OMEREJI EZE AMOS
17/sci01/067
CSC 314
Assignment

1) objective function is $Z = 2x + y$
constraints are $x + 2y \le 10$
$x + y \le 6$
$x - y \le 2$
$x - 2y \le 1$
The non-negativity inclusion is $x \ge 0$
$y \ge 0$

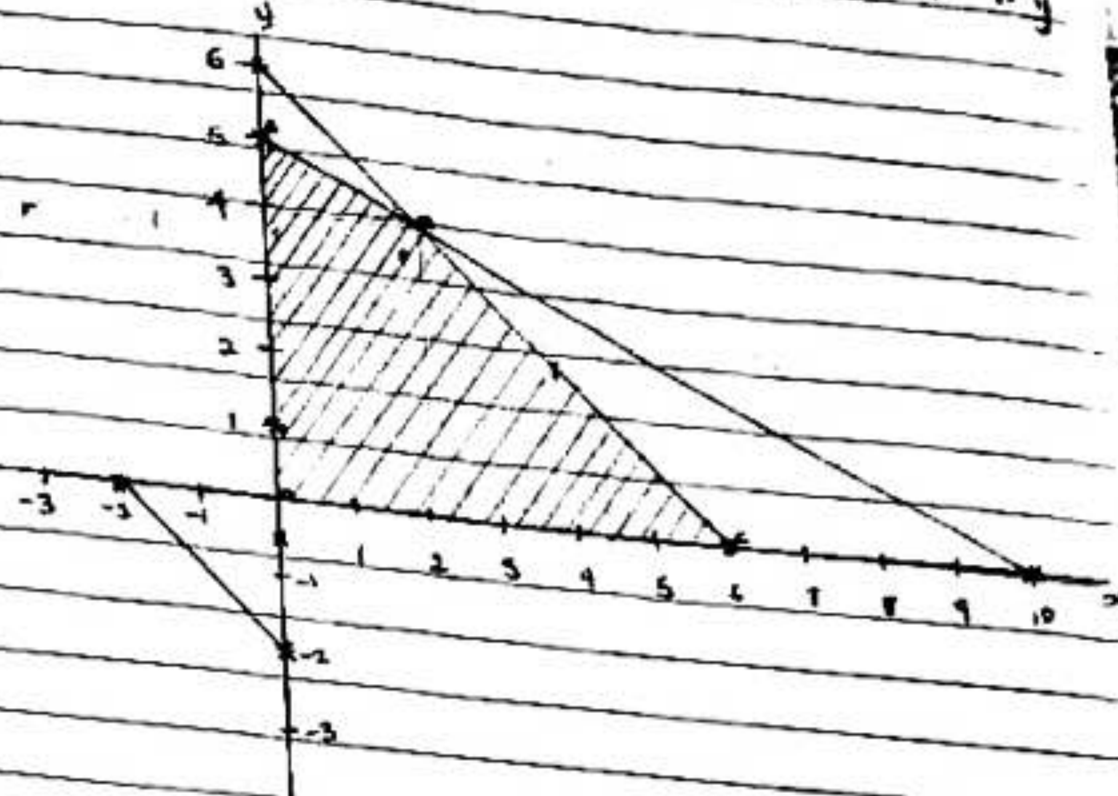
i) $x + 2y \le 10$
when $x = 0$, $y = 10/2 = 5$ } $(0, 5)$
when $y = 0$, $x = 10$ } $(10, 0)$

ii) $x + y \le 6$
when $x = 0$, $y = 6$ } $(0, 6)$
when $y = 0$, $x = 6$ } $(6, 0)$

iii) $x - y \le 2$
when $x = 0$, $y = -2$ } $(0, -2)$
when $y = 0$, $x = -2$ } $(-2, 0)$

iv) $x - 2y \le 1$
when $x = 0$, $y = -0.5$ } $(0, -0.5)$
when $y = 0$, $x = 1$ } $(1, 0)$

1cm → 1unit on x
" " " " y



optimal values:

A (0, 5)

B (2, 3.9)

C (6, 0)

Substitute the values into the objective functions

$A = 2(0) + 5$

$= 5$

$B = 2(2) + 3.9$

$= 7.9$

$C = 2(6) + 0$

$= 12$

The maximum point is C

i) The regret method

2)

	D1	D2	D3	D4	supply	RP1	RP2	RP3	RP4
S1	20 [10]	30 [50]	110	70	~~10~~ ~~60~~	10	10	50	—
S2	10	0	60	10 [10]	~~10~~	10	—	—	—
S3	50 [60]	80	150 [30]	90 [10]	~~100~~ ~~40~~ 10	30	30	40	40
Demand	~~70~~ 60	~~50~~	30	~~10~~ ~~20~~	= 170/170				
CP1	10	30	50	60					
CP2	30	50	40	20					
CP3	30	—	40	20					
~~CP4~~	~~50~~								

