MA162: Finite mathematics

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February 13, 2013

SCHEDULE:

- Exam PDFs on mathclass.org
- HW 3.1 (Late)
- HW 3.2-3.3 due Friday, Feb 15, 2013
- HW 4.1 due Friday, Feb 22, 2013
- HW 2.5-2.6 due Friday, Mar 01, 2013
- Exam 2, Monday, Mar 04, 2013, from 5pm to 7pm

Today we will cover 3.3: solving the small problems with a pretty picture

3.3: Linear programming problems

- An LPP has three parts:
  - The variables (the business decision to be made)
  - The inequalities (the laws, constraints, rules, and regulations)
  - The objective (maximize profit, minimize cost)
- If there are only two variables, they are easy to solve!
- Both the maximum and minimum will occur on a corner.

3.3: Example 1 from Monday

- **Variables**:
  X = the number of bottle cozies to make each day
  Y = the number of phone cozies to make each day

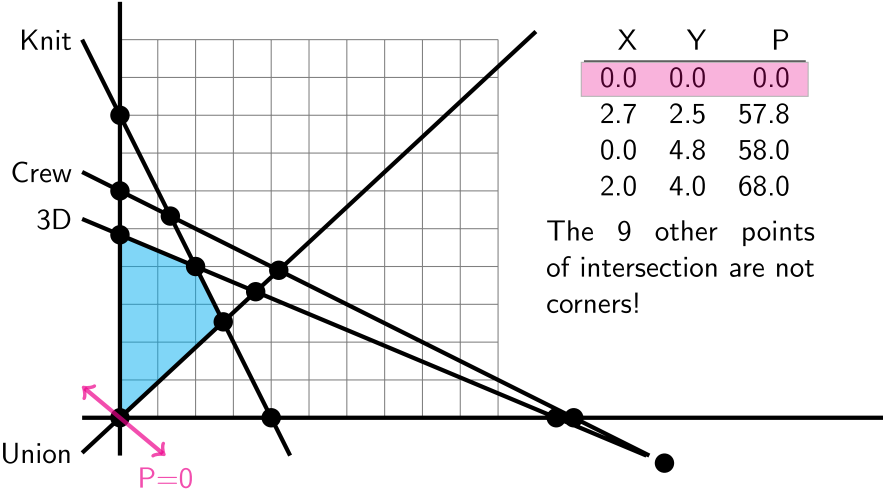
- **Constraints**:

$$\begin{aligned} 26X + 62Y &\le 300 && \text{(3D printer time)} \\ 60X + 30Y &\le 240 && \text{(KnitBot time)} \\ 20X + 40Y &\le 240 && \text{(Human time)} \\ 26X - 28Y &\le 0 && \text{(Union req.)} \end{aligned}$$

  and $X \ge 0,\ Y \ge 0$

- **Objective**:
  Maximize the profit $P = 10X + 12Y$

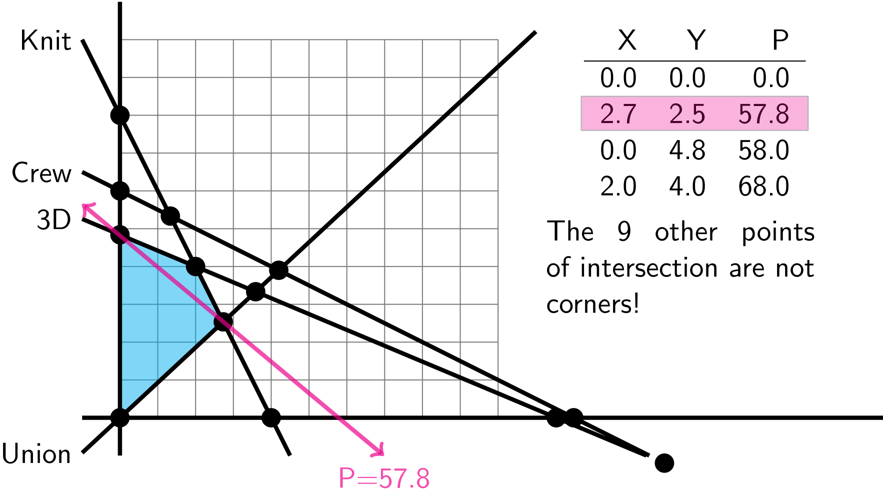
3.3: Graph the region like in 3.1



X	Y	P
0.0	0.0	0.0
2.7	2.5	57.8
0.0	4.8	58.0
2.0	4.0	68.0

The 9 other points of intersection are not corners!

