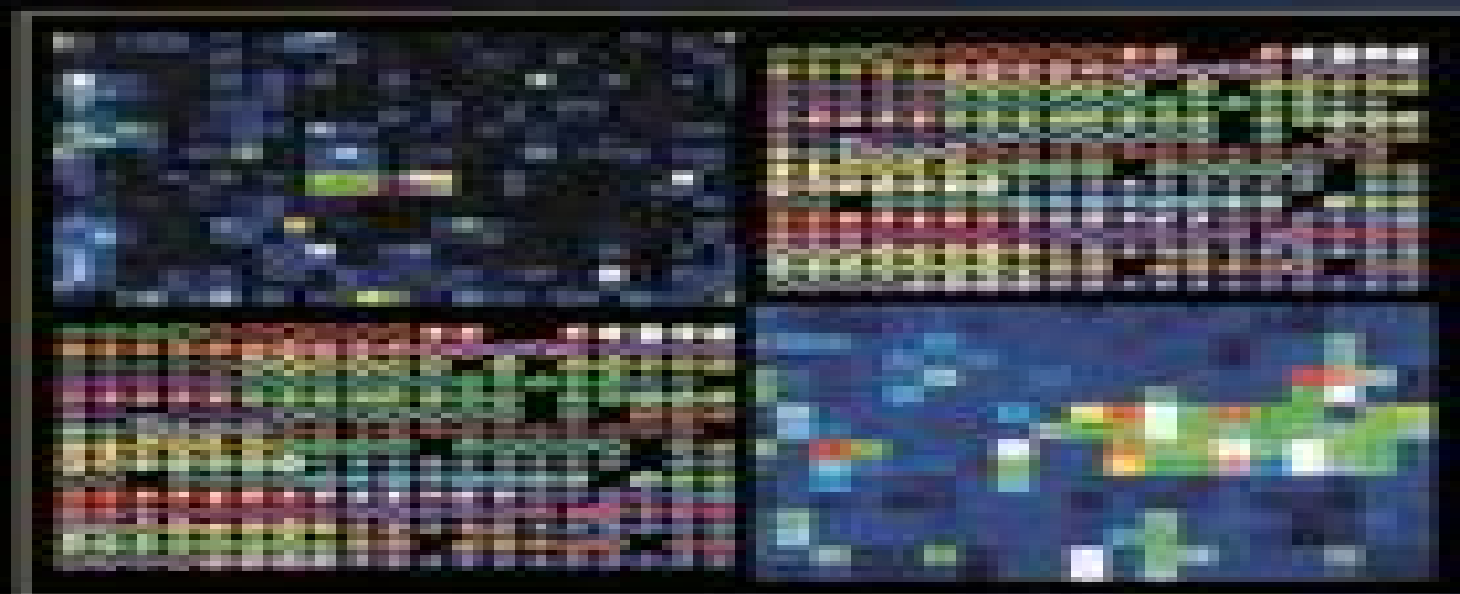


*Interdisciplinary Statistics*

# STATISTICAL ANALYSIS of GENE EXPRESSION MICROARRAY DATA



Edited by  
Terry Speed



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# Statistical Analysis Of Gene Expression Microarray Data

