

Agent-Based and Individual-Based Modeling

A PRACTICAL INTRODUCTION
SECOND EDITION



Steven F. Railsback and Volker Grimm

Agent Based And Individual Based Modeling A Practical Introduction

Patrick Vollmar



Agent Based And Individual Based Modeling A Practical Introduction:

Agent-Based and Individual-Based Modeling Steven F. Railsback, Volker Grimm, 2012 Agent based modeling is a new technique for understanding how the dynamics of biological social and other complex systems arise from the characteristics and behaviors of the agents making up these systems This innovative textbook gives students and scientists the skills to design implement and analyze agent based models It starts with the fundamentals of modeling and provides an introduction to NetLogo an easy to use free and powerful software platform Nine chapters then each introduce an important modeling concept and show how to implement it using NetLogo The book goes on to present strategies for finding the right level of model complexity and developing theory for agent behavior and for analyzing and learning from models Agent Based and Individual Based Modeling features concise and accessible text numerous examples and exercises using small but scientific models The emphasis throughout is on analysis such as software testing theory development robustness analysis and understanding full models and on design issues like optimizing model structure and finding good parameter values The first hands on introduction to agent based modeling from conceptual design to computer implementation to parameterization and analysis Provides an introduction to NetLogo with nine chapters introducing an important modeling concept and showing how to implement it using NetLogo Filled with examples and exercises with updates and supplementary materials at <http://www.railsbackgrimmabmbook.com> Designed for students and researchers across the biological and social sciences Written by leading practitioners Leading universities that have adopted this book include Amherst College Brigham Young University Carnegie Mellon University Cornell University Miami University Northwestern University Old Dominion University Portland State University Rhodes College Susquehanna University University College Dublin University of Arizona University of British Columbia University of Michigan University of South Florida University of Texas at Austin University of Virginia

Agent-Based and Individual-Based Modeling Steven F. Railsback, Volker Grimm, 2025-06-03 The essential textbook on agent based modeling now fully updated and expanded Agent Based and Individual Based Modeling has become the standard textbook on the subject for classroom use and self instruction Drawing on the latest version of NetLogo and fully updated with new examples exercises and an enhanced text for easier comprehension this is the essential resource for anyone seeking to understand how the dynamics of biological social and other complex systems arise from the characteristics of the agents that make up these systems Steven Railsback and Volker Grimm lead students stepwise through the processes of designing programming documenting and doing scientific research with agent based models focusing on the adaptive behaviors that make these models necessary They cover the fundamentals of modeling and model analysis introduce key modeling concepts and demonstrate how to implement them using NetLogo They also address pattern oriented modeling an invaluable strategy for modeling real world problems and developing theory This accessible and authoritative book focuses on modeling as a tool for understanding real complex systems It explains how to pose a specific question use observations from actual systems to

design models write and test software and more A hands on introduction that guides students from conceptual design to computer implementation to analysis Filled with new examples and exercises and compatible with the latest version of NetLogo Ideal for students and researchers across the natural and social sciences Written by two leading practitioners Supported by extensive instructional materials at www.railsback.grimm.abm.book.com

Agent-Based Modelling in Economics Lynne Hamill, Nigel Gilbert, 2016-01-19 Agent based modelling in economics Lynne Hamill and Nigel Gilbert Centre for Research in Social Simulation CRESS University of Surrey UK New methods of economic modelling have been sought as a result of the global economic downturn in 2008 This unique book highlights the benefits of an agent based modelling ABM approach It demonstrates how ABM can easily handle complexity heterogeneous people households and firms interacting dynamically Unlike traditional methods ABM does not require people or firms to optimise or economic systems to reach equilibrium ABM offers a way to link micro foundations directly to the macro situation Key features Introduces the concept of agent based modelling and shows how it differs from existing approaches Provides a theoretical and methodological rationale for using ABM in economics along with practical advice on how to design and create the models Each chapter starts with a short summary of the relevant economic theory and then shows how to apply ABM Explores both topics covered in basic economics textbooks and current important policy themes unemployment exchange rates banking and environmental issues Describes the models in pseudocode enabling the reader to develop programs in their chosen language Supported by a website featuring the NetLogo models described in the book Agent based Modelling in Economics provides students and researchers with the skills to design implement and analyze agent based models Third year undergraduate master and doctoral students faculty and professional economists will find this book an invaluable resource

