Use R!

Daniel Borcard François Gillet Pierre Legendre

# Numerical Ecology with R



# **Numerical Ecology With R Use R**

Keith Alan Hobson, John Whiteman, Seth Newsome

# Numerical Ecology With R Use R:

Numerical Ecology with R Daniel Borcard, Francois Gillet, Pierre Legendre, 2011-01-07 Numerical Ecology with R provides a long awaited bridge between a textbook in Numerical Ecology and the implementation of this discipline in the R language After short theoretical overviews the authors accompany the users through the exploration of the methods by means of applied and extensively commented examples Users are invited to use this book as a teaching companion at the computer The travel starts with exploratory approaches proceeds with the construction of association matrices then addresses three families of methods clustering unconstrained and canonical ordination and spatial analysis All the necessary data files the scripts used in the chapters as well as the extra R functions and packages written by the authors can be downloaded from a web page accessible through the Springer web site http adn biol umontreal ca numericalecology numecolR This book is aimed at professional researchers practitioners graduate students and teachers in ecology environmental science and engineering and in related fields such as oceanography molecular ecology agriculture and soil science who already have a background in general and multivariate statistics and wish to apply this knowledge to their data using the R language as well as people willing to accompany their disciplinary learning with practical applications People from other fields e g geology geography paleoecology phylogenetics anthropology the social and education sciences etc may also benefit from the materials presented in this book The three authors teach numerical ecology both theoretical and practical to a wide array of audiences in regular courses in their Universities and in short courses given around the world Daniel Borcard is lecturer of Biostatistics and Ecology and researcher in Numerical Ecology at Universit de Montr al Qu bec Canada Fran ois Gillet is professor of Community Ecology and Ecological Modelling at Universit de Franche Comt Besan on France Pierre Legendre is professor of Quantitative Biology and Ecology at Universit de Montr al Fellow of the Royal Society of Canada and ISI Highly Cited Researcher in Ecology Environment Numerical Ecology with R Daniel Borcard, François Gillet, Pierre Legendre, 2018-03-19 This new edition of Numerical Ecology with R guides readers through an applied exploration of the major methods of multivariate data analysis as seen through the eyes of three ecologists It provides a bridge between a textbook of numerical ecology and the implementation of this discipline in the R language The book begins by examining some exploratory approaches It proceeds logically with the construction of the key building blocks of most methods i e association measures and matrices and then submits example data to three families of approaches clustering ordination and canonical ordination The last two chapters make use of these methods to explore important and contemporary issues in ecology the analysis of spatial structures and of community diversity The aims of methods thus range from descriptive to explanatory and predictive and encompass a wide variety of approaches that should provide readers with an extensive toolbox that can address a wide palette of questions arising in contemporary multivariate ecological analysis The second edition of this book features a complete revision to the R code and offers improved procedures and more diverse

