

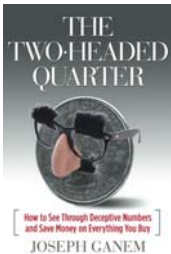
**Integrating Quantitative and Financial Literacy**

Joint Statistical Meetings  
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Miami Beach, Florida

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**The Baltimore Sun:** Education, math, science, personal finance  
<http://www.BaltimoreSun.com>

**The Daily Riff:** Education Issues  
<http://www.TheDailyRiff.com>

**Two Headed Quarters:** Personal blog on how to see through deceptive numbers  
<http://twoheadedquarters.blogspot.com>

**Themes:** Use of numbers for misdirection. Use of numbers in place of judgment. Cost to consumers of quantitative illiteracy.

**Purpose**

**Present instructional resources I've developed to teach "obvious benefit/hidden cost" problems.**

- Resources are intended to integrate financial and quantitative literacy instruction
- Provide motivation for students/educators/policy makers to emphasize quantitative literacy

**Calls for Financial Literacy Education**

*"Thus, in far too many instances, we entered into financial commitments that we couldn't afford, with terms and conditions that we didn't truly understand, in order to buy things that we really didn't need. If more Marylanders had the benefit of sound financial literacy education, fewer of our friends and family members would be facing the loss of homes and life savings today."*

- Maryland Comptroller Peter Franchot  
*Baltimore Sun, Op-Ed, February 10, 2010*

**Education has Limits**

Reminders of the obvious:

*Knowledge is of no use without motivation*

*Education cannot substitute for trust and good judgment*

*All parties must act in good faith for our financial system to work*

**Remedial Education**

Even with the NCLB law, the need for remedial college courses is not changing.

**34.7% of first-year undergraduate in 2003-2004 needed at least one remedial course**

**36.2% of first-year undergraduate in 2007-2008 needed at least one remedial course**

**In many instances math is one of the remedial courses needed.**

SOURCE: U.S. Department of Education, National Center for Education Statistics, 2003-04 and 2007-08 National Postsecondary Student Aid Study (NPSAS:04 and NPSAS:08).

### Quantitative Literacy

**Mathematics proficiency:**  
**32% proficient at grade 8**  
**23% proficient at grade 12**

**“Consistent with these findings is the vast and growing demand for remedial mathematics education among arriving students in four-year colleges and community colleges across the nation.”**

SOURCE: Foundations for Success: The final report of the national mathematics advisory panel, U. S. Department of Education (2008).

### Recommendation

**Students should master arithmetic before they take an Algebra I course.**

***“It is possible that the Accuplacer Arithmetic Test is the first rigorous arithmetic test that many students have ever encountered.”***

**“Algebra can be described as a generalization of arithmetic .... and it should not be formally studied without a thorough knowledge of arithmetic.”**

SOURCE: Gabrielle Martino and W. Stephen Wilson, Doing the Math: Are Maryland’s high school math standards adding up to college success? (Abell Foundation, Baltimore, MD, 2009)

### Behavioral Finance

**Consumers:**

- Are not rational
- Decisions often determined by “framing”

*A decision frame is “the decision maker’s conception of the acts, outcomes, and contingencies associated with a particular choice.”*

**Often decision frames use a quantitative comparison.**

SOURCE: Amos Tversky and Daniel Kahneman, “The framing of decisions and the psychology of choice,” Science, 211, pp. 453-458 (1981).

### Car ad for 0% financing




### Finance Charge

**Use 0% financing from ad:**  
**\$6452 = \$27,340 — \$20,888**

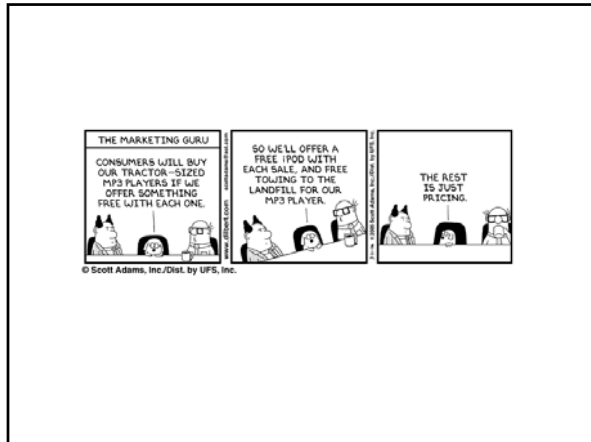
**If we use the monthly payment formula with 11% APR:**

**\$6360 = \$27,250 — \$20,888**

### Equivalent Ad



Price— \$20,888  
 Financing available for 5 years at 11% APR.



