Mathematical Epidemiology of Infectious Diseases

Model Building, Analysis and Interpretation

O. Diekmann, J. A. P. Heesterbeek

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Dr. Alan Hastings,Dr. Louis Gross

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　　Mathematical Epidemiology of Infectious Diseases O. Diekmann,J. A. P. Heesterbeek,2000-04-07 Mathematical Epidemiology of Infectious Diseases Model Building Analysis and Interpretation O Diekmann University of Utrecht The Netherlands J A P Heesterbeek Centre for Biometry Wageningen The Netherlands The mathematical modelling of epidemics in populations is a vast and important area of study It is about translating biological assumptions into mathematics about mathematical analysis aided by interpretation and about obtaining insight into epidemic phenomena when translating mathematical results back into population biology Model assumptions are formulated in terms of usually stochastic behaviour of individuals and then the resulting phenomena at the population level are unravelled Conceptual clarity is attained assumptions are stated clearly hidden working hypotheses are attained and mechanistic links between different observables are exposed Features Model construction analysis and interpretation receive detailed attention Uniquely covers both deterministic and stochastic viewpoints Examples of applications given throughout Extensive coverage of the latest research into the mathematical modelling of epidemics of infectious diseases Provides a solid foundation of modelling skills The reader will learn to translate model analyse and interpret with the help of the numerous exercises In literally working through this text the reader acquires modelling skills that are also valuable outside of epidemiology certainly within population dynamics but even beyond that In addition the reader receives training in mathematical argumentation The text is aimed at applied mathematicians with an interest in population biology and epidemiology at theoretical biologists and epidemiologists Previous exposure to epidemic concepts is not required as all background information is given The book is primarily aimed at self study and ideally suited for small discussion groups or for use as a course text **An Introduction to Infectious Disease Modelling** Emilia Vynnycky,Richard White,2010-05-13 Mathematical models are increasingly being used to examine questions in infectious disease control Applications include predicting the impact of vaccination strategies against common infections and determining optimal control strategies against HIV and pandemic influenza This book introduces individuals interested in infectious diseases to this exciting and expanding area The mathematical level of the book is kept as simple as possible which makes the book accessible to those who have not studied mathematics to university level Understanding is further enhanced by models that can be accessed online which will allow readers to explore the impact of different factors and control strategies and further adapt and develop the models themselves The book is based on successful courses developed by the authors at the London School of Hygiene and Tropical Medicine It will be of interest to epidemiologists public health researchers policy makers veterinary scientists medical statisticians and infectious disease researchers Modeling And Dynamics Of Infectious Diseases Zhien Ma,Yicang Zhou,Jianhong Wu,2009-04-20 This book provides a systematic introduction to the fundamental methods and techniques and the frontiers of along with many new ideas and results on infectious disease modeling parameter estimation and transmission dynamics It provides complementary

approaches from deterministic to statistical to network modeling and it seeks viewpoints of the same issues from different angles from mathematical modeling to statistical analysis to computer simulations and finally to concrete applications

Mathematical Models for Communicable Diseases Fred Brauer,Carlos Castillo-Chavez,2013-02-07 A self contained and comprehensive guide to the mathematical modeling of disease transmission appropriate for graduate students