**Sorin Drăghici**



## **Statistical Analysis Of Gene Expression Microarray Data:**

*Statistical Analysis of Gene Expression Microarray Data* Terry Speed, 2003-03-26 Although less than a decade old the field of microarray data analysis is now thriving and growing at a remarkable pace Biologists geneticists and computer scientists as well as statisticians all need an accessible systematic treatment of the techniques used for analyzing the vast amounts of data generated by large scale gene expression studies *Microarray Data* Shailaja R. Deshmukh, Sudha G. Purohit, 2007 Functional Genomics a branch of bioinformatics is essentially an interdisciplinary subject in which biologists statisticians and computer experts interact to analyze the microarray data This book caters to the needs of all the three disciplines For biologists and computer scientists it explains concepts of statistics and statistical inference For Biologists and Statisticians it provides annotated R programs to analyze microarray data For Statisticians and Computer scientists it explains basics of biology relevant to microarray experiment Thus the book will be useful to scientists from all the three disciplines with not much knowledge of other disciplines to analyze microarray data and interpret the results **Analysis of Microarray Gene Expression Data** Mei-Ling Ting Lee, 2004-04-30 After genomic sequencing microarray technology has emerged as a widely used platform for genomic studies in the life sciences Microarray technology provides a systematic way to survey DNA and RNA variation With the abundance of data produced from microarray studies however the ultimate impact of the studies on biology will depend heavily on data mining and statistical analysis The contribution of this book is to provide readers with an integrated presentation of various topics on analyzing microarray data **The Analysis of Gene Expression Data** Giovanni Parmigiani, Elizabeth S. Garrett, Rafael A. Irizarry, Scott L. Zeger, 2003-04-08 This book presents practical approaches for the analysis of data from gene expression micro arrays It describes the conceptual and methodological underpinning for a statistical tool and its implementation in software The book includes coverage of various packages that are part of the Bioconductor project and several related R tools The materials presented cover a range of software tools designed for varied audiences *Methods for Incorporating Biological Information Into the Statistical Analysis of Gene Expression Microarray Data* Debbie Leader, 2009 Microarray technology has made it possible for researchers to simultaneously measure the expression levels of tens of thousands of genes It is believed that most human diseases and biological phenomena occur through the interaction of groups of genes that are functionally related To investigate the feasibility of incorporating functional information and or constraints based on biological and technical needs into the classification process two approaches were examined in this thesis The first of these approaches investigated the effect of incorporating a pre filter into the gene selection step of the classifier construction process Both simulated and real microarray datasets were used to assess the utility of this approach The pre filter was based on an early method for determining if a gene had undergone a biologically relevant level of differential expression between two classes The genes retained by the pre filter were ranked using one of five standard statistical ranking methods and the most highly ranked were

used to construct a predictive classifier To generate the simulated data a selection of different parametric and non parametric techniques were employed The results from these analyses showed that when the constraints that the pre filter contains were placed on the classification analysis the predictive performance of the classifiers were similar to when the pre filter was not used The second approach explored the feasibility of incorporating sets of functionally related genes into the classification process Three publicly available datasets obtained from studies into breast cancer were used to assess the utility of this approach A summary of each gene set was derived by reducing the dimensionality of each gene set via the use of Principal Co ordinates Analysis The reduced gene sets were then ranked based on their ability to distinguish between the two classes via Hotelling s T<sup>2</sup> and those most highly ranked were used to construct a classifier via logistic regression The results from the analyses undertaken for this approach showed that it was possible to incorporate function information into the classification process whilst maintaining an equivalent if not higher level of predictive performance as well as improving the biological interpretability of the classifier

**Statistical Analysis of Gene Expression Data from DNA Microarrays Based on Partial Least Squares and Related Dimension Reduction Methods** Danh V. Nguyen (Ph. D. in statistics),2000

**Statistical Analysis Using Microarray Gene Expression Data** Xiaohong Huang,2004 **Statistical Analysis of Microarray Data -- Topics in Gene Expression** Xin Victoria Wang,2009 *Gene Expression Data Analysis* Pankaj Barah,Dhruba Kumar Bhattacharyya,Jugal Kumar Kalita,2021-11-21 Development of high throughput technologies in molecular biology during the last two decades has contributed to the production of tremendous amounts of data Microarray and RNA sequencing are two such widely used high throughput technologies for simultaneously monitoring the expression patterns of thousands of genes Data produced from such experiments are voluminous both in dimensionality and numbers of instances and evolving in nature Analysis of huge amounts of data toward the identification of interesting patterns that are relevant for a given biological question requires high performance computational infrastructure as well as efficient machine learning algorithms Cross communication of ideas between biologists and computer scientists remains a big challenge Gene Expression Data Analysis A Statistical and Machine Learning Perspective has been written with a multidisciplinary audience in mind The book discusses gene expression data analysis from molecular biology machine learning and statistical perspectives Readers will be able to acquire both theoretical and practical knowledge of methods for identifying novel patterns of high biological significance To measure the effectiveness of such algorithms we discuss statistical and biological performance metrics that can be used in real life or in a simulated environment This book discusses a large number of benchmark algorithms tools systems and repositories that are commonly used in analyzing gene expression data and validating results This book will benefit students researchers and practitioners in biology medicine and computer science by enabling them to acquire in depth knowledge in statistical and machine learning based methods for analyzing gene expression data Key Features An introduction to the Central Dogma of molecular biology and information flow in biological

systems A systematic overview of the methods for generating gene expression data Background knowledge on statistical modeling and machine learning techniques Detailed methodology of analyzing gene expression data with an example case study Clustering methods for finding co expression patterns from microarray bulkRNA and scRNA data A large number of practical tools systems and repositories that are useful for computational biologists to create analyze and validate biologically relevant gene expression patterns Suitable for multidisciplinary researchers and practitioners in computer science and biological sciences

