APB's method for the IBFS of a Transportation Problem and comparison with Least Cost Method

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Abstract - In this paper, we have given the new method as APB's method for the IBFS of a transportation problem by number theoretic approach for finding out the initial basic feasible solution towards the transportation problems and compare it with Least Cost Method / minimum cell cost method and have shown that the new APB's method gives very much good result as compare to least cost method.

Keywords: Transportation Problem, Congruence, Least Cost Method

AMS Subject Classification (2010): 90B06, 11A07, 90B99

I. 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. A huge number of practical / physical models are transformed into transportation problems which generally include inventory problem, assignment problem, and traffic problem [1].

The transportation problem [5] generally considered as a problems of multi – objective (like minimum cost and shortest path) combinatorial approach on the other hand as we know that the transportation problem were first proposed by Hitchcock in 1941.

The standard transportation problems [9] 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. In LCM, the flow of allocation is directly controlled by the cost entries i.e. lowest cost prefers first

We know that, the congruence relation $a \equiv b(mod\ m)$ is an equivalence relation [6] which tells us that $m\,|(b-a) \leftrightarrow a \equiv b(mod\ m)$. Thus it is interesting to modify the given transportation problem as number theoretic approach using the congruence relation.

The paper mainly consists of three parts. In first part algorithm for proposed method were given[8]. In the second part, new APB's methods [10] along with numerical example were explained. In the third part, we have compared the result with least cost method along with conclusion.

II. Algorithm of Proposed Method

The alternative method can be summarized into following steps applied for balanced transportation problem.

Step I] Examine whether the transportation problem were balanced or not. If balanced, then go to next step.

Step II]: Write the penalties over each rows by taking $[\sum_{j=1}^{n} C_{ij}]$ (modulo m) and write the penalties over each column by taking $[\sum_{i=1}^{k} C_{ij}]$ (modulo m) 'respectively, where 'm' is the value of supply and demand for the respective rows and columns.

Step III] Select the row or column with the highest 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 IV] any row or column with zero supply or demand should not be used in computing future penalties.

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

III. Numerical Example

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

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	Distribution Centers			
	D_1	D_2	D_3	Supply
S_1	2	7	4	**5**
S_2	3	3	1	**8**
S_3	5	4	7	**7**
S_4	1	6	2	**14**
Demand	**7**	**9**	**18**	

Solution:

In the above example as the demand and supply are same the said transportation problem is balanced problem. Now at first step the values of m for the each row are 5, 8, 7 and 14 respectively while for columns it is 7, 9, and 18 respectively and apply the above algorithm.

We get,

	Distribution Centers				Penalty	Penalty	Penalty	Penalty	Penalty
	D_1	D_2	D_3	Supply					
S_1	2 **[5]**	7	4	**5**	**8**	**8**	**---**	**---**	**---**
S_2	3	3 **[2]**	1 **[6]**	**8**	**- 1**	**- 1**	**- 1**	**- 2**	**- 2**
S_3	5	4 **[7]**	7	**7**	**9**	**--**	**---**	**---**	**---**
S_4	1 **[2]**	6	2 **[12]**	**14**	**- 5**	**- 5**	**- 5**	**- 1**	**- 10**
Demand	**7**	**9**	**18**						
Penalty	**4**	**2**	**- 4**						
Penalty	**- 1**	**0**	**- 11**						
Penalty	**0**	**1**	**-15**						
Penalty	**0**	**---**	**- 15**						
Penalty	**---**	**---**	**- 15**						

Total Cost: 2*5 + 3*2 + 1*6 + 4*7 + 1*2 + 2*12 = 10 + 06 + 06 + 28 + 02 + 24 = 76 /-

We compare our with Least Cost Method as;

	Distribution Centers			
	D_1	D_2	D_3	Supply
S_1	2	7 **[2]**	4 **[3]**	**5**
S_2	3	3	1 **[8]**	**8**
S_3	5	4 **[7]**	7	**7**
S_4	1 **[7]**	6	2 **[7]**	**14**
Demand	**7**	**9**	**18**	

Total Cost: 7 * 2 + 4 * 3 + 1 * 8 + 4 * 7 + 1 * 7 + 2 * 7 = 83 /-

B) Now we consider another transportation problem

	Distribution Centers				
	D_1	D_2	D_3	D_4	Supply
S_1	11	13	17	14	**250**
S_2	16	18	14	10	**300**
S_3	21	24	13	10	**400**
Demand	**200**	**225**	**275**	**250**	

Solution:

In the above example as the demand and supply are same the said transportation problem is balanced problem. At first step the value of 'm for each rows are 250, 300 and 400 respectively on the other hand the value of 'm' for each columns are 200, 225, 275 and 250 respectively. Apply the above algorithm to the given transportation problem.

We get,

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	Distribution Centers					Penalty	Penalty	Penalty	Penalty	Penalty	Penalty
	D_1	D_2	D_3	D_4	Supply						
S_1	11 **[200]**	13 **[50]**	17	14	**250**	**-195**	**-6**	**---**	**---**	**---**	**---**
S_2	16	18 **[175]**	14	10 **[125]**	**300**	**-242**	**-258**	**-268**	**-101**	**---**	**---**
S_3	21	24	13 **[275]**	10 **[125]**	**400**	**-332**	**-353**	**-353**	**-377**	**-377**	**-262**
Demand	**200**	**225**	**275**	**250**							
Penalty	**-152**	**-170**	**-231**	**-210**							
Penalty	**---**	**-170**	**-231**	**-216**							
Penalty	**---**	**-133**	**-248**	**-230**							
Penalty	**---**	**---**	**-248**	**-230**							
Penalty	**---**	**---**	**-262**	**-115**							
Penalty	**---**	**---**	**-262**	**---**							

Total Cost: 11*200 + 13 * 50 + 18 *175 + 10 * 125 + 13 *275 + 10 * 125 = 12, 075 /-

We consider the same problem by using Least Cost Method

	Distribution Centers				
	D_1	D_2	D_3	D_4	Supply
S_1	11 **[200]**	13 **[50]**	17	14	**250**
S_2	16 **[75]**	18 **[175]**	14 **[125]**	10	**300**
S_3	21	24	13 **[150]**	10 **[250]**	**400**
Demand	**200**	**225**	**275**	**250**	

Total Cost: 11 * 200 + 13 * 50 + 16 * 75 + 18 * 175 + 14 * 125 + 13 * 150 + 10 * 250 = 12,200/-

IV. CONCLUSION

In this paper, we have developed the new APB's algorithm for finding towards the initial basic feasible solution of transportation problem. The above method is suitable towards finding the initial basic feasible solution of given transportation problem also it is better iterative method than Least Cost Method. Thus the proposed APB's method is important tool for the decision makers when they are handling various types of transportation / logistic problems in number theoretic view.

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