

Optimization Assignment - Linear

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Problem

A factory manufactures two types of screws , A and B.Each type screw requires the use of two machines , an automatic and a hand operated.It takes 4 minutes on the automatic and 6 minutes on hand operated machines to manufacture a package of screws A,while it takes 6 minutes on automatic and 3 minutes on the hand operated machines to manufacture a package of screws B. Each machine is available for at the most 4hrs on any day.The manufacturer can sell a package of screws A at a profit of Rs.7 and screws B at a profit of Rs.10 .Assuming that he can sell all the screws he manufactures,how many packages of each type should the factory owner produce in a day in order to maximise his profit? Determine the maximum profit.

Solution

Let's assume that

Number of Screws A be x
Number of Screws B be y

Item	Number	Machine A	Machine B	Profit
Screw A	x	4(min)	6(min)	7
SCREW B	y	6(min)	3(min)	10
Max.Time available		4 hrs	4 hrs	

According to Question :

Automated machine works on Screw A - 4 min

Automated machine works on Screw B - 6 min

Maximum time - 4hrs = 4 x 60 = 240 min

Therefore,

$$(4 \quad 6) \begin{pmatrix} x \\ y \end{pmatrix} \leq 240 \quad (1)$$

$$(6 \quad 3) \begin{pmatrix} x \\ y \end{pmatrix} \leq 120 \quad (2)$$

$$x \geq 0, y \geq 0 \quad (3)$$

Hand Operated machine works on Screw A - 6 min

Hand Operated machine works on Screw B - 3 min

Maximum time - 4 hrs = 4 x 60 = 240 min

$$(6 \quad 3) \begin{pmatrix} x \\ y \end{pmatrix} \leq 240 \quad (4)$$

$$(2 \quad 1) \begin{pmatrix} x \\ y \end{pmatrix} \leq 80 \quad (5)$$

$$x \geq 0, y \geq 0 \quad (6)$$

As we need to maximize the profit ,
the function used here is z

Profit on Screw A - Rs.7
 Profit on Screw B - Rs.10
 Therefore,

$$\text{Maximize } z = (7 \ 10) \begin{pmatrix} x \\ y \end{pmatrix} \quad (7)$$

Constraints :

$$(2 \ 3) \begin{pmatrix} x \\ y \end{pmatrix} \leq 120 \quad (8)$$

$$(2 \ 1) \begin{pmatrix} x \\ y \end{pmatrix} \leq 80 \quad (9)$$

$$x \geq 0, y \geq 0 \quad (10)$$

We get the maximum profit by solving the following matrix,

$$\begin{pmatrix} 2 & 3 & 120 \\ 2 & 1 & 80 \end{pmatrix} \rightarrow R_2 - R_1 \begin{pmatrix} 2 & 3 & 120 \\ 0 & -2 & -40 \end{pmatrix} \rightarrow R_2 * \frac{-1}{2} \quad (11)$$

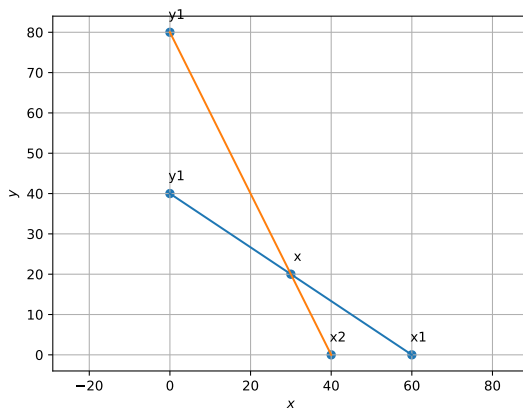
$$\begin{pmatrix} 2 & 3 & 120 \\ 0 & 1 & 20 \end{pmatrix} \rightarrow R_1 - 3R_2 \begin{pmatrix} 2 & 0 & 60 \\ 0 & 1 & 20 \end{pmatrix} \rightarrow \frac{R_1}{2} \begin{pmatrix} 1 & 0 & 30 \\ 0 & 1 & 20 \end{pmatrix} \quad (12)$$

Corner points	Value of Z
(0,40)	400
(30,20)	410
(40,0)	280

Hence ,Profit will be maximum if the company produces
 30 Packages of Screw A
 20 Packages of Screw B

Maximum Profit = Rs.410

Construction



Execution

Verify the above proofs in the following code.

https://github.com/bhavani360/FWC_assignments