

Maths, Teamwork and Googlies

The 2016 IMA-LMS Christopher Zeeman Medal was awarded to Rob Eastaway for excellence in the promotion of mathematics to the public. The Christopher Zeeman Lecture took place at The Royal Society on 22 March 2017 at which Rob was presented with the Medal. Rob's article is based on his lecture.



Rob Eastaway, winner of the Christopher Zeeman Medal, with the presidents of the IMA and LMS.

I was delighted when I discovered that Professor Sir Christopher Zeeman liked googlies. Or at least, that he liked *mathematical* googlies. I should explain, for anyone not up with cricket terminology, that a googly is a particular type of slow delivery which spins in the opposite direction to the one that the batsman is expecting. In other words a googly is a cricketing surprise. (It was invented in 1897 by Bernard Bosanquet, father of the late ITN newsreader Reginald.)

Surprises were at the heart of Zeeman's love of maths. Asked about the secret of how to get pupils engaged in maths, he once said:

You have to find a subject that is *playable* – then you exploit the play area, and usually there's some sort of *surprise* to it.

I share Zeeman's love of mathematical googlies. It's what got me hooked on the subject in the first place. From an early age I was drawn to puzzles and mathematical 'tricks', and these are still the foundation of much of my material when I'm talking to (or writing for) children, teenagers and adults.

The common perception of maths is that it is a solitary activity. But, in another analogy with cricket, maths can often be about teamwork and partnerships, in which individuals of very different abilities can combine for the greater good.

Many of the most fruitful and enjoyable experiences that I have had in maths have come from partnership with others. The highest profile example of this is from the Maths Inspiration shows that we present to teenagers in theatres around the country, where teamwork between the performers is vital if the show is to go smoothly. But partnerships happen behind the scenes, too.

As it happens, my first mathematical partnership was actually to do with cricket. In 1986, my friend Gordon Vince and I were approached by the former England Test cricketer Ted Dexter who wanted us to work with him to develop an international player ranking system.

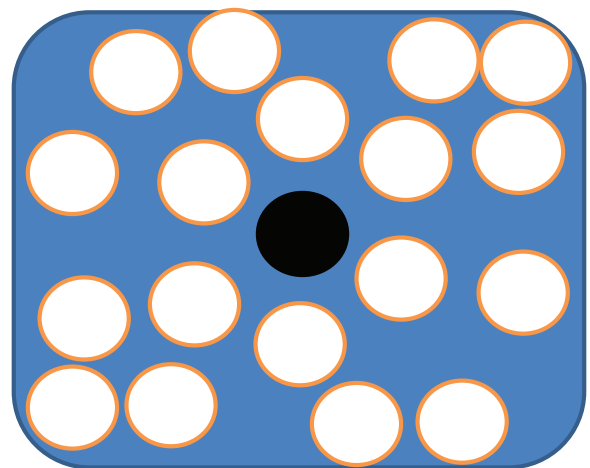
The algorithm that we developed together is still used today for the ICC's international rankings, but in the early days there were googlies that tested our mathematical model to the limit. I recall an Indian bowler called Narendra Hirwani who took an astonishing 16 wickets in his first match and rocketed to an inappropriately high world ranking; and then there was the South African John Traicos who returned to Test cricket after a gap of twenty-two years – and for a different country (Zimbabwe), which confused our system no end.

Anyone involved with mathematical modelling will know that it can be as much an art as a science, and no mathematical model is finished until it has been tested against the quirks and anomalies of the real world.

My first book collaboration was with David Wells, with whom I compiled *The Guinness Book of Mindbenders*. This puzzle collection has deservedly disappeared into obscurity, but the chance to work with David made the project worthwhile. David reinforced my belief that puzzles and games aren't just a bit of fun to sweeten the pill, but are actually at the heart of mathematics – and that big mathematical ideas can come from very simple activities.

Take the beer mat game, for example. Two players each have a stack of beer mats, and take it in turns to put a mat on the table, with no overlapping allowed. The game ends when one player can no longer find space to put a mat.

