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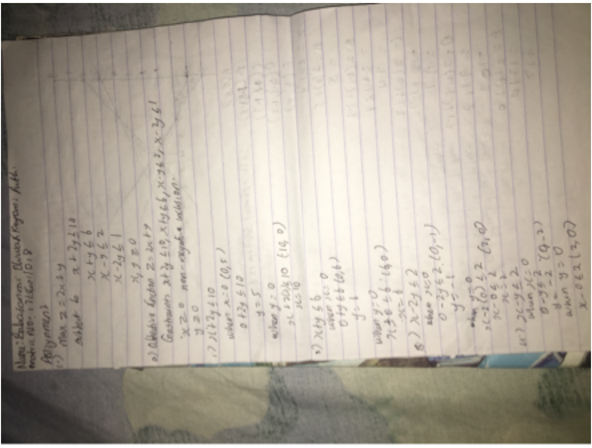
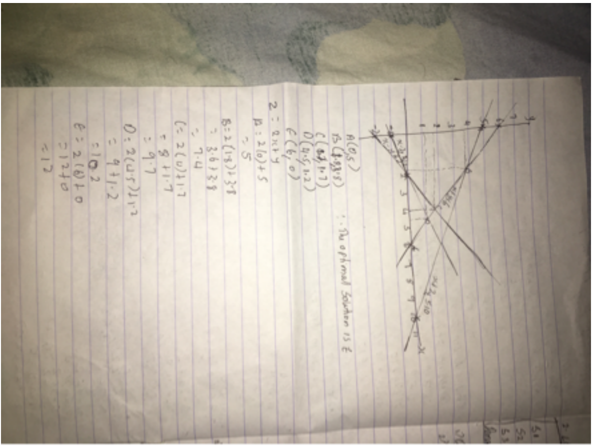
Matric no:17/sci01/018





2. LCM

	D_1	D_2	D_3	D_4	Supply
S_1	20 [110]	30	110	70	60 0
S_2	10 [110]	0 [150]	60 [120]	10 [120]	10 0
S_3	50	80	150	90	100 [illegible]
Demand	70 10	50 0	30 20 0	20 0	

1) Occupied Cells = 6

2) m + n − 1

m = no of rows = 4

n = no of columns = 3

4 + 3 − 1 = 6

① = 2

Total Cost of transportation

$S_1 \to D_1 = 20 \times 6 = 120$

$S_2 \to D_3 = 60 \times 10 = 600$

$S_3 \to D_1 = 50 \times 10 = 500$

$S_3 \to D_2 = 80 \times 50 = 4000$

$S_3 \to D_3 = 150 \times 20 = 3000$

$S_3 \to D_4 = 90 \times 20 = 1800$

Total = 10,020

3) North west corner method

Check for balance

total demand = 70 + 50 + 30 + 20 = 170

total supply = 60 + 10 + 100 = 170

	D_1	D_2	D_3	D_4	Supply
S_1	20 [60]	30	110	30	60 0
S_2	10 [10]	0	60	10	10 0
S_3	50	80 [50]	150 [30]	90 [20]	100 50 20 0
Demand	70 10 0	50 0	30 0	20 0	

Check for degeneracy

① Occupied Cells = 5 | 4 + 3 − 1 = 6

② m + n − 1 | 1 ≠ 2

	D_1	D_2	D_3	D_4	Supply	RP1	RP2	RP3
S_1	[120]	[130]	[110]	[120]	60	10		
S_2	[110]	[10]	[180]	[110]	10	10		
S_3	[150]	[180]	[150]	[190]	100	30		
Demand	70	50	30	20 0				
CP1	10	30	50					

	D_1	D_2	D_3	D_4	Supply	RP
S_1	[120]	[130]	[110]	[120]	60	10
S_2	[110]	[10]	[180]	[110]	10	
S_3	[150]	[180]	[150]	[190]	100	30
Demand	70	50 0	30	20 10		
CP2	30	50	40	20		

