MA162: Finite mathematics

Jack Schmidt

University of Kentucky

October 5, 2011

SCHEDULE:

- HW 3.2-3.3 is due Friday, Oct 7th, 2011.
- HW 4.1-4.2 is due Friday, Oct 13th, 2011.
- Exam 2 is Monday, Oct 17th, 2011, in CB106.

Today we will cover 3.3: Graphical method of solving (and finish 3.2)

Exam 2: Overview

- 50% Ch. 3, Linear optimization with 2 variables
  1. Graphing linear inequalities
  2. Setting up linear programming problems
  3. Method of corners to find optimum values of linear objectives
- 50% Ch. 4, Linear optimization with millions of variables
  1. Slack variables give us flexibility in RREF
  2. Some RREFs are better (business decisions) than others
  3. Simplex algorithm to find the best one using row ops
  4. Accountants and entrepreneurs are two sides of the same coin

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 water bottles to make each day
  Y = the number of OSARPs to make each day

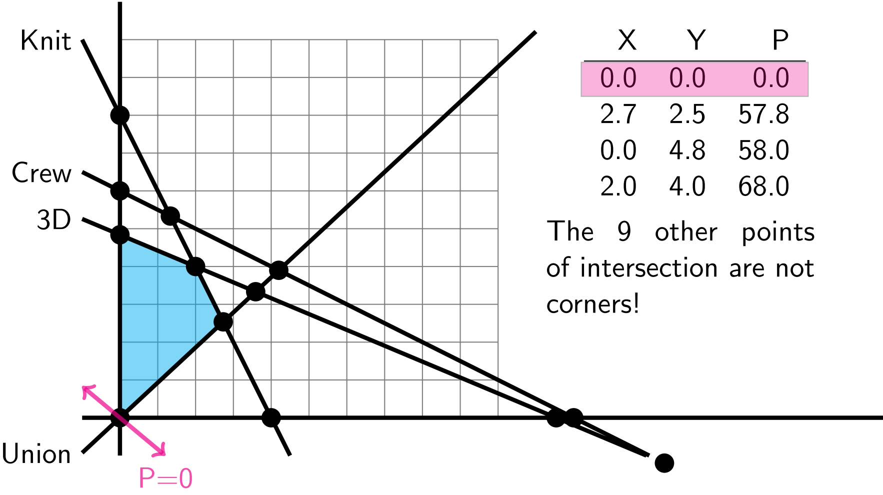
- **Constraints**:

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

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

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

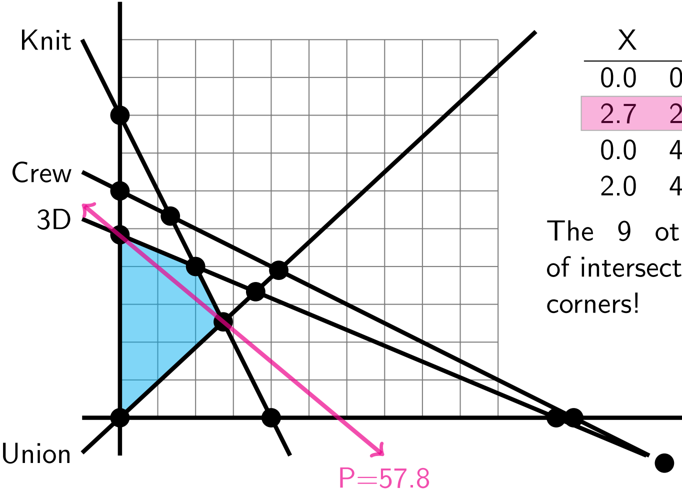
3.3: Graph the region like in 3.1



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!

