
Agent Based Computational Modelling Applications In Demography Social Economic And Environmental Sciences Contributions To Economics

With Applications for the Social Sciences
 A Practical Introduction, Second Edition
 Theory, Algorithms, Techniques and Applications
 Agent-Based Computational Sociology
 Multi-Agent Systems
 Agent-Based Computational Demography
 Transdisciplinary Models and Applications
 Methodological Investigations in Agent-Based Modelling
 Urban Informatics
 A Toolkit
 Agent-based Modeling of Tax Evasion
 Agent-based Computational Modeling of the Human Epidermis and Applications
 Assessing the Use of Agent-Based Models for Tobacco Regulation
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 Spatial Analysis in Field Primatology
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 Applications in Demography, Social, Economic and Environmental Sciences
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 Agent-Based Computational Economics
 Studies in Agent-Based Computational Modeling
 A Practical Primer
 Introduction to Computational Science
 Individual-based Modeling and Ecology
 Agent-Based Models of Geographical Systems
 Cognitive Agent-based Computing-I
 Agent-Based Computational Modelling
 An Introduction to Agent-Based Modeling
 5th KES International Conference, KES-AMSTA 2011, Manchester, UK, June 29 -- July 1, 2011, Proceedings
 Agent-Based Simulation of Vulnerability Dynamics
 Encyclopedia of Artificial Intelligence
 Mediterranean Almanac 2019-20
 Agent-Based Computational Economics Using NetLogo
 A Case Study of the German North Sea Coast
 Agent-Based Models
 Agent-Based and Individual-Based Modeling
 Agent-Based Modeling of Environmental Conflict and Cooperation
 Theoretical Aspects and Computational Simulations
 Formal Languages for Computer Simulation: Transdisciplinary Models and Applications

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With Applications for the Social Sciences Bentham Science Publishers

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.

A Practical Introduction, Second Edition IGI Global

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

Theory, Algorithms, Techniques and Applications Routledge
Agent-based models (ABM) and computational models simulate the actions and interactions of autonomous agents (both individual or collective entities such as organizations or groups) with a view to assessing their effects on the system as a whole. They combine elements of game theory, complex systems, emergence, computational sociology, multi-agent systems, and evolutionary programming. In this book, the authors discuss the modeling, simulation and optimization of resources management in hospital emergency departments using the agent-based approach; computational modeling in male reproduction; consumer-centric agent-based marketing models; Lattice-Boltzmann simulation of transport phenomena in agroindustrial biosystems; agent-based models in cancer prevention research; model-based approaches to diagnosis of multi-agent plans; and modeling behavior of web users as agents with reason and sentiment.

Agent-Based Computational Sociology Springer

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.

Multi-Agent Systems Tomáš Bruckner

This open access book examines the methodological complications of using complexity science concepts within the social science domain. The opening chapters take the reader on a tour through the development of simulation methodologies in the fields of artificial life and population biology, then demonstrates the growing popularity and relevance of these methods in the social sciences. Following an in-depth analysis of the potential impact of these methods on social science and social theory, the text provides substantive examples of the application of agent-based models in the field of demography. This work offers a unique combination of applied simulation work and substantive, in-depth philosophical analysis, and as such has potential appeal for specialist social scientists, complex systems scientists, and philosophers of science interested in the methodology of simulation and the practice of interdisciplinary computing research.

Agent-Based Computational Demography Springer

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.

Transdisciplinary Models and Applications IGI Global

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.

Methodological Investigations in Agent-Based Modelling John Wiley & Sons

Agent-based models (ABM) and computational models simulate the actions and interactions of autonomous agents (both individual or collective entities such as organizations or groups) with a view to assessing their effects on the system as a whole. They combine elements of game theory, complex systems, emergence, computational sociology, multi-agent systems, and evolutionary programming. In this book, the authors discuss the modeling, simulation and optimization of resources management in hospital emergency departments using the agent-based approach; computational modeling in male reproduction; consumer-centric agent-based marketing models; Lattice-Boltzmann simulation of transport phenomena in agroindustrial biosystems; agent-based models in cancer prevention research; model-based approaches to diagnosis of multi-agent plans; and modeling behavior of web users as agents with reason and sentiment.

Urban Informatics Cambridge University Press

Agent-based computational modeling is changing the face of social science. This book argues that this powerful technique permits the social sciences to meet an explanation, in which one 'grows' the phenomenon of interest in an artificial society of interacting agents: heterogeneous, boundedly rational actors.

