

Preface

In mathematics you do not understand things. You just get used to them.

John L. Von Neumann (1903–1957).

We are servants rather than masters in mathematics.

Charles Hermit (1822–1901).

A mathematical model is an equation or a system of equations used to describe a natural phenomenon. Many researchers study the qualitative behavior of nonlinear delay mathematical models in a single species and also species with interactions. The qualitative analysis of delay models with constant coefficients (autonomous models) has been studied extensively. We know that the variation of the environment plays an important role in many biological and ecological dynamical systems. For example, physical environment conditions such as temperature and humidity and availability of food, water, and other resources usually vary in time with seasonal or daily variation. Therefore, more realistic models would be nonautonomous systems. One of the purposes of our book is to study oscillation and global stability of specific types of nonautonomous delay models in biology. In particular, our book presents recent research results on the qualitative behavior of mathematical models in biology.

The book consists of six chapters and is organized as follows:

In Chap. 1, we discuss the derivation and extensions of logistic models and some of their applications. This chapter also contains some useful results from mathematical analysis which are needed throughout the book.

In Chap. 2, we are concerned with oscillation and nonoscillation of different types of delay logistic models and their modified forms. In particular, we study the oscillation of models of Hutchinson type, models with delayed feedback, α -delay logistic models, α -delay models with several delays, models with nonlinear delays, hyperlogistic models, delay models with harvesting, and models with varying capacity.

In Chap. 3, we discuss the local and global stability of different types of delay logistic models. In particular, we are concerned with the local and global stability of autonomous logistic models and the uniform and $3/2$ global stability of nonautonomous delay logistic models. Also we discuss a generalized logistic model and models with impulses.

In Chap. 4, we discuss autonomous and nonautonomous logistic models with piecewise arguments.

In Chap. 5, we discuss the oscillation of autonomous and nonautonomous “food-limited” population models with delay times and impulsive effects as well as the existence of periodic solutions. Also we study the $3/2$ global stability of the classical model and the $3/2$ uniform stability of a model with a parameter l . In addition, we discuss the global stability of models with impulses and more generalized models, “food-limited” population models with periodic coefficients, and the existence of periodic solutions.

In Chap. 6, we are concerned with oscillation, global stability, and periodicity of some diffusive logistic models. In particular, we present oscillation results of a diffusive Malthus model with several delays, oscillation results of an autonomous diffusive logistic model with a Neumann boundary condition (flux conditions), oscillation results of a nonautonomous diffusive logistic model with several delays and a Neumann boundary condition (flux conditions), global stability of the delay logistic diffusion model with a Neumann boundary condition, and periodicity and stability of a periodic diffusive logistic model of Volterra-type with instantaneous and delay effects.

We wish to express our thanks to our families and friends.

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Oscillation and Stability of Delay Models in Biology

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2014, X, 340 p., Hardcover

ISBN: 978-3-319-06556-4