

Brian Charlesworth

Cambridge Studies in Mathematical Biology

Evolution in age-structured populations

**Second
edition**



Evolution In Age Structured Populations

**Bo Peng, Marek Kimmel, Christopher I.
Amos**



Evolution In Age Structured Populations:

Evolution in Age-Structured Populations Brian Charlesworth, 1994-06-30 The populations of many species of animals and plants are age structured i.e. the individuals present at any one time were born over a range of different times and their fertility and survival depend on age. The properties of such populations are important for interpreting experiments and observations on the genetics of populations for animal and plant breeding and for understanding the evolution of features of life histories such as senescence and time of reproduction. In this new edition Brian Charlesworth provides a comprehensive review of the basic mathematical theory of the demography and genetics of age structured populations. The mathematical level of the book is such that it will be accessible to anyone with a knowledge of basic calculus and linear algebra.

Evolution of Age-Structured Populations Brian Charlesworth, 1980-09-25 **Age-Structured Population Dynamics in Demography and Epidemiology** Hisashi Inaba, 2017-03-15 This book is the first one in which basic demographic models are rigorously formulated by using modern age structured population dynamics extended to study real world population problems. Age structure is a crucial factor in understanding population phenomena and the essential ideas in demography and epidemiology cannot be understood without mathematical formulation; therefore this book gives readers a robust mathematical introduction to human population studies. In the first part of the volume classical demographic models such as the stable population model and its linear extensions, density dependent nonlinear models and pair formation models are formulated by the McKendrick partial differential equation and are analyzed from a dynamical system point of view. In the second part, mathematical models for infectious diseases spreading at the population level are examined by using nonlinear differential equations and a renewal equation. Since an epidemic can be seen as a nonlinear renewal process of an infected population, this book will provide a natural unification point of view for demography and epidemiology. The well known epidemic threshold principle is formulated by the basic reproduction number, which is also a most important key index in demography. The author develops a universal theory of the basic reproduction number in heterogeneous environments. By introducing the host age structure, epidemic models are developed into more realistic demographic formulations which are essentially needed to attack urgent epidemiological control problems in the real world. The Basic Approach to Age-Structured Population Dynamics Mimmo Iannelli, Fabio Milner, 2017-08-27 This book provides an introduction to age structured population modeling which emphasizes the connection between mathematical theory and underlying biological assumptions. Through the rigorous development of the linear theory and the nonlinear theory alongside numerics, the authors explore classical equations that describe the dynamics of certain ecological systems. Modeling aspects are discussed to show how relevant problems in the fields of demography, ecology and epidemiology can be formulated and treated within the theory. In particular, the book presents extensions of age structured modeling to the spread of diseases and epidemics while also addressing the issue of regularity of solutions, the asymptotic behavior of solutions and numerical approximation. With

sections on transmission models non autonomous models and global dynamics this book fills a gap in the literature on theoretical population dynamics The Basic Approach to Age Structured Population Dynamics will appeal to graduate students and researchers in mathematical biology epidemiology and demography who are interested in the systematic presentation of relevant models and mathematical methods *The Dynamics of Physiologically Structured Populations* Johan A. Metz, Odo Diekmann, 2014-03-11

Evolution Of Life Histories Derek Roff, 1993-04-30 There are many different types of organisms in the world they differ in size physiology appearance and life history The challenge for evolutionary biology is to explain how such diversity arises The Evolution of Life Histories does this by showing that natural selection is the principal underlying force molding life history variation The book describes in particular the ways in which variation can be analyzed and predicted It covers both the genetic and optimization approaches to life history analysis and gives an overview of the general framework of life history theory and the mathematical tools by which predictions can be made and tested Factors affecting the age schedule of birth and death and the costs of reproduction are discussed The Evolution of Life Histories concentrates on those theoretical developments that have been tested experimentally It will interest both students and professionals in evolution evolutionary ecology mathematical and theoretical biology and zoology and entomology Size-Structured Populations Bo Ebenman, Lennart Persson, 2012-12-06 At last both ecology and evolution are covered in this study on the dynamics of size structured populations How does natural selection shape growth patterns and life cycles of individuals and hence the size structure of populations This book will stimulate biologists to look into some important and interesting biological problems from a new angle of approach concerning life history evolution intraspecific competition and niche theory structure and dynamics of ecological communities *Life History Evolution in Plants* Timo Olavi Vuorisalo, P. Mutikainen, 2001-11-30 The lack of discussion of the life histories of modular organisms is the weakness of this book that I most regret Modular organisms are different S C Steams The Evolution of Life Histories 1992 Life history theory endeavours to increase our understanding of the processes whereby the broad features of the life cycles of organisms such as the timing and magnitude of reproduction have evolved Although reproductive traits have dominated as study objects due to their immediate importance for evolutionary success much work has also been conducted on patterns of development growth and senescence as well as on the shifts in resource allocation related to these processes The basic axiom of life history theory is that patterns of life histories such as reproductive traits are subject to evolutionary explanation This idea can be traced back at least as far as Darwin's Origin of Species 1859 In his discussion of plant domestication Darwin wrote I cannot doubt that the continued selection of slight variations either in the leaves the flowers or the fruit will produce races differing from each other chiefly in these characters Darwin was impressed by the success of plant breeders in moulding the growth and reproductive parameters of cultivated plants and believed that natural selection could have a similar impact in natural populations An Introduction to Structured Population Dynamics J. M. Cushing, 1998-01-01 This monograph introduces the

