

Population Parameters: Estimation for Ecological Models

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Science**

Population Parameters Estimation For Ecological Models

Karline Soetaert, Peter M. J. Herman



Population Parameters Estimation For Ecological Models:

Population Parameters Hamish McCallum, 2008-04-15 Ecologists and environmental managers rely on mathematical models both to understand ecological systems and to predict future system behavior. In turn, models rely on appropriate estimates of their parameters. This book brings together a diverse and scattered literature to provide clear guidance on how to estimate parameters for models of animal populations. It is not a recipe book of statistical procedures. Instead, it concentrates on how to select the best approach to parameter estimation for a particular problem and how to ensure that the quality estimated is the appropriate one for the specific purpose of the modelling exercise. Commencing with a toolbox of useful generic approaches to parameter estimation, the book deals with methods for estimating parameters for single populations. These parameters include population size, birth and death rates, and the population growth rate. For such parameters, rigorous statistical theory has been developed and software is readily available. The problem is to select the optimal sampling design and method of analysis. The second part of the book deals with parameters that describe spatial dynamics and ecological interactions such as competition, predation, and parasitism. Here the principle problems are designing appropriate experiments and ensuring that the quantities measured by the experiments are relevant to the ecological models in which they will be used. This book will be essential reading for ecological researchers, postgraduate students, and environmental managers who need to address an ecological problem through a population model. It is accessible to anyone with an understanding of basic statistical methods and population ecology. Unique in concentrating on parameter estimation within modelling. Fills a glaring gap in the literature. Not too technical, so suitable for the statistically inept. Methods explained in algebra but also in worked examples using commonly available computer packages: SAS, GLIM, and some more specialised packages where relevant. Some spreadsheet-based examples also included.

A Practical Guide to Ecological Modelling Karline Soetaert, Peter M. J. Herman, 2008-10-14 Mathematical modelling is an essential tool in present-day ecological research. Yet for many ecologists, it is still problematic to apply modelling in their research. In our experience, the major problem is at the conceptual level: proper understanding of what a model is, how ecological relations can be translated consistently into mathematical equations, how models are solved, steady states calculated and interpreted. Many textbooks jump over these conceptual hurdles to dive into detailed formulations or the mathematics of solution. This book attempts to fill that gap. It introduces essential concepts for mathematical modelling, explains the mathematics behind the methods, and helps readers to implement models and obtain hands-on experience. Throughout the book, emphasis is laid on how to translate ecological questions into interpretable models in a practical way. The book aims to be an introductory textbook at the undergraduate/graduate level but will also be useful to seduce experienced ecologists into the world of modelling. The range of ecological models treated is wide, from Lotka-Volterra type of principle-seeking models to environmental or ecosystem models, including matrix models, lattice models, and sequential decision models. All chapters

contain a concise introduction into the theory worked out examples and exercises All examples are implemented in the open source package R thus taking away problems of software availability for use of the book All code used in the book is available on a dedicated website

Population-Level Ecological Risk Assessment Lawrence W. Barnthouse, Wayne R. Munns Jr., Mary T. Sorensen, 2007-09-25 Most ecological risk assessments consider the risk to individual organisms or organism level attributes From a management perspective however risks to population level attributes and processes are often more relevant Despite many published calls for population risk assessment and the abundance of available scientific research and technical tool

Fundamentals of Ecological Modelling S.E. Jorgensen, 2011-01-10 Fundamentals of Ecological Modelling Applications in Environmental Management and Research Fourth Edition provides a comprehensive discussion of the fundamental principles of ecological modeling The first two editions of this book published in 1986 and 1994 focused on the roots of the discipline the four main model types that dominated the field 30 40 years ago 1 dynamic biogeochemical models 2 population dynamic models 3 ecotoxicological models and 4 steady state biogeochemical and energy models The third edition focused on the mathematical formulations of ecological processes that are included in ecological models This fourth edition uses the four model types previously listed as the foundation and expands the latest model developments in spatial models structural dynamic models and individual based models As these seven types of models are very different and require different considerations in the model development phase a separate chapter is devoted to the development of each of the model types Throughout the text the examples given from the literature emphasize the application of models for environmental management and research Presents the most commonly used model types with a step by step outline of the modeling procedure used for each Shows readers through an illustrated example of how to use each model in research and management settings New edition is revised to include only essential theory with a focus on applications Includes case studies illustrations and exercises case study of an ecological problem with full illustration on how to solve the problem

