



PRINCETON SERIES IN THEORETICAL AND COMPUTATIONAL BIOLOGY

Individual-based Modeling and Ecology

VOLKER GRIMM AND STEVEN F. RAILSBACK

Individual Based Modeling And Ecology Princeton Series In Theoretical And Computational Biology

James Devillers



Individual Based Modeling And Ecology Princeton Series In Theoretical And Computational Biology:

Individual-based Modeling and Ecology Volker Grimm, Steven F. Railsback, 2005 *Individual-based Modeling and Ecology* Volker Grimm, Steven F. Railsback, 2013-11-28 Individual based models are an exciting and widely used new tool for ecology These computational models allow scientists to explore the mechanisms through which population and ecosystem ecology arises from how individuals interact with each other and their environment This book provides the first in depth treatment of individual based modeling and its use to develop theoretical understanding of how ecological systems work an approach the authors call individual based ecology Grimm and Railsback start with a general primer on modeling how to design models that are as simple as possible while still allowing specific problems to be solved and how to move efficiently through a cycle of pattern oriented model design implementation and analysis Next they address the problems of theory and conceptual framework for individual based ecology What is theory That is how do we develop reusable models of how system dynamics arise from characteristics of individuals What conceptual framework do we use when the classical differential equation framework no longer applies An extensive review illustrates the ecological problems that have been addressed with individual based models The authors then identify how the mechanics of building and using individual based models differ from those of traditional science and provide guidance on formulating programming and analyzing models This book will be helpful to ecologists interested in modeling and to other scientists interested in agent based modeling **Integrated**

Population Biology and Modeling Part B, 2019-02-05 Integrated Population Biology and Modeling Part B Volume 40 offers very delicately complex and precise realities of quantifying modern and traditional methods of understanding populations and population dynamics with this updated release focusing on Prey predator animal models Back projections Evolutionary Biology computations Population biology of collective behavior and bio patchiness Collective behavior Population biology through data science Mathematical modeling of multi species mutualism new insights remaining challenges and applications to ecology Population Dynamics of Manipur Stochastic Processes and Population Dynamics Models The Mechanisms for Extinction Persistence and Resonance Theories of Stationary Populations and association with life lived and life left and more Studies human and animal models that are studied both separately and throughout chapters Presents a comprehensive and timely update on integrated population biology **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 and 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

Tools for Oceanography and Ecosystemic Modeling André Monaco,Patrick Prouzet,2016-07-14 Studying the Ocean Planet requires measuring and sampling instruments to feed models that take into account its complexity This book presents the diversity of observation and monitoring techniques at various scales but also different kinds of model that take into account some conceptual schemes incorporating various scientific knowledge Sampling is approached via the efficiency of fishing gears underwater acoustics is used to detect count identify and listen to live and mobile living resources Bio logging allows us to rely on the behavior of marine animals to help investigate environments that are difficult to sample by conventional means while listing the physiological changes they undergo Modeling is presented not only in a functional framework but also in an exploratory design incorporating various scenarios for ecosystem changes under the pressure of global change This ninth volume completes the Seas and Oceans Set that adopts a transversal approach leading to the governance and sustainable management of the marine environment

Population Ecology in Practice Dennis L. Murray,Brett K. Sandercock,2019-12-20 A synthesis of contemporary analytical and modeling approaches in population ecology The book provides an overview of the key analytical approaches that are currently used in demographic genetic and spatial analyses in population ecology The chapters present current problems introduce advances in analytical methods and models and demonstrate the applications of quantitative methods to ecological data The book covers new tools for designing robust field studies estimation of abundance and demographic rates matrix population models and analyses of population dynamics and current approaches for genetic and spatial analysis Each chapter is illustrated by empirical examples based on real datasets with a companion website that offers online exercises and examples of computer code in the R statistical software platform Fills a niche for a book that emphasizes applied aspects of population analysis Covers many of the current methods being used to analyse population dynamics and structure Illustrates the application of specific analytical methods through worked examples based on real datasets Offers readers the opportunity to work through examples or adapt the routines to their own datasets using computer code in the R statistical platform Population Ecology in Practice is an excellent book for upper level undergraduate and graduate students taking courses in population ecology or ecological statistics as well as established researchers needing a desktop reference for contemporary methods used to develop robust population

