The Mathematical Theory of Selection, Recombination, and Mutation

R. Bürger

Mathematical Theory Of Selection Recombination And Mutation

Yijin Wang

Mathematical Theory Of Selection Recombination And Mutation:

The Mathematical Theory of Selection, Recombination, and Mutation R. Bürger,2000-11-02 It is close to being a masterpiece could well be the classic presentation of the area Warren J Ewens University of Pennsylvania USA Population genetics is concerned with the study of the genetic ecological and evolutionary factors that influence and change the genetic composition of populations The emphasis here is on models that have a direct bearing on evolutionary quantitative genetics Applications concerning the maintenance of genetic variation in quantitative traits and their dynamics under selection are treated in detail Provides a unified self contained and in depth study of the theory of multilocus systems Introduces the basic population genetic models Explores the dynamical and equilibrium properties of the distribution of quantitative traits under selection Summarizes important results from more demanding sections in a comprehensible way Employs a clear and logical presentation style Following an introduction to elementary population genetics and discussion of the general theory of selection at two or more loci the author considers a number of mutation selection models and derives the dynamical equations for polygenic traits under general selective regimes The final chapters are concerned with the maintenance of quantitative genetic variation the response to directional selection the evolutionary role of deleterious mutations and other topics Graduate students and researchers in population genetics evolutionary theory and biomathematics will benefit from the in depth coverage This text will make an excellent reference volume for the fields of quantitative genetics population and theoretical biology **A Mutation-Selection Model with Recombination for General Genotypes** Steven Neil Evans,David Steinsaltz,Kenneth W. Wachter,2013-02-26 The authors investigate a continuous time probability measure valued dynamical system that describes the process of mutation selection balance in a context where the population is infinite there may be infinitely many loci and there are weak assumptions on selective costs Their model arises when they incorporate very general recombination mechanisms into an earlier model of mutation and selection presented by Steinsaltz Evans and Wachter in 2005 and take the relative strength of mutation and selection to be sufficiently small The resulting dynamical system is a flow of measures on the space of loci Each such measure is the intensity measure of a Poisson random measure on the space of loci the points of a realization of the random measure record the set of loci at which the genotype of a uniformly chosen individual differs from a reference wild type due to an accumulation of ancestral mutations The authors motivation for working in such a general setting is to provide a basis for understanding mutation driven changes in age specific demographic schedules that arise from the complex interaction of many genes and hence to develop a framework for understanding the evolution of aging **A Biologist's Guide to Mathematical Modeling in Ecology and Evolution** Sarah P. Otto,Troy Day,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　　　,　**Spatial Fleming-Viot Models with Selection and Mutation** Donald A. Dawson,Andreas Greven,2013-12-12 This book constructs a rigorous framework for analysing selected phenomena in evolutionary theory of populations arising due to the combined effects of migration selection and mutation in a spatial stochastic population model namely the evolution towards fitter and fitter types through punctuated equilibria The discussion is based on a number of new methods in particular multiple scale analysis nonlinear Markov processes and their entrance laws atomic measure valued evolutions and new forms of duality for state dependent mutation and multitype selection which are used to prove ergodic theorems in this context and are applicable for many other questions and renormalization analysis for a variety of phenomena stasis punctuated equilibrium failure of naive branching approximations biodiversity which occur due to the combination of rare mutation mutation resampling migration and selection and make it necessary to mathematically bridge the gap in the limit between time and space scales　　A Quest Towards a Mathematical Theory of Living Systems Nicola Bellomo,Abdelghani Bellouquid,Livio Gibelli,Nisrine Outada,2017-07-13 This monograph aims to lay the groundwork for the design of a unified mathematical approach to the modeling and analysis of large complex systems composed of interacting living things Drawing on twenty years of research in various scientific fields it explores how mathematical kinetic theory and evolutionary game theory can be used to understand the complex interplay between mathematical sciences and the dynamics of living systems The authors hope this will contribute to the development of new tools and strategies if not a new mathematical theory The first chapter discusses the main features of living systems and outlines a strategy for their modeling The following chapters then explore some of the methods needed to potentially achieve this in practice Chapter Two provides a brief introduction to the mathematical kinetic theory of classical particles with special emphasis on the Boltzmann equation

