

# NUMERICAL METHODS

C / KAPPA EXAM 12 / 11/14 / 1002 / 20, 20M

## LEAST SQUARES REGRESSION

Goal: minimize the sum of the square of the residual (error).

Residual  $r_i = y_i - \hat{y}_i$

$S_y = \sum_{i=1}^n y_i$ ,  $S_x = \sum_{i=1}^n x_i$ ,  $S_{xy} = \sum_{i=1}^n x_i y_i$

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$a_0 = \frac{S_y}{n}$ ,  $a_1 = \frac{S_{xy} - \frac{S_x S_y}{n}}{S_x - \frac{S_x^2}{n}}$

POLYNOMIAL QUADRATIC REGRESSION:

$S_y = \sum_{i=1}^n (y_i - a_0 - a_1 x_i - a_2 x_i^2)^2$

$\frac{\partial S_y}{\partial a_0} = -2(\sum y_i - \sum a_0 - a_1 \sum x_i - a_2 \sum x_i^2) = 0$

$\frac{\partial S_y}{\partial a_1} = -2(\sum x_i y_i - \sum a_0 \sum x_i - a_1 \sum x_i^2 - a_2 \sum x_i^3) = 0$

$\frac{\partial S_y}{\partial a_2} = -2(\sum x_i^2 y_i - \sum a_0 \sum x_i^2 - a_1 \sum x_i^3 - a_2 \sum x_i^4) = 0$

$\begin{bmatrix} \sum 1 & \sum x_i & \sum x_i^2 \\ \sum x_i & \sum x_i^2 & \sum x_i^3 \\ \sum x_i^2 & \sum x_i^3 & \sum x_i^4 \end{bmatrix} \begin{bmatrix} a_0 \\ a_1 \\ a_2 \end{bmatrix} = \begin{bmatrix} \sum y_i \\ \sum x_i y_i \\ \sum x_i^2 y_i \end{bmatrix}$

$CX = Y$ ,  $C = \begin{bmatrix} \sum 1 & \sum x_i & \sum x_i^2 \\ \sum x_i & \sum x_i^2 & \sum x_i^3 \\ \sum x_i^2 & \sum x_i^3 & \sum x_i^4 \end{bmatrix}$ ,  $X = \begin{bmatrix} a_0 \\ a_1 \\ a_2 \end{bmatrix}$ ,  $Y = \begin{bmatrix} \sum y_i \\ \sum x_i y_i \\ \sum x_i^2 y_i \end{bmatrix}$

$S_y = \sum_{i=1}^n (y_i - \hat{y}_i)^2$

data points, Advanced Calculus

## STANDARD ERROR:

$$S_y = \sqrt{\frac{\sum y_i^2}{n-2}}, S_x = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n-2}}$$

## STANDARD DEVIATION:

$$S_y = \sqrt{\frac{\sum y_i^2}{n-1}}, S_x = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n-1}}$$

$$a_0 = \bar{y} - a_1 \bar{x}$$

$$y = a_0 + a_1 x$$

## INTERPOLATION

Use a polynomial fit:

Linear:  $y = a_0 + a_1 x$

Quadratic:  $y = a_0 + a_1 x + a_2 x^2$

Cubic:  $y = a_0 + a_1 x + a_2 x^2 + a_3 x^3$

Order:  $n = 1, 2, 3, 4, \dots$

Turns:  $n = 1, 2, 3, 4, \dots$

Spines:  $n = 1, 2, 3, 4, \dots$

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## DEGREE 1

Linear:  $y = a_0 + a_1 x$

Quadratic:  $y = a_0 + a_1 x + a_2 x^2$

Cubic:  $y = a_0 + a_1 x + a_2 x^2 + a_3 x^3$

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## DEGREE 2

Linear:  $y = a_0 + a_1 x$

Quadratic:  $y = a_0 + a_1 x + a_2 x^2$

Cubic:  $y = a_0 + a_1 x + a_2 x^2 + a_3 x^3$

Order:  $n = 1, 2, 3, 4, \dots$

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## ODE'S

Euler's Method:

$y_{n+1} = y_n + f(x_n, y_n) \Delta x$

Runge-Kutta:

$y_{n+1} = y_n + f(x_n, y_n) \Delta x$

# Numerical Methods 4th Numerical Methods 4th

**Karin Nielsen-Saines**



## **Numerical Methods 4th Numerical Methods 4th:**

*Numerical Methods Vol-IV ( Tamil Nadu)* K GUNAVATHI,2006-12 This book on Numerical Methods Actually this is in continuation to other three volumes of our book Text book on Engineering Mathematics for B E Course which cater to the needs of the first and the second year students The present book is to meet the requirements of the students of the fifth semester the need of which was being felt very anxiously In the treatment we have tried to maintain the same style as used in the other three volumes All the topics have been covered comprehensively but with clarity in lucid and easy way to grasp There is a good number of fully solved examples with exercises to be worked out at the end of each chapter