assessments *Environmental Modelling* John Wainwright, Mark Mulligan, 2013-01-22 Simulation models are an established method used to investigate processes and solve practical problems in a wide variety of disciplines Central to the concept of this second edition is the idea that environmental systems are complex open systems The authors present the diversity of approaches to dealing with environmental complexity and then encourage readers to make comparisons between these approaches and between different disciplines *Environmental Modelling Finding Simplicity in Complexity* 2nd edition is divided into four main sections An overview of methods and approaches to modelling State of the art for modelling environmental processes Tools used and models for management Current and future developments The second edition evolves from the first by providing additional emphasis and material for those students wishing to specialize in environmental modelling This edition Focuses on simplifying complex environmental systems Reviews current software tools and techniques for modelling Gives practical examples from a wide variety of disciplines e g climatology ecology hydrology geomorphology and engineering Has an associated website containing colour images links to WWW resources and chapter support pages including data sets relating to case studies exercises and model animations This book is suitable for final year undergraduates and postgraduates in environmental modelling environmental science civil engineering and biology who will already be familiar with the subject and are moving on to specialize in the field It is also designed to appeal to professionals interested in the environmental sciences including environmental consultants government employees civil engineers geographers ecologists meteorologists and geochemists **Active Particles, Volume 4** José Antonio Carrillo, Eitan Tadmor, 2024-12-12 This edited volume collects nine surveys that present the state of the art in modeling qualitative analysis and simulation of active particles focusing on specific applications in the natural sciences As in the preceding *Active Particles* volumes it blends diverse applications that demonstrate the interdisciplinary nature of the subject and the various mathematical tools available Contributions were selected with the aim of covering a variety of viewpoints from modeling the interactions in collective dynamics of animals and in population dynamics through neural networks semi supervised learning and Monte Carlo methods in optimization to kinetic and continuum theories with applications to aggregations and birth and death processes Mathematicians and other members of the scientific community interested in active matter and its many applications will find this volume to be a timely authoritative and valuable resource **The Oxford Handbook of Cognitive Sociology** Wayne H. Brekhus, Gabe Ignatow, 2019-06-26 In recent years there has been a growing interest in cognition within sociology and other social sciences Within sociology this interest cuts across various topical subfields including culture social psychology religion race and identity Scholars within the new subfield of cognitive sociology also referred to as the sociology of culture and cognition are contributing to a rapidly developing body of work on how mental and social phenomena are interrelated and often interdependent In *The Oxford Handbook of Cognitive Sociology* Wayne H Brekhus and Gabe Igantow have gathered some of the most influential scholars working in cognitive sociology to present an

accessible introduction to key research areas in a diverse field While classical sociological and newer interdisciplinary approaches have been covered separately by scholars in the past this volume alternatively presents a broad range of cognitive sociological perspectives The contributors discuss a range of approaches for theorizing and analyzing the social mind including macro cultural approaches interactionist approaches and research that draws on Pierre Bourdieu s major concepts Each chapter further investigates a variety of cognitive processes within these three approaches such as attention and inattention perception automatic and deliberate cognition cognition and social action stereotypes categorization classification judgment symbolic boundaries meaning making metaphor embodied cognition morality and religion identity construction time sequencing and memory A comprehensive look at cognitive sociology s main contributions and the central debates within the field the Handbook will serve as a primary resource for social researchers faculty and students interested in how cognitive sociology can contribute to research within their substantive areas of focus **Multi-Agent-Based**

