

INTERNATIONAL ASSOCIATION FOR MATHEMATICAL GEOLOGY  
STUDIES IN MATHEMATICAL GEOLOGY NO. 7

# Geostatistical Analysis of Compositional Data

*Vera Pawlowsky-Glahn*

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# Geostatistical Analysis Of Compositional Data

**Richard J. Howarth**



## **Geostatistical Analysis Of Compositional Data:**

**Geostatistical Analysis of Compositional Data** Vera Pawlowsky-Glahn, Ricardo A. Olea, 2004-06-03 Geostatistical Analysis of Compositional Data provides a comprehensive coverage of the theory and practice of analysis of data that have both spatial and compositional dependence characteristics of most earth science and environmental measurements

*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

*Book Review Geostatistical Analysis of Compositional Data*, 2007 Compositional data are represented as vector variables with individual vector components ranging between zero and a positive maximum value representing a constant sum constraint usually unity or 100 percent The earth sciences are flooded with spatial distributions of compositional data such as concentrations of major ion constituents in natural waters e g mole mass or volume fractions mineral percentages ore grades or proportions of mutually exclusive categories e g a water oil rock system While geostatistical techniques have become popular in earth science applications since the 1970s very little attention has been paid to the unique mathematical properties of geostatistical formulations involving compositional variables The book *Geostatistical Analysis of Compositional Data* by Vera Pawlowsky Glahn and Ricardo Olea Oxford University Press 2004 unlike any previous book on geostatistics directly confronts the mathematical difficulties inherent to applying geostatistics to compositional variables The book righteously justifies itself with prodigious referencing to previous work addressing nonsensical ranges of estimated values and error spurious correlation and singular cross covariance matrices

**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 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 **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

**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

Geostatistical Functional Data Analysis Jorge Mateu, Ramon Giraldo, 2021-11-16 Geostatistical Functional Data Analysis Explore the intersection between geostatistics and functional data analysis with this insightful new reference Geostatistical Functional Data Analysis presents a unified approach to modelling functional data when spatial and spatio temporal correlations are present The Editors link together the wide research areas of geostatistics and functional data analysis to provide the reader with a new area called geostatistical functional data analysis that will bring new insights and new open questions to researchers coming from both scientific fields This book provides a complete and up to date account to deal with functional data that is spatially correlated but also includes the most innovative developments in different open avenues in this field Containing contributions from leading experts in the field this practical guide provides readers with the necessary tools to employ and adapt classic statistical techniques to handle spatial regression The book also includes A thorough introduction to the spatial kriging methodology when working with functions A detailed exposition of more classical statistical techniques adapted to the functional case and extended to handle spatial correlations Practical discussions of ANOVA regression and clustering methods to explore spatial correlation in a collection of curves sampled in a region In depth explorations of the similarities and differences between spatio temporal data analysis and functional data analysis Aimed at mathematicians statisticians postgraduate students and researchers involved in the analysis of functional

