The Unsuspecting Analyst: Mathematics That Needs No Introduction

Christopher Shaw
Asst. Prof. Mathematics, Columbia College Chicago

Joint Mathematics Meetings
San Antonio, TX
January 13, 2015

Columbia
COLLEGE CHICAGO

DEPARTMENT OF
science
math

Advantage of a QL Course

Repeating Algebra Doesn't Help Students, New California Study Finds

(US News, 12/16/2014)

- In a certain CA district, 44% of students took the same high school algebra *twice.*
- *Half* of the students who repeated the course after earning a C or better ("higher-achieving") saw a decrease in state test scores after repeating the course.

In a QL course, we can cover topics at a college level, where the challenge comes from the Literacy part, and not the Quantitative part.

Liberal Arts Mathematics at Columbia

Columbia College Chicago

- Liberal arts college in downtown Chicago,
- 10,000 students
- Traditional focus on visual, performing, media, and communication arts
  - Creative writing, deaf studies, ASL interpreting, dance, theatre, music, TV/radio, acoustics, game design, game programming

College-level mathematics at Columbia College Chicago

- Three different courses (College Math, Quantitative Reasoning, Liberal Arts Mathematics), totaling about 1500 students enrolled per year.
- Each course must be accessible after completing remedial mathematics, and function as a pre-requisite for College Algebra.

Topics covered

- Problem-solving
- Sets and Venn diagrams
- Logical consequence and deduction
- Number sets
- Algebra:
  - Linear, quadratic equations
  - Ratio, proportion, percent
- Combinatorial counting
- Probability

Jumping into mathematics

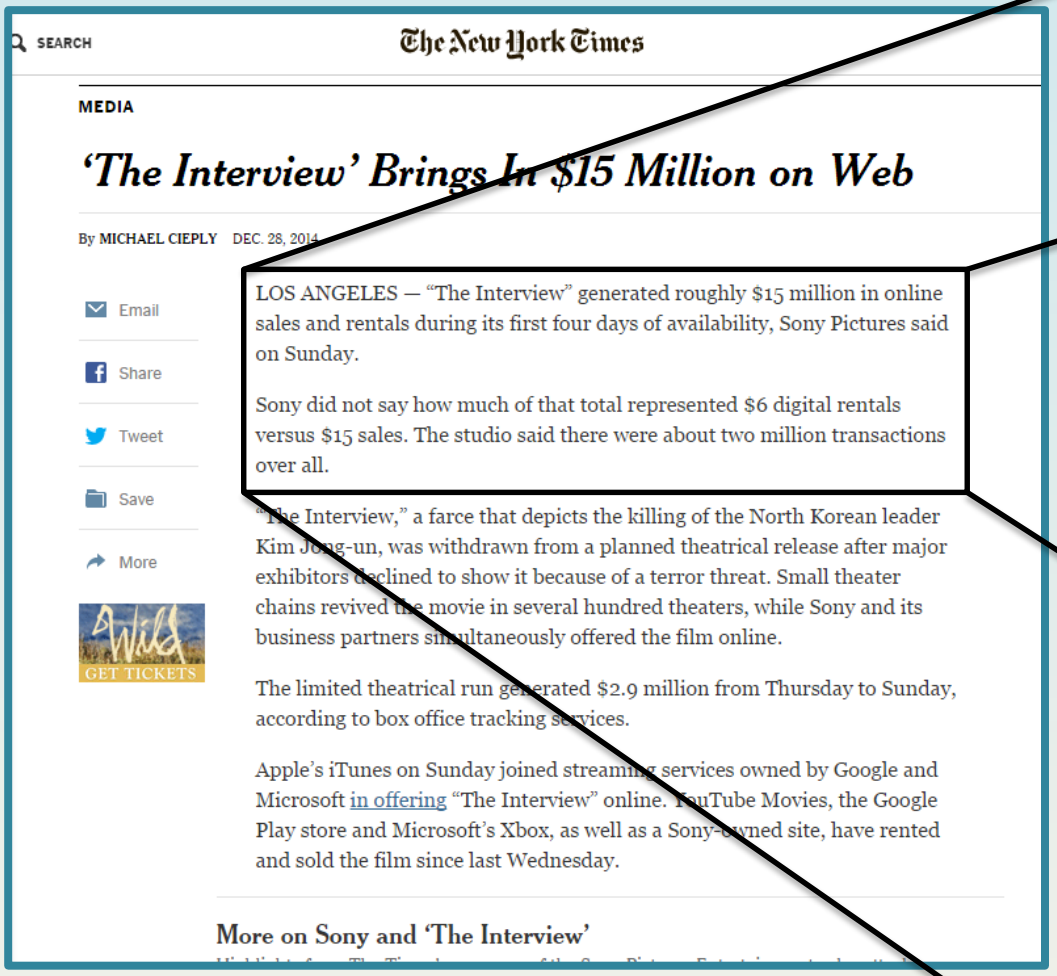
Goals for the first day of class:

1. Learn each other's names
2. Do some collaborative mathematics within the first 10 minutes of class.

In my class, I accomplish 1 and 2 at the same time by assigning a list of problems that can be tackled using a variety of methods, but lend themselves well to visualization.

