Name: ______________________________

Date: ______________________________

1. A thief is filling her backpack with two types of valuable substances. She can carry up to 40 kg, and her backpack can fit up to 15 liters.

   Each bag of X has a weight of 2 kg, volume of 0.1 L, and value of 1000 thousand USD.

   Each bag of Y has a weight of 0.2 kg, volume of 0.09 L, and value of 200 thousand USD.

   There is no requirement to take full bags, so the thief can opt for a fraction of a bag.

   How many bags of each should the thief take to maximize her profit?

2. A thief is filling her backpack with two types of valuable substances. She can carry up to 35 kg, and her backpack can fit up to 10 liters.

   Each bag of X has a weight of 3 kg, volume of 0.2 L, and value of 20 thousand USD.

   Each bag of Y has a weight of 1 kg, volume of 0.7 L, and value of 30 thousand USD.

   There is no requirement to take full bags, so the thief can opt for a fraction of a bag.

   How many bags of each should the thief take to maximize her profit?

3. A thief is filling her backpack with two types of valuable substances. She can carry up to 35 kg, and her backpack can fit up to 15 liters.

   Each bag of X has a weight of 3 kg, volume of 0.5 L, and value of 50 thousand USD.

   Each bag of Y has a weight of 0.3 kg, volume of 0.4 L, and value of 0.6 thousand USD.

   There is no requirement to take full bags, so the thief can opt for a fraction of a bag.

   How many bags of each should the thief take to maximize her profit?

4. A thief is filling her backpack with two types of valuable substances. She can carry up to 15 kg, and her backpack can fit up to 10 liters.

   Each bag of X has a weight of 0.6 kg, volume of 0.6 L, and value of 100 thousand USD.

   Each bag of Y has a weight of 0.2 kg, volume of 0.1 L, and value of 4 thousand USD.

   There is no requirement to take full bags, so the thief can opt for a fraction of a bag.

   How many bags of each should the thief take to maximize her profit?

5. A thief is filling her backpack with two types of valuable substances. She can carry up to 25 kg, and her backpack can fit up to 10 liters.

   Each bag of X has a weight of 4 kg, volume of 0.5 L, and value of 6 thousand USD.

   Each bag of Y has a weight of 2 kg, volume of 1 L, and value of 5 thousand USD.

   There is no requirement to take full bags, so the thief can opt for a fraction of a bag.

   How many bags of each should the thief take to maximize her profit?

6. A thief is filling her backpack with two types of valuable substances. She can carry up to 35 kg, and her backpack can fit up to 25 liters.

   Each bag of X has a weight of 6 kg, volume of 0.5 L, and value of 600 thousand USD.

   Each bag of Y has a weight of 1 kg, volume of 1 L, and value of 1000 thousand USD.

   There is no requirement to take full bags, so the thief can opt for a fraction of a bag.

   How many bags of each should the thief take to maximize her profit?

1. The thief should take 3.75 bags of X and 162.5 bags of Y. We can use linear programming to see this.

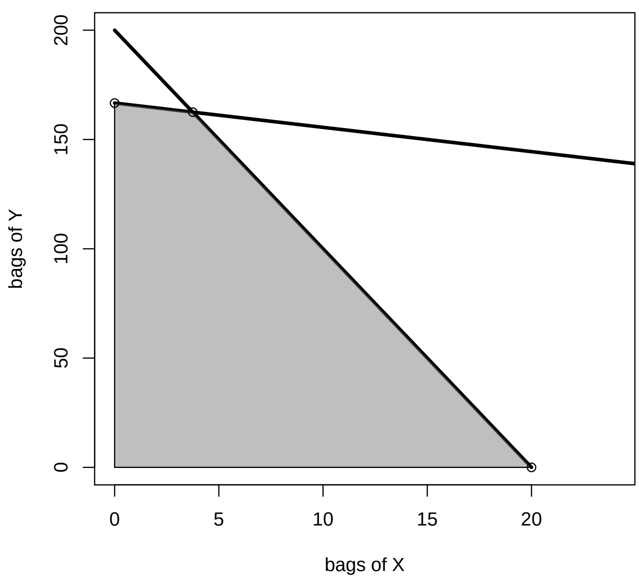
   We write a weight inequality.

$$2x + 0.2y \leq 40$$

   We write a volume inequality.

$$0.1x + 0.09y \leq 15$$

   We graph the two inequalities, shading the feasible region.



   There are three vertices of interest.

$$(0, 166.67)$$

$$(3.75, 162.5)$$

$$(20, 0)$$

   We write a profit function (the objective function).

$$P(x, y) = 1000x + 200y$$

   We determine the profits.

$$P(0, 166.67) = 33333.33$$

$$P(3.75, 162.5) = 36250$$

$$P(20, 0) = 20000$$

   Thus, the thief should take 3.75 bags of X and 162.5 bags of Y.

