Introduction
Noticing numbers

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Plan

Bring copies of today's Globe, ask students to look at it while we take attendance to find one number they think they either understand or don't understand in some story that they actually care about. Do this in groups of three since there are three seats in each row. That should provide us with about eight problems.

Survey class briefly to see what they've chosen. Then pick one or two of the numbers to follow up on – either by show of hands or by what we think will make the best lesson (depends on what the class comes up with). The important questions to raise:

- Is the number plausible, or not? How do you know?
- Is the number surprising? Why?
- How would you verify it? *Don't turn computers on in the first class!*
- What's clear or confusing/misleading about it? How might you say the same thing in another way?

This exercise will lead to some or all of

- Counting zeroes: million, billions, trillions and beyond.
- All interesting numbers are numbers *of something* – units.

- Fermi problem estimation skills.
- Significant digits, orders of magnitude, quick and dirty mental arithmetic.

These are the themes of the first few weeks. We won't get to all of them on the first day.

The advantage to this approach is that it's immediately engaging. We'll have to be pretty nimble, though. We will read the paper that morning to try to guess what the students will choose, and to find some appropriate numbers (in case the students find none.

The only quantitative part of the first homework assignment will mirror this exercise. We assign one number to make sense of and ask them to find another and analyze it themselves in a similar spirit, using whatever techniques/ideas we discussed in class.

Lecture notes

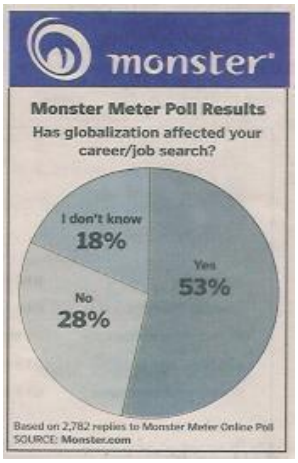
Interesting numbers from the newspaper

The first kinds of questions to ask about any numbers are

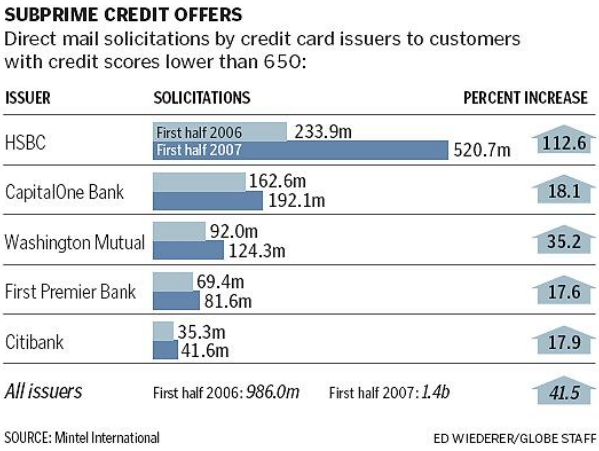
- What do they mean?
- What makes them interesting?
- Do you believe them? Where do they come from?
- How might you check them?
- ...

The class came up with four stories from the *Globe*:

1. A pie chart in the Careers advertising supplement reporting the results of an on line opinion survey about the effect of globalization on job search:



2. Credit card companies woo struggling mortgage-holders (page A1), with this graphic:



(The URL is http://www.boston.com/business/personalfinance/articles/2007/09/04/credit_c

3. Dustin Pedroia's offensive statistics (page D3)

Need to format this table better

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Batters BA SLG G AB R H TB 2B 3B HR RBI BB SO SB CS E
D.Pedroia .327 .449 117 428 71 140 192 32 1 6 44 43 36 5 1 5
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4. Lottery payoffs: State plans new game with big lottery ticket (The URL is http://www.boston.com/news/local/articles/2007/09/04/state_plans_new_game_with_big_l next to a table showing lotter Monday payoffs:

scan table here - can't find it on line

This was a promising start. There was a groundswell of opinion in favor of discussing the lottery. We decided not to honor it because we plan to discuss the lottery later in the semester, when we will have the time and tools to do it right.

The Monster.com pie chart

We began with the Monster.com survey.

The pie chart is interesting because it reflects growing concern about globalization (at least among people looking for jobs). So the discussion began with a the meaning of "globalization." Rachel defined globalization as the current tendency for companies to do their business (buying, selling, manufacturing) paying little attention to national boundaries, just doing what would be best for bottom line profits. Then she pointed out that this survey, among job seekers, was probably really about outsourcing - US companies hiring people elsewhere. The particular example she cited was the staffing of customer service call centers. These days the phone is likely to be answered by someone in India.

