

Dirk Helbing

Quantitative Sociodynamics

Stochastic Methods and Models of
Social Interaction Processes

Second Edition



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Quantitative Sociodynamics Stochastic Methods And Models Of Social Interaction Processes

Dirk Helbing



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Quantitative Sociodynamics D. Helbing, 2013-03-14 Quantitative Sociodynamics presents a general strategy for interdisciplinary model building and its application to a quantitative description of behavioural changes based on social interaction processes Originally the crucial methods for the modeling of complex systems stochastic methods and nonlinear dynamics were developed in physics but they have very often proved their explanatory power in chemistry biology economics and the social sciences Quantitative Sociodynamics provides a unified and comprehensive overview of the different stochastic methods their interrelations and properties In addition it introduces the most important concepts from nonlinear dynamics synergetics chaos theory The applicability of these fascinating concepts to social phenomena is carefully discussed By incorporating decision theoretical approaches a very fundamental dynamic model is obtained which seems to open new perspectives in the social sciences It includes many established models as special cases e.g. the logistic equation the gravity model some diffusion models the evolutionary game theory and the social field theory but it also implies numerous new results Examples concerning opinion formation migration social field theory the self organization of behavioural conventions as well as the behaviour of customers and voters are presented and illustrated by computer simulations Quantitative Sociodynamics is relevant both for social scientists and natural scientists who are interested in the application of stochastic and synergetics concepts to interdisciplinary topics

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chapters available again by a new edition The other reason is that in the meantime many of the methods discussed in this book are more and more used in a variety of different fields Among the ideas worked out in this book are 1 a statistical theory of binary social interactions a mathematical formulation of social field theory which is the basis of social 2 force models a microscopic foundation of evolutionary game theory based on what is known today as proportional imitation rule a stochastic treatment of interactions in evolutionary game theory and a model for the self organization of behavioral 3 conventions in a coordination game It therefore appeared reasonable to make this book available again but at a more affordable price To keep its original character the translation of this book which 1 D Helbing Interrelations between stochastic equations for systems with pair interactions *Physica A* 181 29 52 1992 D Helbing Boltzmann like and Boltzmann Fokker Planck equations as a foundation of behavioral models *Physica A* 196 546 573 1993 2 D Helbing Boltzmann like and Boltzmann Fokker Planck equations as a foundation of behavioral models *Physica A* 196 546 573 1993 D Helbing *Arrovian Aggregation Models* Fuad T. Aleskerov, 2013-06-29 Aggregation of individual opinions into a social decision is a problem widely observed in everyday life For centuries people tried to invent the best aggregation rule In 1951 young American scientist and future Nobel Prize winner Kenneth Arrow formulated the problem in an axiomatic way i e he specified a set of axioms which every reasonable aggregation rule has to satisfy and obtained that these axioms are inconsistent This result often called Arrow's Paradox or General Impossibility Theorem had become a cornerstone of social choice theory The main condition used by Arrow was his famous Independence of Irrelevant Alternatives This very condition pre defines the local treatment of the alternatives or pairs of alternatives or sets of alternatives etc in aggregation procedures Remaining within the framework of the axiomatic approach and based on the consideration of local rules Arrovian Aggregation Models investigates three formulations of the aggregation problem according to the form in which the individual opinions about the alternatives are defined as well as to the form of desired social decision In other words we study three aggregation models What is common between them is that in all models some analogue of the Independence of Irrelevant Alternatives condition is used which is why we call these models Arrovian aggregation models Chapter 1 presents a general description of the problem of axiomatic synthesis of local rules and introduces problem formulations for various versions of formalization of individual opinions and collective decision Chapter 2 formalizes precisely the notion of rationality of individual opinions and social decision Chapter 3 deals with the aggregation model for the case of individual opinions and social decisions formalized as binary relations Chapter 4 deals with Functional Aggregation Rules which transform into a social choice function individual opinions defined as choice functions Chapter 5 considers another model Social Choice Correspondences when the individual opinions are formalized as binary relations and the collective decision is looked for as a choice function Several new classes of rules are introduced and analyzed [City Evacuations: An Interdisciplinary Approach](#) John Preston, Jane M Binner, Layla Branicki, Tobias Galla, Nick Jones, James King, Magdalini Kolokitha, Michalis Smyrnakis, 2014-08-01 Evacuating a city is a complex problem that involves

issues of governance preparedness education warning information sharing population dynamics resilience and recovery As natural and anthropogenic threats to cities grow it is an increasingly pressing problem for policy makers and practitioners The book is the result of a unique interdisciplinary collaboration between researchers in the physical and social sciences to consider how an interdisciplinary approach can help plan for large scale evacuations It draws on perspectives from physics mathematics organisation theory economics sociology and education Importantly it goes beyond disciplinary boundaries and considers how interdisciplinary methods are necessary to approach a complex problem involving human actors and increasingly complex communications and transportation infrastructures Using real world case studies and modelling the book considers new approaches to evacuation dynamics It addresses questions of complexity not only in terms of theory but examining the latest challenges for cities and emergency responders Factors such as social media information quality and visualisation techniques are examined to consider the new dynamics of warning and informing evacuation and recovery

