Chapter 7, Section 1

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Formulation of Linear Programming Problems

Outline

- Constraints
- Feasible Sets
- Objective Functions

Example of System of Linear Equations

A truck rental company has two types of trucks to rent. Each Type A truck has 20 cubic feet of refrigerated space and 40 cubic feet of non-refrigerated space, while each truck of Type B has 30 cubic feet of refrigerated space and 30 cubic feet of non-refrigerated space. Foods-R-Us has to ship 900 cubic feet of refrigerated produce and 1200 cubic feet of non-refrigerated produce. How many trucks of each type should Foods-R-Us rent so that they can ship all the produce without wasting any of the space in any rental truck?

Example of Linear Programming

A truck rental company has two types of trucks to rent. Each Type A truck has 20 cubic feet of refrigerated space and 40 cubic feet of non-refrigerated space, while each truck of Type B has 30 cubic feet of refrigerated space and 30 cubic feet of non-refrigerated space. Foods-R-Us has to ship 900 cubic feet of refrigerated produce and 1200 cubic feet of non-refrigerated produce. They can rent a Type A truck for \$100 and a Type B truck for \$120. How many trucks of each type should Foods-R-Us rent so that they can ship all their produce and minimize the cost of truck rentals?

Setup

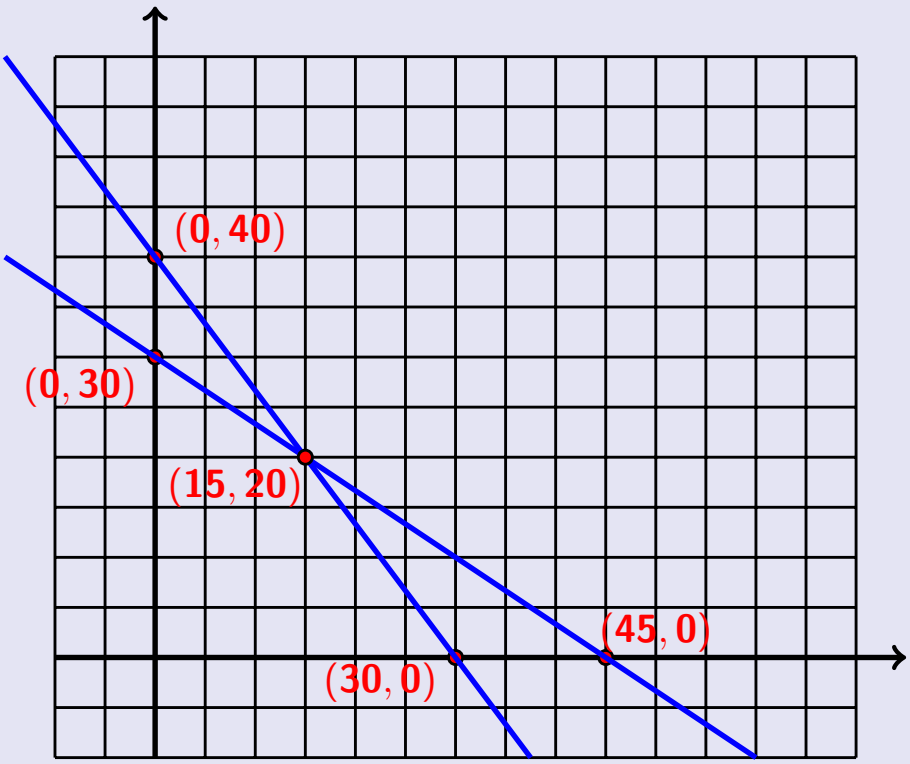
Let $x =$ the number of Type A trucks that will be rented.
Let $y =$ the number of Type B trucks that will be rented.
Write the inequality for refrigerated space.
Write the inequality for non-refrigerated space.

Constraints:

$$\begin{aligned} 20x + 30y &\geq 900 \\ 40x + 30y &\geq 1200 \\ x &\geq 0 \\ y &\geq 0 \end{aligned}$$

Feasible Set:
The set of (x, y) satisfying all constraints simultaneously.

Objective Function: $100x + 120y$
(minimize this in feasible set)



Example

Suppose that Murphy's Muffin Shoppe decides to make both large and small bran muffins. Each large muffin uses 4 ounces of dough and 2 ounces of bran, while a small muffin uses 1 ounce of dough and 1 ounce of bran. Suppose also that there are 300 ounces of dough available each day and 160 ounces of bran. The Shoppe makes a profit of \$0.60 on each large muffin and a profit of \$0.20 on each small muffin it makes. How many muffins of each type should the Shoppe make to maximize its total profit? Formulate a system of inequalities that gives the constraints as well as an objective function for this problem.

Let $x =$ the number of large muffins to bake.
Let $y =$ the number of small muffins to bake.
Write an inequality having to do with the available dough.
Write an inequality having to do with the available bran.
Write an expression that gives the total profit.
Sketch the feasible set for this problem.

Exercise #8

An office furniture manufacturer has available 18 tons of sheet steel to be used to make desks and filing cabinets. It requires 50 pounds of steel and 3 hours of labor to make a filing cabinet and 75 pounds of steel and 2 hours of labor to make a desk. There are 1500 hours of labor available, but only enough tops for 400 desks. The net profit is \$20 on each desk and \$15 on each filing cabinet. How many desks and how many filing cabinets should be produced to provide maximum profit?

Let $x =$ the number of desks to make.
Let $y =$ the number of filing cabinets to make.
Write an inequality having to do with the available sheet steel.
Write an inequality having to do with the available labor.
Write an inequality having to do with the available desk tops.
Write an expression that gives the total profit.
Sketch the feasible set for this problem.