1/8/2021.

Transportation Problem.

North West Corner rule.

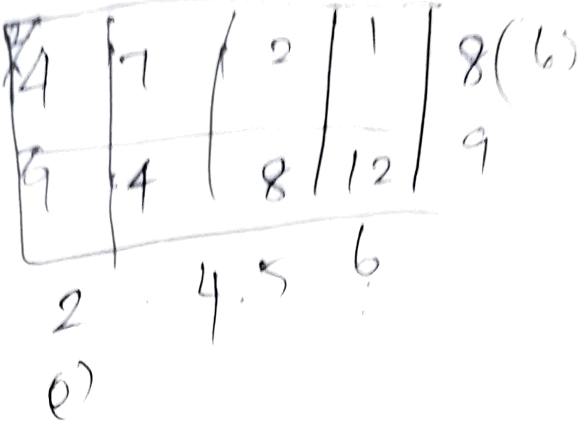
						Supply
P	2	11	10	3	7	4
Q	1	4	7	2	1	8
R	3	9	4	8	12	9
Demand	3	3	4	5	6	21/21

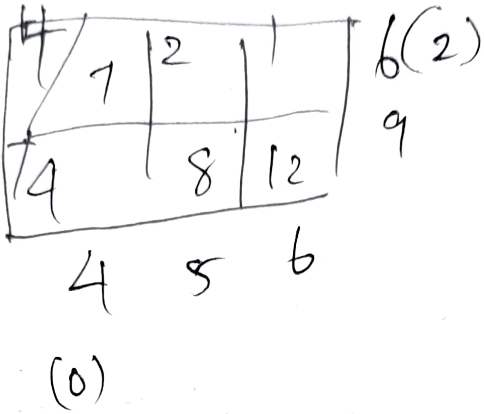
Here demand = supply

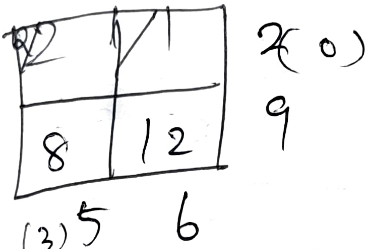
It is a Balanced Transportation Problem

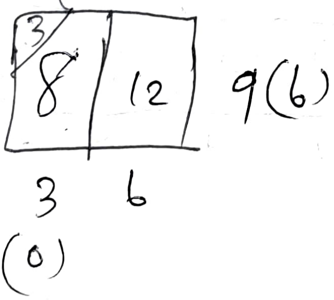
3/2	11	10	3	7	4(1)
1	4	7	2	1	8
3	9	4	8	12	9
3 (0)	3	4	5	6	

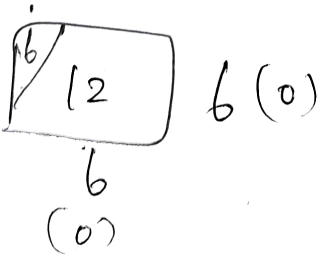
11	10	3	7	1(0)
4	7	2	1	8
9	4	8	12	9
3 (2)	4	5	6	


4 7 2 1 8(6)
9 4 8 12 9
2 4 5 6
(0)


4 7 2 1 6(2)
4 8 12 9
4 5 6
(0)


2 1 2(0)
8 12 9
(3) 5 6


3
8 12 9(6)
3 6
(0)


6
12 6(0)
6
(0)

Total Cost $= 3\times2 + 1\times11 + 2\times4 + 4\times7 + 2\times2$
$+ 3\times8 + 6\times12$

$= 6 + 11 + 8 + 28 + 4 + 24 + 72$

$= 153.$

The no of allocation is

$(\text{row} + \text{column} - 1) = 3 + 5 - 1$

$= 7$

$\therefore$ It is a non degenerate basic feasible solution.

(2)

				Supply
1	2	1	4	30
3	3	2	1	50
4	2	5	9	20
demand 20	40	30	10	100/100.

Here demand = supply.

It is a balanced transportation problem.