applications of the major methods It also highlights important changes in the methods and expands upon topics such as multiple correspondence analysis principal response curves and co correspondence analysis New features include the study of relationships between species traits and the environment and community diversity analysis This book is aimed at professional researchers practitioners graduate students and teachers in ecology environmental science and engineering and in related fields such as oceanography molecular ecology agriculture and soil science who already have a background in general and multivariate statistics and wish to apply this knowledge to their data using the R language as well as people willing to accompany their disciplinary learning with practical applications People from other fields e g geology geography paleoecology phylogenetics anthropology the social and education sciences etc may also benefit from the materials presented in this book Users are invited to use this book as a teaching companion at the computer All the necessary data files the scripts used in the chapters as well as extra R functions and packages written by the authors of the book are available online URL http adn biol umontreal ca numericalecology numecolR Numerical Ecology P. Legendre, Louis Legendre, 2012-07-21 The book describes and discusses the numerical methods which are successfully being used for analysing ecological data using a clear and comprehensive approach These methods are derived from the fields of mathematical physics parametric and nonparametric statistics information theory numerical taxonomy archaeology psychometry sociometry econometry and others An updated 3rd English edition of the most widely cited book on quantitative analysis of multivariate ecological data Relates ecological questions to methods of statistical analysis with a clear description of complex numerical methods All methods are illustrated by examples from the ecological literature so that ecologists clearly see how to use the methods and approaches in their own research All calculations are available in R language functions Mathematical Ecology of Populations and Ecosystems John Pastor, 2011-08-31 MATHEMATICAL ECOLOGY Population ecologists study how births and deaths affect the dynamics of populations and communities while ecosystem ecologists study how species control the flux of energy and materials through food webs and ecosystems Although all these processes occur simultaneously in nature the mathematical frameworks bridging the two disciplines have developed independently Consequently this independent development of theory has impeded the cross fertilization of population and ecosystem ecology Using recent developments from dynamical systems theory this advanced undergraduate graduate level textbook shows how to bridge the two disciplines seamlessly The book shows how bifurcations between the solutions of models can help understand regime shifts in natural populations and ecosystems once thresholds in rates of births deaths consumption competition nutrient inputs and decay are crossed Mathematical Ecology is essential reading for students of ecology who have had a first course in calculus and linear algebra or students in mathematics wishing to learn how dynamical systems theory can be applied to ecological problems

**Mathematical Ecology** Thomas G. Hallam, Simon A. Levin, 2012-12-06 There is probably no more appropriate location to hold a course on mathematical ecology than Italy the country of Vito Volterra a founding father of the subject The Trieste

1982Autumn Course on Mathematical Ecology consisted of four weeksofvery concentrated scholasticism and aestheticism The first weeks were devoted to fundamentals and principles of mathematical ecology A nucleus of the material from the lectures presented during this period constitutes this book The final week and a half of the Course was apportioned to the Trieste Research Conference on Mathematical Ecology whose proceedings have been published as Volume 54 Lecture Notes in Biomathematics Springer Verlag The objectivesofthe first portion of the course were ambitious and probably unattainable Basic principles of the areas of physiological population community and ecosystem ecology that have solid ecological and mathematical foundations were to be presented Classical terminology was to be introduced important fundamental topics were to be developed some past and some current problems of interest were to be presented and directions for possible research were to be provided Due to time constraints the coverage could not be encyclopedic many areas covered already have merited treatises of book length Consequently preliminary foundation material was covered in some detail but subject overviews and area syntheses were presented when research frontiers were being discussed. These lecture notes reflect this course philosophy Mathematische Modelle in der Biologie Wilfried Nöbauer, 2013-07-02 Der Einsatz mathematischer Methoden zur Formulierung und wsung von Problemen aus dem Bereich der Biowissenschaften auch aus dem Bereich der Medizin hat in den letzten Jahrzehnten zunehmend an Bedeutung gewonnen Wahrend die mathematische Behandlung einiger Teilgebiete der Biowissenschaften tiber erste Anflinge noch nicht hinaus gekommen ist gibt es andere Teilgebiete insbesondere die Genetik die Okologie und die Epidemiologie fUr die sich bereits eine umfangreiche mathematische Theorie entwickelt hat Dementsprechend gibt es auch schon eine Reihe von Monographien Uber Teilgebiete der Biomathematik Es gibt aber noch sehr wenige Einftihrungen in das Gesamtgebiet der Biomathematik das heif t also BUcher die ohne zu sehr ins Detail zu gehen einen Einblick in die bisherigen Anslitze auf diesem Gebiet geben Das vorliegende Buch ist als Beitrag zur Schlie ung dieser LUcke gedacht Wir wollen in ibm daher die M6glichkeiten der mathematischen Modellbildung im Bereich der Biologie an charakteristischen Beispielen demonstrieren und analysieren beschranken uns dabei aber bewu t auf relativ einfache Modelle um den mathematischen Aufwand in Grenzen zu halten Daruber hinaus werden wir im Anhang des Buches eine Zusammenstellung der verwendeten Mathematik geben soweit sie nicht zum allgemein bekannten Schullehrstoff gehOrt Wir hoffen d dadurch das Buch auch flir den Biologen ohne zu gro e Mtihe verstandlich wird **Progress in Mathematical Ecology** Sergei Petrovskii, 2018-12-07 This book is a printed edition of the Special Issue Progress in Mathematical Ecology that was published in Mathematics Computing Skills for Biologists Stefano Allesina, Madlen Wilmes, 2019-01-15 A concise introduction to key computing skills for biologists While biological data continues to grow exponentially in size and quality many of today s biologists are not trained adequately in the computing skills necessary for leveraging this information deluge In Computing Skills for Biologists Stefano Allesina and Madlen Wilmes present a valuable toolbox for the effective analysis of biological data Based on the authors experiences teaching scientific computing at the University of Chicago this

