MA 110 SECTION 5.3: LINEAR PROGRAMMING: GEOMETRIC APPROACH
HOMEWORK: 1, 11, 31, 33, 35, 41

1. **THE LINEAR PROGRAMMING PROBLEM:**
   A problem that can be solved using linear programming is recognizable by noting that several constraints and an objective have been listed for a problem.

2. **EXAMPLE:** A dietician in a hospital is to arrange a special diet composed of two foods, M and N. Each ounce of food M contains 30 units of calcium, 10 units of iron, 10 units of vitamin A, and 8 units of cholesterol. Each ounce of food N contains 10 units of calcium, 10 units of iron, 30 units of vitamin A, and 4 units of cholesterol. If the minimum daily requirements are 360 units of calcium, 160 units of iron, and 240 units of vitamin A, how many ounces of each food should be used to meet the minimum requirements and at the same time minimize the cholesterol intake? what is the minimum cholesterol intake?

A. Part One: Steps to Complete:
   1. Identify the decision variables. (What do x and y represent?)
   2. Create a table to summarize the given information.
   3. Determine the objective and write a linear objective function.
   4. Write problem constraints using linear equations and/or inequalities.
   5. Write nonnegative constraints.

STEP 1:
For our example, we are to determine how many ounces of each type of food should be used to meet the minimum daily requirement and minimize the cholesterol intake.

X = Y =

STEP 2: We construct a table with the given information.

STEP 3: Determine the objective and write a linear objective function.

STEP 4: Write problem constraints using linear equations and/or inequalities.

STEP 5: Write nonnegative constraints.

We now have our mathematical model:

We are now ready for part two: finding the optimal solution(s). According to the theorem on page 279, if the optimal value of the objective function in a linear programming problem exists, then that value must occur at one (or more) of the corner points of the feasible region. We will discuss theorem two (page 279) and the cases in which the linear programming problem has no solution next time.

Part Two: Steps to Complete:

1. Graph the feasible region and find the corner points. Note: there are linear programming problems with no solutions – we will discuss those next time.
2. Make a table of the value of the objective at each corner point.
3. Determine the optimal solution(s).
4. For applied problems, interpret the optimal solution(s) in terms of the original problem.
5. Answer related questions.

STEP 1: Graph the feasible region.

$30x + 10y \geq 360$
$10x + 10y \geq 160$
$10x + 30y \geq 240$
$X \geq 0$ and $y \geq 0$

Corner Points:

X	Y	C = 8 x + 4 y

STEP 3: Determine the optimal solution(s).

STEP 4: Write solution in the context of the problem.

STEP 5: Answer any extra questions.

What is the cholesterol intake with the optimal solution?

How much calcium is provided by the optimal solution?

How much iron is provided by the optimal solution?

How much vitamin A is provided by the optimal solution?

Does the optimal solution provide more than the minimum requirements for any of calcium, iron, or vitamin A?