



## **An Optimal Solution for Transportation problem-DFSD**

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### **Abstract**

The new approach proposed in this paper namely DFSD (Difference form Standard Deviation) method is applied for finding the optimal solution for transportation problem. The proposed algorithm is unique way to reach feasible and optimal solution without or with degeneracy condition. It is directly find the optimal solution with minimum number of iterations compared to other existing method.

**Key words:** DFSD, NWCR, LCM,VAM, MODI and optimal solution.

## **1. Introduction**

The transportation model was first presented by FL Hitchcock in 1941. It was further developed by TC Koopmans (1949) and GB Dantzing (1951) towards the formulation and solution of linear programming problem. It is why the transportation model is regarded as a specific type of linear programming problem which analyse the transportation of certain homogeneous goods or services from their different sources of origins to their different destination of requirements.

Kirca and Stir[1] was constitutes an important of transportation problem and developed a heuristic, called part of logistics management. In addition, logistics TOM (Total Opportunity-cost Method), Gass[2] the practical issues for the decision problem of minimizing dead kilometers solving transportation problems. The comments on various aspects of transportation problem is important in urban transport undertakings, methodologies along with discussions on the as dead kilometres mean additional losses.

Many of them define transportation problem procedure in various aspects [3]-[7]. In this paper consisting introduction in section 1 and followed section 2 containing the basic need of existing methods. Section 3 discussed in proposed new

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algorithm and experimental result is confirmed in section 4. Finally conclusions arise in our point of view based on proposed method.

## 2. Basic concept of Existing Methods

According to transportation problem, we are focusing on the original points. These points may represent factories to produce items, and to supply a required quantity of the products to a certain number of destinations. This process must be done successfully in such a way as to maximize the profit or minimize the cost transportation. Therefore, the places of production and supply are collected as the original points and the destinations respectively.

Sometimes the original and destinations points are also termed as sources and sinks. However, to illustrate a typical transportation model, suppose that  $m$  factories supply certain items to  $n$  warehouses. As well as, let factory  $i$  ( $i = 1, 2, \dots, m$ ) produces  $a_i$  units, and the warehouse  $j$  ( $j = 1, 2, \dots, n$ ) requires  $b_j$  units. Furthermore, suppose the cost of transportation from factory  $i$  to warehouse  $j$  is  $c_{ij}$ . The decision variables  $x_{ij}$  is being the transported amount from the factory  $i$  to the warehouse  $j$ . Typically, our objective is to find the transportation pattern that will minimize the total of the transportation cost.

Origins(factories)	Destinations(Warehouses)	Available		
	1,2,.....,n			
1	$c_{11}$	$c_{12}$	$c_{1n}$	$a_1$
2	$c_{21}$	$c_{22}$	$c_{2n}$	$a_2$
	...	...	...	...
m	$c_{m1}$	$c_{m2}$	$c_{mn}$	$a_m$

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

1. Northwest Corner Method (NWCM),
2. Minimum Cost Method (MCM),
3. Genetic algorithm,
4. Vogel's approximation Method (VAM),
5. Row Minimum Method,
6. Column Minimum Method and etc.,

## 3. Hybrid proposed DFSD method

In this study, we proposed a new solving method for transportation problems by using DFSD. The proposed method must operate the as following:

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### Method of DFSD:

Find the difference from standard deviation method (DFSD). The difference is standardized based on the normal distribution. Usually Vogel's Approximation Method (VAM) to chosen the maximum number is different type of difference values in cost matrix. All the methods are finding Initial Basic Feasible Solution (IBFS) and Optimal Solution (OS). In our proposed method to modified this step only. Difference is not give actual difference values so we are standardized that difference so it is bring exact differences.

$$\sigma = S.D = \sqrt{\left[ \left( \frac{\sum x^2}{n} \right) - \left( \frac{\sum x}{n} \right)^2 \right]} \quad (1)$$

where, n is the number of values and x is the corresponding row/column values.

