# A Primer of

# **Ecological Statistics**



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# **A Primer Of Ecological Statistics Second Edition**

**Lynn Arthur Steen** 

#### A Primer Of Ecological Statistics Second Edition:

A Primer of Ecological Statistics Nicholas J. Gotelli, Aaron M. Ellison, 2013-03-14 A Primer of Ecological Statistics Second Edition explains fundamental material in probability theory experimental design and parameter estimation for ecologists and environmental scientists. The book emphasizes a general introduction to probability theory and provides a detailed discussion of specific designs and analyses that are typically encountered in ecology and environmental science Appropriate for use as either a stand alone or supplementary text for upper division undergraduate or graduate courses in ecological and environmental statistics ecology environmental science environmental studies or experimental design the Primer also serves as a resource for environmental professionals who need to use and interpret statistics daily but have little or no formal training in the subject The book is divided into four parts Part I discusses the fundamentals of probability and statistical thinking It introduces the logic and language of probability Chapter 1 explains common statistical distributions used in ecology Chapter 2 and important measures of central tendency and spread Chapter 3 explains P values hypothesis testing and statistical errors Chapter 4 and introduces frequentist Bayesian and Monte Carlo methods of analysis Chapter 5 Part II discusses how to successfully design and execute field experiments and sampling studies Topics include design strategies Chapter 6 a bestiary of experimental designs Chapter 7 and transformations and data management Chapter 8 Part III discusses specific analyses and covers the material that is the main core of most statistics texts Topics include regression Chapter 9 analysis of variance Chapter 10 categorical data analysis Chapter 11 and multivariate analysis Chapter 12 Part IV new to this edition discusses two central topics in estimating important ecological metrics Topics include quantification of biological diversity Chapter 13 and estimating occupancy detection probability and population sizes from marked and unmarked populations Chapter 14 The book includes a comprehensive glossary a mathematical appendix on matrix algebra and extensively annotated tables and figures Footnotes introduce advanced and ancillary material some are purely historical others cover mathematical statistical proofs or details and still others address current topics in the ecological literature Data files and code used for some of the examples as well as errata are available online A Primer of Ecological Statistics **EBook** Nicholas J. Gotelli, Aaron M. Ellison, 2013 A Primer of GIS, Second Edition Francis Harvey, 2015-10-29 This accessible text prepares students to understand and work with geographic information systems GIS offering a detailed introduction to essential theories concepts and skills The book is organized in four modular parts that can be used in any sequence in entry level and more specialized courses Basic cartographic principles are integrated with up to date discussions of GIS technologies and applications Coverage includes everything from what geographic information is to its many uses and societal implications Practical examples and exercises invite readers to explore the choices involved in producing reliable maps and other forms of geographic information Illustrations include 170 figures with 15 in color The companion website provides links to Web resources for each chapter plus downloadable PowerPoint slides of most of the figures New to This

