Evolutionary Dynamics Exploring The Equations Of Life Ma Nowak

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Evolution and the Theory of Games - John Maynard Smith 1982-10-21
This 1982 book is an account of an alternative way of thinking about evolution and the theory of games.
Evolution, Games, and God - Martin A. Nowak 2013-05-07
Evolution, Games, and God explores how cooperation and altruism, alongside mutation and natural selection, play a critical role in evolution, from microbes to human societies. Inheriting a tendency to cooperate and self-sacrifice on behalf of others may be as beneficial to a population's survival as the self-preserving instincts of individuals.
Encyclopedia of Complexity and Systems Science - 2009-06-26
This encyclopedia provides an authoritative single source for

understanding and applying the concepts of complexity theory together with the tools and measures for analyzing complex systems in all fields of science and engineering. It links fundamental concepts of mathematics and computational sciences to applications in the physical sciences, engineering, biomedicine, economics and the social sciences.

The Calculus of Selfishness - Karl Sigmund 2016-05-31

This volume looks at social dilemmas where cooperative motivations are subverted and self-interest becomes self-defeating. Sigmund, a pioneer in evolutionary game theory, uses simple and well-known game theory models to examine the foundations of collective action and the effects of reciprocity and reputation.

Fundamentals of Evolutionary Game Theory and its Applications - Jun Tanimoto 2015-10-23

This book both summarizes the basic theory of evolutionary games and explains their developing applications, giving special attention to the 2-player, 2-strategy game. This game, usually termed a "2×2 game" in the jargon, has been deemed most important because it makes it possible to posit an archetype framework that can be extended to various applications for engineering, the social sciences, and even pure science fields spanning theoretical biology, physics, economics, politics, and information science. The 2×2 game is in fact one of the hottest issues in the field of statistical physics. The book first shows how the fundamental theory of the 2×2 game, based on so-called replicator dynamics, highlights its potential relation with nonlinear dynamical systems. This analytical approach implies that there is a gap between theoretical and reality-based prognoses observed in social systems of humans as well as in those of animal species. The book explains that this perceived gap is the result of an underlying reciprocity mechanism called social

viscosity. As a second major point, the book puts a sharp focus on network reciprocity, one of the five fundamental mechanisms for adding social viscosity to a system and one that has been a great concern for study by statistical physicists in the past decade. The book explains how network reciprocity works for emerging cooperation, and readers can clearly understand the existence of substantial mechanics when the term "network reciprocity" is used. In the latter part of the book, readers will find several interesting examples in which evolutionary game theory is applied. One such example is traffic flow analysis. Traffic flow is one of the subjects that fluid dynamics can deal with, although flowing objects do not comprise a pure fluid but, rather, are a set of many particles. Applying the framework of evolutionary games to realistic traffic flows, the book reveals that social dilemma structures lie behind traffic flow.

Branching Processes - Søren Asmussen 1983

Dynamics of Cancer - Dominik Wodarz 2014-04-24

The book aims to provide an introduction to mathematical models that describe the dynamics of tumor growth and the evolution of tumor cells. It can be used as a textbook for advanced undergraduate or graduate courses, and also serves as a reference book for researchers. The book has a strong evolutionary component and reflects the viewpoint that cancer can be understood rationally through a combination of mathematical and biological tools. It can be used both by mathematicians and biologists. Mathematically, the book starts with relatively simple ordinary differential equation models, and subsequently explores more complex stochastic and spatial models. Biologically, the book starts with explorations of the basic dynamics of tumor growth, including competitive interactions among cells, and subsequently moves on to the evolutionary dynamics of

