OR

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1BM17CS128

1a) Characteristics of OR:

1. Interdisciplinary team approach:
OR involves a team of experts drawn from different scientific and engineering disciplines such as mathematics, statistics, engineering, economics psychology etc.

2. Scientific Research:
OR uses techniques of scientific research to arrive at the optimum solution. In other words, suitable mathematical models are evolved after a careful analysis of the problem. The model is then solved using scientific techniques to get the optimal solution.

3. Wholistic approach:
OR always deals with a problem as a whole. Before arriving at a decision, it takes into consideration all possible interactions between various departments of an organization.

4. Profit and loss:
OR tools and techniques are extremely objective and strictly looks at maximization of profit and minimization of loss.

5. Imperfectness of solutions:
By OR techniques, we may not obtain perfect answers to our problems, but certainly the quality of solution is improved from worse to good answers.

1b) The problem's equations can be written as

MAX $Z = 5x + 3y$

with constraints,

$4x + 5y \leq 1000$

$5x + 2y \leq 1000$

$5x + 8y \leq 1200$

and $x, y \geq 0$

1. To get y intercept, set $x = 0$,

$4(0) + 5y = 1000$

$x = 0 \quad y = 200$ — (1)

to get x intercept, set $y = 0$

$4x + 5(0) = 1000$

$x = 250, \quad y = 0$ — (2)

2. To draw constraint, $5x + 2y = 1000$,

set $y = 0$,

$5x + 2(0) = 1000$

$x = 200, \quad y = 0$ — (3)

set $x = 0$,

$5(0) + 2(y) = 1000$

$y = 500, \quad x = 0$ — (4)

3. To draw constraint, $5x + 8y = 1200$

set $y = 0$,

$x = \frac{1200}{5} = 240$ | 240, 0 — (5)

set $x = 0$,

$y = 150$ | 0, 150 — (6)

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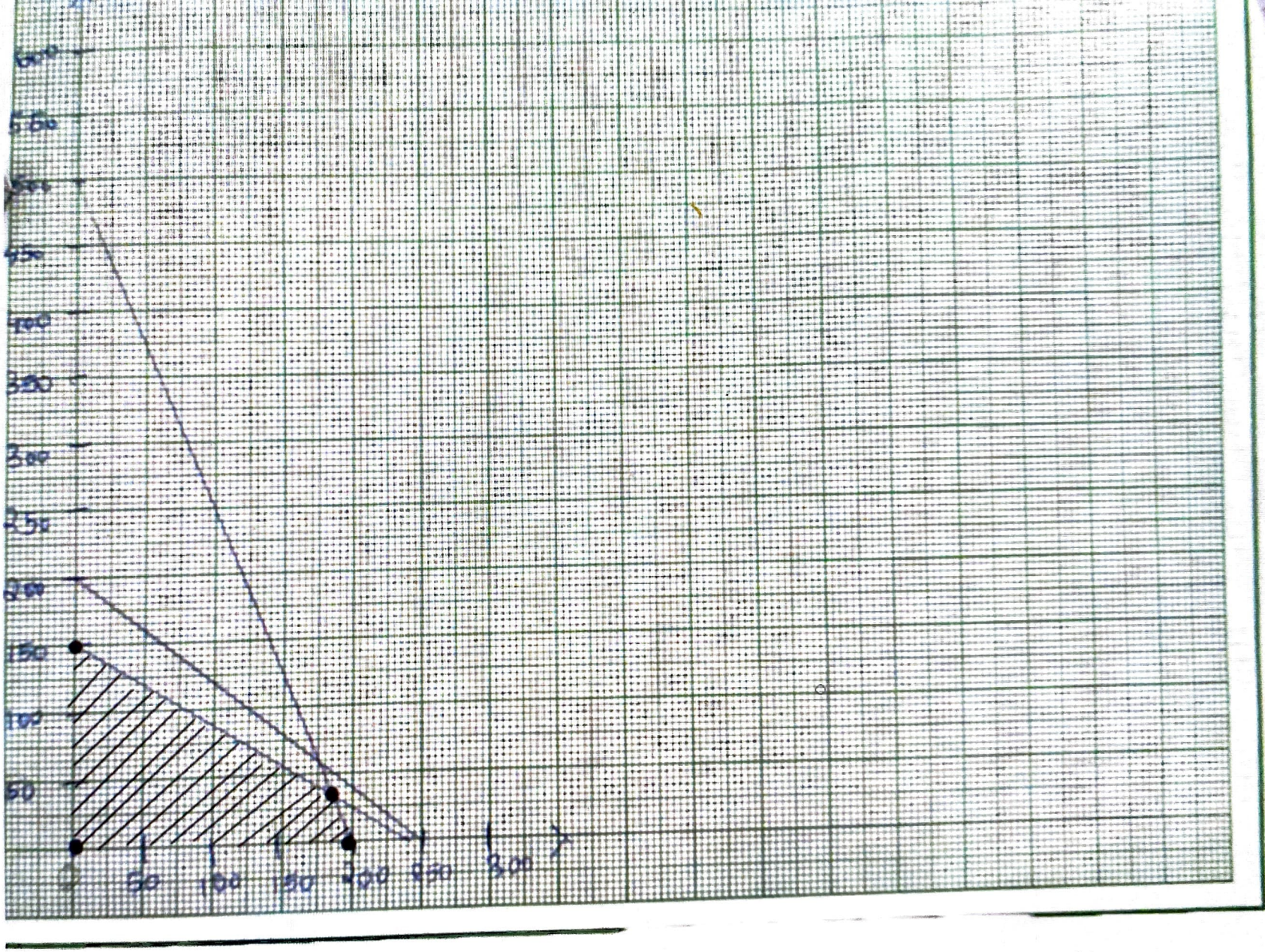
11b)

