

Five Real-Life Math Investigations That Will Astound Teachers and Students

Ed Zaccaro

www.challengemath.com

challengemath@aol.com

Loan sharking

1) What is the typical car loan rate?

5%

What does this mean?

\$100 borrowed x .05 = \$5 fee to use \$100 for one year.

2) What is the typical loan rate for a home?

5%

What does this mean?

\$100 borrowed x .05 = \$5 fee to use \$100 for one year.

3) What is the typical loan rate for a credit card?

20%

What does this mean?

\$100 borrowed x .20 = \$20 fee to use \$100 for one year.

4) What is the typical rate for Payday Loans, Check into Cash etc?

435%

What does this mean?

\$100 borrowed x 4.35 = \$435 fee to use \$100 for one year.

How these companies work: Check into Cash

Write check for \$116.67 and receive \$100. They will cash your \$116.67 check in 2 weeks. You are charged \$16.67 to use \$100 for 2 weeks.

$\$16.67 = 16.67\% \times 26 \text{ two-week segments in one year} = 435\% \text{ (approximately)}$

What if you don't pay \$100 for 5 more years? Interest on interest(Assume no penalties)

Car loan: **Owe \$134**

Home: **\$134**

Credit Card: **\$299**

Check into cash: **\$438,297**

$\$100 \times 5.35 \times 5.35 \times 5.35 \times 5.35 \times 5.35 = \$438,300$

But--It is even worse than this!!!!

Check into Cash charges 16.67% every 2 weeks.

Let the \$100 ride for 1 year---How much will you owe?

$\$100 \times 1.1667^{26}$

2 weeks: \$116.67

4 weeks: \$136 (Round)

6 weeks: \$159

8 weeks: \$186

10 weeks: \$217

12 weeks: \$253

14 weeks: \$295

16 weeks: \$344

18 weeks: \$401

20 weeks: \$468

22 weeks: \$546

24 weeks: \$637

26 weeks: \$743

28 weeks: \$867

30 weeks: \$101

32 weeks: \$1181

34 weeks: \$1378

36 weeks: \$1608

38 weeks: \$1876

40 weeks: \$2189

42 weeks: \$2554

44 weeks: \$2980

46 weeks: \$3477

48 weeks: \$4057

50 weeks: \$4733

52 weeks: \$5522

5522%

After one year owe \$5500 (Rounded)

Let the \$100 ride for 5 more years---How much will you owe?

Look for simple way to estimate.

Notice that it quadruples every 18 weeks. (Approximately)

How many 18 week periods are there in 5 years? $52 \text{ weeks} \times 5 = 260 \div 18 =$ about 14 groups of 18 weeks.

Start: \$5500 Then quadruples every 18 weeks

18 weeks: \$22,000

36 weeks: \$88,000

54 weeks: \$352,000

72 weeks: \$1,408,000

90 weeks: \$5,632,000

108 weeks: \$22,528,000

126 weeks: \$90,112,000

144 weeks: \$360,448,000

162 weeks: \$1,441,792,000

180 weeks: \$5,767,168,000

198 weeks: \$23,068,672,000

216 weeks: \$92,274,688,000

234 weeks: \$369,098,752,000

252 weeks: \$1,476,395,008,000

260 weeks: (Doubles) \$2,952,790,016,000

Almost half the national debt

Ed Zaccaro

E-mail: challengemath@aol.com

Phone: 563-583-4767

Pilots Make Mistakes

As flight 143 cruised at 41,000 feet, the pilots received a warning that a fuel pump in the left wing had probably failed. Shortly after that, a second fuel pressure warning light alerted the crew that another fuel pump was failing.

The pilot now became very concerned and decided to divert to Winnipeg. Shortly after making this decision, another left wing fuel pressure gauge lit up and the left engine stopped completely.

As the pilots prepared for a single engine landing, the remaining engine on the right side of the plane also stopped. Now the pilots were trying to control and land a 132 ton glider because the jet had run out of fuel!

