(Tc) Technique for Finding Optimal Solution To Transportation Problem

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Abstract:

Given the importance of increasing economic openness transport companies' face various issues arising at present time, this required importing different types of goods with different means of transport. Therefore, these companies pay great attention to reducing total costs of transporting commodities by using numbers means of transport methods from their sources to the destinations.

The majority of private companies do not acquire the knowledge of using operations research methods, especially transport models, through which the total costs can be reduced, resulting in the importance and need to solve such a problem. This research presents a proposed method for the sum of Total Costs (Tc) of rows and columns, in order to arrive at the initial solutions accepted by its algorithm and compare the solution with a set of solutions that were reached through classic methods studied previously. Moreover, this research aims to compare results obtained using the proposed method versus the optimal solution after testing using the modified distribution method (MODI), and the percentile deviation scale, these tests were used to measure the efficiency of the solution for the proposed method with the optimal solution.

It was concluded that the proposed method is the easiest with the least iterations number of calculations, which in turn resulted in reaching the optimal solution in transporting the optimal quantities and reducing total costs of transportation from various sources to the requesting destinations. Thus, the proposed method can be used by the companies operating in importation-exportation field to find optimal solutions for the transportation of various commodities.

Key words: Total cost, Optimal Solution, Transportation problem, Degeneracy.

Introduction:

One of the earliest and most significant applications of linear programming problems is the transportation problem, which may be resolved using a simplex methodology known as the transportation method. It has a significant applicability in resolving problems involving multiple product sources and many product destinations; this kind of issue is commonly referred to as the transportation issue.[1]. An important factor of logistics management is the transportation problem. Additionally, logistics problems that do not involve the conveyance of goods might be formulated as problems. These challenges often have two goals: (1) to reduce the cost of transporting m units to n destinations or (2) to increase the profit of shipping m units to n destinations. and The following is a description of a classic transportation problem. A determined amount of a homogenous good is supplied from a number of sources, and a predetermined quantity is needed to satisfy demand at a variety of destinations. It is presumed that there is a balanced state, where total supply and total demand are equal.

The main objective is to determine the amounts shipped from each source to each destination in order to reduce the total costs of shipping commodities from their sources to the destinations requesting them.,According to the quantities offered, this is what is said about the transportation problem (shipping goods from the source to the destinations), and at the present time the transportation problem has become a standard and natural application for industrial organizations that have many manufacturing units, warehouses and distribution centers**.**[2][3]**.**

1. Reviewers Work:

In a presentation from 2013, Ajibade and Babarinde discussed the use of transportation technology to determine the cost of shipping products. While Loch et al. (2014) provided a preliminary, fundamentally useful answer to the transportation problem through the computational analysis of decomposition. Also demonstrated Loch and Silva (2014) also provided a computational study on the quantity of transportation problem iterations. and exhibited While this was going on, Kumaraguru et al. (2014) provided a comparison study of alternative strategies for resolving a transportation problem. When it comes to resolving transportation issues, (Afroz and Hassan) discovered in 2015 that the simplex method Time consuming manual calculation, . Additionally, Sarbjit Singh (2015) offered a specific approach that has been suggested to solve the problem of degeneracy. In 2016, Eghbal Hosseini presented an algorithm with three cases, and a code was prepared for it using the MATLAB program. It was considered better than the algorithms mentioned in previous references, by testing solutions to transport problems with large samples. This algorithm was considered effective for solving transport problems with large variables, and this According to the computational results obtained.

In 2019, researchers J. Ravi, S. Dickson, R. Akila and K. Sathya presented the application of the new approach proposed in this paper, which is the DFSD method (Differential Shape Standard Deviation) Through the proposed algorithm, the optimal solution to a problem can be obtained in a scientific and ideal way, without or with a state of decay. The optimal solution is directly found with the least number of iterations compared to the other existing method..[4],[5],[6]

1. Standard Mathematical Model:-

Objective function :

Minimum z $\sum\sum C_{ij} x_{ij}$

S. To :

$$\sum x_{ij} = ai, I = 1,2,\dots,m$$

$$\sum x_{ij} = bj, J = 1,2,\dots,n$$

$$Xij \geq 0, I = 1,2,\dots,m; J = 1,2,\dots,n$$

Where, C_{ij} = Cost of transportation per source I and destination J.

