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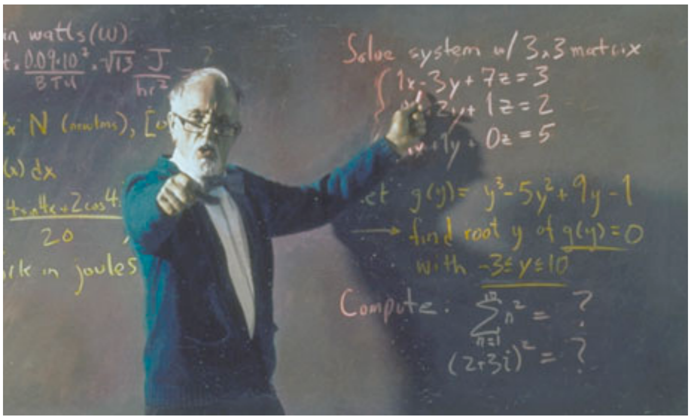
DISPATCHES FROM THE SCIENCE DESK

Win a million dollars with maths

Over the coming months, **Matt Parker** will introduce seven of mathematics' most intractable problems. To win a million dollars, all you have to do is solve one ...



Do the maths and you could be a dollar millionaire. Photograph: White Packert/Getty

Given the current economic climate, people are trying all sorts of things to save money, including maths. Shoppers in supermarkets are using addition and multiplication to squeeze every last saving from two-for-one deals. The frugal are dusting off their old school textbooks to see whether refreshing their knowledge of percentages and interest rates could net them a few pennies.

What they may not know is that there's a maths prize of $1m waiting to be won. There are six unsolved problems in mathematics that could each net this sum for someone smart enough to solve them. Sure, the US dollar is not what it used to be, but £600,000-ish would ease most people's economic woes.

It may strike many as odd that there are unfinished bits of mathematics. In school, maths is presented as a completed textbook that was worked out hundreds of years ago. The truth is that mathematics is a constantly developing field: some problems can be solved comparatively easily while others seem completely resistant to attack.

One such problem is known as Goldbach's conjecture and it has confounded mathematicians since 1742. It involves prime numbers, which are numbers that do not have any factors other than 1 and themselves. (Some of my favourites include 7, 31 and 8,191.) Goldbach said in a letter to his friend Euler that it looks like all even numbers are the sum of two prime numbers. In the two and a half centuries since, no one has found a single even number that cannot be written as the sum of two prime numbers. Go on: try a few. I did.

16 = 5 + 11

40 = 17 + 23

31,556,926 = 89,459 + 31,467,467

I've only tried a handful but other people have gone further. Even before calculators and computers, mathematicians had manually checked every even number up to

100,000. As soon as this arithmetic grinding could be done by electrons, progress exploded; as it stands all of the even numbers up to a billion billion (1.6×10^{18} to be exact) have been checked. Which is officially a lot. If you had started checking those numbers at the rate of one a second from the beginning of the universe 13.7bn years ago, you would only now be about half way.

Surely we can call off the hunt? Goldbach's conjecture is clearly true, isn't it? The trouble is that mathematicians need to know for sure that there will never be an even number that doesn't work. For every number you check, there is always a bigger one that could fail the test. A variation of Fermat's Last Theorem that looked certain to be true, failed on the number 61,917,364,224. Just checking numbers is never enough: showing that something will always, undoubtedly work is known as a proof in maths and a problem isn't finished until one is found.

Which is not to say that unproven mathematical concepts are not useful. Our modern technological world is based on all sorts of mathematical concepts and methods, some proven and some unproven but very well tested. Unproven concepts are used every day by mathematicians, engineers, medical researchers, programmers and indeed all of us via the technology at our fingertips. But their unstable, proof-less foundations leave mathematicians feeling a bit queasy.

This is why the Clay Mathematics Institute set up the Millennium Prize Problems in the year 2000 and put a price on their head. One has been solved, but six of the most important concepts in mathematics have yet to be proven.

Over the coming months I will introduce you to the seven deadly maths puzzles, one a fortnight to allow plenty of thinking time. The first will appear tomorrow. Each is of vital importance and all – bar one – have evaded the mathematical bounty hunters. I'll give you the springboard to launch your own investigations in the hope that someone out there might have the vital insight to finally crack a problem. At the very least, after grappling with these problems, comparing supermarket offers will be a piece of discount cake.

Matt Parker *is based in the mathematics department at Queen Mary, University of London, and can be found online at www.standupmaths.com*

This article was amended on 2 November 2010. The original stated that seven problems remained unsolved. This has been corrected.

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