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STUDY BUDDIES

Assignment LPP

Q:-1

(1) Let day "i" be 1, 2, 3, 4 ...... starting from Monday: day 1, ----
There are 3 shifts.

Night shift - 1 , Day shift - 2 , Late shift - 3.

also, Let N_{ij} denote the number of workers who are starting their work on day i & shift j.

Constraints:-

Total number of workers ≤ 60.

$$\sum_{i=1}^{7} \sum_{j=1}^{3} N_{ij} \leq 60 \qquad -(1)$$

Secondly we have a lower found on number of workers in a single day & particular shift.

Let W_{ij} denote the minimum number of workers required on day i & shift j.

Worker who work on Monday →

- Either they start on Monday.
- or, they had started on Friday, Saturday or Sunday.

∴ For Monday i.e. $i = 1$,

Monday $N_{1j} + N_{7j} + N_{6j} + N_{5j} \geq W_{1j}$ $(j = 1, 2, 3)$

Tuesday $N_{2j} + N_{1j} + N_{7j} + N_{6j} \geq W_{2j}$

Wednesday $N_{3j} + N_{2j} + N_{1j} + N_{7j} \geq W_{3j}$

Thursday $N_{4j} + N_{3j} + N_{2j} + N_{1j} \geq W_{4j}$

Friday $N_{5j} + N_{4j} + N_{3j} + N_{2j} \geq W_{5j}$

Saturday $N_{6j} + N_{5j} + N_{4j} + N_{6j} \geq W_{6j}$

Sunday $N_{7j} + N_{6j} + N_{5j} + N_{4j} \geq W_{7j}$

- The objective function is to minimize

$$\text{Min} \sum_{i=1}^{7} \sum_{j=1}^{3} N_{ij}$$

(2) Advantages of solving this problem as LPP →

(i) Ability to convert work problem systematically into a LPP.

(ii) We can optimize the problem in almost linear time to reduce workforce.

Disadvantages →

(i) The required solution must be integer which is not always TRUE.

(ii) The optimal sol^n doesn't take the learning or arrival of new workers/ holiday taken by worker will be considered).

Q:-2.

Let X_1 denote no. of units of A

X_2 " " " " " B

Objective Function →

$$\text{Max } Z = 20x_1 + 50x_2.$$

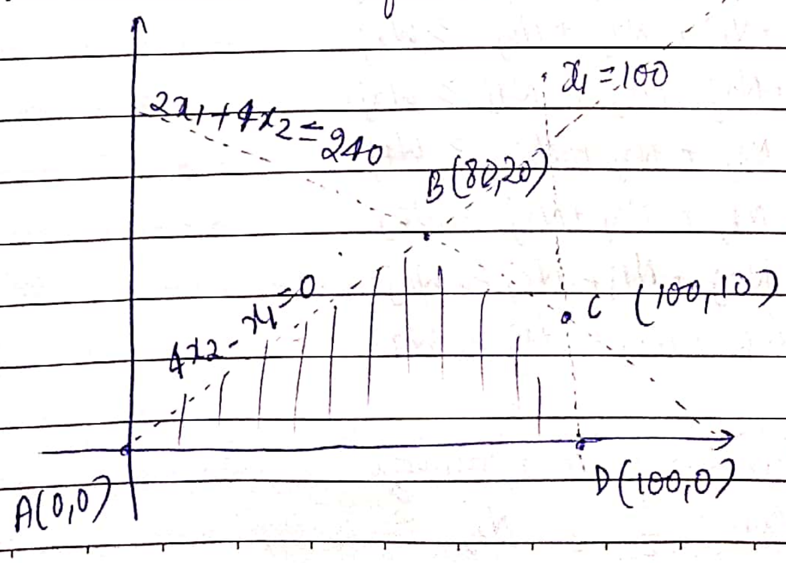
Constraints :-

(1) $\frac{x_1}{x_1+x_2} \geq \frac{80}{100}$ or $4x_2 - x_1 \leq 0$.

(2) $x_1 \leq 100$

(3) $2x_1 + 4x_2 \leq 240$. ; $x_1, x_2 \geq 0$.

Now we have to find the intersection point by graphical method.



Optimum occurs at B (80, 20).

$x_1 = 80, \quad y = 20.$

$Z = 20x_1 + 50x_2 = 20\times80 + 50\times20$

$= 2600$

Q:- 3.

Let X_1 = no. of hour Jack plays.
X_2 = " " " works

Objective Function →
Minimize $Z = 2x_1 + x_2$.

Constraints →

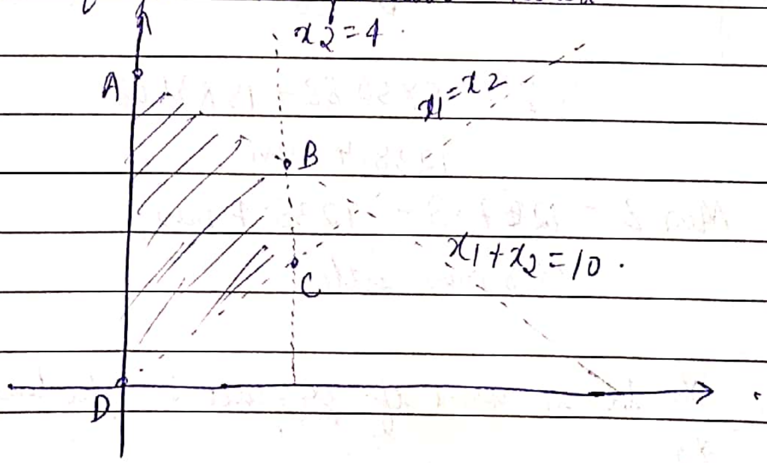
$x_1 + x_2 \le 10$

$x_1 \geq x_2 \Rightarrow x_2 - x_1 \le 0$.