cancer cells, including scenarios of cancer initiation, progression, and treatment. The book finishes with a discussion of advanced topics, which describe how some of the mathematical concepts can be used to gain insights into a variety of questions, such as epigenetics, telomeres, gene therapy, and social interactions of cancer cells.
Contents:Teaching GuideCancer and Somatic EvolutionMathematical Modeling of TumorigenesisBasic Growth Dynamics and Deterministic Models:Single Species GrowthTwo-Species Competition DynamicsCompetition Between Genetically Stable and Unstable CellsChromosomal Instability and Tumor GrowthAngiogenesis Inhibitors, Promoters, and Spatial GrowthEvolutionary Dynamics and Stochastic Models:Evolutionary Dynamics of Tumor Initiation Through Oncogenes: The Gain-of-Function ModelEvolutionary Dynamics of Tumor Initiation Through Tumor-Suppressor Genes: The Loss-of-Function Model and Stochastic TunnelingMicrosatellite and Chromosomal Instability in Sporadic and Familial Colorectal CancersEvolutionary Dynamics in Hierarchical PopulationsSpatial Evolutionary Dynamics of Tumor InitiationComplex Tumor Dynamics in SpaceStochastic Modeling of Cellular Growth, Treatment, and Resistance GenerationEvolutionary Dynamics of Drug Resistance in Chronic Myeloid LeukemiaAdvanced Topics:Evolutionary Dynamics of Stem-Cell Driven Tumor GrowthTumor Growth Kinetics and Disease ProgressionEpigenetic Changes and the Rate of DNA MethylationTelomeres and Cancer ProtectionGene Therapy and Oncolytic Virus TherapyImmune Responses, Tumor Growth, and TherapiesTowards Higher Complexities: Social Interactions Readership: Researchers in mathematical

biology, mathematical modeling, biology, mathematical oncology. Keywords:Mathematical Oncology;Dynamics;Evolution; Evolutionary Dynamics;Cancer;Mathematical Models;Somatic Evolution;TeachingKey Features:Both a reference book for the topic, and provides material for undergraduate and graduate coursesTries to bridge the divide between mathematicians and biologists, which is also reflected in the backgrounds of the two authorsShows how mathematical concepts can be translated into experimentally and clinically useful insightsRooted in evolutionary biology, the book handles this very complex phenomenon in an intuitive and mathematically elegant wayContains problems and research projects for each topic10 pages of figures in color

Darwin's Conjecture - Geoffrey M. Hodgson 2010-12
A theoretical study dealing chiefly with matters of definition and clarification of terms and concepts involved in using Darwinian notions to model social phenomena.

Integrated Genomics - Guy A. Caldwell 2006-08-04
Integrated Genomics: A Discovery-Based Laboratory Course introduces the excitement of discovery to the basic molecular biology laboratory. Utilizing up-to-date molecular biology protocols and a basic experimental design, this text offers experience with three different model systems. Students will become familiar with the simplicity and power of single-celled organisms, Escherichia coli and Saccharomyces cerevisiae, as they search for genes that interact and function within the nematode Caenorhabditis elegans. Incorporated throughout the course are exercises designed to offer students familiarity with the wealth of bioinformatics data that can be accessed on the World Wide Web. Following completion of interaction studies within the yeast, the course is designed to allow students to examine the

functional consequences of reducing a gene's function within the multicellular worm that is both simple and inexpensive to maintain within a laboratory. The inclusion of alternative experiments allow for flexibility in determining the ending date or goal of the laboratory, as well as working within the available budget and resources of most any classroom environment. Further striking features of this title are: An accompanying Web site providing PowerPoint slides, plus links to the internet, and regular updates as bioinformatics databases evolve and methods improve. www.wiley.com/go/caldwell Inclusion of modern genomic/proteomic technologies such as the yeast two-hybrid system and RNAi Detailed experimental protocols and easy access to instructional materials This discovery-based laboratory course provides excellent practical training for those pursuing career paths in biomedicine, pharmacy, and biotechnology.

Evolutionary Dynamics - Martin A. Nowak 2006-09-29

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.

Super Cooperators - Martin A. Nowak 2012

Beyond The Survival of the Fittest: Why Cooperation, not Competition, is the Key to LifeIf life is about survival of the fittest, then why would we risk our own life to jump into a river to save a stranger? Some people argue that issues such as charity, fairness, forgiveness and cooperation are evolutionary loose ends, side issues that are of little consequence. But as Harvard's celebrated evolutionary biologist Martin Nowak explains in this groundbreaking and controversial book, cooperation is central to the four-billion-year-old puzzle of life. Indeed, it is cooperation not competition that is the defining human trait.

