The Realities of Quantitative Illiteracy:

What My Students Do Not Know about "Basic" Mathematics…

&

What They Can Learn in One Semester

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But First: What is important to know? Why?

It depends…
On where you live,
When you live,
What you hope to do,
What you should do …

Milk a cow?
Solve quadratic equations?
Own a house?
Vote intelligently?

My Population

- 21st century American college students
- Not planning on a STEM major
- With typical mediocre U.S. math background through high school Algebra II
- For whom math does not come easily

I.e.:

Typical students at a non-selective college …
taking a single math course …
because it is required for graduation…
who are not going on to calculus.

Chances are that, as adults, they will never have to solve a quadratic equation.

What Should Educated Adults Know About Mathematics?

Mathematics as…
- Practical?
- Logical?
- Mind-Building? (learning to think, getting organized, dealing with the abstract, etc.)
- Beautiful?
- Interesting?
- Traditional?

My Current Answer

1. Mostly practical topics
2. With a <u>huge</u> emphasis on making sense of these topics

Quantitative Literacy—for my students, not Vanderbilt students

- Some number sense
- Some algebra
- Some knowledge about money matters, especially credit cards, loans, mortgages, savings and investments, compound interest
- Strong grasp of decimals and percents
- Good grasp of multiplicative and proportional relationships
- Some familiarity with technology, including scientific calculators, spreadsheets, …
- Some knowledge about exponential growth & decay—cost of living, population growth…

Don't they already know most of this???

I love and respect these students, but most are…

- Coming from a K-12 mathematics education system that the National Mathematics Advisory Panel described as "broken" (2008)
- Not all that fond of mathematics

No, they don't already know most of this.

******** 2005 NAEP Results (Nat'l Assessment of Educational Progress) ***************
[The following are 5-choice multiple choice questions with calculator access.]

Grade 8 :
Start with 90 employees. Then up 10%. How many now? 37% Correct
Dinner bill was $67. Added a $13 tip. What percent of total bill was the tip? 30% Correct

Grade 12:
$20,000 car decreases in value 20% each year, based on the value at the beginning of that year. At the end of how many years will the value be less than half the original cost? 26% Correct

********* Results at UT-Chattanooga (not multiple choice, no calculators) ***************
Midsized public regional university with low admissions requirements (Average ACT ≈ 22)

1. Sample: Liberal Arts Pretest with sample size n = 65
   Problem: Decimal form of 9¼% 28% Correct

2. Sample: College Algebra Posttest with n = 84
   25% off sale with sale price of $360. Original price? 19% Correct

3. Sample: Calculus I Posttest with n = 49
   a. Fraction form of 33⅓% 20% Correct
   b. 1 cubic yard = ? cubic feet 20% Correct

See May/June 2007 issue of MAA *Focus* for more details.

********* Results from **VA Commonwealth University (Aimee Ellington) **********

Sample: Students in Lib. Arts, Coll. Alg., Precalculus, Calc. I
Posttest w/ $n \geq 150$, multiple choice with 5 answers

1. 0.58% of returns are audited. Number of returns audited out of 1000? **38% Correct**
2. Online spending now at $23.5 billion, up 30% from 2001. Spending in 2001? **38% Correct**
3. Number passing decreases by 30% one year and increases by 30% the next year. Year of highest passing rate? **23% Correct**

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What to teach your non-STEM students?

1. Think, read about, and discuss what mathematics <u>your</u> students should know.
2. Give pretests. [Brace yourself.]
3. Do triage. [You may lose the bottom x%.]
4. Think about what is most important for most students to learn in the space of one semester.
5. Be prepared to make mistakes:
   - Expecting too much (They'll just memorize)
   - Expecting too little (They won't learn to think)
   - Assuming too much (You'll lose 'em)
   - Being too theoretical (They'll fall asleep)
   - Being too formula-driven

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What I aim to do in my QL course

1. Basic number sense

a. Meanings (0.004 means …)
b. Conversions (9¼% = 0.0925, etc.)
c. Memorized facts (7×9, 20% = 1/5, etc.)
d. Basic non-calculator calculations (1 + 0.06/2, etc.)
e. Key number properties ($\frac{A+B}{C} = \frac{A}{C} + \frac{B}{C}$, etc.)

2. Technology

a. Compute complicated expressions using calculator
b. Program Excel spreadsheets

3. Money

a. \$0.79 vs. 79¢
b. Savings: compound interest, annuities, …
c. Loans: payday loans, installment loans, amortized loans, credit card loans

4. Multiplicative Comparisons

Ex: Save 62%! Buy crib for \$59….

5. Exponential growth and decay

Ex: U.S. annual population growth is 0.88% ...