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* Methods to solve Transportation Problem

There are 3 types of techniques available to find the initial basic feasible solution.

1. Northwest corner cell method
2. Least cost cell method
3. Vogel's approximation method (VAM) / penalty method.

* Algorithm for Northwest corner cell method

step 1. Find the minimum of the supply & demand values with respect to the current northwest corner cell of the cost matrix

step 2. Allocate this minimum value to the current northwest corner cell and subtract this minimum from the supply & demand values with respect to the current northwest corner cell

step 3. check whether exactly one of the row/column corresponding to the northwest corner cell has zero supply/demand resp. If so, go to step 4, otherwise goto step 5.

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step4. Delete that row/column with respect to the current northwest corner cell which has the zero supply / demand & go to step 6

step5 Delete both the row & the column with respect to the current northwest corner cell.

step6. check whether exactly one row or column is left out. If yes, go to step (7), otherwise go to step (1)

step7. Match the supply/demand of that row/column with the remaining demand / supplies of the undeleted columns/rows

step8. Go to phase 2

North west corner cell method.

Ex:- consider the following transportation problem involving 3 sources and 4 destinations.

The cell entries represent the cost of transportation per unit.

Obtain the initial basic feasible solution using Northwest corner cell method.

	Destination 1	2	3	4	Supply
1	3	1	7	4	300
Source 2	2	6	5	9	400
3	8	3	3	2	500
Demand	250	350	400	200	1200

Soln:- In the above cost matrix the sum of supplies is equal to sum of demands. Hence the given transportation problem is Balanced

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Destination

Source	1	2	3	4	Supply
1	3 (250) 11	1 12	7 13	4 14	~~300~~ 50 − 250 =
2	2 21	6 22	5 23	9 24	400
3	8 31	3 32	3 33	2 34	500
Demand	~~250~~ 0	350	400	200	

(Deleting Column 1)

In the above table, the supply and demand values corresponding to Northwest corner cell (1, 1) are 300 & 250. resp.
of these
The minimum value is 250 unit.
Hence, allocate 250 units to the cell (1, 1) & substract the same from the supply & Demand values of the cell (1, 1)

Now the supply to Destination 1 is fully satisfied. Hence, delete that column & the resultant table is

Destination

Source	2	3	4	Supply
1	1 (50) 12	7 13	4 14	~~50~~ 0
2	6 22	5 23	9 24	400
3	3 32	3 33	2 34	500
Demand	~~350~~ 300	400	200	

(Deleting Row 1)

In the above table the northwest corner cell (1, 2), the Supply & Demand values corresponding to that Northwest Corner cell are 50 and 350

The minimum value is 50.
Hence allocate 50 units to the cell (1, 2) & substract the same from the supply and demand values of the cell (1, 2).

In this process, the supply of the Source 1 is fully exhausted or (satisfied)
Hence, delete that row & the corresponding Resultant table is -

Source \ Destination	2	3	4	Supply
2	300			~~400~~ 100
	6 22	5 23	9 24	
3				500
	3 32	3 33	2 34	
Demand	~~300~~ 0	400	200	

In the above table, the northwest corner cell is (2, 2), the supply & demand values corresponding to that cell are 400 and 300

The minimum values is 300
Hence allocate 300 units to the cell (2, 2) & substract

the same from supply & demand values of the cell (2,2)

In this process, the demand of destination 2 is fully satisfied, hence deleting that column and resultant table is —

Source	Destination 3	Destination 4	supply
2	5 (100) 23	9 24	~~100~~ 0
3	3 33	2 34	500
Demand	~~400~~ 300	200	

In the above table, the Northwest corner cell is (2,3), the supply & demand values corresponding to that cell are 100 & 400.

The minimum value is 100. Hence allocate 100 units to the cell (2,3) & substract the same from supply & demand values of the cell (2,3)

In this process, the supply of source 2 is fully satisfied, Hence delete that row the resultant table is

Source	Destination 3	Destination 4	supply
3	3 (300) 33	2 (200) 34	~~500~~ 200 0
Demand	~~300~~ 0	~~200~~ 0	

In the above table, only one source is left out, Hence the Demands of the destination 3 & 4 need to be matched with the supply of source 3.

