iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 **Issue:** VIII **Month of publication:** August 2018

DOI:

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue VIII, August 2018- Available at www.ijraset.com

An Initial Basic Feasible Solution for Transportation Problem-South West Corner Method

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Abstract: In this paper, a new method is introduced to find the initial basic feasible solution called south-west corner method. Using the solution from this method, MODI can be applied to find the optimum solution.
Keywords: Transportation problem(TP), Initial Basic Feasible Solution(IBFS), South-west corner method(SWR), North-west corner method(NWC)

I. INTRODUCTION

A. Mathematical Formulation Of Any Transportation Problem

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

Subject to constraints $\sum_{j=1}^{n} x_{ij} = a_i \qquad i=1,2,\ldots,m$

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

$x_{ij}>=0$ for all i and j

where ,
a_i= quantity of commodity available at origin i
b_j=quantity of commodity available at destination j
c_{ij}= cost of transporting one unit of commodity from i^{th} origin to j^{th} destination
x_{ij}= quantity transported from i to j
That is, the objective of any transportation problem is to minimize the transportation cost in such a way that all the demands are satisfied.

B. Transportation table

Any TP can be represented explicitly as a following table: Supply

C_{11}	C_{12}	C_{13}	………..	C_{1n}	a_1
C_{21}	C_{22}	C_{23}	………..	C_{2n}	a_2
C_{31}	C_{23}	C_{33}	………..	C_{3n}	a_3
:	:	:	………..	:	
C_{m1}	C_{m2}	C_{m2}	…………	C_{mn}	a_m
Destination	b_1	b_2	b_3 ……….		b_n

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The 'mn' squares are called cells. C_{ij} is the per unit cost of transporting commodity from i^{th} source to j^{th} destination. Any feasible solution is shown by entering x_{ij} in the $(i,j)^{th}$ cell with a box on its top left corner. The various a's and b's are called rim requirements. The feasibility of a solution can be verified by summing the values of x_{ij} along the rows and down the columns.

C. Necessary and Sufficient Condition For The Existence Of A Feasible Solution

$$\sum_{i=1}^{m} a_i = \sum_{j=1}^{n} b_j \qquad \text{i.e Total supply= Total demand}$$

If this condition is satisfied for a TP, it is said to be balanced.

D. Feasible Solution

Any set of x_{ij} that minimizes the objective function of the TP is called optimum solution. This can be found by MODI Method.

E. Basic Feasible solution

The no. of basic (decision) variables of a general TP at any stage must be m+n-1, where m is the no. of origins, n is the no. of destinations.

F. Initial Basic Feasible Solution

An IBFS is a solution that satisfies all the supply & demand conditions.

G. Optimum solution

Any feasible solution that minimizes the objective function of the TP is called optimum solution. This can be found by MODI Method.

II. SOUTH-WEST CORNER METHOD:

This is one of the methods to find IBFS of any TP.Various steps involved are:

1) *Step 1:* If the problem is of maximization type, the problem is to be converted to minimization type by subtracting the other costs from the highest cost available in the table
2) *Step 2:* If the necessary and sufficient condition is not satisfied, i.e.
a) If the Total demand> Total supply, then include a dummy row with cost as '0' and supply value of that row as "Total demand – Total supply"
b) If Total supply > Total demand, then include a dummy column with cost as '0' and demand value of that column as "Total supply – Total demand"

Now, TP becomes balanced.

3) *Step 3:* For the above TP, select the south-west (lower-left hand) of the TP and allocate as much as possible so that either capacity of the last row is exhausted or the destination requirement of the first column is satisfied.
   i.e., $x_{m1}=\min(a_m,b_1)$
4) *Step 4:* If $a_m<b_1$, omit the m^{th}row and fix $b_1=b_1-x_{m1}$. Now the table reduces to (m-1) rows and n columns.

If $b_1<a_m$, omit the first column and fix $a_m=a_m-x_{m1}$ which reduces TP to m rows and (n-1) columns.

5) *Step 5:* Repeat the steps 3 and 4 moving up towards upper right corner of the TP until all requirement are satisfied.
6) *Step 6:* Finally$\sum_{i=1}^{m}\sum_{j=1}^{n} c_{ij}x_{ij}$ will give the transportation cost.

III. EXAMPLES

1) *Example 1:* Consider the following TP with cost in ₹

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

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This problem is balanced as Total supply = Total demand =30. When south west corner method is used to find IBFS the m+n-1=5 solutions becomes,

$x_{13}=7$, $x_{22}=9$, $x_{23}=3$, $x_{31}=10$,$x_{32}=1$

Transportation cost is ₹ 11

When MODI method is applied, it is possible to find the minimized cost.

