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Plausible reasoning in the 21st century.

A K Peters, Ltd., Natick, MA, 2004. x+288 pp. \$45.00. ISBN 1-56881-211-6[00A35](#)

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Let me cut to the chase: every mathematics library requires a copy of this book (and its companion volume [J. M. Borwein, D. H. Bailey and R. Girgensohn, *Experimentation in mathematics*, A K Peters, Natick, MA, 2004 [MR2051473](#)] reviewed separately). Every supervisor of higher degree students requires a copy on their shelf. Welcome to the rich world of computer-supported mathematics! This book advances the thesis that significant and difficult mathematics can and does emerge from experimentation with special cases, especially with computer support.

The introductory chapter quotes a gamut of mathematicians who found inspiration in specifics and who have done pages and pages of calculations not always revealed in the final write-up (Georg Riemann being a case in point with two pages from his scrap book reprinted). Doing mathematics has a strongly experimental, empirical aspect. Who has not followed Hilbert's advice and studied a particular but generic example in detail in order to find out 'what is going on'? Who has not at some time been struck by a similarity between two or more apparently disparate mathematical objects, and wondered if there was not something linking them together? The theme of experimentation as part of doing mathematics is comprehensively developed and illustrated in the book by several dozen pertinent and inspiring examples which draw on the historical as well as the current. The final chapter is also reflective; it's a reprint of [J. M. Borwein et al., *Math. Intelligencer* **18** (1996), no. 4, 12–18 [MR1413248](#)] entitled "Making sense of experimental mathematics" from the *Mathematical Intelligencer*. In between there is a goldmine of suggestive ideas to explore and mathematical results presented which were obtained using computer support.

The book does much more than make claims, however. It provides a wealth of current examples in which deep mathematics has been revealed and sometimes even proved using sophisticated software (not just symbol manipulation). We are talking not just about using dynamic geome-

try or symbol manipulation software like Maple or Mathematica; we are talking not just about analysing hundred or thousands of cases as in the four colour theorem. We are talking about using sophisticated algorithms which, for example, detect possible integer relations amongst a number of specified constants (the PSLQ algorithm and its variants). We are talking about the discovery of formulae for the d th hexadecimal digit of π for any d without requiring knowledge of previous digits, a special case of a more general result concerning the digits of logarithms.

The book is also a rich source of problems on which insight could be expected from the use of computer calculations similar to those described in the book. Most chapters end with a list of twenty or thirty examples or problems from a variety of sources including the Putnam competition, which invite experiment and exploration.

The book is also very well written. The text is friendly and supportive, yet the mathematics discussed is cutting edge. The tone is not patronising as often happens when the author feels the need to talk down to the reader. Rather the tone is, but collegial, expecting the reader to be mathematically confident, while providing enough detail for the argument to be plausible. The reader is invited to pause along the way and to experiment themselves, making use of websites for access to the more sophisticated software, and sometimes code provided for Maple or Mathematica, where suitable. The many diagrams and eight colour illustrations span mathematical sculptures and computer output.

The book obviously displays the authors' love of mathematics, and consummate mastery of a broad range of topics, ranging from the highly technical to the aesthetic and the historical. Topics mentioned include differential equations, differential geometry, integration theory, complex functions and Riemann surfaces, knot theory, quantum field theory, dynamical systems, number theory, Ramsey theory and Gödel, and of course power series. Chapter titles include: Pi and its friends, Normality of numbers, Constructive proofs and Numerical techniques. I suspect that a generation of mathematicians will be inspired to develop even more sophisticated software and mathematical ways of thinking by reading this book and its companion volume.

Reviewed by [*John H. Mason*](#)

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