Quantitative reasoning by Eric Zaslow, pp. 227, £26.99 (paper), ISBN 978-1-10841-090-8, Cambridge University Press (2020) (e-version reviewed)

This is a book written for American first year college students taking a course aimed at developing their skills in quantitative reasoning. The author writes 'Our aim is not perfection but to familiarize ourselves with the methods and practices of structured, numerical arguments. The pieces of these arguments are usually "simple" aspects of mathematics or statistics.' I think for me in the UK these questions would help provide examples of mathematics applied to 'real life' and perhaps help give illuminating illustrations of where the maths we teach can be applied. I am always slightly nervous of this approach, having once worked at a school where a well-meaning senior teacher demanded that every lesson was grounded in an immediate application (and was not amused by the gap between the interesting work on prime numbers and their application to internet security). Nevertheless there is value in having illustrations and ideas to hand and knowing which students and classes will benefit from sharing these.

There are some helpful comments about how to use this book to teach a course, and for students how best to learn whilst using it. Although I will not be using it in that way, the advice is all good and some well worth sharing:

> *READ WITH A PEN AND PAPER! You can't read anything with numbers unless you're constantly jotting them down, verifying that you agree with what is written, and deriving results for yourself.*
>
> *Go slowly! Read a bit; think a lot. The writing is dense. Points are made, but not repeated. There is no "busy reading". The price tag for this is that you need to consider what is being discussed until it is clear to you.*

Both of these encourage 'scholarly behaviour'. As I write this during January lockdown we are drawn to finding ways to encourage more students to do more for themselves; perhaps one of our post-lockdown discussions will be on continuing to encourage independent thinking—and these pieces of advice would be very useful.

The book considers ten key questions, and although some are rather US-centric, others have a more universal appeal.

1. Is College worth the cost?
2. How many people died in the Civil War?
3. How much will this car cost?
4. Should we worry about arsenic in rice?
5. What is the economic impact of the undocumented?
6. Should I buy health insurance?
7. Can we recycle pollution?
8. Why is it dark at night?
9. Where do the stars go in the daytime?
10. Should I take this drug for my headache?

Each chapter has a clearly defined structure. At each step the reader is encouraged to think and write answers, to check and test the author's arguments. The result is like an interactive lecture with readers very much involved. There are suggestions of similar projects and questions to encourage further practice and the development of skills.

I really enjoyed reading this book and I am sure others will find the same. Whilst the whole structure is designed for a specific course, nevertheless the approach is helpful and useful. I suspect it would be well suited to Core Maths, although I am not involved in teaching that myself.

https://doi.org/10.1017/mag.2022.100 Published online by Cambridge University Press

This book demands the reader's attention and practically forces our interaction—students who would benefit from some wider reading would find it hard not to be drawn in. Some of my sixth form students can often tend to be rather passive and I am sure they would gain from working with the author through some of these questions.

10.1017/mag.2022.100 © The Authors, 2022
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An introduction to functional analysis by James C. Robinson, pp 248, £29.99 (paper), ISBN 978-0-52172-839-3, Cambridge University Press (2020)

This excellent new introductory text on functional analysis manages to accomplish two objectives that are both important but also, to some extent, at odds with one another. On the one hand, this book is genuinely accessible, even perhaps to undergraduates (and certainly to first-year graduate students) on my side of the Atlantic. On the other hand, it covers a substantial amount of material, including some topics (e.g., Sturm-Liouville problems and unbounded operators) that go beyond what is generally taught in an introductory course.

The book is divided into four Parts, each one consisting of several chapters. Part I (*Preliminaries*) contains two chapters covering, respectively, background material in linear algebra (including a proof, using Zorn's Lemma, of the existence of a Hamel basis for an arbitrary vector space) and metric spaces. Because the author assumes the reader already has some familiarity with this material, the exposition here is efficient rather than leisurely, with some proofs omitted (but quite a few included).

Part II covers normed linear spaces, with a focus on those that are complete. The term "Banach space" is introduced at this point, but extensive discussion of these spaces is reserved for future chapters. Many examples are given, but discussion of the Lebesgue spaces L^p are, initially anyway, replaced by discussion of the sequence spaces l^p; the L^p spaces are, however, defined in the last chapter of this part as the completion of a space of continuous functions with the L^p norm. (A prior knowledge of Lebesgue theory is not assumed by the author. An Appendix discusses, without proof, Lebesgue measure and the Lebesgue integral, and it is then proved that this construction of L^p agrees with the one given in chapter 7). This last chapter, and the appendix section, evince a fairly sharp spike in level of difficulty from what has come before, but the author does take pains to make it as clear and detailed as possible. Other topics covered in this part of the book include the Contraction Mapping principle (with applications to differential equations discussed as exercises), the Arzela-Ascoli theorem, the Weierstrass Approximation theorem, and the Stone-Weierstrass theorem.

The remaining two parts of the book cover Hilbert and Banach spaces, in that order. (Hilbert spaces are done first because the author felt their additional structure made them easier to study.) The chapters on Hilbert spaces cover, in addition to the usual introductory material (orthonormal bases, projections, the Riesz representation theorem, self-adjoint operators), such additional topics as compact operators on Hilbert spaces and their spectra, and Sturm-Liouville problems.

Part IV of the book covers material that is standard for a first course, including the 'big theorems' (Hahn-Banach, Uniform Boundedness, Open Mapping, Closed Graph) and some of their applications. The Hahn-Banach theorem is initially given an analytic statement but a geometric version (separating hyperplanes) is presented

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