A New Algebraic Method for IBFS of a Transportation Problem and Comparison with NWC Method

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Abstract: ***In this paper, we have develop the new algebraic method for the initial basic feasible solution of the balanced transportation problem by algebraic approach for finding out the initial basic feasible solution and compare it with North – West Corner Method and have shown that the new algebraic method is best as compare to NWC method.***

Keywords: Transportation Problem, Field, Prime Number

AMS Subject Classification (2010): 90B06, 05C25, 11A41

1. Introduction

Though the theory of transportation problems generally evolved during the world war – II but one can think of its roots right from the 400 B. C. or from 3500 B. C. when wheel was invented in the middle east of Asia.

The transportation problem generally considered as a problems of multi – objective (like minimum cost and shortest path) combinatorial approach. During the last decade [1, 2] various authors have delivered the method which are alternative towards the standard transportation problems [4] mainly North– West Corner Method (NWCM), Least Cost Method (LCM) and Vogel's Approximation Method having important application in the area of physical distribution i. e. transportation of goods and services from several supply centers to several demand centers.

We know that Z_n is a commutative[3] ring which becomes a field if and only if n is a prime number. A prime of the form $n = 4K + 1$ can be written as sum of two perfect squares. It is interesting to convert the transportation problem over the field Z_p where $'p'$ is of the form $4K + 1$.

The paper mainly consist of three parts. In first part algorithm for proposed method were given. In the second part,alternative method alongwith numerical example were explained. In the third part, we have compared the result with NWCM along with conclusion.

2. Algorithm of Proposed Method

The alternative method can be summarized into following steps applied for balanced transportation problem.
Step I] Check the given transportation problem were balanced or not. If balanced, then go to next step.
Step II]

Case A: Find out the minimum odd prime number of the form $p = 4K + 1, k > 0$ among the prime entries excluding demand row and supply column.

Case B: If there is no odd primenumber of the form $p = 4K + 1$ among the entries then take the previous immediate prime number of the form $p = 4K + 1$from the smallest value from the entries excluding demand row and supply column.

Case C: If the least number is less than $p = 4K + 1$ for $K = 1$, then take $p = 5$ and apply the process.
Step III]**:** Write the penalties over the rows and columns by taking addition (modulo p).

Step IV] Select the row or column with the smallest penalty and allocate as much as possible in the cell that has least cost in the selected rows or column and satisfies the given condition. If there is tie in the values of penalties, one can take any one of them where the minimum allocation can be made.

Step V] any row or column with zero supply or demand should not be used in computing future penalties.

Step VI] Repeat steps from III] to V] until the available supply at various sources and demand at various destinations is satisfied.

3. Numerical Example

A) Consider the following example to find out the minimum transportation cost

	Distribution Centers				
	D_1	D_2	D_3	D_4	Supply
S_1	2	3	11	7	**6**
S_2	1	0	6	1	**1**
S_3	5	8	15	9	**10**
Demand	**7**	**5**	**3**	**2**	

Solution:
In the above example as the demand and supply are same the said transportation problem isbalanced problem.The cell $(S_3, D_1) = 5$ which is an odd prime of the form $p = 4K + 1$. Thus, we take the addition of the entries of rows and columns over $\boldsymbol{Z_5}$ and apply the above algorithm.

We get,

	Distribution Centers					Penalty	Penalty
	D_1	D_2	D_3	D_4	Supply		
S_1	2	3[4]	11	7[2]	6	3	1
S_2	1	0[1]	6	1	1	3	---
S_3	5[7]	8[0]	15[3]	9	10	2	3
Demand	7	5	3	2			
	3	1	2	2			
	2	1	1	1			
	2	1	1	---			
	0	3	0	---			

Total Cost: 5*7 + 3*4 + 0*1 + 8*0 + 15*3 + 7*2 = 106 /-
The same problem has [4] solution 116 /- by using North – West Corner Method.

B) Now we consider the situation where cells does not have odd prime

	Distribution Centers				
	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	

Solution:
In the above example as the demand and supply are same the said transportation problem is balanced problem and does not have any odd prime in the cell.

Now, the cell $(S_3, D_2) = 8$ which is smallest number in the cell excluding demand row and supply column entry.

The previous immediate prime $p = 4K + 1$ after $(S_3, D_2) = 8$,take$p = 5$. Thus, we take the addition of the entries of rows and columns over $\boldsymbol{Z_5}$ and apply the above algorithm.

We get,

	Distribution Centers					Penalty	Penalty	Penalty	Penalty	Penalty
	D_1	D_2	D_3	D_4	Supply					
S_1	19[5]	30[2]	50	10	7	4	4	4	4	4
S_2	70	30[2]	40[7]	60	9	0	0	0	---	---
S_3	40	8 [4]	70	20[14]	18	3	3	3	3	---
Demand	5	8	7	14						
	4	3	0	0						
	4	3	0	---						
	4	3	---	---						
	4	3	---	---						
	4	0	---	---						

Total Cost: 19*5 + 30*2 + 30*2 + 8*4 + 40*7 + 20*14 = 95 + 60 + 60 + 32 + 228 + 280 = 755 /-
The same problem has [4] solution 1015 /- by using North – West Corner Method respectively.

4. Conclusion

In this paper, we have developed the new algorithm for finding the solution towards the initial basic feasible solutionof transportation problem. The above method is suitable towards finding the initial basic feasible solutionof given transportation problem also it is better alternative iterative method than North – West Corner.Thus the proposed method is important tool for the decision makers when they are handling various types of transportation / logistic problems.

References

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