

The Statistical
Analysis of
Compositional
Data

J. Aitchison

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Statistical Analysis Of Compositional Data

**Antonella Buccianti, G. Mateu-
Figueras, Vera Pawlowsky-Glahn**

Statistical Analysis Of Compositional Data:

The Statistical Analysis of Compositional Data J. Aitchison, 1986-08-21 As long ago as 1897 Karl Pearson in a now classic paper on spurious correlation first pointed out dangers that may befall the analyst who attempts to interpret correlations between ratios whose numerators and denominators contain common parts He thus implied that the analysis of compositional data with its concentration on relationships between proportions of some whole is likely to be fraught with difficulty History has proved him correct over the succeeding years and indeed right up to the present day there has been no other form of data analysis where more confusion has reigned and where more improper and inadequate statistical methods have been applied The special and intrinsic feature of compositional data is that the proportions of a composition are naturally subject to a unit sum constraint For other forms of constrained data in particular for directional data where there is a unit length constraint on each direction vector scientist and statistician alike have readily appreciated that new statistical methods appropriate to the special nature of the data are required and there now exists an extensive literature on the successful statistical analysis of directional data It is paradoxical that for compositional data subject to an apparently simpler constraint such an appreciation and development have been slower to emerge In applications the unit sum constraint has been widely ignored or wished away and inappropriate standard statistical methods devised for and successfully applied to unconstrained data have been used with disastrous consequences

Modeling and Analysis of Compositional Data Vera Pawlowsky-Glahn, Juan José Egozcue, Raimon Tolosana-Delgado, 2015-02-17 Modeling and Analysis of Compositional Data presents a practical and comprehensive introduction to the analysis of compositional data along with numerous examples to illustrate both theory and application of each method Based upon short courses delivered by the authors it provides a complete and current compendium of fundamental to advanced methodologies along with exercises at the end of each chapter to improve understanding as well as data and a solutions manual which is available on an accompanying website Complementing Pawlowsky Glahn's earlier collective text that provides an overview of the state of the art in this field

Modeling and Analysis of Compositional Data fills a gap in the literature for a much needed manual for teaching self learning or consulting

Advances in Compositional Data Analysis Peter Filzmoser, Karel Hron, Josep Antoni Martín-Fernández, Javier Palarea-Albaladejo, 2021-06-01 This book presents modern methods and real world applications of compositional data analysis It covers a wide variety of topics ranging from an updated presentation of basic concepts and ideas in compositional data analysis to recent advances in the context of complex data structures Further it illustrates real world applications in numerous scientific disciplines and includes references to the latest software solutions available for compositional data analysis thus providing a valuable and up to date guide for researchers and practitioners working with compositional data Featuring selected contributions by leading experts in the field the book is dedicated to Vera Pawlowsky Glahn on the occasion of her 70th birthday

Geostatistical Analysis of Compositional Data Vera Pawlowsky-Glahn, Ricardo A.

Olea,2004-06-03 1 Introduction 2 Regionalized Compositions 3 Spatial Covariance Structure 4 Concepts of Null Correlation 5 Cokriging 6 Practical Aspects of Compositional Data Analysis 7 Application to Real Data Summary and Prospects References Index

Compositional Data Analysis Vera Pawlowsky-Glahn, Antonella Buccianti, 2011-09-19 It is difficult to imagine that the statistical analysis of compositional data has been a major issue of concern for more than 100 years. It is even more difficult to realize that so many statisticians and users of statistics are unaware of the particular problems affecting compositional data as well as their solutions. The issue of spurious correlation as the situation was phrased by Karl Pearson back in 1897 affects all data that measures parts of some whole such as percentages, proportions, ppm and ppb. Such measurements are present in all fields of science ranging from geology, biology, environmental sciences, forensic sciences, medicine and hydrology. This book presents the history and development of compositional data analysis along with Aitchison's log ratio approach. Compositional Data Analysis describes the state of the art both in theoretical fields as well as applications in the different fields of science. Key Features: Reflects the state of the art in compositional data analysis. Gives an overview of the historical development of compositional data analysis as well as basic concepts and procedures. Looks at advances in algebra and calculus on the simplex. Presents applications in different fields of science including genomics, ecology, biology, geochemistry, planetology, chemistry and economics. Explores connections to correspondence analysis and the Dirichlet distribution. Presents a summary of three available software packages for compositional data analysis. Supported by an accompanying website featuring R code. Applied scientists working on compositional data analysis in any field of science, both in academia and professionals, will benefit from this book along with graduate students in any field of science working with compositional data.

