A Novel Approach to Obtain Optimal Solution of Transportation Problem

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***Abstract*— The transportation problem is one of those most important areas of operations research frequently used as a decision-making tool in engineering business management and many different fields. In this paper develop a new approach to discover the optimum solution to a transportation problem and minimize the cost also applied to find an initial basic feasible solution and also an optimal rather near-optimal solution to the transport problem. The Salient features of this method depict less time to calculate, which compared to the existing methods, gives an optimal solution nearly comparable to MODI's method and easy to apply. From the simplicity point of view, we Depiction with examples that provide an easy understanding of this method.**

***Keywords*— Transportation problems, Initial Basic feasible solution, Optimal solution**

I. Introduction

The transportation problem is still one the earliest and most important applications of the linear programming problem and also applied in real life can also be applied for different sources of supply to different destinations of demand in such ways as to minimize that total cost and its main role of transportation problem. It is assumed that a balanced condition (i.e. total demand equals total supply). The main object of this problem is to classify an optimal for shipping of the products to satisfy the requirements of each destination.

Transportation is a logistical challenge for companies, especially for manufacturing and transport companies. This approach is a useful tool in the decision-making phase that deals with the delivery (supply) of goods from several locations, so while factories resorted to as sources, to several points of production(demand), such as warehouses, often resorted to as destinations. The cost of shipping has a huge effect on the quality and demand for raw materials and products, as the manufacturer tries to monitor the quality of transport. The way where the optimal minimum transport costs can be obtained is the subject of transportation problems in linear programming.

It was originally researched by F.L. In 1941, Hitchcock [7] was followed separately by T.C. In 1947, Koopmans was eventually brought into linear programming and solved by G.B. using the simplex approach. In 1947, Koopmans was finally put in linear programming and solved by G.B through the simplex method. 1951 Dantzing [5]. The simplex method is not suitable for transportation problems especially for large scale transportation problems due to its special model structure in 1954 Charnes and Cooper was developed the Stepping Stone method [3]. Currently, the transportation problem has become a standard requirement for industrial organizations with several manufacturing plants, factories, and delivery centers.

During the last few years, Abdual Quddoos et.al [2] and sudhaker et.al [11] had already proposed two different methods for finding an optimal solution in 2012. This seems to be Reena G. Patel et. Al ([8], [10]) and The approach developed by A. Amaravathy et.al [1] is very helpful because it has less computations and also needs a short period to get the optimal solution. In addition to the covenantal methods, many researchers have provided some better methods of transportation problems.

The initial feasible basic solution (IBFS) was obtained within the first stage by using one among the available methods like "North West Corner," "Matrix Minima," "Least Cost Method," "Row Minima," "Column Minima" and "Vogel's Approximation method" etc. to get an optimum solution for transportation problems, necessary to solve the problem in two stages. then, MODI (Modified Distribution) approach was implemented in the next and final stage to get an optimal solution. Most manufacturers have been using the optimization technique in Linear Programming Problem most commonly since the last few years to solve real-world problems.

This paper introduces a new, simple approach to finding an optimal solution to the transportation problem. The proposed algorithm gives the idea of a step-by-step process flow. Furthermore, numerical examples for a better understanding of the Algorithm are given here.

II. Algorithm for Proposed Method

Step 1: - Examine whether the transport problem is or is not balanced. If it is balanced, then go to the next step.
Step 2: - Select the smallest cost from each row entries and subtract it from each row entries. (When there's no zero in the column then go to step -3)
Step 3: - Select the smallest cost from each column entries and subtract it from each column entries.
Step 4: - The largest cost value in the row is called the row penalty as well as taking the largest cost value in the column is called column penalty and write it in the side and bottom respectively.
Step 5: - From that select the maximum value and choose the cell which has a minimum cost coefficient, Allocate minimum value of demand/supply in the cell.

I. If the penalty tie takes the average of that row/column entries and selects a maximum average, then allocate the minimum cost coefficient with a minimum value of demand/supply in the cell.

II. whenever the average of the penalty gets the same then choose a maximum of demand/supply and allocate the minimum cost coefficient.

Step 6: - Step 6:-Delete the row/column for further allocation after completion of phase-5, where supply from a given source is exhausted or demand for a given destination is satisfied.
Step 7: - Repeating step 4 to step 5 until the satisfaction of all the supply and demand is met.
Step 8: - Now the total minimum cost is calculated as the sum of the product of cost and corresponding allocate the value of supply/demand.

III.Numerical Example

Example 3.1. Obtain the following cost-minimizing transportation problem.

Table I

	D_1	D_2	D_3	**Supply**
S_1	6	4	1	50
S_2	3	8	7	40
S_3	4	4	2	60
Demand	20	95	35	150 (Total)

The allocations are obtained as follows, by applying the proposed method.

