partitions, cycles in permutations, the inclusion-exclusion principle and generating functions. It is clear from this list that a large amount of material is covered here.

Graph theory has section 3 all to itself, and comprises chapter 9 to 12 inclusive. The topics covered here are the basics of graph theory, trees, colouring and matching, and planar graphs.

The final section (chapters 13 to 20) covers, in general, slightly more advanced topics than those studied in the previous three sections. To give a taste of some of the material considered here, there are chapters on Ramsey theory, the probabilistic method, pattern avoidance, partial orders and lattices, block designs and error correcting codes, combinatorial algorithms and computational complexity.

This book is aimed very much at undergraduate mathematics students and their lecturers. Anyone studying this book in depth would gain an extremely good working knowledge of many of the key aspects of combinatorics. It would certainly be possible to base a final-year undergraduate combinatorics module on a selection of material contained in this textbook. However, such is the wide range of content presented here that only a fraction of it would end up being utilised.

Another potential use of this book is as a resource for final-year undergraduate projects. There are a number of places (such as the chapter on pattern avoidance) that might provide a springboard for further mathematical exploration. For students wishing to pursue a postgraduate degree, either taught or by way of research, containing a combinatorial element, then some preparatory study from this book would serve as a suitable introduction.

All in all, I would regard this as an excellent textbook. The mathematical content and the accompanying diagrams are clear and well-presented throughout. The problems and their solutions are very well-explained. Indeed, the fact that the complete solutions to all the exercises are provided is another excellent feature. I would thoroughly recommend this book either to undergraduate students wishing to study combinatorics to a reasonably high level or to lecturers interested in constructing a final-year undergraduate module on combinatorics.

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Introductory statistics by Sheldon M. Ross, pp. 828, £76 (hard), ISBN 978-0-12804-317-2, also available as e-book, Academic Press (Elsevir) (2017).

This textbook gives a comprehensive coverage of all the statistics that UK students other than specialists are likely to meet. Beginning with GCSE-level data handling, it goes as far as two-sample t-tests, chi-squared tests, two-factor analysis of variance and non-parametric tests, and it ends with one chapter on quality control and one on machine learning and big data. For the fourth edition, material on topics such as the Pareto distribution and Benford's law have been added. The coverage is careful and slow, with many worked examples and plenty of problems, half of which have answers. Many of the exercises are very simple; for instance, the first exercise on linear regression asks for little more than scatter diagrams, and this is as late as page 523. The majority of even the simplest exercises use real data; this is highly impressive and must have been very time-consuming for the author. There is little actual mathematics other than formulae. Explanations vary from the simple mathematical (derivation of the mean and variance of $\mathrm{B}(n, p)$ by considering $\mathrm{B}(1, p)$, asserting that the variances can be added) to handwaving (the shape of the t-distribution is given only qualitatively) and barely more than mere assertion (why $n - 1$ is used as a divisor for sample variance). The introduction of the chi-squared

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distribution is a typical handwave ('although a mathematical proof of this theorem is beyond the scope of this text, we can obtain some understanding of why this is true').

Further features include much use of *R* for exercises involving data handling and hypothesis testing, and a series of historical perspectives, often including quotations from primary sources; these perspectives are welcome and non-chauvinist, though there are few mentions of Frenchmen and none of Russians.

Illuminating examples abound. There are excellent discussions of the friendship paradox and of Galtonian regression of heights, a particularly good example entitled "Be sure you are sampling from the right population" on page 318, and an interesting industrial view on 'variance reduction' on page 341.

There are a few anomalies. On page 173, question 25(b) seems to need Bayes' Theorem, but this is not discussed until the next section. The section on Counting Principles is starred; I would have thought it of central importance. The definition of independence on page 226 is rather hard for learners to take in, being written as continuous prose, and I think the same can be said for the explanation of hypothesis testing on page 384. That passage is followed by the statement "If you are trying to establish a certain hypothesis, that hypothesis should be designated as the alternative hypothesis". What about if you want to test that μ is at least 70.0? (The author uses compound null hypotheses, such as $\mu \geqslant 70.0$, as a norm.) There is no discussion of inverse regression, but there is a question on it (page 531 question 7(d)).

These are unimportant. This book is probably too large for a UK school course but it seems to me admirably fitted for the teachers of any school or college department. Those who are less than wholly confident about any of the material will find it a rich and unthreatening resource of information and also of questions (even if they are almost all derived from a US context). I have been looking for some time for a properly academic superior to Moroney's invaluable if outdated *Facts from figures* [1] which I have used for forty years, and this would seem to fill the bill. The hard copy is large and heavy (and expensive), but there is an e-version.

Reference

1. M. J. Moroney, *Facts from figures*, Penguin Books (1951).

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Emmy Noether's wonderful theorem (revised and updated edition) by Dwight E. Neuenschwander, pp. 344, £22 (paper), ISBN 978-1-42142-267-1, Johns Hopkins University Press (2017).

It is likely that readers will not be familiar with Emmy Noether's theorems on symmetry and conservation laws, and this is a pity. Every physicist should know about them, not only to understand the origin of conservation but also properly to appreciate how powerful (and somewhat abstract) mathematics works hand in hand with physics. Mathematicians, who may know of Noether through her work on Lie Groups, should know these theorems to see just how powerful the conjunction of maths and physics can be, and also to appreciate fully the beautiful work of one of the 20th century's most eminent mathematicians—a lady who taught David Hilbert and Albert Einstein a thing or two!

Noether's theorems fundamentally link certain types of symmetry to conservation laws of physical quantities. Thus conservation of energy is seen as a direct

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