theory of structured population dynamics and its applications focusing on the asymptotic dynamics of deterministic models

Population Genetics and Microevolutionary Theory Alan R. Templeton, 2006-09-29 The advances made possible by the development of molecular techniques have in recent years revolutionized quantitative genetics and its relevance for population genetics Population Genetics and Microevolutionary Theory takes a modern approach to population genetics incorporating modern molecular biology species level evolutionary biology and a thorough acknowledgment of quantitative genetics as the theoretical basis for population genetics Logically organized into three main sections on population structure and history genotype phenotype interactions and selection adaptation Extensive use of real examples to illustrate concepts Written in a clear and accessible manner and devoid of complex mathematical equations Includes the author's introduction to background material as well as a conclusion for a handy overview of the field and its modern applications Each chapter ends with a set of review questions and answers Offers helpful general references and Internet links

Demographic Methods across the Tree of Life Roberto Salguero-Gomez, Marlène Gamelon, 2021-08-31 Demography is everywhere in our lives from birth to death Indeed the universal currencies of survival development reproduction and recruitment shape the performance of all species from microbes to humans The number of techniques for demographic data acquisition and analyses across the entire tree of life microbes fungi plants and animals has drastically increased in recent decades These developments have been partially facilitated by the advent of technologies such as GIS and drones as well as analytical methods including Bayesian statistics and high throughput molecular analyses However despite the universality of demography and the significant research potential that could emerge from unifying i questions across taxa ii data collection protocols and iii analytical tools demographic methods to date have remained taxonomically siloed and methodologically disintegrated This is the first book to attempt a truly unified approach to demography and population ecology in order to address a wide range of questions in ecology evolution and conservation biology across the entire spectrum of life This novel book provides the reader with the fundamentals of data collection model construction analyses and interpretation across a wide repertoire of demographic techniques and protocols It introduces the novice demographer to a broad range of demographic methods including abundance based models life tables matrix population models integral projection models integrated population models individual based models and more Through the careful integration of data collection methods analytical approaches and applications clearly guided throughout with fully reproducible R scripts the book provides an up to date and authoritative overview of the most popular and effective demographic tools Demographic Methods across the Tree of Life is aimed at graduate students and professional researchers in the fields of demography ecology animal behaviour genetics evolutionary biology mathematical biology and wildlife management

Optimal Control of Age-structured Populations in Economy, Demography, and the Environment Raouf Boucekkine, Natali Hritonenko, Yuri Yatsenko, 2013-05-13 This book covers a wide range of topics within mathematical modelling and the optimization of economic demographic technological and

environmental phenomena Each chapter is written by experts in their field and represents new advances in modelling theory and practice These essays are exemplary of the fruitful interaction between theory and practice when exploring global and local changes The unifying theme of the book is the use of mathematical models and optimization methods to describe age structured populations in economy demography technological change and the environment Emphasis is placed on deterministic dynamic models that take age or size structures delay effects and non standard decision variables into account In addition the contributions deal with the age structure of assets resources and populations under study Interdisciplinary modelling has enormous potential for discovering new insights in global and regional development Optimal Control of Age structured Populations in Economy Demography and the Environment is a rich and excellent source of information on state of the art modelling expertise and references The book provides the necessary mathematical background for readers from different areas such as applied sciences management sciences and operations research which helps guide the development of practical models As well as this the book also surveys the current practice in applied modelling and looks at new research areas for a general mathematical audience This book will be of interest primarily to researchers postgraduate students as well as a wider scientific community including those focussing on the subjects of applied mathematics environmental sciences economics demography management and operations research