If a student asks, "do I need to write an equation to solve this?" I can safely answer "no."

The "Dan Meyer Problem"



SEARCH

The New York Times

MEDIA

'The Interview' Brings In $15 Million on Web

By MICHAEL CIEPLY DEC. 28, 2014

Email
Share
Tweet
Save
More

LOS ANGELES — "The Interview" generated roughly $15 million in online sales and rentals during its first four days of availability, Sony Pictures said on Sunday.

Sony did not say how much of that total represented $6 digital rentals versus $15 sales. The studio said there were about two million transactions over all.

"The Interview," a farce that depicts the killing of the North Korean leader Kim Jong-un, was withdrawn from a planned theatrical release after major exhibitors declined to show it because of a terror threat. Small theater chains revived the movie in several hundred theaters, while Sony and its business partners simultaneously offered the film online.

The limited theatrical run generated $2.9 million from Thursday to Sunday, according to box office tracking services.

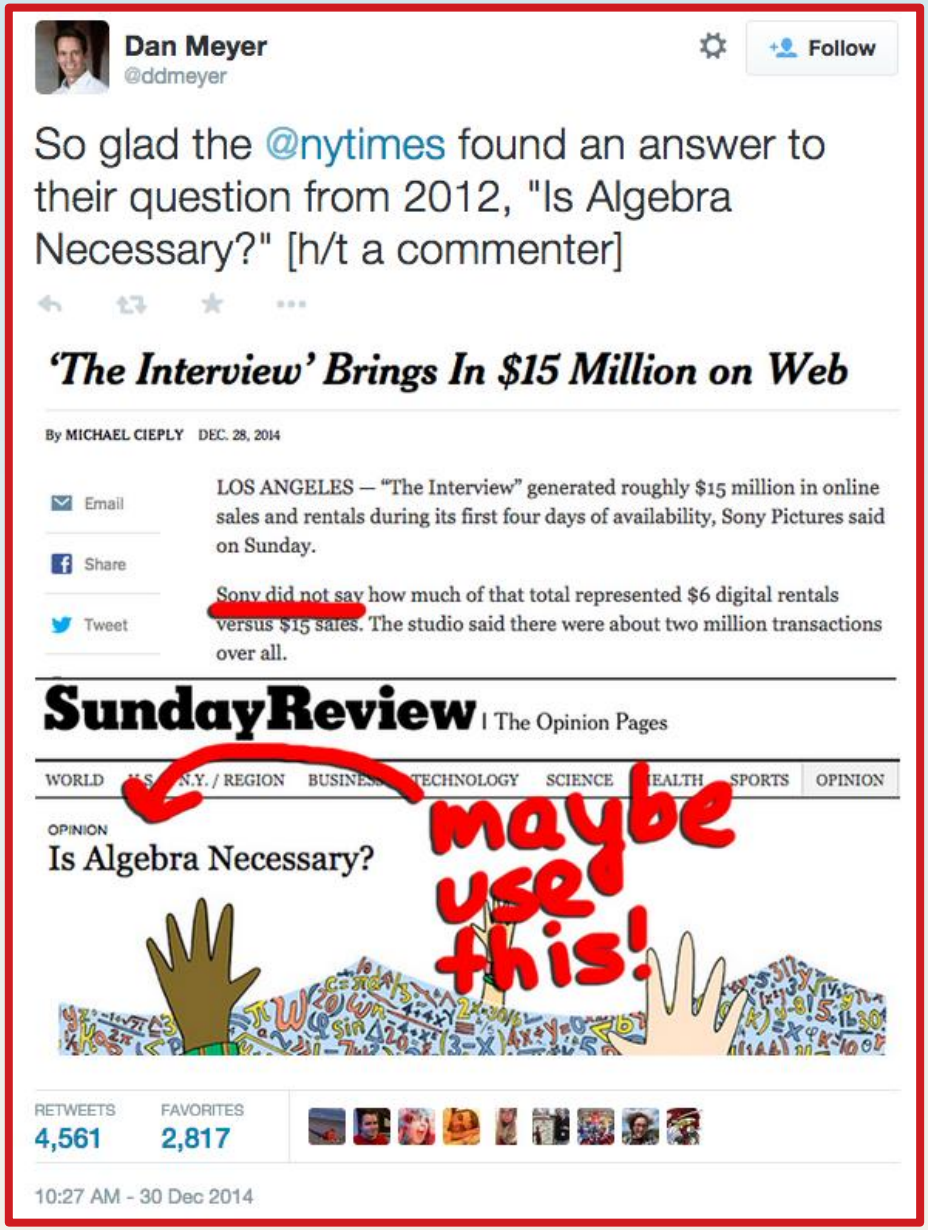
Apple's iTunes on Sunday joined streaming services owned by Google and Microsoft in offering "The Interview" online. YouTube Movies, the Google Play store and Microsoft's Xbox, as well as a Sony-owned site, have rented and sold the film since last Wednesday.

More on Sony and 'The Interview'

"The Interview" generated roughly $15 million in online sales and rentals during its first four days of availability, Sony Pictures said on Sunday.

