University Of Cambridge Numerical Methods

This is the 2005 second edition of a highly successful and well-respected textbook on the numerical techniques used to solve partial differential equations arising from mathematical models in science, engineering and other fields. The authors maintain an emphasis on finite difference methods for simple but representative examples of parabolic, hyperbolic and elliptic equations from the first edition. However this is augmented by new sections on finite volume methods, modified equation analysis, symplectic integration schemes, convection-diffusion problems, multigrid, and conjugate gradient methods; and several sections, including that on the energy method of analysis, have been extensively rewritten to reflect modern developments. Already an excellent choice for students and teachers in mathematics, engineering and computer science departments, the revised text includes more latest theoretical and industrial developments.

Most functions that occur in mathematics cannot be used directly in computer calculations. Instead they are approximated by manageable functions such as polynomials and piecewise polynomials. The general theory of the subject and its application to polynomial approximation are classical, but piecewise polynomials have become far more useful during the last twenty years. Thus many important theoretical properties have been found recently and many new techniques for the automatic calculation of approximations to prescribed accuracy have been developed. This book gives a thorough and coherent introduction to the theory that is the basis of current approximation methods. Professor Powell describes and analyses the main techniques of calculation supplying sufficient motivation throughout the book to make it accessible to scientists and engineers who require approximation methods for practical needs. Because the book is based on a course of lectures to third-year undergraduates in mathematics at Cambridge University, sufficient attention is given to theory to make it highly suitable as a mathematical textbook at undergraduate or postgraduate level.

Written in an easy-to-understand manner, this comprehensive textbook brings together both basic and advanced concepts of numerical methods in a single volume. Important topics including error analysis, nonlinear equations, systems of linear equations, interpolation and interpolation for Equal intervals and bivariate interpolation are discussed comprehensively. The textbook is written to cater to the needs of undergraduate students of mathematics, computer science, mechanical engineering, civil engineering and information technology for a course on numerical methods/numerical analysis. The text simplifies the understanding of the concepts through exercises and practical examples. Pedagogical features including solved examples and unsolved exercises are interspersed throughout the book for better understanding.

This book provides an extensive introduction to the numerical solution of a large class of integral equations.

Partial Differential Equations with Numerical Methods

Numerical Methods with Chemical Engineering Applications

Applications in MATLAB

Introduction to Numerical Analysis

This work addresses the increasingly important role of numerical methods in science and engineering. It combines traditional and well-developed topics with other material such as interval arithmetic, elementary functions, operator series, convergence acceleration, and continued fractions.

Numerical Methods in Engineering with Python, a student text, and a reference for practicing engineers.

Publisher description

In this work, Parviz Moin introduces numerical methods and shows how to develop, analyse, and use them. A thorough and practical text, it is intended as a first course in numerical analysis.

Numerical Analysis with Algorithms and Programming

Fundamentals and Applications

Elements of Numerical Methods for Compressible Flows

Numerical Methods of Statistics

An Introduction to Numerical Analysis

This volume contains invited papers presented at the 16th Dundee Biennial Conference on Numerical Analysis held at the University of Dundee, 27–30 June, 1995. The Dundee Conferences are important events in the numerical analysis calendar, and the thirteen papers published here represent accounts of recent research work by leading numerical analysts covering a wide range of fields of interest. The book is a valuable guide to the direction of current research in many areas of numerical analysis. It will be of particular interest to graduate students and research workers concerned with the theory and application of numerical methods for solving ordinary and partial differential equations, with emphasis on problems in fluid dynamics. It also contains contributions to research into methods of linear algebra, numerical methods for optimisation problems and surface fitting.

Numerical analysis deals with the manipulation of numbers to solve a particular problem. This book discusses in detail the creation, analysis and implementation of algorithms to solve the problems of continuous mathematics. An input is provided in the form of numerical data or it is generated as required by the system to solve a mathematical problem. Subsequently, this input is processed through arithmetic operations together with logical operations in a systematic manner and an output is produced in the form of numbers. Covering the fundamentals of numerical analysis and its applications in one volume, this book offers detailed discussion on relevant topics including difference equations, Fourier series, discrete Fourier transforms and finite element methods. In addition, the important concepts of integral equations, Chebyshev Approximation and Eigen Values of Symmetric Matrices are elaborated upon in separate chapters. The book will serve as a suitable textbook for undergraduate students in science and engineering.