Edition Chapter on online mapping and Big Data New and updated discussions of remote sensing vector and raster data models location privacy uses of geocoding and other timely topics Chapter on the many uses of GIS such as in market analyses emergency responding and tracking of epidemics Section overviews and an end of book glossary Pedagogical Features Modules and individual chapters can be used sequentially or in any order End of chapter review questions with answers exercises and extended exercises for applying theories and concepts In Depth sidebars offering a closer look at key concepts and applications End of chapter links to relevant Web resources Statistics by Simulation Carsten F. Dormann, Aaron M. Ellison, 2025-06-03 An accessible guide to understanding statistics using simulations with examples from a range of scientific disciplines Real world challenges such as small sample sizes skewed distributions of data biased sampling designs and more predictors than data points are pushing the limits of classical statistical analysis This textbook provides a new tool for the statistical toolkit data simulations It shows that using simulation and data generating models is an excellent way to validate statistical reasoning and to augment study design and statistical analysis with planning and visualization Although data simulations are not new to professional statisticians Statistics by Simulation makes the approach accessible to a broader audience with examples from many fields It introduces the reasoning behind data simulation and then shows how to apply it in planning experiments or observational studies developing analytical workflows deploying model diagnostics and developing new indices and statistical methods Covers all steps of statistical practice from planning projects to post hoc analysis and model checking Provides examples from disciplines including sociology psychology ecology economics physics and medicine Includes R code for all examples with data and code freely available online Offers bullet point outlines and summaries of each chapter Minimizes the use of jargon and requires only basic statistical background and skills Environmental and Ecological Statistics with R Song S. Qian, 2016-11-03 Emphasizing the inductive nature of statistical thinking Environmental and Ecological Statistics with R Second Edition connects applied statistics to the environmental and ecological fields Using examples from published works in the ecological and environmental literature the book explains the approach to solving a statistical problem covering model specification parameter estimation and model evaluation It includes many examples to illustrate the statistical methods and presents R code for their implementation The emphasis is on model interpretation and assessment and using several core examples throughout the book the author illustrates the iterative nature of statistical inference The book starts with a description of commonly used statistical assumptions and exploratory data analysis tools for the verification of these assumptions It then focuses on the process of building suitable statistical models including linear and nonlinear models classification and regression trees generalized linear models and multilevel models It also discusses the use of simulation for model checking and provides tools for a critical assessment of the developed models The second edition also includes a complete critique of a threshold model Environmental and Ecological Statistics with R Second Edition focuses on statistical modeling and data analysis for environmental and

ecological problems By guiding readers through the process of scientific problem solving and statistical model development it eases the transition from scientific hypothesis to statistical model Quantitative Ecotoxicology, Second Edition Michael C. Newman, 2012-08-29 Quantitative Ecotoxicology Second Edition explores models and methods of quantitative ecotoxicology at progressively higher biological scales using worked examples and common software packages It complements the author s previous books Fundamentals of Ecotoxicology Third Edition and Ecotoxicology A Comprehensive Treatment Encouraging a more rigorous inferential approach to research the book examines the quantitative features of the science of ecotoxicology The first chapters lay the foundation by introducing fundamental concepts and definitions. The author traces the historical perspective rationale and characteristics of scientific ecotoxicology as well as the general measurement process He also considers methodologies for defining and controlling variance which could otherwise exclude valid conclusions from ecotoxicological endeavors The book then discusses ecotoxicological concepts at increasing levels of ecological organization and outlines quantitative methods used to measure toxicant accumulation and effects Reflecting the importance of establishing type I and type II error rates it highlights design issues particularly sample size and power estimation The final chapter summarizes the book with a brief discussion of ecotoxicology from a nonregulatory perspective Extensively updated this second edition has been expanded to include terrestrial as well as aquatic ecotoxicology Requiring only a basic knowledge of statistics this highly readable book is suitable for graduate students and researchers as well as practicing environmental scientists and engineers It guides readers to better understand the fate and effects of toxicants in the biosphere and helps them frame this understanding in quantitative terms What's New in This Edition More than 40 new figures and 20 new worked examples Updated measurement quality methods and software Expanded coverage of synecological models and methods More integration of Bayesian concepts Appendices for power analysis and basic matrix methods Additional mixture toxicity and up and down methods Greatly expanded discussion of significance testing Expanded discussion of metapopulations Matrix tools for population demography Light isotope based models for trophic transfer of toxicants Inclusion of metacommunity and SHE analysis techniques R script examples by Eduard Sz cs University Koblenz Landau available at http edild github io blog categories quantitative ecotoxicology with r <u>Introductory Fisheries Analyses</u> with R Derek H. Ogle, 2018-09-03 A How To Guide for Conducting Common Fisheries Related Analyses in R Introductory Fisheries Analyses with R provides detailed instructions on performing basic fisheries stock assessment analyses in the R environment Accessible to practicing fisheries scientists as well as advanced undergraduate and graduate students the book demonstrates the flexibility and power of R offers insight into the reproducibility of script based analyses and shows how the use of R leads to more efficient and productive work in fisheries science The first three chapters present a minimal introduction to the R environment that builds a foundation for the fisheries specific analyses in the remainder of the book These chapters help you become familiar with R for basic fisheries analyses and graphics Subsequent chapters focus on