A Toolkit Springer Nature

This thesis constitutes an extraordinary innovative research approach in transferring the concepts and methods of complex systems to risk research. It ambitiously bridges the barriers between theoretical, empirical and methodical research work and integrates these fields into one comprehensive approach of dealing with uncertainty in socio-ecological systems. The developed agent-based simulation aims at the dynamics of social vulnerability in the considered system of the German North Sea

Coast. Thus, the social simulation provides an analytical method to explore the individual, relational, and spatial aspects leading to dynamics of vulnerability in society. Combining complexity science and risk research by the method of agent-based simulation hereby emphasizes the importance of understanding interrelations inside the system for the system's development, i.e. for the evolving. Based on a vulnerability assessment regarding vulnerability characteristics, present risk behavior and self-protection preferences of private households against the impacts of flooding and storm surges, possible system trajectories could be explored by means of simulation experiments. The system-analytical approach therefore contributes to an integrated consideration of multi-dimensional and context-sensitive social phenomena such as vulnerability. Furthermore it achieves conceptually and strategically relevant implications for risk research and complex systems research. Agent-based Modeling of Tax Evasion Cambridge University Press The only single-source guide to understanding, using, adapting, and designing state-of-the-art agent-based modelling of tax evasion A computational method for simulating the behavior of individuals or groups and their effects on an entire system, agent-based modeling has proven itself to be a powerful new tool for detecting tax fraud. While interdisciplinary groups and individuals working in the tax domain have published numerous articles in diverse peer-reviewed journals and have presented their findings at international conferences, until Agent-based Modelling of Tax Evasion there was no authoritative, single-source guide to state-of-the-art agent-based tax evasion modeling techniques and technologies. Featuring contributions from distinguished experts in the field from around the globe, Agent-Based Modelling of Tax Evasion provides in-depth coverage of an array of field tested agent-based tax evasion models. Models are presented in a unified format so as to enable readers to systematically work their way through the various modeling alternatives available to them. Three main components of each agent-based model are explored in accordance with the Overview, Design Concepts, and Details (ODD) protocol, each section of which contains several sub elements that help to illustrate the model clearly and that assist readers in replicating the modeling results described. Presents models in a unified and structured manner to provide a point of reference for readers interested in agent-based modelling of tax evasion Explores the theoretical aspects and diversity of agent-based modeling through the example of tax evasion Provides an overview of the characteristics of more than thirty agent-based tax evasion frameworks Functions as a solid foundation for lectures and seminars on agent-based modelling of tax evasion The only comprehensive treatment of agent-based tax evasion models and their applications, this book is an indispensable working resource for practitioners and tax evasion modelers both in the agent-based computational domain and using other methodologies. It is also an excellent pedagogical resource for teaching tax evasion modeling and/or agent-based modeling generally.

Agent-based Computational Modeling of the Human Epidermis and Applications Ubiquity Press

The present book describes the methodology to set up agent-based models and to study emerging patterns in complex adaptive systems resulting from multi-agent interaction. It offers the application of agent-based models in demography, social and economic sciences and environmental sciences. Examples include population dynamics, evolution of social norms, communication structures, patterns in eco-systems and socio-biology, natural resource management, spread of diseases and development processes. It presents and combines different approaches how to implement agent-based computational

models and tools in an integrative manner that can be extended to other cases.

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

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.

Agent-Based Modelling and Geographical Information Systems Nova Science Pub Incorporated

This book aims to answer two questions that are fundamental to the study of agent-based economic models: what is agent-based computational economics and why do we need agent-based economic modelling of economy? This book provides a review of the development of agent-based computational economics (ACE) from a perspective on how artificial economic agents are designed under the influences of complex sciences, experimental economics, artificial intelligence, evolutionary biology, psychology, anthropology and neuroscience. This book begins with a historical review of ACE by tracing its origins. From a modelling viewpoint, ACE brings truly decentralized procedures into market analysis, from a single market to the whole economy. This book also reviews how experimental economics and artificial intelligence have shaped the development of ACE. For the former, the book discusses how ACE models can be used to analyse the economic consequences of cognitive capacity, personality and cultural inheritance. For the latter, the book covers the various tools used to construct artificial adaptive agents, including reinforcement learning, fuzzy decision rules, neural networks, and evolutionary computation. This book will be of interest to graduate students researching computational economics, experimental economics, behavioural economics, and research methodology.

Spatial Analysis in Field Primatology Springer Science & Business Media

Augmented and virtual reality (AR and VR) offer exciting opportunities for human computer interaction (HCI), the enhancement of places, and new business cases. Though VR is most popular for video games, especially among younger generations, AR and VR can also be used in applications that include military, medical, navigational, tourism, marketing, and maintenance uses. Research in these technologies along with 3D user interfaces has gained momentum in recent years and has solidified it as a staple technology for the foreseeable future. *Multimedia and Sensory Input for Augmented, Mixed, and Virtual Reality* includes a collection of business case studies covering a variety of topics related to AR, VR, and mixed reality (MR) including their use in possible applications. This book also touches on the diverse uses of AR and VR in many industries and discusses their importance, challenges, and opportunities. While discussing the use these technologies in sectors such as education, healthcare, and computer science, this book is ideal for computer scientists, engineers, practitioners, stakeholders,

researchers, academicians, and students who are interested in the latest research on augmented, mixed, and virtual reality.