Numerical Methods for Ordinary Differential Equations is a self-contained introduction to a fundamental field of numerical analysis and scientific computation. Written for undergraduate students with a mathematical background, this book focuses on the analysis of numerical methods without losing sight of the practical nature of the subject. It covers the topics traditionally treated in a first course, but also highlights new and emerging themes. Chapters are broken down into `lecture' sized pieces, motivated and illustrated by numerous theoretical and computational examples. Over 200 exercises are provided and these are starred according to their degree of difficulty. Solutions to all exercises are available to authorized instructors. The book covers key foundation topics: o Taylor series methods o Runge--Kutta methods o Linear multistep methods o Convergence o Stability and a range of modern themes: o Adaptive stepsize selection o Long term dynamics o Modified equations o Geometric integration o Stochastic differential equations The prerequisite of a basic university-level calculus class is assumed, although appropriate background results are also summarized in appendices. A dedicated website for the book containing extra information can be found via www.springer.com

Covers numerical analysis for mathematics students without neglecting practical aspects.

Numerical Methods and Optimization

Numerical Methods of Curve Fitting

A Least Squares Approach

Volume 1

Numerical Methods for Chemical Engineering

This book shows how to derive, test and analyze numerical methods for solving differential equations, including both ordinary and partial differential equations. The objective is that students learn to solve differential equations numerically and understand the mathematical and computational issues that arise when this is done. Includes an extensive collection of exercises, which develop both the analytical and computational aspects of the material. In addition to more than 100 illustrations, the book includes a large collection of supplemental material: exercise sets, MATLAB computer codes for both student and instructor, lecture slides and movies.

This book presents the latest numerical solutions to initial value problems and boundary value problems described by ODEs and PDEs. The author offers practical methods that can be adapted to solve wide ranges of problems and illustrates them in the increasingly popular open source computer language R, allowing integration with more statistically based methods. The book begins with standard techniques, followed by an overview of 'high resolution' flux limiters and WENO to solve problems with solutions exhibiting high gradient phenomena. Meshless methods using radial basis functions are then discussed in the context of scattered data interpolation and the solution of PDEs on irregular grids. Three detailed case studies demonstrate how numerical methods can be used to tackle very different complex problems. With its focus on practical solutions to real-world problems, this book will be useful to students and practitioners in all areas of science and engineering, especially those using R.

This book explains how computer software is designed to perform the tasks required for sophisticated statistical analysis. For statisticians, it examines the nitty-gritty computational problems behind statistical methods. For mathematicians and computer scientists, it looks at the application of mathematical tools to statistical problems. The first half of the book offers a basic background in numerical analysis that emphasizes issues important to statisticians. The next several chapters cover a broad array of statistical tools, such as maximum likelihood and nonlinear regression. The author also treats the application of numerical tools; numerical integration and random number generation are explained in a unified manner reflecting complementary views of Monte Carlo methods. Each chapter contains exercises that range from simple questions to research problems. Most of the examples are accompanied by demonstration and source code available from the author's website. New in this second edition are demonstrations coded in R, as well as new sections on linear programming and the Nelder–Mead search algorithm.

Numerical Analysis with Algorithms and Programming is the first comprehensive textbook to provide detailed coverage of numerical methods, their algorithms, and corresponding computer programs. It presents many techniques for the efficient numerical solution of problems in science and engineering. Along with numerous worked-out examples, end-of-chapter exercises, and Mathematica® programs, the book includes the standard algorithms for numerical computation: Root finding for nonlinear equations Interpolation and approximation of functions by simpler computational building blocks, such as polynomials and splines The solution of systems of linear equations and triangularization Approximation of functions and least square approximation Numerical differentiation and divided differences Numerical quadrature and integration Numerical solutions of ordinary differential equations (ODEs) and boundary value problems Numerical solution of partial differential equations (PDEs) The text develops students’ understanding of the construction of numerical algorithms and the applicability of the methods. By thoroughly studying the algorithms, students will discover how various methods provide accuracy, efficiency, scalability, and stability for large-scale systems.

Numerical Methods in Engineering with Python

Approximation Theory and Methods

Numerical Methods for Evolutionary Differential Equations

A First Course in the Numerical Analysis of Differential Equations

Numerical Methods for Ordinary Differential Equations

Numerical MethodsFundamentals and ApplicationsCambridge University Press

The first three chapters contain the elements of the theory of dynamical systems and the numerical solution of initial-value problems. In the remaining chapters, numerical methods are formulated as dynamical systems and the convergence and stability properties of the methods are examined.

Applications of numerical mathematics and scientific computing to chemical engineering.

Provides aspiring quant developers with the numerical techniques and programming skills needed in quantitative finance. No programming background required.