Simulation XV Francisco Grimaldo, Emma Norling, 2015-01-03 This book constitutes the thoroughly refereed post conference proceedings of the 15th International Workshop on Multi Agent Based Simulation MABS 2014 held in Paris France in May 2014 The workshop was held in conjunction with the 13th International Conference on Autonomous Agents and Multiagent Systems AAMAS 2014 The 17 revised full papers included in this volume were carefully selected from numerous submissions The papers are organized in topical sections on simulation methodologies simulation of social behaviour data and multi agent based simulation and applications *In Silico Bees* James Devillers, 2014-01-27 Bees are critically important for ecosystem function and biodiversity maintenance through their pollinating activity Unfortunately bee populations are faced with many threats and evidence of a massive global pollination crisis is steadily growing As a result there is a need to understand and ideally predict how bees respond to pollution disturbance to the changes over landscape gradients and how their responses can vary in different habitats which are influenced to different degrees by human activities Modeling approaches are useful to simulate the behavior of whole population dynamics as well as to focus on important phenomena detrimental to bee life history traits They also allow simulation of how a disease or a pesticide can impact the survival and growth of a bee population In Silico Bees provides a collection of computational methods to those primarily interested in the study of the ecology ethology and ecotoxicology of bees The book presents different cases studies to enable readers to understand the significance and also the limitations of models in theoretical and applied bee research The text covers modeling of honey bee society organization infectious diseases in colonies pesticide toxicity chemical contamination of the hive and more Written by an international team of scientists this book is of primary interest to those whose research or professional activity is directly concerned with the study of bees It is also intended to provide graduate and post graduate students with a clear and accessible text covering the main types of modeling approaches that can be used in terrestrial ecology and ecotoxicology *The Network Challenge (Chapter 8)* Steven O. Kimbrough, 2009-05-19 Artificial

intelligence AI offers computational methodologies for modeling systems which can be valuable in understanding networks In this chapter the author examines several types of applications of these methods in exploring how the behavior of individual agents leads to outcomes across networks For example he considers how one system based on a Prisoner s Dilemma that provides a higher payoff for players who don t cooperate can result in a surprising outcome in which cooperation dominates after many rounds of play He also considers agent based models including turtles in a pond showing discrimination effects and sugar and spice trading showing interactions through trading Finally he explores applications to ant colony optimization and swarming optimization of flocks of birds or schools of fish He concludes that computational models offer important insights into networks and the procedures used in modeling have a significant impact The discussion also demonstrates that networks matter affecting outcomes in sometimes unpredictable ways

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

Multi-Agent Systems Adelinde M. Uhrmacher, Danny Weyns, 2018-10-08

Methodological Guidelines for Modeling and Developing MAS Based Simulations The intersection of agents modeling simulation and application domains has been the subject of active research for over two decades Although agents and simulation have been used effectively in a variety of application domains much of the supporting research remains scattered in the literature too often leaving scientists to develop multi agent system MAS models and simulations from scratch

Multi Agent Systems Simulation and Applications provides an overdue review of the wide ranging facets of MAS simulation including methodological and application oriented guidelines This comprehensive resource reviews two decades of research in the intersection of MAS simulation and different application domains It provides scientists and developers with disciplined engineering approaches to modeling and developing MAS based simulations After providing an overview of the field s history and its basic principles as well as

cataloging the various simulation engines for MAS the book devotes three sections to current and emerging approaches and applications Simulation for MAS explains simulation support for agent decision making the use of simulation for the design of self organizing systems the role of software architecture in simulating MAS and the use of simulation for studying learning and stigmergic interaction MAS for Simulation discusses an agent based framework for symbiotic simulation the use of country databases and expert systems for agent based modeling of social systems crowd behavior modeling agent based modeling and simulation of adult stem cells and agents for traffic simulation Tools presents a number of representative platforms and tools for MAS and simulation including Jason James II SeSAM and RoboCup Rescue Complete with over 200 figures and formulas this reference book provides the necessary overview of experiences with MAS simulation and the tools needed to exploit simulation in MAS for future research in a vast array of applications including home security computational systems biology and traffic management

Advanced Modelling Techniques Studying Global Changes in Environmental Sciences, 2015-10-08 Advanced Modelling Techniques Studying Global Changes in Environmental Sciences discusses the need for immediate and effective action guided by a scientific understanding of ecosystem function to alleviate current pressures on the environment Research especially in Ecological Modeling is crucial to support the sustainable development paradigm in which the economy society and the environment are integrated and positively reinforce each other Content from this book is drawn from the 2013 conference of the International Society for Ecological Modeling ISEM an important and active research community contributing to this arena Some progress towards gaining a better understanding of the processes of global change has been achieved but much more is needed This conference provides a forum to present current research using models to investigate actions towards mitigating and adapting to change Presents state of the art modeling techniques Drawn from the 2013 conference of the International Society for Ecological Modeling ISEM an important and active research community contributing to this arena Integrates knowledge of advanced modeling techniques in ecological and environmental sciences Describes new applications for sustainability

