Sood have demonstrated that their MDM Method is more often than not superior to VAM [4]. According to Abdul Sattar et al., the outcomes of VAM and MVAM are nearly identical to optimum but best than LCM and NWCM [9]. In his study, M.A.Hakim introduced the Approximation Methodology Proposed (AMP) and demonstrated that his method and VAM produce the same outcome [10]. The historic paper Proposed Method, Algorithm of Direct Sum Method (DSM) to discover the Initial Basic Feasible Solution [11][12] was provided by Ravi Kumar R, et al. The idea of "standard deviation of row/column expenses" is used by Stephen Akpan, et al. in their paper "A Modified Vogel Approximation Method for Solving Balanced Transportation Problems."

2. Methods and Material:

2.1. TP's Mathematical Representation:

The following notations are used to represent the transportation problem mathematically:
Let ′i′ represent one of the ′m′ numbers of origins.
Let ′j′ represent for a destination point among the ′n′ possible destinations.
The number of units available at ′i′ is denoted by ′a_i ′.
Let ′b_j′ represent for the number of units required at ′j′.
Let 'cij' be the cost of transporting a unit of its origins to its requirement.
Let x_{ij} is the number of units that must be transferred of the i^{th} origin into the j^{th} destination.
The transportation problem is possible to express mathematically as choosing a set of variables in decision-making x_{ij} ′ s, for i = 1,2,..., m; j = 1,2,...,n, to minimize.

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

subject to the constraint

$$\sum_{j=1}^{n} x_{ij} = a_i, i = 1,2, \dots, m.$$

$$\sum_{i=1}^{m} x_{ij} = b_j \ , j = 1,2, \dots, n.$$

and $x_{ij} \geq 0$, for all i and j

There are m + n constraint equations in a typical transportation model with m sources and n destinations, one for each origin and requirement. One of the equations is superfluous because the transportation model is always balanced (supply = demand), reducing the model to m + n - 1 independent equations and m + n - 1 fundamental variable. The structure of the transportation problem is unique., one of three strategies can be used to guarantee a non-artificial starting basic solution:

i. Vogel approximation method
ii. Least cost method
iii. North-West corner method

The first strategy is "mechanical" in that it aims to provide a starting point. (basic workable) answer at any cost. The final two heuristics look for a higher-quality (lower objective value) initial solution. The Vogel heuristic is the best in general, while the north-west corner technique is the worst. The North-West corner approach, on the other hand, requires the fewest computations. [2].

2.2. Standard Initial Basic Feasible Solution Methods Algorithms and Methodology Proposed

2.2.1. North-West Corner Technique :

Step 1: Using Available and Required, choose the cell in the north-west corner of the transportation table and assign the minimum amount of transportation to that location.

Step 2: After checking that the first cell's criteria has been met, go horizontally to the next cell in the second column to continue.

Step 3: If the number of cells available in the first row is exhausted, go on to the first cell in the second row and so on.

Step 4: Repeat until all available and required are satisfied.

2.2.2. Least Cost Technique :

Step 1: Using the allocation rule, select the cell with the lowest cost and distribute as much as possible. If no such cell exists, pick a cell at random.

Step 2: Make a cross in the pleased column or row . Continue with the remaining parts of the table until all available and required have been met.

2.2.3. Vogel's Approximation Technique :

Step1: Determine ' Difference ' for each column and row. The penalty between the lowest and next-lowest costs is used to determine the penalty.

Step 2: Determine which column or row has the largest difference and assign it to the cell with the lowest cost in that column or row. If there is a tie, the winner will be chosen at random.

Step3: Continue while all equipping and request have been met.

2.2.4. Proposed Modified Vogel Approximation Method (Mean Absolute Deviations):

I proposed this method as follows. Instead of using the idea of determining two of the least costs as we have in the current Vogel approximation method algorithm, "Mean absolute deviation of row/column costs" is a concept we employ.

Step 1: Locate the costs for each column and row (Mean Absolute Deviations).

Step 2: Using Mean Absolute Deviations, find the column or row with the highest costs and assign the most units possible to the lowest cost route in that column or row.