Agent-Based Models in Economics SAGE

Agent-based Computational Economics using NetLogo explores how researchers can create, use and implement multi-agent computational models in Economics by using NetLogo software platform. Problems of economic science can be solved using multi-agent modelling (MAM). This technique uses a computer model to simulate the actions and interactions of autonomous entities in a network, in order to analyze the effects on the entire economic system. MAM combines elements of game theory, complex systems, emergence and evolutionary programming. The Monte Carlo method is also used in this e-book to introduce random elements. The 11 models presented in this text simulate the simultaneous operations of several agents in an attempt to recreate and predict complex economic phenomena. This e-book explains the topic in a systematic manner, starting with an introduction for readers followed subsequently by methodology and implementation using NetLogo. The volume ends with conclusions based on the results of the experiments presented.

The e-book is intended as a concise and vital resource for economists, applied mathematicians, social sciences scientists, systems analysts, operations researchers and numerical analysts

Applications in Demography, Social, Economic and Environmental Sciences Springer Science & Business Media

Skin is the main organ of our body in direct contact with the external environment. Its core role is to protect the body against various kinds of potential damages. In this work, we have used a systems biology approach and agent-based computational modelling to study skin acute inflammation resulting from topical application of an irritant. We have built a structural and dynamic model of the epidermis. The model can display several clinically observed features such as: the skin barrier effect on water loss and external substance penetration, the dynamic homeostatic state of the epidermis, the steady state water and calcium profiles, etc. Furthermore, we have implemented a simple model of skin acute inflammation, that could be used as baseline for future works. We have studied the kinetic of the inflammatory reaction simulated with the model, as well as the influence of various parameters on that process. We demonstrated that the inflammation as produced by the model, shows a dose-dependent behaviour and that different inflammation intensities can be obtained by changing the values of parameters relating to the physical properties of the irritant. The model enabled the study of scenarios that cannot be studied by 'traditional' methods. In this case, studying an induced inflammation process on baby skin, while excluding the physiological properties of the tissue and only considering the influence of its structure, would have been extremely difficult if not impossible in vivo.

Agent-based Modeling and Simulation Princeton University Press

Agent-based computational modeling is changing the face of social science. In *Generative Social Science*, Joshua Epstein argues that this powerful, novel technique permits the social sciences to meet a fundamentally new standard of explanation, in which one "grows" the phenomenon of interest in an artificial society of interacting agents: heterogeneous, boundedly rational actors, represented as mathematical or software objects. After elaborating this notion of generative explanation in a pair of overarching foundational chapters, Epstein illustrates it with examples chosen from such far-flung fields as archaeology, civil conflict, the evolution of norms, epidemiology, retirement economics, spatial games, and organizational adaptation. In elegant chapter preludes, he explains how these widely diverse modeling studies support his sweeping case for generative explanation. This book represents a powerful consolidation of

Epstein's interdisciplinary research activities in the decade since the publication of his and Robert Axtell's landmark volume, *Growing Artificial Societies*. Beautifully illustrated, *Generative Social Science* includes a CD that contains animated movies of core model runs, and programs allowing users to easily change assumptions and explore models, making it an invaluable text for courses in modeling at all levels.

Applications in Demography, Social, Economic and Environmental Sciences IGI Global

Although there are plenty of publications dealing with the theory of multi-agent systems and agent-based simulations, information about the practical development of such systems is scarce. The aim of this book is to fill this empty space and to provide knowledge about design and development of agent-based simulations in an easy and comprehensible way. The book begins with the fundamentals of multi-agent systems, agent principles and their interaction, and goes on to discuss the philosophy of agent-based programming. Agent-based models - like any other scientific method - have drawbacks and limitations, which are presented in the book as well. The main portion of the text is then devoted to a description of methodology and best practices for the design and development of agent-based simulation software. The methodology (called Agentology) guides the reader through the entire development process, from the formal definition of the problem, through conceptual modeling and the selection of the particular development platform, to the programming and debugging of the code itself and the final assessment of the model. The visual language as the means of

representation of the conceptual model is included. The reader is also presented with a comparison of present multi-agent development environments and tools, which could be helpful for the selection of appropriate development instruments. Given that the theoretical foundation is presented in an accessible way and supported by many practical examples, figures, schemes and source codes, this publication is especially suitable as a textbook for introductory graduate-level courses on multi-agent systems and agent-based modeling. Besides appealing to students and the scientific community, the monograph can aid software architects and developers who are not familiar with agent principles, conveying valuable insights into this distinct computer paradigm.

Agent-Based Computational Economics Springer Science & Business Media

Models and simulations are an important first step in developing computer applications to solve real-world problems. However, in order to be truly effective, computer programmers must use formal modeling languages to evaluate these simulations. *Formal Languages for Computer Simulation: Transdisciplinary Models and Applications* investigates a variety of programming languages used in validating and verifying models in order to assist in their eventual implementation. This book will explore different methods of evaluating and formalizing simulation models, enabling computer and industrial engineers, mathematicians, and students working with computer simulations to thoroughly understand the progression from simulation to product, improving the overall effectiveness of modeling systems.

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