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An Alternative Method to Reduce Medicine Costs By Minimizing Transportation Overheads

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Abstract: ***In this paper, we will introduce a new method to reduce medicine costs by Minimizing transportation Overheads. We have named this method the "Geometric mean method". This method which we have devised provides a more optimal and efficient solution to the problems when compared to many methods like NWCM, BCM, MM method, Vogel's method, Average total Opportunity Cost and many more. Using this method, we can provide solutions for logistical issues faced in various fields. Here, we will focus mainly in the field of pharmacy and healthcare. Today, we are living in a world where diseases are on the rise. So, by reducing the total expenditure on logistics, it will lead to a net profit to the End customer. Also one of the reasons why this method is beneficial is that it determines the exact average while dealing with ratios and is less affected by sampling fluctuations. So, this method gives more efficient results. The procedure and working of this method is explained in a simple and understandable language. Also the method contains less iteration which implies that the method is not too lengthy. In order to deal with the transportation Overheads, we have approached a new method and several examples showing the difference in costs which has been discussed in the chapter will provide a detailed understanding to the concept. Here we will give a detailed comparison between the various methods in a mathematical and graphical manner. The proposed method proves out to be very useful and gives optimal solutions to the problems in contrast to existing available methods.***

Index Terms: ***Feasible Solution, Optimization, Allocation***

I. INTRODUCTION

Transportation problem is well-known in business management study as it has widespread use in today's lifestyle. It basically deals with complex problems where one is known about the demand of the people and also supply is known and in total minimizing the transportation cost. The fundamental transportation problem was initially emerged by F.L. Hitchcock in 1941. Also many well-organized methods studied were emerged essentially by Dantzig in 1951 and after that by Charnes, Cooper and Henderson in 1953 [3]. The replica is effective for potential strategic commitments involved in choosing ideal transportation way so as to assign manufacturing process of different plants to various storehouses [1].

We are known with many techniques of solving final transportation problem which includes NWCM, LCM, BCM, MM method, Modified distribution Method, SS Method, HMM an many more and from the limitation we get to know from these techniques leads us to introduce a new fresh method which is **Geometric Mean Method**. In comparison with these methods Geometric Mean Method proves out to be best method for solving many transport related problems. Many problems are solved by transportation model related to site commitments. This model assists us in siting recent equipment, constructing factories when more than one locality is to be inspected. After this our final work is to lessen our final transportation value or shipping value with the assistance of model approached [4].

The superiority we get from geometric mean method is that it requires less time to know the final costs of transportation which helps the producer in further things. Two facts are involved in development problems relating to production of medicines: one is designing the manufacturing process of the medicines required and also know what is the end demand of the particular medicines so as to gain net profit. Other one is deciding the medicines required previously so as to gain utmost profit, subject to known the end demand of the medicines. When we have to transport medicines from one place to another place then two types of problem arises regarding to time: (i) first one is the reduction of total transportation time when one have to transport goods to shorter distance and (ii) second one is the reduction of total transportation time when one have to transport goods on longest route. Everyone know that the more the time taken to transport goods, the more is the chance of destruction. So, every producer want to have more net gain with less transport time and less chances of destruction.

The fresh method introduced helps us a lot in Multi-Objective transportation problem as it requires less time to know final costs and it is simple too to be understand by the producers as well. Also transportation problem includes many constraints to be taken into notice when one has to transfer goods.

Hence, transportation problem is unique category of linear programming problem where final goal is to lessen the value of dispensing goods from starting point to terminus point [5]. Our aim is to get initial basic feasible solution and also obtain most favorable basic solution.

