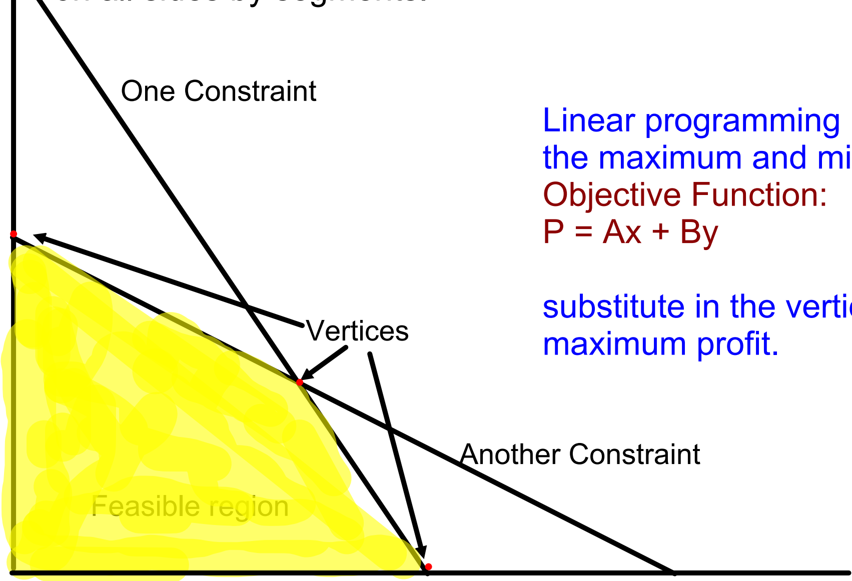
Section 7-6 Linear Programming

Government, business, and industry often require decision makers to find cost-effective solutions to a variety of problems. Linear programming provides businesses and governments with a mathematical form of decision making that makes the most efficient use of time and resources.

Linear programming often serves as a method of expressing the relationships in many of the problems and uses systems of linear inequalities.

Section 7-6 Linear Programing.

Constraints - Restrictions, represented by linear inequalities
Vertices - Where the lines intersect
Feasible Region When the system is graphed, we often obtain a region bounded on all sides by segments.



Linear programming is a powerful tool to find the maximum and minimum values of profit.
Objective Function:
$P = Ax + By$

substitute in the vertices to determine the maximum profit.

Page 458 Linear Programming

EXAMPLE 1 MODELING - *Using the Fundamental Principle of Linear Programming*

The Ric Shaw Chair company makes two types of rocking chairs, a plain chair and a fancy chair. Each rocking chair must be assembled and then finished. The plain chair takes 4 hours to assemble and 4 hours to finish. The fancy chair takes 8 hours to assemble and 12 hours to finish. The company can provide at most 160 worker-hours of assembling and 180 worker-hours of finishing a day. If the profit on a plain chair is $40 and the profit on a fancy chair is $65, how many rocking chairs of each type should the company make per day to maximize profits? What is the maximum profit?

Variables: x= plain y= fancy

Equations:

Assembly: $4x + 8y \le 160$

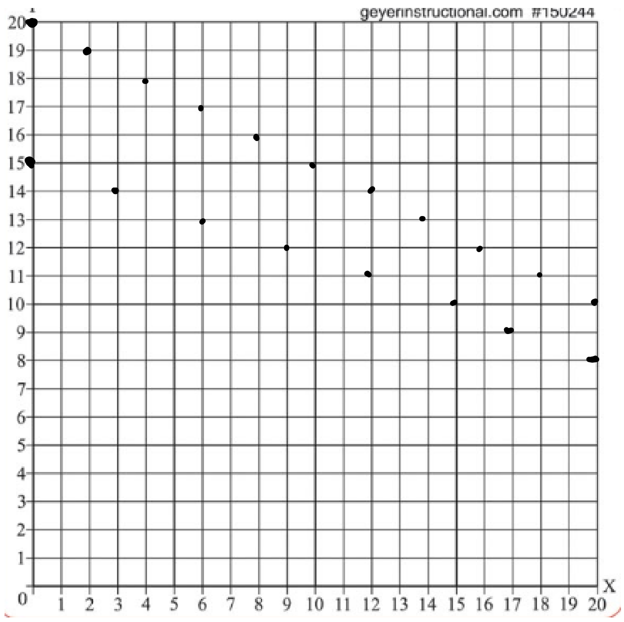
Finish: $4x + 12y \le 180$

$x \ge 0$

$y \ge 0$

Assemby	Finish
4x	4x
8y	12y
160	180

Profit



Assembly → $4x + 8y \le 160$

finish → $4x + 12y \le 180$

$x \ge 0$

$y \ge 0$

$y \le -\frac{1}{2}x + 20$

$y \le -\frac{1}{3}x + 15$

$P = 40x + 65y$

$P =$

Vertices

$(30, 5)$

$(0, 0)$

$(0, 15)$

$(40, 0)$ ← max profit

$P = 40(30) + 65(5) = 1525$

$P = 40(40) + 65(0) = 1600$

Page 459

EXAMPLE 2 MODELING - *Washers and Dryers, Maximizing Profit*

The Admiral Appliance Company makes washers and dryers. The company must manufacture at least one washer per day to ship to one of its customers. No more than 6 washers can be manufactured due to production restrictions. The number of dryers manufactured cannot exceed 7 per day. Also, the number of washers manufactured cannot exceed the number of dryers manufactured per day. If the profit on each washer is $20 and the profit on each dryer is $30, how many of each appliance should the company make per day to maximize profits? What is the maximum profit?

