MA162: Finite mathematics

Jack Schmidt

University of Kentucky

January 16, 2013

SCHEDULE:

- HW 0A due Friday, Jan 11, 2013 (Late; worth half credit)
- HW 1.1-1.4 due Friday, Jan 18, 2013
- HW 2.1-2.2 due Friday, Jan 25, 2013
- HW 2.3-2.4 due Friday, Feb 01, 2013
- Exam 1, Monday, Feb 04, 2013, from 5pm to 7pm
- Sec 018 moved to BH301 (ROTC building, Barker Hall)

Today we cover 2.1: systems of linear equations.

2.1 Linear models

- Situation: You supervise 40 hours of assembly crew and 15 hours of shipping crew. They handle two products the MintyBoost and the TV-B-Gone. The MB takes 15 minutes to assemble, and 5 minutes to pack, while the TV takes 10 minutes to assemble, and 5 minutes to pack. Middle management has given you free reign on how many to produce for now.

	MB	TV	Labor
Assembly	15 min	10 min	40 hrs
Shipping	5 min	5 min	15 hrs

- Goal: Keep the crew busy

2.1 What do we have control over?

- As a low-level supervisor, what do you have the most control over?

(Left) What you tell them to work on

(Right) How fast they work

(Both) Hiring or firing to change the size of the crew

2.1 What do we have control over?

- As a low-level supervisor, what do you have the most control over?

(Left) What you tell them to work on

(Right) How fast they work

(Both) Hiring or firing to change the size of the crew

- Ok, so what should they work on?

2.1 Using math to solve a word problem

- You use variables like x and y to represent the numbers you don't know
- What should x and y represent here?

(L) Let x be the hours spent on assembly,
and y be the hours spent on shipping

(R) Let x be the number of MintyBoost to make,
and y be the number of TV-B-Gone to make

(B) Let x be the revenue from the MintyBoost,
and y be the revenue from the TV-B-Gone

2.1 Using math to solve a word problem

- You use variables like x and y to represent the numbers you don't know
- What should x and y represent here?

  (L) Let x be the hours spent on assembly,
  and y be the hours spent on shipping

  (R) Let x be the number of MintyBoost to make,
  and y be the number of TV-B-Gone to make

  (B) Let x be the revenue from the MintyBoost,
  and y be the revenue from the TV-B-Gone

- Good, now we need to write down the goal in terms of x and y

2.1 Writing down the goal

- The goal is to use up all the labor
- We can write this as "Assembly labor used = Assembly labor available"
- Each MintyBoost uses 15 minutes of assembly labor, so $15x$ total
- Each TV-B-Gone uses 10 minutes of assembly labor, so $10y$ total
- 40 hours available, that is 2400 minutes
- So $15x + 10y = 2400$ (assembly)
- And $5x + 5y = 900$ (shipping)

2.1 Solve it using "balancing"

- So we try to solve it:

$$\begin{cases} 15x + 10y = 2400 \\ 5x + 5y = 900 \end{cases}$$

$$\xrightarrow{\text{Subtract 2·bot from top}} \begin{cases} 5x + 0y = 600 \\ 5x + 5y = 900 \end{cases}$$

$$\xrightarrow{\text{Subtract top from bot}} \begin{cases} 5x + 0y = 600 \\ 0x + 5y = 300 \end{cases}$$

$$\xrightarrow{\text{Divide by 5}} \begin{cases} 1x + 0y = 120 \\ 0x + 1y = 60 \end{cases}$$

- Great so:

$$\begin{cases} x = 120 \\ y = 60 \end{cases}$$

2.1 Ok, so what do we tell the crew

$$\begin{cases} x = 120 \\ y = 60 \end{cases}$$

(L) Hey guys, $x = 120$ and $y = 60$. Get to work. I'll be in my office.

(R) We need to make 120 MintyBoosts and 60 TV-B-Gones this week.

(B) Good news, we expect to earn \$120 from the MintyBoosts and \$60 from the TV-B-Gones this week.

2.1 Ok, so what do we tell the crew

$$\begin{cases} x = 120 \\ y = 60 \end{cases}$$

(L) Hey guys, $x = 120$ and $y = 60$. Get to work. I'll be in my office.

(R) We need to make 120 MintyBoosts and 60 TV-B-Gones this week.

(B) Good news, we expect to earn $120 from the MintyBoosts and $60 from the TV-B-Gones this week.

- Since x is the number of MintyBoosts to make, and $x = 120$, we should make 120 MintyBoosts.

2.1 Ok, so what do we tell the crew

$$\begin{cases} x = 120 \\ y = 60 \end{cases}$$

(L) Hey guys, $x = 120$ and $y = 60$. Get to work. I'll be in my office.

(R) We need to make 120 MintyBoosts and 60 TV-B-Gones this week.

(B) Good news, we expect to earn $120 from the MintyBoosts and $60 from the TV-B-Gones this week.

- Since x is the number of MintyBoosts to make, and $x = 120$, we should make 120 MintyBoosts.
- In this modern world, you'll be expected to **interpret** and **apply**, not just work math problems at your desk.

  WolframAlpha is neat

2.1: Middle management adds more constraints

- Word comes down that you need to make twice as many MintyBoosts as TV-B-Gones
- They don't care about your need to keep the workers busy
- Now we must solve:

$$\begin{cases} 15x + 10y = 2400 \\ 5x + 5y = 900 \\ x - 2y = 0 \end{cases}$$

- Can we do it?
- You bet your minty boots we can!

2.1: Another system

- Ok, what about this system:

$$\begin{cases} x + \ \ y = 4 \\ x + \ \ y = 8 \end{cases}$$

What should x be?

(L) $x = 2$

(R) $x = 4$

(B) no such x

2.1: Impossible mission

- People rarely are so direct about asking the impossible

$$\begin{cases} 2x + 2y = 8 \\ x + y = 8 \end{cases}$$

- But with two equations can the impossible really be disguised?

$$\begin{cases} 5x + 5y = 20 \\ 4x + 4y = 32 \end{cases}$$

$$\begin{cases} 10x - 15y = 20 \\ 4x - 6y = 32 \end{cases}$$

2.1: The impossible game, k?

- Ok, so maybe if we have one equation and part of another, we can make it impossible

$$\begin{cases} x + y = 4 \\ 7x + ky = 56 \end{cases}$$

What value of k makes it impossible?

- Another:

$$\begin{cases} 3x - 7y = 13 \\ 6x + ky = 38 \end{cases}$$

What value of k makes it impossible?

Ch 2.1 summary

- Variables are the business decision; parallel lines look parallel
- Two more word problems on the homework
- Today's homework is not due for a while, but do it today.
- I will be in Mathskeller from 4pm to 5pm