Maximizing the Profit of a Business

Math 1010 Intermediate Algebra Group Project- Names Elaine Ong, Amelia Rock-Ward, & Christopher Ferrin.

In this project your group will solve the following problem using the Algebra skills you have acquired:

Your group owns a company that manufacturers two items: desks and bookcases. Each item requires processing time in each of two departments to be completed. Each week, department A has 48 hours available and department B has 40 hours available for production. A desk requires 2 hours in department A and 4 hours in department B. A bookcase requires 3 hours in department A and 2 hours in department B.

Your company's profit on a desk is $37, while profit on a bookcase is $23. Your company has more orders than it can fill, so every desk and bookcase that is built will be sold. However, your company wants to make the most money possible so you want to be smart about the number of each item you build. How many desks and bookcases should be built to maximize profits?

Let x be the number of desks and y be the number of bookcases.

1. Write down a linear inequality for the hours used in Department A to build x desks and y bookcases.

$2x + 3y \leq 48$

2. Write down a linear inequality for the hours used in Department B to build x desks and y bookcases.

$4x + 2y \leq 40$

There are two other linear inequalities that must be met. These relate to the fact that the manufacturer cannot produce negative numbers of items. These inequalities are as follows:

$$x \geq 0$$
$$y \geq 0$$

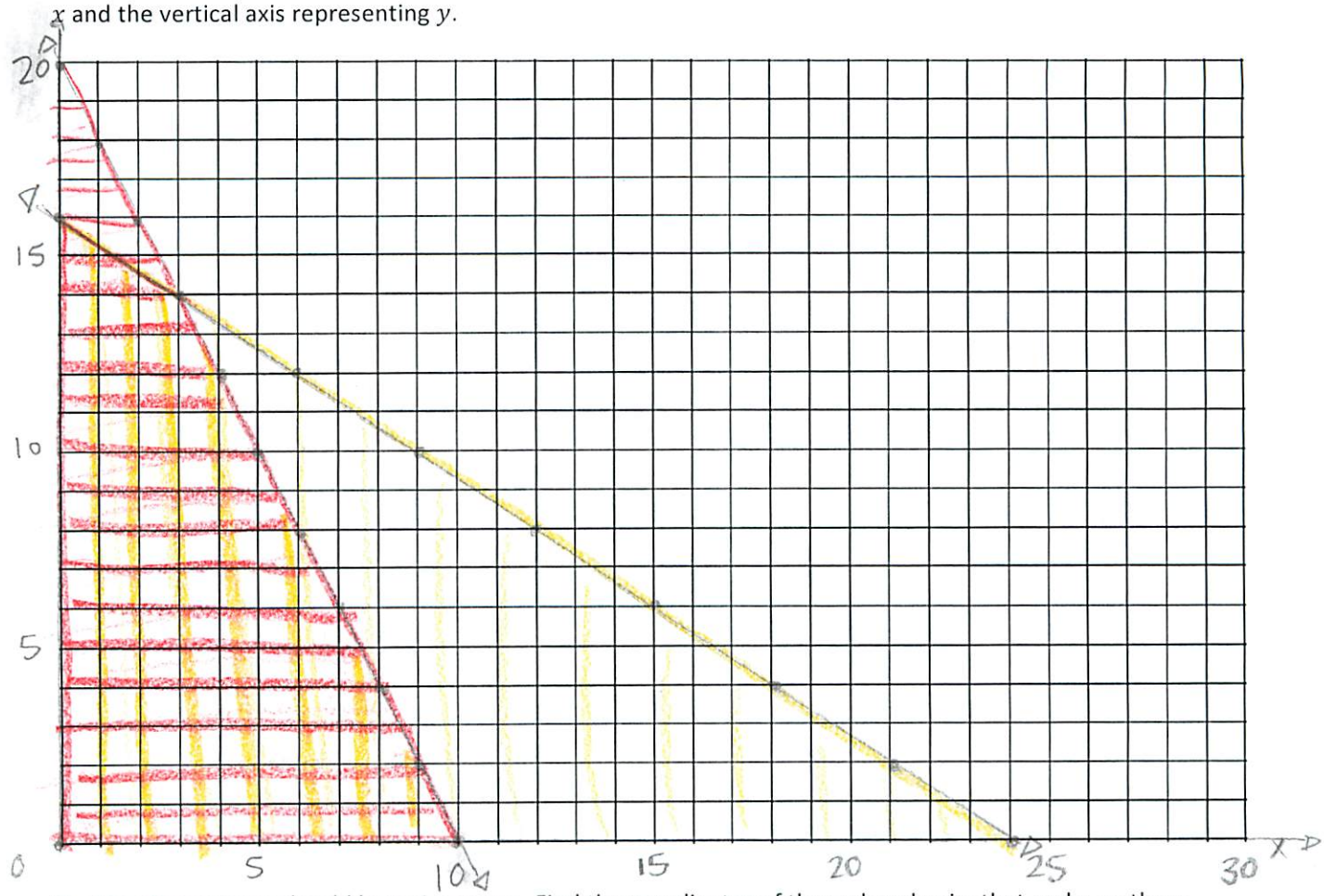
3. Next, write down the profit function for the sale of x desks and y bookcases:

$P = 37x + 23y$

You now have four linear inequalities and a profit function. These together describe the manufacturing situation. These together make up what is known mathematically as a **linear programming** problem. Write all of the inequalities and the profit function together below with the profit function last. Make sure you write the linear inequalities from **parts 1 and 2 above in <u>slope-intercept form</u>**.

1. $y \leq -\frac{2}{3}x + 16$
2. $y \leq -2x + 20$
3. $x \geq 0$
4. $y \geq 0$
5. $P = 37x + 23y$

4. To solve this problem, you will need to graph the **intersection** of all four inequalities on one common x, y plane. Do this on the grid below. Have the bottom left be the origin, with the horizontal axis representing x and the vertical axis representing y.



5. The above shape should have 4 corners. Find the coordinates of the ordered pairs that make up these corners. For the intersection of the two slanted lines you will have to solve the 2 x 2 system made up of their equations. (Show the work needed to solve the 2 x 2 system.)

(0,0) (10,0) (3,14) (0,16)

$x = 3$ desks
$y = 14$ bookcases

$4x + 2(14) =$

$4x + 28 = 40$

$4x = 12$

$x = 3$

$-2(2x + 3y = 48)$

$4x + 2y = 40$

$-4x - 6y = -96$

$-4y = -56$

$y = 14$

6. The last thing to do is to plug each of the points you found in part 5 into the profit function to determine which ordered pair gives the maximum profit. Once you have found the ordered pair that gives the maximum profit write a sentence stating how many of each type of furniture you should build **and** what the maximum profit is for your company. $p = 37x + 23y$

$P = 37(0) + 23(0) = 0$

$P = 37(10) + 23(0) = 370$

$*P = 37(3) + 23(14) = 433$

$P = 37(0) + 23(16) = 368$

To receive the maximum amount of profit for your company, you should build 3 desks & 14 bookcases.

You can read section 4.5 if you need extra help completing this project.