Capture-Recapture: Parameter Estimation for Open Animal Populations George A. F. Seber, Matthew R. Schofield, 2019-08-13 This comprehensive book rich with applications offers a quantitative framework for the analysis of the various capture recapture models for open animal populations while also addressing associated computational methods The state of our wildlife populations provides a litmus test for the state of our environment especially in light of global warming and the increasing pollution of our land seas and air In addition to monitoring our food resources such as fisheries we need to protect endangered species from the effects of human activities e g rhinos whales or encroachments on the habitat of orangutans Pests must be controlled whether insects or viruses and we need to cope with growing feral populations such as opossums rabbits and pigs Accordingly we need to obtain information about a given population s dynamics concerning e g mortality birth growth breeding sex and migration and determine whether the respective population is increasing static or declining There are many methods for obtaining population information but the most useful and most work intensive is

generically known as capture recapture where we mark or tag a representative sample of individuals from the population and follow that sample over time using recaptures resightings or dead recoveries Marks can be natural such as stripes fin profiles and even DNA or artificial such as spots on insects Attached tags can for example be simple bands or streamers or more sophisticated variants such as radio and sonic transmitters To estimate population parameters sophisticated and complex mathematical models have been devised on the basis of recapture information and computer packages This book addresses the analysis of such models It is primarily intended for ecologists and wildlife managers who wish to apply the methods to the types of problems discussed above though it will also benefit researchers and graduate students in ecology Familiarity with basic statistical concepts is essential

Theory of Wildlife Population Ecology Bruce D. Leopold, 2018-10-25 Understanding wildlife population ecology is vital for all wildlife managers and conservation biologists Leopold draws on 30 years of research and teaching experience to give students and natural resource professionals the foundation they need to effectively manage wildlife populations He begins with the key statistical concepts and research approaches necessary to gain insight into various models of population dynamics The many factors that influence wildlife populations are thoroughly explored and their consequences are investigated In addition the author presents techniques for analyzing wildlife harvest data and a lucid discussion of valuable wildlife census methods Frequent examples of foundational literature supplement each chapter with applications of the theories and provide a concise compendium of fundamental concepts of population ecology Abundant statistical exercises reinforce students learning throughout the text

Ecological Census Techniques William J. Sutherland, 2006-08-03 This is an updated version of the best selling first edition Ecological Census Techniques with updating some new chapters and authors Almost all ecological and conservation work involves carrying out a census or survey This practically focussed book describes how to plan a census the practical details and shows with worked examples how to analyse the results The first three chapters describe planning sampling and the basic theory necessary for carrying out a census In the subsequent chapters international experts describe the appropriate methods for counting plants insects fish amphibians reptiles mammals and birds As many censuses also relate the results to environmental variability there is a chapter explaining the main methods Finally there is a list of the most common mistakes encountered when carrying out a census

Advanced Mathematical Methods in Biosciences and Applications Faina Berezovskaya, Bourama Toni, 2019-09-19 Featuring contributions from experts in mathematical biology and biomedical research this edited volume covers a diverse set of topics on mathematical methods and applications in the biosciences Topics focus on advanced mathematical methods with chapters on the mathematical analysis of the quasispecies model Arnold's weak resonance equation bifurcation analysis and the Tonnelier Gerstner model Special emphasis is placed on applications such as natural selection population heterogeneity polyvariant ontogeny in plants cancer dynamics and analytical solutions for traveling pulses and wave trains in neural models A survey on quasiperiodic topology is also presented in this book Carefully peer

reviewed this volume is suitable for students interested in interdisciplinary research Researchers in applied mathematics and the biosciences will find this book an important resource on the latest developments in the field In keeping with the STEAM H series the editors hope to inspire interdisciplinary understanding and collaboration

Modeling Biological Systems:
James W. Haefner, 2005-05-06 I Principles 1 1 Models of Systems 3 1 1 Systems Models and Modeling 3 1 2 Uses of Scientific Models 4 1 3 Example Island Biogeography 6 1 4 Classifications of Models 10 1 5 Constraints on Model Structure 12 1 6 Some Terminology 12 1 7 Misuses of Models The Dark Side 13 1 8 Exercises 15 2 The Modeling Process 17 2 1 Models Are Problems 17 2 2 Two Alternative Approaches 18 2 3 An Example Population Doubling Time 24 2 4 Model Objectives 28 2 5 Exercises 30 3 Qualitative Model Formulation 32 3 1 How to Eat an Elephant 32 3 2 Forrester Diagrams 33 3 3 Examples 36 3 4 Errors in Forrester Diagrams 44 3 5 Advantages and Disadvantages of Forrester Diagrams 44 3 6 Principles of Qualitative Formulation 45 3 7 Model Simplification 47 3 8 Other Modeling Problems 49 viii Contents 3 9 Exercises 53 4 Quantitative Model Formulation I 4 1 From Qualitative to Quantitative Finite Difference Equations and Differential Equations 4 2 4 3 Biological Feedback in Quantitative Models 4 4 Example Model 4 5 Exercises 5 Quantitative Model Formulation II 81 5 1 Physical Processes 81 5 2 Using the Toolbox of Biological Processes 89 5 3 Useful Functions 96 5 4 Examples 102 5 5 Exercises 104 6 Numerical Techniques 107 6 1 Mistakes Computers Make 107 6 2 Numerical Integration 110 6 3 Numerical Instability and Stiff Equations 115

