Linear Programming Problems

1. **A calculator company produces a scientific calculator and a graphing calculator. Long-term projections indicate an expected demand of at least 100 scientific and 80 graphing calculators each day. Because of limitations on production capacity, no more than 200 scientific and 170 graphing calculators can be made daily. To satisfy a shipping contract, a total of at least 200 calculators much be shipped each day. If each scientific calculator sold results in a $2 loss, but each graphing calculator produces a $5 profit, how many of each type should be made daily to maximize net profits?**

x = scientific

y = graphing

$x \geq 100$

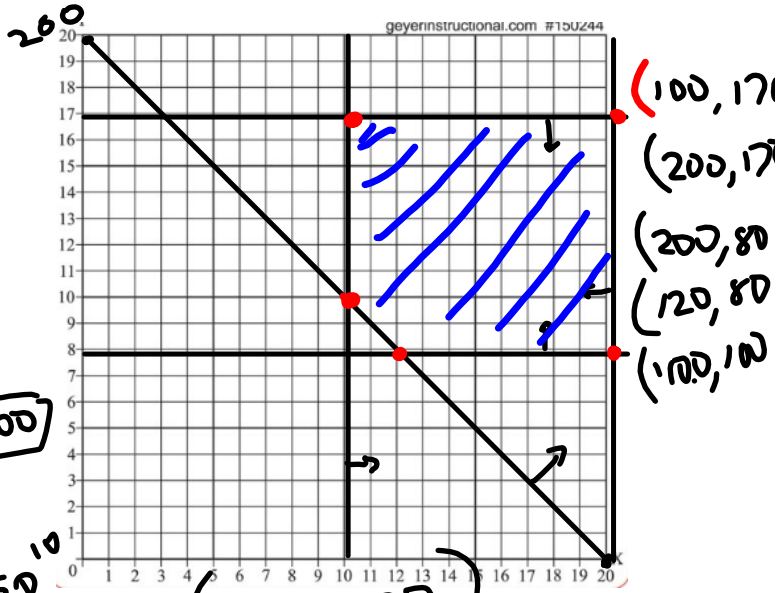
$y \geq 80$

$x \leq 200$

$y \leq 170$

$x + y \geq 200$

$y \geq -x + 200$



$P = -2x + 5y$

$P = -2(100) + 5(170) = 650$

$P = -2(100) + 5(80) = 300$

2. **You need to buy some filing cabinets. You know that Cabinet X costs $10 per unit, requires six square feet of floor space, and holds eight cubic feet of files. Cabinet Y costs $20 per unit, requires eight square feet of floor space, and holds twelve cubic feet of files. You have been given $140 for this purchase, though you don't have to spend that much. The office has room for no more than 72 square feet of cabinets. How many of which model should you buy, in order to maximize storage volume?**

$10x + 20y \leq 140$

$6x + 8y \leq 72$

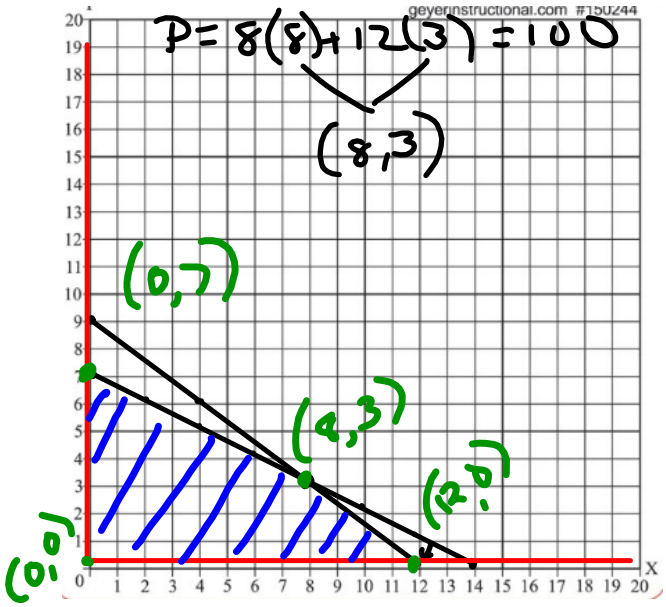
$x \geq 0$

$y \geq 0$

$P = 8x + 12y$

$y \leq -\frac{1}{2}x + 7$

$y \leq -\frac{3}{4}x + 9$



A nutrition center sells health food to mountain climbing teams. The Trailblazer mix package contains one pound of corn cereal mixed with four pounds of wheat cereal and sells for $9.75. The Frontier mix package contains two pounds of corn cereal mixed with three pounds of wheat cereal and sells for $9.50. The center has 60 pounds of corn cereal and 120 pounds of wheat cereal available. How many packages of each mix should the center sell to maximize its income?