**Computational and Statistical Approaches to Genomics** Wei Zhang,Ilya Shmulevich,2007-12-26

The 2nd edition of this book adds 8 new contributors to reflect a modern cutting edge approach to genomics The expanded scope includes coverage of statistical issues on single nucleotide polymorphism analysis array CGH analysis SAGE analysis gene shaving and related methods for microarray data analysis and cross hybridization issues on oligo arrays The authors of the 17 original chapters have updated the contents of their chapters including references on such topics as the development of novel engineering statistical and computational principles as well as methods models and tools from these disciplines applied to genomics

**Statistical Analysis of Gene Expression Data in CDNA Microarray Experiments** Hongya

Zhao,Hong Kong Baptist University. Department of Mathematics,2006 *Probabilistic Modeling in Bioinformatics and Medical Informatics* Dirk Husmeier,Richard Dybowski,Stephen Roberts,2006-05-06 Probabilistic Modelling in Bioinformatics and Medical Informatics has been written for researchers and students in statistics machine learning and the biological sciences The first part of this book provides a self contained introduction to the methodology of Bayesian networks The following parts demonstrate how these methods are applied in bioinformatics and medical informatics All three fields the methodology of probabilistic modeling bioinformatics and medical informatics are evolving very quickly The text should therefore be seen as an introduction offering both elementary tutorials as well as more advanced applications and case studies

*Exploration and Analysis of DNA Microarray and Protein Array Data* Dhammika Amaratunga,Javier Cabrera,2004

A cutting edge guide to the analysis of DNA microarray data Genomics is one of the major scientific revolutions of this century and the use of microarrays to rapidly analyze numerous DNA samples has enabled scientists to make sense of mountains of genomic data through statistical analysis Today microarrays are being used in biomedical research to study such vital areas as a drug s therapeutic value or toxicity and cancer spreading patterns of gene activity Exploration and Analysis of DNA Microarray and Protein Array Data answers the need for a comprehensive cutting edge overview of this important and emerging field The authors seasoned researchers with extensive experience in both industry and academia effectively outline all phases of this revolutionary analytical technique from the preprocessing to the analysis stage Highlights of the text include A review of basic molecular biology followed by an introduction to microarrays and their preparation Chapters on processing scanned images and preprocessing microarray data Methods for identifying differentially expressed genes in comparative microarray experiments Discussions of gene and sample clustering and class prediction

Extension of analysis methods to protein array data Numerous exercises for self study as well as data sets and a useful collection of computational tools on the authors Web site make this important text a valuable resource for both students and professionals in the field

**Batch Effects and Noise in Microarray Experiments** Andreas Scherer, 2009-11-03 Batch Effects and Noise in Microarray Experiments Sources and Solutions looks at the issue of technical noise and batch effects in microarray studies and illustrates how to alleviate such factors whilst interpreting the relevant biological information Each chapter focuses on sources of noise and batch effects before starting an experiment with examples of statistical methods for detecting measuring and managing batch effects within and across datasets provided online Throughout the book the importance of standardization and the value of standard operating procedures in the development of genomics biomarkers is emphasized Key Features A thorough introduction to Batch Effects and Noise in Microarray Experiments A unique compilation of review and research articles on handling of batch effects and technical and biological noise in microarray data An extensive overview of current standardization initiatives All datasets and methods used in the chapters as well as colour images are available on [www the batch effect book org](http://www.thebatcheffectbook.org) so that the data can be reproduced An exciting compilation of state of the art review chapters and latest research results which will benefit all those involved in the planning execution and analysis of gene expression studies