Adventures in Modeling - Vanessa Stevens Colella 2001

Have you ever wondered how birds flock or forest fires spread? For thousands of years people - from DaVinci to Einstein - have created models to help them better understand patterns and processes in the world around them. Computers make it easier for novices to build and explore their own models - and learn new

scientific ideas in the process. Adventures in Modeling introduces you and your students to designing, creating, and investigating models in StarLogo. Computer modeling, the use of computer programs to simulate complex, dynamic systems or events (like population growth or environmental conservation), is a powerful learning tool that is finding a rapidly growing audience among teachers in middle and high school science and mathematics classes, especially since the NCTM Standards 2000 advocates its use in the curriculum. This valuable resource: Provides educators with a rich and accessible introduction to the use of computer modeling in the classroom using the popular StarLogo computer programming language; Takes readers step-by-step through the process of using computer models to simulate complex relationships; Shows how and why computer modeling can lead to powerful and enduring learning outcomes for all students. Provides explicit links between various state and national math and science content standards and the use of computer models, to enable educators to see how this work may enhance standards-based instruction; As computer use gains in currency and value in the middle and high school classroom, Adventures in Modeling will give teachers and students a very effective way to build curiosity and boost learning outcomes in a standards-based curriculum.

Game Theory in Biology - John M. McNamara 2020-09-24

The principles of game theory apply to a wide range of topics in biology. This book presents the central concepts in evolutionary game theory and provides an authoritative and up-to-date account. The focus is on concepts that are important for biologists in their attempts to explain observations. This strong connection between concepts and applications is a recurrent theme throughout the book which incorporates recent and traditional ideas from animal psychology, neuroscience, and

machine learning that provide a mechanistic basis for behaviours shown by players of a game. The approaches taken to modelling games often rest on idealized and unrealistic assumptions whose limitations and consequences are not always appreciated. The authors provide a novel reassessment of the field, highlighting how to overcome limitations and identifying future directions. Game Theory in Biology is an advanced textbook suitable for graduate level students as well as professional researchers (both empiricists and theoreticians) in the fields of behavioural ecology and evolutionary biology. It will also be of relevance to a broader interdisciplinary audience including psychologists and neuroscientists.

A Beautiful Math - Tom Siegfried 2006-09-21

Millions have seen the movie and thousands have read the book but few have fully appreciated the mathematics developed by John Nash's beautiful mind. Today Nash's beautiful math has become a universal language for research in the social sciences and has infiltrated the realms of evolutionary biology, neuroscience, and even quantum physics. John Nash won the 1994 Nobel Prize in economics for pioneering research published in the 1950s on a new branch of mathematics known as game theory. At the time of Nash's early work, game theory was briefly popular among some mathematicians and Cold War analysts. But it remained obscure until the 1970s when evolutionary biologists began applying it to their work. In the 1980s economists began to embrace game theory. Since then it has found an ever expanding repertoire of applications among a wide range of scientific disciplines. Today neuroscientists peer into game players' brains, anthropologists play games with people from primitive cultures, biologists use games to explain the evolution of human language, and mathematicians exploit games

to better understand social networks. A common thread connecting much of this research is its relevance to the ancient quest for a science of human social behavior, or a Code of Nature, in the spirit of the fictional science of psychohistory described in the famous Foundation novels by the late Isaac Asimov. In A Beautiful Math, acclaimed science writer Tom Siegfried describes how game theory links the life sciences, social sciences, and physical sciences in a way that may bring Asimov's dream closer to reality.

Holism and Evolution - Jan Christiaan Smuts 1926

Introduction to Evolutionary Computing - Agoston E. Eiben 2013-03-14

The first complete overview of evolutionary computing, the collective name for a range of problem-solving techniques based on principles of biological evolution, such as natural selection and genetic inheritance. The text is aimed directly at lecturers and graduate and undergraduate students. It is also meant for those who wish to apply evolutionary computing to a particular problem or within a given application area. The book contains quick-reference information on the current state-of-the-art in a wide range of related topics, so it is of interest not just to evolutionary computing specialists but to researchers working in other fields.