x = Trail
y = Frontier

e) List the constraints.
f) Graph the constraints.
g) List the vertices of the feasible region.
h) Write the Profit formula and use the vertices to determine the maximum profit.

$P = 9.75x + 9.50y$

$1x + 2y \leq 60$

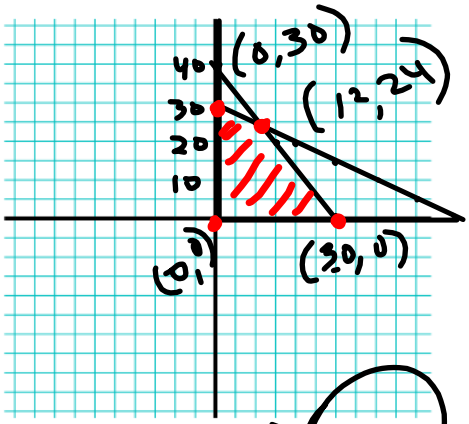
$4x + 3y \leq 120$

$x \geq 0$

$y \geq 0$

$y = -\frac{1}{2}x + 30$

$y = -\frac{4}{3}x + 40$

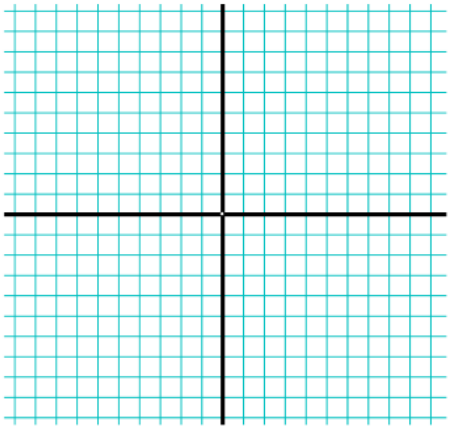


$P = 9.75(12) + 9.50(24) = 345$

$P = 9.75(30) = 292$

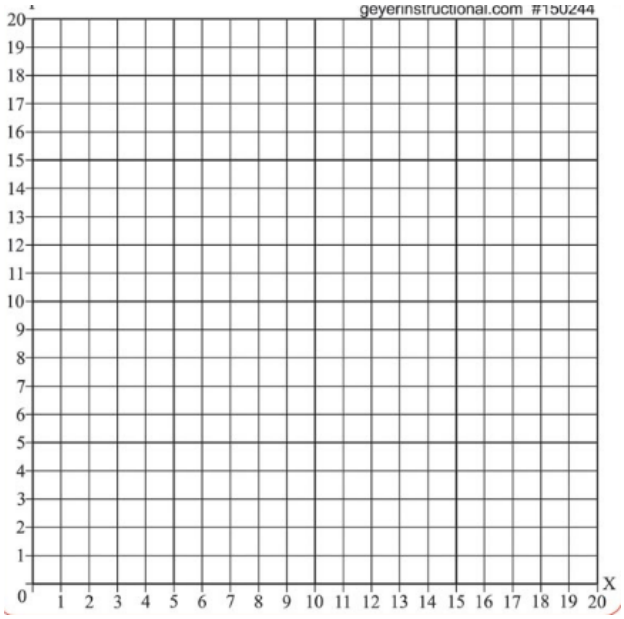
Consider this scenario: your school is planning to make hats and mittens to sell at the winter festival as a fundraiser. The school's sewing classes divide into two groups – one group can make hats, the other group knows how to make mittens. The sewing teachers are also willing to help out. Considering the number of people available and time constraints due to classes, only 150 hats and 120 pairs of mittens can be made each week. Enough material is delivered to the school every Monday morning to make a total of 200 items per week. Because the material is being donated by community members, each hat sold makes a profit of $2 and each pair of mittens sold makes a profit of $5.

a) List the constraints.
b) Graph the constraints.
c) List the vertices of the feasible region.
d) Write the Profit formula and use the vertices to determine the maximum profit.



