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North-East Corner Method-An Initial Basic Feasible Solution for Transportation Problem

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Abstract: A transportation problem can be solved by using modi method. Modi method is not a self-starting method which requires an initial basic feasible solution. In this paper, north east corner method is introduced in order to find the initial basic feasible solution. Using this solution modi method can be applied to find the optimum solution.
Keywords: transportation problem, initial basic feasible solution, north east corner method.

I. INTRODUCTION

A. General Form of Transportation Problem

Let a_i = quantity of commodity available at origin i

b_i = quantity of commodity needed at destination j

c_{ij} = cost of transporting one unit of commodity from origin 'i' to destination 'j'.

and x_{ij}= quantity transported from origin i to destination j

Then the problem is to determine the transportation schedule so as to minimize the total transportation cost satisfying supply and demand constraints.

Mathematically, the problem may be stated as a linear programming problem (L. P. P) as follows:

$$\text{Minimize } z = \sum_{i=1}^{m}\sum_{j=1}^{n} x_{ij}\ c_{ij}$$

subject to constraints

$$\sum_{j=1}^{n} x_{ij} = b_i ,\ i = 1, 2, \ldots, m$$

$$\sum_{i=1}^{m} x_{ij} = a_j ,\ j = 1, 2, \ldots\ldots, n$$

$$\text{and } x_{ij} \geq 0 \text{ for all i and j.}$$

B. Solution of L.P.P

A set of real numbers which satisfies the constraints of the above L.P.P is called a solution to the Transportation Problem (TP).

C. Feasible Solution

Any solution to a TP which also satisfies the non-negative restrictions of the problem, is called a feasible solution to the TP.

D. Necessary and Sufficient Condition for the Existence of a Feasible Solution

A necessary and sufficient condition for the existence of a feasible solution to the general transportation problem is that

$$\sum_{i=1}^{m} a_i = \sum_{j=1}^{n} b_j \text{ i.e. Total Supply=Total Demand}$$

E. Optimum Solution

Any feasible solution which optimizes (minimizes or maximizes) the objective function of an TP is called an optimum solution to the TP.

F. Basic Feasible Solution

The number of basic (decision) variables of the general transportation problem at any stage of feasible solution must be m+n-1.

H. Initial Basic Feasible Solution (IBFS)

An initial basic feasible solution is a solution that satisfies all the supply and demand conditions.

H. Degenerate Basic Feasible Solution

A feasible solution involving exactly (m+n-1) positive variables is known as non- degenerate basic feasible solution, otherwise it is said to be degenerate basic feasible solution

I. Balanced Problem

When the total demand is equal to the total supply, the transportation problem is said to be balanced and otherwise unbalanced.

J. The Transportation Table

The transportation problem is a special case of general L.P.P. To facilitate presentation and solution, the transportation problem is generally portrayed in a tabular form as shown below:

Destination					
	1	2	……	n	Supply
1	x_{11}	x_{12}	……	x_{1n}	b_1
2	x_{21}	x_{22}	……	x_{2n}	b_2
. . .	. . .	. . .		. . .	
m	x_{m1}	x_{m2}	……	x_{mn}	b_m
Demand	a_1	a_2		a_n	

The m*n large squares are called the cells. The per unit cost c_{ij} of transporting from the i^{th} origin to the j^{th} destination is displayed in the lower right position of the (i , j)th cell. Any feasible solution to the T.P is displayed in the table by variable x_{ij} at the upper left position of the (i , j)th cell. The various origin capacities and destination requirements are listed in the right most (outer) column and the bottom (outer) row respectively. These are called rim requirements.

To solve the transportation problem, first Initial Basic Feasible Solution (IBFS) is found. This IBFS can be found using North West Corner rule, Least cost Method and Vogel's approximation method. This IBFS can be made as optimum using Modi method. This paper gives a new method to find the IBFS called North east corner method.

This paper is organised as follows. Section 2 explains the method and in section 2.1 examples are given. Section 3 concludes the paper.

K. North – East Corner Method

The North – east corned method is used to obtain an initial basic feasible solution. Then MODI method is used to arrive at the optimum solution. Various steps of the method are

Step 1: If the problem is of maximization type, subtract the lower costs from higher cost so that the problem is converted to minimization type.

Step 2: If Total demand $>$ Total supply, include a row with cost 0 and let

Supply = Total demand – Total supply.

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If Total supply $>$ Total demand , include a column with cost 0 and let

Demand = Total supply – Total demand.

This will make the problem balanced.

Step 3: Consider the transportation table with m rows and n columns. Select the North – East (upper right hand) of the Transportation table and allocate as much as possible so that either capacity of the first row is exhausted or the destination requirement of the last column is satisfied

$$x_{1n} = \min(a_n , b_1)$$

Step 4: If $a_n < b_1$, omit the n[th] column and fix $b_1 = b_1 - x_{1n}$. The table is reduced to m rows and n-1 columns.

If $b_1 < a_n$, omit the 1[st] row and fix $a_n = a_n - x_{1n}$. The table is reduced to m-1 rows and n columns.

Step 5: Repeat steps 1 and 2 moving down towards the lower left corner of the transportation table until all the requirements are satisfied.

Step 6: Finally $\sum_{i=1}^{n}\sum_{j=1}^{m} c_{ij}\ x_{ij}$ will give the transportation cost.

II. EXAMPLES

This section gives examples for the implementation of North East Corner method to the given transportation problems with unit cost in €.

