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18/SCI01/099
CSC 314

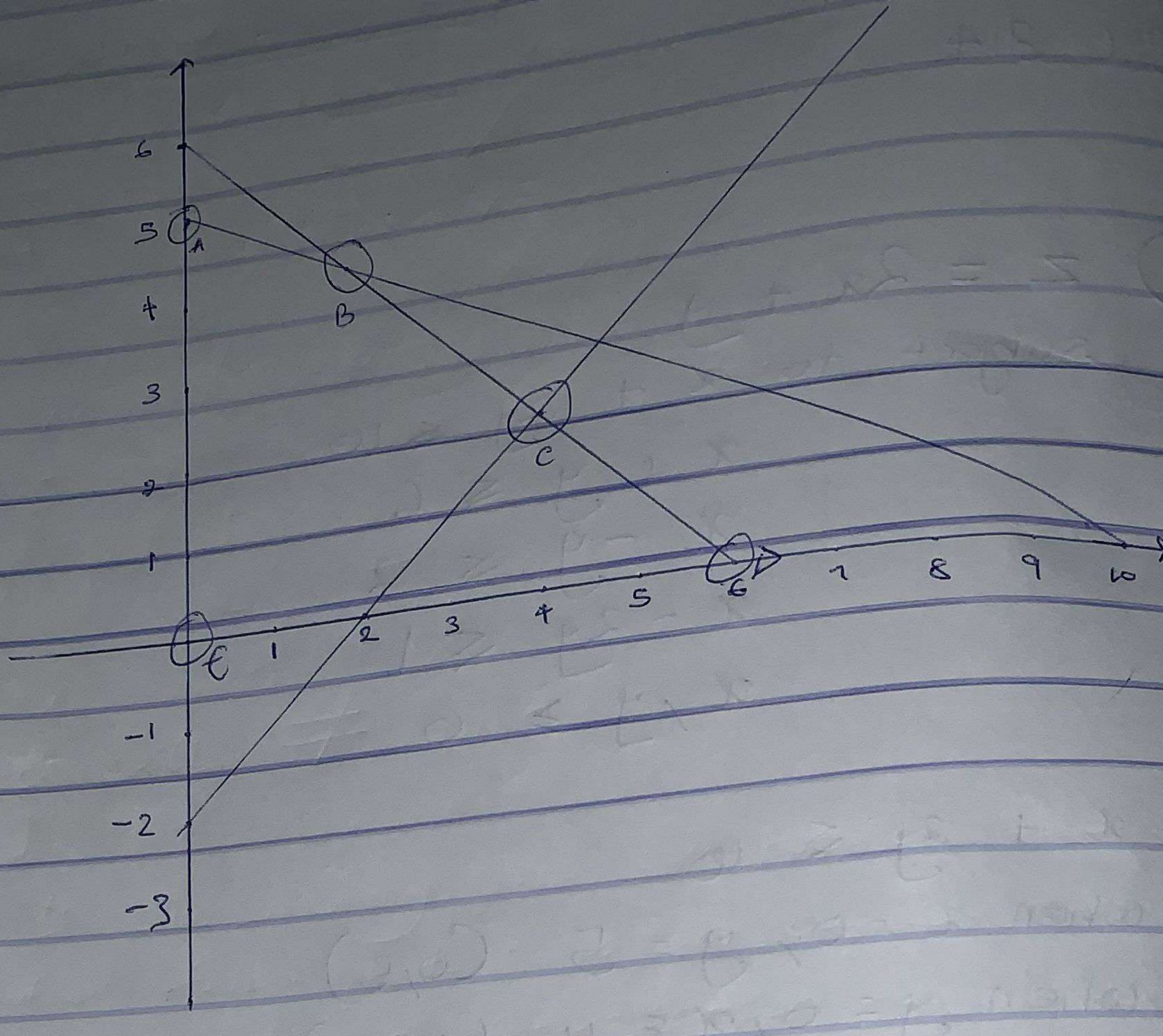
1) $z = 2x + y$
subject to $x + 2y \leq 10$
$x + y \leq 6$
$x - y \leq 2$
$x - 2y \leq 1$
$x, y \geq 0$

1) $x + 2y \leq 10$
when $x = 0, y = 5$ $(0, 5)$
when $y = 0, x = 10$ $(10, 0)$

2) $x + y \leq 6$
when $x = 0, y = 6$ $(0, 6)$
when $y = 0, x = 6$ $(6, 0)$

3) $x - y \leq 2$
when $x = 0, y = -2$ $(0, -2)$
when $y = 0, x = 2$ $(2, 0)$

4) $x - 2y \leq 1$
when $x = 0, y = -0.5$ $(0, -0.5)$
when $y = 0, x = 1$ $(1, 0)$