20 / 1	2	1	4	30 (10)
3	3	2	1	50
4	2	5	9	20
20 (0)	40	30	10	

10/2	1	4	10(0)
3	2	1	50
2	5	9	20
40	30	10	
(30)			

30/3	2	1	50(20)
2	5	9	20
30	30	10	
(0)			

20/2	1	20(0)
5	9	20
30	10	
(10)		

10/5	9	20(10)
10	10	
(0)		

10/9	10(0)
10	
(0)	

Total cost $= 20\times1 + 10\times2 + 40\times3 + 20\times2$

$+ 10\times5 + 10\times9$

$= 20 + 20 + 90 + 40 + 50 + 90$

$= 310.$

The no of allocation is

$m+n-1 = 3+4-1$

$= 6$

$\therefore$ It is an non-degenerate basic feasible solution.

(3)

			Supply
8	9	8	8
10	7	10	7
11	9	7	9
12	14	10	4
Demand 10	10	8	25/25

Here, demand = supply

$\therefore$ It is an balanced Transportation problem.

8/8	~~9~~	~~8~~	8(0)
10	7	10	7
11	9	7	9
12	14	10	4
10 (2)	10	8	

12/10	7	10	1 (5)
11	9	7	9
12	14	14	4
2 (0)	10	8	

5/7	10	5(0)
9	7	9
14	10	4
10 (5)	8	

5/9	7	9(4)
14	10	4
5 (0)	8	

4/7	4(0)
10	4
8 (4)	

4/10	4(0)
4 (0)	

Total cost = $8\times8+2\times10+5\times7+5\times9+4\times7+4\times10$.

$= 64+20+35+45+28+40$

$= 232$

No of allocation $m+n-1 = 4+3-1=6$.

$\therefore$ It is a non-degenerate basic feasible solution.

Row minimum method.

①.

					Supply
	5	2	4	3	22
	4	8	1	6	15
	4	6	7	5	8
demand	7	12	7	19	45/45.

Here Demand = Supply

$\therefore$ It is an Balanced T.P

5	12 2	4	3	22 (10)
4	8	1	6	15
4	6	7	5	8
7	12 (0)	7	19	

5	4	10/3	10(0)
4	1	6	15
4	7	5	8
7	7	19 (9)	

4	7/1	6	15(8)
4	7	5	8
7	7 (0)	9	

1/4	6	8(1)
7/4	5	8
7 (0)	9	

1/6	1(0)
5	8
9 (8)	

8/5	8(0)
8 (0)	

Total Cost = 12×2 + 10×3 + 7×1 + 7×4 + 1×6 + 8×5 = 24 + 30 + 7 + 28 + 6 + 40

= 135

no of allocation = m+n−1 = 3+4−1 = 6

∴ It is an non-degenerate basic feasible solution..

(2).

			Supply
8	9	8	8
10	7	10	7
11	9	7	9
12	14	10	4
Demand 10	10	8	28/28

Here Demand = supply.
It is an balanced T.P.

(8) 8	9	8	(8 0)
10	7	10	7
11	9	7	9
12	14	10	4
(2) 10	10	8	

~~10~~	~~7~~	~~10~~	7(0)
11	9	7	9
12	14	10	4
2	10 (3)	8	

11	9	8/7	9(1)
12	14	~~10~~	4
2	3	8 (0)	

~~11~~	~~1/9~~	1(0)
12	14	4
2	3 (2)	

2/12	14	4(2)
2 (0)	2	

2/14	2(0)
2(0)	

Total cost $= 8\times 8 + 7\times 7 + 8\times 7 + 1\times 9$
$+ 2\times 12 + 2\times 14$
$= 64 + 49 + 56 + 9 + 24 + 28$

$= 230.$

no of allocation $= m+n-1$

$= 4+3-1 = 6.$

$\therefore$ It is an non-degenerate basic feasible solution.

16/8/2021 Column minimum method.

5	2	4	3	22
4	8	1	6	15
4	6	7	5	8
7	12	7	19	45/45

It is a blanced T.P.

demand = supply.

5	2	4	3	22
7 4	8	1	6	15 (8)
4	6	7	5	8
7	12	7	19	

(6)

12 2	4	3	22 (10)
8	1	6	8
6	7	5	8
12	7	19	

(0)

4	3	10
7 1	6	8 (1)
7	5	8
7	19	

(0)

$\boxed{\overset{10}{\cancel{3}}}$ 10(0)

$\boxed{6}$ 1

$\boxed{5}$ 8

19

(9)

$\boxed{6}$ 1

$\boxed{8/5}$ 8(0)

9

(1)

$\boxed{1/6}$ 1(0)

1

(0)

Least Cost method.