To further complicate the problem the pilots were facing was the fact that they soon discovered that the huge jet was sinking too fast to make it to the Winnipeg Airport. Their only chance was a pair of abandoned Royal Canadian Air Force runways.

What the pilot and the air traffic controllers who began to guide flight 143 to the abandoned runways did not know was that parts of both runways were being used by the Winnipeg Sports Car Club for a “Family Day” celebration. The runway that Flight 143 was heading for was filled with spectators, racers, and children who all fled when they saw the jet approaching.

The plane did manage to land, but the front landing gear collapsed. The passengers quickly evacuated the plane and all survived. (Several were injured sliding down the emergency chute.)

It was July 23rd 1983 and Air Canada 143 was being prepared for departure from Montreal when the crew discovered that the fuel gauge did not work. Instead of canceling the flight, the crew and mechanics decided to check the amount of fuel in the tank by hand. They used a procedure that is call a “drip”. This procedure, which has been used since the beginning of flight, is similar to the dipstick in a car.

When the mechanics measured each wing tank, they found that the plane had a total of 7682 liters of jet fuel.

The flight crew and pilot knew the flight required 22,300 kilograms of fuel. They used a conversion of 1.77 and determined that there were $7682 \times 1.77 = 13,597$ kilograms of jet fuel already in the tanks. $22,300 - 13,597 = 8703$ kilograms of jet fuel were needed.

8703 kilograms divided by the conversion factor of 1.77 = 4917 liters of jet fuel needed. So 4917 liters of jet fuel were added and flight 143 took off for its destination of Edmonton. (With a short stop in Ottawa.)

Ethanol

(All information is from Scientific American January 2007)

A gallon of ethanol contains approximately 80,000 Btu of energy.

A gallon of gasoline contains approximately 120,000 Btu of energy.

A Btu is a measurement of how much energy is in a fuel.

(British Thermal Unit)

In 2006, the United States used 5 billion gallons of ethanol.

In 2006, the United States used 140 billion gallons of gasoline and diesel fuel.

It takes 36,000 Btu of natural gas to make a gallon of ethanol.

The production of corn uses approximately 7,500,000 Btu per acre. (U.S. Department of Agriculture)

An acre produces approximately 120 bushels of corn.

A bushel of corn yields approximately 2.5 gallons of ethanol.

In the year 2005, 14% of the corn crop in the United States went toward the production of ethanol.

3.4 billion gallons of ethanol were produced in the year 2005.

1) How many Btu of energy does it take to grow a bushel of corn?

Answer: 62,500 Btu per bushel

7,500,000 Btu per acre

120 bushels of corn per acre

$$7,500,000 \div 120 = 62,500 \text{ Btu per bushel of corn}$$

2) How many Btu of energy does it take to produce enough corn for a gallon of ethanol?

Answer: 25,000 Btu

Bushel of corn: 62,500 Btu

2.5 gallons of ethanol in a bushel of corn

$$62,500 \div 2.5 = 25,000 \text{ Btu for enough corn to make a gallon of ethanol}$$

2) Al has a vehicle that can run on ethanol or gasoline. Gasoline cost \$3 per gallon and ethanol cost \$2.75 per gallon so Al always fills his car with ethanol. Is this a wise financial decision?

Answer: No. There is only 2/3 the amount of energy in ethanol compared to gasoline.

Should I Purchase a Hybrid Car to Save Money?

There are many reasons to buy a hybrid car including:

- 1) Very friendly to the environment, especially in cities.
- 2) If all cars in the United States were hybrid, we would need very little oil from the Middle East.

We will only concern ourselves with the financial aspects of buying a hybrid car. In other words: Does it make financial sense?

Demand for hybrids such as the Toyota Prius have grown dramatically, especially because the price of gas has risen so high.

What does the math say about buying a hybrid to save money?