and spatial data Geostatistical Functional Data Analysis will also prove to be a powerful addition to the libraries of geoscientists environmental scientists and economists seeking insightful new knowledge and questions at the interface of geostatistics and functional data analysis      *Geostatistics Oslo 2012* Petter Abrahamsen,Ragnar Hauge,Odd Kolbjørnsen,2012-05-08 This book consists of 44 technical papers presented at the Ninth International Geostatistics Congress held in Oslo Norway in June 2012 The papers have been reviewed by a panel of specialists in Geostatistics The book is divided into four main sections Theory Petroleum Mining and Environment Climate and Hydrology The first section focuses on new ideas of general interest to many fields of applications The next sections are more focused on the particular needs of the particular industry or activity Geostatistics is vital to any industry dependent on natural resources Methods from geostatistics are used for estimating reserves quantifying economical risk and planning of future industrial operations Geostatistics is also an important tool for mapping environmental hazard and integrating climate data      **Geostatistics** Jean-Paul Chilès,Pierre Delfiner,2012-02-08 Praise for the First Edition a readable comprehensive volume that belongs on the desk close at hand of any serious researcher or practitioner Mathematical Geosciences The state of the art in geostatistics Geostatistical models and techniques such as kriging and stochastic multi realizations exploit spatial correlations to evaluate natural resources help optimize their development and address environmental issues related to air and water quality soil pollution and forestry Geostatistics Modeling Spatial Uncertainty Second Edition presents a comprehensive up to date reference on the topic now featuring the latest developments in the field The authors explain both the theory and applications of geostatistics through a unified treatment that emphasizes methodology Key topics that are the foundation of geostatistics are explored in depth including stationary and nonstationary models linear and nonlinear methods change of support multivariate approaches and conditional simulations The Second Edition highlights the growing number of applications of geostatistical methods and discusses three key areas of growth in the field New results and methods including kriging very large datasets kriging with outliers nonseparable space time covariances multipoint simulations plurigaussian simulations gradual deformation and extreme value geostatistics Newly formed connections between geostatistics and other approaches such as radial basis functions Gaussian Markov random fields and data assimilation New perspectives on topics such as collocated cokriging kriging with an external drift discrete Gaussian change of support models and simulation algorithms Geostatistics Second Edition is an excellent book for courses on the topic at the graduate level It also serves as an invaluable reference for earth scientists mining and petroleum engineers geophysicists and environmental statisticians who collect and analyze data in their everyday work      *MATLAB® Recipes for Earth Sciences* Martin Trauth,2010-06-26 MATLAB is used for a wide range of applications in geosciences such as image processing in remote sensing the generation and processing of digital elevation models and the analysis of time series This book introduces methods of data analysis in geosciences using MATLAB such as basic statistics for univariate bivariate and multivariate datasets jackknife and bootstrap

resampling schemes processing of digital elevation models gridding and contouring geostatistics and kriging processing and georeferencing of satellite images digitizing from the screen linear and nonlinear time series analysis and the application of linear time invariant and adaptive filters The revised and updated Third Edition includes ten new sections and has greatly expanded on most chapters from the previous edition including a step by step discussion of all methods before demonstrating the methods with MATLAB functions New sections include Data Storage and Handling Data Structures and Classes of Objects Generating M Files to Regenerate Graphs Publishing M Files Distribution Fitting Nonlinear and Weighted Regression Color Intensity Transects of Varved Sediments and Grain Size Analysis from Microscope Images The text includes numerous examples demonstrating how MATLAB can be used on data sets from earth sciences All MATLAB recipes can be easily modified in order to analyse the reader's own data sets

*Handbook of Mathematical Geosciences* B.S. Daya Sagar, Qiuming Cheng, Frits Agterberg, 2018-06-25 This Open Access handbook published at the IAMG's 50th anniversary presents a compilation of invited path breaking research contributions by award winning geoscientists who have been instrumental in shaping the IAMG It contains 45 chapters that are categorized broadly into five parts i theory ii general applications iii exploration and resource estimation iv reviews and v reminiscences covering related topics like mathematical geosciences mathematical morphology geostatistics fractals and multifractals spatial statistics multipoint geostatistics compositional data analysis informatics geocomputation numerical methods and chaos theory in the geosciences

**Geostatistics Valencia 2016** J. Jaime Gómez-Hernández, Javier Rodrigo-Ilarri, María Elena Rodrigo-Clavero, Eduardo Cassiraga, José Antonio Vargas-Guzmán, 2017-03-07 This book contains selected contributions presented at the 10th International Geostatistics Congress held in Valencia from 5 to 9 September 2016 This is a quadrennial congress that serves as the meeting point for any engineer professional practitioner or scientist working in geostatistics The book contains carefully reviewed papers on geostatistical theory and applications in fields such as mining engineering petroleum engineering environmental science hydrology ecology and other fields

**Using Geochemical Data** Hugh Richard Rollinson, Hugh Rollinson, Victoria Pease, 2021-05-06 How best to interpret and apply geochemical data to understand geological processes for graduate students researchers and professionals

**Using Geochemical Data** Hugh Rollinson, Victoria Pease, 2021-05-06 This textbook is a complete rewrite and expansion of Hugh Rollinson's highly successful 1993 book Using Geochemical Data Evaluation Presentation Interpretation Rollinson and Pease's new book covers the explosion in geochemical thinking over the past three decades as new instruments and techniques have come online It provides a comprehensive overview of how modern geochemical data are used in the understanding of geological and petrological processes It covers major element trace element and radiogenic and stable isotope geochemistry It explains the potential of many geochemical techniques provides examples of their application and emphasizes how to interpret the resulting data Additional topics covered include the critical statistical analysis of geochemical data current geochemical techniques effective display of geochemical data and

the application of data in problem solving and identifying petrogenetic processes within a geological context It will be invaluable for all graduate students researchers and professionals using geochemical techniques