Information—Consciousness—Reality - James B. Glattfelder 2019-04-10

This open access book chronicles the rise of a new scientific paradigm offering novel insights into the age-old enigmas of existence. Over 300 years ago, the human mind discovered the machine code of reality: mathematics. By utilizing abstract thought systems, humans began to decode the workings of the cosmos. From this understanding, the current scientific paradigm emerged, ultimately discovering the gift of technology. Today, however, our island of knowledge is

surrounded by ever longer shores of ignorance. Science appears to have hit a dead end when confronted with the nature of reality and consciousness. In this fascinating and accessible volume, James Glattfelder explores a radical paradigm shift uncovering the ontology of reality. It is found to be information-theoretic and participatory, yielding a computational and programmable universe.

Fundamentals of Galaxy Dynamics, Formation and Evolution - Ignacio Ferreras 2019-04-02

Galaxies, along with their underlying dark matter halos, constitute the building blocks of structure in the Universe. Of all fundamental forces, gravity is the dominant one that drives the evolution of structures from small density seeds at early times to the galaxies we see today. The interactions among myriads of stars, or dark matter particles, in a gravitating structure produce a system with fascinating connotations to thermodynamics, with some analogies and some fundamental differences. Ignacio Ferreras presents a concise introduction to extragalactic astrophysics, with emphasis on stellar dynamics, and the growth of density fluctuations in an expanding Universe. Additional chapters are devoted to smaller systems (stellar clusters) and larger ones (galaxy clusters). Fundamentals of Galaxy Dynamics, Formation and Evolution is written for advanced undergraduates and beginning postgraduate students, providing a useful tool to get up to speed in a starting research career. Some of the derivations for the most important results are presented in detail to enable students appreciate the beauty of maths as a tool to understand the workings of galaxies. Each chapter includes a set of problems to help the student advance with the material.

Modeling Life - Alan Garfinkel 2017-09-06

This book develops the

mathematical tools essential for students in the life sciences to describe interacting systems and predict their behavior. From predator-prey populations in an ecosystem, to hormone regulation within the body, the natural world abounds in dynamical systems that affect us profoundly. Complex feedback relations and counter-intuitive responses are common in nature; this book develops the quantitative skills needed to explore these interactions. Differential equations are the natural mathematical tool for quantifying change, and are the driving force throughout this book. The use of Euler's method makes nonlinear examples tractable and accessible to a broad spectrum of early-stage undergraduates, thus providing a practical alternative to the procedural approach of a traditional Calculus curriculum. Tools are developed within numerous, relevant examples, with an emphasis on the construction, evaluation, and interpretation of mathematical models throughout. Encountering these concepts in context, students learn not only quantitative techniques, but how to bridge between biological and mathematical ways of thinking. Examples range broadly, exploring the dynamics of neurons and the immune system, through to population dynamics and the Google PageRank algorithm. Each scenario relies only on an interest in the natural world; no biological expertise is assumed of student or instructor. Building on a single prerequisite of Precalculus, the book suits a two-quarter sequence for first or second year undergraduates, and meets the mathematical requirements of medical school entry. The later material provides opportunities for more advanced students in both mathematics and life sciences to revisit theoretical knowledge in a rich, real-world framework. In all cases, the focus is clear: how does the math help us understand the science?

Evolutionary Dynamics - Martin

A. Nowak 2006-09-29
Draws on the languages of biology and mathematics to outline the mathematical principles according to which life evolves in an intriguing study that makes a clear and compelling case for understanding every living system in terms of evolutionary dynamics.

Eco-Evolutionary Dynamics - 2014-08-12
The theme of this volume is to discuss Eco-evolutionary Dynamics. Updates and informs the reader on the latest research findings Written by leading experts in the field Highlights areas for future investigation

Evolutionary Dynamics - Martin A. Nowak 2006-09-29
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.