### Algorithm: DFSD

**Step1:** The result of DFSD method (from equation 1) the smallest unit cost element in the row/column (cell) from the immediate next smallest unit cost element in the same row/column is determining a penalty measure for the target row/column.

i). This step includes the following sub-steps:

- a. Identify the row or the column that includes the largest penalty.
- b. Break ties arbitrarily.
- c. As much as possible, the lowest cost row/column (cell) in the row or column should be allocated with the highest difference.
- d. Adjust the supply and demand, and then cross out the satisfied row or column.
- e. If a row and column are satisfied simultaneously, then only one of them is crossed out, as well the remains rows or columns are assigned to supply as zero (demand).

ii). finally, the result should be computed as follows:

- a. If a row or a column is assigned as zero supply, or demand remains uncrossed out, then stop the process.
- b. If one row/column with positive supply (demand) remains uncrossed out, then determine the basic variables in the row/column by the lowest cost method, and then stop.
- c. If all the uncrossed out rows and columns have (remaining) zero supply and demand then determine the zero basic variables by the lowest cost method and stop.
- d. Otherwise, go to step (1).

#### 4. Experimental Study

Problem 1: In this problem is balanced one. We applying the most familiar methods of NWCM, LCM and VAM compared to our proposed DFSD method. Finding the Optimal solution for the given T.P.

Origin/Destination	$D_1$	$D_2$	$D_3$	$D_4$	Supply
$O_1$	4	7	8	3	10
$O_2$	2	1	10	12	15
$O_3$	7	8	3	4	10
<b>Demand</b>	7	10	6	12	35

(i) NWCR

Origin/Destination	$D_1$	$D_2$	$D_3$	$D_4$	Supply
$O_1$	4	7	8	3	10
$O_2$	2	1	10	12	15
$O_3$	7	8	3	4	10
<b>Demand</b>	7	10	6	12	35

Diagram illustrating the initial basic feasible solution (NWCR) for the transportation problem. The table shows the supply and demand values for each origin and destination. The solution is represented by the following allocations:

- From  $O_1$  to  $D_1$ : 7 units (indicated by (7) and an arrow to (3) in  $D_2$ )
- From  $O_1$  to  $D_2$ : 3 units (indicated by (3) in  $D_2$ )
- From  $O_2$  to  $D_2$ : 1 unit (indicated by (1) in  $D_2$ )
- From  $O_2$  to  $D_3$ : 7 units (indicated by (7) and an arrow to (8) in  $D_3$ )
- From  $O_2$  to  $D_4$ : 2 units (indicated by (2) in  $D_4$ )
- From  $O_3$  to  $D_4$ : 10 units (indicated by (10) in  $D_4$ )

The Initial basic feasible solution is,

$$(7 \times 4) + (7 \times 3) + (7 \times 1) + (6 \times 10) + (12 \times 2) + (10 \times 4) = Rs.180/-$$

After applying modified Distribution method the problem gives the optimal transportation cost is Rs.86/-.

(ii). LCM

Origin/Destination	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	D <sub>4</sub>	Supply
O <sub>1</sub>	4	7	8	3 (10)	10
O <sub>2</sub>	2 (5)	1 (10)	10	12	15
O <sub>3</sub>	7 (2)	8	3 (6)	4 (2)	10
<b>Demand</b>	7	10	6	12	35

The Initial basic feasible solution is,

$$(3 \times 10) + (2 \times 5) + (1 \times 10) + (7 \times 2) + (3 \times 6) + (4 \times 2) = \text{Rs. } 90/-$$

After applying modified Distribution method the problem gives the optimal transportation cost is Rs.86/-

(iii) VAM

Origin/Destination	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	D <sub>4</sub>	Supply
O <sub>1</sub>	4	7	8	3 (10)	10
O <sub>2</sub>	2 (5)	1 (10)	10	12	15
O <sub>3</sub>	7 (2)	8	3 (6)	4 (2)	10
<b>Demand</b>	7	10	6	12	35