3.3: Graph the region like in 3.1



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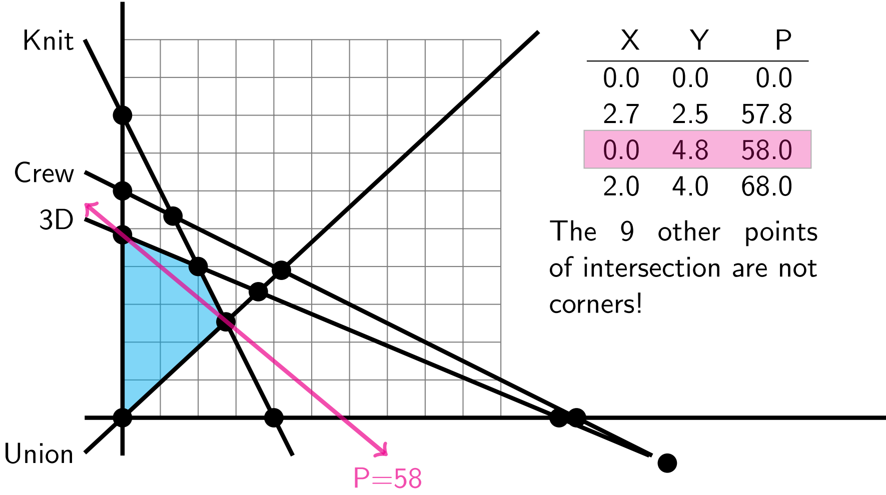

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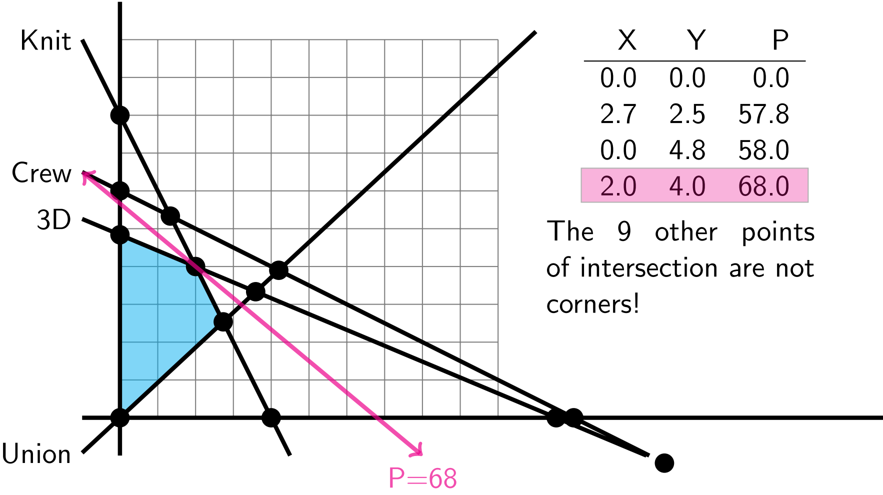


X	Y	P
0.0	0.0	0.0
2.7	2.5	57.8
0.0	4.8	58.0
2.0	4.0	68.0

The 9 other points of intersection are not corners!

3.2: Example 2 from Monday

- **Variables**:
  X = number of pills of brand A
  Y = number of pills of brand B

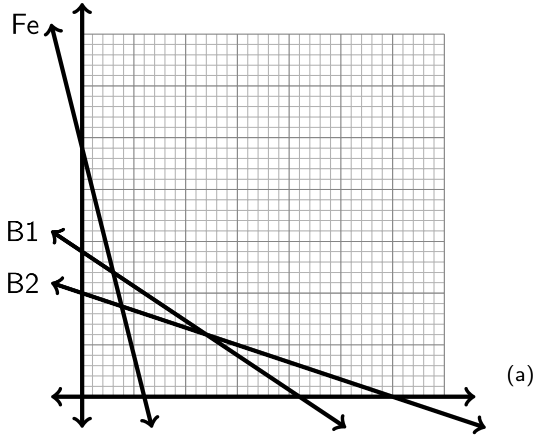
- **Constraints**:

$$\begin{aligned} 40X + 10Y &\geq 2400 \qquad \text{(Iron)} \\ 10X + 15Y &\geq 2100 \qquad \text{(B1)} \\ 5X + 15Y &\geq 1500 \qquad \text{(B2)} \end{aligned}$$