A. Example 1

Consider the minimized transportation problem as a table

					Supply
	11	13	17	14	250
	16	18	14	10	300
	21	24	13	10	400
Demand	200	225	275	250	950

By North east corner method, the initial basic feasible solution to the problem is $x_{13} = 0$, $x_{14} = 250$, $x_{22} = 25$, $x_{23} = 275$, $x_{31} = 200$, $x_{32} = 200$ and transportation cost is €16, 800.

B. Example 2

When the following minimization problem is considered, the IBFS was found to be $x_{13} = 7$,

$x_{22} = 9$, $x_{23} = 3$, $x_{31} = 10$, $x_{32} = 1$, with transportation cost € 115.

				Supply
	1	2	6	7
	0	4	2	12
	3	1	5	11
Demand	10	10	10	

C. Example 3

					Supply
	11	20	7	8	50
	21	16	20	12	40
	8	12	18	9	70
Demand	30	25	35	40	

The above unbalanced and minimized transportation problem gives the IBFS as x_{14} = 20, x_{23} = 20, x_{24} = 20, x_{31} = 30, x_{32} = 25, x_{33} = 15 using North east corner rule after making it as balanced. Its cost is €610.

D. Example 4

Consider a maximized transportation problem. It is converted to minimized problem and proceeded with NEC method. It is found that IBFS of the problem as x_{14} = 23, x_{22} = 21, x_{23} = 16, x_{24} = 7, x_{31} = 23, x_{32} = 10 and cost as € 5094.

					Supply
	15	51	42	33	23
	80	42	26	81	44
	90	40	66	60	33
Demand	23	31	16	30	100

III. CONCLUSION

A transportation problem can be solved using MODI method. But it can optimise an initial basic feasible solution only. Thus an initial basic feasible solution has to be found. Hence a new method called North East Corner Method has been introduced to find the initial basic feasible solution. The initial basic feasible solutions of four different problems have been found here.

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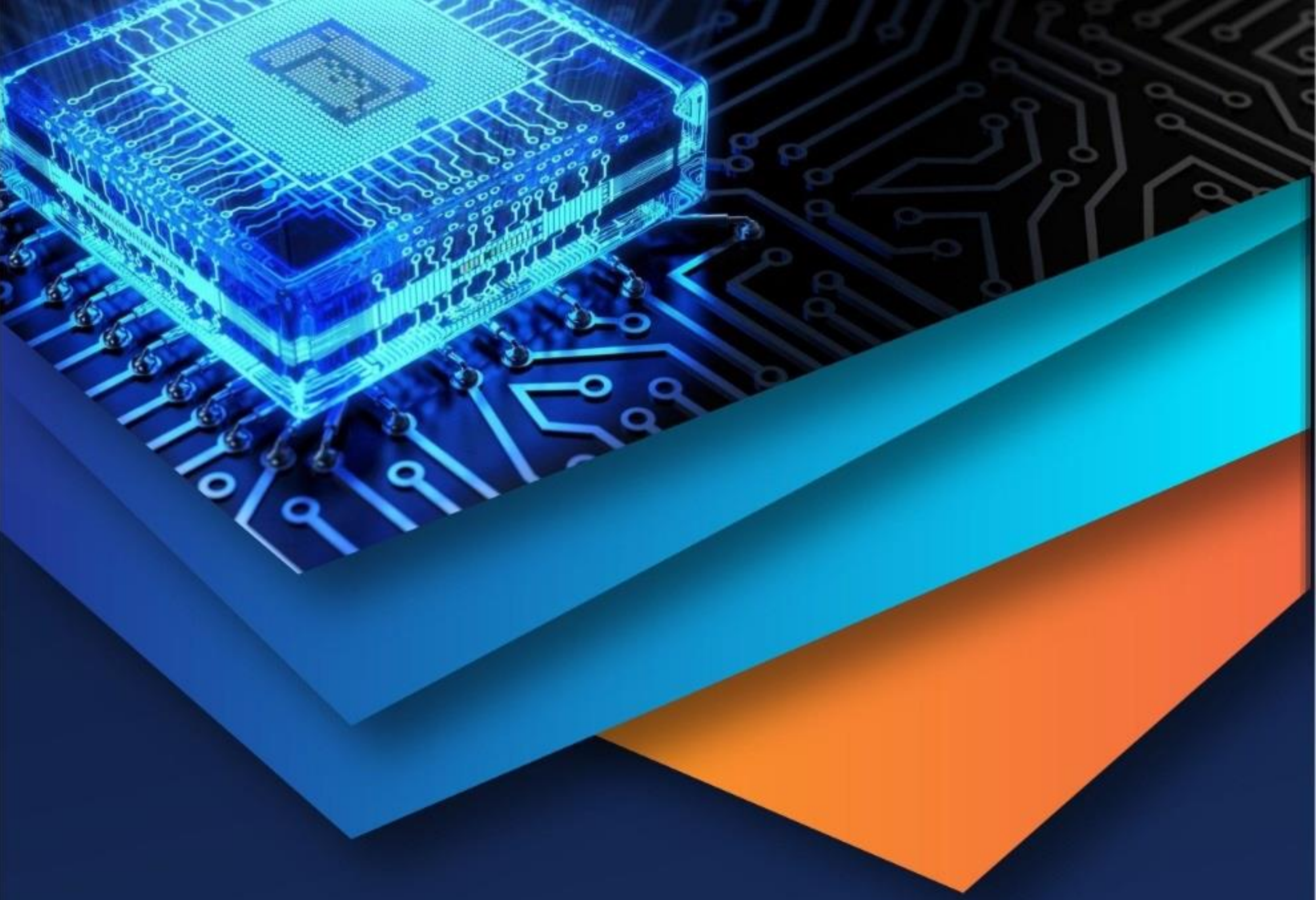

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