Part III
Dynamical Systems

Chapters 5–7 provide a treatment of dynamical systems, beginning with one-variable discrete and continuous equations in Chapter 5, progressing to discrete linear systems in Chapter 6, and concluding with nonlinear continuous systems in Chapter 7. It is easy to see how to interpret discrete systems and use them for simulations. Their advantages end there; the remaining advantages lie with continuous models. Continuous systems have superior graphical methods and simpler mathematical properties. These advantages, which will become apparent in Chapter 5, more than offset the initial advantages of discrete models. In general, one should only use discrete models when synchronicity of events dictates discrete time.

The importance of good nondimensionalization of models is a recurring theme. This is one additional advantage of continuous models, which allow for nondimensionalization of time. At minimum, nondimensionalization reduces the number of parameters requiring estimated values for simulation or study in analysis. Beyond that, it can sometimes be used to reduce the number of essential components in a model. As will be seen in Chapter 7 in particular, analysis of models becomes more difficult as the number of components increases, and graphical methods are generally limited to one-component discrete models and two-component continuous models. Any reader who has skipped Section 2.6 so as to get to this point sooner is strongly urged to go back and study that section in detail before continuing.

The reader should have noticed that there is no mention of discrete nonlinear models in the description of the chapters in this part. I have not omitted these models entirely, but have relegated them to an appendix. This choice makes the material accessible to those who need it, while de-emphasizing it according to the author's professional judgment.

The accompanying sketch shows the interdependencies of the sections in Part III and connections to prerequisite topics.