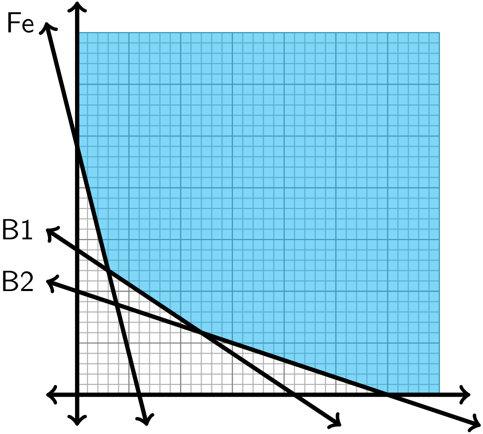
  and $X \geq 0,\ Y \geq 0$

- **Objective**:
  Minimize cost $C = 0.06X + 0.08Y$

3.3: Example 2 graphed

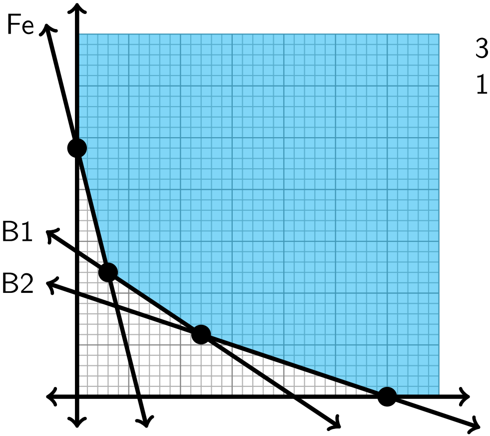


3.3: Example 2 graphed



(b)

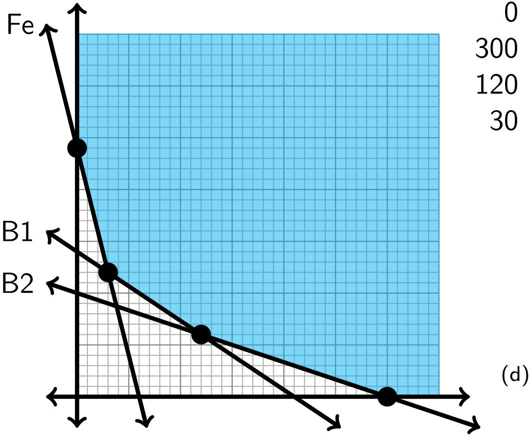
3.3: Example 2 graphed



X	Y	C
0	240	
300	0	
120	60	
30	120	

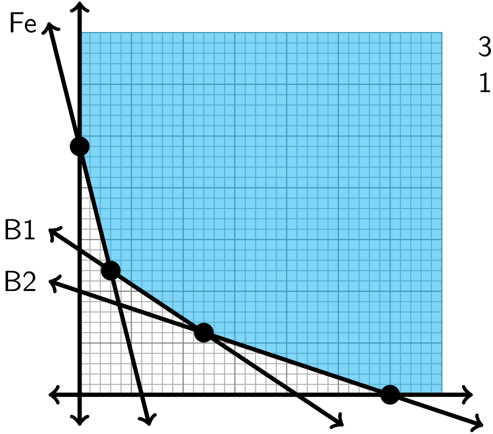
(c)