textbook emphasizes the automation of repetitive tasks and the construction of pipelines for data organization analysis visualization and publication Stressing practice rather than theory the book s examples and exercises are drawn from actual biological data and solve cogent problems spanning the entire breadth of biological disciplines including ecology genetics microbiology and molecular biology Beginners will benefit from the many examples explained step by step while more seasoned researchers will learn how to combine tools to make biological data analysis robust and reproducible The book uses free software and code that can be run on any platform Computing Skills for Biologists is ideal for scientists wanting to improve their technical skills and instructors looking to teach the main computing tools essential for biology research in the twenty first century Excellent resource for acquiring comprehensive computing skills Both novice and experienced scientists will increase efficiency by building automated and reproducible pipelines for biological data analysis Code examples based on published data spanning the breadth of biological disciplines Detailed solutions provided for exercises in each chapter Extensive companion website Matrices and Graphs Stability Problems in Mathematical Ecology D. Logofet, 2018-02-01 Intuitive ideas of stability in dynamics of a biological population community or ecosystem can be formalized in the framework of corresponding mathematical models These are often represented by systems of ordinary differential equations or difference equations Matrices and Graphs covers achievements in the field using concepts from matrix theory and graph theory The book effectively surveys applications of mathematical results pertinent to issues of theoretical and applied ecology The only mathematical prerequisite for using Matrices and Graphs is a working knowledge of linear algebra and matrices The book is ideal for biomathematicians ecologists and applied mathematicians doing research on dynamic behavior of model populations and communities consisting of multi component systems It will also be valuable as a text for a graduate level topics course in applied math or mathematical ecology Applied Mathematical Ecology Simon A. Levin, Thomas G. Hallam, Louis J. Gross, 2012-12-06 The Second Autumn Course on Mathematical Ecology was held at the International Centre for Theoretical Physics in Trieste Italy in November and December of 1986 During the four year period that had elapsed since the First Autumn Course on Mathematical Ecology sufficient progress had been made in applied mathemat ical ecology to merit tilting the balance maintained between theoretical aspects and applications in the 1982 Course toward applications The course format while similar to that of the first Autumn Course on Mathematical Ecology consequently focused upon applications of mathematical ecology Current areas of application are almost as diverse as the spectrum covered by ecology The topiys of this book reflect this diversity and were chosen because of perceived interest and utility to developing countries Topical lectures began with foundational material mostly derived from Math ematical Ecology An Introduction a compilation of the lectures of the 1982 course published by Springer Verlag in this series Volume 17 and when possible progressed to the frontiers of research In addition to the course lectures workshops were arranged for small groups to supplement and enhance the learning experience Other perspectives were provided through presentations by course participants and

speakers at the associated Research Conference Many of the research papers are in a companion volume Mathematical Ecology Proceedings Trieste 1986 published by World Scientific Press in 1988 This book is structured primarily by application area Part II provides an introduction to mathematical and statistical applications in resource management

