

Editorial

Mathematics Today is not a newspaper, nor is it intended to be one. Our publishing schedules mean that copy is, almost always, written well in advance of publication. In general, this is good. Whatever walk of life you're in, last minute panics are rarely beneficial, either to the quality of the product, or to personal well-being. However, as I write this editorial, that distance between writing and publication brings with it some challenges.

Given the prevailing circumstances, there's one topic I have to mention: the Coronavirus, or COVID-19. But, the situation is changing sufficiently fast that there's a significant risk that whatever I write may be, using a phrase that has absolved many workers from actions placed during meetings, 'overtaken by events'. I hope you will forgive me, if that proves to be the case.

As well as a love of mathematics, I also have a fondness for reading. In addition to the maths books I sometimes review for *Mathematics Today*, I'm rarely without a novel. I get these from all sorts of places: I'm a proud member of my local library (which, like many up and down the country, does an excellent job, especially, it seems to me, for the youngest and oldest in our communities); I buy from charity shops; obtain second-hand copies from the Internet; pick up an occasional item with my weekly shop; and purchase from well-known high street stores.

The variety of places I get books from is almost, but not quite, matched by the variety of genres I read. I get through lots of thrillers, crime (both cosy and not) and science fiction. I've also been known to read young adult novels, as well as the occasional piece of chick-lit! Amongst all this, I've read a few tomes set in speculative, typically dystopian or post-apocalyptic, futures, including classics like *1984* and *The Handmaid's Tale*, along with more recent offerings, like *Bird Box* and the *Hunger Games* trilogy: 'if we burn, you burn with us'.

I don't like to think of myself as a proud man. Whilst I have some skills, I know that many possess these to greater degrees than I. There are also many things that I do not have a gift for. Playing an instrument is definitely one of these; fortunately for my family, and our neighbours, it didn't take me long to figure that out. DIY is another. Sometimes, I'll understand the theory. More often I'll get a grasp of the basics from YouTube videos and I'll rehearse the activity many times in my mind, trying to think it through from every angle. Despite that, the reality never seems to match the theory. Nothing quite works out as planned. Given that experience, I've always thought that I'd be pretty useless in one of the speculative futures I sometimes read about.

The situation we're facing, both as a nation and across the world, may not be post-apocalyptic or dystopian, but, the Government has taken significant, 'draconian', to quote Boris Johnson, measures in our shared battle against COVID-19; the sorts of measures that would be unthinkable outside a significant, national-level crisis. This definitely counts as the sort of situation that novels are written about. And, it turns out, in this situation mathematical skills are critical to the health and well-being of our nation.

You don't have to look too hard before you see that mathematics appears everywhere, including: analysing protein folding; modelling of infection transmission and control; use of artificial intelligence to monitor and digest academic publications; and how the Tragedy of the Commons can help us understand the (unnecessary and unhelpful) urge to stockpile. From the molecular to the societal, mathematics is vital.

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The nature of our subject means, in some applications, mathematics can create elements of certainty, even in uncertain times.

Despite this, it should not dictate decisions. To give a very simple, entirely fictitious case, suppose we have two choices before us. The first has a 1% chance of causing 1000 casualties, whereas the second has a 50% chance

of causing 20 casualties. Even in the unlikely situation where we agreed that the only measure we cared about was the expected number of casualties, mathematics alone can't distinguish between these two cases: both of them have an expectation of precisely 10 casualties.

Decision making in the real world is, obviously, much more complex than this simple illustration. In the current situation, and many others, we only get to make a decision once: it's not like repeatedly betting on a roulette wheel where, over time, we can rely on probability distributions to govern long-term behaviour. In addition, we may not have the opportunity to wait for more data. We're often faced with making a decision based on imperfect information, in full knowledge that the decision will be analysed (typically, critically) with the full benefit of hindsight. And, since 'decisions not taken' are never subject to the harshness of reality, it's easy for them to be viewed too optimistically in any post-event analysis.

There are further complications. Making a particular choice now may preclude other choices being made later. There's also a need to balance different outcome measures: it's almost never as simple as just measuring one variable. Put simply: real-world decision making is never a simple optimisation problem.

I'm in danger of rewriting history with the benefit of hindsight and, even worse, rewriting history that I have little direct knowledge of. However, if you'll forgive my arrogance, it seems to me that our community's contribution to the international response to COVID-19 has been enabled by three relatively recent trends.

Firstly, a greater emphasis on inter-disciplinary work means mathematicians are used to collaborating with a range of other disciplines and vice versa. Secondly, a general emphasis on the many uses of mathematics, including the IMA's excellent Mathematics Matters series, has raised the profile of our profession, making our contribution more visible. Thirdly, work on communicating specific aspects of mathematics, for example, informing the public understanding of risk, has enabled us to talk clearly and succinctly to decision-makers, and others. This is vitally important because fast-moving crises don't allow people time to re-learn mathematics from their school years, nor do they allow for hour-long discussions of theory (or minutiae).

We may not have deliberately set out to prepare the mathematical community to support society at this time of crisis. But, these three trends (supported by a whole number of other things) have had that effect nonetheless. I am sure they will mean that, as things continue to progress, we are also ready, willing and able to make direct and effective contributions to the longer-term health and prosperity of our society.

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