the Enskog equation mean field models and Monte Carlo methods are also briefly covered Chapter Three uses concepts from evolutionary game theory to derive mathematical structures that are able to capture the complexity features of interactions within living systems The book then shifts to exploring the relevant applications of these methods that can potentially be used to derive specific usable models The modeling of social systems in various contexts is the subject of Chapter Five and an overview of modeling crowd dynamics is given in Chapter Six demonstrating how this approach can be used to model the dynamics of multicellular systems The final chapter considers some additional applications before presenting an overview of open problems The authors then offer their own speculations on the conceptual paths that may lead to a mathematical theory of living systems hoping to motivate future research activity in the field A truly unique contribution to the existing literature A Quest Toward a Mathematical Theory of Living Systems is an important book that will no doubt have a significant influence on the future directions of the field It will be of interest to mathematical biologists systems biologists biophysicists and other researchers working on understanding the complexities of living systems   The Evolution of Personality and Individual Differences David M. Buss,2011 Capturing a scientific change in thinking about personality and individual differences this volume provides theories and empirical evidence which suggest that personality and individual differences are central to evolved psychological mechanisms and behavioural functioning   *Spatial Ecology via Reaction-Diffusion Equations* Robert Stephen Cantrell,Chris Cosner,2004-01-09 Many ecological phenomena may be modelled using apparently random processes involving space and possibly time Such phenomena are classified as spatial in their nature and include all aspects of pollution This book addresses the problem of modelling spatial effects in ecology and population dynamics using reaction diffusion models Rapidly expanding area of research for biologists and applied mathematicians Provides a unified and coherent account of methods developed to study spatial ecology via reaction diffusion models Provides the reader with the tools needed to construct and interpret models Offers specific applications of both the models and the methods Authors have played a dominant role in the field for years Essential reading for graduate students and researchers working with spatial modelling from mathematics statistics ecology geography and biology   *The Origins of Evolutionary Innovations* Andreas Wagner,2011-07-14 The theory can successfully unify innovations that occur at different levels of organization   *In the Light of Evolution* National Academy of Sciences,2007-12-28 In December 2006 the National Academy of Sciences sponsored a colloquium featured as part of the Arthur M Sackler Colloquia series on Adaptation and Complex Design to synthesize recent empirical findings and conceptual approaches toward understanding the evolutionary origins and maintenance of complex adaptations Darwin s elucidation of natural selection as a creative natural force was a monumental achievement in the history of science but a century and a half later some religious believers still contend that biotic complexity registers conscious supernatural design In this book modern scientific perspectives are presented on the evolutionary origin and maintenance of complex phenotypes including various behaviors anatomies and physiologies After an introduction by the

editors and an opening historical and conceptual essay by Francisco Ayala this book includes 14 papers presented by distinguished evolutionists at the colloquium The papers are organized into sections covering epistemological approaches to the study of biocomplexity a hierarchy of topics on biological complexity ranging from ontogeny to symbiosis and case studies explaining how complex phenotypes are being dissected in terms of genetics and development **Problem Solving Handbook in Computational Biology and Bioinformatics** Lenwood S. Heath,Naren Ramakrishnan,2010-10-20 Bioinformatics is growing by leaps and bounds theories algorithms statistical techniques are constantly evolving Nevertheless a core body of algorithmic ideas have emerged and researchers are beginning to adopt a problem solving approach to bioinformatics wherein they use solutions to well abstracted problems as building blocks to solve larger scope problems Problem Solving Handbook for Computational Biology and Bioinformatics is an edited volume contributed by world renowned leaders in this field This comprehensive handbook with problem solving emphasis covers all relevant areas of computational biology and bioinformatics Web resources and related themes are highlighted at every opportunity in this central easy to read reference Designed for advanced level students researchers and professors in computer science and bioengineering as a reference or secondary text this handbook is also suitable for professionals working in this industry

One-Locus and Multi-Locus Theory and Recombination Igor M. Rouzine,2020-11-23 The book will benefit a reader with a background in physical sciences and applied mathematics interested in the mathematical models of genetic evolution In the first chapter we analyze several thought experiments based on a basic model of stochastic evolution of a single genomic site in the presence of the factors of random mutation directional natural selection and random genetic drift In the second chapter we present a more advanced theory for a large number of linked loci In the third chapter we include the effect of genetic recombination into account and find out the advantage of sexual reproduction for adaptation These models are useful for the evolution of a broad range of asexual and sexual populations including virus evolution in a host and a host population *Stochastic Models for Structured Populations* Sylvie Meleard,Vincent Bansaye,2015-09-03 In this contribution several probabilistic tools to study population dynamics are developed The focus is on scaling limits of qualitatively different stochastic individual based models and the long time behavior of some classes of limiting processes Structured population dynamics are modeled by measure valued processes describing the individual behaviors and taking into account the demographic and mutational parameters and possible interactions between individuals Many quantitative parameters appear in these models and several relevant normalizations are considered leading to infinite dimensional deterministic or stochastic large population approximations Biologically relevant questions are considered such as extinction criteria the effect of large birth events the impact of environmental catastrophes the mutation selection trade off recovery criteria in parasite infections genealogical properties of a sample of individuals These notes originated from a lecture series on Structured Population Dynamics at Ecole polytechnique France Vincent Bansaye and Sylvie M l ard are Professors at Ecole Polytechnique France