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

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

$$C = 10200$$

ii) Least cost method

	D1	D2	D3	D4	supply
S1	20 [60]	30	110	70	~~60~~
S2	10	0 [10]	60	10	~~10~~
S3	50 [10]	80 [40]	150 [30]	90 [20]	~~100~~ ~~90~~ ~~50~~ 30
Demand	~~70~~ ~~10~~	~~40~~ ~~50~~	~~30~~	~~20~~	

occupied cells = 6

$m + n - 1$

m = No of rows = 4

n = No of columns = 3

$4 + 3 - 1 = 6$ This means there is no degeneracy

Total cost

$S_1 \to D_1 = 20 \times 60 = 1200$

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

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

$S_3 \to D_2 = 80 \times 40 = 3200$

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

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

11200

ii) North-west corner method

	D1	D2	D3	D4	supply
S1	20 [60]	30	110	70	~~60~~
S2	10 [10]	0	60	10	~~10~~
S3	50	80 [50]	150 [30]	90 [20]	~~100~~ ~~50~~ ~~20~~
Demand	~~70~~ ~~10~~	~~50~~	~~30~~	~~20~~	

occupied cells = 5

$m+n-1$

m = No of rows = 4

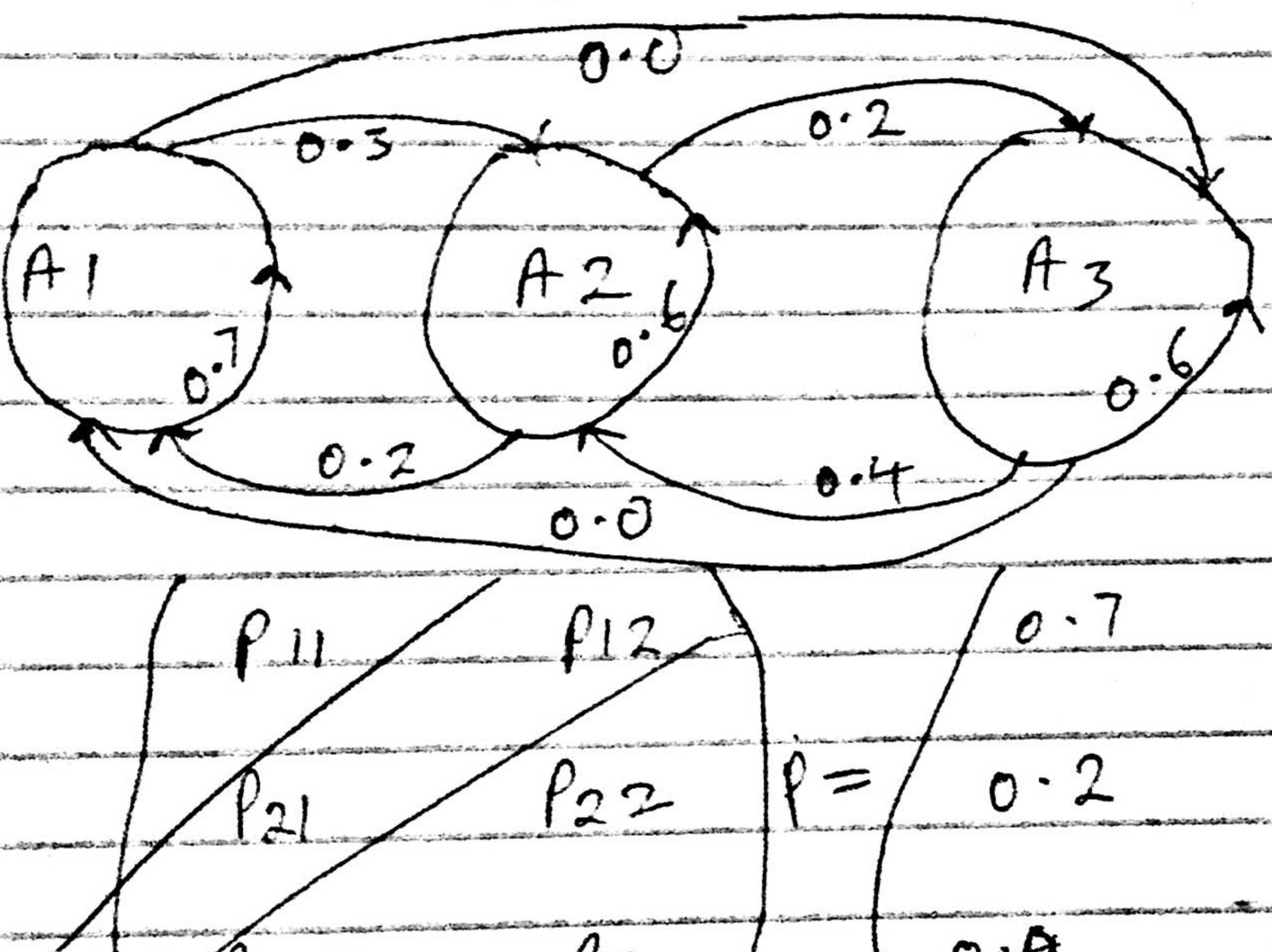
n = No of colums = 3

$4+3-1 = 6$

since occupied cells $\neq m+n-1$ this means there is degeneracy.

