

NUMERICAL METHODS

Dr. KARITY

EXAM 1/10/17 Score 88.5%

LEAST SQUARES REGRESSION

MINIMIZES THE SUM OF THE SQUARES OF THE RESIDUAL ERROR

$$S_{\text{sq}} = \sum_{i=1}^n (y_i - a_0 - a_1 x_i)^2$$

MINIMIZES THE SUM OF THE SQUARES OF THE RESIDUAL ERROR

$$a_0 = \frac{\sum y_i}{n}, a_1 = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sum (x_i - \bar{x})^2}$$

$$a_0 = \frac{\sum y_i}{n}, a_1 = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{\sum (x_i - \bar{x})^2}$$

POLYNOMIAL REGRESSION

$$S_{\text{sq}} = \sum_{i=1}^n (y_i - a_0 - a_1 x_i - a_2 x_i^2 - \dots - a_n x_i^n)^2$$

MINIMIZES THE SUM OF THE SQUARES OF THE RESIDUAL ERROR

$$\sum_{i=1}^n a_i x_i^n = 0 \quad \Rightarrow \quad \sum_{i=1}^n a_i = 0$$

$$\sum_{i=1}^n a_i x_i^{2n} = 0 \quad \Rightarrow \quad \sum_{i=1}^n a_i x_i^2 = 0$$

$$\sum_{i=1}^n a_i x_i^{3n} = 0 \quad \Rightarrow \quad \sum_{i=1}^n a_i x_i^3 = 0$$

$$\sum_{i=1}^n a_i x_i^{4n} = 0 \quad \Rightarrow \quad \sum_{i=1}^n a_i x_i^4 = 0$$

$$\sum_{i=1}^n a_i x_i^{5n} = 0 \quad \Rightarrow \quad \sum_{i=1}^n a_i x_i^5 = 0$$

$$\sum_{i=1}^n a_i x_i^{6n} = 0 \quad \Rightarrow \quad \sum_{i=1}^n a_i x_i^6 = 0$$

$$\sum_{i=1}^n a_i x_i^{7n} = 0 \quad \Rightarrow \quad \sum_{i=1}^n a_i x_i^7 = 0$$

$$\sum_{i=1}^n a_i x_i^{8n} = 0 \quad \Rightarrow \quad \sum_{i=1}^n a_i x_i^8 = 0$$

$$\sum_{i=1}^n a_i x_i^{9n} = 0 \quad \Rightarrow \quad \sum_{i=1}^n a_i x_i^9 = 0$$

$$\sum_{i=1}^n a_i x_i^{10n} = 0 \quad \Rightarrow \quad \sum_{i=1}^n a_i x_i^{10} = 0$$

$$\sum_{i=1}^n a_i x_i^{11n} = 0 \quad \Rightarrow \quad \sum_{i=1}^n a_i x_i^{11} = 0$$

$$\sum_{i=1}^n a_i x_i^{12n} = 0 \quad \Rightarrow \quad \sum_{i=1}^n a_i x_i^{12} = 0$$

$$\sum_{i=1}^n a_i x_i^{13n} = 0 \quad \Rightarrow \quad \sum_{i=1}^n a_i x_i^{13} = 0$$

$$\sum_{i=1}^n a_i x_i^{14n} = 0 \quad \Rightarrow \quad \sum_{i=1}^n a_i x_i^{14} = 0$$

$$\sum_{i=1}^n a_i x_i^{15n} = 0 \quad \Rightarrow \quad \sum_{i=1}^n a_i x_i^{15} = 0$$

$$\sum_{i=1}^n a_i x_i^{16n} = 0 \quad \Rightarrow \quad \sum_{i=1}^n a_i x_i^{16} = 0$$

$$\sum_{i=1}^n a_i x_i^{17n} = 0 \quad \Rightarrow \quad \sum_{i=1}^n a_i x_i^{17} = 0$$

$$\sum_{i=1}^n a_i x_i^{18n} = 0 \quad \Rightarrow \quad \sum_{i=1}^n a_i x_i^{18} = 0$$

$$\sum_{i=1}^n a_i x_i^{19n} = 0 \quad \Rightarrow \quad \sum_{i=1}^n a_i x_i^{19} = 0$$

$$\sum_{i=1}^n a_i x_i^{20n} = 0 \quad \Rightarrow \quad \sum_{i=1}^n a_i x_i^{20} = 0$$

$$\sum_{i=1}^n a_i x_i^{21n} = 0 \quad \Rightarrow \quad \sum_{i=1}^n a_i x_i^{21} = 0$$

