Linear Programming Problems:

Engagement:

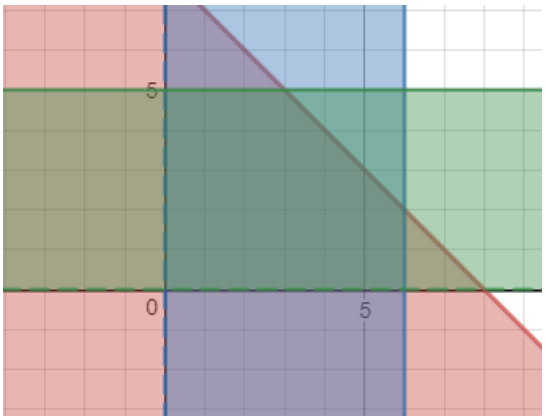
1. A movie theater contains 500 seats. For an upcoming showing of It, the theater sells $11 and $15 dollar tickets. They must sell at least 200 $11 dollar tickets and 100 $15 dollar tickets for the movie to be shown, and the theater must make at least $2000 dollars to break even. How many tickets at each price should be sold to maximize income? What is the maximum income?

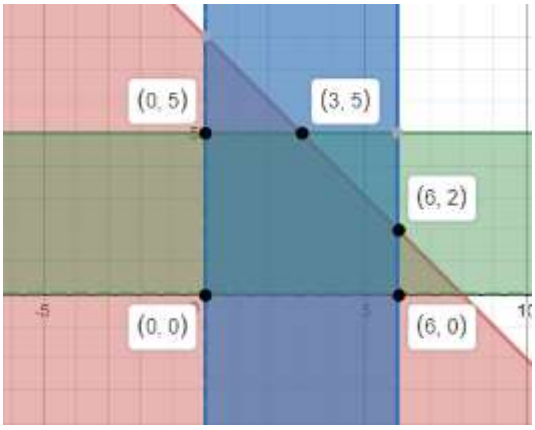
Explore: Different problem, also relatable.

1. A machine can produce Iphone 7 or Iphone X, but not at the same time. The machine can be used for at most 8 hours a day. Also, at most 6 hours a day can be used for making Iphone 7s and at most 5 hours a day can be used for making Iphone Xs. There is a $50 profit for each hour the machine makes Iphone 7s and a $75 profit for each hour the machine makes Iphone Xs. How many hours per day should the machine make each item in order to maximize profit? What is the maximum profit per day?

a. Constraints: x=hours per day machine makes iphone 7; y= hours per day machine makes iphone X. $x+y\leq 8$, $x\leq 6$, $y\leq 5$

b. Objective function is $P=50x+75y$

c. 

d. 

e. P=50(0)+75(5)=375

P=50(3)+75(5)=525
P=50(6)+75(2)=450
P=50(6)+75(0)=300

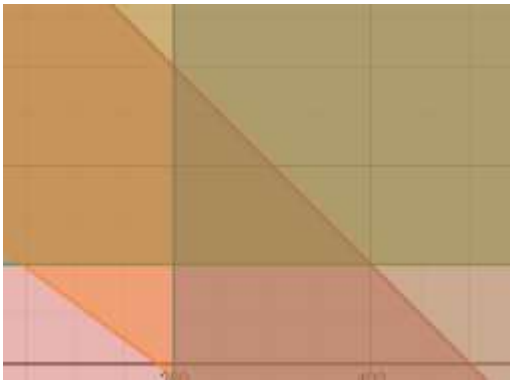
f. The feasible maximum profit lies at the point (3,5) and the value is $525

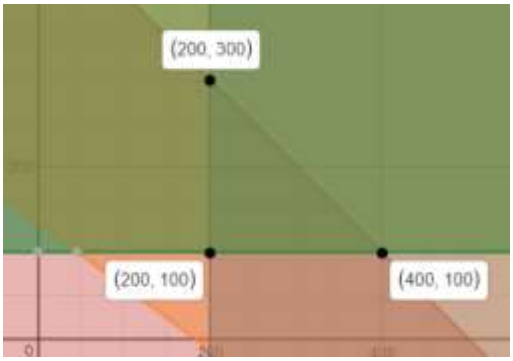
Explain: Practice problems (2) but 1 is taken from engagement

1. A movie theater contains 500 seats. For an upcoming showing of It, the theater sells $11 and $15 dollar tickets. They must sell at least 200 $11 dollar tickets and 100 $15 dollar tickets for the movie to be shown, and the theater must make at least $2000 dollars to break even. How many tickets at each price should be sold to maximize income? What is the maximum income?

a. Constraints: x=number of tickets sold at $11; y=number of tickets sold at $15; $x+y \leq 500$, $x \geq 200$, $y \geq 100$, $11x+15y \geq 2000$

b. Objective function is I=11x+15y

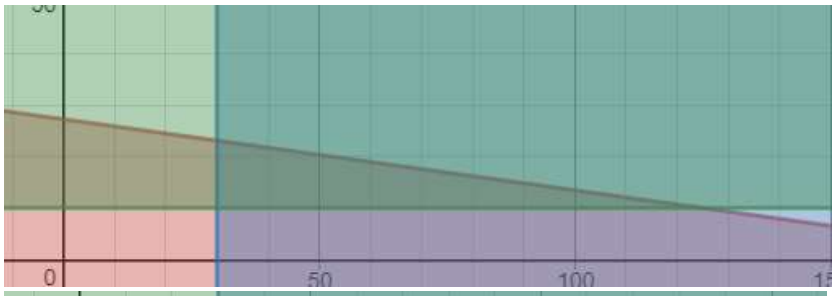
c. 

