



Evolutionary Dynamics: Exploring the Equations of Life

By Martin A. Nowak

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At a time of unprecedented expansion in the life sciences, evolution is the one theory that transcends all of biology. Any observation of a living system must ultimately be interpreted in the context of its evolution. Evolutionary change is the consequence of mutation and natural selection, which are two concepts that can be described by mathematical equations. *Evolutionary Dynamics* is concerned with these equations of life. In this book, **Martin A. Nowak** draws on the languages of biology and mathematics to outline the mathematical principles according to which life evolves. His work introduces readers to the powerful yet simple laws that govern the evolution of living systems, no matter how complicated they might seem.

Evolution has become a mathematical theory, Nowak suggests, and any idea of an evolutionary process or mechanism should be studied in the context of the mathematical equations of evolutionary dynamics. His book presents a range of analytical tools that can be used to this end: fitness landscapes, mutation matrices, genomic sequence space, random drift, quasispecies, replicators, the Prisoner's Dilemma, games in finite and infinite populations, evolutionary graph theory, games on grids, evolutionary kaleidoscopes, fractals, and spatial chaos. Nowak then shows how evolutionary dynamics applies to critical real-world problems, including the progression of viral diseases such as AIDS, the virulence of infectious agents, the unpredictable mutations that lead to cancer, the evolution of altruism, and even the evolution of human language. His book makes a clear and compelling case for understanding every living system—and everything that arises as a consequence of living systems—in terms of evolutionary dynamics.

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Editorial Review

Review

I read this book with huge enjoyment. It is wonderfully well presented, and offers a wide range of new insights into interesting and important and emerging topics in mathematical biology. The book will have a wide and enthusiastic readership. (Robert M. May, Professor of Zoology, Oxford University)

This is a brilliant book by the master of his field. Simple, clear and profound on topics of major importance: cooperation, cancer, language, and HIV itself. You can only benefit by learning what Martin Nowak knows. (Robert Trivers, Professor of Anthropology and Biological Sciences, Rutgers University, and co-author of *Genes in Conflict*)

Martin Nowak has injected rigor and new ideas into the study of the evolution of language and cooperation. This book is brimming with insights and surprising findings and should be of interest to anyone who is curious about these topics. (Steven Pinker, Johnstone Professor of Psychology, Harvard University, and author of *The Language Instinct, Words and Rules: The Ingredients of Language*, and *How the Mind Works*)

Martin Nowak is undeniably a great artist, working in the medium of mathematical biology... Nowak has seemingly effortlessly produced a stream of remarkable theoretical explorations into areas as diverse as the evolution of language, cooperation, cancer and the progression from HIV infection to AIDS. *Evolutionary Dynamics*, based on a course he gives at Harvard, is a comprehensive summary of this work... This is a unique book. It should be on the shelf of anyone who has, or thinks they might have, an interest in theoretical biology. (Sean Nee *Nature* 2006-11-01)

The lucid presentation, drawing frequently on the author's own research, provides a uniquely compelling introduction to mathematical biology. Nowak aims to demonstrate the power of simple mathematics to illuminate diverse aspects of evolutionary analysis... *Evolutionary Dynamics* provides a new generation with an opportunity to draw from the masters. (Steven A. Frank *Science* 2006-12-22)

The book will be a valuable resource both for those familiar with evolutionary dynamics and for those who are interested in learning the subject. (Ross Cressman *Mathematical Reviews* 2007-01-01)

Two of the crucial processes that drive evolution, mutation and selection, can be described with mathematical equations. This book introduces the reader to the basic mathematical laws that govern the evolution of life... This is a fascinating treatment of evolutionary theory, with many fresh insights. (S.E. *Southeastern Naturalist* 2007-12-01)

About the Author

Martin A. Nowak is Director of the Program for Evolutionary Dynamics and Professor of Mathematics and Biology at Harvard University.

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