$$\sum_{i=1}^n a_i x_i^{22n} = 0 \quad \Rightarrow \quad \sum_{i=1}^n a_i x_i^{22} = 0$$

$$\sum_{i=1}^n a_i x_i^{23n} = 0 \quad \Rightarrow \quad \sum_{i=1}^n a_i x_i^{23} = 0$$

$$\sum_{i=1}^n a_i x_i^{24n} = 0 \quad \Rightarrow \quad \sum_{i=1}^n a_i x_i^{24} = 0$$

$$\sum_{i=1}^n a_i x_i^{25n} = 0 \quad \Rightarrow \quad \sum_{i=1}^n a_i x_i^{25} = 0$$

$$\sum_{i=1}^n a_i x_i^{26n} = 0 \quad \Rightarrow \quad \sum_{i=1}^n a_i x_i^{26} = 0$$

$$\sum_{i=1}^n a_i x_i^{27n} = 0 \quad \Rightarrow \quad \sum_{i=1}^n a_i x_i^{27} = 0$$

$$\sum_{i=1}^n a_i x_i^{28n} = 0 \quad \Rightarrow \quad \sum_{i=1}^n a_i x_i^{28} = 0$$

STANDARD ERROR:

$$S_{\text{sq}} = \sqrt{\frac{\sum_{i=1}^n (y_i - a_0 - a_1 x_i)^2}{n-2}}$$

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INTERPOLATION

USING A POLYNOMIAL FIT

LEADER: DEGREES

DEGREES 0

DEGREES 1

DEGREES 2

DEGREES 3

DEGREES 4

DEGREES 5

DEGREES 6

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DEGREES 8

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Numerical Analysis

M. Schatzman

Numerical Analysis:

Numerical Analysis Walter Gautschi,1997-08-19 A First Course in Numerical Analysis Anthony Ralston,Philip Rabinowitz,2001-01-01 Outstanding text oriented toward computer solutions stresses errors in methods and computational efficiency Problems some strictly mathematical others requiring a computer appear at the end of each chapter

Numerical Analysis Larkin Ridgway Scott,2011-04-18 Computational science is fundamentally changing how technological questions are addressed The design of aircraft automobiles and even racing sailboats is now done by computational simulation The mathematical foundation of this new approach is numerical analysis which studies algorithms for computing expressions defined with real numbers Emphasizing the theory behind the computation this book provides a rigorous and self contained introduction to numerical analysis and presents the advanced mathematics that underpin industrial software including complete details that are missing from most textbooks Using an inquiry based learning approach Numerical Analysis is written in a narrative style provides historical background and includes many of the proofs and technical details in exercises Students will be able to go beyond an elementary understanding of numerical simulation and develop deep insights into the foundations of the subject They will no longer have to accept the mathematical gaps that exist in current textbooks For example both necessary and sufficient conditions for convergence of basic iterative methods are covered and proofs are given in full generality not just based on special cases The book is accessible to undergraduate mathematics majors as well as computational scientists wanting to learn the foundations of the subject Presents the mathematical foundations of numerical analysis Explains the mathematical details behind simulation software Introduces many advanced concepts in modern analysis Self contained and mathematically rigorous Contains problems and solutions in each chapter Excellent follow up course to Principles of Mathematical Analysis by Rudin **Numerical Analysis** M. Schatzman,2002 Numerical analysis explains why numerical computations work or fail This book is divided into four parts Part I starts with a guided tour of floating number systems and machine arithmetic The exponential and the logarithm are constructed from scratch to present a new point of view on questions well known to the reader and the needed knowledge of linear algebra is summarized Part II starts with polynomial approximation polynomial interpolation mean square approximation splines It then deals with Fourier series providing the trigonometric version of least square approximations and one of the most important numerical algorithms the fast Fourier transform Any scientific computation program spends most of its time solving linear systems or approximating the solution of linear systems even when trying to solve non linear systems Part III is therefore about numerical linear algebra while Part IV treats a selection of non linear or complex problems resolution of linear equations and systems ordinary differential equations single step and multi step schemes and an introduction to partial differential equations The book has been written having in mind the advanced undergraduate students in mathematics who are interested in the spice and spirit of numerical analysis The book does not

