



APB's method for the IBFS of a Transportation Problem and comparison with Vogel's Approximation 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 Vogel's Approximation method and have shown that the new APB's method can become an alternative to Vogel's Approximation method.

Keywords: Transportation Problem, Congruence, Vogel's Approximation

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I. INTRODUCTION:

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 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.

As we saw towards [2] the VAM, its variants and some other methods, the flow of allocations is controlled by the DI [Distribution Indicator] or TOC [Total Opportunity Cost] tables. But these DI or TOC tables are formulated by the manipulation of cost entries only. None of them considers demand and/or supply entry to formulate the DI/ TOC table.

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 $a \equiv b \pmod{m}$ is an equivalence relation [3] which tells us that $m \mid (b - a) \leftrightarrow a \equiv b \pmod{m}$.

The paper mainly consists of three parts. In first part algorithm for proposed method were given. In the second part, new APB's methods along with numerical example were explained. In the third part, we have compared the result with Vogel's Approximation 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

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

Now we solve the problem by VAM method

	Distribution Centers			
	D_1	D_2	D_3	Supply
S_1	2 [5]	7	4	5
S_2	3	3	1 [8]	8
S_3	5	4 [7]	7	7
S_4	1 [2]	6 [2]	2 [10]	14
Demand	7	9	18	

Total Cost: $2 * 5 + 1 * 8 + 4 * 7 + 1 * 2 + 6 * 2 + 2 * 10 = 80 /-$

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	Penalty	Penalty
	D_1	D_2	D_3	D_4	Supply						
S_1	11 [200]	13 [50]	17	14	250	-195	-6	---	---	---	---

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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: $11 \times 200 + 13 \times 50 + 18 \times 175 + 10 \times 125 + 13 \times 275 + 10 \times 125 = 12,075$ /-

We consider the same problem by VAM

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

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

C) Now consider the another transportation problem

	Distribution Centers				Supply
	D_1	D_2	D_3	D_4	
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, 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	Penalty	Penalty
	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	-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 VAM

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

Total Cost: $20 * 60 + 22 * 40 + 4 * 20 + 7 * 70 + 20 * 30 + 15 * 20 = 3550$ /-

D) Now consider the another transportation problem

	Distribution Centers				Supply
	D_1	D_2	D_3	D_4	
S_1	23	27	16	18	30
S_2	12	17	20	51	40
S_3	22	28	12	32	53
Demand	22	35	25	41	

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 30, 40, 53 respectively on the other hand the value of 'm' for each columns are 22, 35, 25 and 41 respectively. Apply the above algorithm to the given transportation problem.

We get,

	Distribution Centers				Penalty	Penalty	Penalty	Penalty	Penalty	Penalty	
	D_1	D_2	D_3	D_4							Supply
S_1	23	27	16	18 [30]	30	- 6	+ 1	15	---	---	---
S_2	12 [22]	17 [18]	20	51	40	20	- 2	- 4	- 4	---	---
S_3	22	28 [17]	12 [25]	32 [11]	53	- 12	19	19	4	4	4
Demand	22	35	25	41							
Penalty	13	2	- 2	19							
Penalty	---	2	- 2	19							
Penalty	---	2	---	19							
Penalty	---	10	---	6							
Penalty	---	- 6	---	- 1							
Penalty	---	---	---	- 1							

Total Cost: $18 * 30 + 12 * 22 + 17 * 18 + 28 * 17 + 12 * 25 + 32 * 11 = 2238$ /-

We consider the same problem by VAM

	Distribution Centers				Supply
	D_1	D_2	D_3	D_4	
S_1	23	27	16	18 [30]	30
S_2	12 [22]	17 [18]	20	51	40
S_3	22	28 [17]	12 [25]	32 [11]	53
Demand	22	35	25	41	

Total Cost: $18 * 30 + 12 * 22 + 17 * 18 + 28 * 17 + 12 * 25 + 32 * 11 = 2238$ /-

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 alternative method towards Vogel's Approximation

Method for some situations. 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.

REFERENCES:

- [1]. Amaravathy A., Thiagarajan K. and Vimala S., "MDMA Method – An optimal solution for transportation problem", Middle – East Journal of Scientific Research, 24(12), pp. 3706 – 3710, (2016).
- [2]. Azad, S. M. A. K., Hossain, M. B. and Rahman, M. M., "An algorithmic approach to solve transportation problems with the average total opportunity cost method", International Journal of Scientific and Research Publications, vol.7, No.2, pp. 266-269, (2017)
- [3]. Bhadane A. P., Manjarekar S. D. , "APB's method for the IBFS of transportation problems and comparison with least cost method", IJREAM vol.6, issue. 8, (2020)
- [4]. Bhadane A. P., Manjarekar S. D., "APB's statistical quartile method for IBFS of transportation problem and comparison with least cost method", IJRAR, (2020)
- [5]. Duraphe S, Modi G. and Raigar S., "A new method for the optimum solution of a transportation problem", pp. 309 – 312, vol. 5, issue 3 – C, (2017).
- [6]. Gupta and Kapoor, "Fundamentals of Mathematical Statistics", S. Chand Publication, New Delhi
- [7]. Fatima Jannat, "A Weighted Least Cost Matrix Approach in Transportation Problem", M. Sc. Thesis, Khulna University of Engineering & Technology Khulna, Bangladesh
- [8]. Sharma J. K., "Operations Research: Theory and Applications", Trinity Press, (2013)
- [9]. Sharma N. M., Bhadane A. P., "An Alternative method to north – west corner method for solving transportation problem", IJREAM, (2016).

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