Analysis of Ecological Systems: State-of-the-Art in Ecological Modelling W.K. Lauenroth, G.V. Skogerboe, M. Flug, 2013-10-22 The International Society for Ecological Modelling ISEM sponsors conferences workshops and training courses with the aim of advancing the development of ecological and environmental modelling The 3rd International Conference on the state of the art in ecological modelling was sponsored by the ISEM in cooperation with the National Park Service Water Resources Laboratory and hosted by the Natural Resource Ecology Laboratory at Colorado State University Its theme was the application of ecological modelling to environmental management and this book contains the full texts of the three invited papers presented in the five general sessions plus the final summaries and syntheses of the topics covered during those sessions

Ecological Modeling in Risk Assessment Robert A. Pastorok, Steven M. Bartell, Scott Ferson, Lev R. Ginzburg, 2016-04-19 Expanding the risk assessment toolbox this book provides a comprehensive and practical evaluation of specific ecological models for potential use in risk assessment Ecological Modeling in Risk Assessment Chemical Effects on Populations Ecosystems and Landscapes goes beyond current risk assessment practices for toxic chemicals as applied to individual organism endpoints to describe ecological effects models useful at the population ecosystem and landscape levels The authors demonstrate the utility of a set of ecological effects models eventually improving the ecological relevance of risk assessments and making data collection more cost effective

Quantitative Ecology and Evolutionary Biology Otso Ovaskainen, Henrik Johan de Knecht, Maria del Mar Delgado, 2016-09-01 This novel interdisciplinary text achieves an integration of empirical data and theory with the aid of

mathematical models and statistical methods The emphasis throughout is on spatial ecology and evolution especially on the interplay between environmental heterogeneity and biological processes The book provides a coherent theme by interlinking the modelling approaches used for different subfields of spatial ecology movement ecology population ecology community ecology and genetics and evolutionary ecology each being represented by a separate chapter Each chapter starts by describing the concept of each modelling approach in its biological context goes on to present the relevant mathematical models and statistical methods and ends with a discussion of the benefits and limitations of each approach The concepts and techniques discussed throughout the book are illustrated throughout with the help of empirical examples This is an advanced text suitable for any biologist interested in the integration of empirical data and theory in spatial ecology evolution through the use of quantitative statistical methods and mathematical models The book will also be of relevance and use as a textbook for graduate level courses in spatial ecology ecological modelling theoretical ecology and statistical ecology *Handbook of Ecological Modelling and Informatics* Sven Erik Jørgensen, T-S. Chon, Friedrich Recknagel, 2009-01-30 The book gives a comprehensive overview of all available types of ecological models It is the first book of its kind that gives an overview of different model types and will be of interest to all those involved in ecological and environmental modelling and ecological informatics Handbook of Measurement Error Models Grace Y. Yi, Aurore Delaigle, Paul Gustafson, 2021-10-17

Measurement error arises ubiquitously in applications and has been of long standing concern in a variety of fields including medical research epidemiological studies economics environmental studies and survey research While several research monographs are available to summarize methods and strategies of handling different measurement error problems research in this area continues to attract extensive attention The Handbook of Measurement Error Models provides overviews of various topics on measurement error problems It collects carefully edited chapters concerning issues of measurement error and evolving statistical methods with a good balance of methodology and applications It is prepared for readers who wish to start research and gain insights into challenges methods and applications related to error prone data It also serves as a reference text on statistical methods and applications pertinent to measurement error models for researchers and data analysts alike Features Provides an account of past development and modern advancement concerning measurement error problems Highlights the challenges induced by error contaminated data Introduces off the shelf methods for mitigating deleterious impacts of measurement error Describes state of the art strategies for conducting in depth research

Encyclopedia of Ecology Brian D. Fath, 2018-08-23 Encyclopedia of Ecology Second Edition Four Volume Set continues the acclaimed work of the previous edition published in 2008 It covers all scales of biological organization from organisms to populations to communities and ecosystems Laboratory field simulation modelling and theoretical approaches are presented to show how living systems sustain structure and function in space and time New areas of focus include micro and macro scales molecular and genetic ecology and global ecology e g climate change earth transformations ecosystem services and

the food water energy nexus are included In addition new international experts in ecology contribute on a variety of topics Offers the most broad ranging and comprehensive resource available in the field of ecology Provides foundational content and suggests further reading Incorporates the expertise of over 500 outstanding investigators in the field of ecology including top young scientists with both research and teaching experience Includes multimedia resources such as an Interactive Map Viewer and links to a CSDMS Community Surface Dynamics Modeling System an open source platform for modelers to share and link models dealing with earth system processes

