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Mathematical Concepts and Methods in Modern Biology John Wiley & Sons

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 Computational Modelling

Princeton University Press

Aimed at readers with minimal experience in computer programming, this text provides a theoretical and methodological rationale for using agent-based models in the social sciences.

Agent-Based Modeling for Archaeology John Wiley & Sons

Agent-based simulation has become increasingly popular as a modeling approach in the social sciences because it enables researchers to build models where individual entities and their interactions are directly represented. The Second Edition of Nigel Gilbert's Agent-Based Models introduces this technique; considers a range of methodological and theoretical issues; shows how to design an agent-based model, with a simple example; offers some practical advice about developing, verifying and validating agent-based models; and finally discusses how to plan an agent-based modelling project, publish the results and apply agent-based modeling to formulate and evaluate social and economic policies. An accompanying simulation using NetLogo and commentary on the program can be downloaded on the book's website: <https://study.sagepub.com/researchmethods/qass/gilbert-agent-based-models-2e>

Modeling Populations of Adaptive Individuals Springer

Tobacco consumption continues to be the leading cause of preventable disease and death in the United States. The Food and Drug Administration (FDA) regulates the manufacture, distribution, and marketing of tobacco products - specifically cigarettes, cigarette tobacco, roll-your-own tobacco, and smokeless tobacco - to protect public health and reduce tobacco use in the United States. Given the strong social component inherent to tobacco use onset, cessation, and relapse, and given the heterogeneity of those social interactions, agent-based models have the potential to be an essential tool in assessing the effects of policies to control tobacco. Assessing the Use of Agent-Based Models for Tobacco Regulation describes the complex tobacco environment; discusses the usefulness of agent-based models to inform tobacco policy and regulation; presents an evaluation framework for policy-relevant agent-based models; examines the role and type of data needed to develop agent-based models for tobacco regulation; provides an assessment of the agent-based model developed for FDA; and offers strategies for using agent-based models to inform decision making in the future.

Agent and Multi-Agent Systems: Technologies and Applications Princeton University Press

A comprehensive introduction to ocean ecology and a new way of thinking about ocean life Marine ecology is more interdisciplinary, broader in scope, and more intimately linked to human activities than ever before. Ocean Ecology provides advanced undergraduates, graduate students, and practitioners with an integrated approach to marine ecology that reflects these new scientific realities, and

prepares students for the challenges of studying and managing the ocean as a complex adaptive system. This authoritative and accessible textbook advances a framework based on interactions among four major features of marine ecosystems—geomorphology, the abiotic environment, biodiversity, and biogeochemistry—and shows how life is a driver of environmental conditions and dynamics. Ocean Ecology explains the ecological processes that link organismal to ecosystem scales and that shape the major types of ocean ecosystems, historically and in today's Anthropocene world. Provides an integrated new approach to understanding and managing the ocean Shows how biological diversity is the heart of functioning ecosystems Spans genes to earth systems, surface to seafloor, and estuary to ocean gyre Links species composition, trait distribution, and other ecological structures to the functioning of ecosystems Explains how fishing, fossil fuel combustion, industrial fertilizer use, and other human impacts are transforming the Anthropocene ocean An essential textbook for students and an invaluable resource for practitioners

Individual-based Modeling and Ecology SAGE

Geocomputation is the use of software and computing power to solve complex spatial problems. It is gaining increasing importance in the era of the 'big data' revolution, of 'smart cities', of crowdsourced data, and of associated applications for viewing and managing data geographically - like Google Maps. This student focused book: Provides a selection of practical examples of geocomputational techniques and 'hot topics' written by world leading practitioners. Integrates supporting materials in each chapter, such as code and data, enabling readers to work through the examples themselves. Chapters provide highly applied and practical discussions of: Visualisation and exploratory spatial data analysis Space time modelling Spatial algorithms Spatial regression and statistics Enabling interactions through the use of neogeography All chapters are uniform in design and each includes an introduction, case studies, conclusions - drawing together the generalities of the introduction and specific findings from the case study application - and guidance for further reading. This accessible text has been specifically designed for those readers who are new to Geocomputation as an area of research, showing how complex real-world problems can be solved through the integration of technology, data, and geocomputational methods. This is the applied primer for Geocomputation in the social sciences.

Agent-Based Models SAGE

Generate and Analyze Multi-Level Data Spatial

microsimulation involves the generation, analysis, and modeling of individual-level data allocated to geographical zones. Spatial Microsimulation with R is the first practical book to illustrate this approach in a modern statistical programming language.