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II. FORMULATION OF PROBLEM AND MATHEMATICAL MODELLING

Assume that there are 'm' numbers of medical equipment manufacturers taken as originations and 'n' be the number of stations where the medical

equipment's has to be delivered that is taken as targets. The main motive of obtaining the solution to the transportation problem is to reduce the aggregate cost or charges of transporting equipment's from originations to targets. The mathematical equation for single objective TP can be given as:

Minimize $z = \sum_{i=1}^{k} \sum_{j=1}^{l} \; c_{ij} x_{ij}$

and the mathematical equation for multi objective TP can be given as:

Minimize $z = \sum_{i=1}^{k} \sum_{j=1}^{l} \; c_{ij}^{s} \, x_{ij}$

Subject to $\sum_{j=1}^{l} \; x_{ij} = a_i$; i = 1,2,3…..,k (Supply)

Subject to $\sum_{i=1}^{k} \; x_{ij} = b_j$; j = 1,2,3…..,l (Demand)

Where,

x_{ij} is the amount of goods from p sources to q destinations,

c_{ij} is the charge of delivering a single quantity of good from p sources to q destinations,

c_{ij}^{s} represents 's' number of objectives,

a_i is the supply available at each sources,

b_j is the requirement available at target,

k is the overall sources, and

l is the overall destinations

(A) Algorithm

The algorithm of the proposed method to transportation problems is given below:

Step 1: The transportation table is to be constructed using given transportation problem.

Step 2: Examine whether the given problem is balanced or not. If the problem is unbalanced, make it balanced by inserting dummy row/column accordingly.

Step 3: Find the Geometric Mean for all the respective rows and columns. Determine the maximum value of mean from all the obtained geometric means.

Step 4: Allocate the minimum supply/demand to the cell having least value in the row /column of the maximum obtained mean.

Step 5: The above step is repeated until all the demand and supply constraints are satisfied.

Step 6: Obtain the total transportation cost by adding the product of allocation to their respective cell values.

III. NUMERICAL EXAMPLES

Example -1: Suppose there are three suppliers for hospital beds, namely A, B and C. And the beds have to be transported to the three hospitals 1, 2 and 3. The supply and demand for the same at various sources and destinations are shown below using the transportation table. Solve the transportation problem in such a way that the overall cost of transporting bed is minimized.

Geometric Mean Method

	A	B	C	Supply	M1	M2	M3
1	25 6	25 8	100 10	150	7.82	6.92	6.92
2	175 7	11	11	175	9.46	8.77	-
3	4	275 5	12	275	6.21	4.47	4.47
Demand	200	300	100				

M1	5.51	7.60	10.96
M2	5.51	7.60	-
M3	4.89	6.32	-

Total Cost = **3950**

Step 1 : Identify the penalty costs for each row and column by multiplying all the elements and taking their root by the following formula $\sqrt[n]{a1 * a2 * \ldots an}$.

Step 2 : Identify the maximum penalty cost from the row or column and allocate the lowest value from the particular row or column with the lowest unit cost and cross it out if the hole demand or supply is done in particular row or column.

Step 3 :

- If exactly one row or column is left with its demand or supply equal to zero then we have to stop.
- If there is one row or column left with positive demand or supply then will allocate the minimum element with lowest unit costs after that stop.

In any other case, move again to step 1.

Example 2: Consider that there are three manufacturers of medical equipment namely A, B and C that are to be transported to the three clinics 1, 2 and 3. The supply and demand for the same from various manufacturers to the clinics are shown below using the transportation table. Solve the transportation problem to minimize the total transportation cost of transporting equipment's.

Geometric Mean Method:

	A	B	C	Supply	M1	M2	M3
1	4	5	40 1	40	2.71	2	2
2	40 3	4	20 3	60	3.30	3	3
3	30 6	40 2	8	70	4.57	6.92	-
Demand	70	40	60				

M1	4.16	3.41	2.88
M2	4.16	-	2.88
M3	3.46	-	1.73

Total Costs = **Rs. 480**

Step 1 : Identify the penalty costs for each row and column by multiplying all the elements and taking their root by the following formula $\sqrt[n]{a1 * a2 * \ldots an}$.