Human Evolutionary Demography Oskar Burger, Ronald Lee, Rebecca Sear, 2024-06-14 Human evolutionary demography is an emerging field blending natural science with social science This edited volume provides a much needed interdisciplinary introduction to the field and highlights cutting edge research for interested readers and researchers in demography the evolutionary behavioural sciences biology and related disciplines By bridging the boundaries between social and biological sciences the volume stresses the importance of a unified understanding of both in order to grasp past and current demographic patterns Demographic traits and traits related to demographic outcomes including fertility and mortality rates marriage parental care menopause and cooperative behavior are subject to evolutionary processes Bringing an understanding of evolution into demography therefore incorporates valuable insights into this field just as knowledge of demography is key to understanding evolutionary processes By asking questions about old patterns from a new perspective the volume composed of contributions from established and early career academics demonstrates that a combination of social science research and evolutionary theory offers holistic understandings and approaches that benefit both fields Human Evolutionary Demography introduces an emerging field in an accessible style It is suitable for graduate courses in demography as well as upper level undergraduates Its range of research is sure to be of interest to academics working on demographic topics anthropologists sociologists demographers natural scientists working on evolutionary processes and disciplines which cross cut natural and social science such as evolutionary psychology human behavioral ecology cultural evolution and evolutionary medicine As an accessible introduction it should interest readers whether or not they are currently familiar with human evolutionary demography

Structured Population

Models in Biology and Epidemiology Pierre Magal, Shigui Ruan, 2008-04-30 In this new century mankind faces ever more challenging environmental and public health problems such as pollution invasion by exotic species the emergence of new diseases or the emergence of diseases into new regions West Nile virus SARS Anthrax etc and the resurgence of existing diseases in uenza malaria TB HIV AIDS etc Mathematical models have been successfully used to study many biological epidemiological and medical problems and nonlinear and complex dynamics have been observed in all of those contexts Mathematical studies have helped us not only to better understand these problems but also to find solutions in some cases such as the prediction and control of SARS outbreaks understanding HIV infection and the investigation of antibiotic resistant infections in hospitals Structured population models distinguish individuals from one another according to characteristics such as age size location status and movement to determine the birth growth and death rates interaction with each other and with environment infectivity etc The goal of structured population models is to understand how these characteristics affect the dynamics of these models and thus the outcomes and consequences of the biological and epidemiological processes There is a very large and growing body of literature on these topics This book deals with the recent and important advances in the study of structured population models in biology and epidemiology There are six chapters in this book written by leading researchers in these areas

Forward-Time Population Genetics Simulations Bo Peng, Marek Kimmel, Christopher I. Amos, 2012-02-14 The only book available in the area of forward time population genetics simulations applicable to both biomedical and evolutionary studies The rapid increase of the power of personal computers has led to the use of serious forward time simulation programs in genetic studies Forward Time Population Genetics Simulations presents both new and commonly used methods and introduces simuPOP a powerful and flexible new program that can be used to simulate arbitrary evolutionary processes with unique features like customized chromosome types arbitrary nonrandom mating schemes virtual subpopulations information fields and Python operators The book begins with an overview of important concepts and models then goes on to show how simuPOP can simulate a number of standard population genetics models with the goal of demonstrating the impact of genetic factors such as mutation selection and recombination on standard Wright Fisher models The rest of the book is devoted to applications of forward time simulations in various research topics Forward Time Population Genetics Simulations includes An overview of currently available forward time simulation methods their advantages and shortcomings An overview and evaluation of currently available software A simuPOP tutorial Applications in population genetics Applications in genetic epidemiology statistical genetics and mapping complex human diseases The only book of its kind in the field today Forward Time Population Genetics Simulations will appeal to researchers and students of population and statistical genetics

Analysis and Management of Animal Populations Byron K. Williams, James D. Nichols, Michael J. Conroy, 2002-05-16 Analysis and Management of Animal Populations deals with the processes involved in making informed decisions about the management of animal populations It covers the modeling of population responses to

management actions the estimation of quantities needed in the modeling effort and the application of these estimates and models to the development of sound management decisions The book synthesizes and integrates in a single volume the methods associated with these themes as they apply to ecological assessment and conservation of animal populations Integrates population modeling parameter estimation and decision theoretic approaches to management in a single cohesive framework Provides authoritative state of the art descriptions of quantitative approaches to modeling estimation and decision making Emphasizes the role of mathematical modeling in the conduct of science and management Utilizes a unifying biological context consistent mathematical notation and numerous biological examples