$x_2 \le 4$

$x_1, x_2 \geq 0$.

Now, Min of $Z = 2x_1 + x_2$ is equivalent to 0 because the graph of above eq^n give the feasiable area.



In this the point D satisfies the least criteria & so;
Min $Z = 0$. at $x_1 = 0$ & $x_2 = 0$.

Q:- 4. X_1 = no. of HiFi-1 unit
X_2 = " " HiFi-2 "

Constraints :-

$$6x_1 + 4x_2 \le 432$$
$$5x_1 + 5x_2 \le 412.8$$
$$4x_1 + 6x_2 \le 422.4$$

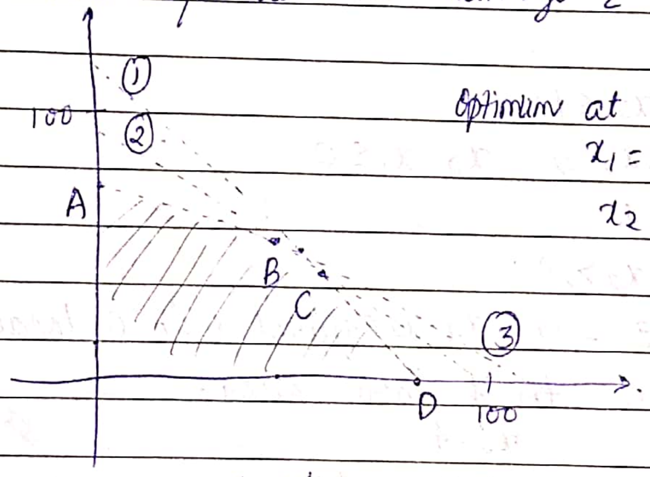
Let I_1 be the time machine 1 sits idle, same for I_2 & I_3.

Hence, $6x_1 + 4x_2 + I_1 = 432$.
$5x_1 + 5x_2 + I_2 = 412.8$.
$4x_1 + 6x_2 + I_3 = 422.8$.

Objective Function →

Min $Z = I_1 + I_2 + I_3 = 1267.2 - 15x_1 - 15x_2$.

This is equivalent to Maximize $Z' = 15x_1 + 15x_2$.



Optimum at
$x_1 = 50.88$
$x_2 = 31.68$.

$\therefore Z' = 15 \times 50.88 + 15 \times 31.68$
$= 1238.4$ min.

Hence; Min $Z = 1267.8 - 1238.4$ min
$= 28.8$ min idle

Q:5 Let x_i be amount of product i, produced on machine X per week
x_2 " " " " y "

Constraints →

$$0.1x_1 + 0.15(x_2 + y_2) + 0.5(x_3 + y_3) + 0.05(x_4 + y_4) \le 50.$$
$$0.95(2(x_3 + y_3)) \le x_2 + y_2 \le 1.05(2(x_3 + y_3)).$$
$$10x_1 + 12x_2 + 13x_3 + 8x_4 \le 1995$$
$$27y_1 + 19y_2 + 33y_3 + 23y_4 \le 1953.$$

Objective Function →

$$Max\ Z = 10x_1 + 12(x_2+y_2) + 17(x_3+y_3) + 8(x_4+y_4)$$

Q:-6.

x_1 = Ratio of scrap A alloy
x_2 = " " scrap B alloy

Objective Function →

$$Min\ Z = 100x_1 + 80x_2.$$

Constraints →

$$0.03 \le 0.06x_1 + 0.03x_2 \le 0.06.$$
$$0.03 \le 0.03x_1 + 0.06x_2 \le 0.05$$
$$0.03 \le 0.04x_1 + 0.03x_2 \le 0.07.$$
$$x_1 + x_2 = 1.$$
and, $x_1, x_2 \geq 0$.

For solving this eqn we have to use LPP solver. After putting the constraints in the LPP solver then;

optimum $x_1 = 0.33$, $x_2 = 0.67$.

$$Min\ Z = \cancel{86.67}\ 100 \times 0.33 + 80 \times 0.67$$
$$= 33 + 53.6$$
$$= 86.6.$$

Q:-7. Let given →

X_1 = No. of single family homes
X_2 = " " double " "
X_3 = " " triple " "
X_4 = No. of recreation areas

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Maximize $z = 10000x_1 + 12000x_2 + 15000x_3$.

Constraints →

$2x_1 + 3x_2 + 4x_3 + x_4 \leq 680$.

$0.5x_1 - 0.5x_2 - 0.5x_3 \geq 0$.

$200x_4 - x_1 - 2x_2 - 3x_3 \geq 0$.

$1000x_1 + 1200x_2 + 1400x_3 + 800x_4 \geq 100000$.

$400x_1 + 600x_2 + 840x_3 + 450x_4 \leq 200000$.

& $x_1, x_2, x_3, x_4 \geq 0$.

Using LPP Solver →

optimum solution is at →

$x_1 = 339.15$ homes.

$x_2 = 0$

$x_3 = 0$

$x_4 = 1.69$ recreation areas.

Hence,

$\text{Max } Z = 10000 \times 339.15 + 0 + 0 + 15000 \times 1.69$

$= 3391500 + 25350$

$= 3416850$.