2) *Example 2:* When south west cost method is applied to the following TP, it gives cheaper cost than NWC Supply

5	1	3	3	34
3	3	5	4	15
6	4	4	3	12
4	-1	4	2	19
Demand 21	25	17	17	

Here Total supply = 80 = Total demand

Hence solution is, when SWC method is used,

$x_{13}=17$, $x_{14}=17$, $x_{22}=15$,$x_{23}=0$,$x_{31}=2$,$x_{32}=10$,$x_{41}=19$

Cost= ₹ 259

3) *Example 3:* Consider the following maximized TP cost with cost in $

SUPPLY

71	13	17	14	200
16	18	14	10	300
21	24	13	10	450
DEMAND 200	225	275	250	

The corresponding TP is

13	11	7	10	200
8	6	10	14	300
3	0	11	14	450
200	225	275	250	

The solution to the given TP is

$X_{14}=200$, $x_{23}=250$, $x_{24}=50$, $x_{31}=200$, $x_{32}=225$,$x_{33}=25$ using SWC

Cost for given TP is $ 16525

4) *Example 4:* For the following unbalanced TP solution from south west corner method is $x_{14}=2$, $x_{23}=4$, $x_{24}=4$, $x_{31}=4$, $x_{32}=2$,$x_{33}=4$. Cost= ₹28

1	2	3	4	6
4	3	2	0	8
0	2	2	1	10
4	2	8	6	

IV. CONCLUSION

A new south west corner method is introduced to find the IBFS for any TP which is very simple and provides better transportation cost than NWC at times. It is explained with 4 examples.

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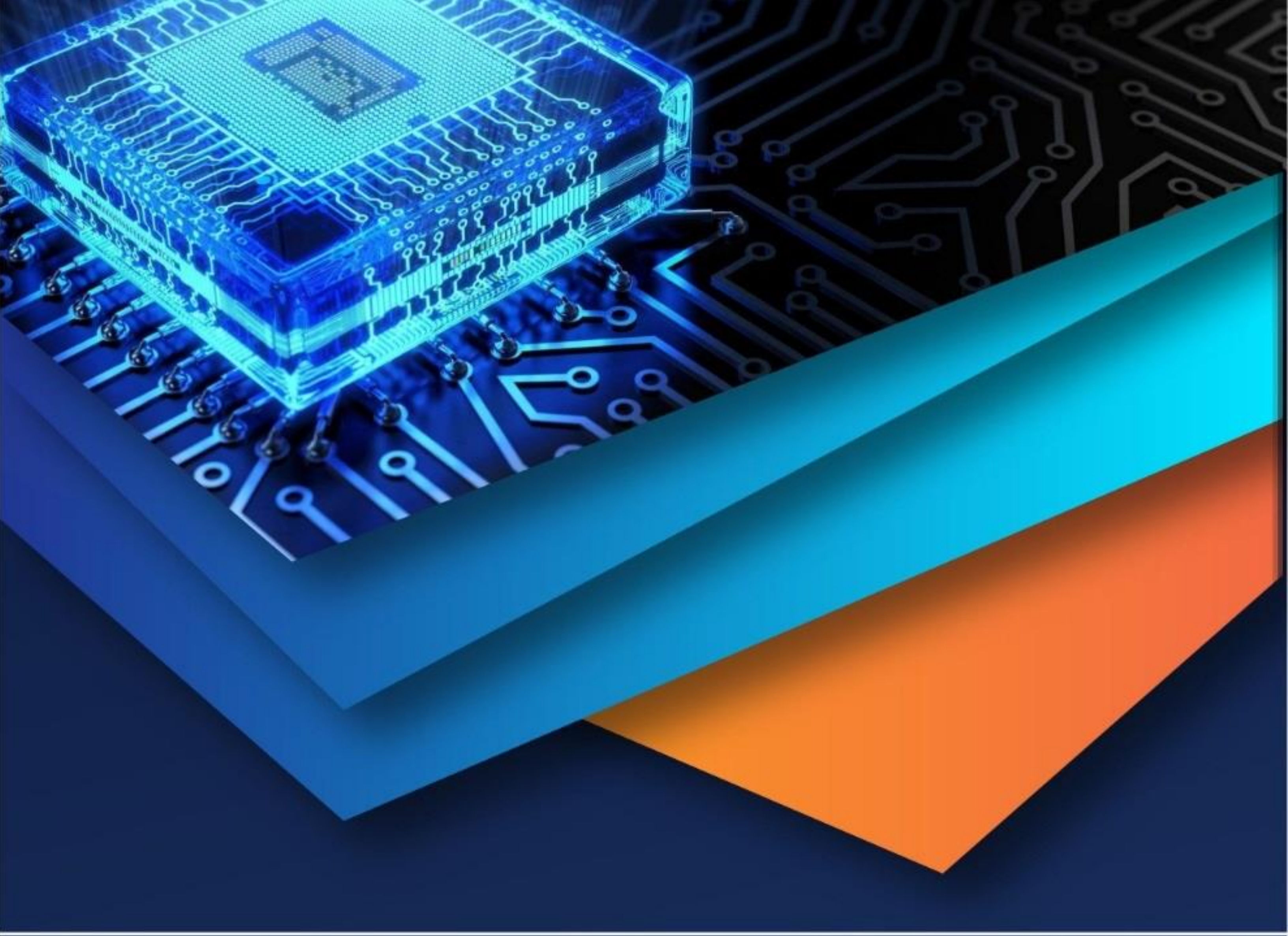

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