3) outstanding = A1
fair = A2
poor = A3

$A_1 - A_1 = P_{11} = 0.7$ ✓
$A_1 - A_2 = P_{12} = 0.3$ ✓
$A_2 - A_1 = P_{21} = 0.2$ ✓
$A_2 - A_2 = P_{22} = 0.6$ ✓
$A_2 - A_3 = P_{23} = 0.2$ ✓
$A_3 - A_2 - P_{32} = 0.4$
$A_3 - A_3 - P_{33} = 0.6$ ✓



$$\begin{pmatrix} P_{11} & P_{12} \\ P_{21} & P_{22} \\ P_{32} & P_{33} \end{pmatrix} \quad P = \begin{pmatrix} 0.7 & 0.3 & 0.0 \\ 0.2 & 0.6 & 0.2 \\ 0.0 & 0.4 & 0.6 \end{pmatrix}$$

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

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

$= (0.33, 0.49, 0.18)$

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

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

$= (0.329, 0.465, 0.206)$

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

$P^{(s)} = (x, y, z)$

$P^{(s)} = P^{(s)} \cdot P$

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

~~$(x, y, z) = (0.7x + 0.2y + 0$~~

$x = 0.7x + 0.2y$

$x - 0.7x = 0.2y$

$0.3x = 0.2y$

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

$x = 0.667y \quad \cdots (1)$

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

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

$0.4y = 0.3x + 0.4z$

$y = 0.75x + z \quad \cdots (2)$

$z = 0.2y + 0.6z$

$z - 0.6z = 0.2y$

$0.4z = 0.2y$

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

$x + y + z = 1 \quad \cdots (4)$

put equation 1

$x = 0.667y$

$0.667y + y + z = 1$

$1.667y + z = 1$

$1.667y + z = 1$

$z = 1 - 1.667y \quad \cdots (5)$

From equation (2)

$y = 0.75x + z$

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

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

$y = 0.5y + 1 - 1.667y$

$$2.1667y = 1$$

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

$$y = 0.4615$$

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

since $z = 1 - 1.667(y)$

$$z = 1 - 1.667(0.4615)$$

$$z = 1 - 0.7639$$

$$z = 0.2307$$

$$z = \sout{0.23}\ 3/13$$

$$x = 0.667y$$

$$x = 0.667(0.4615)$$

$$x = 0.3076$$

$$x = 4/13$$

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

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

service rate $= \frac{480}{80} = 6$

a) Traffick intensity $= \frac{\lambda}{\mu} = \frac{5}{6} = 0.83$

b) Average number of items in the queue $= \frac{\lambda^2}{\mu(\mu-\lambda)} = \frac{5^2}{6(6-5)} = 4.17$

c) Average number of items in the system $= \frac{\lambda}{\mu-\lambda} = \frac{5}{6-5} = 5$

d) Average time in the queue before service $= \frac{\lambda}{\mu(\mu-\lambda)} = \frac{5}{6(6-5)}$

$= 0.83$

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

5)

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	2	1	1	—	2	2	4
7	3	1	2	—	—	2	—	5	2
8	—	—	4	3	—	2	5	—	6
9	5	—	—	—	—	4	2	6	—

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
9	2	—	—	—	—	3	(1)	4	—

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~~	~~—~~	~~—~~		~~—~~	~~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 = 8

8 – 4 = 3

7 – 3 = 2

6 – 5 = 2

6 – 5 = 1

5 – 6 = 1

5 – 6 = 1

4 — 2 = 2

3 — 8 = 4

2 — 1 = 4

1 — 9 = 5

24//

6) a)

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

Identify the smallest numbers in each column. Then deduct the smallest number in each column.

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

Identify the smallest number in each row. Then deduct the smallest number in each row.

Machine	A	B	C
X	~~0~~	~~0~~	~~5~~
Y	4	(3)	~~0~~
Z	10	9	~~0~~

Cross all the zeros with minimal number of lines. Pick the smallest 3, subtract from the rest and add 3 to 5

Machine	A	B	C
X	~~0~~	~~0~~	~~8~~
Y	~~1~~	~~0~~	~~0~~
Z	~~7~~	~~6~~	~~0~~

∴ X = C 22
Y = B 20
Z = A 35

77

b) i) 1) Network optimization: For instance, setup of telecommunications or power system networks to maintain quality of service during outages.

2) Routing: such as determining the routes of buses so that ~~a~~ few buses are needed as possible.

3) Project planning: identifying those processes in a complex project which affect the overall duration of the project.

ii) Impacts of Operation Research in organization:

a) Samsung electronics applied operations research and it helped them to reduce manufacturing time and inventory levels and made them an excess of 200 million dollars.

b) General motors applied operations research and it was able to improve the efficiency of their production line.