Optimal value include

A $(0,5)$

B $(2,4)$

C $(2.5, 3.7)$

D $(6,0)$

E $(0,0)$

Substitute the optimal values into the objective functions

$A = 2(0) + 5$

$= 5$

$B = 2(2) + 4$

$= 8$

$C = 2(2.5) + 3.7$

$5 + 3.7 = 8.7$

$D = 2(6) + 0$

$= 12$

$E = 2(0) + 0$

$= 0$

The maximum point/optimal solution is D, $(6,0)$

2 I) The regret method

	D_1	D_2	D_3	D_4	Supply	RP_1	RP_2	RP_3
S_1	$\boxed{20}$ 10	$\boxed{30}$ 50	$\boxed{110}$	$\boxed{70}$	60 ~~10~~ 0	10	10	50
S_2	$\boxed{10}$	$\boxed{0}$	$\boxed{60}$	$\boxed{10}$ 10	~~10~~ 0	10	—	—
S_3	$\boxed{50}$ 60	$\boxed{80}$	$\boxed{150}$ 30	$\boxed{90}$ 10	~~100~~ ~~40~~ ~~10~~ 0	30	30	40
Demand	~~70~~ ~~60~~ 0	~~50~~ 0	~~30~~ 0	~~20~~ ~~10~~ 0				
CP_1	10	30	50	60				
CP_2	30	50	40	20				
CP_3	30	‖	40	20				

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

$C = 200 + 1500 + 100 + 3000 + 4500 + 900$

$C = 10,200$

II) Least Cost method

	D_1	D_2	D_3	D_4	Supply
S_1	20 $\boxed{60}$	30	110	70	~~60~~ 0
S_2	10	0 $\boxed{10}$	60	10	~~10~~ 0
S_3	50 $\boxed{10}$	80 $\boxed{40}$	150 $\boxed{30}$	90 $\boxed{20}$	~~100~~ ~~90~~ ~~50~~ ~~20~~ 0
Demand	~~70~~ ~~10~~ 0	~~50~~ ~~40~~ 0	~~30~~ 0	~~20~~ 0	

demand = supply ∴ the transportation is balanced

checking for degeneracy

occupied cells = 6

$m + (n-1) = 3 + (4-1) = 6$

occupied cell = $(m + (n-1))$

∴ There is no degeneracy

Total cost of transportation

$S_1 \rightarrow D_1 = 60 \times 20 = 1,200$

$S_2 \rightarrow D_2 = 10 \times 0 = 0$

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

$S_3 \rightarrow D_2 = 40 \times 80 = 3,200$

$S_3 \rightarrow D_3 = 150 \times 30 = 4500$

$S_3 \rightarrow D_4 = 1,800$

Total cost $\underline{11,200}$

iii) North-west corner Rule method

Plta	D_1	D_2	D_3	D_4	Supply
S_1	20 [60]	30	110	70	~~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	

Demand = Supply $\therefore$ The transportation is balanced

Checking for degeneracy

occupied cells $= 5$

$m + (n-1) = 3 + (4-1) = 6$

occupied cells $\neq (m + (n-1))$

$\therefore$ There is degeneracy and we would have to use perturbation technique to solve for degeneration but we have not been taught pertubation technique.

