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# The New Technique for Solving Transportation Problem

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**Abstract.** One of the most important programming applications in operations research (OR) is the transportation problem (TP) formulation and solution as a linear programming problem (LPP) which is attach to everyday life and basically transact with logistics. The purpose of this paper is to propose new method, named N.R 1 method to fine an optimal-solution(OS) for (TP). However, this NOOR1 method is debated in this research give us an initial solution close to optimal solution or optimal In most cases. The suggested method (NOOR1) is simple to solve both type of balanced or unbalanced TP with minimize objective function .

**Keywords.** problem of Transportation(TP). Initial-basic-feasible-solution-(IBFS). Optimal-solution(OS). Vogel`s-Approximation method(VA). North-west-corner method(NWC). Least-cost method(LCM). Saeedi 2 method

## 1. Introduction

The problem of transportation show due to Charge of goods to the destination of their requirement from different exported sources. The market imposes, when transporting goods, many costs for several different reasons. At the same time it is possible that profit received when transporting goods to a particular destination differs from another, and therefore an appropriate transportation schedule must be set to achieve the minimize possible cost as in such a competitive market (Bindu Choudhary, 2016). A definite amount of congener commodity is ready at number of origins and a fixed cost is required to meet the demand at each number of destinations. Many researchers have presented other methods to get (IBFS) to the (TP). In 1781, French mathematician Gaspard Monge, in cooperation with the army of Napoleon Bonaparte, published a mathematical model sealing with transporting soil at the lowest possible cost between different construction sites for the purpose of building forts and military ways (Muhammad Hanif and Farzana Sultana Rafi, 2018). Although Monge laid a theoretical basis for solving (TP), no algorithm was advanced till 1941 when American mathematician Frank L.Hitchcock disseminated his solution of Monge`s problem In 1941, Hitchcock developed a basic problem (H A Hussein et al 2021) of transportation then in 1949, Koopmans debate the problem of transportation in detail. In 1951, Dantzig coined the problem of transportation as a LPP. Transportation problem was first debated by F.L.Hitchcock in (Bindu Choudhary, 2016). T.C.Koopans displays the F.L.Hitchcock in these two Proposals are most useful in the development of methods of transportation. Since that time, especially in past years, many manners have been presented to find Initial basic feasible solution (Reena G Patel et al 2017), for example, in 2015, Abudl S.Soomro et.al. suggested an adjustment vogel`s approximate method (Mohammed S. et al 2020) for solving (TP) .In this work we present a new approach to find (IBFS) of (TP) which minimize is cost, so researchers are seeking to provide the best results showed the efficiency of the new method (NOOR1) by comparing its solution at the solution of the vintage methods (NWC, LC, and VA) and the new method (Saeedi 2). Moreover, it is in some cases give us the optimal solution.

## 2. Transportation Model

Transportation means the transfer of materials from different sources to different destinations. Suppose that a firm has production units at $S_1, S_2, \dots, S_m$ The demand to produce merchandise is at n various centers $D_1, D_2, \dots, D_n$ . The firm problem is to transport merchandise from m different production units to n different demand centers with minimum cost. Consider the cost of shipping from production unit $S_i$ to the demand center $D_j$ is $C_{ij}$ , and $X_{ij}$ unit is shipped from $S_i$ to $D_j$ , then the cost is $C_{ij}X_{ij}$. Therefore, the total shipping cost is

$$z = \sum_{i=1}^{m}\sum_{j=1}^{n} C_{ij}X_{ij} \qquad (2.1)$$

Note that z is a linear. From (2.1), the matrix $(C_{ij})_{m\times n}$ is called the unit cost matrix. The goods are transferred from the source i to the demand center j. We wish to find $X_{ij} \geq 0$ which satisfy the m + n constraints. Then, we have

$$\sum_{i=1}^{m} a_i = a \qquad (2.2)$$

$$\sum_{j=1}^{n} b_j = b \qquad (2.3)$$

where a and b are total supply and demand. The problem of transportation is to find $X_{ij}$ so that the cost of transportation z is minimum. If the amount of goods available at the $i^{th}$ source is transferred to $j^{th}$ destination, then

$$\sum_{j=1}^{n} x_{ij} = a_j \qquad (2.4)$$

$$\sum_{i=1}^{m} x_{ij} = b_i \qquad (2.5)$$

Using (1.2) and (2.4), (2.5), problem of transportation can be elicit as a LPP

minimize

$$z = \sum_{i=1}^{m} \sum_{j=1}^{n} c_{ij} x_{ij}$$

subject to

$$\sum_{j=1}^{n} x_{ij} = a_i \qquad i = 1,2, \dots, m \qquad (2.6)$$

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

**3. Balanced Transportation Problem**

If the total quantity required at destinations is precisely the same as the amount available at the origins then the problem is called a balanced TP. Therefore, using (2.2) and (2.3) to get