→ The initial basic feasible solution for the given problem using the northwest corner cell method is shown in following table

Table

Source	Destination 1	2	3	4	Supply
1	250 3 11	50 1 12	7 13	4 14	300
2	2 21	300 6 22	100 5 23	9 24	400
3	8 31	3 32	300 3 33	200 2 34	500
Demand	250	350	400	200	

⇒ The total cost of the solution is calculated by adding the products of the transportation cost per unit in each & every basic cell & the corresponding number of units allocated to it.

A basic cell is one which has a positive allocation.

Thus,

Total cost = $3 \times 250 + 1 \times 50 + 6 \times 300 + 5 \times 100 + 3 \times 300 + 2 \times 200$

$= 750 + 50 + 1800 + 500 + 900 + 400$

$=$ Rs. 4400

$\therefore$ **Total cost = Rs. 4400.**

Ex (2) Solve the following transportation problem using Northwest corner cell method

From \ To	1	2	3	supply
1	2	7	4	5
2	3	3	1	8
3	5	4	7	7
4	1	6	2	14
Demand	2	9	18	

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Thus,

Total cost = $3 \times 250 + 1 \times 50 + 6 \times 300$

$+ 5 \times 100 + 3 \times 300 + 2 \times 200$

$= 750 + 50 + 1800 + 500 + 900 + 400$

= Rs. 4400

$\therefore$ **Total cost = Rs. 4400**

Ex (2) Solve the following transportation problem using Northwest corner cell method

From \ To	1	2	3	supply
1	2	7	4	5
2	3	3	1	8
3	5	4	7	7
4	1	6	2	14
Demand	2	9	18	

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soln:- In the given cost matrix, the sum of supplies is not equal to sum of demand.

Thus, it need to be balanced & after balancing, the cost matrix is as follows.

Source \ Destn	1	2	3	4	Supply
1	2	7	4	0	5
2	3	3	1	0	8
3	5	4	7	0	7
4	1	6	2	0	14
Demand	2	9	18	5	34 / 34

~~Source~~ \ Destn	1	2	3	4	Supply
1	2 (2) 11	7 12	4 13	0 14	~~5~~ 5-2=3
2	3 21	3 22	1 23	0 24	8
3	~~5~~ 31	4 32	7 33	0 34	7
4	1 41	6 42	2 43	0 44	14
Demand	~~2~~ 0	9	18	5	

In the above table, the supply & demand values corresponding to NWCC (1,1) are 5 and 2

Minimum value is 2

∴ Substract same from supply & demand values.

Now ~~si~~ demand to destination 1 is fully satisfied

Hence delete that column & resultant table is

Source \ Destin	2	3	4	supply
1	7 [3] 12	4 15	0 14	~~3~~ 0
2	3 22	1 25	0 24	8
3	4 32	7 33	0 34	7
4	6 42	2 43	0 44	14
Demand	~~9~~ 6	18	5	

In the above table, the supply & Demand values corresponding to NWCC (1, 2) are 3 and 9. Minimum value is 3 ∴ substract same from supply & demand values.

In this process, the supply of the source 1 is fully exhausted ∞ (satisfied) Hence, delete that row & the corresponding Resultant table is-

Source \ Destin	2	3	4	supply
2	3 [6] 22	1 23	0 24	~~8~~ 2
3	4 32	7 33	0 34	7
4	6 42	2 43	0 44	14
Demand	~~6~~ 0	18	5	

In the above table, the supply & demand values corresponding to NWCC (2, 2) are ~~8~~ 2 & 6. Minimum value is 6. ∴ substract the same from supply & demand

In this process, the Demand of destination 2 is fully satisfied Hence delete that column and the resultant table is,

Source \ Destn	3	4	Supply
2	1 (2) 23	0 24	~~2~~ 0
3	7 33	0 34	7
4	2 43	0 44	14
Demand	~~18~~ 16	5	

In the above table, the supply & demand values corresponding to NWCC (2,3) are 2 and 18.

