What are the chances of that? by Andrew Elliott, pp. 356, £25 (hard), ISBN 978-0-19886-902-3, Oxford University Press (2021)

This book on probability for a general readership is one of several that cover similar ground, such as [1] and [2], both reviewed in March 2021. This one uses many of the same examples – the Sally Clark case, Galton's bagatelle board, false positives and the Prosecutor's Fallacy and so on – but it does so in a framework of dichotomies such as individual/collective or foresight/hindsight. Calculations are shown as they are needed, usually in boxes labelled ‘Getting technical’.

A particular strength of the book is its lively style, not at all dumbed down but full of interest and even enthusiasm. It is extremely readable, and not just for the wide range of topics that it covers. The author takes an unusual opportunity of including two sections written when information was limited, unchanged by later knowledge – one at an early stage of the Coronavirus pandemic, the other when the choice of Democratic candidate for the U.S. Presidential Election of 2020 was not yet decided. If nothing else this draws vivid attention to the foresight/hindsight dichotomy. There are excellent historical and cultural contextualisations: “to make calculations that would presume to predict the future would have required an intellectual irreverence that was not cowed by superstition or religious restraint.” Words such as *random* and *risk* are given dictionary definitions and also their derivations.

The first quarter of the book introduces basic probabilistic ideas and calculations, mostly through bets based on games of chance; this may alienate some, although the author is careful to provide appropriate health warnings. This is followed by a section called ‘Life Chances’, covering material such as coincidences and life expectancy. The apparently incredible recorded coincidence that for a certain engaged couple not only did their fathers have identical first and last names, but so also did their mothers, is given a very careful and sensible debunking, in a chapter that shows how coincidences that are apparently incredible happen all the time. (Littlewood is quoted as estimating that each of us would experience a ‘miraculous event’ about once every 35 days.) There is an interesting distinction drawn between “*aleatoric* uncertainty, where no good explanation is available, and *epistemic* uncertainty, where an explanation exists but we don't know what it is.”

The second half of the book is less focused on probability calculations, simply giving overviews of areas in which probabilistic methods can be used. ‘Happy Accidents’ starts with an apparent digression on the use of aleatoric methods by the composer Xenakis, with some stunning diagrams; this leads to interesting discussion of chance discoveries, for instance of penicillin, saccharin and glass lamination. Such discoveries are classified as, for instance, searching for one thing but producing another, or an untargeted search producing a solution to a completely different problem, perhaps even one that arises only later. (Subsequently Elliott mistitles John Cage's notorious silent work as 2′ 33″. I prefer that version.) There is a lengthy discussion on the random aspects of the mechanism of heredity. The last section, ‘Taking Charge of Chance’, reaches Elliott's own professional specialisation, the financial world, moving from insurance to hedge funds and a mention of the ubiquitous Black-Scholes formula. This section may appeal less to readers without particular interest in this area. However, the application of probability to legal issues is splendid, and there is a very good explanation of Bayes's Theorem, though I would have welcomed a more explicit spelling out of the crucial distinction between $\mathrm{P}(A \mid B)$ and $\mathrm{P}(B \mid A)$. Likewise the “Getting Technical” box on the Central Limit Theorem needs more emphasis on the independence condition.

https://doi.org/10.1017/mag.2023.86 Published online by Cambridge University Press

The whole book is handsomely produced and has very few typos. Throughout Elliott uses pictures that show the results of a simulation, typically a rectangle of 5000 tiny squares of which the successes are coloured red and the failures grey. These get the book off to a good start but I think later examples don't give a clear enough impression to justify their continued use. The index is unusually good.

The book is very readable and it is crammed full of both interesting examples and wise observations. It is clearly one of the best in a market that, although increasingly crowded, can hardly be overstocked. Strongly recommended to a wide readership.

References

1. Ian Stewart, *Do dice play God*?, Profile Books (2019).
2. Steve Selvin, *The joy of statistics*, Oxford University Press (2019).

10.1017/mag.2023.86

OWEN TOLLER
4 Caldwell House,
48 Trinity Church Road,
London SW13 8EJ
e-mail: *owen.toller@btinternet.com*

The discrete mathematical charms of Paul Erdős by Vašek Chvátal, pp 248, £22.99 (paper), ISBN 978-1-108-92740-6, Cambridge University Press (2021)

I was very happy to be asked to review this book. Like most readers of the *Gazette*, I knew something about Erdős —his love of collaboration, his eccentricity (‘stateless by political conviction’), and his unending stream of conjectures, theorems and proofs. My one worry was that I might not be able to follow his genius-level mathematics. And so I was doubly happy when I unwrapped the book and saw the subtitle: ‘a simple introduction’.

In the early seventies, Chvátal collaborated with Erdős and his book is clearly a labour of love. The background to each problem is meticulously researched and supported by a comprehensive bibliography, there are some interesting biographical details, and some amusing Erdős anecdotes, but all of these take second place to Chvátal's exposition of Erdős's mathematics. The arguments are so clever and so clearly explained that there is something to make you smile on almost every page. Here are some of the intriguing problems and theorems, each taken from a different chapter of the book:

From Chapter 1, A Glorious Beginning: Bertrand's Postulate

For every positive integer n there is at least one prime p such that $n < p \leqslant 2n$.

Erdős found a proof of this when he was just 18 years old. Bertrand's postulate says that the primes are not too infrequent. But “paradoxically Erdős's proof depends on the fact that they do not occur too often.”

From Chapter 2, Discrete Geometry and Spinoffs

How many points (no three of them collinear) do you need to guarantee that five of them form a convex pentagon?

When Erdős took up this problem the upper bound was about 210 000. He reduced it by elementary arguments to 21. (If that makes you smile, I think you'll like this book).