3 States :-

Outstanding : A_1

fair : A_2

Poor : A_3

$A_1 \rightarrow A_1 \Rightarrow P_{11} \Rightarrow 0.7$

$A_1 \rightarrow A_2 \Rightarrow P_{12} \Rightarrow 0.3$

$A_1 \rightarrow A_3 \Rightarrow P_{13} \Rightarrow 0.0$

$A_2 \rightarrow A_1 \Rightarrow P_{21} \Rightarrow 0.2$

$A_2 \rightarrow A_2 \Rightarrow P_{22} \Rightarrow 0.6$

$A_2 \rightarrow A_3 \Rightarrow P_{23} \Rightarrow 0.2$

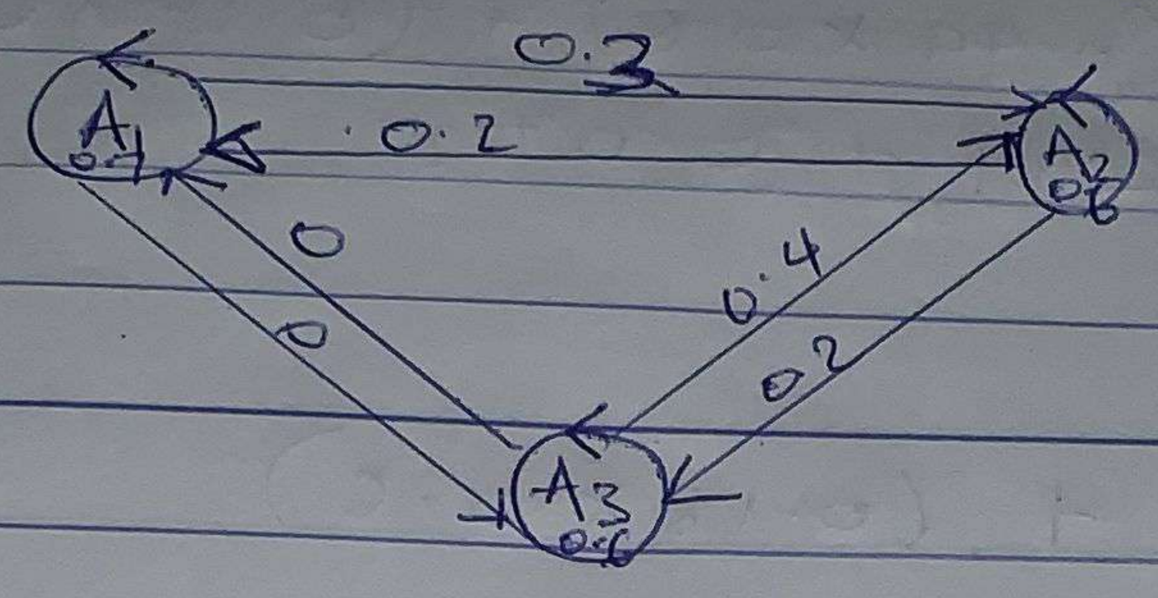
$A_3 \rightarrow A_1 \Rightarrow P_{31} \Rightarrow 0.0$

$A_3 \rightarrow A_2 \Rightarrow P_{32} \Rightarrow 0.4$

$A_3 \rightarrow A_3 \Rightarrow P_{33} \Rightarrow 0.6$

$$\begin{pmatrix} P_{11} & P_{12} & P_{13} \\ P_{21} & P_{22} & P_{23} \\ P_{31} & P_{32} & P_{33} \end{pmatrix}$$

$$\begin{pmatrix} 0.7 & 0.3 & 0 \\ 0.2 & 0.6 & 0.2 \\ 0 & 0.4 & 0.6 \end{pmatrix}$$



b) $P^1 = P^{(0)} \cdot P$

$$= (0.3, 0.6, 0.1) \begin{pmatrix} 0.7 & 0.3 & 0 \\ 0.2 & 0.6 & 0.2 \\ 0 & 0.4 & 0.6 \end{pmatrix}$$

$= (0.3 \times 0.7) + (0.6 \times 0.2) + (0.1 \times 0)$

$= 0.21 + 0.12$

$= 0.33$

$= (0.3 \times 0.3) + (0.6 \times 0.6) + (0.1 \times 0.4)$

$= 0.09 + 0.36 + 0.04$

$= 0.49$

$= (0.3 \times 0) + (0.2 \times 0.6) + (0.1 \times 0.6)$

$0 + 0.12 + 0.66$

$= 0.18$

$P_1 = (0.33, 0.49, 0.18)$

Second transetion

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

$$= (0.33, 0.49, 0.18) \begin{pmatrix} 0.7 & 0.3 & 0 \\ 0.2 & 0.6 & 0.2 \\ 0 & 0.4 & 0.6 \end{pmatrix}$$

$= (0.33 \times 0.7) + (0.49 \times 0.2) + (0.18 \times 0)$
$= 0.231 + 0.098$
$= 0.329$

$= (0.33 \times 0.3) + (0.49 \times 0.6) + (0.18 \times 0.4)$
$= 0.099 + 0.294 + 0.072$
$= 0.465$

$= (0.2 \times 0.49) + (0.18 \times 0.6)$
$= 0.098 + 0.108$
$= 0.206$

$P^2 = (0.329, 0.465, 0.206)$

c) $P(s) = (x, y, z)$
$P(s) = P(s) \cdot P$

$$(x, y, z) = (x, y, z) \begin{pmatrix} 0.7 & 0.3 & 0 \\ 0.2 & 0.6 & 0.2 \\ 0 & 0.4 & 0.6 \end{pmatrix}$$