Function Spaces, Differential Operators and Nonlinear Analysis Dorothee Haroske, Thomas Runst, Hans-Jürgen Schmeisser, 2012-12-06 This volume is dedicated to our teacher and friend Hans Triebel The core of the book is based on lectures given at the International Conference Function Spaces Differential Operators and Nonlinear Analysis FSDONA 01 held in Teistungen Thuringia Germany from June 28 to July 4 2001 in honour of his 65th birthday This was the fifth in a series of meetings organised under the same name by scientists from Finland Helsinki Oulu the Czech Republic Prague Plzen and Germany Jena promoting the collaboration of specialists in East and West working in these fields This conference was a very special event because it celebrated Hans Triebel's extraordinary impact on mathematical analysis The development of the modern theory of function spaces in the last 30 years and its application to various branches in both pure and applied mathematics is deeply influenced by his lasting contributions In a series of books Hans Triebel has given systematic treatments of the theory of function spaces from different points of view thus revealing its interdependence with interpolation theory harmonic analysis partial differential equations nonlinear operators entropy spectral theory and most recently analysis on fractals The presented collection of papers is a tribute to Hans Triebel's distinguished work The book is subdivided into three parts Part I contains the two invited lectures by O V Besov Moscow and D E Edmunds Sussex having a survey character and honouring Hans Triebel's contributions

Conceptual Breakthroughs in The Evolutionary Biology of Aging Kenneth R. Arnold, Michael R. Rose, 2023-07-10 Conceptual Breakthroughs in the Evolutionary Biology of Aging continues the innovative Conceptual Breakthroughs series by providing a comprehensive outline of the major breakthroughs that built the evolutionary biology of aging as a leading scientific field Following the evolutionary study of aging from its humble origins to the present the book's chapters treat the field's breakthroughs one at a time Users will find a concise and accessible analysis of the science of aging viewed through an evolutionary lens Building upon widely cited studies conducted by author Michael Rose this book covers 30 subsequent years of growth and development within the field The book highlights key publications for those who are not experts in the field providing an important resource for researchers Given the prevailing interest in changing the aging process dramatically it is a powerful tool for readers who have a vested interest in understanding its causes and future control measures Reviews cell molecular theories of aging in the light of evolutionary biology Offers an evolutionary analysis

of prospects for mitigating aging not commonly discussed within private and public sectors Provides readers with a radically different perspective on contemporary biological gerontology specifically through the lens of evolutionary biology

Encyclopedia of Evolutionary Biology ,2016-04-14 Encyclopedia of Evolutionary Biology Four Volume Set is the definitive go to reference in the field of evolutionary biology It provides a fully comprehensive review of the field in an easy to search structure Under the collective leadership of fifteen distinguished section editors it is comprised of articles written by leading experts in the field providing a full review of the current status of each topic The articles are up to date and fully illustrated with in text references that allow readers to easily access primary literature While all entries are authoritative and valuable to those with advanced understanding of evolutionary biology they are also intended to be accessible to both advanced undergraduate and graduate students Broad topics include the history of evolutionary biology population genetics quantitative genetics speciation life history evolution evolution of sex and mating systems evolutionary biogeography evolutionary developmental biology molecular and genome evolution coevolution phylogenetic methods microbial evolution diversification of plants and fungi diversification of animals and applied evolution Presents fully comprehensive content allowing easy access to fundamental information and links to primary research Contains concise articles by leading experts in the field that ensures current coverage of each topic Provides ancillary learning tools like tables illustrations and multimedia features to assist with the comprehension process *Structured-Population Models in Marine, Terrestrial, and Freshwater Systems* Shripad Tuljapurkar, Hal Caswell, 2012-12-06 In the summer of 1993 twenty six graduate and postdoctoral students and fourteen lecturers converged on Cornell University for a summer school devoted to structured population models This school was one of a series to address concepts cutting across the traditional boundaries separating terrestrial marine and freshwater ecology Earlier schools resulted in the books Patch Dynamics S A Levin T M Powell a book on food webs is in preparation Models of population structure differences among individuals due to age size developmental stage spatial location or genotype have an important place in studies of all three kinds of ecosystem In choosing the participants and lecturers for the school we selected for diversity biologists who knew some mathematics and mathematicians who knew some biology field biologists sobered by encounters with messy data and theoreticians intoxicated by the elegance of the underlying mathematics people concerned with long term evolutionary problems and people concerned with the acute crises of conservation biology For four weeks these perspectives swirled in discussions that started in the lecture hall and carried on into the sweltering Ithaca night Diversity may or may not increase stability but it surely makes things interesting

Evolution In Age Structured Populations Book Review: Unveiling the Magic of Language

In a digital era where connections and knowledge reign supreme, the enchanting power of language has become much more apparent than ever. Its power to stir emotions, provoke thought, and instigate transformation is really remarkable. This extraordinary book, aptly titled "**Evolution In Age Structured Populations**," published by a very acclaimed author, immerses readers in a captivating exploration of the significance of language and its profound impact on our existence. Throughout this critique, we shall delve into the book's central themes, evaluate its unique writing style, and assess its overall influence on its readership.

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Evolution In Age Structured Populations Introduction

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