Bruliana described what Monster.com does. We won't repeat the description here.

The chart does a good job reporting what the $2,782$ people who took the on line survey said in answer to the simple question. There's no reason to doubt the *accuracy* of the figures. 53% *believe* that globalization has affected their career/job search. But that does not say very much about whether globalization really mattered in their cases. There's a lot of built in *bias* in the *sample*. Who are the people who answered the question? Just a small number of people looking for work. Maybe the ones who couldn't find a high tech job and blame their failure on "globalization" rather than on their own lack of qualifications. Maybe some of them answered the question more than once to express their frustration more forcefully. On the other hand, maybe some of the 28% who said globalization didn't matter in their job search were

just the successful ones, or even CEOs who took the survey multiple times to try to influence public perception of the problem.

We decided that the pie chart wasn't really intended to convey useful information. It's just there as a paid ad by the sponsor, Monster.com, to lure people to their Boston Globe web site.

In fact, Boston.com runs a survey like this pretty regularly. On http://www.boston.com/help/su they say explicitly that

> Boston.com's surveys are not intended to be a scientific sampling of local or national opinion, but rather, a quick and informal way for you to record your views on a variety of subjects. Although the surveys are designed to record just one vote per person, savvy users may find a way to vote more than once. So take that into consideration the next time you see Spam outpolling turkey as a favorite Thanksgiving Day meal.

Morals of this story: there's nothing wrong with the graph itself, but the information it conveys can't be used to say much more than that half the people who answered the question *thought* that globalization mattered to them. That they thought so is true. That it did is unknown and unknowable.

Credit card offers

Adriana described the graph. She knew "credit score lower than 650" meant a poor credit risk, even without knowing how the actual number is computed. (In fact that's pretty complex.) She got the point of the article, which is a moral one: it's not nice that credit card companies are trying to give cards to people already in a hole, which is likely to put them in more of a hole.

A brief informal survey of the class showed that about 1/3 have credit cards, about 2/3 have debit cards, and about 2/3 have received mail solicitations for credit cards.

Do we believe the numbers? The graphic says that the total number of mailings to people with low credit scores in the first half of this year was 1.4b, which we correctly recognized as 1.4 billion and wrote as 1,400,000,000.[1] Is that a lot?

One way to try to understand a large number is to reorganize it in more everyday terms. In this case we decided to figure out how many mailings that

[1] A billion has nine zeroes. There are just eight zeroes here because of the 0.4.

would be *per person* if everyone in the United States got them.[2] How many people are there in the United States? For the kind of rough estimating we're doing now, the figure is 300 million, or 300,000,000 (a million is six zeroes).[3]

Now how do we figure out how many mailings per person? Everyone in the class remembered from some previous class that we had to divide. But which way? The first person to volunteer an answer guessed wrong.

That provided an opportunity for what we consider the first real lesson: numbers are never just numbers, they are always numbers *of something*. We call the something the *units*. In this problem we care about 1.4 billion *mailings* and 300 million *people*. Ordinary common sense tells us the answer to our question has units *mailings per person*. And we remember[4] that the word "per" means "divide". So before we do any arithmetic at all we can write the fraction that tells us the units of our answer:

$$\frac{\text{mailings}}{\text{person}}$$

Only after we write the units do we write the numbers:

$$\frac{1,400,000,000 \text{ mailings}}{300,000,000 \text{ persons}}$$

Then we do the arithmetic. Seven of the zeroes cancel, leaving

$$\frac{14 \text{ mailings}}{3 \text{ persons}}$$

Finally, Matt noted that $14/5 \approx 5$ (no calculator needed), so the credit card companies sent more than five unsolicited mailings to each person with a low credit score.

Discussion next about the source of the data: Mintel.

Beginning of a discussion about increase and percent increase - that's what the next class will be about.

When we talk later this semester about interest we will talk about credit card interest rates.

[2]Working with the whole population is much easier than working with the number of people with credit scores less than 650. And it's just as good if all we want is to find out whether the numbers make sense.

[3]Remember that number. You'll need it often this semester and don't want to have to look it up each time.

[4]or learn right now and remember from now on