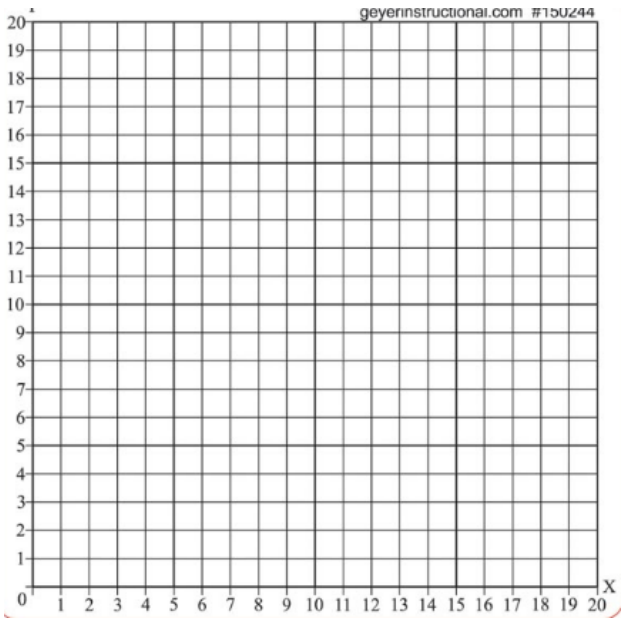
Example - potter making cups and plates

A potter is making cups and plates. It takes her 6 minutes to make a cup and 3 minutes to make a plate. Each cup uses 3/4 lb. of clay and each plate uses one lb. of clay. She has 20 hours available for making the cups and plates and has 250 lbs. of clay on hand. She makes a profit of $2 on each cup and $1.50 on each plate. How many cups and how many plates should she make in order to maximize her profit?



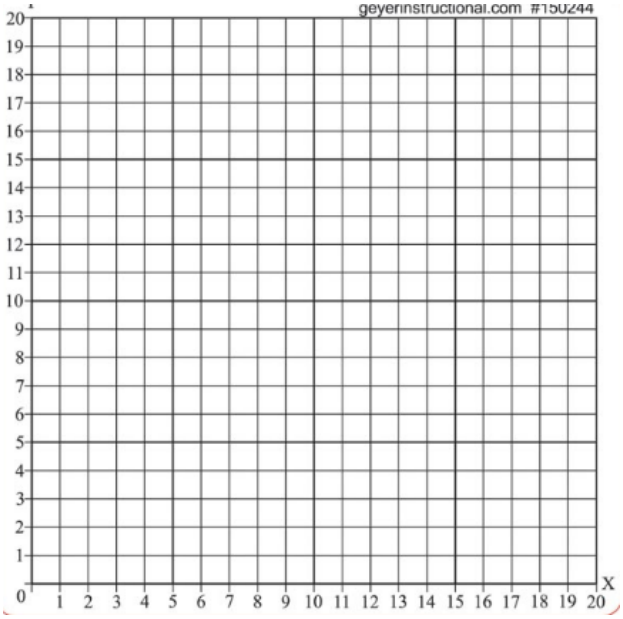
Farmer planting corn and soybeans

A farmer has a 320 acre farm on which she plants two crops: corn and soybeans. For each acre of corn planted, her expenses are $50 and for each acre of soybeans planted, her expenses are $100.Each acre of corn requires 100 bushels of storage and yields a profit of $60; each acre of soybeans requires 40 bushels of storage and yields a profit of $90. If the total amount of storage space available is 19,200 bushels and the farmer has only $20,000 on hand, how many acres of each crop should she plant in order to maximize her profit? What will her profit be if she follows this strategy?



Example - Aluminum and Copper Wire

A plant makes aluminum and copper wire. Each pound of aluminum wire requires 5 kwh of electricity and 1/4 hr. of labor. Each pound of copper wire requires 2 kwh of electricity and 1/2 hr. of labor. Production of copper wire is restricted by the fact that raw materials are available to produce at most 60 lbs./day. Electricity is limited to 500 kwh/day and labor to 40 person–hrs./day. If the profit from aluminum wire is $.25/lb. and the profit from copper is $.40/lb., how much of each should be produced to maximize profit and what is the maximum profit?