Mathematics and Computing 2013 Ram N. Mohapatra,Debasis Giri,P. K. Saxena,P. D. Srivastava,2014-08-22 This book discusses recent developments and contemporary research in mathematics statistics and their applications in computing All contributing authors are eminent academicians scientists researchers and scholars in their respective fields hailing from around the world The conference has emerged as a powerful forum offering researchers a venue to discuss interact and collaborate and stimulating the advancement of mathematics and its applications in computer science The book will allow aspiring researchers to update their knowledge of cryptography algebra frame theory optimizations stochastic processes compressive sensing functional analysis complex variables etc Educating future consumers users producers developers and researchers in mathematics and computing is a challenging task and essential to the development of modern society Hence mathematics and its applications in computer science are of vital importance to a broad range of communities including mathematicians and computing professionals across different educational levels and disciplines **Predicting Pandemics in a Globally Connected World, Volume 1** Nicola Bellomo,Mark A. J. Chaplain,2022-09-22 This contributed volume investigates several mathematical techniques for the modeling and simulation of viral pandemics with a special focus on COVID 19 Modeling a pandemic requires an interdisciplinary approach with other fields such as epidemiology virology immunology and biology in general Spatial dynamics and interactions are also important features to be considered and a multiscale framework is needed at the level of individuals and the level of virus particles and the immune system Chapters in this volume address these items as well as offer perspectives for the future **Mathematical Models for Neglected Tropical Diseases: Essential Tools for Control and Elimination, Part A** ,2015-03-10 First published in 1963 Advances in Parasitology contains comprehensive and up to date reviews in all areas of interest in contemporary parasitology Advances in Parasitology includes medical studies of parasites of major influence such as Plasmodium falciparum and trypanosomes The series also contains reviews of more traditional areas such as zoology taxonomy and life history which shape current thinking and applications The 2013 impact factor is 4 36 Informs and updates on all the latest developments in the field Contributions from leading authorities and industry experts Biological Networks Fran□ois K□p□s,2007 This volume presents a timely and comprehensive overview of biological networks at all organization levels in the spirit of the complex system approach It discusses the transversal issues and fundamental principles as well as the overall structure dynamics and modeling of a wide array of biological networks at the molecular cellular and population levels Anchored in both empirical data and a strong theoretical background the book therefore lends valuable credence to the complex systems approach Infectious Disease

<u>Modeling</u> Xinzhi Liu,Peter Stechlinski,2017-02-25 This volume presents infectious diseases modeled mathematically taking seasonality and changes in population behavior into account using a switched and hybrid systems framework The scope of coverage includes background on mathematical epidemiology including classical formulations and results a motivation for seasonal effects and changes in population behavior an investigation into term time forced epidemic models with switching parameters and a detailed account of several different control strategies The main goal is to study these models theoretically and to establish conditions under which eradication or persistence of the disease is guaranteed In doing so the long term behavior of the models is determined through mathematical techniques from switched systems theory Numerical simulations are also given to augment and illustrate the theoretical results and to help study the efficacy of the control schemes

Vaccinology W. John W. Morrow,Nadeem A. Sheikh,Clint S. Schmidt,D. Huw Davies,2012-06-12 Covering all aspects of vaccine research and development in one volume this authoritative resource takes a comprehensive and systematic approach to the science of vaccinology focusing not only on basic science but also on the many stages required to commercialize and navigate the regulatory requirements for human application both in the United States and Europe Reviews in detail the process of designing a vaccine from the initial stages of antigen discovery to human application Includes evaluation of vaccine efficacy and safety Details clinical trial design including regulatory requirements Discusses the emerging field of active cellular immunotherapy Vaccinology Principles and Practice provides an invaluable resource for clinicians scientific and medical researchers lecturers and postdoctoral fellows working in the field of vaccines **Bioterrorism** H. T. Banks,C. Castillo-Ch?avez,2003-01-01 Bioterrorism Mathematical Modeling Applications in Homeland Security collects the detailed contributions of selected groups of experts from the fields of biostatistics control theory epidemiology and mathematical biology who have engaged in the development of frameworks models and mathematical methods needed to address some of the pressing challenges posed by acts of terror The ten chapters of this volume touch on a large range of issues in the subfields of biosurveillance agroterrorism bioterror response logistics deliberate release of biological agents impact assessment and the spread of fanatic behaviors *Nature-Inspired Intelligent Techniques for Solving Biomedical Engineering Problems* Kose, Utku,Guraksin, Gur Emre,Deperlioglu, Omer,2018-03-31 Technological tools and computational techniques have enhanced the healthcare industry These advancements have led to significant progress and novel opportunities for biomedical engineering Nature Inspired Intelligent Techniques for Solving Biomedical Engineering Problems is a pivotal reference source for emerging scholarly research on trends and techniques in the utilization of nature inspired approaches in biomedical engineering Featuring extensive coverage on relevant areas such as artificial intelligence clinical decision support systems and swarm intelligence this publication is an ideal resource for medical practitioners professionals students engineers and researchers interested in the latest developments in biomedical technologies <u>The Dynamics of Biological Systems</u> Arianna Bianchi,Thomas Hillen,Mark A. Lewis,Yingfei Yi,2019-10-02 The book presents nine