Evolutionary Theory - Sean H. Rice 2004

Evolutionary Theory is for graduate students, researchers, and advanced undergraduates who want an understanding of the mathematical and biological reasoning that underlies evolutionary theory. The book covers all of the major theoretical approaches used to study the mechanics of evolution, including classical one- and two-locus models, diffusion theory, coalescent theory, quantitative genetics, and game theory. There are also chapters on theoretical approaches to the evolution of development and on multilevel selection theory. Each subject is illustrated by focusing on those results that have the greatest power to influence the way that we think about how evolution works. These major results are developed in detail, with many accompanying illustrations, showing exactly how they are derived and how the mathematics relates to the biological insights that they yield. In this way, the reader learns something of the actual machinery of different branches of theory while gaining a deeper understanding of the evolutionary process. Roughly half of the book focuses on gene-based models, the other half being concerned with general phenotype-based theory. Throughout, emphasis is placed on the fundamental relationships between the different branches of theory, illustrating how all of these branches are united by a few

basic, universal, principles. The only mathematical background assumed is basic calculus. More advanced mathematical methods are explained, with the help of an extensive appendix, when they are needed.

A Cooperative Species - Samuel Bowles 2013-07-21

Why do humans, uniquely among animals, cooperate in large numbers to advance projects for the common good? Contrary to the conventional wisdom in biology and economics, this generous and civic-minded behavior is widespread and cannot be explained simply by far-sighted self-interest or a desire to help close genealogical kin. In A Cooperative Species, Samuel Bowles and Herbert Gintis--pioneers in the new experimental and evolutionary science of human behavior--show that the central issue is not why selfish people act generously, but instead how genetic and cultural evolution has produced a species in which substantial numbers make sacrifices to uphold ethical norms and to help even total strangers. The authors describe how, for thousands of generations, cooperation with fellow group members has been essential to survival. Groups that created institutions to protect the civic-minded from exploitation by the selfish flourished and prevailed in conflicts with less cooperative groups. Key to this process was the evolution of social emotions such as shame and guilt, and our capacity to internalize social norms so that acting ethically became a personal goal rather than simply a prudent way to avoid punishment. Using experimental, archaeological, genetic, and ethnographic data to calibrate models of the coevolution of genes and culture as well as prehistoric warfare and other forms of group competition, A Cooperative Species provides a compelling and novel account of how humans came to be moral and cooperative.

Science, Music, And Mathematics: The Deepest Connections - Michael

Edgeworth Mcintyre 2021-11-03
Professor Michael Edgeworth McIntyre is an eminent scientist who has also had a part-time career as a musician. From a lifetime's thinking, he offers this extraordinary synthesis exposing the deepest connections between science, music, and mathematics, while avoiding equations and technical jargon. He begins with perception psychology and the dichotomization instinct and then takes us through biological evolution, human language, and acausality illusions all the way to the climate crisis and the weaponization of the social media, and beyond that into the deepest parts of theoretical physics — demonstrating our unconscious mathematical abilities.He also has an important message of hope for the future. Contrary to popular belief, biological evolution has given us not only the nastiest, but also the most compassionate and cooperative parts of human nature. This insight comes from recognizing that biological evolution is more than a simple competition between selfish genes. Rather, he suggests, in some ways it is more like turbulent fluid flow, a complex process spanning a vast range of timescales.Professor McIntyre is a Fellow of the Royal Society of London (FRS) and has worked on problems as diverse as the Sun's magnetic interior, the Antarctic ozone hole, jet streams in the atmosphere, and the psychophysics of violin sound. He has long been interested in how different branches of science can better communicate with each other and with the public, harnessing aspects of neuroscience and psychology that point toward the deep 'lucidity principles' that underlie skilful communication.

A Biologist's Guide to Mathematical Modeling in Ecology and Evolution - Sarah P. Otto 2011-09-19
Thirty years ago, biologists could get by with a rudimentary grasp of mathematics and modeling. Not so today. In seeking to