Information:

- 1) We will compare the Honda Civic Hybrid to the standard gas-engine Civic because it is comparing two like cars. With the Prius, there is no exact car to compare.
- 2) Cost of a Hybrid Civic is $\$20,915 + 5\% \text{ tax} = \$21,960$
Cost of standard Civic is $\$15,610 + 5\% \text{ tax} = \$16,390$
- 3) Mileage for Civic Hybrid: 45 mpg
Mileage for Civic: 34 mpg
- 4) Price of gas: \$2.50
- 5) Loan: 5 years at 5% interest
- 6) Government deduction saves \$500 (\$2000 deduction)
- 7) Miles driven per year will be 15,000 miles

Again, what does the math say about buying a hybrid to save money?

Further study: What price must gas reach to make hybrids financially the right choice? (We will define right choice as complete payback in three years.)

Answer Part 1:

- 1) Cost with tax: Hybrid Civic-----\$21,960
Civic: \$16,390
- 2) Difference: \$5570 - \$500 tax savings = \$5070
- 3) Gallons used each year: Hybrid Civic---15,000÷45 = 333 gallons
Civic-----15,000÷ 34 = 441 gallons
- 4) Gas cost each year: Hybrid Civic-----\$832.50
Civic-----\$1102.50
- 5) Hybrid savings: \$270 each year
\$5070 (Extra cost) ÷ \$270 = 19 years to break even
- 6) Even worse \$254 interest cost in first year for \$5070 extra cost

Answer Part 2:

- 1) \$5070 in three years (45,000 miles)
- 2) Gas used in 45,000 miles: Hybrid--1000 gallons
Civic-----1324 gallons
- 3) 324 “free gallons” must pay off \$5070 extra charge.

\$5070 ÷ 324 = \$15.65 per gallon

Proofread for math mistakes

The Bottom Line on hybrids USA Today June 1, 2005

After reading USA TODAY's recent article “Consider the hybrid payoff” and many similar articles, I had to say that, unfortunately, some reporters are missing the point.

Sure, it may take several years to recoup the initial costs of hybrid technology. But what should be examined is its impact on reducing our dependency on fossil fuels and, more importantly, foreign oil. Using a conservative savings of 10 miles per gallon over a similar vehicle, one such car traveling 15,000 miles a year can save 1500 gallons of fuel.

Now multiply that by the 20,000 vehicles set for production, and there's a savings of 30 million gallons a year. Multiply that by the number of different models of hybrids and--- you get my point.

People need to stop looking at their own bottom line and start looking beyond to our country's bottom line. The extra money that each of us might spend now will greatly improve our country's position in the world in the future--definitely an investment worth pursuing.

Thank You For Smoking by Christopher Buckley (page 30)

Craighead's office dispensed about \$300 million a year to anti-smoking and anti-drunk-driving groups. Though it has been calculated that the tobacco industry spends \$2.5 billion a year, or \$4,000 per second, promoting smoking, Nick nonetheless railed against OSAP's "runaway budgets."

AARP Bulletin/April 2004

A study of a cross-section of Americans ages 30 to 60 found that 45% of men and 25% of women snore. When the doors are closed, the lights are out and a man and a woman are in bed together, then:

"There is a 70% chance someone is snoring," says John W. Shepard Jr., M.D., professor of medicine at the Mayo Clinic in Rochester, Minnesota.

Book by George Carlin (Title is offensive)

Right now there are 110 million land mines in 72 countries; and every 22 minutes, one of them explodes. Seventy-five mines explode every day, and each month seven hundred people are maimed or killed. That's 26,000 people a year!

Reporter:

"In Arizona, a ballot measure approved by voters meant to tax each pack of cigarettes by 80 cents. Unfortunately, the ballot measure added a period in front of the 80 cents - .80 - actually making it only 8 cents per pack. Legislators are going to collect the tax anyway, it will just be 90% less than they expected."