And minimum value is 2

∴ substract the same from supply & demand.

In this process, the supply of source 2 is fully exhausted. Hence delete that Row & resultant table is,

Source \ Destn	3	4	Supply
3	(7) 7 33	0 34	~~7~~ 0
4	2 43	0 44	14
Demand	~~16~~ 9	5	

In the above table, the supply & demand values corresponding to NWCC (3,3) are 7 & 16 & minimum value is 7

∴ substract the same from supply and

demand values

In this process, supply of source 3 is fully exhausted, Hence delete that row & the resultant table is.

	Destn 3	4	supply
source 4	2 [9] 43	0 [5] 44	~~4~~ ~~9~~ 0
Demand	~~9~~ 0	~~5~~ 0	

In the above table the NWCC (4,3) the supply & demand values corresponding to that NWCC are

In the above table, only one source is left out, Hence the Demands of the destination 3 & 4 need to be matched with the supply of source 4

→ The initial basic feasible solution for the given problem using the NWCC method is shown in following table

	Destn 1	2	3	4	supply
1	2 [2] 11	7 [3] 12	4 13	0 14	5
2	3 21	3 [6] 22	1 [2] 23	0 24	8
3	5 31	4 32	7 [7] 33	0 34	7
4	1 41	6 42	2 [9] 43	0 [5] 44	14
Demand	2	9	18	5	

source

The total cost is calculated by adding the product of transportation cost per unit in each of every basic cell & corresponding no. of units allocated to it.

∴ Total cost = $2\times2 + 7\times3 + 3\times6 + 1\times2 + 7\times7 + 2\times9 + 0\times5$

$= 4 + 21 + 18 + 2 + 49 + 18 + 0$

∴ **Total cost = Rs. 112**

③ ex:- obtain an initial basic feasible solution to the following transportation problem using the North-west-corner rule

	D	E	F	G	Available
A	11	13	17	14	250
B	16	18	14	10	300
C	21	24	13	10	400
Requirement	200	225	275	250	

soln:-

Source (From) \ Destn (To)	1	2	3	4	
1	11 [200]	13 [50]	17	14	250
2	16	18 [175]	14 [125]	10	300
3	21	24	13 [150]	10 [250]	400
	200	225	275	250	

The transportation cost according to the above route is given by

$$Z = 200 \times 11 + 50 \times 13 + 175 \times 18 + 125 \times 14 + 150 \times 13 + 250 \times 10$$

$$= ₹\ 12,200$$

(4) Ex:- Determine initial basic feasible soln to the following transportation problem using NWCR

Source \ Destin	1	2	3	4	Supply
1	2	3	11	7	6
2	1	0	6	1	1
3	5	8	15	9	10
Demand	7	5	3	12	17/17 (Total)

Ans (11,600) or (11,200)

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* 2 By Least cost cell method:-

Algorithm for Least cost cell method

step 1. Find the minimum of the (undeleted) values in the cost matrix (i.e. find the matrix minimum)

step 2: Find the minimum of the supply & demand values (X) with respect to the cell corresponding to the matrix minimum.

step 3:- Allocate X units to the cell with the matrix minimum. Also, subtract X units from the supply & the demand values corresponding to the cell with the matrix minimum.

tep 4:- check whether exactly one of the row/column corresponding to the cell with the matrix minimum has zero supply / zero demand resp.
If yes, goto step 5 otherwise go to step 6

ep 5 Delete that row/column with respect to the cell with matrix minimum which has the zero supply / zero demand & go to step (7)

step 6. Delete both the row & column with respect to the cell with matrix minimum.

step 7. check whether exactly one row or column is Left out
If yes, go to step 8 otherwise goto step 1.

step 8. Match the supply / demand of that row / column with the remaining demands / supplies of the undeleted columns / rows

step 9. Go to phase 2