

Numerical Methods Lecture 5 - Curve Fitting Techniques

Topics

motivation
interpolation
linear regression
higher order polynomial form
exponential form

Curve fitting - motivation

For root finding, we used a given function to identify where it crossed zero
where does $f(x) = 0$??

Q: Where does this given function $f(x)$ come from in the first place?

- Analytical models of phenomena (e.g. equations from physics)
- Create an equation from observed data

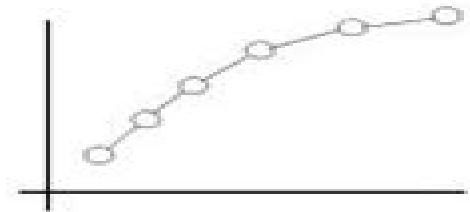
1) Interpolation (connect the data-dots)

If data is reliable, we can plot it and connect the dots

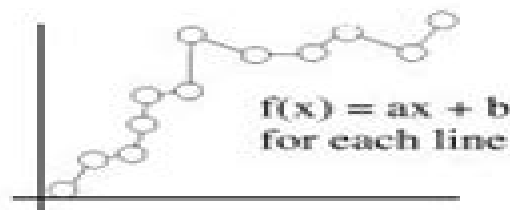
This is piece-wise, linear interpolation

This has limited use as a general function $f(x)$

Since its really a group of small $f(x)$ s, connecting one point to the next it doesn't work very well for data that has built in random error (scatter)

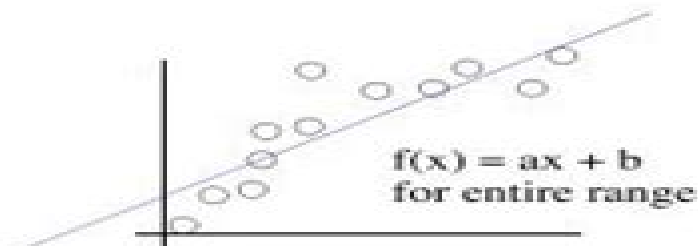


2) Curve fitting - capturing the trend in the data by assigning a single function across the entire range.
The example below uses a straight line function



Interpolation

$f(x) = ax + b$
for each line



Curve Fitting

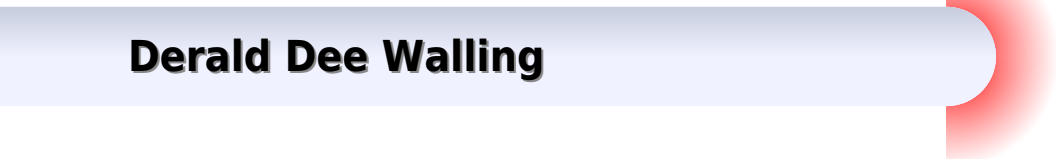
$f(x) = ax + b$
for entire range

A straight line is described generically by $f(x) = ax + b$

The goal is to identify the coefficients 'a' and 'b' such that $f(x)$ 'fits' the data well

Numerical Methods Of Curve Fitting

Derald Dee Walling



Numerical Methods Of Curve Fitting:

Numerical Methods of Curve Fitting P. G. Guest, Philip George Guest, 2012-12-13 This 1961 book provides information on the methods of treating series of observations the field covered embraces portions of both statistics and numerical analysis

Numerical Methods of Curve Fitting Philip George Guest, 2003-01 **Numerical methods of curve fitting** P. G. Guest, 1961 Numerical Methods of Curve Fitting Paul Gordon Guest, 1961 Numerical Methods for Non-linear Least Squares Curve Fitting Derald Dee Walling, 1963 A Least-square Distance Curve-fitting Technique John Q. Howell, 1971

