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Heinz, Stefan

Mathematical modeling.

Berlin: Springer (ISBN 978-3-642-20310-7/hbk; 978-3-642-20311-4/ebook). xvi, 460 p. (2011).

The book under review is aimed at students in mathematics, physics, engineering, biology, chemistry, economics, finance. It is based on the material used by the author for teaching an undergraduate course "Introduction to Mathematical Modeling" and a graduate course "Deterministic and Stochastic Mathematical Modeling" over the past ten years. The essential prerequisites for the reader include basic algebra, single variable calculus, and acquaintance with a computer algebra system. Professor Heinz mentions that "examples for calculations that students should be able to perform after the explanation of the corresponding concepts are the plot of model functions in comparison to random data, the calculation of a probability density function, and the numerical solution of ordinary differential equations." The characteristic feature of this book is the parallel development of deterministic and stochastic modeling approaches. The author points out that "the consideration of stochastic methods enables a comprehensive understanding, for example, of the basis of optimal deterministic models and how closed deterministic equations can be obtained." This approach to mathematical modeling influences significantly the way the material is grouped and presented. In fact, all chapters in the book are practically paired up: Chapters 1 and 2 "Deterministic Analysis Observations" and "Stochastic Analysis Observations," Chapters 3 and 4 "Deterministic States" and "Stochastic States," Chapters 5 and 6 "Deterministic Changes" and "Stochastic Changes," Chapters 7 and 8 "Deterministic Evolution" and "Stochastic Evolution," Chapters 9 and 10 "Deterministic Multivariate Evolution" and "Stochastic Multivariate Evolution." In the Preface, Professor Heinz provides several useful ideas regarding organization of different courses based on the material included in the book. In particular, it is suggested to use the first four chapters for teaching an undergraduate course "Introduction to Mathematical Modeling," Chapters 5, 7, and 9 for teaching an undergraduate or graduate course "Deterministic Mathematical Modeling," and Chapters 6, 8, and 10 for teaching a graduate course "Stochastic Mathematical Modeling." The book is well-written, generously illustrated, and contains many carefully explained examples that are often based on real data. Each chapter starts with a brief "Motivation" section and concludes with a "Summary" that emphasizes the most important ideas and techniques. There are 570 exercise questions in the text organized in 220 problems; detailed solutions to all questions are given in the Instructor's Solutions Manual provided to instructors by the publisher upon request. In the final part of the book, the reader can find a substantial list of references, author and subject indices, as well as a brief information about the author. This textbook nicely complements existing literature on mathematical modeling and can be used both as a main source or as a supplementary text for a variety of courses in applied mathematics and mathematical modeling.

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