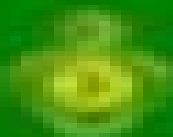
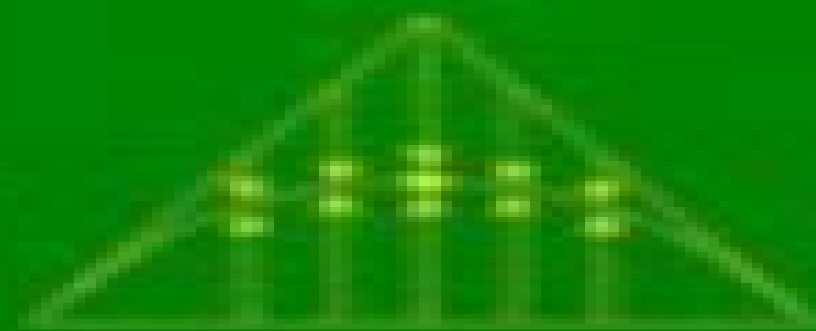


Biometrical Genetics
Volume 2.2

Yuri I. Lyubich

Mathematical Structures in Population Genetics



Springer

Mathematical Structures In Population Genetics

**Fabio A. C. C. Chalub, José Francisco
Rodrigues**



Mathematical Structures In Population Genetics:

Mathematical Structures in Population Genetics Iñaki Il'ich Liñich, 1992 *Mathematical Structures in Population Genetics* Yuri I. Lyubich, 1992 Mathematical methods have been applied successfully to population genetics for a long time. Even the quite elementary ideas used initially proved amazingly effective. For example, the famous Hardy Weinberg Law 1908 is basic to many calculations in population genetics. The mathematics in the classical works of Fisher, Haldane and Wright was also not very complicated but was of great help for the theoretical understanding of evolutionary processes. More recently, the methods of mathematical genetics have become more sophisticated. In use are probability theory, stochastic processes, non-linear differential and difference equations and nonassociative algebras. First contacts with topology have been established. Now, in addition to the traditional movement of mathematics for genetics, inspiration is flowing in the opposite direction, yielding mathematics from genetics. The present monograph reflects to some degree both patterns but especially the latter one. A pioneer of this synthesis was S. N. Bernstein. He raised and partially solved the problem of characterizing all stationary evolutionary operators, and this work was continued by the author in a series of papers 1971-1979. This problem has not been completely solved but it appears that only certain operators devoid of any biological significance remain to be addressed. The results of these studies appear in chapters 4 and 5. The necessary algebraic preliminaries are described in chapter 3, after some elementary models in chapter 2. **Mathematical Population Genetics 1** Warren J.

Ewens, 2004-01-09 This is the first of a planned two-volume work discussing the mathematical aspects of population genetics with an emphasis on evolutionary theory. This volume draws heavily from the author's 1979 classic but it has been revised and expanded to include recent topics which follow naturally from the treatment in the earlier edition, such as the theory of molecular population genetics. Population Genetics W.J. Ewens, 2013-03-12 Population genetics is the mathematical investigation of the changes in the genetic structure of populations brought about by selection, mutation, inbreeding, migration and other phenomena, together with those random changes deriving from chance events. These changes are the basic components of evolutionary progress, and an understanding of their effect is therefore necessary for an informed discussion of the reasons for and nature of evolution. It would however be wrong to pretend that a mathematical theory depending as it must on a large number of simplifying assumptions should be accepted unreservedly and that its conclusions should be accepted uncritically. No one would pretend that in the event of disagreement between observation and mathematical prediction, the discrepancy is due to anything other than the inadequacy of the mathematical treatment. The biological world is of course far too complex for the study of population genetics to be simply a branch of applied mathematics, so that while we are concerned here with the mathematical theory, I have tried to indicate which of our results should continue to apply in a context wider than that in which they are formally derived. The difficulties involved in the joint discussions of mathematical and genetical problems are obvious enough. I have tried to aim this book rather more at the mathematician than at the

geneticist and for this reason a brief glossary of common genetical terms is included *Genetics and Social Structure: Mathematical Structuralism in Population Genetics and Social Theory* Paul A. Ballonoff, 1974

Information Geometry and Population Genetics Julian Hofrichter, Jürgen Jost, Tat Dat Tran, 2017-02-23 The present monograph develops a versatile and profound mathematical perspective of the Wright Fisher model of population genetics This well known and intensively studied model carries a rich and beautiful mathematical structure which is uncovered here in a systematic manner In addition to approaches by means of analysis combinatorics and PDE a geometric perspective is brought in through Amari's and Chentsov's information geometry This concept allows us to calculate many quantities of interest systematically likewise the employed global perspective elucidates the stratification of the model in an unprecedented manner Furthermore the links to statistical mechanics and large deviation theory are explored and developed into powerful tools Altogether the manuscript provides a solid and broad working basis for graduate students and researchers interested in this field