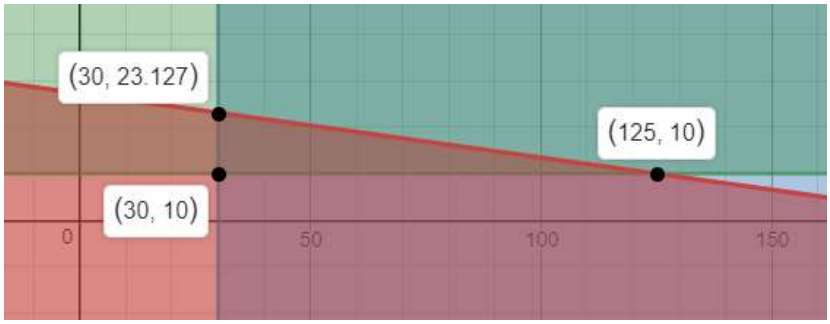
d. 

e. I=11(200)+15(300)=6700
I=11(400)+15(100)=5900
I=11(200)+15(100)=3700

f. The feasible maximum income lies at the point (200,300) and the profit is $6700.

2. Shawn has to buy some Chick Fil A for his friends get together. He needs at least 30 chicken nuggets and at least 10 milkshakes. He can choose between the nuggets which cost $0.38 per nugget and small milkshakes for $2.75 each. Shawn has a total of $75 to spend. How many of each should he buy to minimize his cost yet get enough food for his friends?

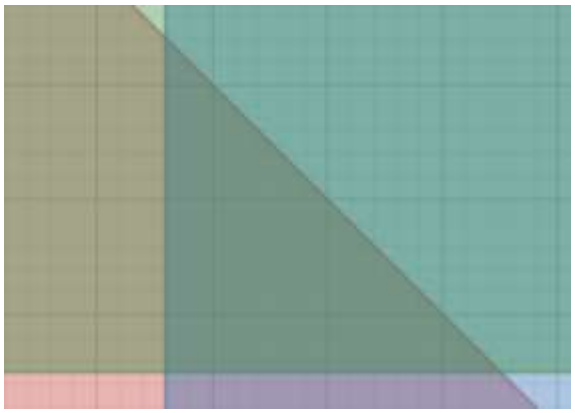
a. Constraints: x=number of nuggets to buy; y=number of milkshakes to buy, $x \geq 30$, $y \geq 10$, $.38x+2.75y \leq 75$
b. Objective function is $C=.38x+2.75y$
c. 

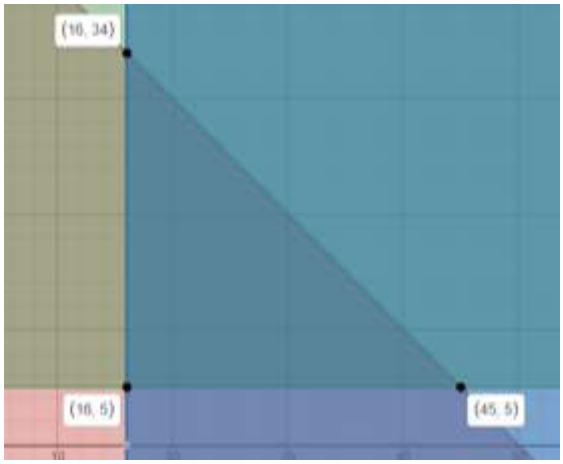
d. 

e. $C=.38(30)+2.75(23.127)=74.99$
$C=.38(30)+2.75(10)=38.90$
$C=.38(125)+2.75(10)=75.00$
f. The most feasible minimum cost is at the point (30,10) and minimum cost is $38.90

Evaluation: Kahoot question

1. What are the constraints of this problem? (adapted from book) Robin takes vitamin pills each day. She wants at least 16 units of Vitamin A and at least 5 units of Vitamin B. She can choose between red pills, costing $.10 each that contain Vitamin A or she can choose the blue pills costing $.20 each, containing B. Robin has room in her container for 50 pills. How many of each pill should she buy to minimize her cost and yet fulfill her daily requirements? X=number of red pills she should buy Y=number of blue pills she should buy
    a. Constraints: $x \geq 16$, $y \geq 5$, $x+y \leq 50$
    b. Objective function is $.10x+.20y=Cost$

c. 

d. 

e. Cost=.1(16)+.2(34)=8.40
   Cost=.1(45)+.2(5)=5.50
   Cost=.1(16)+.2(5)=2.60

f. The most feasible minimum cost is at the point (16,5) and cost at this point is $2.60.

2. What are the constraints of this problem? (adapted from book) Robin takes vitamin pills each day. She wants at least 16 units of Vitamin A and at least 5 units of Vitamin B. She can choose between red pills, costing $.10 each that contain Vitamin A or she can choose the blue pills costing $.20 each, containing B. Robin has room in her container for 50 pills. How many of each pill should she buy to minimize her cost and yet fulfill her daily requirements? X=number of red pills she should buy Y= number of blue pills she should buy

   a. $x \geq 16$, $y \geq 5$, $x+y \leq 50$
   b. $y \geq 16$, $x \geq 5$, $x+y \geq 50$
   c. I don't know
   d. $x \geq .10$, $y \geq .20$, $x+y \leq .30$

3. What is the objective function of this problem?
    a. .10x+.20y=Cost
    b. 16x+5y=Number
    c. 16x+5y=Cost
    d. .10x+.20y=Number

Pause at this time, to look at the premade graph so students can see what the region of feasible solutions looks like for this problem.

4. These are the vertices of the region of feasible solutions. (16,34), (45,5), (16,5). Which of the vertices yields the minimum cost?
    a. (16,34)
    b. (45,5)
    c. (16, 5) yes
    d. I don't have any clue
5. What is the minimum cost?
    a. $8.40
    b. $5.50
    c. None of these
    d. $2.60