

PART I

**MODELS OF CONTROLLED ECONOMIC
SYSTEMS**

Applied mathematical models can be categorized according to their various features: mathematical tools used, techniques of model construction, research goals, complexity of the real-world systems under investigation, and so on.

The following types of economic-mathematical models are usually marked out: deterministic and stochastic, continuous and discrete, static and dynamical, econometric and phenomenological, linear and nonlinear, multi-sector and low-sector (aggregated), models of economic growth and economic equilibrium, etc. In this textbook we mainly restrict our attention to *deterministic models of economic growth and development*.

We will classify the models under consideration in accordance with their *degree of detailing the real economic factors being considered* (aspects of real processes in an economic system). In so doing, the following types of economic-mathematical models should be emphasized:

- *Aggregate (low-sector) models of mathematical economics* describe the interaction among several (from two to ten) generalized homogeneous economic indices. Such models reflect nonlinear interconnections in an economic system and use production functions. They are described in the Chapters 2 and 3 of the textbook (their economic-ecological analogs are analyzed in the Chapters 10 and 11).
- *Multi-sector models of economic dynamics* take into consideration presence of various intermediate and final outputs for different industrial branches that produce these outputs (the models with disaggregated production output). Because a large number of the outputs being usually considered, such models describe only linear relations between the branches (a commonly accepted theory of nonlinear multi-sector models has not yet been developed). Brief description of the linear multi-sector models is given in the Chapter 4 (an economic-ecological analogue is exposed in the Chapter 11).

- *Models of evolutionary (developing) economics* focus on description of disaggregated (heterogeneous) production resources (fixed assets, set of the technologies in use, capital equipment, labor force, etc.) and their evolution. The models are described by means of partial differential equations and integral equations (in continuous time) or their discrete analogues. In this book, we mainly concentrate on a well-known example of such models - *the models of technological change*. These models (in particular, their specific type - *the models with controlled lifetime of technologies*) are analyzed in the Chapters 5 and 6 (the economic-ecological analogies are discussed in the Chapter 12).