X_{ij} = Units transferred from the source to the destination

a_i = Supply from sources.

b_j = Demand from destination..

2. Methods

2.1 Different Methods To Finding Initial Basic Feasible Solution And Optimal Solution:

To find the optimal solution to the transportation problems it was required to solve the problem in two stages.

(1) In the first stage, an initial basic feasible solution (IBFS) was obtained by means of available methods such as (northwest corner, least cost method, minimum row, minimum column and Vogel's approximation method).

(2) The following and final MODI (modified distribution) method is adopted to obtain the optimum solution.

Here a much easier heuristic approach (TC method) is proposed to find an ideal straightforward solution with fewer iterations and very easy calculations. The step-by-step procedure of the proposed method is carried out Following is.

2.2 Total Cost Method (Proposed Algorithm):

1- Create A Matrix Form For The Following Problem And Formulate It. Check To See If The Transportation Problem Is Balanced Or Unbalanced. Add Dummy Sources (Rows) Or Destinations (Columns) As Necessary If The Data Is Imbalanced.

2- Get The Basic Initial Possible Solution In A New Method And Select The Lowest Total Cost In The Row And Column Of The Table Transport.

3- Determine the lowest total costs value in the row or column and make a customization in the least expensive cell in the selected row or column.

4- 4. Delete the row or column that has no values for either the source or the destination.

5- Retract the steps to assign the available values with the new small table until all rim requirements have been met.

3. Comparison Test Of Optimization Solution:-

Although one typically uses an approximate algorithm since there isn't precise method for obtaining the optimal solution or it would take too much time, there are occasionally procedures that can yield the optimum for a certain collection of samples (usually small sized instances). It is possible to evaluate the effectiveness of the heuristic method using this set of cases. The percentage departure of the heuristic solution value from the ideal value and the mean of these deviations are typically measured for each sample. If we denote by C_A the value of the solution delivered by heuristic A and by $C_{optimum}$ We can get the optimal value for any example (lop maximization problem) through the percentage deviation (*PD)* is given by the expression

$$PD = \frac{C_{optimum} - C_A}{C_{optimum}} * 100\%$$

(We assume that all feasible solutions have a positive value.)

3. *Numerical problem :*

The Numerical Problem By (P.Kousalyal, P.Malarvizhi) is considered here and the proposed algorithm is applied to the problem. The tableau representation of numerical problem is given in (Tabl.1) 1.find the optimal solution using the new method and compare your values with (northwest corner, lowest cost method, minimum row, minimum column and Vogel's approximation method).

Tabl.1: Cost Transportation Problem

	A	B	C	Supply
1	2	7	4	5
2	3	3	1	8
3	5	4	7	7
4	1	6	2	14
demand	7	9	18	34/34

Sol:

<u>Step 1:</u> Get the basic initial possible solution in a new method and select the lowest total cost in the row and column of the table transport

	A	B	C	Supply	Total cost row (Tcr)
1	2 5	7	4	5 0	13
2	3	3	1	8	7
3	5	4	7	7	16
4	1	6	2	14	9
demand	7 2	9	18	34/34	-
Total cost Colum (Tcc)	7	9	18	-	-

Now, delete the exhausted Row1 which gives a new reduced table as shown below. again repeat the steps.

Step2 :

	A	B	C	Supply	Total cost row (Tcr)
2	3	3	1 8	8 0	7
3	5	4	7	7	16
4	1	6	2	14	9
demand	2	9	18 10	-	-
Total cost Colum (Tcc)	**7**	9	18	-	-

delete the exhausted Row2 which gives a new reduced table as shown below. again repeat the steps.