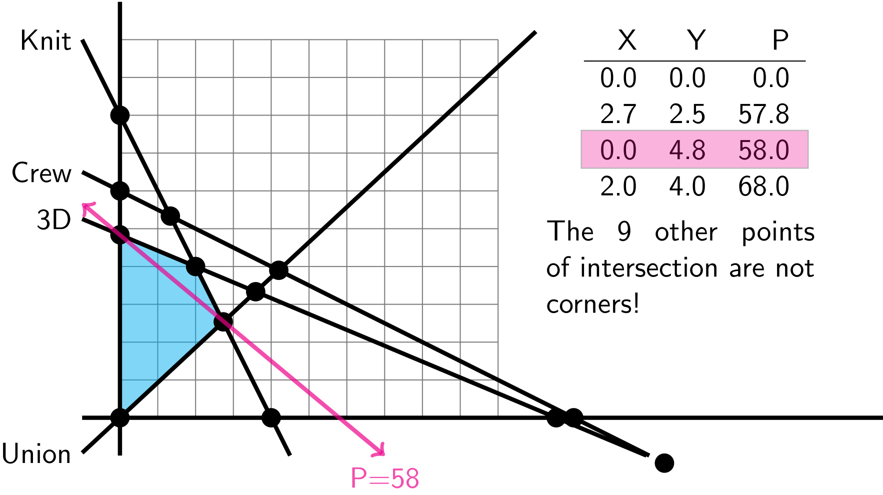
3.3: Graph the region like in 3.1



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

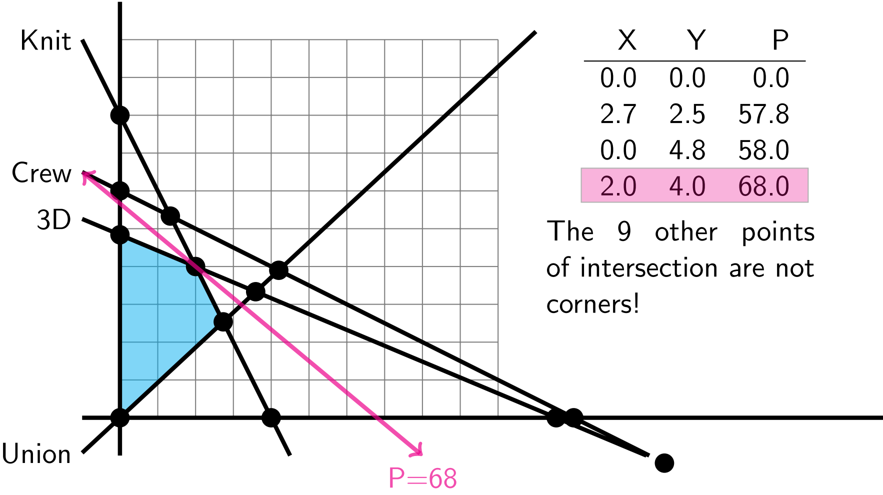
The 9 other points of intersection are not corners!

3.3: Graph the region like in 3.1



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!



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

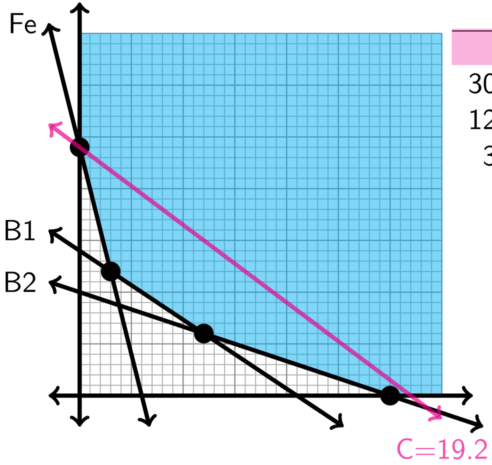
- **Constraints**:

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

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

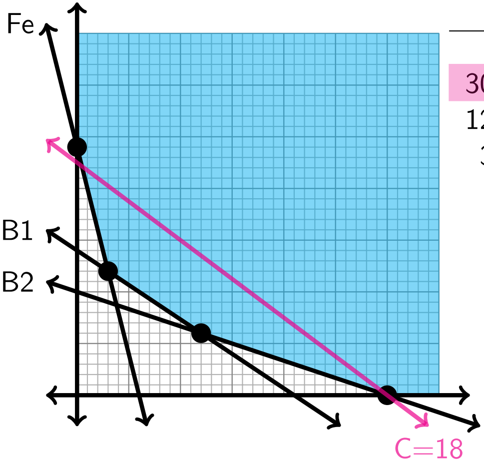
- **Objective**:
  Minimize cost $C = 0.06X + 0.08Y$