**Numerical Methods for Engineers, Second Edition** D. Vaughan Griffiths, I.M. Smith, 1991-03-31 Numerical Methods for Engineers A Programming Approach is devoted to solving engineering problems using numerical methods It covers all areas of introductory numerical methods and emphasizes techniques of programming in FORTRAN 77 and developing subprograms using FORTRAN functions and subroutines In this way the book serves as an introduction to using powerful mathematical subroutine libraries Over 40 main programs are provided in the text and all subroutines are listed in the Appendix Each main program is presented with a sample data set and output and all FORTRAN programs and subroutines described in the text can be obtained on disk from the publisher Numerical Methods for Engineers A Programming Approach is an excellent choice for undergraduates in all engineering disciplines providing a much needed bridge between classical mathematics and computer code based techniques

Recent Advances In Numerical Methods And Applications II - Proceedings Of The Fourth International Conference Panayot S Vassilevski, Blagovest H Sendov, Oleg P Iliev, Mikhail S Kaschiev, Svetozar D Margenov, 1999-07-05 This volume contains the proceedings of the 4th International Conference on Numerical Methods and Applications The major topics covered include general finite difference finite volume finite element and boundary element methods general numerical linear algebra and parallel computations numerical methods for nonlinear problems and multiscale methods multigrid and domain decomposition methods CFD computations mathematical modeling in structural mechanics and environmental and engineering applications The volume reflects the current research trends in the specified areas of numerical methods and their applications

**Numerical Methods and Optimization in Finance** Manfred Gilli, Dietmar Maringer, Enrico Schumann, 2019-08-16 Computationally intensive tools play an increasingly important role in financial decisions Many financial problems ranging from asset allocation to risk management and from option pricing to model calibration can be efficiently handled using modern computational techniques Numerical Methods and Optimization in Finance presents such computational techniques with an emphasis on simulation and optimization particularly so called heuristics This book treats quantitative analysis as an essentially computational discipline in which applications are put into software form and tested empirically This revised edition includes two new chapters a self contained tutorial on implementing and using heuristics and an explanation of software used for testing portfolio selection models Postgraduate

students researchers in programs on quantitative and computational finance and practitioners in banks and other financial companies can benefit from this second edition of Numerical Methods and Optimization in Finance *Numerical Methods, 4th* J. Douglas Faires, Richard L. Burden, 2012-04-23

**NUMERICAL METHODS** Fourth Edition emphasizes the intelligent application of approximation techniques to the type of problems that commonly occur in engineering and the physical sciences Students learn why the numerical methods work what kinds of errors to expect and when an application might lead to difficulties The authors also provide information about the availability of high quality software for numerical approximation routines The techniques are the same as those covered in the authors top selling Numerical Analysis text but this text provides an overview for students who need to know the methods without having to perform the analysis This concise approach still includes mathematical justifications but only when they are necessary to understand the methods The emphasis is placed on describing each technique from an implementation standpoint and on convincing the student that the method is reasonable both mathematically and computationally Important Notice Media content referenced within the product description or the product text may not be available in the ebook version **Applied Numerical Methods Using MATLAB** Won Y. Yang, Wenwu Cao, Jaekwon Kim, Kyung W. Park, Ho-Hyun Park, Jingon Joung, Jong-Suk Ro, Han L. Lee, Cheol-Ho Hong, Taeho Im, 2020-05-12

This new edition provides an updated approach for students engineers and researchers to apply numerical methods for solving problems using MATLAB This accessible book makes use of MATLAB software to teach the fundamental concepts for applying numerical methods to solve practical engineering and or science problems It presents programs in a complete form so that readers can run them instantly with no programming skill allowing them to focus on understanding the mathematical manipulation process and making interpretations of the results **Applied Numerical Methods Using MATLAB Second Edition** begins with an introduction to MATLAB usage and computational errors covering everything from input output of data to various kinds of computing errors and on to parameter sharing and passing and more The system of linear equations is covered next followed by a chapter on the interpolation by Lagrange polynomial The next sections look at interpolation and curve fitting nonlinear equations numerical differentiation integration ordinary differential equations and optimization Numerous methods such as the Simpson Euler Heun Runge kutta Golden Search Nelder Mead and more are all covered in those chapters The eighth chapter provides readers with matrices and Eigenvalues and Eigenvectors The book finishes with a complete overview of differential equations Provides examples and problems of solving electronic circuits and neural networks Includes new sections on adaptive filters recursive least squares estimation Bairstow s method for a polynomial equation and more Explains Mixed Integer Linear Programing MILP and DOA Direction of Arrival estimation with eigenvectors Aimed at students who do not like and or do not have time to derive and prove mathematical results **Applied Numerical Methods Using MATLAB Second Edition** is an excellent text for students who wish to develop their problem solving capability without being involved in details about the MATLAB codes It will also be useful to

those who want to delve deeper into understanding underlying algorithms and equations