$x = 0.7x + 0.2y$
$x - 0.7x = 0.2y$
$0.3x = \cancel{y}\, 0.2y$
$x = \frac{0.2}{0.3} y$
$x = 0.667y \quad \cdots \quad (1)$

$y = 0.3x + 0.6y + 0.4z$
$y \cancel{x} - 0.6y = 0.3x + 0.4z$
$0.4y = 0.3x + 0.4z$
$y = 0.75x + z \quad \cdots \quad (2)$

$z = 0.2y + 0.6z$
$z - 0.6z = 0.2y$

$0.4z = 0.2y$

$z = 0.5y \quad \ldots (3)$

put eq 1 in eq 2

$x = 0.667y$

$y = 0.75x + z$

$y = 0.75(0.667y) + z$

$y = 0.5y + z$

$y - 0.5y = z$

$0.5y = z$

$y = 2z$

put $y = 2z$ in eq (3)

$z = 0.5y$

$z = 0.5(2z)$

$z\ z$

$x + y + z = 1 - (4)$

now put eq 1 in eq 4

$x = 0.667y$

$0.667y + y + z = 1$

$1.667y + z = 1$

$z = 1 - 1.667y - (5)$

from eq (2)

$y = 0.75x + z$

$y = 0.75(0.667y) + (1 - 1.667y)$

$y = 0.75(0.667y) + (1 - 1.667y)$

$y = 0.5y + 1 - 1.667y$

$2.1667y = 1$

$y = \dfrac{1}{2.1667}$

$y = 0.4615$

$y = \dfrac{6}{13}$

Since

$z = 1 - 1.667(y)$

$z = 1 - 1.667(0.4615)$

$z = 1 - 0.7639$

$z = 0.2307$

$z = 3/13$

$x = 0.667\,y$

$x = 0.667\,(0.4615)$

$x = 0.3076$

$x = 4/13$

$\therefore x = 4/13,\ y = 6/13,\ z = 3/13$

4 a) Arrival rate $= \lambda = \frac{200}{40} = 5$

Service rate $= \mu = \frac{480}{80} = 6$

The traffic intensity $= S = \frac{\lambda}{\mu} = \frac{5}{6} = 0.83$

b) Avg no of items in the queue $= \frac{\lambda^2}{\mu(\mu-\lambda)}$

$= \frac{5^2}{6(6-5)} = 4.17$

c) Average number of items $= \frac{\lambda}{\mu-\lambda}$

$= \frac{5}{6-5} = 5$

d) Average time in queue before services are rendered

$= \frac{\lambda}{\mu(\mu-\lambda)} = \frac{5}{6(6-5)} = 0.83$

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

$\frac{1}{6-5} = \frac{1}{1}$

$= 1$

6a) The as...
various ...
on a one ...
resultant ...
special ...
problem, ...
availabilit...

Ans)

X

Y

Sub...

(6a) The assignment problem deals in allocating the various items (resources) to various receivers (activities) on a one to one basis in such a way that the resultant effectiveness is optimized. It is a special case of transportation problems. In the problem, ~~transportation~~ supply in each row represents the availability of a resource such as a vehicle etc

(b)

	A	B	C
X	25	15	22
Y	31	20	19
Z	35	24	17

Subtract the smallest number from each column

	A	B	C
X	0	0	5
Y	6	5	2
Z	10	9	0

Subtract the smallest number from each row

	A	B	C
X	0	0	5
Y	6	5	2
Z	10	9	0

	A	B	C
X	0	0	5
Y	4	3	0
Z	10	9 ~~8~~	0

Pick the smallest no that is not crossed and subtract from the rest

	A	B	C
X	0	0	0
Y	+	0	0
Z	7	6	0

Job B would be assigned to X = 15
Job C would be assigned to Y = 19
Job A would be assigned to Z = 35
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b1) O.R applies to the following process to problems
- Orientation
- Problem Definition
- Data Collection
- Model formulation
- Validation and analysis etc

Application to O.R in Computer ~~Systems~~ science are generally in the area of computerized systems (production control, scheduling e.t.c) where the technique of the O.R discipline enables the logical development of the ~~ett~~ computer segments that make up the integrated system

4) - AT&T applied O.R and it helped them to design the operation of their call centers and it made them $750 million in excess
- Samsung electronics applied OR and it helped them to reduce manufacturing time & inventory level & it made them in excess of $200 million.