$$\sum_{i=1}^{m} a_i = \sum_{j=1}^{n} b_j \qquad (3.7)$$

The TP is a particular type of LPP. Thus, the definition of basic feasible solution of the transportation problem is the same as the definition of the linear programming problem. From (2.6), it follows that $x_{ij}$ are known as decision variables. They are m × n in total. But, the number of basic variables is much less than m × n in a transportation problem.

**Theorem 1.** In a balanced transportation problem, there are at most $m + n - 1$ basic variables.

**4. Types of transportation problem**

1)Balanced (TP). The problem is said to be balanced TP if $\sum_{i=1}^{m} a_i = \sum_{j=1}^{n} b_j$.

2) Unbalanced (TP). The problem is said to be unbalanced TP if $\sum_{i=1}^{m} a_i \neq \sum_{j=1}^{n} b_j$.

**5. The New Algorithm (NOOR1)**

**Step1)** Build the transportation problem cost matrix. The transportation problem must be balanced.

**Step2)** Calculate the number of specializations required for the optimal solution according to **Theorem 1** which is $m + n - 1$.

**Step3)** Determine $(m + n - 1)$ among the lowest different costs found in the transportation problem table.

**Step4)** link the values identified in step 3 to their possible allocation (assign $\min\{a_i, b_j\}$ such that $a_i$ is available supply at the $i^{th}$ source and $b_j$ is demand at the $j^{th}$ destination). ).

**Step5)** Choose the call with the least allocation from step 4 and allocate it.

**Step6)** Repeat steps 2,3 and 4 until capacity condition of all the sources demand conditions of all destination of all destination have been satisfied.

**Step7)** Calculate transportation cost $z = \sum_{i=1}^{m} \sum_{j=1}^{n} c_{ij} x_{ij}$ .

### 6. Numerical examples

purpose of the numerical Experiments is to check the efficiency of the proposed Algorithm (NOOR1). There are three classical methods (NWCM), (MCM) and (VAM) and new method (Al- Saeedi 2), we compare the new Algorithm with them.

**Example 1.** Consider the next transportation cost problem in table 1.

**Table 1**

| Origin | Destination | | | | supply |
|---|---|---|---|---|---|
| | $D_1$ | $D_2$ | $D_3$ | $D_4$ | |
| $S_1$ | 1 | 2 | 3 | 4 | 30 |
| $S_2$ | 7 | 6 | 2 | 5 | 50 |
| $S_3$ | 3 | 3 | 2 | 7 | 35 |
| Demand | 15 | 30 | 25 | 45 | 115 |

The presented transportation problem is balanced total demand=total supply=115.

According to new algorithm (NOOR1), the above table acquired as follows:

**Table 2**

| Origin | Destination | | | | supply |
|---|---|---|---|---|---|
| | $D_1$ | $D_2$ | $D_3$ | $D_4$ | |
| $S_1$ | 1<br>15 | 2<br>15 | 3 | 4 | 30 |
| $S_2$ | 7 | 6 | 2<br>5 | 5<br>45 | 50 |
| $S_3$ | 3 | 3<br>15 | 2<br>20 | 7 | 35 |
| Demand | 15 | 30 | 25 | 45 | 115 |

The transportation cost total is $z = \sum_{i=1}^{3} \sum_{j=1}^{4} c_{ij} x_{ij}$

$z = (1 \times 15) + (2 \times 15) + (2 \times 5) + (5 \times 45) + (3 \times 15) + (2 \times 20) = 365.$

**Example 2.** Consider the next transportation cost problem in table 3.

**Table 3**

| Origin | Destination | | | | supply |
|---|---|---|---|---|---|
| | $D_1$ | $D_2$ | $D_3$ | $D_4$ | |
| $S_1$ | 4 | 6 | 8 | 13 | 20 |
| $S_2$ | 10 | 5 | 5 | 11 | 30 |
| $S_3$ | 12 | 16 | 15 | 10 | 15 |
| $S_4$ | 3 | 9 | 14 | 14 | 13 |
| Demand | 6 | 8 | 18 | 6 | 78 / 38 |

The present (TP) is unbalanced because the total demand is not equal to the total supply.

