Optimization Problems

1. define variables
2. write inequalities
3. write objective function
   - maximize, minimize, lowest...
4. graph inequalities
5. find vertices
6. sub vertices obj. func.

J: juice

J, P $\in \mathbb{W}$

P: pop

3. A vending machine sells juice and pop.

- The machine holds, at most, 240 cans of drinks. $J + P \leq 240$
- Sales from the vending machine show that at least 2 cans of juice are sold for each can of pop. $2P \leq J$
- Each can of juice sells for \$1.00, and each can of pop sells for \$1.25.

Create a model that could be used to determine the maximum revenue from the vending machine.

Revenue

$R = J + 1.25P$

3. P: pop
J: juice
$P, J \in W$

$P + J \le 240$

$J \ge 2P$

$P + J = 240$

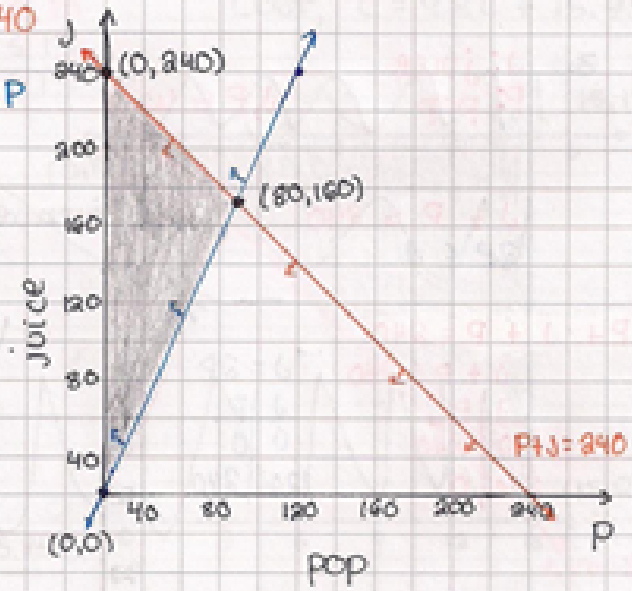
P	J
0	240
240	0

$J = 2P$

P	J
0	0
1	2
...	...
120	240

(0,0)
$0 \le 240$ ✓

(40,40)
$40 \ge 80$ ✗



Revenue = $J + 1.25P$

Vertices	Revenue
(0,0)	0
(80,160)	240
(0,240)	260

Intersection

$J = 2P$ $\quad P + J = 240$

$P + 2P = 240$

$3P = 240$

$P = 80$

$J = 160$

Max revenue is \$260 from selling 80 pop and 160 juice

L: letter

P: poster

$P, L \in W$

4. A student council is ordering signs for the spring dance. Signs can be made in letter size or poster size.

- No more than 15 of each size are wanted. $L \le 15$ $P \le 15$
- At least 15 signs are needed altogether. $L + P \ge 15$
- Letter-size signs cost \$9.80 each, and poster-size signs cost \$15.75 each.

Create a model that could be used to determine a combination of the two sizes of signs that would result in the lowest cost to the council.

Cost $C = 9.8L + 15.75P$

4. L: letter
P: poster

$L, P \in \omega$

$L + P \geq 15$
$P \leq 15$
$L \leq 15$

Cost, $C = 9.8L + 15.75P$

$L + P = 15$

L	P
0	15
15	0

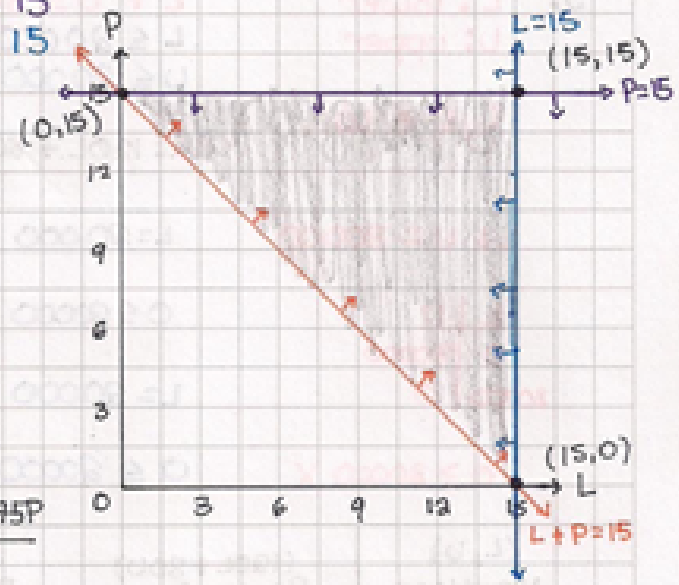
$0 \geq 15$ ✗

$P = 15$

$0 \leq 15$ ✓

$L = 15$

$0 \leq 15$ ✓



Vertices (L,P)	C = 9.8L + 15.75P
(0, 15)	\$236.25
(15,15)	\$147
(15,0)	\$383.25

Minimum cost is \$147
For 15 letter, 0 poster

U: upperdeck

L: lowerdeck

$U, L \in W$

5. A football stadium has 50 000 seats.

- Two-fifths of the seats are in the lower deck.
- Three-fifths of the seats are in the upper deck.
- At least 30 000 tickets are sold per game.

Graph

- A lower deck ticket costs \$120, and an upper deck ticket costs \$80.

Create a model that could be used to determine a combination of tickets for lower-deck and upper-deck seats that should be sold to maximize revenue.

$L \leq 20000$

$U \leq 30\,000$

$U + L \geq 30\,000$

Revenue $R = 120L + 80U$

5. L: lower
U: upper

$L, U \in W$

$L + U = 30000$

L	U
0	30000
30000	0

$0 \geq 30000$ X

$L + U \geq 30000$
$L \leq 20000$
$U \leq 20000$

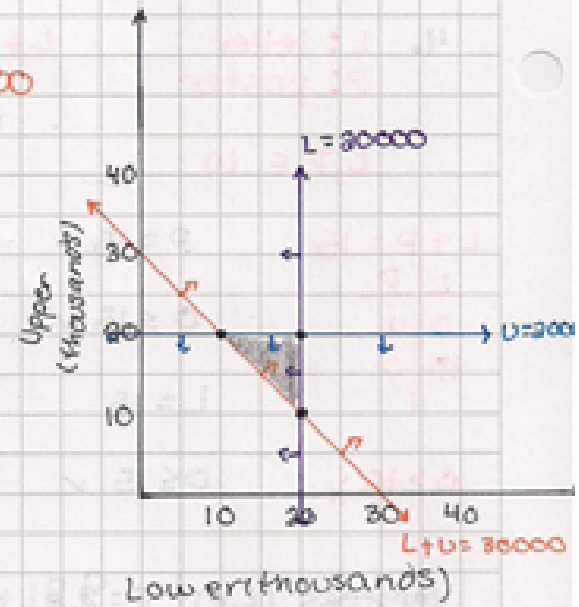
$R = 120L + 80U$

$L = 20000$

$0 \leq 20000$ ✓

$L = 20000$

$0 \leq 20000$ ✓



(L, U) Vertices	(120L + 80U) Revenue
(0, 30000)	\$2 400 000
(20000, 10000)	\$3200000
(20000, 30000)	\$4800 000

Maximum revenue \$4,800 000 when 20000 lower bowl + 30000 upper bowl tickets are sold.