**Innovative Numerical Methods in Engineering** Richard Paul Shaw, 1986

**Numerical Methods Using MathCAD** Laurene V. Fausett, 2002

This book presents the fundamental numerical techniques used in engineering applied mathematics computer science and the physical and life sciences in a way that is both interesting and understandable Using a wide range of examples and problems this book focuses on the use of MathCAD functions and worksheets to illustrate the methods used when discussing the following concepts solving linear and nonlinear equations numerical linear algebra numerical methods for data interpolation and approximation numerical differentiation and integration and numerical techniques for solving differential equations For professionals in the fields of engineering mathematics computer science and physical or life sciences who want to learn MathCAD functions for all major numerical methods

*Numerical Methods in Offshore Engineering* O. C. Zienkiewicz, Roland Wynne Lewis, Kenneth Geoffrey Stagg, 1978

**Numerical Methods Using Matlab** John E. T. Penny, George R. Lindfield, 2000

Ideal for those in science and industry this state of the art guide to using MATLAB introduces readers to a wide range of numerical algorithms implemented by this modern and powerful computer software with full explanations of their fundamental principles and clear visual interpretation of results using MATLAB graphics Provides clear visual interpretation of results using MATLAB graphics and discusses the solution of linear equations and eigenvalue problems methods for solving non linear equations numerical integration and differentiation the solution of initial value and boundary value problems curve fitting including splines least squares and Fourier analysis Integrates developing computer technology through all algorithms and scripts encourages systematic experimentation and offers a thorough hands on study of MATLAB functions that includes optimization and regression analysis with applications of symbolic methods For electrical engineers

*Numerical Methods Using Matlab 4Th Ed.* Mathews & Fink, 2005

**Design and Optimization of Thermal Systems, Third Edition** Yogesh Jaluria, 2019-09-06

Design and Optimization of Thermal Systems Third Edition with MATLAB Applications provides systematic and efficient approaches to the design of thermal systems which are of interest in a wide range of applications It presents basic concepts and procedures for conceptual design problem formulation modeling simulation design evaluation achieving feasible design and optimization Emphasizing modeling and simulation with experimentation for physical insight and model validation the third edition covers the areas of material selection manufacturability economic aspects sensitivity genetic and gradient search methods knowledge based design methodology uncertainty and other aspects that arise in practical situations This edition features many new and revised examples and problems from diverse application areas and more extensive coverage of analysis and simulation with MATLAB

**28th AIAA Fluid Dynamics Conference, 4th AIAA Shear Flow Control Conference**, 1997

*Bulletin (new Series) of the American Mathematical Society*, 1897

4th AIAA Theoretical Fluid Mechanics Meeting: 05-4669 - 05-4941, 2005

**Mathematical Analysis and Numerical Methods for Science and Technology** Robert Dautray, Jacques-Louis

Lions,2012-12-06 The advent of high speed computers has made it possible for the first time to calculate values from models accurately and rapidly Researchers and engineers thus have a crucial means of using numerical results to modify and adapt arguments and experiments along the way Every facet of technical and industrial activity has been affected by these developments The objective of the present work is to compile the mathematical knowledge required by researchers in mechanics physics engineering chemistry and other branches of application of mathematics for the theoretical and numerical resolution of physical models on computers Since the publication in 1924 of the Methoden der mathematischen Physik by Courant and Hilbert there has been no other comprehensive and up to date publication presenting the mathematical tools needed in applications of mathematics in directly implementable form      **Numerical Methods with Fortran IV Case Studies** William S. Dorn,Daniel D. McCracken,1972      **Numerical Methods:** Ram,2010 Numerical Methods is a mathematical tool used by engineers and mathematicians to do scientific calculations It is used to find solutions to applied problems where ordinary analytical methods fail This book is intended to serve for the needs of co      **Lectures on Clinical Medicine** Armand Trousseau,1873      Clinical Medicine Armand Trousseau,1882

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