Agent-Based Modelling in Population Studies André Grow, Jan Van Bavel, 2016-08-11 This book examines the use of agent based modelling ABM in population studies from concepts to applications best practices to future developments It features papers written by leading experts in the field that will help readers to better understand the usefulness of ABM for population projections how ABM can be injected with empirical data to achieve a better match between model and reality how geographic information can be fruitfully used in ABM and how ABM results can be reported effectively and correctly Coverage ranges from detailing the relation between ABM and existing paradigms in population studies to infusing agent based models with empirical data The papers show the benefits that ABM offers the field including enhanced theory formation by better linking the micro level with the macro level the ability to represent populations more adequately as complex systems and the possibility to study rare events and the implications of alternative mechanisms in artificial laboratories In addition readers will discover guidelines and best practices with detailed examples of how to apply agent based models in different areas of population research including human mating behaviour migration and socio structural determinants of health behaviours Earlier versions of the papers in this book have been presented at the workshop Recent

Developments and Future Directions in Agent Based Modelling in Population Studies which took place at the University of Leuven KU Leuven Belgium in September 2014 The book will contribute to the development of best practices in the field and will provide a solid point of reference for scholars who want to start using agent based modelling in their own research

Agent-Based Modelling and Geographical Information Systems Andrew Crooks, Nicolas Malleon, Ed Manley, Alison Heppenstall, 2018-12-13 This is the era of Big Data and computational social science It is an era that requires tools which can do more than visualise data but also model the complex relation between data and human action and interaction Agent Based Models ABM computational models which simulate human action and interaction do just that This textbook explains how to design and build ABM and how to link the models to Geographical Information Systems It guides you from the basics through to constructing more complex models which work with data and human behaviour in a spatial context All of the fundamental concepts are explained and related to practical examples to facilitate learning with models developed in NetLogo with all code examples available on the accompanying website You will be able to use these models to develop your own applications and link where appropriate to Geographical Information Systems All of the key ideas and methods are explained in detail geographical modelling an introduction to ABM the fundamentals of Geographical Information Science why ABM and GIS using QGIS designing and building an ABM calibration and validation modelling human behavior An applied primer that provides fundamental knowledge and practical skills it will provide you with the skills to build and run your own models and to begin your own research projects

Industrial, medical and environmental applications of microorganisms Antonio Méndez-Vilas, 2023-09-04 Industrial medical and environmental applications of microorganisms offers an excellent opportunity to learn about new insights methods techniques and advances in applied microbiology It is useful not only for those traditionally involved in this research area but for everyone that needs to keep up with this diverse discipline The articles are written by researchers from around the world and focus on seven themes Environmental microbiology Agriculture soil and forest microbiology Food microbiology Industrial microbiology Medical microbiology Biotechnologically relevant enzymes and proteins Methods and techniques education This book contains a compilation of papers presented at the V International Conference on Environmental Industrial and Applied Microbiology BioMicroWorld2013 held in Madrid Spain in October 2013

Agent-Based Models with MATLAB Erik Cuevas, Karla Avila, Miguel Islas Toski, Héctor Escobar, 2025-01-20 Agent Based Models with MATLAB introduces Agent Based Modeling ABM one of the most important methodologies for complex systems modeling The book explores computational implementations and accompanying MATLAB software code as a means of inspiring readers to apply agent based models to solve a diverse range of problems It comes with a large amount of software code that accompanies the main text and the modeling systems described in the book are implemented using MATLAB as the programming language Despite the heavy mathematical components of Agent Based Models and complex systems it is possible to utilize these models without in depth understanding of their mathematical

fundamentals This book enables computer scientists mathematicians researchers and engineers to apply ABM in a wide range of research and engineering applications It gradually advances from basic to more advanced methods while reinforcing complex systems through practical hands on applications of various computational models Considers the most crucial methods and models of Agent Based Models and complex systems Demonstrates how to use computational implementations in applying Agent Based Models to solve a diverse range of scientific research and engineering problems Provides a wide range of hands on implementation examples along with MATLAB software code readers can experiment with and modify