methods to analyze age comparisons age length keys size structure weight length relationships condition abundance from capture recapture and depletion data mortality rates individual growth and the stock recruit relationship The fundamental statistical methods of linear regression analysis of variance ANOVA and nonlinear regression are demonstrated within the contexts of these common fisheries analyses For each analysis the author completely explains the R functions and provides sufficient background information so that you can confidently implement each method Web Resource The author's website at http derekogle com IFAR includes the data files and R code for each chapter enabling you to reproduce the results in the book as well as create your own scripts The site also offers supplemental code for more advanced analyses and practice exercises for every chapter Math and Bio 2010 Lynn Arthur Steen, 2005 Math and bio 2010 grew out of Meeting the Challenges Education across the Biological Mathematical and Computer Sciences a joint project of the Mathematical Association of America MAA the National Science Foundation Division of Undergraduate Education NSF DUE the National Institute of General Medical Sciences NIGMS the American Association for the Advancement of Science AAAS and the American Society for Microbiology ASM Foreword p vi Quantitative Analysis of Marine Biological Communities Gerald J. Bakus, 2007-01-22 Quantitative methods specifically tailored for the marine biologist While there are countless texts published on quantitative methods and many texts that cover quantitative terrestrial ecology this text fills the need for the special quantitative problems confronting marine biologists and biological oceanographers. The author combines common quantitative techniques with recent advances in quantitative methodology and then demonstrates how these techniques can be used to study marine organisms their behaviors and their interactions with the environment Readers learn how to better design experiments and sampling employ sophisticated mathematical techniques and accurately interpret and communicate the results Most of this text is written at an introductory level with a few topics that advance to more complex themes Among the topics covered are plot plotless sampling biometrics experimental design game theory optimization time trends modeling and environmental impact assessments Even readers new to quantitative methods will find the material accessible with plenty of features to engage their interest promote learning and put their knowledge into practice One or more examples are provided to illustrate each individual quantitative technique presented in the text The accompanying CD ROM features two multimedia programs several statistical programs help to run complex statistical programs and additional information amplifying topics covered in the text References lead readers to additional information to pursue individual topics in greater depth Quantitative Analysis of Marine Biological Communities with its extensive use of examples is ideal for undergraduate and graduate students in marine biology Marine biologists regardless of their level of experience will also discover new approaches to quantitative analysis tailored to the particular needs of their field **Environmental Management** Handbook, Second Edition - Six Volume Set Sven Erik Jorgensen, Brian D. Fath, 2022-07-30 Bringing together a wealth of knowledge the Handbook of Environmental Management Second Edition gives a comprehensive overview of environmental

problems their sources their assessment and their solutions Through in depth entries and a topical table of contents readers will quickly find answers to questions about pollution and management issues This six volume set is a reimagining of the award winning Encyclopedia of Environmental Management published in 2013 and features insights from more than 500 contributors all experts in their fields The experience evidence methods and models used in studying environmental management is presented here in six stand alone volumes arranged along the major environmental systems Features of the new edition The first handbook that demonstrates the key processes and provisions for enhancing environmental management Addresses new and cutting edge topics on ecosystem services resilience sustainability food energy water nexus socio ecological systems and more Provides an excellent basic knowledge on environmental systems explains how these systems function and offers strategies on how to best manage them Includes the most important problems and solutions facing environmental management today **Ecological Statistics** Gordon A. Fox, Simoneta Negrete-Yankelevich, Vinicio J. Sosa, 2015 The application and interpretation of statistics are central to ecological study and practice Ecologists are now asking more sophisticated questions than in the past These new questions together with the continued growth of computing power and the availability of new software have created a new generation of statistical techniques. These have resulted in major recent developments in both our understanding and practice of ecological statistics. This novel book synthesizes a number of these changes addressing key approaches and issues that tend to be overlooked in other books such as missing censored data correlation structure of data heterogeneous data and complex causal relationships These issues characterize a large proportion of ecological data but most ecologists training in traditional statistics simply does not provide them with adequate preparation to handle the associated challenges Uniquely Ecological Statistics highlights the underlying links among many statistical approaches that attempt to tackle these issues In particular it gives readers an introduction to approaches to inference likelihoods generalized linear mixed models spatially or phylogenetically structured data and data synthesis with a strong emphasis on conceptual understanding and subsequent application to data analysis Written by a team of practicing ecologists mathematical explanations have been kept to the minimum necessary This user friendly textbook will be suitable for graduate students researchers and practitioners in the fields of ecology evolution environmental studies and computational biology who are interested in updating their statistical tool kits A companion web site provides example data **How to Do Ecology** Richard Karban, Mikaela Huntzinger, Ian S. sets and commented code in the R language Pearse, 2014-07-21 The essential guide to successful ecological research now updated and expanded Most books and courses in ecology cover facts and concepts but don't explain how to actually do ecological research How to Do Ecology provides nuts and bolts advice on organizing and conducting a successful research program This one of a kind book explains how to choose a research question and answer it through manipulative experiments and systematic observations Because science is a social endeavor the book provides strategies for working with other people including professors and collaborators It suggests