Get Insight into Complex Behaviors The book progresses from the principles underlying population synthesis toward more complex issues such as household allocation and using the results of spatial microsimulation for agent-based modeling. This equips you with the skills needed to apply the techniques to real-world situations. The book demonstrates methods for population synthesis by combining individual and geographically aggregated datasets using the recent R packages `ipfp` and `mipfp`. This approach represents the "best of both worlds" in terms of spatial resolution and person-level detail, overcoming issues of data confidentiality and reproducibility. Implement the Methods on Your Own Data Full of reproducible examples using code and data, the book is suitable for students and applied researchers in health, economics, transport, geography, and other fields that require individual-level data allocated to small geographic zones. By explaining how to use tools for modeling phenomena that vary over space, the book enhances your knowledge of complex systems and empowers you to provide evidence-based policy guidance.

21st Century Skills Development Through Inquiry-Based Learning John Wiley & Sons

This book constitutes the refereed proceedings of the nine workshops co-located with the 15th International Conference on Practical Applications of Agents and Multi-Agent Systems, PAAMS 2017, held in Porto, Portugal, in June 2017. The 41 full papers presented were carefully reviewed and selected from 80 submissions. The volume presents the papers that have been accepted for the following workshops: Workshop on Agent based Applications for Air Transport and Application of Agents to Passenger Transport; Workshop on Agent-based Artificial Markets Computational Economics; Workshop on Agents and Multi-agent Systems for AAL and e-HEALTH; Workshop on Agent-Based Solutions for Manufacturing and Supply Chain; Workshop on MAS for Complex Networks and Social Computation; Workshop on Decision Making in Dynamic Information Environments; Workshop on Multi-agent based Applications for Smart Grids and Sustainable Energy Systems; Workshop on Multiagent System based Learning Environments; Workshop on Smart Cities and Intelligent Agents.

Generative Social Science Springer Science & Business Media

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 behaviour; visualisation and 3D ABM; using Big Geosocial Data, GIS and ABM. 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. Highlights of Practical Applications of Cyber-Physical Multi-Agent Systems Agent-Based and Individual-Based Modeling Most of the intriguing social phenomena of our time, such as international terrorism, social inequality, and urban ethnic segregation, are consequences of complex forms of agent interaction that are difficult to observe methodically and experimentally. This book looks at a new research stream that makes use of advanced computer simulation modelling techniques to spotlight agent interaction that allows us to explain the emergence of social patterns. It presents a method to pursue analytical sociology investigations that look at relevant social mechanisms in various empirical situations, such as markets, urban cities, and organisations. This book: Provides a comprehensive introduction to epistemological, theoretical and methodological features of agent-based modelling in sociology through various discussions and examples. Presents the pros and cons of using agent-based models in sociology. Explores agent-based models in combining quantitative and qualitative aspects, and micro- and macro levels of analysis. Looks at how to pose an agent-based research question, identifying the model building blocks, and how to validate simulation results. Features examples of agent-based models that look at crucial sociology issues. Supported by an accompanying website featuring data sets and code for the models included in the book. Agent-Based Computational Sociology is written in a common sociological language and features examples of models that look at all the traditional explanatory challenges of sociology. Researchers and graduate students involved in the field of agent-based modelling and computer simulation in areas such as social sciences, cognitive sciences and computer sciences will benefit from this book.

Agent-based Modeling and Simulation American Mathematical Soc.

The MATSim (Multi-Agent Transport Simulation) software project was started around 2006 with the goal of generating traffic and congestion patterns by following individual synthetic travelers through their daily or weekly activity programme. It has since then evolved from a collection of stand-alone C++ programs to an integrated Java-based framework which is publicly hosted, open-source available, automatically regression tested. It is currently used by about 40 groups throughout the world. This book takes stock of the current status. The first part of the book gives an introduction to the most important concepts, with the intention of enabling a potential user to set up and run basic simulations. The second part of the book describes how the basic functionality can be extended, for example by adding schedule-based public transit, electric or autonomous cars, paratransit, or within-day replanning. For each extension, the text provides pointers to the additional documentation and to the code base. It is also discussed how people with appropriate Java programming skills can write their own extensions, and plug them into the MATSim core. The project has started from the basic idea that traffic is a consequence of human behavior, and thus humans and their behavior should be the starting point of all modelling, and with the intuition that when simulations with 100 million particles are possible in computational physics, then behavior-oriented simulations with 10 million travelers should be possible in travel behavior research. The initial implementations thus combined concepts from computational physics and complex adaptive systems with concepts from travel behavior research. The third part of the book looks at theoretical concepts that are able to describe important aspects of the simulation system; for example, under certain conditions the code becomes a Monte Carlo engine sampling from a discrete choice model. Another important

aspect is the interpretation of the MATSim score as utility in the microeconomic sense, opening up a connection to benefit cost analysis. Finally, the book collects use cases as they have been undertaken with MATSim. All current users of MATSim were invited to submit their work, and many followed with sometimes crisp and short and sometimes longer contributions, always with pointers to additional references. We hope that the book will become an invitation to explore, to build and to extend agent-based modeling of travel behavior from the stable and well tested core of MATSim documented here.

