

# Linear Programming

Level 1 - Solve simple linear programming problems



Linear programming is a method used to find the best solution under a set of constraints. This is usually the maximum or minimum value. You'll use inequalities, graphing, and evaluation of key points to solve real-world optimization problems.

## Example:

A student is making bookmarks and posters for a fundraiser. The following constraints are taken into consideration.

- Each bookmark takes 2 minutes to create, uses 1 sheet of paper and earns them 1 dollar.
- Each poster takes 10 minutes to create, uses 2 sheets of paper and earns them 3 dollars

If they only have 12 sheets of paper to work with and can only work for 30 minutes how many of each should they create in order to maximize their profit?

## Solution:

Let  $x$  be the number of bookmarks and let  $y$  be the number of posters.

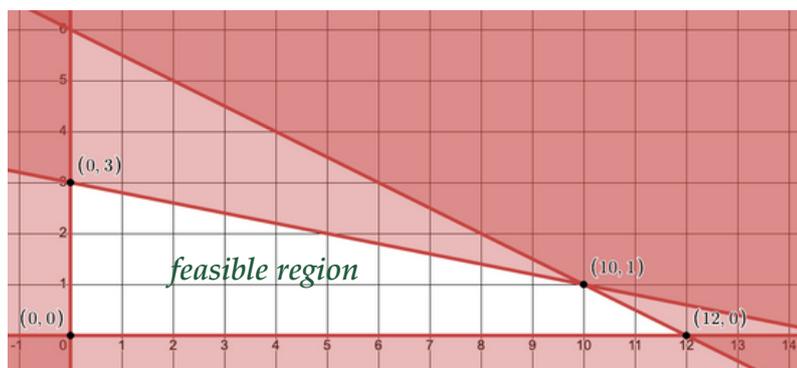
**Profit Function:**  $P = 1x + 3y$

**Paper Constraint:**  $x + 2y \leq 12$

**Time Constraint:**  $2x + 10y \leq 30$

**Non-negative constraints:**  $x \geq 0, y \geq 0$

Graph the constraints to find the feasible region and test the vertex points.



Testing the vertex points we can see that (10, 1) gives the maximum profit:

$$P = x + 3y$$

$$P = (10) + 3(1)$$

$$P = 13 \text{ dollars.}$$

Therefore, the student should make 10 bookmarks and 1 poster to maximize their profits.

## **Remember:**

- Always graph constraints carefully as shading mistakes lead to wrong solutions.
- Only test corner points when optimizing the objective function.
- Check that the corner points make sense. (If they're not integers, is that ok?)
- Remember your non-negative constraints if necessary. (For example, you can't make negative products)