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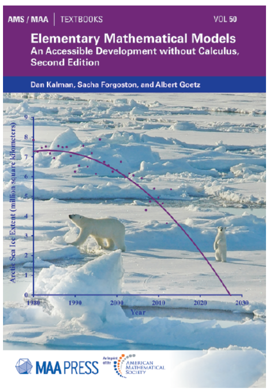


Elementary Mathematical Models

An Accessible Development without Calculus, Second Edition

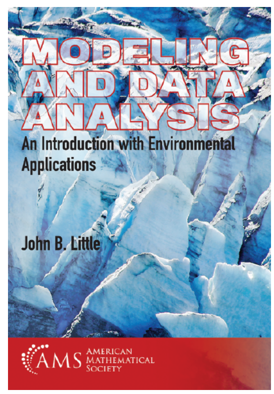
By Dan Kalman, Sacha Forgoston, and Albert Goetz

Each year tens of thousands of college students take the last mathematics course of their lives. For many students who do not plan to pursue a degree in STEM, that course is a class in college algebra, or liberal arts mathematics, or quantitative reasoning. These are great final mathematical experiences; each serves a valid, indeed potentially noble, purpose.

Dan Kalman, lead author of *Elementary Mathematical Models*, suggests an alternative, equally noble in intent, terminal mathematics course. Kalman argues that we could teach students, who have an interest in science but no future plans to study it, how to understand scientific arguments based on mathematical models.

The book focuses on very simple classes of mathematical models of growth: linear, quadratic, exponential, logistic. All of the models are presented as simple difference equations and analyzed symbolically and graphically. Thus the mathematical content matter has considerable overlap with a college algebra or precalculus course, and students develop a degree of mastery over the elementary functions and their properties. But this facility is not developed as an end in itself, instead always with the greater purpose of understanding a model of some scientific phenomenon.

There are, literally, hundreds of modeling scenarios in the book. And the modeling is practiced realistically; we usually start with a very rudimentary growth model based on actual data. Gradually layers of adjustment and nuance are added. Always the reader is asked to consider questions of legitimacy: Does this assumption make sense? Does this result accord with your physical intuition? Is it realistic to use these twenty years of data to predict three centuries into the future? The authors try to use data from scenarios that students will care about: public health, ecology, climate science. The polar sea ice data they present can be modeled either linearly or quadratically. Which makes more sense? Which fits better? The goal is not to train students in the creation of mathematical models. The goal is to create informed consumers of the conclusions of applied mathematics.



Modeling and Data Analysis

An Introduction with Environmental Applications

By John B. Little

John Little's book shares the noble goal of training future consumers of and participants in scientific arguments using mathematical modeling as in Kalman et al.'s *Elementary Mathematical Models*. But *Modeling and Data Analysis* restricts its attention to models of environmental phenomena. Little's intent is for his readers to understand the predictions and limitations of a mathematical model of the physical environment, to be able to communicate that understanding, and thereby be able to take part in informed public decision-making about critical environmental issues. Little is not political; he does not take a position on the human contribution to climate change or the desirability of nuclear power replacing coal. But he wants his students to be participants in an informed, scientifically and mathematically accurate, public discussion in contrast with the current "debate" in the US.

Modeling and Data Analysis focuses exclusively on models that do not require knowledge of calculus. In addition to difference equations and linear, exponential, and power law growth models—topics also covered in *Elementary Mathematical Models*—Little includes elementary topics in data science and statistics. Each chapter of *Modeling and Data Analysis* concludes with a substantial project intended for teams of students. The chapter on linear models, for example, asks students to model carbon dioxide concentration in the atmosphere by using sixty years' worth of data collected at Mauna Loa Observatory by the NOAA. The chapter on difference equations has students build a compartment model for the planet's carbon cycle.

Either one of these books would form the basis for an extremely valuable and interesting introduction to modeling. There is a good argument that such a course should be more widely taught.

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