assume previous knowledge of numerical methods It will also be useful to scientists and engineers wishing to learn what mathematics has to say about the reason why their numerical methods work or fail **Numerical Analysis** Ishaq Murad Khabaza,1965 Digital computers Desk machines errors in computations Finite difference methods Recurrence relations and algebraic equations Numerical solution of ordinary differential equations Matrices Relaxation methods Numerical methods for unequal intervals *Theoretical Numerical Analysis* Peter Linz,2019-06-12 This concise text introduces numerical analysis as a practical problem solving discipline The three part presentation begins with the fundamentals of functional analysis and approximation theory Part II outlines the major results of theoretical numerical analysis reviewing product integration approximate expansion methods the minimization of functions and related topics Part III considers specific subjects that illustrate the power and usefulness of theoretical analysis Ideal as a text for a one year graduate course the book also offers engineers and scientists experienced in numerical computing a simple introduction to the major ideas of modern numerical analysis Some practical experience with computational mathematics and the ability to relate this experience to new concepts is assumed Otherwise no background beyond advanced calculus is presupposed Moreover the ideas of functional analysis used throughout the text are introduced and developed only to the extent they are needed

Afternotes on Numerical Analysis G. W. Stewart,1996-01-01 This book presents the central ideas of modern numerical analysis in a vivid and straightforward fashion with a minimum of fuss and formality Stewart designed this volume while teaching an upper division course in introductory numerical analysis An Introduction to Numerical Analysis Kendall Atkinson,1991-01-16 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 Contains many problems some with solutions An Introduction to Numerical Methods and Analysis James F. Epperson,2007-09-17 Praise for the First Edition outstandingly appealing with regard to its style contents considerations of requirements of practice choice of examples and exercises Zentralblatt Math carefully structured with many detailed worked examples The Mathematical Gazette an up to date and user friendly account Mathematika An Introduction to Numerical Methods and Analysis addresses the mathematics underlying approximation and scientific computing and successfully explains where approximation methods come from why they sometimes work or don't work and when to use one of the many techniques that are available Written in a style that emphasizes readability and usefulness for the numerical methods novice the book begins with basic elementary material and gradually builds up to more advanced topics A selection of concepts required for the study of computational mathematics is introduced and simple approximations using Taylor's Theorem are also treated in some depth The text includes exercises that run the gamut from simple hand computations to challenging

derivations and minor proofs to programming exercises A greater emphasis on applied exercises as well as the cause and effect associated with numerical mathematics is featured throughout the book An Introduction to Numerical Methods and Analysis is the ideal text for students in advanced undergraduate mathematics and engineering courses who are interested in gaining an understanding of numerical methods and numerical analysis

Numerical Analysis with Algorithms and Programming

Santanu Saha Ray,2018-09-03 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

Classical and Modern Numerical Analysis

Azmy S. Ackleh,Edward James Allen,R. Baker Kearfott,Padmanabhan Seshaiyer,2009-07-20 Classical and Modern Numerical Analysis Theory Methods and Practice provides a sound foundation in numerical analysis for more specialized topics such as finite element theory advanced numerical linear algebra and optimization It prepares

graduate students for taking doctoral examinations in numerical analysis The text covers the main areas o

Explorations In Numerical Analysis: Python Edition

James V Lambers,Amber C Sumner Mooney,Vivian Ashley Montiforte,2021-01-14 This textbook is intended to introduce advanced undergraduate and early career graduate students to the field of numerical

analysis This field pertains to the design analysis and implementation of algorithms for the approximate solution of mathematical problems that arise in applications spanning science and engineering and are not practical to solve using analytical techniques such as those taught in courses in calculus linear algebra or differential equations Topics covered include computer arithmetic error analysis solution of systems of linear equations least squares problems eigenvalue problems nonlinear equations optimization polynomial interpolation and approximation numerical differentiation and integration ordinary differential equations and partial differential equations For each problem considered the presentation includes the derivation of solution techniques analysis of their efficiency accuracy and robustness and details of their implementation illustrated through the Python programming language This text is suitable for a year long sequence in numerical analysis and can also be used for a one semester course in numerical linear algebra

Numerical Analysis

Brian Sutton,2019-04-18 This textbook develops the fundamental skills of numerical analysis designing numerical methods implementing them in computer code and analyzing their accuracy and efficiency A number of mathematical problems interpolation integration linear systems zero finding and differential equations are considered and some of the most important methods for their solution are demonstrated and analyzed Notable features of this book include the development of Chebyshev methods alongside more classical ones a dual emphasis on theory and experimentation the use of linear algebra to solve problems from analysis which enables students to gain a greater appreciation for both subjects and many examples and exercises Numerical Analysis Theory and Experiments is designed to be the primary text for a junior or senior level undergraduate course in numerical analysis for mathematics majors Scientists and engineers interested in numerical methods particularly those seeking an accessible introduction to Chebyshev methods will also be interested in this book