Analyzing Compositional Data with R K. Gerald van den Boogaart, Raimon Tolosana-Delgado, 2013-06-29 This book presents the statistical analysis of compositional data sets, i.e. data in percentages, proportions, concentrations, etc. The subject is covered from its grounding principles to the practical use in descriptive, exploratory analysis, robust linear models and advanced multivariate statistical methods including zeros and missing values, and paying special attention to data visualization and model display issues. Many illustrated examples and code chunks guide the reader into their modeling and interpretation. And though the book primarily serves as a reference guide for the R package compositions, it is also a general introductory text on Compositional Data Analysis. Awareness of their special characteristics spread in the Geosciences in the early sixties but a strategy for properly dealing with them was not available until the works of Aitchison in the eighties. Since then research has expanded our understanding of their theoretical principles and the potentials and limitations of their interpretation. This is the first comprehensive textbook addressing these issues as well as their practical implications with regard to software. The book is intended for scientists interested in statistically analyzing their compositional data. The subject enjoys relatively broad awareness in the geosciences and environmental sciences but the spectrum of recent applications also covers areas like medicine, official statistics and

economics Readers should be familiar with basic univariate and multivariate statistics Knowledge of R is recommended but not required as the book is self contained **The Statistical Analysis of Compositional Data** Shir-ming Shen,1983

Compositional Data Analysis in the Geosciences Antonella Buccianti,G. Mateu-Figueras,Vera Pawlowsky-Glahn,2006 Since Karl Pearson wrote his paper on spurious correlation in 1897 a lot has been said about the statistical analysis of compositional data mainly by geologists such as Felix Chayes The solution appeared in the 1980s when John Aitchison proposed to use Iogratios Since then the approach has seen a great expansion mainly building on the idea of the natural geometry of the sample space Statistics is expected to give sense to our perception of the natural scale of the data and this is made possible for compositional data using Iogratios This publication will be a milestone in this process **The Statistical Analysis of Compositional Data** Shir-Ming Shen,2017-01-27 This dissertation The Statistical Analysis of Compositional Data by Shir ming Shen was obtained from The University of Hong Kong Pokfulam Hong Kong and is being sold pursuant to Creative Commons Attribution 3.0 Hong Kong License The content of this dissertation has not been altered in any way We have altered the formatting in order to facilitate the ease of printing and reading of the dissertation All rights not granted by the above license are retained by the author DOI 10.5353/th_b3123037 Subjects Distribution Probability theory Statistics

Applied Compositional Data Analysis Peter Filzmoser,Karel Hron,Matthias Templ,2018-11-03 This book presents the statistical analysis of compositional data using the log ratio approach It includes a wide range of classical and robust statistical methods adapted for compositional data analysis such as supervised and unsupervised methods like PCA correlation analysis classification and regression In addition it considers special data structures like high dimensional compositions and compositional tables The methodology introduced is also frequently compared to methods which ignore the specific nature of compositional data It focuses on practical aspects of compositional data analysis rather than on detailed theoretical derivations thus issues like graphical visualization and preprocessing treatment of missing values zeros outliers and similar artifacts form an important part of the book Since it is primarily intended for researchers and students from applied fields like geochemistry chemometrics biology and natural sciences economics and social sciences all the proposed methods are accompanied by worked out examples in R using the package robCompositions **CODA** John Aitchison,1986

Microcomputer Package for the Statistical Analysis of Compositional Data **Novel Methods for the Statistical Analysis of Compositional Data** Michail Tsagris,2014

Statistical Analysis of Microbiome Data with R Yinglin Xia,Jun Sun,Ding-Geng Chen,2018-10-06 This unique book addresses the statistical modelling and analysis of microbiome data using cutting edge R software It includes real world data from the authors research and from the public domain and discusses the implementation of R for data analysis step by step The data and R computer programs are publicly available allowing readers to replicate the model development and data analysis presented in each chapter so that these new methods can be readily applied in their own research The book also discusses recent developments in statistical modelling and data analysis in

microbiome research as well as the latest advances in next generation sequencing and big data in methodological development and applications This timely book will greatly benefit all readers involved in microbiome ecology and microarray data analyses as well as other fields of research **Geostatistics for Compositional Data with R** Raimon

Tolosana-Delgado,Ute Mueller,2021-11-19 This book provides a guided approach to the geostatistical modelling of compositional spatial data These data are data in proportions percentages or concentrations distributed in space which exhibit spatial correlation The book can be divided into four blocks The first block sets the framework and provides some background on compositional data analysis Block two introduces compositional exploratory tools for both non spatial and spatial aspects Block three covers all necessary facets of multivariate spatial prediction for compositional data variogram modelling cokriging and validation Finally block four details strategies for simulation of compositional data including transformations to multivariate normality Gaussian cosimulation multipoint simulation of compositional data and common postprocessing techniques valid for both Gaussian and multipoint methods All methods are illustrated via applications to two types of data sets one a large scale geochemical survey comprised of a full suite of geochemical variables and the other from a mining context where only the elements of greatest importance are considered R codes are included for all aspects of the methodology encapsulated in the R package gmGeostats available in CRAN

The Analysis of Compositional Data Diane

Carol Leighy,1993 **Compositional Data Analysis** Josep Antoni Martín-Fernández,Santiago Thió-Henestrosa,2016-11-19