effective ways to communicate your findings in the form of journal articles oral presentations posters and grant and research proposals The book also includes ideas to help you identify your goals organize a season of fieldwork and deal with negative results In short it makes explicit many of the unspoken assumptions behind doing good research in ecology and provides an invaluable resource for meaningful conversations between ecologists This second edition of How to Do Ecology features new sections on conducting and analyzing observational surveys job hunting and becoming a more creative researcher as well as updated sections on statistical analyses Wildlife Study Design Michael L. Morrison, William M. Block, M. Dale Strickland, Bret A. Collier, Markus J. Peterson, 2008-03-21 We developed the first edition of this book because we perceived a need for a compilation on study design with application to studies of the ecology consertion and management of wildlife We felt that the need for coverage of study design in one source was strong and although a few books and monographs existed on some of the topics that we covered no single work attempted to synthesize the many facets of wildlife study design We decided to develop this second edition because our original goal synthesis of study design remains strong and because we each gathered a substantial body of new material with which we could update and expand each chapter Several of us also used the first edition as the basis for workshops and graduate teaching which provided us with many valuable suggestions from readers on how to improve the text In particular Morrison received a detailed review from the graduate s dents in his Wildlife Study Design course at Texas A M University We also paid heed to the reviews of the first edition that appeared in the literature Using the Biological Literature Diane Schmidt, 2014-04-14 The biological sciences cover a broad array of literature types from younger fields like molecular biology with its reliance on recent journal articles genomic databases and protocol manuals to classic fields such as taxonomy with its scattered literature found in monographs and journals from the past three centuries Using the Biological Literature A Practical Guide Fourth Edition is an annotated guide to selected resources in the biological sciences presenting a wide ranging list of important sources. This completely revised edition contains numerous new resources and descriptions of all entries including textbooks The guide emphasizes current materials in the English language and includes retrospective references for historical perspective and to provide access to the taxonomic literature It covers both print and electronic resources including monographs journals databases indexes and abstracting tools websites and associations providing users with listings of authoritative informational resources of both classical and recently published works With chapters devoted to each of the main fields in the basic biological sciences this book offers a guide to the best and most up to date resources in biology It is appropriate for anyone interested in searching the biological literature from undergraduate students to faculty researchers and librarians The guide includes a supplementary website dedicated to keeping URLs of electronic and web based resources up to date a popular feature continued from the third edition Bayesian Disease Mapping Andrew B. Lawson, 2013-03-18 Since the publication of the first edition many new Bayesian tools and methods have been developed for space time data analysis the predictive modeling