1. In order to ensure optimal health (and thus accurate test results), a lab technician needs to feed the rabbits a daily diet containing a minimum of 24 grams (g) of fat, 36 g of carbohydrates, and 4 g of protien. But the rabbits should be fed no more than five ounces of food a day.

   Rather than order rabbit food that is custom-blended, it is cheaper to order Food X and Food Y, and blend them for an optimal mix. Food X contains 8 g of fat, 12 g of carbohydrates, and 2 g of protein per ounce, and costs $0.20 per ounce. Food Y contains 12 g of fat, 12 g of carbohydrates, and 1 g of protein per ounce, at a cost of $0.30 per ounce.

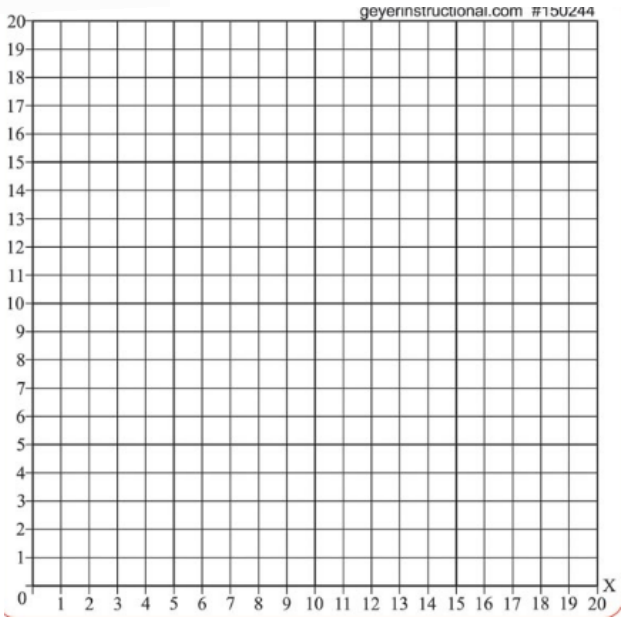
   a) List the constraint.

   b) Determine the objective function for maximizing profit.

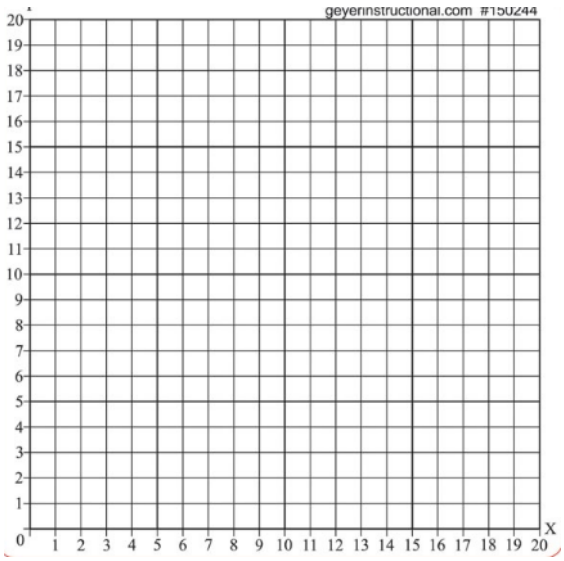
   c) Graph the set of constraints.

   d) Determine the vertices of the feasible region.

   e) What is the optimal blend?



1. A farmer has 10 acres to plant in wheat and rye. He has to plant at least 7 acres. However, he has only $1200 to spend and each acre of wheat costs $200 to plant and each acre of rye costs $100 to plant. Moreover, the farmer has to get the planting done in 12 hours and it takes an hour to plant an acre of wheat and 2 hours to plant an acre of rye. If the profit is $500 per acre of wheat and $300 per acre of rye how many acres of each should be planted to maximize profits?



2. A gold processor has two sources of gold ore, source A and source B. In order to kep his plant running, at least three tons of ore must be processed each day. Ore from source A costs $20 per ton to process, and ore from source B costs $10 per ton to process. Costs must be kept to less than $80 per day. Moreover, Federal Regulations require that the amount of ore from source B cannot exceed twice the amount of ore from source A. If ore from source A yields 2 oz. of gold per ton, and ore from source B yields 3 oz. of gold per ton, how many tons of ore from both sources must be processed each day to maximize the amount of gold extracted subject to the above constraints?