Step 3: Delete the appropriate column if the assignment in step two meets the demand at that destination. Otherwise, when the supply at the origin is depleted, delete the relevant row.

Step 4: When all supplies have been depleted and all demands have been met, come to a halt. Otherwise, go back to the first step.

3. Results and Discussions:

Let's take a look at the following transportation issue:

Destination	D_1	D_2	D_3	D_4	Supply

Source					
S_1	8	6	10	9	**35**
S_2	9	12	13	7	**50**
S_3	14	9	16	5	**40**
Demand	**45**	**20**	**30**	**30**	125

The initial basic possible solution to the aforesaid problem is summarized below, using the different methods discussed in this work.

3.1. The Conventional Initial Solution By North-West Corner Method:

Destination / **Source**	D_1	D_2	D_3	D_4	Supply
S_1	8(35)	6	10	9	**35**
S_2	9(10)	12(20)	13(20)	7	**50**
S_3	14	9	16(10)	5(30)	**40**
Demand	**45**	**20**	**30**	**30**	125

S_1 to D_1 (**x_{11}**) **= 35** , S_2 to D_1 (**x_{21}**) =**10** , S_2 to D_2 (**x_{22}**) = **20** , S_2 to D_3 (**x_{23}**) =**20** ,S_3 to D_3 (**x_{33}**) = **10**, S_3 to D_4 (**x_{34}**) = **30**.

With objective function value (Z) =**1180.**

3.2. The Conventional Initial Solution By Least Cost Method:

Destination / **Source**	D_1	D_2	D_3	D_4	Supply
S_1	8(**15**)	6(**20**)	10	9	**35**
S_2	9(**30**)	12	13(**20**)	7	**50**
S_3	14	9	16(**10**)	5(**30**)	**40**
Demand	**45**	**20**	**30**	**30**	125

S_1 to D_1 (**x_{11}**) **= 15** , S_1 to D_2 (**x_{12}**) =**20** , S_2 to D_1 (**x_{21}**) = **30** , S_2 to D_3 (**x_{23}**) =**20** ,S_3 to D_3 (**x_{33}**) = **10**, S_3 to D_4 (**x_{34}**) = **30**.

With objective function value (Z) =**1080.**

3.3. The Conventional Initial Solution By Vogel's Approximation Method (VAM):

Destination / **Source**	D_1	D_2	D_3	D_4	Supply
S_1	8	6(**10**)	10(**25**)	9	**35**
S_2	9(**45**)	12	13(**5**)	7	**50**
S_3	14	9(**10**)	16	5(**30**)	**40**
Demand	**45**	**20**	**30**	**30**	125

S_1 to D_2 (**x_{12}**) **= 10** , S_1 to D_3 (**x_{13}**) =**25** , S_2 to D_1 (**x_{21}**) = **45** , S_2 to D_3 (**x_{23}**) =5 ,S_3 to D_2 (**x_{32}**) = **10**, S_3 to D_4 (**x_{34}**) = **30**.

With objective function value (Z) =**1020.**

3.4. The Conventional Initial Solution By Proposed Method (Mean Absolute Deviations):

Destination / Source	D_1	D_2	D_3	D_4	Supply
S_1	8	6(**10**)	10(**25**)	9	**35**
S_2	9(**45**)	12	13(**5**)	7	**50**
S_3	14	9(**10**)	16	5(**30**)	**40**
Demand	**45**	**20**	**30**	**30**	125

S_1 to D_2 ($\mathbf{x_{12}}$) **= 10** , S_1 to D_3 ($\mathbf{x_{13}}$) =**25** , S_2 to D_1 ($\mathbf{x_{21}}$) = **45** , S_2 to D_3 ($\mathbf{x_{23}}$) =5 ,S_3 to D_2 ($\mathbf{x_{32}}$) = **10**, S_3 to D_4 ($\mathbf{x_{34}}$) = **30**.
With objective function value (Z) =**1020.**

4. Conclusions and Recommendations
It may be possible to obtain more efficient starting solutions for the transportation problem utilizing my proposed method, and thus it can be used for further optimization of the answer.

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