3.3: Example 2 graphed



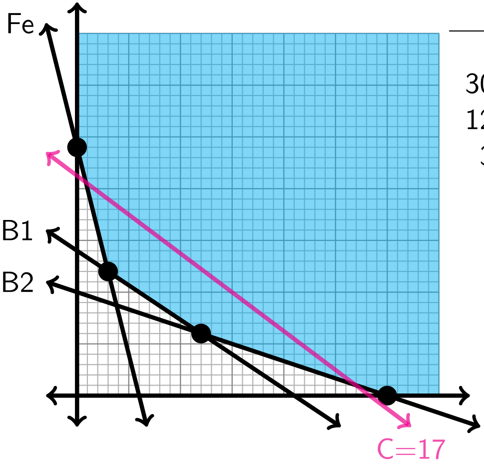
X	Y	C
0	240	$19.20
300	0	$18.00
120	60	$12.00
30	120	$11.40

3.3: Example 2 graphed



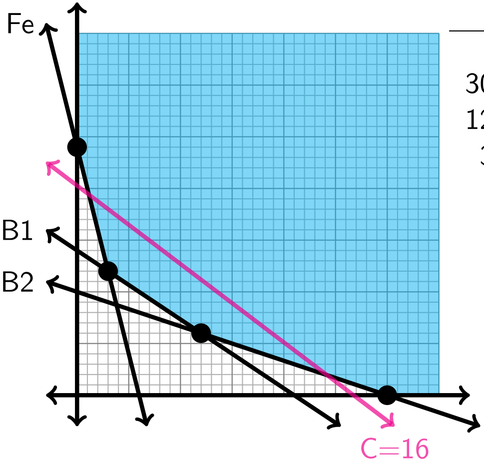
X	Y	C
0	240	\$19.20
300	0	\$18.00
120	60	\$12.00
30	120	\$11.40

3.3: Example 2 graphed



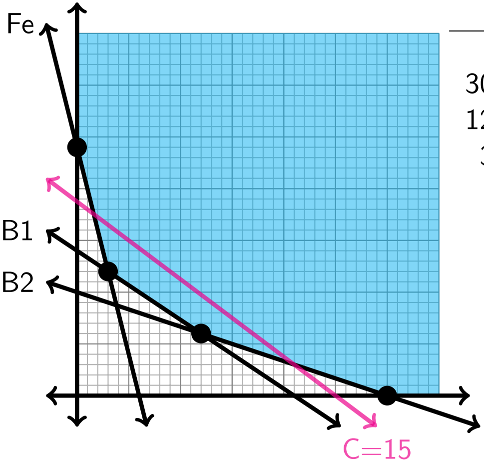
X	Y	C
0	240	\$19.20
300	0	\$18.00
120	60	\$12.00
30	120	\$11.40

