

Forget perfect pizzas, here are four things simple maths really can help you with

November 27 2013, by Adam Kucharski



Perfect? Maybe, but it's not really maths. Credit: Jon Sullivan

Newspapers recently reported that a mathematician has created an equation for the [perfect pizza](#). It does not take much to spot that this was not exactly serious research. Not only was the study commissioned by Pizza Express, it is also the latest in a long line of such formula-based stories: ranging from the [perfect day](#) to the [perfect piece of toast](#).

I could spend rest of this piece explaining how these articles are mostly glorified PR exercises, funded by the companies that make the products.

How they waste newspaper space that could go to interesting, genuine science stories. And how their authors, while often claiming that it is "just a bit of fun", are instead helping media outlets spread the idea that maths has so little use in daily life, it is only worth covering if some number bod has come up with a funny formula.

But I won't. Partly because you may well know all of that already, but also because if you did not, there are plenty of [good critiques](#). Instead, I will share some proper examples of everyday maths that are both useful and ad-free.

How many drinks can you have at lunchtime and still turn up to your 5pm meeting sober?

It is lunchtime, and you fancy a drink. But you have a meeting (or date) at 5pm. Should you just have the one, or can you get away with a bit more and still turn up sober?

Sobriety (or lack thereof) is measured via the level of alcohol in the blood. One way to estimate blood alcohol content (BAC) is to use the [Widmark formula](#), which was originally concocted by EMP Widmark, a Swedish doctor, in the 1930s.

If you weigh W kilos, and have consumed A units of alcohol at a lunch that started T hours before 5pm, your estimated [blood alcohol content](#) is:

$$\text{BAC} = (0.967 \times A) / (W \times C) - (0.017 \times T)$$

(Here 0.967 adjusts for the level of water in the blood, 0.017 represents the amount of alcohol you burn off over time and C adjusts for body composition – it equals 0.58 for the average man and 0.49 for a woman.)

So how much should you have? The drink driving limit in the UK is a [BAC of 0.08](#). However, there is evidence that with this BAC, the alcohol could already have some effects. Let's be cautious, and say you want to turn up at 5pm with a BAC of less than 0.05. Rearranging the formula above, we have

$$\text{Maximum units} = (0.017 \times T + 0.05) \times 1.03 \times C \times W$$

For example, if lunch is at 1pm and you are an average 75kg man, you probably should not have more than 5.3 units, which is a couple of pints.

How long does it take for a debt (or investment) to double in size?

With the rise of pay day lenders, compound interest is back in the news. When interest rolls over again and again, the amount owed can balloon. But how long does it take for a debt to double in size?

Let us assume you pay a percentage R in interest per week. To find out how many weeks it will take for the debt to double in size – call this time T – you need to solve the following equation:

$$(1+R/100)^T=2$$

Clearly this is a bit of a hassle to calculate, but fortunately you can use the "rule of 72" instead. If you want to work out how many weeks it will take for a debt to double, you can get a pretty good estimate by simply dividing 72 by the interest rate:

$$T=72/R$$

So if you pay 5% interest per week, the debt will double in size in about

14 weeks.

How fast will you go if you jump out of a plane?

I went skydiving a few weeks ago. It is one of those activities best researched after the event: I did not particularly want to know the probability of death (around 0.0007%) beforehand. Nor did I want to discover what speed I would be going. But afterwards, I decided to find out.

When you jump out of a plane, there are two forces acting on your body. Gravity increases your overall velocity and drag works against the acceleration. When the two forces are eventually equal, you have reached the somewhat unfortunately named "terminal velocity".



Credit: Ann W.

During the average skydive, if you are in the standard jump pose – with arms and legs out – your terminal velocity will be around 124 miles per hour.

When jumping from a lesser height, into a swimming pool for example, things are a bit different. Gravity will be the dominant force, so you will still be accelerating when you hit the water. Jump from 3 metres and you will be travelling about 17mph when you break the surface. From 15 metres you will reach a velocity of 38mph.

How much can you expect to win if you buy up every possible combination of lottery numbers?

The UK National Lottery recently increased its ticket price to £2. With 49 numbers to choose from, though, your chances of winning are tiny (1 in 13,983,816 to be exact). Unless, that is, you buy up every single possible combination of numbers. This is exactly what Stefan Mandel, a Romanian mathematician, did in 1992 when he netted US\$28m in the Virginia State Lottery.

So how much can you expect to win if you buy up all possible National Lottery tickets? Well, you will get the jackpot (although you might have to share it). Plus you will receive about £50k for matching 5 numbers plus the bonus ball. There are 6 different ways you could do this, and you will have bought all of them, so that is £300k. You will also have [lots of tickets that match 3, 4 or 5 numbers](#), which will win you £25, £100 and £1000 respectively. Subtracting the amount you'll have spent on tickets, this works out as:

$$\text{Profit} = \text{Jackpot} + (£50,000 \times 6 + £1,000 \times 252 + £100 \times 13,545 + £25 \times 246,820) - (13,983,816 \times £2)$$

$$\text{Profit} = \text{Jackpot} + \text{£8m} - \text{£28m}$$

Ideally you want your profit to be positive, which means that this strategy is only worth considering if the jackpot is at least £20m. Given the amount of effort it would take to pull off, however, you might be better off spending your time on other activities. Like perfecting your pizza recipe.

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