answer fundamental questions about how biological systems function and change over time, the modern biologist is as likely to rely on sophisticated mathematical and computer-based models as traditional fieldwork. In this book, Sarah Otto and Troy Day provide biology students with the tools necessary to both interpret models and to build their own. The book starts at an elementary level of mathematical modeling, assuming that the reader has had high school mathematics and first-year calculus. Otto and Day then gradually build in depth and complexity, from classic models in ecology and evolution to more intricate class-structured and probabilistic models. The authors provide primers with instructive exercises to introduce readers to the more advanced subjects of linear algebra and probability theory. Through examples, they describe how models have been used to understand such topics as the spread of HIV, chaos, the age structure of a country, speciation, and extinction. Ecologists and evolutionary biologists today need enough mathematical training to be able to assess the power and limits of biological models and to develop theories and models themselves. This innovative book will be an indispensable guide to the world of mathematical models for the next generation of biologists. A how-to guide for developing new mathematical models in biology Provides step-by-step recipes for constructing and analyzing models Interesting biological applications Explores classical models in ecology and evolution Questions at the end of every chapter Primers cover important mathematical topics Exercises with answers Appendixes summarize useful rules Labs and advanced material available

Darwinian Dynamics - Richard E. Michod 2000-01-30 In this book, Richard Michod offers a fresh, dynamical interpretation of evolution and fitness concepts. He argues that evolution has no enduring

products; what matters is the process of genetic change. Whereas many biologists have focused on competition and aggression as determining factors in survival, Michod, by concentrating on the emergence of individuality at new and more complex levels, finds that cooperation plays an even greater role.

SuperCooperators - Martin Nowak 2012-03-27

Examines the importance of cooperation in human beings and in nature, arguing that this social tool is as an important aspect of evolution as mutation and natural selection.

The Ant and the Peacock - Helena Cronin 1993-09-24

This book is a success story. It explains two long-running puzzles of the theory of natural selection. How can natural selection favour those, like the ant, that renounce tooth and claw in favour of the public-spirited ways of the commune? How can it explain the peacock's tail, flamboyant and a burden to its bearer; surely selection would act against useless ornamentation? Helena Cronin's enthralling account blends history, science and philosophy in a gripping tale that is scholarly, entertaining and eminently readable. The hardback edition was selected by Nature as one of the best scientific books in 1992. Also the New York Times chose it as one of their best books of 1992. The author divides her time between the Philosophy Department at the London School of Economics and the Zoology Department at Oxford.

Introduction to Mathematical Oncology - Yang Kuang 2018-09-03

Introduction to Mathematical Oncology presents biologically well-motivated and mathematically tractable models that facilitate both a deep understanding of cancer biology and better cancer treatment designs. It covers the medical and biological background of the diseases, modeling issues, and existing methods and their limitations. The authors introduce mathematical and programming tools, along with analytical and numerical

studies of the models. They also develop new mathematical tools and look to future improvements on dynamical models. After introducing the general theory of medicine and exploring how mathematics can be essential in its understanding, the text describes well-known, practical, and insightful mathematical models of avascular tumor growth and mathematically tractable treatment models based on ordinary differential equations. It continues the topic of avascular tumor growth in the context of partial differential equation models by incorporating the spatial structure and physiological structure, such as cell size. The book then focuses on the recent active multi-scale modeling efforts on prostate cancer growth and treatment dynamics. It also examines more mechanistically formulated models, including cell quota-based population growth models, with applications to real tumors and validation using clinical data. The remainder of the text presents abundant additional historical, biological, and medical background materials for advanced and specific treatment modeling efforts. Extensively classroom-tested in undergraduate and graduate courses, this self-contained book allows instructors to emphasize specific topics relevant to clinical cancer biology and treatment. It can be used in a variety of ways, including a single-semester undergraduate course, a more ambitious graduate course, or a full-year sequence on mathematical oncology.

The Evolution of Cooperation - Robert Axelrod 2009-04-29

A famed political scientist's classic argument for a more cooperative world We assume that, in a world ruled by natural selection, selfishness pays. So why cooperate? In The Evolution of Cooperation, political scientist Robert Axelrod seeks to answer this question. In 1980, he organized the famed Computer Prisoners Dilemma Tournament, which sought to find the optimal

strategy for survival in a particular game. Over and over, the simplest strategy, a cooperative program called Tit for Tat, shut out the competition. In other words, cooperation, not unfettered competition, turns out to be our best chance for survival. A vital book for leaders and decision makers, The Evolution of Cooperation reveals how cooperative principles help us think better about everything from military strategy, to political elections, to family dynamics.