### Loan Comparison

**Auto Financing Savings**

Cost without rebate (dollars):

Cost with rebate (dollars):

Loan term (years):

Reduced financing (APR\*):

Alternate financing (APR\*):

Monthly Payment: (reduced APR)

Monthly Payment: (alternate APR)

Difference:

\* APR = annual percentage rate

The Two Headed Quarter  
How to See Through Deceptive Numbers

**Cost without rebate: \$27,340**

**Cost with rebate: \$20,888**

**Loan term (years): 5**

**Reduced APR: 0%**

**Alternate APR: 9%**

**Monthly payment (reduced): \$456**

**Monthly Payment (alternate): \$434**

**Difference: — \$22**

Source: [www.ComputeGasSavings.com](http://www.ComputeGasSavings.com)

### Obvious Benefit/Hidden Cost Problems

Consider these obvious benefit propositions:

- I have a coupon to save \$5 on any size purchase at a store 20 miles away. I need to buy a \$15 calculator. Should I make the trip?
- On my street gas sells for \$3.95 per gallon. If I drive to the next town 15 miles away it sells for \$3.85 per gallon. Should I make the trip?
- At a neighborhood cash-for-gold party, I've been offered \$600 for a gold chain that I no longer wear. Should I sell it?

**The problem in each case is to determine the cost.**

### Driving to Save on a Purchase

**Total Savings**

Miles per gallon:

Cost per gallon (dollars):

Discount (dollars):

Distance (miles):

Total Savings:

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**Miles per gallon: 25**

**Cost per gallon: \$3.50**

**Discount: \$5**

**Distance: 20 miles**

**Total Savings: – \$0.60**

Source: [www.ComputeGasSavings.com](http://www.ComputeGasSavings.com)

### Driving to Save on Gas

**Gas Savings**

Tank Size (gallons):

Miles per gallon:

Cost local (dollars):

Cost away (dollars):

Distance (miles):

Savings per Gallon:

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**Tank Size (gallons): 16**

**Miles per gallon: 30**

**Cost per gallon (local): \$3.95**

**Cost per gallon (away): \$3.85**

**Distance: 15 miles**

**Savings per gallon: – \$0.14**

Source: [www.ComputeGasSavings.com](http://www.ComputeGasSavings.com)

### Cash for Gold

**Gold Jewelry Pricing**

Weight (oz):

Purity (carats):

Gold (dollars/oz troy):

Gold value

The Two Headed Quarter  
How to See Through Deceptive Numbers and Save Money on Deceptive Transactions

**Weight (ounces): 1.2**

**Purity (carats): 14**

**Gold price (\$/troy ounce): \$1600**

**Gold value: \$1021**

## Complex Scenarios

The cost of going to work in a two-income family:

- Commuting costs
- Daycare costs
- Work-related expenses
- Taxes

### A Solution for the Two-Income Family

**Real Earnings Per Day**

Distance to work (miles):

Miles per gallon:

Cost per gallon (dollars):

Cost of daycare (dollars):

Work-related costs (dollars):

Federal tax rate (%):

State tax rate (%):

Social Security/Medicare (%):

Daily pay:

Cost of gas per day:

After tax earnings per day:

Real earnings per day:

Distance: 10 miles

Miles per gallon: 20

Cost per gallon: \$3.75

Day care cost: \$35

Work-related costs: \$10

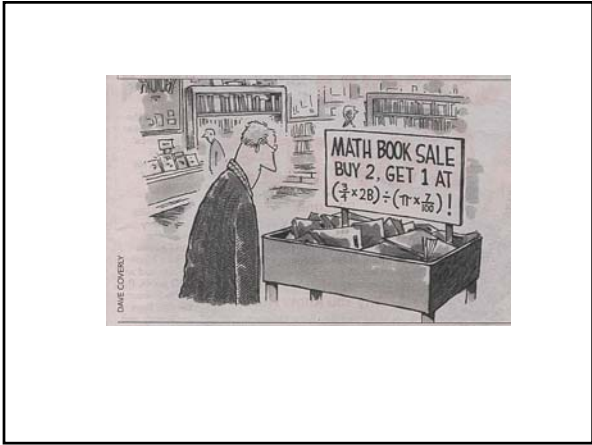
Federal Tax rate: 15%

State Tax rate: 5%

Daily Pay: \$96

**Real earnings per day: \$20.70**

Source: [www.ComputeGasSavings.com](http://www.ComputeGasSavings.com)



## Generalizing with Algebra

**Consumers:**

Finance charge = Total cost — Cash price

**Marketers:**

Finance charge = Fraction of the cost determined by the interest rate in the monthly payment formula

$$v \cdot \left( \frac{100}{i} \right) (1 - s) P = -SF$$

where  $s = \left( 1 + \frac{i}{100} \right)^{-N}$

## Conclusion

- All resources available at [www.ComputeGasSavings.com](http://www.ComputeGasSavings.com)
- Consumers cannot act rationally if they don't understand the choices
- Learning quantitative reasoning can help consumers make better decisions
- Integrating financial and quantitative education could provide the motivation for real learning of both