Agent-based Modeling of Tax Evasion SAGE Publications
Mathematical Concepts and Methods in Modern Biology offers a quantitative framework for analyzing, predicting, and modulating the behavior of complex biological systems. The book presents important mathematical concepts, methods and tools in the context of essential questions raised in modern biology. Designed around the principles of project-based learning and problem-solving, the book considers biological topics such as neuronal networks, plant population growth, metabolic pathways, and phylogenetic tree reconstruction. The mathematical modeling tools brought to bear on these topics include Boolean and ordinary differential equations, projection matrices, agent-based modeling and several algebraic approaches. Heavy computation in some of the examples is eased by the use of freely available open-source software. Features self-contained chapters with real biological research examples using freely available computational tools Spans several mathematical techniques at basic to advanced levels Offers broad perspective on the uses of algebraic geometry/polynomial algebra in molecular systems biology
Geocomputation Princeton University Press
Operational Research (OR) deals with the use of advanced analytical methods to support better decision-making. It is multidisciplinary with strong links to management science, decision science, computer science and many application areas such as engineering, manufacturing, commerce and healthcare. In the study of emergent behaviour in complex adaptive systems, Agent-based Modelling & Simulation (ABMS) is being used in many different domains such as healthcare, energy, evacuation, commerce, manufacturing and defense. This collection of articles presents a convenient introduction to ABMS with papers ranging from contemporary views to representative case studies. The OR Essentials series presents a unique cross-section of high quality research work fundamental to understanding contemporary issues and research across a range of Operational Research (OR) topics. It brings together some of the best research papers from the esteemed Operational Research Society and its associated journals, also published by Palgrave Macmillan.

Principles of Financial Modelling John Wiley & Sons
Presents an overview of the complex biological systems used within a global public health setting and features a focus on malaria analysis Bridging the gap between agent-based modeling and simulation (ABMS) and geographic information systems (GIS), **Spatial Agent-Based Simulation Modeling in Public Health: Design, Implementation, and Applications for Malaria Epidemiology** provides a useful introduction to the development of agent-based models (ABMs) by following a conceptual and biological core model of *Anopheles gambiae* for malaria epidemiology. Using spatial ABMs, the book includes mosquito (vector) control interventions and GIS as two example applications of ABMs, as well as a brief description of epidemiology modeling. In addition, the authors discuss how to most effectively integrate spatial ABMs with a GIS. The book concludes with a combination of knowledge from entomological, epidemiological, simulation-based, and geo-spatial domains in order to identify and analyze relationships between various transmission variables of the disease. **Spatial Agent-Based Simulation Modeling in Public Health: Design, Implementation, and Applications for Malaria Epidemiology** also features: Location-specific mosquito abundance maps that play an important role in malaria control activities by guiding future resource allocation for malaria control and identifying hotspots for further investigation Discussions on the best modeling practices in an effort to achieve improved efficacy, cost-effectiveness, ecological soundness, and sustainability of vector control for malaria An overview of the various ABMs, GIS, and spatial statistical methods used in entomological and epidemiological studies, as well as the model malaria study A companion website with computer source code and flowcharts of the spatial ABM and a landscape generator tool that can simulate landscapes with varying spatial heterogeneity of different types of resources including aquatic habitats and houses **Spatial Agent-Based Simulation Modeling in Public Health: Design, Implementation, and Applications for Malaria Epidemiology** is an excellent reference for professionals such as modeling and simulation experts, GIS experts, spatial analysts, mathematicians, statisticians, epidemiologists, health policy makers, as well as researchers and scientists who use, manage, or analyze infectious disease data and/or infectious disease-related projects. The book is also ideal for graduate-level courses in modeling and simulation, bioinformatics, biostatistics, public health and policy, and epidemiology.
Agent-Based Modelling and Geographical Information Systems John Wiley & Sons

This unique book brings together a comprehensive set of papers on the background, theory, technical issues and applications of agent-based modelling (ABM) within geographical systems. This collection of papers is an invaluable reference point for the experienced agent-based modeller as well those new to the area. Specific geographical issues such as handling scale and space are dealt with as well as practical advice from leading experts about designing and creating ABMs, handling complexity, visualising and validating model outputs. With contributions from many of the world's leading research institutions, the latest applied research (micro and macro applications) from around the globe

exemplify what can be achieved in geographical context. This book is relevant to researchers, postgraduate and advanced undergraduate students, and professionals in the areas of quantitative geography, spatial analysis, spatial modelling, social simulation modelling and geographical information sciences.