Numerical Methods with C++ Programming NITA H. SHAH, 2008-12-15 The rapid development of high speed digital computers and the increasing desire for numerical answers to applied problems have led to increased demands in the courses dealing with the methods and techniques of numerical analysis Numerical methods have always been useful but their role in the present day scientific research has become prominent For example they enable one to find the roots of transcendental equations and in solving nonlinear differential equations Indeed they give the solution when ordinary analytical methods fail This well organized and comprehensive text aims at enhancing and strengthening numerical methods concepts among students using C programming a fast emerging preferred programming language among software developers The book provides an synthesis of both theory and practice It focuses on the core areas of numerical analysis including algebraic equations interpolation boundary value problem and matrix eigenvalue problems The mathematical concepts are supported by a number of solved examples Extensive self review exercises and answers are provided at the end of each chapter to help students review and reinforce the key concepts KEY FEATURES C programs are provided for all numerical methods discussed More than 400 unsolved problems and 200 solved problems are included to help students test their grasp of the subject The book is intended for undergraduate and postgraduate students of Mathematics Engineering and Statistics Besides students pursuing BCA and MCA and having Numerical Methods with C Programming as a subject in their course will benefit from this book **Numerical Methods for Experimental Mechanics** Donald

Berghaus, 2013-11-27 The purpose of this book is to place a resource in the hands of experimental mechanics researchers to enable them to understand and to obtain a working familiarity with certain of the numerical methods particularly useful to the field The book is organized to permit readers to study the methods and to observe their application in experimental problems It is also intended to encourage readers to directly apply the methods to the same problems or to similar problems of their choosing To this end computer programs are available electronically together with data for easy application Program listings are given in the appendix There are four chapters which make up the central coverage of the text The first of these deals with least square methods of problem solution both for curve fitting and for general solution of overdetermined problems Nonlinear least squares methods are included Secondly splines specifically smoothed splines are covered including specification of boundary conditions for the latter Use for differentiation is emphasized with attention to control of possible

excesses in smoothing Transform methods are the third major area covered both the Discrete Fourier Transform and the Fast Fourier Transform Their combined use is described for appropriate problems Finally digital filters are included principally the Butterworth low pass filter Coverage also includes different filter orders high pass filters and the two pass filter technique The author has had experience with the four areas covered and with all of the example problems described in the text

Encyclopedic Dictionary of Mathematics Nihon Sūgakkai, 1993 V 1 A N v 2 O Z Appendices and indexes

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 Programming 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

Numerical Techniques of Curve Fitting Using Orthogonal Polynomials James Paul Sharkey, 1970

Fundamentals of Computational Methods for Engineers Md. Masud Rana, Wei Xu, Youguang Guo, 2022-06-01 This textbook bridges the gap between introductory and advanced numerical methods for engineering students The book initially introduces readers to numerical methods before progressing to linear and nonlinear equations Next the book covers the topics of interpolation curve fitting and approximation integration differentiation and differential equations The book concludes with a chapter on advanced mathematical analysis which explains methods for finite difference

method of moments and finite elements The book introduces readers to key concepts in engineering such as error analysis algorithms applied mathematics with the goal of giving an understanding of how to solve engineering problems using computational methods Each of the featured topics is explained with sufficient detail while retaining the usual introductory nuance This blend of beginner friendly and applied information along with reference listings makes the textbook useful to students of undergraduate and introductory graduate courses in mathematics and engineering Dennis G. Zill, Warren S. Wright, 2009-12-21 Now with a full color design the new Fourth Edition of Zill's Advanced Engineering Mathematics provides an in depth overview of the many mathematical topics necessary for students planning a career in engineering or the sciences A key strength of this text is Zill's emphasis on differential equations as mathematical models discussing the constructs and pitfalls of each The Fourth Edition is comprehensive yet flexible to meet the unique needs of various course offerings ranging from ordinary differential equations to vector calculus Numerous new projects contributed by esteemed mathematicians have been added New modern applications and engaging projects makes Zill's classic text a must have text and resource for Engineering Math students

Computer Methods for Engineering with MATLAB Applications
Yogesh Jaluria, 2011-09-08 Substantially revised and updated Computer Methods for Engineering with MATLAB Applications Second Edition presents equations to describe engineering processes and systems It includes computer methods for solving these equations and discusses the nature and validity of the numerical results for a variety of engineering problems This edition now

