RABBIT FOOD – *The Task*

In order to maintain the weight and health of rabbits that will be sold for pets, rabbits must be fed a daily diet containing a minimum of 24 grams (g) of fat, 36 g of carbohydrates, and 4 g of protein and should be fed no more than five ounces of food a day.

There are two major products on the market you are considering: Food X and Food Y. 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. It may be that one of these products meets all constraints set out in the problem and achieves the lowest total cost, or it may be necessary to blend Food X and Food Y to achieve an optimal mix. Use this information to answer the questions below:

Let x = number of ounces of Food X
Let y = number of ounces of Food Y

1. What linear inequality, in terms of x and y, would represent the total amount of food in ounces?

2. What linear inequality would represent the total fat content?

3. What linear inequality would represent the total carbohydrate content?

4. What linear inequality would represent the total protein content?

5. In a single coordinate plane, graph these equations including any other reasonable constraints. Shade the feasible region, label your equations, and identify the scale on the axes.

6. Write an equation that models the total cost of the food blend (optimization equation).

7. Using your graph from question 5 and total cost equation from question 6, determine the optimum solution to the problem – the solution that meets all constraints set out in the problem and achieves the lowest total cost. What point on the graph identifies this optimum solution?

8. Show/Explain how you know your solution is the optimum one. Discuss any concerns or qualifications that might arise in selecting this optimal solution.

9. Given that your facility can hold 250 rabbits and feed is 92% of your cost, use your minimum daily cost of feed per rabbit to determine your total expenses for each day.

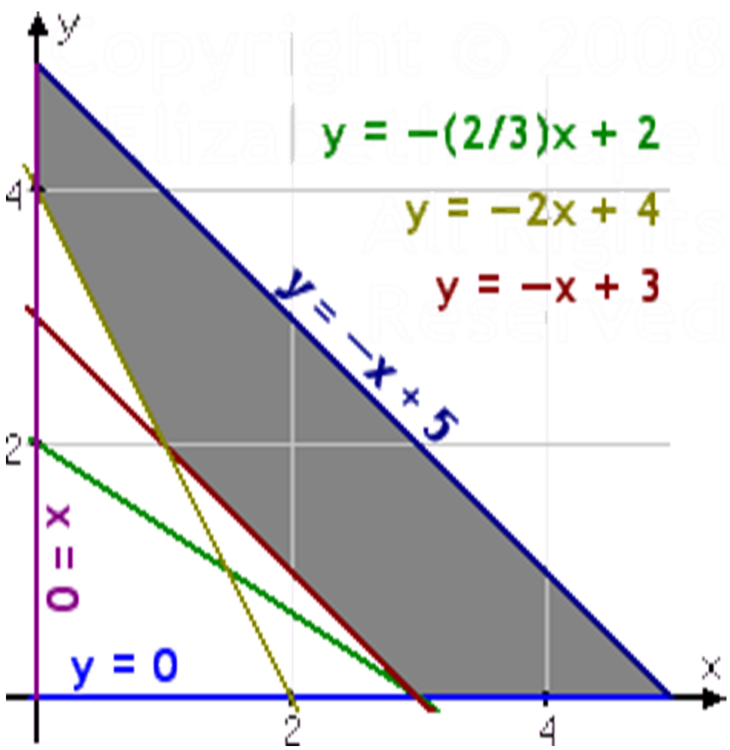
10. You will sell the rabbits at five weeks of age. If you want to make $400, for how much do you need to sell each rabbit? What would be the price per rabbit for a 15% profit?

RABBIT FOOD – *Possible Solution(s)*

Since there cannot be negative amounts of food, the first two constraints are: ***x ≥ 0*** and ***y ≥ 0***. The other constraints come from total ounces of food, and grams of fat, carbohydrates, and protein per ounce.

1. Total ounces of food:	$x + y \le 5$	or	$y \le - x + 5$
2. Fat content:	$8x + 12y \ge 24$	or	$y \ge -(2/3)x + 2$
3. Carbohydrate content:	$12x + 12y \ge 36$	or	$y \ge - x + 3$
4. Protein content:	$2x + y \ge 4$	or	$y \ge -2x + 4$

5.



6. The equation that models total cost of the food blend is the cost relation: ***C = 0.2x + 0.3y***.

7. At any place in the shaded area the fat/carb/protein requirements are met. All feasible solutions to the problem are contained in the shaded region. To find the optimum solution, substitute the coordinate pairs at the intersections of the boundaries into the objective function (total cost equation) and compare the total cost:

- Where y = -x + 5 intersects x = 0 and y = 0: (5, 0) and (0, 5)
- Where y = - 2x + 4 intersects x = 0: (0, 4)
- Where y = - x + 3 intersects y = 0: (3, 0)
- Where y = - 2x + 4 intersects y = - x + 3: (1, 2)

Point	0.2x + 0.3y	= Total cost
(0, 5)	0.2(0) + 0.3(5)	= $1.50
(5, 0)	0.2(5) + 0.3(0)	= $1.00
(0, 4)	0.2(0) + 0.3(4)	= $1.20
(3, 0)	0.2(3) + 0.3(0)	= $0.60
(1, 2)	0.2(1) + 0.3(2)	= $0.80

The minimum cost will be **3 ounces of Food X and 0 ounces of Food Y, corresponding to coordinate point (3,0) for a total cost of $0.60 per ounce.**

8. At the point (3, 0) we find the minimum cost. All other intersection points have a larger total cost than (3, 0). The fat/carb/protein ratio for 3 oz of Food X would be 24/36/6, which falls within the constraints of the requirements (a minimum of 24/36/4).

While 3 ounces of food is only 60% of the maximum total amount of food recommended, it is assumed that it is adequate since the problem specifies no clear minimum for the number of ounces a rabbit should eat each day. This might, however, be a consideration if experience shows the caloric intake to be insufficient for rabbits to thrive.

9. 250 rabbits times $0.60 per day = $150.00 per day (daily cost for rabbit food).

$150 = 92% of X

150 / 0.92 = $163.04

The total daily expense for raising the rabbits is **$163.04**

10. 5 weeks = 7 x 6 days = 35 days

Expenses for five weeks = 35($163.04) = **$5706.40**

$400 profit:

Total revenue would need to be $5706.40 + $400 = $6106.40

Divide total revenue by the number of rabbits: $6106.40/ 250 = **$24.43 price per rabbit**

15% profit:

Using the *revenue* (R)/profit formula:

$$\frac{R - \$5706.40}{\$5706.40} = 15\% = 0.15$$

R – $5706.40 = 0.15($5706.40) = $855.96

R = $855.96+ $5706.40 = **$6562.36**

Now divide the total revenue by the number of rabbits:

$6562.36 / 250 = **$26.25 price per rabbit**