They are a specialists of branching processes and random particle systems in biology Most of their research concerns the applications of probability to biodiversity ecology and evolution **Seminar on Stochastic Analysis, Random Fields and Applications V** Robert Dalang,Marco Dozzi,Francesco Russo,2008-03-12 This volume contains refereed research or review papers presented at the 5th Seminar on Stochastic Processes Random Fields and Applications which took place at the Centro Stefano Franscini Monte Verit in Ascona Switzerland from May 29 to June 3 2004 The seminar focused mainly on stochastic partial differential equations stochastic models in mathematical physics and financial engineering *Quasispecies: Concept and Implications for Virology* Esteban Domingo,2006-02-19 Continuous genetic variation and selection of virus subpopulations in the course of RNA virus replications are intimately related to viral disease mechanisms The central topics of this volume are the origins of the quasispecies concept and the implications of quasispecies dynamics for viral populations Inevitable Aging? Annette Baudisch,2008-01-08 Aging is inevitable this is gerontological dogma And humans do inevitably grow old which is probably why it seems so unlikely to us that other forms of life could escape aging Escaping aging is not escaping death Death is an inherent part of life and it can strike any time But the question is whether death necessarily becomes more likely as life proceeds And it does not The theoretical results in this monograph indicate that life provides alternative strategies While some organisms will deteriorate over adult ages for others mortality appears to fall or remain constant at least over an extended period of life after reproductive maturity This is empirically observed especially for species that keep on growing during adult ages Perhaps the diversity of aging matches the diversity of life My thesis the central insight of this monograph is to deeply understand why some species age it is necessary to understand why other species do not **The Evolution of Biological Information** Christoph Adami,2024-01-16 Why information is the unifying principle that allows us to understand the evolution of complexity in nature More than 150 years after Darwin s revolutionary On the Origin of Species we are still attempting to understand and explain the amazing complexity of life Although we now know how evolution proceeds to build complexity from simple ingredients quantifying this complexity is still a difficult undertaking In this book Christoph Adami offers a new perspective on Darwinian evolution by viewing it through the lens of information theory This novel theoretical stance sheds light on such matters as how viruses evolve drug resistance how cells evolve to communicate and how intelligence evolves By this account information emerges as the central unifying principle behind all of biology allowing us to think about the origin of life on Earth and elsewhere in a systematic manner Adami a leader in the field of computational biology first provides an accessible introduction to the information theory of biomolecules and then shows how to apply these tools to measure information stored in genetic sequences and proteins After outlining the experimental evidence of the evolution of information in both bacteria and digital organisms he describes the evolution of robustness in viruses the cooperation among cells animals and people and the evolution of brains and intelligence Building on extensive prior work in bacterial and digital evolution Adami establishes that expanding on Dobzhansky s famous remark

nothing in biology makes sense except in the light of information Understanding that information is the foundation of all life he argues allows us to see beyond the particulars of our way of life to glimpse what life might be like in other worlds

Biometrics - Volume I Susan R. Wilson,Conard Burden,2009-02-18 Biometrics is a component of Encyclopedia of Mathematical Sciences in the global Encyclopedia of Life Support Systems EOLSS which is an integrated compendium of twenty one Encyclopedias Biometry is a broad discipline covering all applications of statistics and mathematics to biology The Theme Biometrics is divided into areas of expertise essential for a proper application of statistical and mathematical methods to contemporary biological problems These volumes cover four main topics Data Collection and Analysis Statistical Methodology Computation Biostatistical Methods and Research Design and Selected Topics These volumes are aimed at the following five major target audiences University and College students Educators Professional practitioners Research personnel and Policy analysts managers and decision makers and NGOs **Plant Breeding Reviews, Volume 24, Part 1** Jules Janick,2010-05-11 Plant Breeding Reviews Volume 24 Part 1 presents state of the art reviews on plant genetics and the breeding of all types of crops by both traditional means and molecular methods The emphasis of the series is on methodology a practical understanding of crop genetics and applications to major crops **The Evolution of Population Biology** Rama S. Singh,Marcy K. Uyenoyama,2004-01-15 This 2004 collection of essays deals with the foundation and historical development of population biology and its relationship to population genetics and population ecology on the one hand and to the rapidly growing fields of molecular quantitative genetics genomics and bioinformatics on the other Such an interdisciplinary treatment of population biology has never been attempted before The volume is set in a historical context but it has an up to date coverage of material in various related fields The areas covered are the foundation of population biology life history evolution and demography density and frequency dependent selection recent advances in quantitative genetics and bioinformatics evolutionary case history of model organisms focusing on polymorphisms and selection mating system evolution and evolution in the hybrid zones and applied population biology including conservation infectious diseases and human diversity This is the third of three volumes published in honour of Richard Lewontin

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