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BOOK REVIEWS

Growth and Diffusion Phenomena: Mathematical Frameworks and Applications, Robert B. Banks, Springer-Verlag, New York, 1994. $49.00 (cloth), 455 pp.

While the purpose of a textbook is to inform, a good one also imparts a style and approach for tackling a subject. This is particularly valid to texts in applied mathematics: A good text attempts to teach students powerful mathematical ways to understand their world. In his introduction to the 14th Springer-Verlag Text in Applied Math, *Growth and Diffusion Phenom ena: Mathematical Frameworks and Applications*, Robert B. Banks states that his major purpose is to "amalgamate some of the many advances.., on topics relating to growth and diffusion phenomena." To this end he successfully informs the reader of many interesting advances in the theory of single-species growth and diffusion. While the focus of the book is on applications rather than on applied mathematical methods, the approach, however, is more that of cataloging than of enquiring. The book fails to give us examples of the full scientific process, never guiding us from the beginning scientific question to the observations and proposed mechanism before discussing the mathematical model itself with results, numerics and data comparisons. This is not to say that the book lacks in-depth examples; there are 64 very interesting applications, about half of which relate to biological problems. However, because the book is structured about a progression of mathematical frameworks, ranging from exponential growth to nonlinear growth with diffusion, the focus is not on the scientific questions, observations and proposed mechanisms, but rather is on the 206 BOOK REVIEWS mathematical models, results and data comparisons. Thus the accent on the last three stages of scientific process and the diminished focus on the first three make the book more suitable as a useful reference than as a text on how to apply mathematics to problems involving growth and movement.

The book begins with a detailed analysis of exponential and logistic growth, with and without migration and harvesting. The connection is made between exact solutions to nonlinear growth equations and cumulative distributions for density functions. This permits the reader to focus on the relationships between the assumptions that go into the nonlinear model and the distribution functions that can be fitted to data. Here, and through- out the book, the examples are clearly presented and are drawn from a wide spectrum of subjects ranging from technology transfer to tumor growth. While the focus is on single-species models, the phase plane is visited several times throughout the book, in the context of epidemics near the end of Chapter 2, for example, and in the context of sinusoidally variable carrying capacities in Chapter 5. Considerable attention is given to time-dependent growth coefficients and carrying capacities, as well as discrete and distributed time delays. The penultimate chapter addresses diffusion processes, diffusion-reaction equations and traveling waves. The book concludes with elaborations on some earlier subjects and a brief introduction to ideas for further enquiry. Throughout are many numerical examples and comparisons with real data drawn from a great variety of sources.

Growth and Diffusion represents a wealth of detail on the analysis of equations for growth of a single species in continuous space and time. It is written clearly and is easy to read. The level of mathematical sophistication needed to comprehend the material is fairly low--an upper level under- graduate understanding of ordinary differential equations, partial differential equations and complex variables and a facility for working through the algebra should suffice.

The major drawback of the book is its limited scope. It does not have the full modeling pedagogy needed to teach students how to use mathematics to answer questions about the world around them. In addition, many of the current areas of exciting research such as multi-species interactions, dis-crete time and/or space models and dynamics in two and three space dimensions are not included. For those already doing research in the field, however, Growth and Diffusion is likely to be a very useful reference book.

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