	D_1	D_2	D_3	D_4	Supply	RP3
S_1	10 [120]	50 [130]	[110]	[120]	60 0	50
S_2	[110]	[10]	[180]	[110]	10 0	
S_3	60 [150]	[180]	30 [150]	10 [180]	100 40 0	210
Demand	70 60 0	50 0	30 0	20 10 0		
CP3	30		40	20		

$C = 10(20) + 50(30) + 60(50) + 30(150) + 10(90)$

$= 200 + 1500 + 3000 + 4500 + 900$

$C = 10{,}100$

3) Check $R_1 \to R_1 \Rightarrow P_{11} = 0.7$

$R_1 \to R_2 \Rightarrow P_{12} = 0.3$

$R_2 \to R_1 \Rightarrow P_{21} = 0.2$

$R_2 \to R_2 \Rightarrow P_{22} = 0.6$

$R_2 \to R_3 \Rightarrow P_{23} = 0.2$

$R_3 \to R_2 \Rightarrow P_{32} = 0.4$

$R_3 \to R_3 \Rightarrow P_{33} = 0.6$

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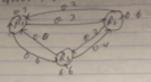
Directed graph



$$P = \begin{pmatrix} 0.7 & 0.3 & 0.0 \\ 0.2 & 0.6 & 0.2 \\ 0.0 & 0.4 & 0.6 \end{pmatrix}$$

$P^{(1)} = P^{(0)} P$

$$P^{(1)} = (0.3, 0.6, 0.1) \begin{pmatrix} 0.7 & 0.3 & 0.0 \\ 0.2 & 0.6 & 0.2 \\ 0.0 & 0.4 & 0.6 \end{pmatrix}$$

$= (0.33, 0.49, 0.18)$

$P^{(2)} = P^{(1)} \cdot P$

$$P^{(2)} = (0.33, 0.49, 0.18) \begin{pmatrix} 0.7 & 0.3 & 0.0 \\ 0.2 & 0.6 & 0.2 \\ 0.0 & 0.4 & 0.6 \end{pmatrix}$$

$= (0.329, 0.465, 0.206)$

c) $xyz = (x, y, z) \begin{pmatrix} 0.7 & 0.3 & 0.0 \\ 0.2 & 0.6 & 0.2 \\ 0.0 & 0.4 & 0.6 \end{pmatrix}$

$(x, y, z) = 0.7x + 0.2y + z,\ 0.3x + 0.6y + 0.4z,\ 0.2y + 0.6z$

$x = 0.7x + 0.2y + z$ — ①

$y = 0.3x + 0.6y + 0.4z$ — ②

$z = 0.2y + 0.6z$ — ③

$x - 0.7x = 0.2y$

$0.3x = 0.2y$

$x = \frac{0.2}{0.3} y$

$x = 0.66y$ — ④

from eqn ①

$1 - 0.6y = 0.3x + 0.4z$

$0.4y = 0.3x + 0.4z$

from eqn ③

$z - 0.6z = 0.2y$

$0.4z = 0.2y$

$z = \frac{0.2}{0.4}y$

$z = 0.5y$

But

$x + y + z = 1 \quad$ ⑤

Put $x = 0.66y$ and $z = 0.5y$ in eqn ⑤

$0.66y + y + 0.5y = 1$

$\frac{2.16y}{2.16} = \frac{1}{2.16}$

$y = 0.46$

Put $y = 0.46$ in eqn ④

$x = 0.66y$

$= 0.66(0.46)$

$x = 0.3$

Put y in $z = 0.5y$

$z = 0.5(0.46)$

$= 0.23$

$\therefore x = 0.3,\ y = 0.46,\ z = 0.23$

4i) $\lambda = \frac{200}{40} = 5$ customers per hour

$\mu = \frac{480}{80} = 6$ customers per hour

i) utility ratio $\rho = \frac{\lambda}{\mu} = \frac{5}{6} = 0.83$

ii) Average no of items in queue $= \frac{\rho^2}{(1-\rho)}$

$\frac{(0.83)^2}{(1-0.83)} = \frac{0.6889}{0.17}$

$= 4.7$

$Lq \approx 4$

iii) Average no of items in system $(Ln) = \frac{\rho}{(1-\rho)}$

$= \frac{0.83}{1-0.83} = \frac{0.83}{0.17}$

$= 4.88$

$Ln \Rightarrow 5$

iv) Average waiting length $= E = \frac{1}{1-\rho} = \frac{1}{1-0.83} = \frac{1}{0.17}$