Some Mathematical Models from Population Genetics Alison Etheridge, 2011-01-07 Based on the author's lectures at the 2009 St Flour summer school in probability this volume provides an introduction to a range of mathematical models that have their origins in theoretical population genetics

Mathematical Properties of Population-Genetic Statistics Noah A. Rosenberg, 2025-05-20 A powerful new approach to interpreting population genetic data in evolution and ecology Population genetics uses statistical analysis to catalog genetic variation among populations and species Summary statistics computed from allele frequencies mathematical functions that measure features of genetic similarity and diversity are key to this global effort Yet despite their widespread use in evolutionary biology ecology and conservation biology their mathematical properties have largely been overlooked This book shows how to use the mathematical bounds on summary statistics to make better interpretations of population genetic data Noah Rosenberg discusses how the behavior of these statistics depends not only on the biology of the populations they seek to describe but also on the mathematical properties of the functions used to compute them properties that produce constraints on the values of the statistics and influence their interpretation Focusing on the concept of homozygosity a quadratic function of allele frequencies in a population he demonstrates how to account for mathematical constraints when measuring genetic similarity and diversity Rosenberg illustrates the results using examples from empirical data and shares strategies that readers can use to apply this mathematical perspective to different kinds of summary statistics including those for measuring biodiversity in ecological communities Drawing inspiration from Charles Darwin who marveled at evolution's endless forms most beautiful and most wonderful this book presents a groundbreaking approach to the study of genetic variation It is sure to stimulate new research in population biology and deeper thinking about the meaning and interpretation of essential measurements of the world's genomes

Population Dynamics: Algebraic And Probabilistic Approach Utkir A Rozikov, 2020-04-22 A population is a summation of all the organisms of the same group or species which live in a particular geographical area and have the capability of interbreeding The main

mathematical problem for a given population is to carefully examine the evolution time dependent dynamics of the population. The mathematical methods used in the study of this problem are based on probability theory, stochastic processes, dynamical systems, nonlinear differential and difference equations, and non associative algebras. A state of a population is a distribution of probabilities of the different types of organisms in every generation. Type partition is called differentiation, for example sex differentiation which defines a bisexual population. This book systematically describes the recently developed theory of bisexual population and mainly contains results obtained since 2010. The book presents algebraic and probabilistic approaches in the theory of population dynamics. It also includes several dynamical systems of biological models such as dynamics generated by Markov processes of cubic stochastic matrices, dynamics of sex linked population dynamical systems generated by a gonosomal evolution operator dynamical system, and an evolution algebra of mosquito population and ocean ecosystems. The main aim of this book is to facilitate the reader's in depth understanding by giving a systematic review of the theory of population dynamics which has wide applications in biology, mathematics, medicine, and physics.

Tutorials in Mathematical Biosciences IV Avner Friedman, 2008-04-26. This book offers an introduction to fast growing research areas in evolution of species, population genetics, ecological models, and population dynamics. It reviews the concept and methodologies of phylogenetic trees, introduces ecological models, examines a broad range of ongoing research in population dynamics, and deals with gene frequencies under the action of migration and selection. The book features computational schemes, illustrations, and mathematical theorems.

Mathematics of Genetic Diversity J. F. C. Kingman, 1980-01-01. This book draws together some mathematical ideas that are useful in population genetics, concentrating on a few aspects which are both biologically relevant and mathematically interesting.

Genetics and Social Structure: Mathematical Structuralism in Population Genetics and Social Theory Paul A. Ballonoff, 1974.

Mathematical Theories of Populations Frank Hoppensteadt, 1975-12-01. A basic model in population age structure is studied and then applied and extended to several population phenomena.