Extreme Point coordinates (x_1, y)	Lines through Extreme points	Objective function value $Z = 5x + 3y$
$(0,0)$	$4 \rightarrow x \geq 0$ $5 \rightarrow y \geq 0$	$5(0) + 3(0) = 0$
$(200, 0)$	$2 \rightarrow 5x + 2y \leq 1000$ $5 \rightarrow y \geq 0$	$5(200) + 3(0) = 1000$
$(186.67, 33.33)$	$2 \rightarrow 5x + 2y \leq 1000$ $3 \rightarrow 5x + 8y \geq 1200$	$5(186.67) + 3(33.3) = 1033.33$
$(0, 150)$	$3 \rightarrow 5x + 8y \leq 1200$ $4 \rightarrow x \geq 0$	$5(0) + 3(150) = 450$

$\max = 5x + 3y$

185m of type A cloth & 35 m of type B cloth will give maximum profit.


150
100
50
0
50
100
150
200
250
300
x

OR

2a.) $Z = x_1 + 3x_2$

Subject to

$x_1 + 2x_2 \leq 10$

$x_1 \leq 5$

$x_2 \leq 4$

$x_1, x_2 \geq 0$

By simplex method:

Introducing slack variables : $Z = x_1 + 3x_2 + 0S_1 + 0S_2 + 0S_3$

subject to

$x_1 + 2x_2 + S_1 = 10$

$x_1 + S_2 = 5$

$x_2 + S_3 = 4$

Iteration 1:→

		Cj	1	3	0	0	0	
B	C_B	X_B	x_1	x_2	S_1	S_2	S_3	min ratio
S_1	0	10	1	2	1	0	0	5
S_2	0	5	1	0	0	1	0	
S_3	0	4	0	1	0	0	1	4
Z=0		Z_j	0	0	0	0	0	
		$Z_j - C_j$	-1	-3	0	0	0	

∴ entering variable : x_2

leaving basic variable : S_3

pivot element : 1

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Iteration: 2 :→

B	C_B	X_B	x_1	x_2	S_1	S_2	S_3	min ratio
S_1	0	2	1	0	1	1	-2	(2)
S_2	0	5	1	0	0	0	0	5
x_2	3	4	0	1	0	0	1	
		Z_j	0	3	0	0	3	
		$Z_j - C_j$	(-1)	0	0	0	3	

∴ entering variable : x_1, leaving variable : S_1, pivot: 1

Iteration 3

B	C_B	X_B	x_1	x_2	S_1	S_2	S_3	min ratio.
x_1	1	2	1	0	1	0	-2	
S_2	0	3	0	0	-1	1	2	
x_2	3	4	0	1	0	0	1	
		Z_j	1	3	1	0	1	
		$Z_j - C_j$	0	0	1	0	1	

∴ optimal Solution → $x_1 = 2$

$x_2 = 4$

$Z_{max} = 14$

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2b) $F(x) = x_1 + 4x_2 + 5x_3 \rightarrow \max$ (OR)

$3x_1 + 6x_2 + 3x_3 \leq 22$
$x_1 + 2x_2 + 3x_3 \leq 14$
$3x_1 + 2x_2 \leq 14$

Introducing slack variables S_1, S_2, S_3

$3x_1 + 6x_2 + 3x_3 + 0S_1 = 22$
$x_1 + 2x_2 + 3x_3 + 0S_2 = 14$
$3x_1 + 2x_2 + 0S_3 = 14$

Iteration 1

B	Cb	P	x_1	x_2	x_3	S_1	S_2	S_3	
			1	4	5	0	0	0	Q
S_1	0	22	3	6	3	1	0	0	7.33
S_2	0	14	1	2	3	0	1	0	4.67
S_3	0	14	3	2	0	0	0	1	∞
max		0	-1	-4	-5	0	0	0	

$\therefore$ entering variable = x_3
departing variable = S_2

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Iteration 2

C_{Bi}	C_j	1	4	5	0	0	0	solution	Ratio
	B_V	x_1	x_2	x_3	S_1	S_2	S_3		
0	S_1	2	4	0	1	-1	0	8	$8/4 = 2$
5	x_3	1/3	2/3	1	0	1/3	0	14/3	7
0	S_3	3	2	0	0	0	1	14	7
	Z_j =	5/3	10/3	5	0	5/3	0		
	$Z_j - C_j$ =	2/3	-2/3	0	0	5/3	0		

C_{Bi}	C_j	1	4	5	0	0	0	solution	Ratio
	B_V	x_1	x_2	x_3	S_1	S_2	S_3		
4	x_2	1/2	1	0	1/4	-1/4	0	2	
5	x_3	0	0	1	-1/6	1/2	0	10/3	
0	S_3	2	0	0	-1/2	1/2	1	10	
	Z_j =	2	4	5	1/6	3/2	0		
	$Z_j - C_j$ =	1	0	0	1/6	3/2	0		

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$\therefore Z_j - C_j \geq 0$. : The solution is optimum

$x_2 = 2$, $x_3 = 10/3$, $x_1 = 0$

$Z_{max} = x_1 + 4x_2 + 5x_3$

$= 0 + 4 \times 2 + 5 \times 10/3$

$= 8 + 50/3 = 74/3 = 24.667$