APBs method for the IBFS of a Transportation Problem and comparison with North West Corner Method

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Abstract

In this paper, we have given the new method as APBs method for the Initial Basic Feasible solution of a transportation problem by number theoretic / algebraic approach (congruence relation) relation which generally used in algebraic number theory. So, we used this relation for finding penalties in the initial basic feasible solution towards the transportation problems and compare it with North West Corner method and have shown that the new APBs method gives very much good result as compare to North West Corner method.

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1 Introduction

We know that Most of the practical / physical models are transformed into transportation problems which generally include inventory problem, assignment problem, and traffic problem [2]. The transportation problem [1] 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 [4] mainly North West Corner Method (NWCM), Least Cost Method (LCM) and Vogels 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. As we saw towards NWC [2], it is an iterative method / procedure which generally used to find out initial basic feasible solution towards the transportation problems like Least Cost Method it also takes the cost into consideration but in relative sense.
To overcome this difficulty it is interesting to modify the given transportation problem as number theoretic approach using the congruence relation. We know that, the congruence relation $a \equiv b(modm)$ is an equivalence relation [3] which tells us that $m \mid (b-a) \Leftrightarrow a \equiv b(modm)$.
The paper mainly consists of three parts. In first part algorithm for proposed method

were given. In the second part, new APBs methods along with numerical example were explained. In the third part, we have compared the result with North West Corner method along with conclusion.

2 Algorithm of Proposed Method:

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

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

II) Write the penalties over each i^{th} row taking $[\sum_{j=1}^{n} C_{ij}]$ (modulo m) and for each j^{th} column 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.

III) Select the row or column with the highest penalty and allocate 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.

IV) Any row or column with zero supply or demand should not be used in computing future penalties.

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

3 Numerical Example

A) Consider the following example for the minimum transportation cost

	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	Penalty
	D_1	D_2	D_3	Supply						
S_1	2	7	4[5]	5	3	1	1	1	−−	−−
S_2	3	3[2]	1[6]	8	−1	−4	−4	−4	−4	−−
S_3	5	4[7]	7	7	2	4	−−	−−	−−	−−
S_4	1[7]	6	2[7]	14	−5	1	1	−−	−−	−−
Demand	7	9	18							
Penalty	4	2	−4							
Penalty	−−	2	−4							
Penalty	−−	0	−11							
Penalty	−−	0	−6							
Penalty	−−	1	−5							
Penalty	−−	−−	−5							

Total Cost: $4*5+3*2+1*6+4*7+1*7+2*7=20+6+6+28+7+14=81/-$

We compare our solution with North West Corner Method as;

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

Total Cost: $2*5+3*2+3*6+4*3+7*4+2*14=102/-$

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

	Distribution Centers					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
Demand	200	225	275	250					
Penalty	−152	−170	−231	−216					
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 NWC method

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

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

C) Now we consider another transportation problem

	Distribution Centers				
	D_1	D_2	D_3	D_4	Supply
S_1	20	22	17	4	120
S_2	24	37	9	7	70
S_3	32	37	20	15	50
Demand	60	40	30	110	

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 120,70 and 50 respectively on the other hand the value of ' m ' for each columns are 60,40,30 and 110 respectively. Apply the above algorithm to the given transportation problem. We get

	Distribution Centers					Penalty	Penalty	Penalty	Penalty	Penal
	D_1	D_2	D_3	D_4	Supply					
S_1	20[60]	22[40]	17	4[20]	120	−57	−74	−56	−16	−16
S_2	24	37	9[30]	7[40]	70	7	−12	−9	−33	−
S_3	32	37	20	15[50]	50	4	−16	−3	−35	−35
Demand	60	40	30	110						
Penalty	16	16	16	−84						
Penalty	16	16	−	−84						
Penalty	16	−	−	−84						
Penalty	−	−	−	−84						
Penalty	−	−	−	−35						

Total Cost: $20 * 60 + 22 * 40 + 4 * 20 + 9 * 30 + 7 * 40 + 15 * 50 = 3460/-$
We consider the same problem by NWC method

	Distribution Centers				
	D_1	D_2	D_3	D_4	Supply
S_1	20[60]	22[40]	17[20]	4	120
S_2	24	37	9[10]	7[60]	70
S_3	32	37	20	15[50]	50
Demand	60	40	30	110	

Total Cost: $20 * 60 + 22 * 40 + 17 * 20 + 9 * 10 + 7 * 60 + 15 * 50 = 3480/-$

4 Conclusion

In this paper, we have developed the new APBs algorithm for finding 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 North West Corner Method. Thus the proposed APBs 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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