Sony did not say how much of that total represented $6 digital rentals versus $15 sales. The studio said there were about two million transactions over all.

(Maybe you saw this one already?)



With no preparation, this question can be approached with an educated guessing system: suppose 1 million rentals, and 1 million sales?

Rentals (millions)	Sales (millions)	Revenue (millions)
1	1	$6 + $15 = $21

With no preparation, this question can be approached with an educated guessing system: suppose 1 million rentals, and 1 million sales?

Rentals (millions)	Sales (millions)	Revenue (millions)
1	1	$6 + $15 = $21

$21 is too high, so we overestimated the number of sales. Adjust the number of sales downward!

With no preparation, this question can be approached with an educated guessing system: suppose 1 million rentals, and 1 million sales?

Rentals (millions)	Sales (millions)	Revenue (millions)
1	1	$6 + $15 = $21
1.5	0.5	$9 + $7.5 = $16.5

Adjust again.

With no preparation, this question can be approached with an educated guessing system: suppose 1 million rentals, and 1 million sales?

Rentals (millions)	Sales (millions)	Revenue (millions)
1	1	$6 + $15 = $21
1.5	0.5	$9 + $7.5 = $16.5
1.7	0.3	$10.2 + $4.5 = $14.7

This is quite close to the total revenue quoted in the article.

Of course, it is also straightforward to set this up algebraically:

$$6r + 15s = 15$$

$$r + s = 2$$

Solve to get:

$r \approx 1.67$ million rentals

$s \approx 0.33$ million sales

The dartboard problem

Throw a dart at a standard dartboard, hoping to get the highest possible score. Where do you aim?

The dartboard problem

Model the problem, making some simplifying assumptions:

- Forget the bullseye and the multipliers.
- Quantify your accuracy: Suppose half of your throws hit the intended target value, and the other half hit the adjacent values, with equal probabilities on either side.
- Assume you throw 100 darts.

The dartboard problem

Aim	Hits	Miss left	Miss right	Total
20	1000	125	25	1150
1	50	500	450	1000
18	900	25	100	1025
4	200	450	325	975
13	650	100	150	900
6	300	325	250	875
10	500	150	375	1025
15	750	250	50	1050
2	100	375	425	900
17	850	50	75	975
3	150	425	475	1050
19	950	75	175	1200
7	350	475	400	***1225***
16	800	175	200	1175
8	400	400	275	1075
11	550	200	350	1100
14	700	275	225	1200
9	450	350	300	1100
12	600	225	125	950
5	250	300	500	1050

The dartboard problem

Brute force: students calculate the points earned by 100 throws at each of the 20 options.

10 weeks later, this whole problem can be redone as an expected value calculation!

The washer problem

Modern washer and dryer cycles equipped with sensors have different durations depending on the size of the load.

Should this impact the way you do laundry?

The washer problem

	Washer	Dryer
Small load	20 minutes	25 minutes
Large load	30 minutes	40 minutes

Suppose you have a small load and a large load. Does the order in which you do your laundry loads make a difference for the amount of time it takes to complete?

The washer problem

	Washer	Dryer
Small load	20 minutes	25 minutes
Large load	30 minutes	40 minutes

Large, then small:

	Washer	Dryer	Total time
Load 1	(Large) 30 min	---	30 min
Load 2	(Small) 20 min	(Large) 40 min	70 min
Load 3	---	(Small) 25 min	95 min

The washer problem

	Washer	Dryer
Small load	20 minutes	25 minutes
Large load	30 minutes	40 minutes

Large, then small:

	Washer	Dryer	Total time
Load 1	(Large) 30 min	---	30 min
Load 2	(Small) 20 min	(Large) 40 min	70 min
Load 3	---	(Small) 25 min	95 min

Small, then large:

	Washer	Dryer	Total time
Load 1	(Small) 20 min	---	20 min
Load 2	(Large) 30 min	(Small) 25 min	50 min
Load 3	---	(Large) 40 min	90 min

The paint problem

You have a cup of pure white paint, and one drop each of three different powerful dyes. How many different colors of paint can you make?

The paint problem

No dye: white
One dye: red, yellow, blue
Two dyes: orange, green, purple
Three dyes: brown

For a total of 8 colors.

The paint problem

You have a cup of pure white paint, and one drop each of ***four*** different powerful dyes. How many different colors of paint can you make?

The paint problem

0 dyes	1
1 dye	4
2 dyes	6
3 dyes	4
4 dyes	1
Total	16 colors

Topics previewed in the first 45 minutes of the semester

- ☑ Red herring numbers
- ☑ Simplify like units
- ☑ Guess-and-check
- ☑ Simultaneous equations
- ☑ Approximation
- ☑ Make informed predictions
- ☑ Brute force calculation
- ☑ Expected value
- ☑ Diagramming time
- ☑ Sets and subsets
- ☑ Combinations

Thank you

Christopher Shaw
Asst. Prof. Mathematics
Columbia College Chicago
cshaw@colum.edu
www.schris.com

Columbia
COLLEGE CHICAGO

DEPARTMENT OF
science
math