3.3: Example 2 graphed



X	Y	C
0	240	$19.20
300	0	$18.00
120	60	$12.00
30	120	$11.40

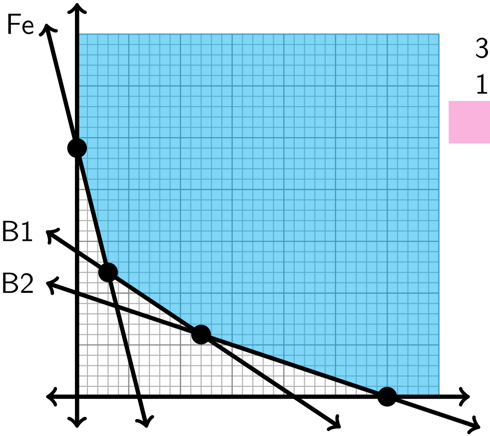
3.3: Example 2 graphed



(e)

X	Y	C
0	240	\$19.20
300	0	\$18.00
120	60	\$12.00
30	120	\$11.40
∞	0	$\$\infty$
0	∞	$\$\infty$

3.3: Example 2 graphed



X	Y	C
0	240	\$19.20
300	0	\$18.00
120	60	\$12.00
30	120	\$11.40
∞	0	\$$\infty$
0	∞	\$$\infty$

(f)

Example 3 from Monday

- **Variables**:
  X = Number of engines from P1 to A1
  Y = Number of engines from P1 to A2
  $80 - X$ = Number of engines from P2 to A1 (the rest of A1's demand)
  $70 - Y$ = Number of engines from P2 to A2 (the rest of A2's demand)

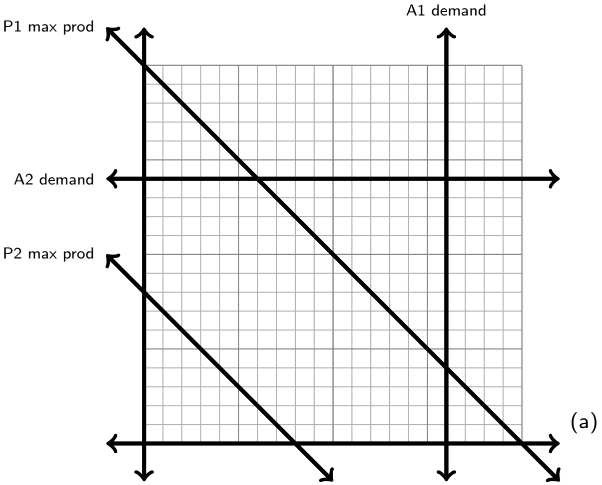
- **Constraints**:

$$\begin{array}{rcll} X + Y & \leq & 100 & \text{(P1 max production)} \\ X + Y & \geq & 40 & \text{(P2 max production)} \\ X \quad & \leq & 80 & \text{(sanity, A1 max demand)} \\ Y & \leq & 70 & \text{(sanity, A2 max demand)} \end{array}$$