Classical Numerical Analysis Abner J. Salgado,Steven M. Wise,2022-10-20 Numerical Analysis is a broad field and coming to grips with all of it may seem like a daunting task This text provides a thorough and comprehensive exposition of all the topics contained in a classical graduate sequence in numerical analysis With an emphasis on theory and connections with linear algebra and analysis the book shows all the rigor of numerical analysis Its high level and exhaustive coverage will prepare students for research in the field and become a valuable reference as they continue their career Students will appreciate the simple notation clear assumptions and arguments as well as the many examples and classroom tested exercises ranging from simple verification to qualifying exam level problems In addition to the many examples with hand calculations readers will also be able to translate theory into practical computational codes by running sample MATLAB codes as they try out new concepts

A Theoretical Introduction to Numerical Analysis Victor S. Ryaben'kii,Semyon V. Tsynkov,2006-11-02 A Theoretical Introduction to Numerical Analysis presents the general methodology and principles of numerical analysis illustrating these concepts using numerical methods from real analysis linear algebra and differential equations The book focuses on how to efficiently represent mathematical models for computer based study An accessible yet rigorous mathematical introduction this book provides a pedagogical account of the fundamentals of numerical analysis The authors thoroughly explain basic concepts such as discretization error efficiency complexity numerical stability consistency and convergence The text also addresses more complex topics like intrinsic error limits and the effect of smoothness on the accuracy of approximation in the context of Chebyshev interpolation Gaussian quadratures and spectral methods for differential equations Another advanced subject discussed the method of difference potentials employs discrete analogues of Calderon's potentials and boundary projection operators The authors often delineate various techniques through exercises that require further theoretical study or computer implementation By lucidly presenting the central mathematical concepts of numerical methods A Theoretical Introduction to Numerical Analysis provides a foundational link to more specialized computational work in fluid dynamics acoustics and electromagnetism

Elements Of Numerical Analysis With

Mathematica John Loustau,2017-08-23 Here we present numerical analysis to advanced undergraduate and master degree level grad students This is to be done in one semester The programming language is Mathematica The mathematical foundation and technique is included The emphasis is geared toward the two major developing areas of applied mathematics mathematical finance and mathematical biology

Numerical Analysis with Applications in Mechanics and

Engineering Petre Teodorescu,Nicolae-Doru Stanescu,Nicolae Pandrea,2013-05-07 A much needed guide on how to use numerical methods to solve practical engineering problems Bridging the gap between mathematics and engineering Numerical Analysis with Applications in Mechanics and Engineering arms readers with powerful tools for solving real world problems in mechanics physics and civil and mechanical engineering Unlike most books on numerical analysis this outstanding work links theory and application explains the mathematics in simple engineering terms and clearly demonstrates how to use numerical methods to obtain solutions and interpret results Each chapter is devoted to a unique analytical methodology including a detailed theoretical presentation and emphasis on practical computation Ample numerical examples and applications round out the discussion illustrating how to work out specific problems of mechanics physics or engineering Readers will learn the core purpose of each technique develop hands on problem solving skills and get a complete picture of the studied phenomenon Coverage includes How to deal with errors in numerical analysis Approaches for solving problems in linear and nonlinear systems Methods of interpolation and approximation of functions Formulas and calculations for numerical differentiation and integration Integration of ordinary and partial differential equations Optimization methods and solutions for programming problems Numerical Analysis with Applications in Mechanics and Engineering is a one of a kind guide for engineers using mathematical models and methods as well as for physicists and mathematicians interested in engineering problems

Fundamentals of Engineering Numerical Analysis Parviz

Moin,2010-08-23 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 in Modern

Scientific Computing Andreas Hohmann,Peter Deuflhard,2003-01-14 This book introduces the main topics of modern numerical analysis sequence of linear equations error analysis least squares nonlinear systems symmetric eigenvalue problems three term recursions interpolation and approximation large systems and numerical integrations The presentation draws on geometrical intuition wherever appropriate and is supported by a large number of illustrations exercises and examples

Numerical Analysis James M. Ortega,1990-01-01 Mathematics of Computing Numerical Analysis

Unveiling the Magic of Words: A Overview of "**Numerical Analysis**"

In a world defined by information and interconnectivity, the enchanting power of words has acquired unparalleled significance. Their ability to kindle emotions, provoke contemplation, and ignite transformative change is truly awe-inspiring. Enter the realm of "**Numerical Analysis**," a mesmerizing literary masterpiece penned by a distinguished author, guiding readers on a profound journey to unravel the secrets and potential hidden within every word. In this critique, we shall delve into the book's central themes, examine its distinctive writing style, and assess its profound effect on the souls of its readers.

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