3.3: Example 2 graphed

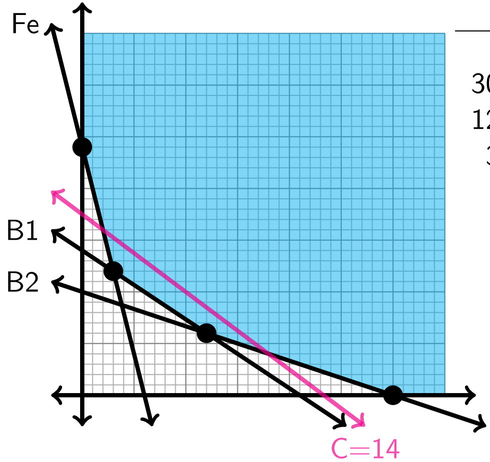


X	Y	C
0	240	\$19.20
300	0	\$18.00
120	60	\$12.00
30	120	\$11.40

3.3: Example 2 graphed

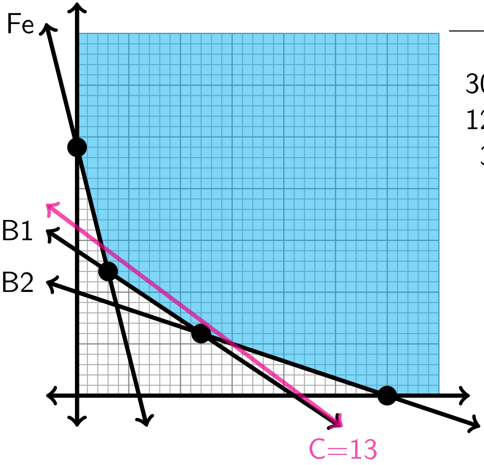


X	Y	C
0	240	\$19.20
300	0	\$18.00
120	60	\$12.00
30	120	\$11.40



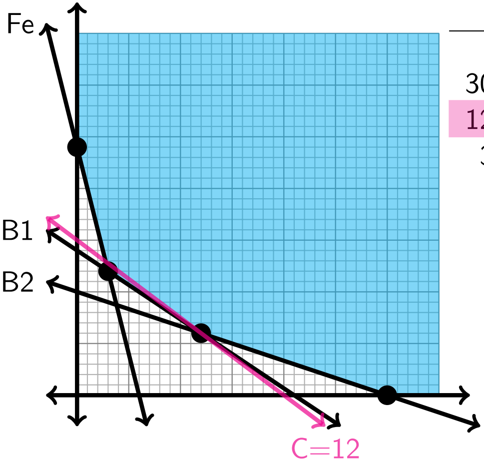
X	Y	C
0	240	$19.20
300	0	$18.00
120	60	$12.00
30	120	$11.40

3.3: Example 2 graphed



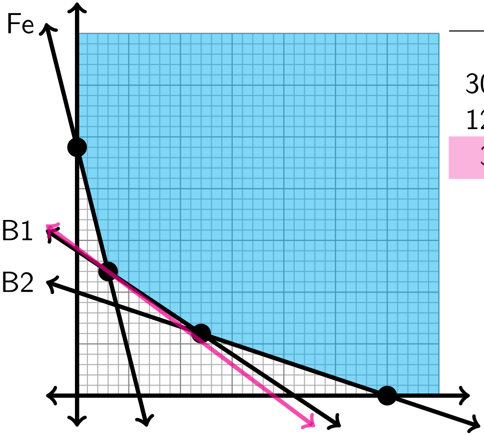
X	Y	C
0	240	\$19.20
300	0	\$18.00
120	60	\$12.00
30	120	\$11.40

3.3: Example 2 graphed



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

3.3: Example 2 graphed



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

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)

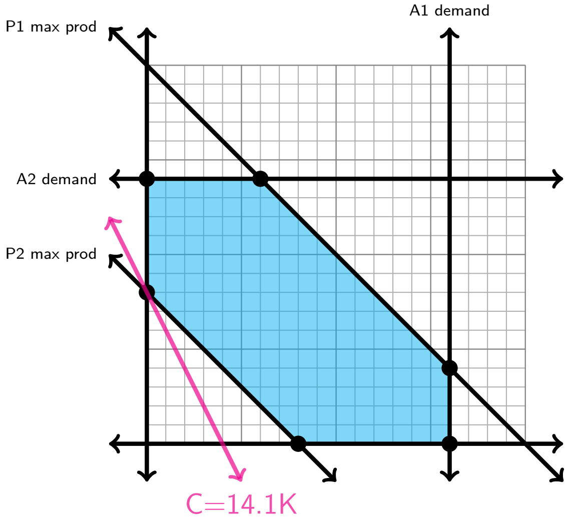
- **Constraints**:

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

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

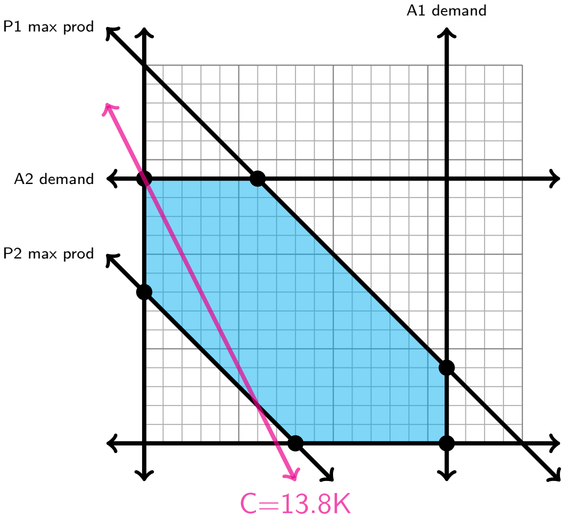
- **Objective**:
  minimize shipping cost $C = 14500 - 20X - 10Y$