$= 5.88$

≈ 6 hours

v) Average time in a system $= \frac{1}{\mu-\lambda} = \frac{1}{6-5} = \frac{1}{1}$

$= 1$ hour

6)

	A	B	C
x	(25)	(15)	22
y	31	20	19
z	35	24	(17)

subtract the number from the smallest in the column.

table 2

	A	B	C
x	(0)	(0)	5
y	6	5	(2)
z	10	9	(0)

Circle the least no in rows.

table 3

	A	B	C
x	0	0	3
y	6	(5)	2
z	10	9	0

The numbers where the line cross and meet each other, circle the smallest number, then deduct the smallest number from the ones not crossed

Table	A	B	C
x	0	0	10
y	1	0	2
z	5	4	0

x = 25
y = 20
z = 17
62

5) The minimized cost can be held with assignment problem method

i) Bin	1	2	3	4	5	6	7	8	9
1	-	4	-	6	7	-	3	-	5
2	4	-	5	2	-	3	(1)	-	-
3	-	5	-	7	-	2	2	4	-
4	6	2	7	-	4	(1)	-	3	-
5	-	-	-	4	-	1	-	-	-
6	-	3	(3)	1	1	-	2	(2)	4
7	(5)	(4)	2	-	-	2	-	5	(2)
8	-	-	4	3	-	2	5	-	6
9	5	-	-	-	-	4	2	6	-

ii) Bin	1	2	3	4	5	6	7	8	9
1	-	3	-	5	6	-	(2)	-	3
2	1	-	3	1	-	2	(0)	-	-
3	-	4	-	6	-	(1)	1	2	-
4	3	1	5	-	3	(0)	-	1	-
5	-	-	-	3	-	(0)	-	-	-
6	-	2	(0)	0	0	-	1	0	2
7	(0)	0	0	-	-	1	-	3	0
8	-	-	2	2	-	(1)	4	-	4
4	2	-	-	-	-	3	(1)	4	-

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Bin	1	2	3	4	5	6	7	8	9
1	-	1	-	3	4	-	0	-	1
2	1	-	3	1	-	2	0	-	-
3	-	3	-	5	-	0	0	1	-
4	3	1	5	-	3	0	-	1	-
5	-	-	-	3	-	0	-	-	-
6	-	2	0	0	0	-	1	0	2
7	0	0	0	-	-	1	-	3	0
8	-	-	1	1	-	0	3	-	3
9	(1)	-	-	-	-	2	0	3	-

Bin	1	2	3	4	5	6	7	8	9
1	-	0	-	2	3	-	0	-	0
2	0	-	2	0	-	2	0	-	-
3	-	2	-	4	-	0	0	0	-
4	2	0	4	-	2	0	-	0	-
5	-	-	-	2	-	0	-	-	-
6	-	2	0	0	0	-	1	0	2
7	0	0	0	-	-	1	-	3	0
8	-	-	0	0	-	0	3	-	2
9	0	-	-	-	-	2	0	2	-

9 → 7 = 2
8 → 4 = 3
7 → 3 = 2
6 → 5 = 1
5 → 6 = 1
4 → 7 = 2
3 → 8 = 4
2 → 1 = 4
1 → 9 = 5
24

6b ii) Samsung applied O.R and it helped them to reduce manufacturing times and inventory levels and they made 200 million dollars
- General motors applied OR and it was able to improve the efficiency of their production line.

i) O.R can be applied to communication operations, transporting, computer operations