Topics in Functional Analysis and Algebra Bernard Russo, Asuman Güven Aksoy, Ravshan Ashurov, Shavkat Ayupov, 2016-08-25. The USA-Uzbekistan Conference on Analysis and Mathematical Physics focusing on contemporary issues in dynamical systems, mathematical physics, operator algebras, and several complex variables was hosted by California State University Fullerton from May 20-23, 2014. The main objective of the conference was to facilitate scientific communication and collaboration between mathematicians from the USA and Uzbekistan. This volume contains the proceedings of the Special Session on Algebra and Functional Analysis. The theory of operator algebras is the unified theme for many papers in this volume. Out of four extensive survey papers, two cover problems related to derivation of various algebras of functions. The other two surveys are on classification of Leibniz algebras and on evolution algebras. The sixteen research articles are devoted to certain analytic topics such as minimal projections with respect to numerical radius, functional equations, and discontinuous polynomials, Fourier inversion for distributions, Schrödinger operators, convexity, and

dynamical systems **Graph-Theoretic Problems and Their New Applications** Frank Werner, 2020-05-27 Graph theory is an important area of applied mathematics with a broad spectrum of applications in many fields This book results from a Special Issue in the journal Mathematics entitled Graph Theoretic Problems and Their New Applications It contains 20 articles covering a broad spectrum of graph theoretic works that were selected from 151 submitted papers after a thorough refereeing process Among others it includes a deep survey on mixed graphs and their use for solutions to scheduling problems Other subjects include topological indices domination numbers of graphs domination games contraction mappings and neutrosophic graphs Several applications of graph theory are discussed e g the use of graph theory in the context of molecular processes

Evolution Algebras and Their Applications Jianjun Paul Tian, 2008 Behind genetics and Markov chains there is an intrinsic algebraic structure It is defined as a type of new algebra as evolution algebra This concept lies between algebras and dynamical systems Algebraically evolution algebras are non associative Banach algebras dynamically they represent discrete dynamical systems Evolution algebras have many connections with other mathematical fields including graph theory group theory stochastic processes dynamical systems knot theory 3 manifolds and the study of the Ihara Selberg zeta function In this volume the foundation of evolution algebra theory and applications in non Mendelian genetics and Markov chains is developed with pointers to some further research topics

Models and Inferences in Science Emiliano Ippoliti, Fabio Sterpetti, Tom Nickles, 2016-01-27 The book answers long standing questions on scientific modeling and inference across multiple perspectives and disciplines including logic mathematics physics and medicine The different chapters cover a variety of issues such as the role models play in scientific practice the way science shapes our concept of models ways of modeling the pursuit of scientific knowledge the relationship between our concept of models and our concept of science The book also discusses models and scientific explanations models in the semantic view of theories the applicability of mathematical models to the real world and their effectiveness the links between models and inferences and models as a means for acquiring new knowledge It analyzes different examples of models in physics biology mathematics and engineering Written for researchers and graduate students it provides a cross disciplinary reference guide to the notion and the use of models and inferences in science

The Mathematics of Darwin's Legacy Fabio A. C. C. Chalub, José Francisco Rodrigues, 2011-06-24 The book presents a general overview of mathematical models in the context of evolution It covers a wide range of topics such as population genetics population dynamics speciation adaptive dynamics game theory kin selection and stochastic processes Written by leading scientists working at the interface between evolutionary biology and mathematics the book is the outcome of a conference commemorating Charles Darwin's 200th birthday and the 150th anniversary of the first publication of his book On the origin of species Its chapters vary in format between general introductory and state of the art research texts in biomathematics in this way addressing both students and researchers in mathematics biology and related fields Mathematicians looking for new problems as well as biologists looking for rigorous

description of population dynamics will find this book fundamental

Topological Data Analysis for Genomics and Evolution Raul Rabadan, Andrew J. Blumberg, 2019-12-19 An introduction to geometric and topological methods to analyze large scale biological data includes statistics and genomic applications

Evolutionary Theory and Processes: Modern Horizons Solomon P. Wasser, 2013-03-09 Evolution is the most profound of human ideas integrating all natural phenomena cosmic biological and cultural into a continuous universal change This volume deals with evolutionary observations experiments and theories contributing to a deeper understanding of the evolutionary process th honoring the 75 birthday of Eviatar Eibi Nevo I first met Eibi in 1966 when he was a Fellow in the Museum of Comparative Zoology at Harvard University and working mostly on cricket frog vocalization and speciation in the United States His unique discovery of pipid fossil frogs in the Israeli Early Cretaceous central Negev is possibly the largest world collection of ancient fossil frogs Our acquaintance developed into mutual friendship and admiration Since then our long lasting friendship has included a visit to Israel enabling me to follow Eibi s major scientific achievements in particular his founding of the Institute of Evolution in the University of Haifa and now the pending establishment of the International Graduate School of Evolution The research program of Eibi Nevo in collaboration with numerous colleagues and students in Israel and across the world encompasses diverse perspectives of evolutionary biology and biodiversity of genes populations species and ecosystems integrating modern and classical evolutionary approaches molecular and organismal They deal with model organisms in all forms from bacteria through plants fungi animals and humans conducted over local regional and global scales

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