Example 3 graphed



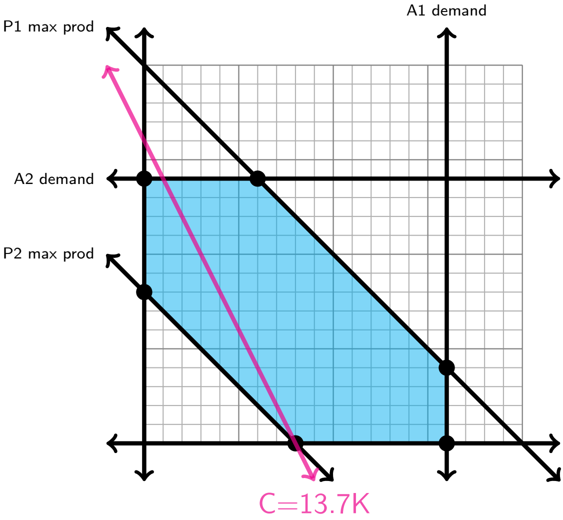
X	Y	C
0	40	\$14.1K
0	70	\$13.8K
40	0	\$13.7K
30	70	\$13.2K
80	0	\$12.9K
80	20	\$12.7K

Example 3 graphed



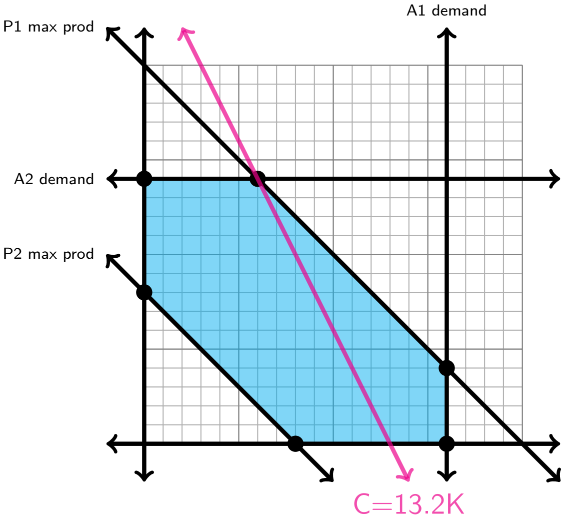
X	Y	C
0	40	$14.1K
0	70	$13.8K
40	0	$13.7K
30	70	$13.2K
80	0	$12.9K
80	20	$12.7K

Example 3 graphed



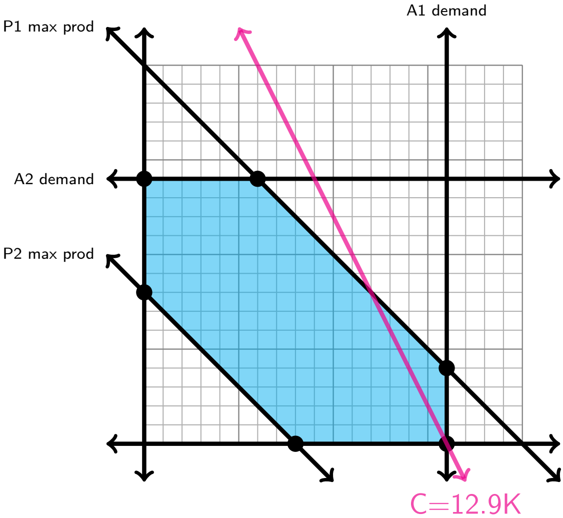
X	Y	C
0	40	\$14.1K
0	70	\$13.8K
40	0	\$13.7K
30	70	\$13.2K
80	0	\$12.9K
80	20	\$12.7K

Example 3 graphed



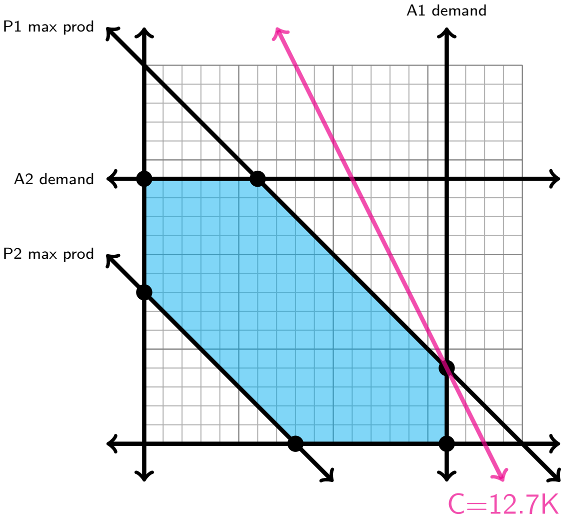
X	Y	C
0	40	$14.1K
0	70	$13.8K
40	0	$13.7K
30	70	$13.2K
80	0	$12.9K
80	20	$12.7K

Example 3 graphed



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