of health outcomes and other spatial biostatistical areas Exploring these new developments Bayesian Disease Mapping Hierarchical Modeling in Spatial Epidemiology Second Edition provides an up to date cohesive account of the full range of Bayesian disease mapping methods and applications A biostatistics professor and WHO advisor the author illustrates the use of Bayesian hierarchical modeling in the geographical analysis of disease through a range of real world datasets New to the Second Edition Three new chapters on regression and ecological analysis putative hazard modeling and disease map surveillance Expanded material on case event modeling and spatiotemporal analysis New and updated examples Two new appendices featuring examples of integrated nested Laplace approximation INLA and conditional autoregressive CAR models In addition to these new topics the book covers more conventional areas such as relative risk estimation clustering spatial survival analysis and longitudinal analysis After an introduction to Bayesian inference computation and model assessment the text focuses on important themes including disease map reconstruction cluster detection regression and ecological analysis putative hazard modeling analysis of multiple scales and multiple diseases spatial survival and longitudinal studies spatiotemporal methods and map surveillance It shows how Bayesian disease mapping can yield significant insights into georeferenced health data WinBUGS and R are used throughout for data manipulation and simulation Numerical Analysis in Science and Engineering Victor A. Bloomfield, 2018-09-03 Instead of presenting the standard theoretical treatments that underlie the various numerical methods used by scientists and engineers Using R for Numerical Analysis in Science and Engineering shows how to use R and its add on packages to obtain numerical solutions to the complex mathematical problems commonly faced by scientists and engineers This practical guide to the capabilities of R demonstrates Monte Carlo stochastic deterministic and other numerical methods through an abundance of worked examples and code covering the solution of systems of linear algebraic equations and nonlinear equations as well as ordinary differential equations and partial differential equations It not only shows how to use R s powerful graphic tools to construct the types of plots most useful in scientific and engineering work but also Explains how to statistically analyze and fit data to linear and nonlinear models Explores numerical differentiation integration and optimization Describes how to find eigenvalues and eigenfunctions Discusses interpolation and curve fitting Considers the analysis of time series Using R for Numerical Analysis in Science and Engineering provides a solid introduction to the most useful numerical methods for scientific and engineering data analysis using R Bayesian Models N. Thompson Hobbs, Mevin B. Hooten, 2025-06-03 A fully updated and expanded edition of the essential primer on Bayesian modeling for ecologists Uniquely suited to deal with complexity in a statistically coherent way Bayesian modeling has become an indispensable tool for ecological research This book teaches the basic principles of mathematics and statistics needed to apply Bayesian models to the analysis of ecological data using language non statisticians can understand Deemphasizing computer coding in favor of a clear treatment of model building it starts with a definition of probability and proceeds step by step through distribution theory likelihood simple

Bayesian models and hierarchical Bayesian models Now revised and expanded Bayesian Models enables students and practitioners to gain new insights from ecological models and data properly tempered by uncertainty Covers the basic rules of probability needed to model diverse types of ecological data in the Bayesian framework Shows how to write proper mathematical expressions for posterior distributions using directed acyclic graphs as templates Explains how to use the powerful Markov chain Monte Carlo algorithm to find posterior distributions of model parameters latent states and missing data Teaches how to check models to assure they meet the assumptions of model based inference Demonstrates how to make inferences from single and multiple Bayesian models Provides worked problems for practicing and strengthening modeling skills Features new chapters on spatial models and modeling missing data **Applied Statistical Modelling for** Ecologists Marc Kéry, Kenneth F. Kellner, 2024-07-18 2025 PROSE Award Finalist in Environmental Science Applied Statistical Modelling for Ecologists provides a gentle introduction to the essential models of applied statistics linear models generalized linear models mixed and hierarchical models All models are fit with both a likelihood and a Bayesian approach using several powerful software packages widely used in research publications JAGS NIMBLE Stan and TMB In addition the foundational method of maximum likelihood is explained in a manner that ecologists can really understand This book is the successor of the widely used Introduction to WinBUGS for Ecologists K ry Academic Press 2010 Like its parent it is extremely effective for both classroom use and self study allowing students and researchers alike to quickly learn understand and carry out a very wide range of statistical modelling tasks The examples in Applied Statistical Modelling for Ecologists come from ecology and the environmental sciences but the underlying statistical models are very widely used by scientists across many disciplines This book will be useful for anybody who needs to learn and quickly become proficient in statistical modelling with either a likelihood or a Bayesian focus and in the model fitting engines covered including the three latest packages NIMBLE Stan and TMB Contains a concise and gentle introduction to probability and applied statistics as needed in ecology and the environmental sciences Covers the foundations of modern applied statistical modelling Gives a comprehensive applied introduction to what currently are the most widely used and most exciting cutting edge model fitting software packages JAGS NIMBLE Stan and TMB Provides a highly accessible applied introduction to the two dominant methods of fitting parametric statistical models maximum likelihood and Bayesian posterior inference Details the principles of model building model checking and model selection Adopts a Rosetta Stone approach wherein understanding of one software and of its associated language will be greatly enhanced by seeing the analogous code in other engines Provides all code available for download for students at https www elsevier com books and journals book companion 9780443137150 Stochastic Simulation Brian D. Ripley, 2009-09-25 WILEY INTERSCIENCE PAPERBACK SERIES The Wiley Interscience Paperback Series consists of selected books that have been made more accessible to consumers in an effort to increase global appeal and general circulation With these new unabridged softcover volumes Wiley hopes to extend the lives of these works by making them