The authoritative contributions gathered in this volume reflect the state of the art in compositional data analysis CoDa The respective chapters cover all aspects of CoDa ranging from mathematical theory statistical methods and techniques to its broad range of applications in geochemistry the life sciences and other disciplines The selected and peer reviewed papers were originally presented at the 6th International Workshop on Compositional Data Analysis CoDaWork 2015 held in L Escala Girona Spain Compositional data is defined as vectors of positive components and constant sum and more generally all those vectors representing parts of a whole which only carry relative information Examples of compositional data can be found in many different fields such as geology chemistry economics medicine ecology and sociology As most of the classical statistical techniques are incoherent on compositions in the 1980s John Aitchison proposed the log ratio approach to CoDa This became the foundation of modern CoDa which is now based on a specific geometric structure for the simplex an appropriate representation of the sample space of compositional data The International Workshops on Compositional Data Analysis offer a vital discussion forum for researchers and practitioners concerned with the statistical treatment and modelling of compositional data or other constrained data sets and the interpretation of models and their applications The goal of the workshops is to summarize and share recent developments and to identify important lines of future research

Compositional Data Analysis in Practice Michael Greenacre,2018-07-17 Compositional data are quantitative descriptions of the parts of some whole conveying exclusively relative information Examples are found in various fields including geology

medicine chemistry agriculture economics social science etc This concise book presents a very applied introduction to compositional data analysis focussing on the use of R for analysis It includes lots of real examples code snippets and colour figures to illustrate the methods Contribution to the Statistical Analysis of Compositional Data with an Application to Political Economy Thi Huong An Nguyen,2019 The objective of this thesis is to investigate the outcome of an election and the impacts of the socio economics factors on the vote shares in the multiparty system from mathematical point of view The vote shares of the departmental election in France in 2015 form a vector called composition Thus the classical regression model cannot be used directly to model these vote shares because of contraints of compositional data In Chapter 2 we present a regression model in which the dependent variable is a compositional variable and the set of explanatory variables contains both classical variables and compositional variables We analyze the impacts of socio economic factors on the outcome of the election through predicting the vote shares according to either a classical explanatory variable or a compositional explanatory variable Some graphical techniques are also presented However it would be more appreciated to interpret the coefficients of regression model on the simplex Furthermore some authors show that electoral data often exhibit heavy tail behavior Thus we propose to replace the Normal distribution by the Student distribution However there are two versions of the Student distribution the uncorrelated Student UT distribution and the independent Student IT distribution In Chapter 3 we present a complete summary for the Student distributions which includes the univariate and multivariate Student the IT and the UT distribution with fixed degrees of freedom We prove that the maximum likelihood estimator of the covariance matrix in the UTmodel is asymptotically biased We also provide an iterative reweighted algorithm to compute the maximum likelihood estimator of parameter of the IT model A simulation is provided and some Kolmogorov Smirnov tests based on the Mahalanobis distance are carried out to select the right model However this does not work for the UT model because of a single realization of n observation of the multivariate distribution In Chapter 4 we apply the multivariate Student IT regression model to our political economy data We then compare this model to the multivariate Normal regression model We also apply the Kolmogorov Smirnov tests based on the Mahalanobis distance which is proposed in chapter 3 to select a better model Finally we investigate the assumption of statistical independence across territorial units which may be questionable due to potential spatial autocorrelation for compositional data We develop a simultaneous spatial autoregressive model for compositional data which allows for both spatial correlation and correlations across equations by using two stage and three stage least squares methods We present a simulation study to illustrate these methods An application to a data set from the 2015 French departmental election are also showed There is still work to continue in the direction of overcoming the problem of zeros in vote shares This problem is already present for the departmental French elections at the canton level when aggregating the electoral parties in three categories It would have been even more serious when considering the original political parties with no aggregation Besides another direction consists in considering the multivariate Student

distribution for a spatial model *Aspects of Multivariate Statistical Analysis in Geology* R.A. Reyment,E. Savazzi,1999-11-24 The book presents multivariate statistical methods useful in geological analysis The essential distinction between multivariate analysis as applied to full space data measurements on lengths heights breadths etc and compositional data is emphasized with particular reference to geochemical data Each of the methods is accompanied by a practically oriented computer program and backed up by appropriate examples The computer programs are provided on a compact disk together with trial data sets and examples of the output An important feature of this book is the graphical system developed by Dr Savazzi which is entitled Graph Server Geological data often deviate from ideal statistical requirements For this reason close attention has been paid to the analysis of data that contain atypical observations **Western Pueblo Identities** Andrew Ian Duff,2002-02 Developed from his dissertation the author s study proposes a new interpretation of the Western Pueblo material remains that focuses on the interaction between communities and questions old assumptions about group boundaries The study relies on the chemical analysis of ceramics from the areas to show identity of and patterns of exchange between different communities within the region

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