The Contribution of Young Researchers to Bayesian Statistics Ettore Lanzarone, Francesca Ieva, 2013-11-22 The first Bayesian Young Statisticians Meeting BAYSM 2013 has provided a unique opportunity for young researchers M S students Ph D students and post docs dealing with Bayesian statistics to connect with the Bayesian community at large exchange ideas and network with scholars working in their field The Workshop which took place June 5th and 6th 2013 at CNR IMATI Milan has promoted further research in all the fields where Bayesian statistics may be employed under the guidance of renowned plenary lecturers and senior discussants A selection of the contributions to the meeting and the summary of one of the plenary lectures compose this volume

Spatiotemporal Patterns in Ecology and Epidemiology Horst Malchow, Sergei V. Petrovskii, Ezio Venturino, 2007-12-26 Although the spatial dimension of ecosystem dynamics is now widely recognized the specific mechanisms behind species patterning in space are still poorly understood and the corresponding theoretical framework is

underdeveloped Going beyond the classical Turing scenario of pattern formation Spatiotemporal Patterns in Ecology and Epidemiology **Euro-Par 2017: Parallel Processing Workshops** Dora B. Heras, Luc Bougé, Gabriele

Mencagli, Emmanuel Jeannot, Rizos Sakellariou, Rosa M. Badia, Jorge G. Barbosa, Laura Ricci, Stephen L. Scott, Stefan Lankes, Josef Weidendorfer, 2018-02-07 This book constitutes the proceedings of the workshops of the 23rd International Conference on Parallel and Distributed Computing Euro Par 2017 held in Santiago de Compostela Spain in August 2017 The 59 full papers presented were carefully reviewed and selected from 119 submissions Euro Par is an annual international conference in Europe covering all aspects of parallel and distributed processing These range from theory to practice from small to the largest parallel and distributed systems and infrastructures from fundamental computational problems to full edged applications from architecture compiler language and interface design and implementation to tools support infrastructures and application performance aspects **The Individual Microbe: Single-Cell Analysis and Agent-Based**

Modelling Johan H. J. Leveau, Ferdi L. Hellweger, Jan-Ulrich Kreft, Clara Prats, Weiwen Zhang, 2019-02-19 Recent technological advances in single cell microbiology using flow cytometry microfluidics x ray fluorescence microprobes and single cell omics allow for the observation of individuals within populations Simultaneously individual based models or more generally agent based models allow for individual microbes to be simulated Bridging these techniques forms the foundation of individual based ecology of microbes IBE IBE has elucidated genetic and phenotypic heterogeneity that has important consequences for a number of human interests including antibiotic or biocide resistance the productivity and stability of industrial fermentations the efficacy of food preservatives and the potential of pathogens to cause disease Individual based models can help us to understand how these sets of traits of individual microbes influence the above This eBook compiles all publications from a recent Research Topic in Frontiers in Microbiology It features recent research where individual observational and or modelling techniques are applied to gain unique insights into the ecology of microorganisms The Research Topic The Individual Microbe Single Cell Analysis and Agent Based Modelling arose from the 2016 ASM conference of the same name hosted by the American Society for Microbiology at its headquarters in Washington D C We are grateful to ASM for funding and hosting this conference **Advances in Social Simulation** Harko Verhagen, Melania

Borit, Giangiacomo Bravo, Nanda Wijermans, 2020-04-30 This book presents the state of the art in social simulation as presented at the Social Simulation Conference 2018 in Stockholm Sweden It covers the developments in applications and methods of social simulation addressing societal issues such as socio ecological systems and policy making Methodological issues discussed include large scale empirical calibration model sharing and interdisciplinary research as well as decision making models validation and the use of qualitative data in simulation modeling Research areas covered include archaeology cognitive science economics organization science and social simulation education This collection gives readers insight into the increasing use of social simulation in both its theoretical development and in practical applications such as policy making

whereby modelling and the behavior of complex systems is key The book will appeal to students researchers and professionals in the various fields

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