available to future generations of statisticians mathematicians and scientists this is a very competently written and useful addition to the statistical literature a book every statistician should look at and that many should study Short Book Reviews International Statistical Institute reading this book was an enjoyable learning experience The suggestions and recommendations on the methods make this book an excellent reference for anyone interested in simulation With its compact structure and good coverage of material it is an excellent textbook for a simulation course Technometrics this work is an excellent comprehensive guide to simulation methods written by a very competent author It is especially recommended for those users of simulation methods who want more than a cook book Mathematics Abstracts This book is a comprehensive guide to simulation methods with explicit recommendations of methods and algorithms It covers both the technical aspects of the subject such as the generation of random numbers non uniform random variates and stochastic processes and the use of simulation Supported by the relevant mathematical theory the text contains a great deal of unpublished research material including coverage of the analysis of shift register generators sensitivity analysis of normal variate generators analysis of simulation output and more Statistics for Spatio-Temporal Data Noel Cressie, Christopher K. Wikle, 2015-11-02 Winner of the 2013 DeGroot Prize A state of the art presentation of spatio temporal processes bridging classic ideas with modern hierarchical statistical modeling concepts and the latest computational methods Noel Cressie and Christopher K Wikle are also winners of the 2011 PROSE Award in the Mathematics category for the book Statistics for Spatio Temporal Data 2011 published by John Wiley and Sons The PROSE awards for Professional and Scholarly Excellence are given by the Association of American Publishers the national trade association of the US book publishing industry Statistics for Spatio Temporal Data has now been reprinted with small corrections to the text and the bibliography The overall content and pagination of the new printing remains the same the difference comes in the form of corrections to typographical errors editing of incomplete and missing references and some updated spatio temporal interpretations From understanding environmental processes and climate trends to developing new technologies for mapping public health data and the spread of invasive species there is a high demand for statistical analyses of data that take spatial temporal and spatio temporal information into account Statistics for Spatio Temporal Data presents a systematic approach to key quantitative techniques that incorporate the latest advances in statistical computing as well as hierarchical particularly Bayesian statistical modeling with an emphasis on dynamical spatio temporal models Cressie and Wikle supply a unique presentation that incorporates ideas from the areas of time series and spatial statistics as well as stochastic processes Beginning with separate treatments of temporal data and spatial data the book combines these concepts to discuss spatio temporal statistical methods for understanding complex processes Topics of coverage include Exploratory methods for spatio temporal data including visualization spectral analysis empirical orthogonal function analysis and LISAs Spatio temporal covariance functions spatio temporal kriging and time series of spatial processes Development of hierarchical dynamical spatio temporal models DSTMs

with discussion of linear and nonlinear DSTMs and computational algorithms for their implementation Quantifying and exploring spatio temporal variability in scientific applications including case studies based on real world environmental data Throughout the book interesting applications demonstrate the relevance of the presented concepts Vivid full color graphics emphasize the visual nature of the topic and a related FTP site contains supplementary material Statistics for Spatio Temporal Data is an excellent book for a graduate level course on spatio temporal statistics It is also a valuable reference for researchers and practitioners in the fields of applied mathematics engineering and the environmental and health sciences

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