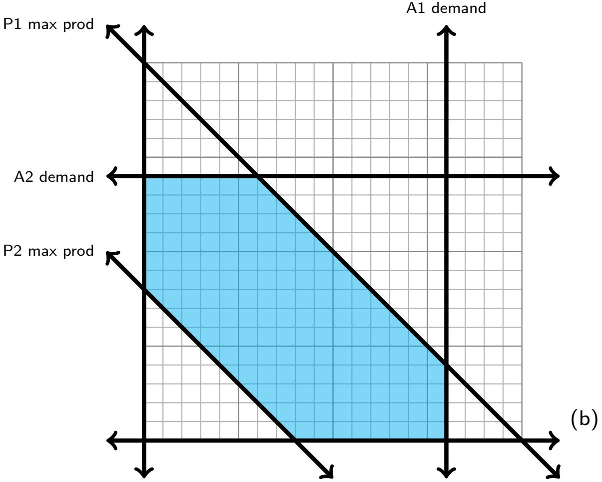
  and $X \geq 0$, $Y \geq 0$

- **Objective**:
  minimize shipping cost $C = 14500 - 20X - 10Y$

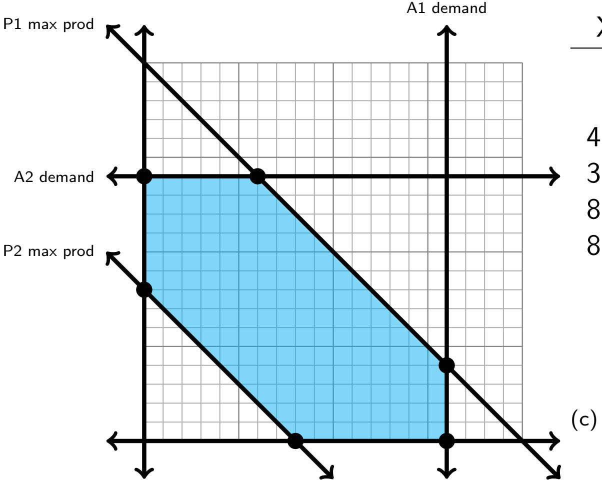
Example 3 graphed



Example 3 graphed

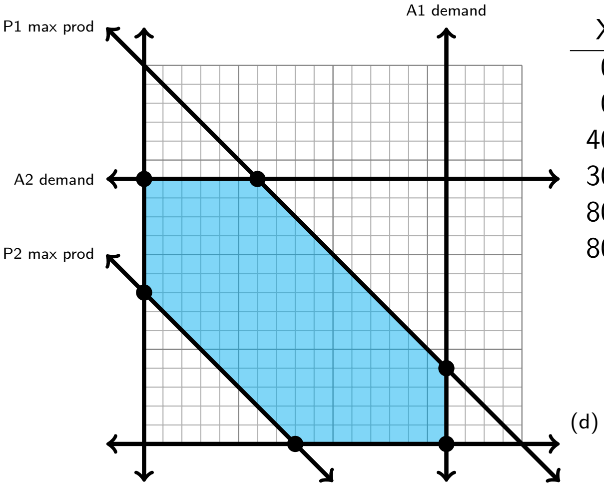


Example 3 graphed



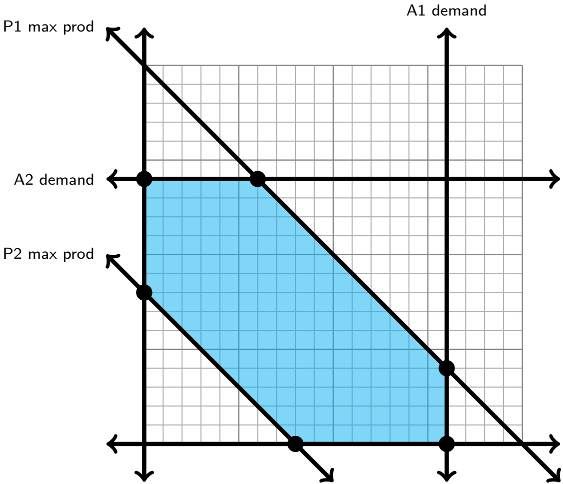
X	Y	C
0	40	
0	70	
40	0	
30	70	
80	0	
80	20	

Example 3 graphed



X	Y	C
0	40	$14.1K
0	70	$13.8K
40	0	$13.7K
30	70	$13.2K
80	0	$12.9K
80	20	$12.7K

Example 3 graphed



X	Y	C
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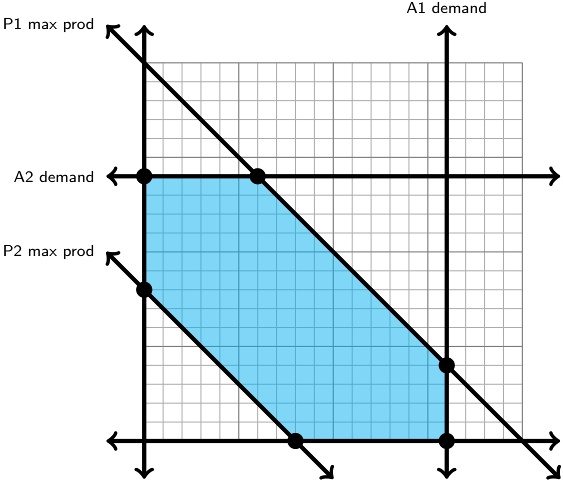
0	70	\$13.8K
40	0	\$13.7K
30	70	\$13.2K
80	0	\$12.9K
80	20	\$12.7K

(e) All the corners are there.

Example 3 graphed



X	Y	C
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0	70	$13.8K
40	0	$13.7K
30	70	$13.2K
80	0	$12.9K
80	20	$12.7K

(f) (80,20)