2. The thief should take 7.63 bags of X and 12.11 bags of Y. We can use linear programming to see this.

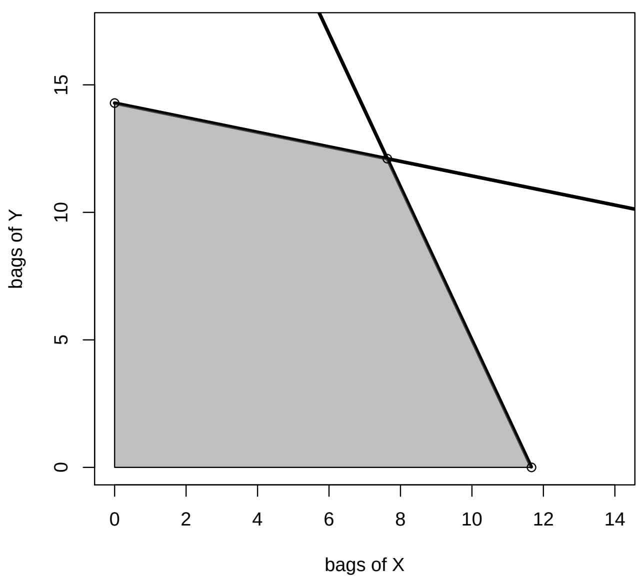
   We write a weight inequality.

$$3x + 1y \le 35$$

   We write a volume inequality.

$$0.2x + 0.7y \le 10$$

   We graph the two inequalities, shading the feasible region.



   There are three vertices of interest.

$$(0, 14.29)$$

$$(7.63, 12.11)$$

$$(11.67, 0)$$

   We write a profit function (the objective function).

$$P(x, y) = 20x + 30y$$

   We determine the profits.

$$P(0, 14.29) = 428.57$$

$$P(7.63, 12.11) = 515.79$$

$$P(11.67, 0) = 233.33$$

   Thus, the thief should take 7.63 bags of X and 12.11 bags of Y.

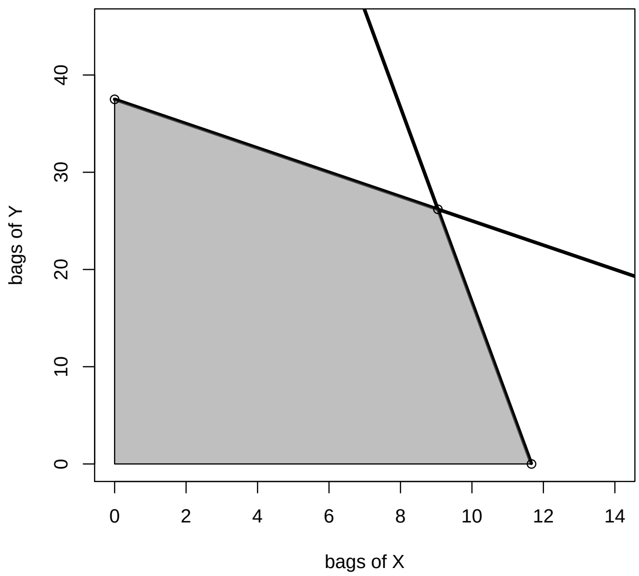
3. We write a weight inequality.

$$3x + 0.3y \leq 35$$

We write a volume inequality.

$$0.5x + 0.4y \leq 15$$

We graph the two inequalities, shading the feasible region.



There are three vertices of interest.

$$(0, 37.5)$$

$$(9.05, 26.19)$$

$$(11.67, 0)$$

We write a profit function (the objective function).

$$P(x, y) = 50x + 0.6y$$

We determine the profits.

$$P(0, 37.5) = 22.5$$

$$P(9.05, 26.19) = 468.1$$

$$P(11.67, 0) = 583.33$$

Thus the thief should take 11.67 bags of X and 0 bags of Y.

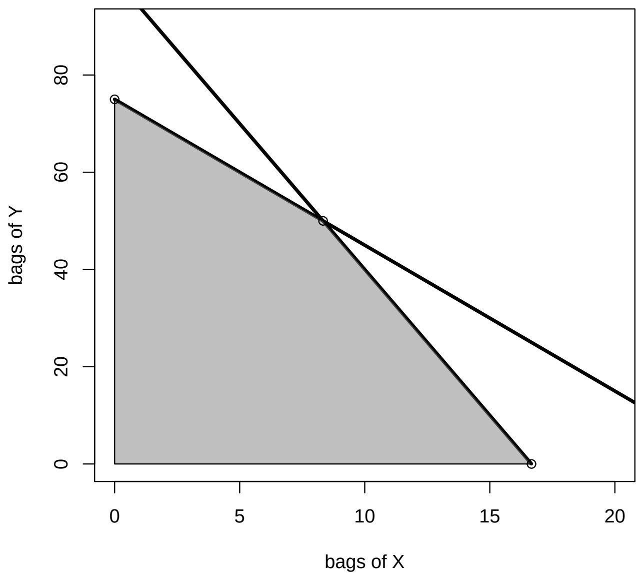
4. We write a weight inequality.

$$0.6x + 0.2y \leq 15$$

We write a volume inequality.

$$0.6x + 0.1y \leq 10$$

We graph the two inequalities, shading the feasible region.