One can imagine the geometry of working out where to place a mat getting quite involved, yet it turns out that with a simple strategy Player 1 can always win. All they need to do is place the first mat in the centre of the table. Thereafter whatever move Player 2 makes, Player 1 copies it, but diametrically across the table. If Player 2 is able to go, then Player 1 can too.



Where next? The secret to winning the beer mat game is to place the first mat in the centre of the table.

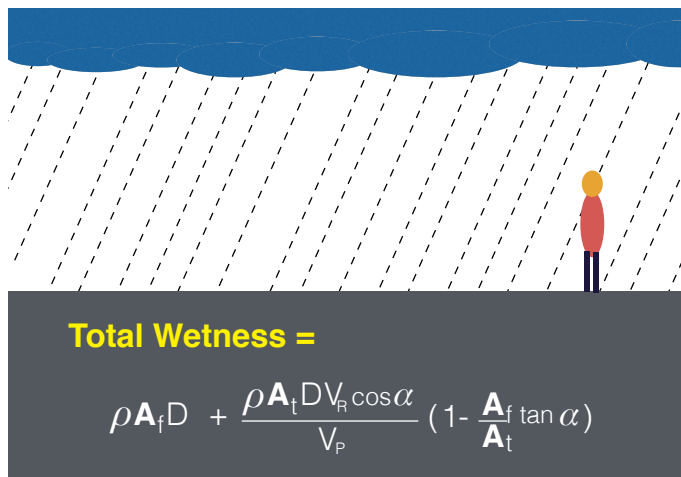
I encountered other mathematical googlies with Jeremy Wyndham, with whom I wrote the more successful book *Why Do Buses Come In Threes?* Until we made a last minute change before publication, that book went by the title *How Fast Should You Run In the Rain?* And we included in it one of the most wonderfully useless bits of applied maths that I know.

Walking in the rain

If rain falls at an angle $\alpha > 15^\circ$, then to minimise wetness a pedestrian of normal build should walk no faster than the horizontal component of the rain – in this simplified model, at least.

Key:

A_f and A_t – area of pedestrian's front and top
 ρ – density of rain
 V_R and V_P – speed of rain and pedestrian
 D – distance home



If rain is falling vertically, then you stay driest if you run as fast as possible. That much is not very surprising. But it turns out that if you are of normal build and the rain is angling from behind you at more than 15 degrees, you will end up drier if you walk at the horizontal component of the rain's speed, and no faster.

Some of the biggest surprises in maths crop up in probability. In our book *The Hidden Maths of Sport*, Dr John Haigh and I encountered quite a few. We worked out that middling darts players shouldn't aim at treble 20 but instead should go for treble 14, while weak players should aim at 16. Meanwhile in football, we found that penalty takers would be more successful if they aimed straight at the goalkeeper more often – perhaps as much as one third of the time – rather than almost always aiming for a corner as they tend to do.

Mathematical partnerships are not uncommon – as a skim through previous editions of this magazine will demonstrate. And throughout history there have been some great examples of mathematical partnerships, perhaps the most famous being that of G.H. Hardy and Ramanujan (celebrated last year in the excellent film *The Man Who Knew Infinity*). These two were dealing with maths several leagues above the trivialities I have mentioned

in this article, though one of the joys of maths is that mathematicians of all levels can often get enjoyment from the same simple mathematical puzzle.

In any case, there is another field in which G.H. Hardy and I would have connected, because apart from maths, Hardy's great passion in life was cricket.

For a while Hardy ran a cricket team in Oxford. I have a photo of that team. Loitering at the back, hands in pockets, is a young man by the name of Stephen Bosanquet, later to become a

notable mathematician. If the name sounds familiar, it's because he was a distant cousin of the inventor of the googly.

In cricket, as in maths, it sometimes feels as if everything, and everyone, is connected.

Rob Eastaway

Director, Maths Inspiration



Hardy leads his Mathematics