

Preface to the First Edition (1977)

This book is concerned with commonsense questions about, for instance, the effect of a lowered death rate on the proportion of old people or the effect of abortions on the birth rate. The answers that it reaches are not always commonsense, and we will meet instances in which intuition has to be adjusted to accord with what the mathematics shows to be the case. Even when the intuitive answer gives the right direction of an effect, technical analysis is still needed to estimate its amount. We may see intuitively that the drop from an increasing to a stationary population will slow the promotion for the average person in a factory or office, but nothing short of an integral equation can show that each drop of 1 percent in the rate of increase will delay promotion to middle-level positions by 2.3 years.

The aim has been to find answers that will be serviceable to those working on population and related matters, whether or not they care to go deeply into the mathematics behind the answers. My earlier book, *Introduction to the Mathematics of Population*, had the opposite purpose of developing the theory, and mentioned applications mostly to illuminate the theory. Because of their different objectives there is virtually no overlap between the two books.

Population theory has developed at a sufficiently fast rate and in enough directions that no book of reasonable size can include all of its applications. A full development of theory ought to recognize not only age-specific rates of birth and death but also two sexes and two or more species. Age-specific rates can vary through time, and the theory can be stochastic in allowing to each individual member of the population his own separate risk, or deterministic in supposing that whatever probability applies to each in-

dividual is also the fraction of the population that succumbs to the risk. Thus population theory can be classified into the 16 categories shown in the accompanying table. By far the largest part of what is taken up in this book falls into the upper left category: it deals with one sex, usually female, and one species, man; it takes the age-specific rates of birth and death as fixed through time; it is deterministic rather than stochastic. This upper left-hand cell is conceptually the simplest of the 16, and it is mathematically the most tractable. But are these decisive arguments for its emphasis, given that real populations include two sexes; human populations interact with other species; birth and death rates change through time; and all life is stochastic?

The art of theory construction is to start with simple assumptions and then to introduce greater realism, which means more complexity, as required. On the path from simplicity to realism one must stop at a compromise point. My taste may not always be that of my readers; they may often say that a particular model I use is too simple, that they need to take into account factors that I neglect. This line of criticism is welcome, even though it leads to further and more difficult mathematics.

Classification of population theory			
	Fixed rate		Changing rate
	Deterministic	Stochastic	Deterministic Stochastic
One sex			
One species		*	
Two or more species			
Two sexes			
One species			
Two or more species			

During 10 or more years of work on this book I have incurred more obligations than I can acknowledge or even remember. Students pointed out errors and obscurities; they helped in some cases by conspicuously failing to understand what I was saying and compelling me to think the matter through afresh. Colleagues looked at drafts and were generous with comments. Editors and referees of journals were helpful, especially Paul Demeny. No one is responsible for errors that remain but me.

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