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APB's Statistical Quartile method for IBFS of a Transportation Problem and comparison with North – West Corner Method

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ABSTRACT:
In this paper, we study the new APB's statistical quartile method for finding the Initial Basic Feasible Solution (IBFS) to the transportation problem (TP) by quartile approach. By this method the problem was solved without changing the order of the transportation table, we can achieve the goal with less number of calculations and iterations. Moreover, we illustrate the method by suitable applications and compare it with North – West Corner method and have shown that the new APB's quartile method gives very much good result as compare to North – West Corner method.

Keywords: Transportation Problem, Statistical Method, North – West Corner Method
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I. INTRODUCTION:

As we have seen the history of transportation right from the invention of wheel 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, 2, 9].

Now as we know that, the quartile are nothing but the special case of quantile and generally associated with probability distribution contains 25% of total observations. They are generally used to calculate the interquartile range, which is a measure of variability around the median.

The paper mainly consists of three parts. In first part, basic definitions were given. In second part, algorithms for proposed method were given. The third part, explains new APB's quartile method along with numerical example. In the Four part, we have compared the result with North – West Corner method along with conclusion.

II. BASIC DEFINITIONS:

[I] Transportation:

Let there be 'm' origins O_1, O_2, ..., O_m having a_i ($a_i > 0$, i = 1, 2, 3, ..., m) units of availability respectively and 'n' destinations D_1, D_2, ..., D_n with b_j ($b_j > 0$, j = 1, 2, 3, ...n) units of requirements. If C_{ij} are the cost of transporting one unit of the commodity from i^{th} origin to j^{th} destination and X_{ij} be the units of transporting from i^{th} to j^{th} destination. The objective is to determine Xij which minimizes the total transporting cost (Z) satisfying all the availability constraints and the requirement constraints [6].

[II] Mathematical Formulation:

If $\sum a_{ij} = S$ is the total availability of origins and $\sum b_{ij} = D$ is the total requirements of destinations and if $S = D$ then the given transportation problem is balanced [6].

Minimize $Z = \sum\sum C_{ij} X_{ij}$

Subject to

$\sum X_{ij} = a_i$, $i = 1, 2, 3, \ldots, m$ (Availability constraints)

$\sum X_{ij} = b_j$, $j = 1, 2, 3, \ldots, n$ (Requirement constraints)

and $X_{ij} \geq 0$ for all I and j (Non Negative constraints)

In case if $\sum a_{ij} \neq \sum b_{ij}$ then it becomes unbalanced so that we have to make some manipulation to make balanced i.e. $\sum a_{ij} = \sum b_{ij}$.

[III] IBFS Methods: To find the initial basic feasible solution of a transportation problem, there are some standard methods which are mentioned below [6]:

1] Vogel's Approximation Method
2] Least Cost Method
3] North – West Corner Method

[IV] Quartile: As we have seen that the quartiles are three points that divide the data into four equal parts.

$Q_1 = \frac{N}{4}$ and $N = \sum C_{ij}$, where the addition has done for each row and column separately.

III. ALGORITHM OF PROPOSED APB'S QUARTILE 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] Now for each rows of the transportation table identity "the Quartile cost" is calculated. Write them along the side of the transportation table which is to be considered as Penalty.

Similarly compute the quartile cost for each column.

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 that is select from any arbitrary tie breaking choice.

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

Step V] Re – compute quartile cost of each row and each column for the reduced transportation table and go to step III].

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

IV. 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	6	5	8	8	**30**
S_2	5	11	9	7	**40**
S_3	8	9	7	13	**50**
Demand	**35**	**28**	**32**	**25**	

Solution:

In the above example as the demand and supply are same, the said transportation problem is balanced problem.

We get,

	Distribution Centers					Penalty	Penalty	Penalty	Penalty	Penalty	Penalty
	D_1	D_2	D_3	D_4	Supply						
S_1	6	5 **[28]**	8	8 **[2]**	**30**	**6.75**	**4.75**	**4.75**	**3.25**	**3.25**	**2**
S_2	5 **[17]**	11	9	**7 [23]**	**40**	**8**	**5.75**	**5.75**	**4.5**	**---**	**---**
S_3	8 **[18]**	9	7 **[32]**	13	**50**	**9.25**	**7.5**	**---**	**---**	**---**	**---**
Demand	**35**	**28**	**32**	**25**							
Penalty	**4.75**	**6.25**	**6**	**7**							
Penalty	**4.75**	**6.25**	**---**	**7**							
Penalty	**2.75**	**4**	**---**	**3.25**							
Penalty	**---**	**4**	**---**	**3.25**							
Penalty	**---**	**1.25**	**---**	**2**							
Penalty	**---**	**---**	**---**	**2**							

Total Cost: 5 * 28 + 8 * 2 + 5 * 17 + 7 * 23 + 8 * 18 + 7 * 32 = 770 /-

We compare our with North – West Corner Method as;

	Distribution Centers				
	D_1	D_2	D_3	D_4	Supply
S_1	6 [30]	5	8	8	**30**
S_2	5 **[5]**	11 **[28]**	9 **[7]**	7	**40**
S_3	8	9	7 [25]	13 **[25]**	**50**
Demand	**35**	**28**	**32**	**25**	

Total Cost: = 6 * 30 + 5 * 5 + 11 * 28 + 9 * 7 + 7 * 25 + 13 * 25 = 1076/-

V. CONCLUSION:

In this paper, we have developed the new APB's Quartile 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 North – West Corner Method. Thus the proposed APB's Quartile 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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