The Initial basic feasible solution is,

$$(3 \times 10) + (2 \times 5) + (1 \times 10) + (7 \times 2) + (3 \times 6) + (4 \times 2) = \text{Rs. } 90/-$$

After applying modified Distribution method the problem gives the optimal transportation cost is Rs.86/-

(iv) **DFSD**

**Step: 1**

Origin/Destination	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	D <sub>4</sub>	Supply	SD <sub>1</sub>
O <sub>1</sub>	4	7	8	3	10	2.06
O <sub>2</sub>	2	1 10	10	12	15	4.8 ←
O <sub>3</sub>	7	8	3	4	10	2.06
<b>Demand</b>	7	10	6	12	35	
<b>SD<sub>1</sub></b>	2.05	3.85	3.09	1.46		

**Step: 2**

Origin/Destination	D <sub>1</sub>	D <sub>3</sub>	D <sub>4</sub>	Supply	SD <sub>2</sub>
O <sub>1</sub>	4	8	3	10	2.16
O <sub>2</sub>	2 5	10	12	5	4.3 ←
O <sub>3</sub>	7	3	4	10	2.6
<b>Demand</b>	7	6	12	35	
<b>SD<sub>2</sub></b>	2.05	3.09	1.46		

**Step: 3**

Origin/Destination	D <sub>1</sub>	D <sub>3</sub>	D <sub>4</sub>	Supply	SD <sub>3</sub>
O <sub>1</sub>	4	8	3	10	2.16
O <sub>3</sub>	7	3 6	4	10	2.6 ←
<b>Demand</b>	7	6	12	35	
<b>SD<sub>3</sub></b>	1.5	2.5	0.5		

It follow the same procedure to get the final cost matrix is

Origin/Destination	D <sub>1</sub>	D <sub>2</sub>	D <sub>3</sub>	D <sub>4</sub>	Supply
O <sub>1</sub>	4 (2)	7	8	3 (8)	10
O <sub>2</sub>	2 (5)	1 (10)	10	12	15
O <sub>3</sub>	7	8	3 (6)	4 (2)	10
<b>Demand</b>	7	10	6	12	35

The Initial basic feasible solution is,

$$(3 \times 8) + (2 \times 5) + (1 \times 10) + (4 \times 2) + (3 \times 6) + (4 \times 2) = \text{Rs. } 86/-$$

After applying modified Distribution method the problem gives the optimal transportation cost is Rs.86/-

*Table 2: IBFS and OS is obtained in different types of problems*

Methods Type of Problems	NWCR		LCM		VAM		DFSD	
	IBFS	OS	IBFS	OS	IBFS	OS	IBFS	OS
<b>Balanced</b>	180	86	90	86	90	86	86	86
<b>No. of iteration</b>	-	3	-	2	-	1	-	0
<b>Unbalanced</b>	246	184	190	184	186	184	184	184
<b>No. of iteration</b>	-	3	-	2	-	2	-	0
<b>Non-Degeneracy</b>	1256	980	1080	980	1010	980	980	980
<b>No. of iteration</b>	-	3	-	3	-	1	-	0
<b>Degeneracy</b>	456	210	421	210	245	210	210	210
<b>No. of iteration</b>	-	2	-	2	-	1	-	0

The above table indicate that the different types of problems solved and noted IBFS and OS. Compare to other existing method our proposed method directly give the OS. So, no need to go IBFS and our proposed method gave minimum number of iteration to get the OS.

## 5. Conclusion

In this paper we are proposed new hybrid T.P by using DFSD method. The above table indicate that the different types of problems solved and noted IBFS and OS. The example 1 is the gives the model problem and how to solve the DFSD method. Compare to other existing method our proposed method directly gave the OS. So, no need to go apply optimal solution (like MODI method) and our proposed method gave minimum number of iteration. Our proposed method is quite easy and minimizing valuable time. It is only applying the existing methods the complicated problem to give minimum number of iteration to get OS compared to other methods.

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