SAGE
Introduction to Agent-Based Economics describes the principal elements of agent-based computational economics (ACE). It illustrates ACE's theoretical foundations, which are rooted in the application of the concept of complexity to the social sciences, and it depicts its growth and development from a non-linear out-of-equilibrium approach to a state-of-the-art agent-based macroeconomics. The book helps readers gain a better understanding of the limits and perspectives of the ACE models and their capacity to reproduce economic phenomena and empirical patterns. Reviews the literature of agent-based computational economics Analyzes approaches to agents' expectations Covers one of the few large macroeconomic agent-based models, the Modellaccio Illustrates both analytical and computational methodologies for producing tractable solutions of macro ACE models Describes diffusion and amplification mechanisms Depicts macroeconomic experiments related to ACE implementations

Agent-Based Modelling in Economics Princeton University Press
A comprehensive and hands-on introduction to the core concepts, methods, and applications of agent-based modeling, including detailed NetLogo examples. The advent of widespread fast computing has enabled us to work on more complex problems and to build and analyze more complex models. This book provides an introduction to one of the primary methodologies for research in this new field of knowledge. Agent-based modeling (ABM) offers a new way of doing science: by conducting computer-based experiments. ABM is applicable to complex systems embedded in natural, social, and engineered contexts, across domains that range from engineering to ecology. An Introduction to Agent-Based Modeling offers a comprehensive description of the core concepts, methods, and applications of ABM. Its hands-on approach—with hundreds of examples and exercises using NetLogo—enables readers to begin constructing models immediately, regardless of experience or discipline. The book first describes the nature and rationale of agent-based modeling, then presents the methodology for designing and building ABMs, and finally discusses how to utilize ABMs to answer complex questions. Features in each chapter include step-by-step guides to developing models in the main text; text boxes with additional information and concepts; end-of-chapter explorations; and references and lists of relevant reading. There is also an accompanying website with all the models and code.

Spatial Microsimulation with R Springer

This instructional book showcases techniques to parameterise human agents in empirical agent-based models (ABM). In doing so, it provides a timely overview of key ABM methodologies and the most innovative approaches through a variety of empirical applications. It features cutting-edge research from leading academics and practitioners, and will provide a guide for characterising and parameterising human agents in empirical ABM. In order to facilitate learning, this text shares the valuable experiences of other modellers in particular modelling situations. Very little has been published in the area of empirical ABM, and this contributed volume will appeal to graduate-level students and researchers studying simulation modeling in economics, sociology, ecology, and trans-disciplinary studies, such as topics related to sustainability. In a similar vein to the instruction found in a cookbook, this text provides the empirical modeller with a set of 'recipes' ready to be implemented. Agent-based modeling (ABM) is a powerful, simulation-modeling technique that has seen a dramatic increase in real-world applications in recent years. In ABM, a system is modeled as a collection of autonomous decision-making entities called "agents." Each agent individually assesses its situation and makes decisions on the basis of a set of rules. Agents may execute various behaviors appropriate for the system they represent—for example, producing, consuming, or selling. ABM is increasingly used for simulating real-world systems, such as natural resource use, transportation, public health, and conflict. Decision makers increasingly demand support that covers a multitude of indicators that can be effectively addressed using ABM. This is especially the case in situations where human behavior is identified as a critical element. As a result, ABM will only continue its rapid growth. This is the first volume in a series of books that aims to contribute to a cultural change in the community of empirical agent-based modelling. This series will bring together representational experiences and solutions in empirical agent-based modelling. Creating a platform to exchange such experiences allows comparison of solutions and facilitates learning in the empirical agent-based modelling community. Ultimately, the community requires such exchange and learning to test approaches and, thereby, to develop a robust set of techniques within the domain of empirical agent-based modelling. Based on robust and defensible methods, agent-based modelling will become a critical tool for research agencies, decision making and decision supporting agencies, and funding agencies. This series will contribute to more robust and defensible empirical agent-based modelling.

Agent-Based Models Academic Press
This book constitutes the refereed proceedings of the First International Conference on Computer Science, Engineering and Information Technology, CCSEIT 2011, held in Tirunelveli, India, in September 2011.

The 73 revised full papers were carefully reviewed and selected from more than 400 initial submissions. The papers feature significant contributions to all major fields of the Computer Science and Information Technology in theoretical and practical aspects.

Assessing the Use of Agent-Based Models for Tobacco Regulation SFI Press

Agent-based modeling is a flexible and intuitive approach that is close to both data and theories, which gives it a special position in the majority of scientific communities. Agent models are as much tools of understanding, exploration and adaptation as they are media for interdisciplinary exchange. It is in this kind of framework that this book is situated, beginning with agent-based modeling of spatialized phenomena with a methodological and practical orientation. Through a governing example, taking inspiration from a real problem in epidemiology, this book proposes, with pedagogy and economy, a guide to good practices of agent modeling. The reader will thus be able to understand and put the modeling into practice and acquire a certain amount of autonomy. Featuring the following well-known techniques and tools: Modeling, such as UML, Simulation, such as the NetLogo platform, Exploration methods, Adaptation using participative simulation