mini courses from a summer school Dynamics of Biological Systems held at the University of Alberta in 2016 as part of the prestigious seminar series S minaire de Math matiques Sup rieures SMS It includes new and significant contributions in the field of Dynamical Systems and their applications in Biology Ecology and Medicine The chapters of this book cover a wide range of mathematical methods and biological applications They explain the process of mathematical modelling of biological systems with many examples introduce advanced methods from dynamical systems theory present many examples of the use of mathematical modelling to gain biological insight discuss innovative methods for the analysis of biological processes contain extensive lists of references which allow interested readers to continue the research on their own Integrating the theory of dynamical systems with biological modelling the book will appeal to researchers and graduate students in Applied Mathematics and Life Sciences **Network Science** Ernesto Estrada,Maria Fox,Desmond J. Higham,Gian-Luca Oppo,2010-08-24 Network Science is the emerging field concerned with the study of large realistic networks This interdisciplinary endeavor focusing on the patterns of interactions that arise between individual components of natural and engineered systems has been applied to data sets from activities as diverse as high throughput biological experiments online trading information smart meter utility supplies and pervasive telecommunications and surveillance technologies This unique text reference provides a fascinating insight into the state of the art in network science highlighting the commonality across very different areas of application and the ways in which each area can be advanced by injecting ideas and techniques from another The book includes contributions from an international selection of experts providing viewpoints from a broad range of disciplines It emphasizes networks that arise in nature such as food webs protein interactions gene expression and neural connections and in technology such as finance airline transport urban development and global trade Topics and Features begins with a clear overview chapter to introduce this interdisciplinary field discusses the classic network science of fixed connectivity structures including empirical studies mathematical models and computational algorithms examines time dependent processes that take place over networks covering topics such as synchronisation and message passing algorithms investigates time evolving networks such as the World Wide Web and shifts in topological properties connectivity spectrum percolation explores applications of complex networks in the physical and engineering sciences looking ahead to new developments in the field Researchers and professionals from disciplines as varied as computer science mathematics engineering physics chemistry biology ecology neuroscience epidemiology and the social sciences will all benefit from this topical and broad overview of current activities and grand challenges in the unfolding field of network science

Mathematical and Computational Modeling Roderick Melnik,2015-05-21 Mathematical and Computational Modeling Illustrates the application of mathematical and computational modeling in a variety of disciplines With an emphasis on the interdisciplinary nature of mathematical and computational modeling Mathematical and Computational Modeling With Applications in the Natural and Social Sciences Engineering and the Arts features chapters written by well known

international experts in these fields and presents readers with a host of state of theart achievements in the development of mathematical modeling and computational experiment methodology The book is a valuable guide to the methods ideas and tools of applied and computational mathematics as they apply to other disciplines such as the natural and social sciences engineering and technology The book also features Rigorous mathematical procedures and applications as the driving force behind mathematical innovation and discovery Numerous examples from a wide range of disciplines to emphasize the multidisciplinary application and universality of applied mathematics and mathematical modeling Original results on both fundamental theoretical and applied developments in diverse areas of human knowledge Discussions that promote interdisciplinary interactions between mathematicians scientists and engineers Mathematical and Computational Modeling With Applications in the Natural and Social Sciences Engineering and the Arts is an ideal resource for professionals in various areas of mathematical and statistical sciences modeling and simulation physics computer science engineering biology and chemistry and industrial and computational engineering The book also serves as an excellent textbook for graduate courses in mathematical modeling applied mathematics numerical methods operations research and optimization

Modeling Infectious Diseases in Humans and Animals Matt J. Keeling,Pejman Rohani,2011-09-19 For epidemiologists evolutionary biologists and health care professionals real time and predictive modeling of infectious disease is of growing importance This book provides a timely and comprehensive introduction to the modeling of infectious diseases in humans and animals focusing on recent developments as well as more traditional approaches Matt Keeling and Pejman Rohani move from modeling with simple differential equations to more recent complex models where spatial structure seasonal forcing or stochasticity influence the dynamics and where computer simulation needs to be used to generate theory In each of the eight chapters they deal with a specific modeling approach or set of techniques designed to capture a particular biological factor They illustrate the methodology used with examples from recent research literature on human and infectious disease modeling showing how such techniques can be used in practice Diseases considered include BSE foot and mouth HIV measles rubella smallpox and West Nile virus among others Particular attention is given throughout the book to the development of practical models useful both as predictive tools and as a means to understand fundamental epidemiological processes To emphasize this approach the last chapter is dedicated to modeling and understanding the control of diseases through vaccination quarantine or culling Comprehensive practical introduction to infectious disease modeling Builds from simple to complex predictive models Models and methodology fully supported by examples drawn from research literature Practical models aid students understanding of fundamental epidemiological processes For many of the models presented the authors provide accompanying programs written in Java C Fortran and MATLAB In depth treatment of role of modeling in understanding disease control   Encyclopedia of Theoretical Ecology Dr. Alan Hastings,Dr. Louis Gross,2012-05-31 This major reference is an overview of the current state of theoretical ecology through a series of topical entries centered on both