Step 2 : Identify the maximum penalty cost from the row or column and allocate the lowest value from the particular row or column with the lowest unit cost and cross it out if the hole demand or supply is done in particular row or column.

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Step 3 :

- If exactly one row or column is left with its demand or supply equal to zero then we have to stop.
- If there is one row or column left with positive demand or supply then will allocate the minimum element with lowest unit costs after that stop.

In any other case, move again to step 1.

Example 3: A pharmaceutical company produces four types of medicines, say A, B, C and D whose demand and supply at various medical institutions 1, 2 and 3 are given below in the form of transportation matrix. Obtain the solution for given transportation problem to minimize the transportation cost.

Geometric Mean Method

	A	B	C	D	Supply	M1	M2	M3	M4
1	3	250 1	7	4	250	3.02	3.03	3.03	2
2	200 2	6	150 5	9	350	4.82	6.46	-	-
3	8	50 3	200 3	150 2	400	3.46	2.62	2.62	2.4
Demand	200	300	350	150					
M1	3.63	2.62	4.71	4.16					
M2	-	2.62	4.71	4.16					
M3	-	1.73	4.58	2.82					
M4	-	1.73	-	2.82					

Total Costs =**Rs. 2450**

Example 4: A hospital has to send a number of workers of different posts say A, B, C, D and E to the three of its branches namely, 1, 2 and 3. The supply and requirements of the number of workers is shown here. Determine the solution of given transportation problem to minimize the overall cost of transporting workers from sources to destinations.

Geometric Mean Method

	A	B	C	D	E	supply	M_1	M_2	M_3	M_4	M_5
1	5 5	4 3	4	3	7	9	4.16	4.21	4.21	3.97	3
2	6	2 5	6	9 3	1 4	12	4.64	4.35	4.35	3.91	3.87
3	7	6	8 2	8	8 4	16	4.85	6.05	-	-	-
Demand	5	6	8	9	9						
M_1	5.94	4.48	3.63	4.16	4.82						
M_2	5.94	4.48	-	4.16	4.82						
M_3	5.47	3.87	-	3	5.29						
M_4	-	3.87	-	3	5.29						
M_5	-	3.87	-	3	-						

Total cost = 5x5+4x3+2x5+8x2+9x3+1x4+8x4
=25+12+10+16+27+4+32 = **Rs 126**

Example 5: Four Ambulance manufacturer companies A, B, C and D have to manufacture ambulances to the three hospitals 1, 2 and 3. The total supply and demand for the ambulances are represented as a transportation matrix. Solve the given transportation problem to find the minimum for transporting ambulances to the hospitals.

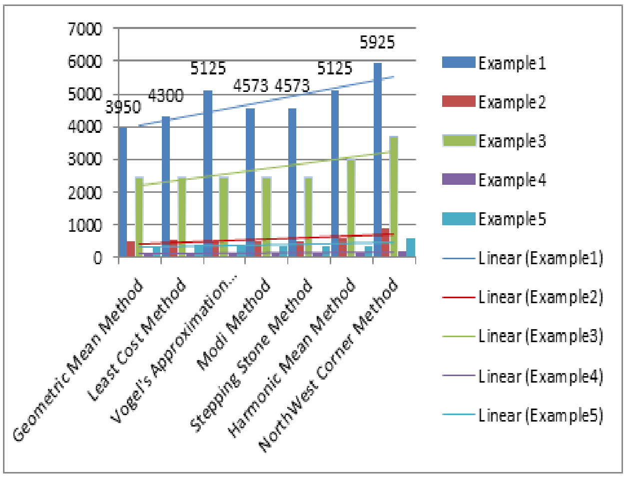
Geometric Mean Method

	A	B	C	D	supply	M_1	M_2	M_3	M_4
1	5	3	19 6	2	19	5.64	-	-	-
2	12 4	7	9	25 1	37	3.98	3.98	3.03	2
3	4 3	18 4	12 7	5	34	4.52	4.52	3.91	3.87
Demand	16	18	31	25					
M_1	3.91	4.37	7.23	2.15					
M_2	3.46	5.29	7.93	2.23					
M_3	3.46	5.29	-	2.23					
M_4	3.46	-	-	2.23					