**Statistical Methods for Microarray Data Analysis** Andrei Y. Yakovlev, Lev Klebanov, Daniel Gaile, 2013-02-06 Microarrays for simultaneous measurement of redundancy of RNA species are used in fundamental biology as well as in medical research Statistically a microarray may be considered as an observation of very high dimensionality equal to the number of expression levels measured on it In Statistical Methods for Microarray Data Analysis Methods and Protocols expert researchers in the field detail many methods and techniques used to study microarrays guiding the reader from microarray technology to statistical problems of specific multivariate data analysis Written in the highly successful Methods in Molecular Biology™ series format the chapters include the kind of detailed description and implementation advice that is crucial for getting optimal results in the laboratory Thorough and intuitive Statistical Methods for Microarray Data Analysis Methods and Protocols aids scientists in continuing to study microarrays and the most current statistical methods

**Methods of Microarray Data Analysis V** Patrick McConnell, Simon Lin, Patrick Hurban, 2007-02-24 As studies using microarray technology have evolved so have the data analysis methods used to analyze these experiments The CAMDA Critical Assessment of Microarray Data Analysis conference was the first to establish a forum for a cross section of researchers to look at a common data set and apply innovative analytical techniques to microarray data Methods of Microarray Analysis V includes selected papers from CAMDA 04 and focuses on data sets relating to a significant global health issue malaria Previous books focused on classification V I pattern recognition V II quality control issues V III and associating array data with a survival endpoint lung cancer V IV The contributions come from research fields including statistics biology computer science and mathematics Part of the book is devoted to review papers which provide a more

general look at various analytical approaches It also presents some background readings for the advanced topics discussed in the CAMDA papers

**Statistical Analysis for Microarray Data** Yang Xie,2006 Biotechnology Annual Review M. Raafat El-Gewely,2008-10-03 Biotechnology is a diverse complex and rapidly evolving field Students and experienced researchers alike face the challenges of staying on top of developments in their field of specialty and maintaining a broader overview of the field as a whole This latest volume of Biotechnology Annual Review comprises expert reviews on a diverse range of topics ranging from gene expression microarray analysis to the use of ethnomedicines and ethnomedicinal phytophores to treat herpes viruses Such a diverse range of review topics will keep biotechnologists of all levels up to date on the latest in the vast field of biotechnology and deepen their understanding of the many facets of the field as a whole More than 150 figures elucidate and reinforce key points Inclusion of reviews of such hot topics as arginine methylation in health and disease Wide variety of coverage keeps biotechnologists up to date on many facets of the field

Statistics and Data Analysis for Microarrays Using R and Bioconductor Sorin Drăghici,2016-04-19 Richly illustrated in color Statistics and Data Analysis for Microarrays Using R and Bioconductor Second Edition provides a clear and rigorous description of powerful analysis techniques and algorithms for mining and interpreting biological information Omitting tedious details heavy formalisms and cryptic notations the text takes a hands on example based approach that teaches students the basics of R and microarray technology as well as how to choose and apply the proper data analysis tool to specific problems New to the Second Edition Completely updated and double the size of its predecessor this timely second edition replaces the commercial software with the open source R and Bioconductor environments Fourteen new chapters cover such topics as the basic mechanisms of the cell reliability and reproducibility issues in DNA microarrays basic statistics and linear models in R experiment design multiple comparisons quality control data pre processing and normalization Gene Ontology analysis pathway analysis and machine learning techniques Methods are illustrated with toy examples and real data and the R code for all routines is available on an accompanying downloadable resource With all the necessary prerequisites included this best selling book guides students from very basic notions to advanced analysis techniques in R and Bioconductor The first half of the text presents an overview of microarrays and the statistical elements that form the building blocks of any data analysis The second half introduces the techniques most commonly used in the analysis of microarray data

**Encyclopedia of Biopharmaceutical Statistics - Four Volume Set** Shein-Chung Chow,2018-09-03 Since the publication of the first edition in 2000 there has been an explosive growth of literature in biopharmaceutical research and development of new medicines This encyclopedia 1 provides a comprehensive and unified presentation of designs and analyses used at different stages of the drug development process 2 gives a well balanced summary of current regulatory requirements and 3 describes recently developed statistical methods in the pharmaceutical sciences Features of the Fourth Edition 1 78 new and revised entries have been added for a total of 308 chapters and a fourth volume has been added to encompass the increased number

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