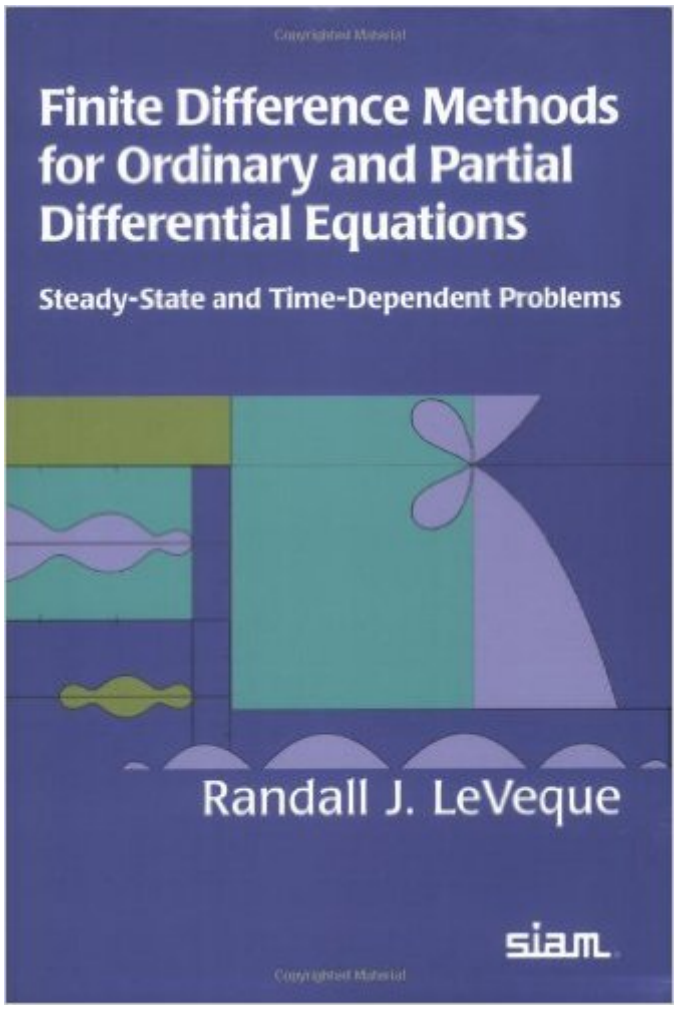
Finite Difference Methods For Ordinary And Partial Differential Equations: Steady-State And Time-Dependent Problems (Classics In Applied Mathematics)



Synopsis

This book introduces finite difference methods for both ordinary differential equations (ODEs) and partial differential equations (PDEs) and discusses the similarities and differences between algorithm design and stability analysis for different types of equations. A unified view of stability theory for ODEs and PDEs is presented, and the interplay between ODE and PDE analysis is stressed. The text emphasizes standard classical methods, but several newer approaches also are introduced and are described in the context of simple motivating examples. The book is organized into two main sections and a set of appendices. Part I addresses steady-state boundary value problems, starting with two-point boundary value problems in one dimension, followed by coverage of elliptic problems in two and three dimensions. It concludes with a chapter on iterative methods for large sparse linear systems that emphasizes systems arising from difference approximations. Part II addresses time-dependent problems, starting with the initial value problem for ODEs, moving on to initial boundary value problems for parabolic and hyperbolic PDEs, and concluding with a chapter on mixed equations combining features of ODEs, parabolic equations, and hyperbolic equations. The appendices cover concepts pertinent to Parts I and II. Exercises and student projects, developed in conjunction with this book, are available on the book s webpage along with numerous MATLAB m-files. Readers will gain an understanding of the essential ideas that underlie the development, analysis, and practical use of finite difference methods as well as the key concepts of stability theory, their relation to one another, and their practical implications. The author provides a foundation from which students can approach more advanced topics and further explore the theory and/or use of finite difference methods according to their interests and needs. Audience: This book is designed as an introductory graduate-level textbook on finite difference methods and their analysis. It is also appropriate for researchers who desire an introduction to the use of these methods. Contents: Preface; Part I: Boundary Value Problems and Iterative Methods. Chapter 1: Finite Difference Approximations; Chapter 2: Steady States and Boundary Value Problems; Chapter 3: Elliptic Equations; Chapter 4: Iterative Methods for Sparse Linear Systems; Part II: Initial Value Problems. Chapter 5: The Initial Value Problem for Ordinary Differential Equations; Chapter 6: Zero-Stability and Convergence for Initial Value Problems; Chapter 7: Absolute Stability for Ordinary Differential Equations; Chapter 8: Stiff Ordinary Differential Equations; Chapter 9: Diffusion Equations and Parabolic Problems; Chapter 10: Advection Equations and Hyperbolic Systems; Chapter 11: Mixed Equations; Appendix A: Measuring Errors; Appendix B: Polynomial Interpolation and Orthogonal Polynomials; Appendix C: Eigenvalues and Inner-Product Norms; Appendix D: Matrix Powers and Exponentials; Appendix E: Partial Differential Equations; Bibliography; Index.

Book Information

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Customer Reviews

I’m literally in love with this book. It helped me tremendously in my computational methods class during the first year of my applied math PhD. I still try to read a section of it every night. It has a great section on Fourier analysis and PDEs in general in the appendix. I strongly strongly STRONGLY recommend you get this essential resource if you are going to be taking any class that involves numerical methods for solving ODEs and PDEs or if you have an interest in these subjects. This book is an easy read.

If you are an applied mathematician, then you will be working with partial differential equations on several occasions. As one of my favorite professors says, analytic solutions to PDEs are almost useless, as the world can hardly ever be modeled by such PDEs that are simple enough to be solved. Welcome to the world of difference methods. Learn to approximate them solutions. The text here is in clear language. It is a book for an applied mathematician (i.e. no rigorous proofs of convergence and nonsense like that). Buy this book and learn the stuff. And then keep it and love it.

This is one of the best Books on the subject among many books that I have seen. It is very well explained, and covers both ODE’s and PDE’s very well. Although the book is SIAM publication, it is

not too heavy on the math side, making it approachable for engineers interested in the subject. The book has many great appendices explaining the necessary mathematical concepts.

This is a great book for numerical analysis and finite differences. The author makes it simple to understand(well mostly) without sacrificing rigor.

As the other two reviewers have already stated, the book is very well written. Unlikely other math books, its learning curve is appropriate, and all of its examples are well-written to maximize comprehension. I would highly suggest this book for a Numerical Methods for PDEs course or as a review tool.

This is one of those books you're required to buy for a class and after getting it, you think, "If I already knew all of this, I wouldn't have bought the book; as I don't already know it all, I had hoped for a book that explained something and this wasn't it". If you don't already know it, get Burden & Faires' "Numerical Analysis".

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