Figure 3, first published in 1999, is called a "hockey stick" because of the plot's dramatic upward slope recorded at the very end of the 20th century. The evidence Weart provides has convinced this initially doubtful reviewer of the causes behind global warming. Let us cite Weart's own words found on the final page of his book, which call upon all of humanity to act:

> Much more likely than not, global warming is upon us. We should expect weather patterns to continue to change and the seas to continue to rise, in an ever worsening pattern, in our lifetimes and on into our grandchildren's. The question has graduated from the scientific community: climate change is a major social, economic, and political issue. Nearly everyone in the world will need to adjust. It will be hardest for the poorer groups and nations among us, but nobody is exempt.

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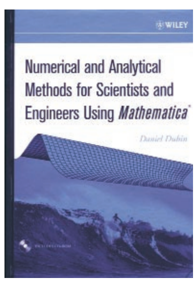
Numerical and Analytical Methods for Scientists and Engineers Using *Mathematica*

Daniel Dubin
Wiley, Hoboken, NJ, 2003. $120.00 (633 pp.). ISBN 0-471-26610-8, CD-ROM

Like Daniel Dubin, author of *Numerical and Analytical Methods for Scientists and Engineers Using* Mathematica, I find myself using this technical computing software nearly every day to perform routine mathematical drudgery, such as analytical differentiation, integration, and series summation. I also employ *Mathematica* as a sophisticated graphical tool. I was therefore interested to see how Dubin would use the program to teach mathematics.



In the preface, addressed to the student, he explains how the book was developed from lecture courses aimed at advanced undergraduates and graduates studying the physical sciences or engineering. His informal style, generally clear and concise, is continued throughout the book and will probably be appreciated by the intended audience. Extensive exercises that appear at regular intervals in the text also clearly mark Dubin's work as a textbook.

Although the title appears more general, the motivation and focus of this book from start to finish is solving differential equations. The emphasis is clear from the table of contents: Five of the eight chapters have the words "differential equations" in their titles. The other three chapters, on Fourier series and transforms, eigenmode analysis, and random processes, are also inspired by applications that involve solving differential equations. The coverage of methods for solving both ordinary and partial differential equations probably extends well beyond most introductory courses, and thus the book is a potentially useful reference for research applications. An introductory chapter with references to other textbooks and online collections of numerical software might have been helpful, because those sources are likely to be the best places to turn for additional information—or when *Mathematica* runs out of steam and specialized programs are needed.

The book assumes that readers have already had introductory courses in calculus. From the very beginning, the text presents *Mathematica* program examples and exercises. Accompanying the book is a CD-ROM featuring a supplementary chapter with a useful guide that includes the most commonly used *Mathematica* routines and exercises, plus an explanation of potential error messages. Readers who are new to the program should work through this chapter first.

The entire book is also on the accompanying CD-ROM, which enables readers to come to grips with the content first hand and should be especially valuable to students. Working examples that can be adapted for related problems of particular interest will help readers to avoid the frustration that may result from making common syntactical mistakes. Examples include a wide range of standard problems from physics and engineering, such as initial- and boundary-value problems involving the Poisson, wave, Schrödinger, heat, diffusion, Fokker–Planck, and Laplace equations and problems concerning geometric optics.

There are probably fewer examples of direct interest to chemists, although the chapter on stochastic processes provides useful prerequisites for electronic structure methods, such as the diffusion Monte Carlo approach. Molecular dynamics is introduced in this chapter in the context of solving the differential equations that correspond to many-body systems obeying Newton's laws.

A particular strength of this book is its coverage of both analytical and numerical methods. Chapter 1 acknowledges that most differential equations do not possess closed-form solutions and may exhibit chaos. Using a numerical tool like *Mathematica* to analyze such situations seems highly appropriate. The author includes definitions and example calculations of Lyapunov exponents to illustrate the effect of chaos. Graphical illustrations of how solutions diverge are used to good effect in this chapter—and also in chapter 2, where the accuracy of Fourier series representations is considered. Dubin's approach should enable students to understand such topics without becoming bogged down in routine but potentially error-prone algebra, and hence obtain physical insight much more rapidly.

Unfortunately, some of the illustrations in the book use features that are not implemented in the older versions of *Mathematica* that I have access to. For example, *Mathematica* 4.1 is required to run all the examples in the book, although most should work with version 4.0. The novelty of audible comparisons between time signals and their Fourier series representations is very entertaining. The coverage of special functions in the context of differential equations is also worthwhile—particularly the discussions of the Dirac delta function.

Although the range of topics covered in the book is not as wide as I had expected from the title, I was pleased to pick up some useful tips. Overall, I recommend *Numerical and Analytical Methods for Scientists and Engineers Using* Mathematica because it provides a wealth of *Mathematica* examples and resources, as well as an insightful way to treat a multitude of differential equations.

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The Music of the Primes: Searching to Solve the Greatest Mystery in Mathematics

Marcus du Sautoy
HarperCollins, New York, 2003. $24.95 (352pp.).
ISBN 0-06-621070-4

The Riemann Hypothesis: The Greatest Unsolved Problem in Mathematics

Karl Sabbagh
Farrar, Straus and Giroux, New York, 2003. $25.00 (340 pp.).
ISBN 0-374-25007-3

Prime Obsession: Bernhard Riemann and the Greatest Unsolved Problem in Mathematics

John Derbyshire
Joseph Henry Press, Washington, DC, 2003. $27.95 (422 pp.).
ISBN 0-309-08549-7

The Riemann hypothesis is widely regarded as the most important unsolved problem in mathematics. Put forward by Bernhard Riemann in 1859, it concerns the positions of the zeros of a certain function, the Riemann zeta function, in the complex plane. The hypothesis is that, apart from some trivial exceptions, all of the zeros of this complex function (which is defined by an infinite series with nth term n^{-z}) lie on a straight line, known as the critical line, corresponding to points with real part 1/2.

Proving this hypothesis is of central importance in mathematics because the Riemann zeta function encodes information about the prime numbers—the atoms of arithmetic. The nontrivial zeros play a pivotal role in an exact formula, first written down by Riemann, for the number of primes less than a given size. Individual zeros determine correlations between the positions of the primes. Finding a proof has been the main goal of most number theorists since Riemann published his hypothesis. In 1900, David Hilbert listed proving the Riemann hypothesis as one of his 23 mathematical challenges for the 20th century. In 2000, the Clay Mathematics Institute listed it as one of its seven Millennium Prize Problems, with $1 million offered for its solution. Presently, the most we know is that at least 40% of the infinitely many nontrivial zeros satisfy the hypothesis and that it holds true for the first 100 billion of them.

Remarkably, it turns out that striking similarities exist between the Riemann zeros and the quantum energy levels of classically chaotic systems. Michael Berry pointed out, in the mid-1980s, that Riemann's formula relating the zeros to the primes is closely analogous to one discovered by Martin Gutzwiller in 1971 that relates quantum energy levels to unstable classical periodic orbits in the semiclassical limit. In 1973, following a comment by Freeman Dyson, Hugh