5	4	3	6
4	7	6	8
2	5	8	12
8	6	7	4
8	10	12	30/30.

* In the overall cell choose the least no.

* Suppose if we have a least no we can choose any one.

/5	4	3	6
/4	7	6	8
8/2	5	8	12(4)
/8	6	7	4
8 (0)	10	12	

4	6/3	6(0)
7	6	8
5	8	4
6	7	4
10	12	
	6	

7	6	8
4/5	8	4(0)
6	7	4
10	6	
(6)		

7	6/6	8(2)
6	4/7	4
6	6	
	(0)	

7	2
4/6	4(0)
6	
(2)	

2/7	2(0)
2	
(0)	

Total cost $= (8\times 2) + (6\times 3) + (4\times$

$+ (6\times 6) + (4\times 6) + (2\times$

$= 16 + 18 + 20 + 36 + 24 + 1$

$= 128.$

no of allocation $= m+n-1$

$= 4+3-1 = 6.$

$\therefore$ It is an non-degenerate BFS.

Vogels Approximation method (VAM)

Unit cost penalty method.

10	9	8	8
10	7	10	7
11	9	7	9
12	14	10	4
10	10	8	

10	9	8	8	1 (9-8)
10	7	10	7(0)	3 (10-7)
11	9	7	9	2 (9-7)
12	14	16	4	2 (12-10)
10	10 (3)	8		
1 (11-10)	2 (9-7)	1 (8-7)		

10	9	8	8	1
11	3 9	7	9(6)	2
12	14	10	4	2
10	3(0)	8		
1	5 14-9	1		

10	8	8	1	
11	6 7	6(0)	4	11-7
12	10	4	2	
10	8			
1	1			

10	2/8	8 (6)	2 (10 - 8)
12	1/10	4	2
10 (0)	2		
2	2		

6/10	6 (0)
12	4
10 (4)	
2 (12 - 10)	

4/12	4 (0)
4 (0)	

Total Cost = (7×7) + (3×9) + (6×7) + (2×8) + (6×10) + (4×12)

= 49 + 27 + 42 + 16 + 60 + 48

= 242.

no of allocation = m+n-1

= 4+3-1

= 6.

∴ It is an non-degenerate BFS.

(2).

8	7	3	60
3	8	9	70
11	3	5	80
50	80	80	

∴ It is a Balanced T P.

Demand = supply.

8	7	3	60	4	(7-3)
50 3	8	9	70 (20)	5	(8-3)
11	3	5	80	2	(5-3)
50. (0)	80	80			
5	4	2			

8-3 7-3 5-3

60

~~7~~	~~3~~	60(0)	4	(7-3)
8	9	20	1	9-8
3	5	80	2	5-3
80	80 (20)			
4	2			
7-3	5-3			

8	9	20	1
80/3	5	80(0)	2
80 (0)	20		
5	2		
(8-3)			

20/9	20 (0)
20 (0)	

Total cost $= (50\times3)+(60\times3)+(80\times3)$
$+ (20\times9)$
$= 150+180+240+180$

no of allocation $= m+n-1 = 3+3-1 = 5$.

It is a degenerate BFS.

Unbalanced Transportation problem.

25	17	25	300
15	10	18	500
300	300	800	1100/800

Here Demand $\neq$ supply.

25	17	25	300
15	10	18	500
0	0	0	300
300	300	500	1100/1100

Maximization problems on transportation Problem.

145	143	140	125	135
152	154	151	148	146
160	161	162	160	155
Demand 3000	3000	10000	5000	4000

Solve maximization transportation problem.

(step 1 : Convert maximization problem into minimization problem by multiplying - in all the cost entries :

Supply
5000
10000
12500

-145	-143	-140	-125	-135	5000
-152	-154	-151	-148	-146	10000
-160	-161	-162	-160	-155	12500
3000	3000	10000	5000	4000	

~~1) North west corner rule.~~

~~-145 -143 -140~~ -125

-152 -154 -151 -148

~~-160 -161 -162 -160~~

-145	-143	-140	-125	-125	0
-152	-154	-151	-148	-146	0
-160	-161	-162	-160	-155	0

i) North West Corner Rule.

