Optimization Assignment

Name:A.Gowri Priya   Email : gowripriyaappayyagari@gmail.com

1 Problem

A factory makes tennis rackets and cricket bats. A tennis racket takes 1.5 hours of machine time and 3 hours of craftman's time in its making while a cricket bat takes 3 hour of machine time and 1 hour of craftman's time. In a day, the factory has the availability of not more than 42 hours of machine time and 24 hours of craftsman's time.
(i) What number of rackets and bats must be made if the factory is to work at full capacity?
(ii) If the profit on a racket and on a bat is Rs 20 and Rs 10 respectively, find the maximum profit of the factory when it works at full capacity.

2 Solution

Let's assume that

Number of Tennis rackets be x
Number of Cricket Bats be y

Item	Number	Machine hours	Craftman's hours	Profit
Tennis Rackets	x	1.5	3	$Rs.20$
Cricket Bats	y	3	1	$Rs.10$
Maximum time available		42	24	

According to question:

$$1.5x + 3y \leq 42 \tag{1}$$
$$=> 3x + 6y \leq 84 \tag{2}$$
$$=> x + 2y \leq 28 \tag{3}$$

$$\begin{pmatrix} 1 & 2 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} \leq 28 \tag{4}$$

Also,

$$3x + y \leq 24 \tag{5}$$
$$\tag{6}$$

$$\begin{pmatrix} 3 & 1 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} \leq 24 \tag{7}$$

As we need to maximize profit,
Hence,function used here will be maximize Z

profit on Tennis Racket$=Rs.20$
profit on Cricket Bat$=Rs.10$
Maximize Z=20x+10y

$$Max \ Z = \begin{pmatrix} 20 & 10 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} \tag{8}$$

combining all constraints
subject to constraints

$$\begin{pmatrix} 1 & 2 \\ 3 & 1 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} \leq \begin{pmatrix} 28 \\ 24 \end{pmatrix} \tag{9}$$

$$x \geq 0, y \geq 0 \tag{10}$$

$$\begin{pmatrix} 1 & 2 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} \leq 28 \tag{11}$$

x	0	14
y	14	7

$$\begin{pmatrix} 3 & 1 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} \leq 24 \tag{12}$$

x	2	8
y	18	0

Corner points	Value of Z
(0,14)	140
(4,12)	200
(8,0)	160

(i).Hence,When the factory is work at full capacity,factory produces:

$$\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 4 \\ 12 \end{pmatrix} \tag{13}$$
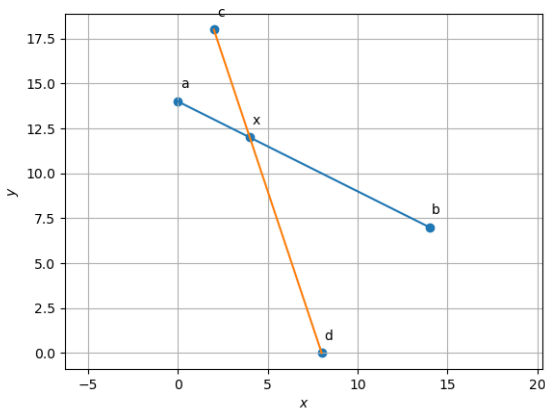
Number of Tennis Rackets=x=4
Number of Cricket Bats=y=12
(ii).Hence,Maximum profit of factory when it works at full capacity:

$$Max \ \ Z = \begin{pmatrix} 20 & 10 \end{pmatrix} \begin{pmatrix} x \\ y \end{pmatrix} \tag{14}$$

$$Max \ \ Z = \begin{pmatrix} 20 & 10 \end{pmatrix} \begin{pmatrix} 4 \\ 12 \end{pmatrix} \tag{15}$$

$\therefore$Maximum profit=Rs.200

3 Construction

4 Execution

Verify the above proofs in the following code.

`https://github.com/gowripriya-2002/FWC/blob/main/Optimization/Basic/code/opp.py`