Numerical Methods

AN INTRODUCTION TO NUMERICAL ANALYSIS, 2ND ED

Numerical Methods in Finance and Economics

Numerical Analysis 1995

Numerical Methods in Engineering with Python 3

Numerical analysis provides the theoretical foundation for the numerical algorithms we rely on to solve a multitude of computational problems in science. Based on a successful course at Oxford University, this book covers a wide range of such problems ranging from the approximation of functions and integrals to the approximate solution of algebraic, transcendental, differential and integral equations. Throughout the book, particular attention is paid to the essential qualities of a numerical algorithm - stability, accuracy, reliability and efficiency. The authors go further than simply providing recipes for solving computational problems. They carefully analyse the reasons why methods might fail to give accurate answers, or why one method might return an answer in seconds while another would take billions of years. This book is ideal as a text for students in the second year of a university mathematics course. It combines practicality regarding applications with consistently high standards of rigour.

First published in 1961, this book provides information on the methods of treating series of observations, the field covered embraces portions of both statistics and numerical analysis. Originally intended as an introduction to the topic aimed at students and graduates in physics, the types of observation discussed reflect the standard routine work of the time in the physical sciences. The text partly reflects an aim to offer a better balance between theory and practice, reversing the tendency of books on numerical analysis to omit numerical examples illustrating the applications of the methods. This book will be of value to anyone with an interest in the theoretical development of its field.

Provides an introduction to numerical methods for students in engineering. It uses Python 3, an easy-to-use, high-level programming language.

A plain language style, worked examples and exercises help students to understand the foundations of computational physics and engineering.

Numerical Methods in Finance

The Numerical Solution of Integral Equations of the Second Kind

Numerical Analysis Using R

Numerical Methods in Physics with Python

A MATLAB-Based Introduction

Numerical Methods in Finance describes a wide variety of numerical methods used in financial analysis.

Market_Desc: · Mathematics Students · Instructors About The Book: This Second Edition of a standard numerical analysis text retains organization of the original edition, but all sections have been revised, some extensively, and bibliographies have been updated. New topics covered include optimization, trigonometric interpolation and the fast Fourier transform, numerical differentiation, the method of lines, boundary value problems, the conjugate gradient method, and the least squares solutions of systems of linear equations.

This textbook provides an introduction to constructive methods that provide accurate approximations to the solution of numerical problems using MATLAB.

This 2001 book provides a basic background in numerical analysis and its applications in statistics.

Initial Value Problems

A Student's Guide to Numerical Methods

Fundamentals of Engineering Numerical Analysis

Solutions to ODEs and PDEs

Numerical Analysis

lead the reader to a theoretical understanding of the subject without neglecting its practical aspects. The outcome is a textbook that is mathematically honest and rigorous and provides its target audience with a wide range of skills in both ordinary and partial differential equations." --Book Jacket.

A standalone text for courses on computational physics combining idiomatic Python, foundational numerical methods, and physics applications.

The main theme is the integration of the theory of linear PDE and the theory of finite difference and finite element methods. For each type of PDE, elliptic, parabolic, and hyperbolic, the text contains one chapter on the mathematical theory of the differential equation, followed by one chapter on finite difference methods and one on finite element methods. The chapters on elliptic equations are preceded by a chapter on the two-point boundary value problem for ordinary differential equations. Similarly, the chapters on time-dependent problems are preceded by a chapter on the initial-value problem for ordinary differential equations. There is also one chapter on the elliptic eigenvalue problem and eigenfunction expansion. The presentation does not presume a deep knowledge of mathematical and functional analysis. The required background on linear functional analysis and Sobolev spaces is reviewed in an appendix. The book is suitable for advanced undergraduate and beginning graduate students of applied mathematics and engineering.

A state-of-the-art introduction to the powerful mathematical and statistical tools used in the field of finance The use of mathematical models and numerical techniques is a practice employed by a growing number of applied mathematicians working on applications in finance. Reflecting this development, Numerical Methods in Finance and Economics: A MATLAB?-Based Introduction, Second Edition bridges the gap between financial theory and computational practice while showing readers how to utilize MATLAB?--the powerful numerical computing environment--for financial applications. The author provides an essential foundation in finance and numerical analysis in addition to background material for students from both engineering and economics perspectives. A wide range of topics is covered, including standard numerical analysis methods, Monte Carlo methods to simulate systems affected by significant uncertainty, and optimization methods to find an optimal set of decisions. Among this book's most outstanding features is the integration of MATLAB?, which helps students and practitioners solve relevant problems in finance, such as portfolio management and derivatives pricing. This tutorial is useful in connecting theory with practice in the application of classical numerical methods and advanced methods, while illustrating underlying algorithmic concepts in concrete terms. Newly featured in the Second Edition: * In-depth treatment of Monte Carlo methods with due attention paid to variance reduction strategies * New appendix on AMPL in order to better illustrate the optimization models in Chapters 11 and 12 * New chapter on binomial and trinomial lattices * Additional treatment of partial differential equations with two space dimensions * Expanded treatment within the chapter on financial theory to provide a more thorough background for engineers not familiar with finance * New coverage of advanced optimization methods and applications later in the text Numerical Methods in Finance and Economics: A MATLAB?-Based Introduction, Second Edition presents basic treatments and more specialized literature, and it also uses algebraic languages, such as AMPL, to connect the pencil-and-paper statement of an optimization model with its solution by a software library. Offering computational practice in both financial engineering and economics fields, this book equips practitioners with the necessary techniques to measure and manage risk.

