

NUMERICAL METHODS

C / KAPPA EXAM 12 / 11/14 / 1002 / 20.000

LEAST SQUARES REGRESSION

Goal: Minimize the sum of the squares of the residual (errors)

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

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

$S_{xy} = \sum_{i=1}^n x_i y_i$ $S_{xx} = \sum_{i=1}^n x_i^2$

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

POLYNOMIAL QUADRATIC REGRESSION:

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

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

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

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

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

$C(A) \rightarrow [A] [X] = [Y]$

$S_y = \sqrt{\frac{1}{n-1} \sum (y_i - \bar{y})^2}$

data points $\rightarrow$ Advanced (Excel)

STANDARD ERROR:

$$S_y = \sqrt{\frac{S_y}{n-2}} \quad S_x = \sqrt{\frac{S_x - y^2}{n-2}}$$

STANDARD DEVIATION:

$$S_y = \sqrt{\frac{S_y}{n-1}} \quad S_x = \sqrt{\frac{S_x - y^2}{n-1}}$$

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

$$y = a_0 + a_1 x$$

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: $n = 1, 2, 3, 4$

TURNS: $n = 0, 1, 2, 3$

SPINES: $n = 1, 2, 3, 4$

ODE'S

CLASSIC METHOD:

$$\frac{dy}{dx} = f(x, y) \quad y_{n+1} = y_n + f(x_n, y_n) \Delta x$$

ROUN'S METHOD:

$$\frac{dy}{dx} = f(x, y) \quad y_{n+1} = y_n + f(x_n, y_n) \Delta x$$

$$\frac{dy}{dx} = f(x, y) \quad y_{n+1} = y_n + f(x_n, y_n) \Delta x$$

$$\frac{dy}{dx} = f(x, y) \quad y_{n+1} = y_n + f(x_n, y_n) \Delta x$$

$$y = \frac{y_1 + y_2}{2} + \frac{f(x_1, y_1) + f(x_2, y_2)}{2} \Delta x$$

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DEGREE 1

LINEAR: $y = a_0 + a_1 x$

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

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CLASSIC 1st ORDER RUNGE-KUTTA:

$$y_{n+1} = y_n + \frac{1}{2} (k_1 + k_2) \Delta x$$

$$k_1 = f(x_n, y_n)$$

$$k_2 = f(x_n + \frac{1}{2} \Delta x, y_n + \frac{1}{2} k_1 \Delta x)$$

$$k_3 = f(x_n + \frac{1}{2} \Delta x, y_n + \frac{1}{2} k_2 \Delta x)$$

$$k_4 = f(x_n + \Delta x, y_n + k_3 \Delta x)$$

$$y_{n+1} = y_n + \Delta x \frac{k_1 + 2k_2 + 2k_3 + k_4}{6}$$

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EIGEN VALUES

$\lambda = \text{eigen value}$

EXAMPLE:

$$\begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

THE CHARACTERISTIC EQUATION:

$$\begin{bmatrix} a_{11} - \lambda & a_{12} & a_{13} \\ a_{21} & a_{22} - \lambda & a_{23} \\ a_{31} & a_{32} & a_{33} - \lambda \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

$$\lambda = \frac{a_{11} + a_{22} \pm \sqrt{(a_{11} - a_{22})^2 + 4a_{12}a_{21}}}{2}$$

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Numerical Methods In Engineering Applied Science

M Mosston



Numerical Methods In Engineering Applied Science:

The book delves into Numerical Methods In Engineering Applied Science. Numerical Methods In Engineering Applied Science is a vital topic that needs to be grasped by everyone, ranging from students and scholars to the general public. The book will furnish comprehensive and in-depth insights into Numerical Methods In Engineering Applied Science, encompassing both the fundamentals and more intricate discussions.

1. This book is structured into several chapters, namely:
 - Chapter 1: Introduction to Numerical Methods In Engineering Applied Science
 - Chapter 2: Essential Elements of Numerical Methods In Engineering Applied Science
 - Chapter 3: Numerical Methods In Engineering Applied Science in Everyday Life
 - Chapter 4: Numerical Methods In Engineering Applied Science in Specific Contexts
 - Chapter 5: Conclusion
 2. In chapter 1, this book will provide an overview of Numerical Methods In Engineering Applied Science. This chapter will explore what Numerical Methods In Engineering Applied Science is, why Numerical Methods In Engineering Applied Science is vital, and how to effectively learn about Numerical Methods In Engineering Applied Science.
 3. In chapter 2, the author will delve into the foundational concepts of Numerical Methods In Engineering Applied Science. This chapter will elucidate the essential principles that need to be understood to grasp Numerical Methods In Engineering Applied Science in its entirety.
 4. In chapter 3, this book will examine the practical applications of Numerical Methods In Engineering Applied Science in daily life. This chapter will showcase real-world examples of how Numerical Methods In Engineering Applied Science can be effectively utilized in everyday scenarios.
 5. In chapter 4, this book will scrutinize the relevance of Numerical Methods In Engineering Applied Science in specific contexts. This chapter will explore how Numerical Methods In Engineering Applied Science is applied in specialized fields, such as education, business, and technology.
 6. In chapter 5, the author will draw a conclusion about Numerical Methods In Engineering Applied Science. This chapter will summarize the key points that have been discussed throughout the book.
- This book is crafted in an easy-to-understand language and is complemented by engaging illustrations. This book is highly recommended for anyone seeking to gain a comprehensive understanding of Numerical Methods In Engineering Applied Science.

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Numerical Methods In Engineering Applied Science Introduction

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