ecological and statistical themes Coverage ranges across scales from the physiological to populations landscapes and ecosystems Entries provide an introduction to broad fields such as Applied Ecology Behavioral Ecology Computational Ecology Ecosystem Ecology Epidemiology and Epidemic Modeling Population Ecology Spatial Ecology and Statistics in Ecology Others provide greater specificity and depth including discussions on the Allee effect ordinary differential equations and ecosystem services Descriptions of modern statistical and modeling approaches and how they contributed to advances in theoretical ecology are also included Succinct uncompromising and authoritative a must have for those interested in the use of theory in the ecological sciences   *13th International Conference on Theory and Application of Fuzzy Systems and Soft Computing — ICAFS-2018* Rafik A. Aliev,Janusz Kacprzyk,Witold Pedrycz,Mo. Jamshidi,Fahreddin M. Sadikoglu,2018-12-28 This book presents the proceedings of the 13th International Conference on Application of Fuzzy Systems and Soft Computing ICAFS 2018 held in Warsaw Poland on August 27 28 2018 It includes contributions from diverse areas of soft computing such as uncertain computation Z information processing neuro fuzzy approaches evolutionary computing and others The topics of the papers include theory of uncertainty computation theory and application of soft computing decision theory with imperfect information neuro fuzzy technology image processing with soft computing intelligent control machine learning fuzzy logic in data analytics and data mining evolutionary computing chaotic systems soft computing in business economics and finance fuzzy logic and soft computing in the earth sciences fuzzy logic and soft computing in engineering soft computing in medicine biomedical engineering and the pharmaceutical sciences and probabilistic and statistical reasoning in the social and educational sciences The book covers new ideas from theoretical and practical perspectives in economics business industry education medicine the earth sciences and other fields In addition to promoting the development and application of soft computing methods in various real life fields it offers a useful guide for academics practitioners and graduates in fuzzy logic and soft computing fields   **Novel Ecosystems** Richard J. Hobbs,Eric S. Higgs,Carol Hall,2013-01-07 Land conversion climate change and species invasions are contributing to the widespread emergence of novel ecosystems which demand a shift in how we think about traditional approaches to conservation restoration and environmental management They are novel because they exist without historical precedents and are self sustaining Traditional approaches emphasizing native species and historical continuity are challenged by novel ecosystems that deliver critical ecosystems services or are simply immune to practical restorative efforts Some fear that by raising the issue of novel ecosystems we are simply paving the way for a more laissez faire attitude to conservation and restoration Regardless of the range of views and perceptions about novel ecosystems their existence is becoming ever more obvious and prevalent in today s rapidly changing world In this first comprehensive volume to look at the ecological social cultural ethical and policy dimensions of novel ecosystems the authors argue these altered systems are overdue for careful analysis and that we need to figure out how to intervene in them responsibly This book brings together researchers from a range of disciplines together

with practitioners and policy makers to explore the questions surrounding novel ecosystems It includes chapters on key concepts and methodologies for deciding when and how to intervene in systems as well as a rich collection of case studies and perspective pieces It will be a valuable resource for researchers managers and policy makers interested in the question of how humanity manages and restores ecosystems in a rapidly changing world A companion website with additional resources is available at www wiley com go hobbs ecosystems   Using the Mathematics Literature Kristine K. Fowler,2004-05-25 This reference serves as a reader friendly guide to every basic tool and skill required in the mathematical library and helps mathematicians find resources in any format in the mathematics literature It lists a wide range of standard texts journals review articles newsgroups and Internet and database tools for every major subfield in mathematics and details methods of access to primary literature sources of new research applications results and techniques Using the Mathematics Literature is the most comprehensive and up to date resource on mathematics literature in both print and electronic formats presenting time saving strategies for retrieval of the latest information

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