Making Sense of Billions and Trillions

Tricia Donovan

What's A Billion to You?

One of the major causes of the economic crisis was that investment banks (not to be confused with local banks) began to fail. A failing bank does not have enough assets or money on hand to cover its debts or the loans it has made to others.

To help failed banks stay open for business, the U.S. Congress established a $700 billion Troubled Asset Relief Program (TARP) in October 2008. The government loaned this money to banks and other industrial corporations.

Given that each and every one of us who works and pays taxes is responsible to cover these loans, we should understand how much $700 billion really is. Let's start by thinking about what *one* billion dollars means to us.

To make our figuring easier, let's assume that a person (you) makes $10/hour. How many hours will you need to work to earn $1,000,000,000 (one billion dollars)? To figure this out, divide the total dollars by the dollars per hour you make. An easy way to do this division is to set it up as a fraction and to cross out matching zeros (every set of matching zeros represents a division by 10). See the example below:

$$\frac{\$1,000,000,000}{\$10}$$

When we do the division, we learn that you would need to work 100,000,000 (one hundred million) hours at $10/hour to earn a billion dollars.

Once you know how many hours you would need to work to make a billion, you can figure out how many 40-hour work weeks you would need to work. How many 40-hour work weeks are there in 100,000,000 hours? Hint: try setting up a fraction division problem again. Remember you divide the numerator (top number) by the denominator (bottom number).

$$\frac{100,000,000 \text{ hours}}{40 \text{ hours}}$$

Your answer should be 2,500,000. If you earn $10/hour, you would need to work 2,500,000 weeks to make $1 billion. 2,500,000 still seems like an unreal number. Let's think about how many *years* you

Ten	10 =	$10^1 = 10$
One Hundred	100 =	$10^2 = 10 \times 10$
One Thousand	1000	$10^3 = 10 \times 10 \times 10$
Ten Thousand	10,000	$10^4 = 10 \times 10 \times 10 \times 10$
100 Thousand	100,000	$10^5 = 10 \times 10 \times 10 \times 10 \times 10$
One Million	1,000,000	$10^6 = 10 \times 10 \times 10 \times 10 \times 10 \times 10$
Ten Million	10,000,000	$10^7 = 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10$
100 Million	100,000,000	$10^8 = 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10$
One Billion	1,000,000,000	$10^9 = 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10$
Ten Billion	10,000,000,000	$10^{10} = 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10$
100 Billion	100,000,000,000	$10^{11} = 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10$
One Trillion	1,000,000,000,000	$10^{12} = 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10 \times 10$

What is the difference between a million, or a billion, or a trillion dollars? Look at the chart above to see these numbers described in different ways. What patterns do you notice? The small, upraised numbers are called "exponents" or "powers" of the "base" number, in this case ten. You read the number 10^4 as "ten to the fourth power." What does the "four" tell you in this number?

would need to work if you worked 50 weeks a year. Using division, you'll find that you would work 50,000 years at $10/hour to make a billion.

$$\frac{\text{2,500,000 weeks}}{\text{50 weeks}}$$

Remember, we have only gotten to one billion so far. How long would it take to earn $700 billion?

$$\text{50,000 years} \times 700$$

You can solve this on paper or in your head by multiplying 5 by 7 and then adding six zeroes. The answer is 35,000,000. We now know it would take 35 million years for one person to earn $700 billion.

Since that's impossible, let's see what would happen if you shared the burden with 35 million workers. Again, try setting up a fraction:

$$\frac{\text{35,000,000 workers}}{\text{35,000,000 years}}$$

A fraction that has the same numerator and denominator is always equal to 1. So, to sum up: It would take 35 million $10-per-hour workers one year to earn $700 billion.

Theory versus Reality

This math problem is only partly based on reality. Look for (and underline) the places in the text that indicate *assumptions* rather than *reality*.

But...this problem is also rooted in something familiar, that is: earning wages. The idea here is to grasp the enormity of $700 billion by starting with something much more familiar, such as a $10 per hour wage rate. Did this exercise help you grasp the meaning of one billion? Of 700 billion? How could you make this exercise better? Create your own exercise to explain really big numbers.

Back to Reality

Why do you think our government decided to support the banks with $700,000,000,000? Would you do the same? Why? Why not?

Tricia Donovan is the co-author of the Empower Math books, and she works at World Education.

What Will You Be Doing A Trillion Seconds from Now?

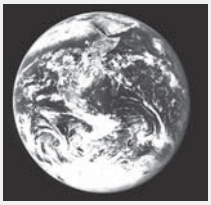
David Schwartz
author, *How Much Is a Million?*

My favorite way to think of a trillion is in terms of seconds. One million seconds comes out to be about 11½ days. A billion seconds is 32 years. And a trillion seconds is 32,000 years. I like to say that I have a pretty good idea what I'll be doing a million seconds from now, no idea what I'll be doing a billion seconds from now, and an excellent idea of what I'll be doing a trillion seconds from now.

Visualizing a Trillion

Mike Prokosch

What is a trillion? This simple activity helps you visualize very large numbers. Draw a thin chalk line on the board. This line is 1/16 inch wide. If this is equal to a dollar, a thousand dollars would be 5 feet ½ inch wide. A million dollars would be 5,208 feet wide, 72 feet short of a mile. A trillion dollars would be almost one million miles. It would be 209.16 times around the earth.



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