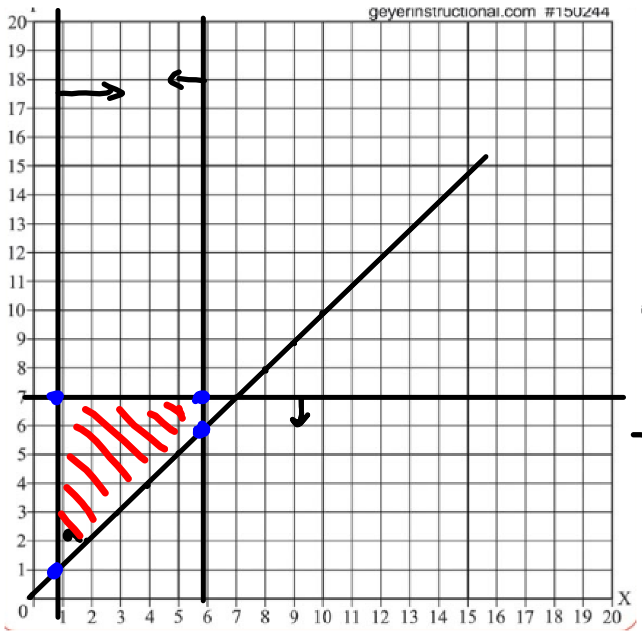
$x \geq 1$ $P = 20x + 30y$ x = wash

$x \leq 6$ y = dry

$y \leq 7$

$x \leq y$

$y \geq 0$



$x \geq 1$

$x \leq 6$

$y \leq 7$

$0 + x \leq y$

$y \geq 0$

$P = 20x + 30y$

Vertices

(1,7)

(6,7)

(6,6)

(1,1)

$P = 20(6) + 30(7)$

Page 463

22) A dietitian prepares a special diet using two food groups, A and B. Each ounce of food group A contains 3 units of vitamin C and 1 unit of vitamin D. Each ounce of food group B contains 1 unit of vitamin C and 2 units of vitamin D. The minimum daily requirements with this diet are at least 9 units of vitamin C and at least 8 units o vitamin D. Each ounce of food group A costs 50 cents, and each ounce of food group B costs 30 cents.

x = Group A   y = Group B

a) List the constraints.

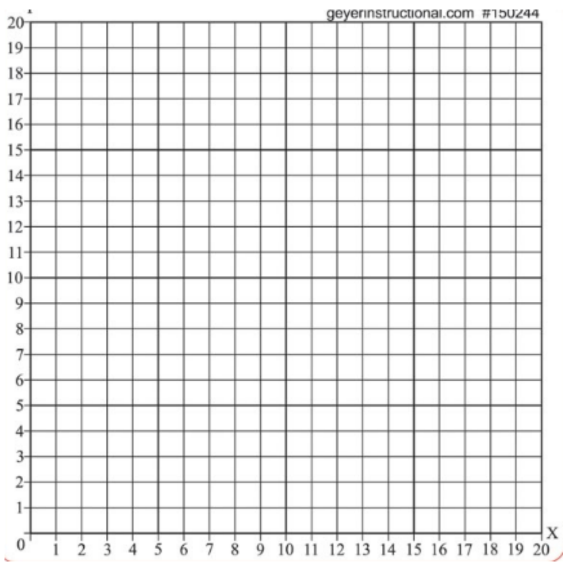
b) Determine the objective function for minimizing cost.

c) Graph the set of constraints.

d) Determine the vertices of the feasible region.

e) How many ounces of each food group should be used to meet the daily requirements and minimize the cost?

f) Determine the minimum cost.



18. **MODELING** - *On Wheels* The Boards and Blades Company manufactures skateboards and in-line skates. The company can produce a maximum of 20 skateboards and pairs of in-line skates per day. It makes a profit of $25 on a skateboard and a profit of $20 on a pair of in-line skates. The company's planners want to make at least 3 skateboards but not more than 6 skateboards per day. To keep customers happy, they must make at least 2 pairs of in-line skates per day.

a) List the constraints.

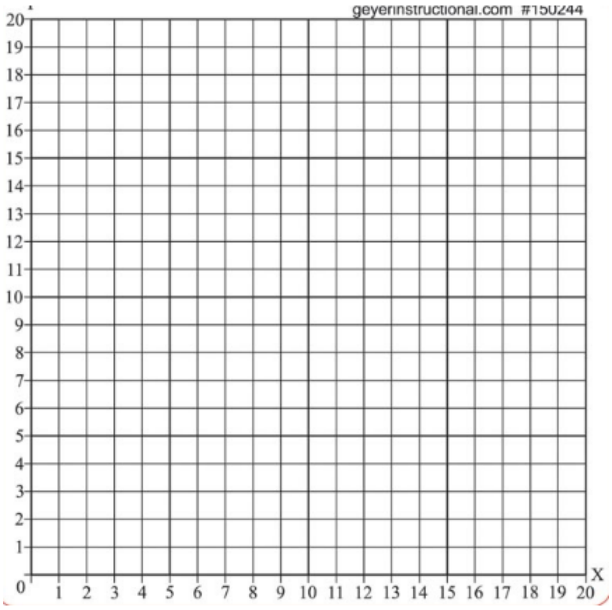
b) Determine the objective function.

c) Graph the set of constraints.

d) Determine the vertices of the feasible region.

e) How many skateboards and pairs of in-line skates should be made to maximize the profit?

f) Find the maximum profit.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X

Cost and Revenue

A manufacturer sells cell phones for $300 per unit. Manufacturing costs consist of a fixed cost of $8400 and a production cost of $230 per unit.

a) Write the cost and revenue equations.

b) Graph both equations (for up to and including 150 units) on the same axes.

c) Determine the number of units the manufacturer must sell to break even.

d) Write the profit formula.

e) Determine the manufacturer's profit or loss if 100 units are sold.

f) How many units must the manufacturer sell to make a profit of $1260?