Guesstimation: Solving the World's Problems on the Back of a Cocktail Napkin

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While Tony Mann risks buying ice-cream that might melt, others puzzle over fridge insurance and health

On the first day of their studies, I ask our new mathematics undergraduates to estimate numerical solutions to unexpected problems - the number of piano tuners in the UK or the volume of all the human blood in the world. While questions such as these - called "Fermi problems" by physicists after the great nuclear physicist - may seem rather arbitrary, the point is that, with a little thought, one can give approximate answers that will be accurate to within an order of magnitude.

This is a useful life skill - we all have to make judgments based on approximations and "guesstimates". Only this week I had to decide whether it was worth buying a tub of my favourite, locally unobtainable ice-cream when it would have to survive a long journey home: my estimate of its speed of melting led me to take the risk (with happy outcome).

Similar thought processes might help one to decide whether to take out insurance on a new fridge or to evaluate the real risk underlying a medical scare story in the press. Employers sometimes use such questions to assess candidates for appointments, believing that they provide evidence of problem-solving skills.

Lawrence Weinstein and John A. Adam have compiled a useful book of such estimation problems. They range from serious questions about energy consumption and carbon emissions, through practical problems such as estimating the number of portable toilets required at mass events, to the frankly silly - could Spider-Man stop a runaway subway train or would the Sun generate more energy if it were composed of gerbils?

Their valuable introduction suggests ways to approach problems (beginning with Cliff Swartz's helpful methodology - "Step 1: Write down the answer") and working

through some examples in detail. The explanation of the advantage of the geometric over the arithmetic mean is particularly illuminating. The bulk of the book consists of problems, for each of which a number of hints is given, and then the authors' solution or solutions. Appendices include a list of further examples, some useful numbers and formulae, and some reference dimensions (from the size of an atom to the Earth-Sun distance).

The puzzles draw on elementary mathematics, physics and chemistry but require little specialist knowledge. Those relating to environmental issues are particularly timely: the analysis of the amount of land required to grow corn to replace petrol by ethanol is devastating, and any reader who works through these examples will emerge with an excellent appreciation of the scale of our environmental problems.

There were places where I felt more discussion would have been useful - my students often learn most when a superficially plausible method of estimation gives a wrong answer (such as extrapolating from the number of blind piano tuners, found on the web, forgetting that a disproportionate number of blind people may tune pianos). The problems are often oriented towards the US rather than the UK, but that is of little importance: more of a problem for some readers may be the authors' jokes, of which I rather quickly tired, although I appreciated the accessible style of the book.

Not only is the ability to solve Fermi problems useful, but it is also empowering. My students gain enormous confidence when they find that they can accurately estimate the answer to apparently difficult questions. They also gain a feel for dimensions and orders of magnitude.

This book is a stimulating collection that will help the reader to reach informed judgments and will be a useful source of inspiration for mathematics and physics teachers: my only concern is that if my students have read it before they arrive at university, I may have to find a new approach to my first day's teaching.

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Reviewer :

Tony Mann is head of the department of mathematical sciences, University of Greenwich.