Biomathematical Modeling Olcay Akman, Christopher Hay-Jahans, 2025-05-19 Welcome to the fascinating intersection of mathematics biology and ecology This book is intended primarily as a resource for teachers planning to teach their first introductory course on modeling in mathematical biology and or ecology This being said it can also be used by students preparing to embark on an independent studies project in one of these fields or by researchers unfamiliar with the methods or software introduced who are seeking an accessible and quick introduction to one of the methods and or software presented here or by curious biologists ecologists or mathematicians who may be unfamiliar with the other side or maybe by the perpetual learner who is intrigued by the dynamics of living ecosystems For each of the above this book is designed to be an accessible introduction to the captivating landscape of biomathematics The approach used in this book takes advantage of technology in leading readers on a journey that bridges seemingly distinct fields through introductions to three methods and software platforms Compartmental models with Berkeley Madonna agent based models with NetLogo and cluster analysis through selforganizing maps using an R Shiny app This is not intended to be a textbook though it may be used as one nor is it a purely mathematics book or one purely about deeper aspects of biology or ecology It focuses on three selected ways in which the intersection of mathematics and biology and mathematics and ecology can be explored with the help of software Moreover the manner in which the content is presented makes it possible to use this book to help prepare for an introductory course at a wide range of levels depending on the discipline within which the course is taught and the mathematical prerequisites for the course There are four chapters the first of which presents the reader with a bit of background information followed by suggestions on how to get the most out of this book The three core chapters introduce the three previously mentioned methods and software in a manner envisioned to be accessible to most **Modern Epidemiology**

Timothy L. Lash, Tyler J. VanderWeele, Sebastien Haneuse, Kenneth Rothman, 2020-12-11 Now in a fully revised Fourth Edition *Modern Epidemiology* remains the gold standard text in this complex and evolving field This edition continues to provide comprehensive coverage of the principles and methods for the design analysis and interpretation of epidemiologic research Featuring a new format allowing space for margin notes this edition Reflects both the conceptual development of this evolving science and the increasing role that epidemiology plays in improving public health and medicine Features new coverage of methods such as agent based modeling quasi experimental designs mediation analysis and causal modeling

Updates coverage of methods such as concepts of interaction bias analysis and time varying designs and analysis Continues to cover the full breadth of epidemiologic methods and concepts including epidemiologic measures of occurrence and effect study designs validity precision statistical interference field methods surveillance ecologic designs and use of secondary data sources Includes data analysis topics such as Bayesian analysis probabilistic bias analysis time to event analysis and an extensive overview of modern regression methods including logistic and survival regression splines longitudinal and cluster correlated hierarchical data analysis propensity scores and other scoring methods and marginal structural models Summarizes the history specialized aspects and future directions of topical areas including among others social epidemiology infectious disease epidemiology genetic and molecular epidemiology psychiatric epidemiology injury and violence epidemiology and pharmacoepidemiology

Translational Systems Biology Yoram Vodovotz, Gary An, 2014-10-08 Are we satisfied with the rate of drug development Are we happy with the drugs that come to market Are we getting our money's worth in spending for basic biomedical research In *Translational Systems Biology* Drs Yoram Vodovotz and Gary An address these questions by providing a foundational description the barriers facing biomedical research today and the immediate future and how these barriers could be overcome through the adoption of a robust and scalable approach that will form the underpinning of biomedical research for the future By using a combination of essays providing the intellectual basis of the Translational Dilemma and reports of examples in the study of inflammation the content of *Translational Systems Biology* will remain relevant as technology and knowledge advances bring broad translational applicability to other diseases Translational systems biology is an integrated multi scale evidence based approach that combines laboratory clinical and computational methods with an explicit goal of developing effective means of control of biological processes for improving human health and rapid clinical application This comprehensive approach to date has been utilized for in silico studies of sepsis trauma hemorrhage and traumatic brain injury acute liver failure wound healing and inflammation Provides an explicit reasoned and systematic approach to dealing with the challenges of translational science across disciplines Establishes the case for including computational modeling at all stages of biomedical research and healthcare delivery from early pre clinical studies to long term care by clearly delineating efficiency and costs saving important to business investment Guides readers on how to communicate across domains and disciplines particularly between biologists and computational researchers to effectively develop multi and trans disciplinary research teams

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