**Encyclopedia of Ecology** Brian D. Fath, 2018-08-23 Encyclopedia of Ecology Second Edition Four Volume Set continues the acclaimed work of the previous edition published in 2008 It covers all scales of biological organization from organisms to populations to communities and ecosystems Laboratory field simulation modelling and theoretical approaches are presented to show how living systems sustain structure and function in space and time New areas of focus include micro and macro scales molecular and genetic ecology and global ecology e g climate change earth transformations ecosystem services and the food water energy nexus are included In addition new international experts in ecology contribute on a variety of topics Offers the most broad ranging and comprehensive resource available in the field of ecology Provides foundational content and suggests further reading Incorporates the expertise of over 500 outstanding investigators in the field of ecology including top young scientists with both research and teaching experience Includes multimedia resources such as an Interactive Map Viewer and links to a CSDMS Community Surface Dynamics Modeling System an open source platform for modelers to share and link models dealing with earth system processes Mathematical Ecology S.A. Levin, T.G. Grassland-Invertebrate Interactions: Plant Productivity, Resilience and Community Dynamics Ivan Hallam, 2013-03-13 Hiltpold, Michael Rostás, 2017-10-13 Natural and anthropogenic grasslands such as prairies meadows rangelands and pastures cover more than 40% of the planet's surface and provide a wealth of ecological services Grasslands alone store one third of the global carbon stocks and grass roots through their specific architectures ensure water cycling and prevent the erosion of fertile topsoil In addition grasslands are of vital importance for human food production as vast areas of rangelands and pastures provide feed for livestock Pastoral legumes mobilize atmospheric nitrogen and improve fertility of arable soils Not least grasslands are an essential genetic resource The three major crop species that feed half of the global population have been bred from wild grasses Ancestors of our contemporary turf cultivars common components of urban landscapes and recreation spaces originated from wild grasslands Although natural and managed grasslands represent pivotal ecosystems many aspects of how they function are poorly understood To date most attention has focused on grassland primary producers i e forage plants and mammalian grazers but invertebrates are likely to play an equally if not more important role in grassland ecosystem functioning In Australian pastures for example the biomass of root feeding scarab beetles can often exceed that of sheep and plant damage caused by invertebrates is sometimes equivalent to an average dairy cow s grass consumption Indeed grasslands are one of the most densely populated ecosystems with invertebrates being probably the most important engineers that shape both plant communities and the grassland as a whole In a rapidly changing world with increasing anthropogenic pressure on grasslands this Research Topic focuses on 1 How grassland habitats shape

invertebrate biodiversity 2 Impacts of climate change on grassland invertebrate interactions 3 Plant and invertebrate pest monitoring and management 4 Plant mediated multitrophic interactions and biological control in grasslands 5 Land use and grassland invertebrates 6 Plant resistance to invertebrate pests Given the increasing demand for food and land for human habitation unprecedented threats to grasslands are anticipated Resilient to some extent these key ecosystems need to be better comprehended to guarantee their sustainable management and ecosystem services New frontiers in the application of stable isotopes to ecological and ecophysiological research Keith Alan Hobson, John Whiteman, Seth Multivariate Statistical Methods Bryan F. J. Manly, Jorge A. Navarro Alberto, Ken Gerow, 2024-10-04 Newsome, 2023-08-14 Multivariate Statistical Methods A Primer offers an introduction to multivariate statistical methods in a rigorous yet intuitive way without an excess of mathematical details In this fifth edition all chapters have been revised and updated with clearer and more direct language than in previous editions and with more up to date examples exercises and references in areas as diverse as biology environmental sciences economics social medicine and politics Features A concise and accessible conceptual approach that requires minimal mathematical background Suitable for a wide range of applied statisticians and professionals from the natural and social sciences Presents all the key topics for a multivariate statistics course The R code in the appendices has been updated and there is a new appendix introducing programming basics for R The data from examples and exercises are available on a companion website This book continues to be a great starting point for readers looking to become proficient in multivariate statistical methods but who might not be deeply versed in the language of mathematics In this edition we provide readers with conceptual introductions to methods practical suggestions new references and a more extensive collection of R functions and code that will help them to deepen their toolkit of multivariate statistical methods