Conservation Biology for All Navjot S. Sodhi,Paul R. Ehrlich,2010-01-07 Conservation Biology for All provides cutting edge but basic conservation science to a global readership A series of authoritative chapters have been written by the top names in conservation biology with the principal aim of disseminating cutting edge conservation knowledge as widely as possible Important topics such as balancing conversion and human needs climate change conservation planning designing and analyzing conservation research ecosystem services endangered species management extinctions fire habitat loss and invasive species are covered Numerous textboxes describing additional relevant material or case studies are also included The global biodiversity crisis is now unstoppable what can be saved in the developing world will require an educated constituency in both the developing and developed world Habitat loss is particularly acute in developing countries which is of special concern because it tends to be these locations where the greatest species diversity and richest centres of endemism are to be found Sadly developing world conservation scientists have found it difficult to access an authoritative textbook which is particularly ironic since it is these countries where the potential benefits of knowledge application are greatest There is now an urgent need to educate the next generation of scientists in developing countries so that they are in a better position to protect their natural resources

Stable Isotopes in Ecology and Environmental Science Robert Michener,Kate Lajtha,2008-04-15 This book highlights new and emerging uses of stable isotope analysis in a variety of ecological disciplines While the use of natural abundance isotopes in ecological research is now relatively standard new techniques and ways of interpreting patterns are developing rapidly The second edition of this book provides a thorough up to date examination of these methods of research As part of the Ecological Methods and Concepts series which provides the latest information on experimental techniques in ecology this book looks at a wide range of techniques that use natural abundance isotopes to follow whole ecosystem element cycling understand processes of soil organic matter formation follow the movement of water in whole watersheds understand the effects of pollution in both terrestrial and aquatic environments study extreme systems such as hydrothermal vents follow migrating organisms In each case the book explains the background to the methodology looks at the underlying principles and assumptions and outlines the potential limitations and pitfalls Stable Isotopes in Ecology and Environmental Science is an ideal resource for both ecologists who are new to isotopic analysis and more experienced isotope ecologists interested in innovative techniques and pioneering new uses

ISS-2012 Proceedings Volume On Longitudinal Data Analysis

Subject to Measurement Errors, Missing Values, and/or Outliers Brajendra C. Sutradhar, 2013-08-13 This proceedings volume contains nine selected papers that were presented in the International Symposium in Statistics 2012 held at Memorial University from July 16 to 18 These nine papers cover three different areas for longitudinal data analysis four dealing with longitudinal data subject to measurement errors four on incomplete longitudinal data analysis and the last one for inferences for longitudinal data subject to outliers Unlike in the independence setup the inferences in measurement errors missing values and or outlier models are not adequately discussed in the longitudinal setup The papers in the present volume provide details on successes and further challenges in these three areas for longitudinal data analysis This volume is the first outlet with current research in three important areas in the longitudinal setup The nine papers presented in three parts clearly reveal the similarities and differences in inference techniques used for three different longitudinal setups Because the research problems considered in this volume are encountered in many real life studies in biomedical clinical epidemiology socioeconomic econometrics and engineering fields the volume should be useful to the researchers including graduate students in these areas

Ecological Model Types, 2016-10-28 Ecological Model Types brings an understanding on how to quantitatively analyze complex and dynamic ecosystems with the tools available today Ecosystem studies widely use the notions of order complexity randomness and organization and are used interchangeably in literature which causes much confusion Better models synthesize our knowledge on ecosystems and their environmental problems in contrast to statistical analysis which only reveal the relationships between the data This book brings together experts on ecological models to create a definitive work on how to understand our complex Earth Bridges the gap between statistical analysis and synthesis of data enhancing our understanding about ecosystems and their environmental problems Helps readers understand complex ecosystems by walking through the best modeling options to analyze and predict environmental effects Provides a detailed review of 14 model types covering the breadth of options available for analysis at this time

Modeling and Simulation in Ecotoxicology with Applications in MATLAB and Simulink Kenneth R. Dixon, 2016-04-19 Exploring roles critical to environmental toxicology Modeling and Simulation in Ecotoxicology with Applications in MATLAB and Simulink covers the steps in modeling and simulation from problem conception to validation and simulation analysis Using the MATLAB and Simulink programming languages the book presents examples of mathematical functions a

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