3000 -145	-143	-140	-125	-135	
-152	-154	-151	-148	-146	
-160	-161	-162	-160	-155	
2000	3000	10,000	5000	4000	2

2000
(0)

2000 -143	-140	-125	-135	0	2000
-154	-151	-148	-146	0	10,000
-161	-162	-160	-155	0	12,500
8000	10,000	5000	4000	2500	

8000
(1000)

1000 -154	-151	-148	-146	0	10,0
-161	-162	-160	-155	0	12,5
1000	10,000	5000	4000	2500	

1000
(0)

35	0	5000 (10000)
46		10,000
55	0	10,5000
	0	
00	2500	

2000 (0)

10,000

12,5000

10,0 00 (9000)

12,5 00

9000	-151	-148	-146	0	9000 (0)
	-162	-160	-155	0	12500
	10000	5000	4000	2500	
	(1000)				

1000	-162	-160	-155	0	12,500 (11,500) ~~2500~~
	10000	5000	4000	2500	
	(0)				

~~-160~~	~~-155~~	~~0~~	~~2500~~
5000	4000	2500	

5000	-160	-155	0	11,500 (6,500)
	5000	4000	2500	
	(0)			

4000	-155	0	6,500 (2500)
	4000	2500	
	(0)		

2500	0	2500 (0)
	2500	
	(0)	

$\cancel{= 3000 \times (-145) + (-2000)}$

$= 3000 \times (-145) + 2000 \times (-143) + 1000(-154)$

$+ 9000 \times (-151) + 1000 \times (-162) +$

$5000 \times (-160) + 4000 \times (-155)$

$= \overset{-435000}{\cancel{2835}} - 286000 - 1{,}54{,}000 - 162000$

$- 1359000 - 800000 - 620000$

$\text{Min } z \boxed{= -3{,}816000}$

$\text{Max } z = 3{,}81{,}16{,}000.$

ii) Row minimum method.

								(2000)
3000	-145	-143	-140	-125	-135	0		5000
	-152	-154	-151	-148	-146	0		10,000
	-160	-161	-162	-160	-155	0		12,500
	3000	3000	10,000	5000	4000	2500		
	(0)							

2000	-143	-140	-125	-135	0	2000 (0)
	-154	-151	-148	-146	0	10,000
	-161	-162	-160	-155	0	12,500
	3000	10,000	5000	4000	2500	
	(1000)					

						(9,000)
1000	-154	-151	-148	-146	0	10,000
	-161	-162	-160	-155	0	12,500
	1000	10,000	5000	4000	2500	
	(0)					

					~~1000~~(0)
900	-151	-148	-146	0	9000
	-162	-160	-155	0	12,500
(1000)	10,000	5000	4000	2500	

(11,500)

10 | ~~1000~~ -162 | -160 | -155 | 0 | 12,500

1000 5000 4000 2500

(0)

(6,500)

5000 | ~~0~~ -160 | -155 | 0 | 11,500

5000 4000 2500

(0)

(2,500)

4000 | ~~0~~ -155 | 0 | 6,500

4000 2500

(0)

(0)

2500 | ~~0~~ 0 | 2500

2500

(0)

total cost = (3000X-145)+(2000X-143)+ (1000X-154) +(9000X-151)+(1000X -162)+(5000X-160)+(4000X-155) +(2500X0)

= -435000-286000-154000 -1359000-162000 ~~-800000~~ -620000+0

= -3,816,000

iii) Column minimum method.

-145	-143	-140	-125	-135	0	5000
-152	-154	-151	-148	-146	0	10,000
3000 -160	-161	-162	-160	-155	0	12,500 (9,500)
3000 (0)	3000	10,000	5000	4000	2500	

-143	-140	-125	-135	0	5000
-154	-151	-148	-146	0	10,000
3000 -161	-162	-160	-155	0	9,500 (6,500)
3000 (0)	10000	5000	4000	2500.	