Step 3:

	A	B	C	Supply	Total cost row (Tcr)
3	5	4	7	7	16
4	1 2	6	2	14 12	9
demand	2 0	9	10	-	-
Total cost Colum (Tcc)	7	9	18	-	-

delete the exhausted Colum A which gives a new reduced table as shown below. again repeat the steps.

Step4.

	B	C	Supply	Total cost row (Tcr)
3	4	7	7	16
4	6	2 10	12 2	9
demand	9	10 0	-	-
Total cost Colum (Tcc)	9	18	-	-

delete the exhausted Colum C which gives a new reduced table as shown below. again repeat the steps.

Step5:

	B	Supply	Total cost row (Tcr)
3	4	7	16
~~4~~	6 2	2 0	~~9~~
demand	9 7	-	-
Total cost Colum (Tcc)	9	-	-

delete the exhausted Row4 which gives a new reduced table as shown below. again repeat the steps.

Step6:

	B	Supply	Total cost row (Tcr)
3	4 7	7 0	16
demand	7 0	-	-
Total cost Colum (Tcc)	9	-	-

Step7: the initial basic feasible solution using proposed method of transportation problem is given as follows:

	A	B	C	Supply
1	2 **5**	7	4	5
2	3	3	1 **8**	8
3	5	4 **7**	7	7
4	1 **2**	6 **2**	2 **10**	14
demand	7	9	18	34/34

Not : M+n-1=6 cell not degeneracy transportation problem.

Transportation cost = (5*2)+(8*1)+(7*4)+(2*1)+(2*6)+(10*2)

= 10+8+28+2+12+20

=80

6. Compare Results

methods	NWCM	LCM	VOGM	ROWMIN	COLUMMIN	TC
Initial Basic feasible solution vector	X11, X21, X22, X32, X33, X43	X11, X13, X23, X32 ,X41 ,X43	X11, X12, X23, X32, X41, X43	X11, X23, X32, X41, X42, X43	X13, X22, X32, X33, X41, X43	X11, X23, X32, X41, X42, X43
Optimal cost	102	83	80	80	111	80
Optimal solution vector	-	-	X11, X12, X23, X32, X41, X43	X11, X12, X23, X32, X41, X43	-	X11, X12, X23, X32, X41, X43
Optimal solution	-	-	76	76	-	76

Tabl.2: The results of the initial basic feasible solution and the optimal solution with the initial and optimal vector that will be transferred from their sources to the requesting destinations.

4. Discussion :

Through the above table, we note that the basic feasible solution of the proposed method (Tc) approached the optimal solution for (VOGM) method and (ROWMIN) method, as the total costs reached (80), and after testing to improve the solution by means of the modified distribution method (MODI), it was found that the proposed method has reached the optimal solution and the total cost has been reduced to (76). The proposed method gave better results in terms of reducing costs than methods (NWCM, LCM, COLUMMIN), and gave quite similar results. Results by allocating the optimal quantities to (ROWMIN) method, and it was found that the proposed method its solution steps are much simpler than all methods and take shorter time to find optimal solutions.

Also, the proposed method was allocated quantities other than the quantities allocated by the (VOGM) method, but the cost is the same in both methods.

7. Conclusion

1- In this paper (Tc method) provides an optimal solution with less iteration for transportation problem. This method provides less time and make easy to understand. So it will be helpful for decision makers who are dealing with this problem.

2- the method is an important tool for solution makers who deal with different types of logistical problems.

3- The proposed method gave better results in terms of reducing costs than methods (NWCM, LCM, COLUMMIN), and gave quite similar results. Results by allocating the optimal quantities to (ROWMIN) method, and it was found that the proposed method its solution steps are much simpler than all methods and take shorter time to find optimal solutions.

8. Recommendation

We recommend the researchers to compare the results of the proposed method with the results of other proposed methods whose results are better than the Vogel method.

We also recommend applying the method to real practical data to reach better solutions in terms of reducing costs for any commodity that can be transferred from its sources to its distribution centers.

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