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K. Akbar Ansari, Bonni Dichone, 2019 An Introduction to Numerical Methods using MATLAB is designed to be used in any introductory level numerical methods course It provides excellent coverage of numerical methods while simultaneously demonstrating the general applicability of MATLAB to problem solving This textbook also provides a reliable source of reference material to practicing engineers scientists and students in other junior and senior level courses where MATLAB can be effectively utilized as a software tool in problem solving The principal goal of this book is to furnish the background needed to generate numerical solutions to a variety of problems Specific applications involving root finding interpolation curve fitting matrices derivatives integrals and differential equations are discussed and the broad applicability of MATLAB demonstrated This book employs MATLAB as the software and programming environment and provides the user with powerful tools in the solution of numerical problems Although this book is not meant to be an exhaustive treatise on MATLAB MATLAB solutions to problems are systematically developed and included throughout the book MATLAB files and scripts are generated and examples showing the applicability and use of MATLAB are presented throughout the book Wherever appropriate the use of MATLAB functions offering shortcuts and alternatives to otherwise long and tedious numerical solutions is also demonstrated At the end of every chapter a set of problems is included covering the material presented A solutions manual to these exercises is available to instructors

Mine Planning and Equipment Selection 1995 J.

Hadjigeorgiou,A.K. Mehmotra,R. Poulin,R.K. Singhal,1995-10-31 This text presents about 150 papers based on an international symposium on mine planning and equipment selection held in Canada in 1995 Coverage includes design and planning of surface and underground mines surface mining and the environment tailings disposal and slope stability analysis

Engineering Optimization 2014 Hélder Rodrigues,José Herskovits,Christóvão Mota Soares,José Miranda Guedes,Aurelio Araujo,João Folgado,Filipa Moleiro,José Aguilar Madeira,2014-09-26 Optimization methodologies are fundamental instruments to tackle the complexity of today s engineering processes Engineering Optimization 2014 is dedicated to optimization methods in engineering and contains the papers presented at the 4th International Conference on Engineering Optimization ENGOPT2014 Lisbon Portugal 8 11 September 2014 The book will be of interest to engineers applied mathematicians and computer scientists working on research development and practical applications of optimization methods in engineering

Practical Numerical Methods with C# Jack Xu,2019 The second edition of this book builds all the code example within a single project by incorporating new advancements in C NET technology and open source math libraries It also uses C Interactive Window to test numerical computations without compiling or running the complete project code The second edition includes three new chapters including Plotting Fourier Analysis and Math Expression Parser As in the first edition this book presents an in depth exposition of the various numerical methods used in real world scientific and engineering computations It emphasizes the practical aspects of C numerical methods and mathematical functions programming and discusses various techniques in details to enable you to implement these numerical methods in your NET application Ideal for scientists engineers and students who would like to become more adept at numerical methods the second edition of this book covers the following content Overview of C programming The mathematical background and fundamentals of numerical methods plotting the computation results using a 3D chart control Math libraries for complex numbers and functions real and complex vector and matrix operations and special functions Numerical methods for generating random numbers and random distribution functions Various numerical methods for solving linear and nonlinear equations Numerical differentiation and integration Interpolations and curve fitting Optimization of single variable and multi variable functions with a variety of techniques including advanced simulated annealing and evolutionary algorithms Numerical techniques for solving ordinary differential equations Numerical methods for solving boundary value problems Eigenvalue problems Fourier analysis mathematical expression parser and evaluator In addition this book provides testing examples for every math function and numerical method to show you how to use these functions and methods in your own NET applications in a manageable and step by step fashion Please visit the author s website for more information about this book at <https://drxudotnet.com> <https://drxudotnet.com> and <https://gincker.com>

Julia Programming for Operations Research

Research Changhyun Kwon,2019-03-03 Last Updated December 2020 Based on Julia v1.3 and JuMP v0.21 The main motivation of writing this book was to help the author himself He is a professor in the field of operations research and his

daily activities involve building models of mathematical optimization developing algorithms for solving the problems implementing those algorithms using computer programming languages experimenting with data etc Three languages are involved human language mathematical language and computer language His team of students need to go over three different languages which requires translation among the three languages As this book was written to teach his research group how to translate this book will also be useful for anyone who needs to learn how to translate in a similar situation The Julia Language is as fast as C as convenient as MATLAB and as general as Python with a flexible algebraic modeling language for mathematical optimization problems With the great support from Julia developers especially the developers of the JuMP Julia for Mathematical Programming package Julia makes a perfect tool for students and professionals in operations research and related areas such as industrial engineering management science transportation engineering economics and regional science For more information visit <http://www.chkwon.net/julia>

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