**Python Recipes for Earth Sciences** Martin H. Trauth,2022-09-28 Python is used in a wide range of geoscientific applications such as in processing images for remote sensing in generating and processing digital elevation models and in analyzing time series This book introduces methods of data analysis in the geosciences using Python that include basic statistics for univariate bivariate and multivariate data sets time series analysis and signal processing the analysis of spatial and directional data and image analysis The text includes numerous examples that demonstrate how Python can be used on data sets from the earth sciences The supplementary electronic material available online through Springer Link contains the example data as well as recipes that include all the Python commands featured in the book

**Dictionary of Mathematical Geosciences** Richard J. Howarth,2017-05-27 This dictionary includes a number of mathematical statistical and computing terms and their definitions to assist geoscientists and provide guidance on the methods and terminology encountered in the literature Each technical term used in the explanations can be found in the dictionary which also includes explanations of basics such as trigonometric functions and logarithms There are also citations from the relevant literature to show the term s first use in mathematics statistics etc and its subsequent usage in geosciences

Mining goes Digital Christoph Mueller,Winfred Assibey-Bonsu,Ernest Baafi,Christoph Dauber,Chris Doran,Marek Jerzy Jaszczuk,Oleg Nagovitsyn,2019-05-22 The conferences on Applications for Computers and Operations Research in the Minerals Industry APCOM initially focused on the optimization of geostatistics and resource estimation Several standard methods used in these fields were presented in the early days of APCOM While geostatistics remains an important part information technology has emerged and nowadays APCOM not only focuses on geostatistics and resource estimation but has broadened its horizon to Information and Communication Technology ICT in the mineral industry Mining Goes Digital is a collection of 90 high quality peer reviewed papers covering recent ICT related developments in Geostatistics and Resource Estimation Mine Planning Scheduling and Dispatch Mine Safety and Mine Operation Internet of Things Robotics Emerging Technologies Synergies from other industries General aspects of Digital Transformation in Mining Mining Goes Digital will be of interest to professionals and academics involved or interested in the above mentioned areas

Advances and Innovations in Statistics and Data Science Wenqing He,Liqun Wang,Jiahua Chen,Chunfang Devon Lin,2022-10-27 This book highlights selected papers from the 4th ICSA Canada Chapter Symposium as well as invited articles from established researchers in the areas of statistics and data science It covers a variety of topics including methodology development in data science such as methodology in the analysis of high dimensional data feature screening in ultra high dimensional data and natural language ranking statistical analysis challenges in sampling multivariate survival models and contaminated data as well as applications of statistical methods With this book readers can make use of frontier research methods to tackle their problems in research education training and



consultation     **MATLAB® Recipes for Earth Sciences** Martin H. Trauth, 2015-02-17 MATLAB is used for a wide range of applications in geosciences such as image processing in remote sensing the generation and processing of digital elevation models and the analysis of time series This book introduces methods of data analysis in geosciences using MATLAB such as basic statistics for univariate bivariate and multivariate datasets time series analysis signal processing the analysis of spatial and directional data and image analysis The revised and updated Fourth Edition includes sixteen new sections and most chapters have greatly been expanded so that they now include a step by step discussion of all methods before demonstrating the methods with MATLAB functions New sections include Array Manipulation Control Flow Creating Graphical User Interfaces Hypothesis Testing Kolmogorov Smirnov Test Mann Whitney Test Ansari Bradley Test Detecting Abrupt Transitions in Time Series Exporting 3D Graphics to Create Interactive Documents Importing Processing and Exporting LANDSAT Images Importing and Georeferencing TERRA ASTER Images Processing and Exporting EO 1 Hyperion Images Image Enhancement Correction and Rectification Shape Based Object Detection in Images Discriminant Analysis and Multiple Linear Regression The text includes numerous examples demonstrating how MATLAB can be used on data sets from earth sciences The book s supplementary electronic material available online through Springer Link includes recipes that include all the MATLAB commands featured in the book and the example data

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