Total cost = 12x4+4x3+18x4+7x12+19x6+1x25 = **Rs 355**

IV. ANALYSIS

Methods	Example1	Example2	Example3	Example4	Example5
Geometric Mean Method	3950	480	2450	126	355
Least Cost Method	4300	520	2450	147	367
Vogel's Approximation Method	5125	480	2450	124	355
Modi Method	4573	480	2450	124	355
Stepping Stone Method	4573	480	2450	124	355
Harmonic Mean Method	5125	570	3000	150	355
NorthWest Corner Method	5925	870	3700	196	580



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V. CONCLUSION

In most of the transportation module, basic thing to be considered is the road irregularity index of various ways one has to go through. Earlier many methods were proposed but there was a need of some advancement in those techniques so we have thought of constructing a new model called 'Geometric Mean Method' which includes less iterations and gives simple, straightforward and understandable solutions. There was a requirement of a fresh unreel structure for up gradation of thoughts into transportation organization. So, these techniques were introduced to improve the strategically planned structure. The method proposed permits us to conserve our time and struggle that guide us to have best solutions.

REFERENCES

1. Optimization techniques for transportation problems of three variables, Mrs. Rekha Vivek Joshi, Sydenham college of commerce and economics, IOSR Journal of mathematics, December 2013.
2. Solving transportation problem using the best candidate method, Computer science and engineering: an International Journal, October, 2012.
3. A new approach to solve transportation problems, Open Journal of optimization, 2016.
4. Multi-objective transportation problem with cost reliability under uncertain environment, International Journal of computational Intelligence systems, vol.9 No.5, 2016.
5. A new approach for solving transportation problem, Journal for research, volume 03, ISSN:2395-7549, 2017.
6. The optimization of transportation costs in logistics enterprises with time-window constraints, Hindawi Publishing
7. Corporation, Discrete dynamics in nature and society, volume 2015.
8. Alternate solutions Analysis for transportation problems, Journal of business and economics research- November, 2009.
9. The use of the transportation problem in coordinating the selection of samples for business surveys, Philip T. Reiss, Lenka Mach, SSC Annual Meeting, Proceedings of the survey methods section, June 2003.
10. A new method for the Optimum solution of a transportation problem, Sushma Duraphe, Geeta Modi and Sarla Raigar, International Journal of Mathematics and its application, Volume 5, ISSN: 2347-1557.
11. Advanced Vogel's Approximation Method: A new approach to determine penalty cost for better feasible solution of transportation problem, Uptpal Kanti Das, Md. Ashraful Babu, Aminur Rahman Khan, Dr.Md. Sharif Uddin, International Journal of engineering research and technology, ISSN: 2278-0181, Vol. 3, January 2014.
12. Solving time minimizing transportation problem by zero point method, Gaurav Sharma, S.H. Abbas, Vijay Kumar Gupta, Research inventy: International Journal of engineering and science, vol.5, July 2015.
13. An algorithmic approach to solve transportation problems with the average total opportunity cost method, S.M. Abul Khan Azad, Md. Bellel Hossian, Md. Mizanur Rahman, International Journal of scientific and research publications, volume 7, February, 2017.
14. An innovative method for unravelling transportation problems with mixed constraints, Rabindra Nath Mondal, Farhana Rashid, Poly Rani Shaha, Raju Roy, American Journal of mathematics and Statistics 2015.
15. A new method for optimal solutions of transportation problems in LPP, Muhammad Hanif, Farzana Sultana Rafi, Journal of mathematics research, vol.10, October, 2018.
16. A new method to solve transportation problem- Harmonic Mean Approach, Palanivel and Suganya, Engineering Technology open access journal, August, 2018.