There are three vertices of interest.

$$(0, 75)$$

$$(8.33, 50)$$

$$(16.67, 0)$$

We write a profit function (the objective function).

$$P(x, y) = 100x + 4y$$

We determine the profits.

$$P(0, 75) = 300$$

$$P(8.33, 50) = 1033.33$$

$$P(16.67, 0) = 1666.67$$

Thus the thief should take 16.67 bags of X and 0 bags of Y.

5. The thief should take 1.67 bags of X and 9.17 bags of Y. We can use linear programming to see this.

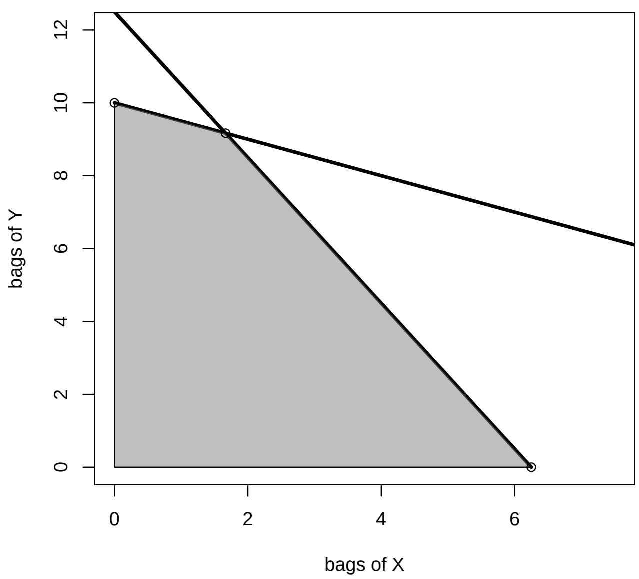
   We write a weight inequality.

$$4x + 2y \leq 25$$

   We write a volume inequality.

$$0.5x + 1y \leq 10$$

   We graph the two inequalities, shading the feasible region.



   There are three vertices of interest.

$$(0, 10)$$

$$(1.67, 9.17)$$

$$(6.25, 0)$$

   We write a profit function (the objective function).

$$P(x, y) = 6x + 5y$$

   We determine the profits.

$$P(0, 10) = 50$$

$$P(1.67, 9.17) = 55.83$$

$$P(6.25, 0) = 37.5$$

   Thus, the thief should take 1.67 bags of X and 9.17 bags of Y.

6. The thief should take 1.82 bags of X and 24.09 bags of Y. We can use linear programming to see this.

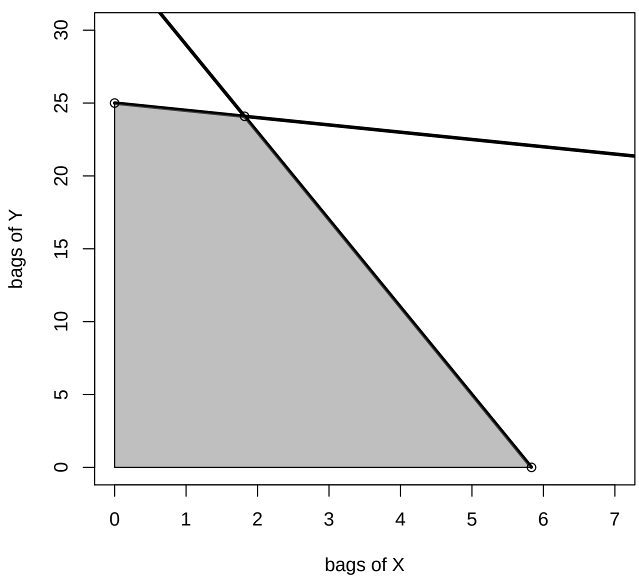
   We write a weight inequality.

$$6x + 1y \leq 35$$

   We write a volume inequality.

$$0.5x + 1y \leq 25$$

   We graph the two inequalities, shading the feasible region.



   There are three vertices of interest.

$$(0, 25)$$

$$(1.82, 24.09)$$

$$(5.83, 0)$$

   We write a profit function (the objective function).

$$P(x, y) = 600x + 1000y$$

   We determine the profits.

$$P(0, 25) = 25000$$

$$P(1.82, 24.09) = 25181.82$$

$$P(5.83, 0) = 3500$$

   Thus, the thief should take 1.82 bags of X and 24.09 bags of Y.