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Nota di contenuto	Mathematical Modeling and Simulation; Contents; Preface; 1 Principles of Mathematical Modeling; 1.1 A Complex World Needs Models; 1.2 Systems, Models, Simulations; 1.2.1 Teleological Nature of Modeling and Simulation; 1.2.2 Modeling and Simulation Scheme; 1.2.3 Simulation; 1.2.4 System; 1.2.5 Conceptual and Physical Models; 1.3 Mathematics as a Natural Modeling Language; 1.3.1 Input-Output Systems; 1.3.2 General Form of Experimental Data; 1.3.3 Distinguished Role of Numerical Data; 1.4 Definition of Mathematical Models; 1.5 Examples and Some More Definitions 1.5.1 State Variables and System Parameters1.5.2 Using Computer Algebra Software; 1.5.3 The Problem Solving Scheme; 1.5.4 Strategies to Set up Simple Models; 1.5.4.1 Mixture Problem; 1.5.4.2 Tank

Labeling Problem; 1.5.5 Linear Programming; 1.5.6 Modeling a Black Box System; 1.6 Even More Definitions; 1.6.1 Phenomenological and Mechanistic Models; 1.6.2 Stationary and Instationary models; 1.6.3 Distributed and Lumped models; 1.7 Classification of Mathematical Models; 1.7.1 From Black to White Box Models; 1.7.2 SQM Space Classification: S Axis; 1.7.3 SQM Space Classification: Q Axis
1.7.4 SQM Space Classification: M Axis1.8 Everything Looks Like a Nail?; 2 Phenomenological Models; 2.1 Elementary Statistics; 2.1.1 Descriptive Statistics; 2.1.1.1 Using Calc; 2.1.1.2 Using the R Commander; 2.1.2 Random Processes and Probability; 2.1.2.1 Random Variables; 2.1.2.2 Probability; 2.1.2.3 Densities and Distributions; 2.1.2.4 The Uniform Distribution; 2.1.2.5 The Normal Distribution; 2.1.2.6 Expected Value and Standard Deviation; 2.1.2.7 More on Distributions; 2.1.3 Inferential Statistics; 2.1.3.1 Is Crop A's Yield Really Higher?; 2.1.3.2 Structure of a Hypothesis Test
2.1.3.3 The t test2.1.3.4 Testing Regression Parameters; 2.1.3.5 Analysis of Variance; 2.2 Linear Regression; 2.2.1 The Linear Regression Problem; 2.2.2 Solution Using Software; 2.2.3 The Coefficient of Determination; 2.2.4 Interpretation of the Regression Coefficients; 2.2.5 Understanding LinRegEx1.r; 2.2.6 Nonlinear Linear Regression; 2.3 Multiple Linear Regression; 2.3.1 The Multiple Linear Regression Problem; 2.3.2 Solution Using Software; 2.3.3 Cross-Validation; 2.4 Nonlinear Regression; 2.4.1 The Nonlinear Regression Problem; 2.4.2 Solution Using Software
2.4.3 Multiple Nonlinear Regression2.4.4 Implicit and Vector-Valued Problems; 2.5 Neural Networks; 2.5.1 General Idea; 2.5.2 Feed-Forward Neural Networks; 2.5.3 Solution Using Software; 2.5.4 Interpretation of the Results; 2.5.5 Generalization and Overfitting; 2.5.6 Several Inputs Example; 2.6 Design of Experiments; 2.6.1 Completely Randomized Design; 2.6.2 Randomized Complete Block Design; 2.6.3 Latin Square and More Advanced Designs; 2.6.4 Factorial Designs; 2.6.5 Optimal Sample Size; 2.7 Other Phenomenological Modeling Approaches; 2.7.1 Soft Computing
2.7.1.1 Fuzzy Model of a Washing Machine

Sommario/riassunto

This concise and clear introduction to the topic requires only basic knowledge of calculus and linear algebra - all other concepts and ideas are developed in the course of the book. Lucidly written so as to appeal to undergraduates and practitioners alike, it enables readers to set up simple mathematical models on their own and to interpret their results and those of others critically. To achieve this, many examples have been chosen from various fields, such as biology, ecology, economics, medicine, agricultural, chemical, electrical, mechanical and process engineering, which are subsequently