**Table 4**

| Origin | Destination | | | | | supply |
|---|---|---|---|---|---|---|
| | $D_1$ | $D_2$ | $D_3$ | $D_4$ | $D_5$ | |
| $S_1$ | 4 | 6 | 8 | 13 | 0 | 20 |
| $S_2$ | 10 | 5 | 5 | 11 | 0 | 30 |
| $S_3$ | 12 | 16 | 15 | 10 | 0 | 15 |
| $S_4$ | 3 | 9 | 14 | 14 | 0 | 13 |
| Demand | 6 | 8 | 18 | 6 | 40 | 78 |

Now (TP) is balanced because the total demand=total supply=78.

**Table 5**

| Origin | Destination | | | | | supply |
|---|---|---|---|---|---|---|
| | $D_1$ | $D_2$ | $D_3$ | $D_4$ | $D_5$ | |
| $S_1$ | 4 | 6 | 8 | 13 | 0 [20] | 20 |
| $S_2$ | 10 | 5 [8] | 5 [18] | 11 | 0 [4] | 30 |
| $S_3$ | 12 | 16 | 15 | 10 [6] | 0 [9] | 15 |
| $S_4$ | 3 [6] | 9 | 14 | 14 | 0 [7] | 13 |
| Demand | 6 | 8 | 18 | 6 | 40 | 78 |

The transportation cost total is $z = \sum_{i=1}^{4} \sum_{j=1}^{5} c_{ij} x_{ij}$

$z = (0 \times 20) + (5 \times 8) + (5 \times 18) + (0 \times 4) + (6 \times 10) + (9 \times 0) + (6 \times 3) + (7 \times 0) = 208.$

## 7.Comparison

The results of solving the examples given in this research were compared to explain the efficiency of the new methods work. The comparison has been made with three traditional solution methods which is (VAM, LCM, NWCM) and new method (Saeedi 2). The suggested algorithm gives comparatively a finer Initial basic feasible solution than those obtained by the tradition algorithms which is either (OS) or close to (OS). It is observed that our suggested algorithm gives comparatively a finer Initial basic feasible solution than those obtained by vogel`s Approximation method. This new method (NOOR1) can be used for both type balanced TP and unbalanced TP transportation problem which is having objective function of minimize.

**Table 6**

| Name of method | NWCM | LCM | VAM | Saeedi2 | NOOR1 | OPS |
|---|---|---|---|---|---|---|
| Example1 | 480 | 380 | 375 | 405 | 365 | 365 |
| Example2 | 246 | 256 | 294 | 218 | 208 | 208 |

## 8. Conclusion

In this research study, the (TP) that has an objective function of the type of minimization has been taken by proposing a my new method (NOOR1) to solve this problem. When observing the previous section on comparing The results of solving the examples given in this research, the results obtained using this (NOOR1) method are better than the results of the solution by the three traditional methods and Saeedi 2 method or equal with some (Table 6 can be noted), It is seen that employing this new method (NOOR1) to solve the (TP) (balanced and unbalanced) that has an objective function of the type of minimization gives preferred and appropriate results, as this new technique is characterized by easy understanding and application of its steps and reduces a much of time and work to obtain the (OS) or close to the (OS). Based on the (OS) it permits us to take the best soundly. Thus, several ways are possible to promote the algorithm of the method.

## 9. References


[1] Muhammad Hanif and Farzana Sultana Rafi, 2018. "A New Method for Optimal solution of Transportation Problems in LPP". Journal of Mathematics Research, Vol. 10, No. 5, pp 60-61.

[2] H A Hussein, Mushtak A K Shiker and Mohamad S M Zabiba, 2021. "A New Revised Efficient of VAM to Find The Initial Solution for The Transportation Problem". Journal of physics, pp 1-2.

[3] Bindu Choudhary, 2016. "Optimal Solution of Transportation Problem Based on Revised Distribution Method". International Journal of Innovative Research in science, Engineering and technology, Vol. 5, Issue 8, pp 14873-14874.

[4] Reena G Patel, Dr. Patel, Dr. Bhavin S. Patel and Dr. P. H. Bhathawala, 2017. "On Optimal Solution of a Transportation problem". Glonal Jounral of pure and Applied Mathemetics, ISSN 0973-1768 Volume 13, Number 9, pp 6201-6202.

[5] Mohammed S M Zabiba, Hussein A H Al-Dallal, Karrar H Hashim, Mohammed M Mahdi, Mushtak A K Shiker, 2020. "A New Technique to Solve the Maximization of the Transportation Problems". Journal of physics, pp 1-2.