-140	-125	-135	0	5000
-151	-148	-146	0	10,000
6500 -162	-160	-155	0	6,500 (0)
10,000 (3,500)	5000	4000	2500	

	140	125	135	0	5000
35	151	148	146	0	10,000 (6,500)
	3500	5000	4000	2500	
	(0)				

	125	135	0	5000
5000	148	146	0	6,500 (1500)
	5000	4000	2500	
	(0)			

	135	0	5000
1500	146	0	1500 (0)
	4000	2500	
	(2500)		

2500	135	0	5000 (2500)
	2500	2500
	(0)	

2500	0	2500 (0)
	2500 (0)	

Total cost $= (3000 \times -160) + (3000 \times -161) + (6500 \times -162)$

$+ (3500 \times -151) + (-148 \times 5000)$

$+ (1500 \times -146) + (2500 \times -135)$

$+ 2500 \times 0$

$= -480,000 - 483,000 - 1053000$

$- 528500 - 740000 - 219000 -$

337500

$\min z = -3841000$

$\max z = 3841000$

iv) Least cost method.

-145	-143	-140	-125	-135	0	5000
-152	-154	-151	-148	-146	0	10,000
-160	-161	10000 -162	-160	-155	0	2500 (2500)
3000	3000	10,000 (0)	5000	4000	2500	

-145	-143	-125	-135	0	5000
-152	-154	-148	-146	0	10,000
-160 2500	-161	-160	-155	0	2500 (0)
3000	3000 (500)	5000	4000	2500	

-145	-143	-125	-135	0	5000
-152 500	-154	-148	-146	0	10,000
3000	500 (0)	5000	4000	2500	

-145	-125	-135	0	5000
3000 -152	-148	-146	0	9500 (6500)
3000 (0)	5000	4000	2500	

	−125	−135	0	5000
	500 / −148	−148	0	6500 (1500)
	5000 (0)	4000	2500	

	−135	0	5000
	1500 / −146	0	1500 (0)
	4000 (2500)	2500	

2500 / −135	0	5000 (2500)
2500 (0)	2500	

2500 / 0	2500 (0)
2500 (0)	

Total cost = (10,000 × −162) + (2500 × −161)
+ (500 × −154) + (3000 × −152)
+ (5000 × −148) + (1500 × −146)
+ (2000 × −135) + (2500 × 0)

0
(9500)

= −1,620,000 − 402500 − 77000
− 456000 − 740000 − 219000

-337500

= -3,852,000

min z = -3,852,000

max z = 3,852,000

v) VAM.

-145	-143	-140	-125	-135	0	5000
-152	-154	-151	-148	-146	0	10,000
-160	-161	-162	-161	-155 2500	0	12500
3000	3000	10,000	5000	4000	2500 (0)	10000
7	11	11	23	11	0	

0-(-125)=125

146

155

5000

-145	-143	-140	-125	-135	10	(0) 5000
-152	-154	-151	-148	-146	2	10000
-160	-161	-162	-160	-155	5	10000
7	11	11	23	11		
3000	3000	10000	5000 (0)	4000		

~~145~~ ~~145~~ 142

10000

~~-152~~	~~-154~~	~~-151~~	-146	10000 (0)	5
-160	-161	~~-162~~	-155	10000	5
3000	3000	10000 (0)	4000		

8 ~~10~~ 7 11 ~~108~~ 9

0-(-125)=125

146

155

-160	-161		~~-155~~	~~10000~~ (6000)
3000	3000	~~10000~~	4000 (0)	

-160	-161	~~-162~~	~~6000~~
3000			

-160	-161	~~4000~~ -155	10000 (6000)
3000	3000	4000 (0)	

~~3000~~ -160	-161	6000 (3000)
3000	3000	

(0) (0)

~~3000~~ -161	3000
3000 (0)	

Total no of cost = 2000 X 0 +

$(5000X - 125) +$

$(10000X - 151) +$

$(4000X - 155) +$

$(3000X - 160) +$

$(3000X - 161)$

$= -625000 - 1510000 -$

$620000 - 480{,}000$

$- 483{,}000$

48

min z = $-37{,}18600$

max z = $3{,}718{,}000$