Cellular Automata Peter M.A. Slood, Bastien Chopard, Alfons G. Hoekstra, 2004-09-28 This book constitutes the refereed proceedings of the 6th International Conference on Cellular Automata for Research and Industry ACRI 2004 held in Amsterdam The Netherlands in October 2004 The 60 revised full papers and 30 poster papers presented were carefully reviewed and selected from 150 submissions The papers are devoted to methods and theory evolved cellular automata traffic networks and communication applications in science and engineering biomedical applications natural phenomena and ecology and social and economical applications

Modelling and Simulation in the Social Sciences from the Philosophy of Science Point of View R. Hegselmann, Ulrich Mueller, Klaus G. Troitzsch, 2013-03-09 Model building in the social sciences can increasingly rely on well elaborated formal theories At the same time inexpensive large computational capacities are now available Both make computer based model building and simulation possible in social science whose central aim is in particular an understanding of social dynamics Such social dynamics refer to public opinion formation partner choice strategy decisions in social dilemma situations and much more In the context of such modelling approaches novel problems in philosophy of science arise which must be analysed the main aim of this book Interest in social simulation has recently been growing rapidly world wide mainly as a result of the increasing availability of powerful personal computers The field has also been greatly influenced by developments in cellular automata theory from mathematics and in distributed artificial intelligence which provided tools readily applicable to social simulation This book presents a number of modelling and simulation approaches and their relations to problems in philosophy of science It addresses sociologists and other social scientists interested in formal modelling mathematical sociology and computer simulation as well as computer scientists interested in social science applications and philosophers of social science

Managing Complexity: Insights, Concepts, Applications Dirk Helbing, 2007-10-13 Each chapter in Managing Complexity focuses on analyzing real world complex systems and transferring knowledge from the complex systems sciences to applications in business industry and society The

interdisciplinary contributions range from markets and production through logistics traffic control and critical infrastructures up to network design information systems social conflicts and building consensus They serve to raise readers awareness concerning the often counter intuitive behavior of complex systems and to help them integrate insights gained in complexity research into everyday planning decision making strategic optimization and policy Intended for a broad readership the contributions have been kept largely non technical and address a general scientifically literate audience involved in corporate academic and public institutions

Brownian Agents and Active Particles Frank

Schweitzer, 2007-08-29 When we contemplate phenomena as diverse as electrochemical deposition or the spatial patterns of urban development it is natural to assume that they have nothing in common After all there are many levels in the hierarchy that builds up from atoms to human society and the rules that govern atoms are quite different from those that govern the geographical emergence of a city The common view among many if not most biologists and social scientists is that the devil is entirely in the details This school of thought asserts that social science and biology have little or nothing in common and indeed many biologists claim that even different fields of biology have little in common If they are right then science can only proceed by recording vast lists of details that no common principles will ever link together Physics in contrast has achieved a parsimonious description for a broad range of phenomena based on only a few general principles The phenomena that physics addresses are unquestionably much simpler than those of biology or social science and on the surface appear entirely dissimilar A cell is far more complicated than a pendulum or an atom and human society being built out of a great many cells is far more complicated still Cells and societies have many layers of hierarchical organization with complex functional and computational properties they have identities idiosyncracies stemming from an accumulation of historical contingency that makes them impossible to characterize in simple mathematical terms Their complexity is far beyond that of the simple systems usually studied in physics

Beliefs, Interactions and Preferences Mark J. Machina, Bertrand Munier, 2013-03-09

Beliefs Interactions and Preferences in Decision Making mixes a selection of papers presented at the Eighth Foundations and Applications of Utility and Risk Theory FUR VIII conference in Mons Belgium together with a few solicited papers from well known authors in the field This book addresses some of the questions that have recently emerged in the research on decision making and risk theory In particular authors have modeled more and more as interactions between the individual and the environment or between different individuals the emergence of beliefs as well as the specific type of information treatment traditionally called rationality This book analyzes several cases of such an interaction and derives consequences for the future of decision theory and risk theory In the last ten years modeling beliefs has become a specific sub field of decision making particularly with respect to low probability events Rational decision making has also been generalized in order to encompass in new ways and in more general situations than it used to be fitted to multiple dimensions in consequences This book deals with some of the most conspicuous of these advances It also addresses the difficult question to incorporate

several of these recent advances simultaneously into one single decision model And it offers perspectives about the future trends of modeling such complex decision questions The volume is organized in three main blocks The first block is the more traditional one It deals with new extensions of the existing theory as is always demanded by scientists in the field A second block handles specific elements in the development of interactions between individuals and their environment as defined in the most general sense The last block confronts real world problems in both financial and non financial markets and decisions and tries to show what kind of contributions can be brought to them by the type of research reported on here

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