Virus Dynamics - Martin Nowak 2000-11-23

"In this accessible and well-written text, Martin Nowak and Robert May describe the emerging field of theoretical immunology. Using mathematical and computational models, the authors explore how populations of viruses and immune cells interact in various circumstances, and how infectious diseases spread with-in patients."--Page 4 de la couverture.

Journey of the Universe - Brian Thomas Swimme 2011-06-28

The authors tell the epic story of the universe from an inspired new perspective, weaving the findings of modern science together with enduring wisdom found in the humanistic traditions of the West, China, India, and indigenous peoples. This book is part of a larger project that includes a documentary film, educational DVD series, and Web site.

Evolutionary Games and Population Dynamics - Josef Hofbauer 1998-05-28

How to understand evolution in mathematical terms, i.e. how to model natural selection by game theory.

Coalescent Theory - John Wakeley 2009

"An introduction to coalescent theory, which provides the foundation for molecular population genetics and genomics. Coalescent theory is the conceptual framework for studies of DNA sequence variation within species, and is the source of essential tools for making inferences about mutation, recombination,

population structure and natural selection from DNA sequence data"--Provided by publisher.

Why Beauty Is Truth - Ian Stewart 2007-08-02

At the heart of relativity theory, quantum mechanics, string theory, and much of modern cosmology lies one concept: symmetry. In Why Beauty Is Truth, world-famous mathematician Ian Stewart narrates the history of the emergence of this remarkable area of study. Stewart introduces us to such characters as the Renaissance Italian genius, rogue, scholar, and gambler Girolamo Cardano, who stole the modern method of solving cubic equations and published it in the first important book on algebra, and the young revolutionary Evariste Galois, who refashioned the whole of mathematics and founded the field of group theory only to die in a pointless duel over a woman before his work was published. Stewart also explores the strange numerology of real mathematics, in which particular numbers have unique and unpredictable properties related to symmetry. He shows how Wilhelm Killing discovered "Lie groups" with 14, 52, 78, 133, and 248 dimensions-groups whose very existence is a profound puzzle. Finally, Stewart describes the world beyond superstrings: the "octonionic" symmetries that may explain the very existence of the universe.

Population Games and Evolutionary Dynamics - William H. Sandholm 2010-12-17

Evolutionary game theory studies the behaviour of large populations of strategically interacting agents & is used by economists to predict in settings where traditional assumptions about the rationality of agents & knowledge may be inapplicable.

An Evolutionary Theory of Economic Change - Richard R. Nelson 1985-10-15

This book contains the most sustained and serious attack on mainstream, neoclassical

economics in more than forty years. Nelson and Winter focus their critique on the basic question of how firms and industries change overtime. They marshal significant objections to the fundamental neoclassical assumptions of profit maximization and market equilibrium, which they find ineffective in the analysis of technological innovation and the dynamics of competition among firms. To replace these assumptions, they borrow from biology the concept of natural selection to construct a precise and detailed evolutionary theory of business behavior. They grant that films are motivated by profit and engage in search for ways of improving profits, but they do not consider them to be profit maximizing. Likewise, they emphasize the tendency for the more profitable firms to drive the less profitable ones out of business, but they do not focus their analysis on hypothetical states of industry equilibrium. The results of their new paradigm and analytical framework are impressive. Not only have they been able to develop more coherent and powerful models of competitive firm dynamics under conditions of growth and technological change, but their approach is compatible with findings in psychology and other social sciences. Finally, their work has important implications for welfare economics and for government policy toward industry.

Mutualism - Judith L. Bronstein 2015

Mutualisms, interactions between two species that benefit both of them, have long captured the public imagination. Their influence transcends levels of biological organisation from cells to populations, communities, and ecosystems. Focusing on a range of ecological and evolutionary aspects over different scales (from individual to ecosystem), the chapters in this book provide expert coverage of our current understanding of mutualism whilst highlighting the most important questions that remain to be answered.

Discovering Evolutionary Ecology - Peter J. Mayhew 2006-01-05
This text provides a concise and readable introduction to evolutionary ecology, a field of questions united by the intermix of evolutionary and ecological knowledge.