Elements of Mathematical Ecology Mark Kot,2001-07-19 Elements of Mathematical Ecology provides an introduction to classical and modern mathematical models methods and issues in population ecology The first part of the book is devoted to simple unstructured population models that ignore much of the variability found in natural populations for the sake of tractability Topics covered include density dependence bifurcations demographic stochasticity time delays population interactions predation competition and mutualism and the application of optimal control theory to the management of renewable resources The second part of this book is devoted to structured population models covering spatially structured population models with a focus on reaction diffusion models age structured models and two sex models Suitable for upper level students and beginning researchers in ecology mathematical biology and applied mathematics the volume includes numerous clear line diagrams that clarify the mathematics relevant problems thoughout the text that aid understanding and supplementary mathematical and historical material that enrich the main text Spatial Heterogeneity of Forest-Steppes Laszlo Erdos, 2021-06-03 Forest steppes occupy a wide zone between Eurasian closed canopy forests and open steppes and feature a mosaic of woody and herbaceous vegetation Due to the occurrence of structurally compositionally and

environmentally strongly different habitats in close proximity high spatial heterogeneity is one of the key characteristics of forest steppe ecosystems This volume presents ten contributions examining forest steppe heterogeneity and its effects on **Population Ecology in Practice** Dennis L. Murray, Brett K. environmental factors plant communities and animals Sandercock, 2020-02-10 A synthesis of contemporary analytical and modeling approaches in population ecology. The book provides an overview of the key analytical approaches that are currently used in demographic genetic and spatial analyses in population ecology The chapters present current problems introduce advances in analytical methods and models and demonstrate the applications of quantitative methods to ecological data The book covers new tools for designing robust field studies estimation of abundance and demographic rates matrix population models and analyses of population dynamics and current approaches for genetic and spatial analysis Each chapter is illustrated by empirical examples based on real datasets with a companion website that offers online exercises and examples of computer code in the R statistical software platform Fills a niche for a book that emphasizes applied aspects of population analysis Covers many of the current methods being used to analyse population dynamics and structure Illustrates the application of specific analytical methods through worked examples based on real datasets Offers readers the opportunity to work through examples or adapt the routines to their own datasets using computer code in the R statistical platform Population Ecology in Practice is an excellent book for upper level undergraduate and graduate students taking courses in population ecology or ecological statistics as well as established researchers needing a desktop reference for contemporary methods used to develop robust population assessments

Neue Funde im Osten - Entstehung, Verbreitung und Charakteristik des Phänomens Michelsberg im Lichte neuer Forschungen Ralf Gleser, Silviane Scharl, Ute Seidel, Michael Strobel, Das Buch enth lt Beitr ge zu einer internationalen Konferenz die vom 31 Mai bis 2 Juni 2023 an der Universit t M nster stattgefunden hat Landschaften Europas mit Michelsberger Fundmaterial vom Pariser Becken und Flandern im Westen bis Sachsen und Tschechien im Osten stehen im Fokus unter Einbeziehung neuer und methodisch interdisziplin rer Ans tze 22 Beitr ge markieren den aktuellen Forschungsstand zur Entstehung und Verbreitung der Michelsberger Kultur in der zweiten H lfte des 5 Jahrtausends vor Christus Es werden regionale Entwicklungstendenzen herausgearbeitet und die verschiedenen kulturellen Grundlagen des Ph nomens Michelsberg aufgezeigt Developments in Numerical Ecology Pierre Legendre, Louis Legendre, 2013-06-29 From earlier ecological studies it has become apparent that simple univariate or bivariate statistics are often inappropriate and that multivariate statistical analyses must be applied Despite several difficulties arising from the application of multivariate methods community ecology has acquired a mathematical framework with three consequences it can develop as an exact science it can be applied operationally as a computer assisted science to the solution of environmental problems and it can exchange information with other disciplines using the language of mathematics This book comprises the invited lectures as well as working group reports on the NATO workshop held in Roscoff France to improve the applicability of this

new method numerical ecology to specific ecological problems

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