Step 1: - Since Σai = Σbj = 150

Step 2: - select the smallest cost from each row entries and subtract it from each row entries. (when there's no zero in the column then go to step -3)

	D_1	D_2	D_3	Supply
S_1	5	3	0	50
S_2	0	5	4	40
S_3	2	2	0	60
Demand	20	95	35	150 (Total)

Step 3: - select the smallest cost from each column entries and subtract it from each column entries

	D_1	D_2	D_3	Supply
S_1	5	1	0	50
S_2	0	3	4	40
S_3	2	0	0	60
Demand	20	95	35	150 (Total)

Step 4: - largest cost value in row penalty as well as in column penalty then apply step-5

	D_1	D_2	D_3	Supply	Row Penalty			
S_1	5	[15] 1	[35] 0	50	5=2	1	1=0.5	1=0.5
S_2	[20] 0	[20] 3	4	40	4	4=3.5	---	---
S_3	2	[60] 0	0	60	2	0	0	---
Demand	20	95	35	150 (Total)				
Column penalty	5=2.33 --- --- ---	3 3 1=0.5 1	4 4=1.33 0 0					

Therefore, the allocation of the original TT is given,

	D_1	D_2	D_3	Supply
S_1	6	[15] 4	[35] 1	50
S_2	[20] 3	[20] 8	7	40
S_3	4	[60] 4	2	60
Demand	20	95	35	150 (Total)

The transportation cost is: Z = 4*15 + 1*35 + 3*20 + 8*20 + 4*60 = 555/-

From these allocations, the total cost is 555.

Example 3.2. Obtain the following cost-minimizing transportation problem.

Table: -II

	D_1	D_2	D_3	D_4	**Supply**
S_1	19	30	50	10	7
S_2	70	30	40	60	9
S_3	40	8	70	20	18
Demand	5	8	7	14	34(Total)

The allocations are obtained as follows, by applying the proposed method

	D_1	D_2	D_3	D_4	Supply
S_1	[5] 19	30	50	[2] 10	7
S_2	70	[2] 30	[7] 40	60	9
S_3	40	[6] 8	70	[12] 20	18
Demand	5	8	7	14	34(Total)

From these allocations, the total cost is 743.

Example 3.3. Obtain the following cost-minimizing transportation problem.

Table: -III

	D_1	D_2	D_3	**Supply**
S_1	16	20	12	200
S_2	14	8	18	160
S_3	26	24	16	90
Demand	180	120	150	450 (Total)

The allocations are obtained as follows, by applying the proposed method

	D_1	D_2	D_3	Supply
S_1	[140] 16	20	[60] 12	200
S_2	[40] 14	[120] 8	18	160
S_3	26	24	[90] 16	90
Demand	180	120	150	450 (Total)

From these allocations, the total cost is 5920.

Example 3.4. Obtain the following cost-minimizing transportation problem.

Table: -IV

	D_1	D_2	D_3	D_4	D_5	**Supply**
S_1	1	9	13	36	5	50
S_2	24	12	16	20	1	100
S_3	14	35	1	23	26	150
Demand	100	70	50	40	40	300 (Total)

The allocations are obtained as follows, by applying the proposed method

	D_1	D_2	D_3	D_4	D_5	Supply
S_1	[40] 1	[10] 9	13	36	5	50
S_2	24	[60] 12	16	20	[40] 1	100
S_3	[60] 14	35	[50] 1	[40] 23	26	150
Demand	100	70	50	40	40	300 (Total)

From these allocations, the total cost is 2700.

Example 3.5. Obtain the following cost-minimizing transportation problem.

Table: -V

	D_1	D_2	D_3	D_4	**Supply**
S_1	13	18	30	8	8
S_2	55	20	25	40	10
S_3	30	6	50	10	11
Demand	4	7	6	12	29(Total)

The allocations are obtained as follows, by applying the proposed method

	D_1	D_2	D_3	D_4	Supply
S_1	[4] 13	18	30	[4] 8	8
S_2	55	[4] 20	[6] 25	40	10
S_3	30	[3] 6	50	[8] 10	11
Demand	4	7	6	12	29(Total)

From these allocations, the total cost is 412.

Example 3.6. Obtain the following cost-minimizing transportation problem.

Table: -VI

	D_1	D_2	D_3	**Supply**
S_1	6	8	10	150
S_2	7	11	11	175
S_3	4	5	12	275
Demand	200	100	300	600(Total)

The allocations are obtained as follows, by applying the proposed method

	D_1	D_2	D_3	Supply
S_1	[25] 6	8	[125] 10	150
S_2	7	11	[175] 11	175
S_3	[175] 4	[100] 5	12	275
Demand	200	100	300	600(Total)

From these allocations, the total cost is 4525.

IV. COMPARISON OF TOTAL COST OF TRANSPORTATION PROBLEM FROM VARIOUS METHODS

Example No.	*Problem Dimension*	*Proposed method*	*NWCM*	*LCM*	*VAM*	*MODI*
3.1	3×3	555	730	555	555	555
3.2	3×4	743	1015	814	779	743
3.3	3×3	5920	6600	6460	5920	5920
3.4	3×5	2700	4560	2830	2830	2700
3.5	3×4	412	484	516	476	412
3.6	3×3	4525	5925	4550	5125	4525

V. CONCLUSIONS

In this paper, the proposed method considered the ‘maximum value done after each row & column subtraction to be a different concept and easy to implement. The solution obtained by the proposed method is optimal for less iterations, and are the same as the MODI method or the Vogel’s approximation method. The developed method is appropriate for both large and small transportation problems as seen in the last table.

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