Problem

A company produces two types of bikes, mountain bikes and road bike. It takes 3 hours to assemble a mountain bike and 4 hours to assemble a road bike. The total time available to assemble bikes is 60 hours. The company wants to sell at least twice as many mountain bikes as road bikes. The company makes a profit of £200 per road bike and £100 per mountain bike. What is the result of the division between the optimal number of mountain and road bikes that should be made to maximize profit?

Solution

x=mountain bike; y=road bike

$$\max_{x,y} 100x + 200y$$

$$\text{s.t.} \quad 3x + 4y \leq 60$$

$$x \geq 0$$

$$y \geq 0$$

$$x \geq 2y$$

Looking at the equation, we want to find the points that intercept the axis.

If $x=0$, then $y=15$, hence the point (0,15).

If $x=20$, then $y=0$, hence the point (20,0).

We plot the line intercepting both points.

Let's rewrite the $x \geq 2y$ constraint as $y \leq \frac{x}{2}$.

Plot this line on the graph. The area underneath it contains all possible values.

The common area underneath the two lines contains all the solutions that satisfy both constraints.

To find the intersection point between the two lines, we try to solve the following:

$$3x + 4\left(\frac{x}{2}\right) = 60$$

$$5x = 60$$

$$x = 12$$

$$y = \frac{x}{2} = \frac{12}{2} = 6$$

So, the point is (12,6).

We are trying to calculate the value of the profit for these 3 points. Any other point results in an inferior result.

For the first point (0,0), the profit is 0.

For the second point (20,0), the profit is 2000.

For the third point (12,6), the profit is 2400.

The point (12,6) generates the highest profit and represents the optimal solution.

We compute the ratio as $\frac{x}{y} = \frac{12}{6} =$ **2**.

Answer: 2

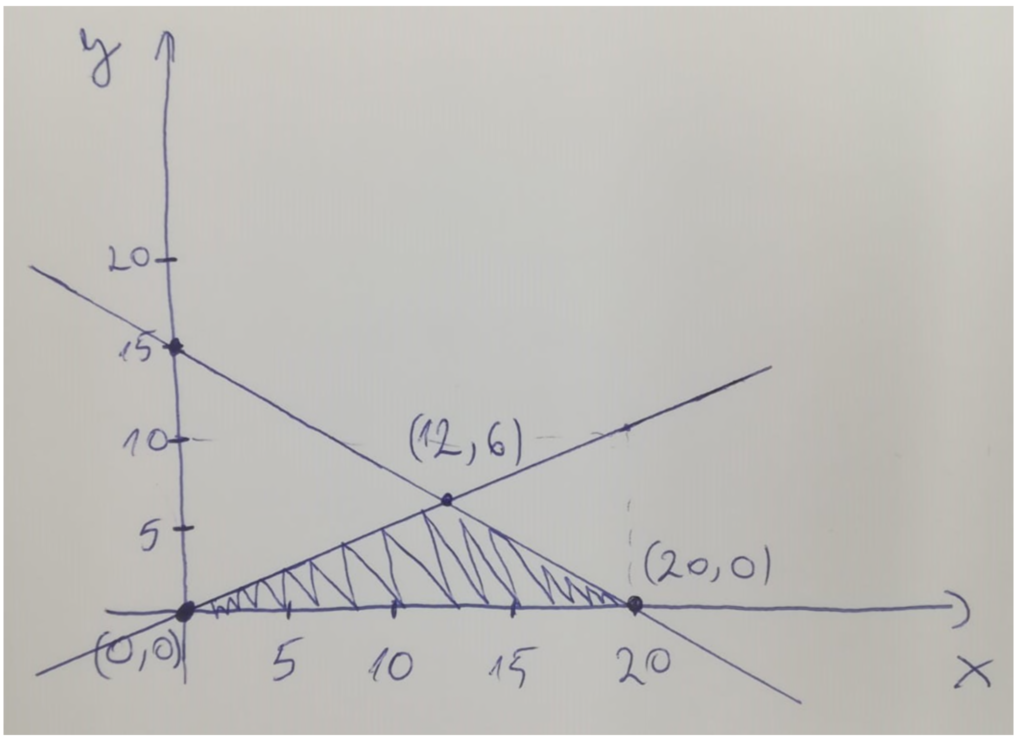

Figure 1. Plotting the feasible area and corner points