Numerical Methods in Scientific Computing:

Dynamic Data Assimilation

Numerical Methods for Time-optimal and Fuel-optimal Control

Introduction to Numerical Methods in Differential Equations

Dynamical Systems and Numerical Analysis

Since the original publication of this book, available computer power has increased greatly. Today, scientific computing is playing an ever more prominent role as a tool in scientific discovery and engineering analysis. In this second edition, the key addition is an introduction to the finite element method. This is a widely used technique for solving partial differential equations (PDEs) in complex domains. This text introduces numerical methods and shows how to develop, analyse, and use them. Complete MATLAB programs for all the worked examples are now available at www.cambridge.org/Moin, and more than 30 exercises have been added. This thorough and practical book is intended as a first course in numerical analysis, primarily for new graduate students in engineering and physical science. Along with mastering the fundamentals of numerical methods, students will learn to write their own computer programs using standard numerical methods.

This undergraduate textbook integrates the teaching of numerical methods and programming with problems from core chemical engineering subjects.

Dynamic data assimilation is the assessment, combination and synthesis of observational data, scientific laws and mathematical models to determine the state of a complex physical system, for instance as a preliminary step in making predictions about the system's behaviour. The topic has assumed increasing importance in fields such as numerical weather prediction where conscientious efforts are being made to extend the term of reliable weather forecasts beyond the few days that are presently feasible. This book is designed to be a basic one-stop reference for graduate students and researchers. It is based on graduate courses taught over a decade to mathematicians, scientists, and engineers, and its modular structure accommodates the various audience requirements. Thus Part I is a broad introduction to the history, development and philosophy of data assimilation, illustrated by examples; Part II considers the classical, static approaches, both linear and nonlinear; and Part III describes computational techniques. Parts IV to VII are concerned with how statistical and dynamic ideas can be incorporated into the classical framework. Key themes covered here include estimation theory, stochastic and dynamic models, and sequential filtering. The final part addresses the predictability of dynamical systems. Chapters end with a section that provides pointers to the literature, and a set of exercises with instructive hints.

Develops, analyses, and applies numerical methods for evolutionary, or time-dependent, differential problems.

Proceedings of the 9th Biennial Conference Held at Dundee, Great Britain, June 1981

Numerical Methods in Finance with C++

A Concise Introduction to Numerical Analysis

Numerical Solution of Partial Differential Equations

Theory and Practice for Engineers

This textbook provides an accessible and concise introduction to numerical analysis for upper undergraduate and beginning graduate students from various backgrounds. It was developed from the lecture notes of four successful courses on numerical analysis taught within the MPhil of Scientific Computing at the University of Cambridge. The book is easily accessible, even to those with limited knowledge of mathematics. Students will get a concise, but thorough introduction to numerical analysis. In addition the algorithmic principles are emphasized to encourage a deeper und of why an algorithm is suitable, and sometimes unsuitable, for a particular problem. A Concise Introduction to Numerical Analysis strikes a balance between being mathematically comprehensive, but not overwhelming with mathematical detail. In some places where further detail was felt to be out of scope of the book, the reader is referred to further reading. The book uses MATLAB® implementations to demonstrate the workings of the method and thus MATLAB's own implementations are avoided, unless they are used as building blocks of an algorithm. In some cases the list printed in the book, but all are available online on the book’s page at www.crcpress.com. Most implementations are in the form of functions returning the outcome of the algorithm. Also, examples for the use of the functions are given. Exercises are included in line with the text where appropriate, and each chapter ends with a selection of revision exercises. Solutions to odd-numbered exercises are also provided on the book’s page at www.crcpress.com. This textbook is also an ideal resource for graduate students coming from other subjects who will use numerical techniques their graduate studies.

Numerical methods

Elements of Numerical Analysis

An Introduction