

Eric D. Feigelson / G. Jogesh Babu
Editors

Statistical Challenges In Modern Astronomy



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Statistical Challenges In Modern Astronomy

Eric D. Feigelson



Statistical Challenges In Modern Astronomy:

Statistical Challenges in Modern Astronomy V Eric D. Feigelson, Jogesh Babu, 2012-08-15 This volume contains a selection of chapters based on papers to be presented at the Fifth Statistical Challenges in Modern Astronomy Symposium. The symposium will be held June 13-15th at Penn State University. Modern astronomical research faces a vast range of statistical issues which have spawned a revival in methodological activity among astronomers. The Statistical Challenges in Modern Astronomy V conference will bring astronomers and statisticians together to discuss methodological issues of common interest. Time series analysis, image analysis, Bayesian methods, Poisson processes, nonlinear regression, maximum likelihood, multivariate classification and wavelet and multiscale analyses are all important themes to be covered in detail. Many problems will be introduced at the conference in the context of large scale astronomical projects including LIGO, AXAF, XTE, Hipparcos and digitized sky surveys.

Statistical Challenges in Modern Astronomy Eric D. Feigelson, G. Jogesh Babu, 2012-12-06 Modern astronomy has been characterized by an enormous growth in data acquisition from new technologies in telescopes, detectors and computation. One can now compile catalogs of tens or hundreds of millions of stars or galaxies and databases from satellite based observations are reaching terabit proportions. This wealth of data gives rise to statistical challenges not previously encountered in astronomy. This book is the result of a workshop held at Pennsylvania State University in August 1991 that brought together leading astronomers and statisticians to consider statistical challenges encountered in modern astronomical research. The chapters have all been thoroughly revised in the light of the discussions at the conference and some of the lively discussion is recorded here as well.

Statistical Challenges in Modern Astronomy II G. Jogesh Babu, Eric D. Feigelson, 2012-12-06 Modern astronomical research faces a vast range of statistical issues which have spawned a revival in methodological activity among astronomers. The Statistical Challenges in Modern Astronomy II conference held in June 1996 at the Pennsylvania State University five years after the first conference brought astronomers and statisticians together to discuss methodological issues of common interest. Time series analysis, image analysis, Bayesian methods, Poisson processes, nonlinear regression, maximum likelihood, multivariate classification and wavelet and multiscale analyses were important themes. Astronomers frequently encounter troublesome situations such as heteroscedastic weighting of data, unevenly spaced time series and selection effects leading to censoring and truncation. Many problems were introduced at the conference in the context of large scale astronomical projects including LIGO, AXAF, XTE, Hipparcos and digitized sky surveys. This volume will be of interest to researchers and advanced students in both fields: astronomers who seek exposure to recent developments in statistics and statisticians interested in confronting new problems. It is edited by two faculty members of the Pennsylvania State University who have a long standing cross disciplinary collaboration and jointly authored the recent introductory monograph *Astrostatistics*. G. J. Babu is Professor of Statistics, Fellow of the Institute of Mathematical Statistics and Associate Editor of the *Journal of Statistical Planning, Inference* and the *Journal of*

Nonparametric Statistics Eric D Feigelson is Professor of Astronomoy and Astrophysics

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Astronomy Eric D. Feigelson, Jogesh Babu, 2006-05-26 Digital sky surveys high precision astrometry from satellite data deep space data from orbiting telescopes and the like have all increased the quantity and quality of astronomical data by orders of magnitude per year for several years Making sense of this wealth of data requires sophisticated statistical techniques Fortunately statistical methodologies have similarly made great strides in recent years Powerful synergies thus emerge when astronomers and statisticians join in examining astrostatistical problems and approaches The book begins with an historical overview and tutorial articles on basic cosmology for statisticians and the principles of Bayesian analysis for astronomers As in earlier volumes in this series research contributions discussing topics in one field are joined with commentary from scholars in the other Thus for example an overview of Bayesian methods for Poissonian data is joined by discussions of planning astronomical observations with optimal efficiency and nested models to deal with instrumental effects The principal theme for the volume is the statistical methods needed to model fundamental characteristics of the early universe on its largest scales

Statistical Challenges in Modern Astronomy IV : proceedings of a Conference held at Pennsylvania State University, University Park, Pennsylvania, USA 12 - 15 June 2006 Statistical Challenges in Modern Astronomy

Conference, 2007 *Statistical Challenges in Astronomy* Eric D. Feigelson, Jogesh Babu, 2013-04-25 Digital sky surveys high precision astrometry from satellite data deep space data from orbiting telescopes and the like have all increased the quantity and quality of astronomical data by orders of magnitude per year for several years Making sense of this wealth of data requires sophisticated statistical techniques Fortunately statistical methodologies have similarly made great strides in recent years Powerful synergies thus emerge when astronomers and statisticians join in examining astrostatistical problems and approaches The book begins with an historical overview and tutorial articles on basic cosmology for statisticians and the principles of Bayesian analysis for astronomers As in earlier volumes in this series research contributions discussing topics in one field are joined with commentary from scholars in the other Thus for example an overview of Bayesian methods for Poissonian data is joined by discussions of planning astronomical observations with optimal efficiency and nested models to deal with instrumental effects The principal theme for the volume is the statistical methods needed to model fundamental characteristics of the early universe on its largest scales

Astrostatistical Challenges for the New Astronomy Joseph M. Hilbe, 2012-11-07 Astrostatistical Challenges for the New Astronomy presents a collection of monographs authored by several of the disciplines leading astrostatisticians i e by researchers from the fields of statistics and astronomy astrophysics who work in the statistical analysis of astronomical and cosmological data Eight of the ten monographs are enhancements of presentations given by the authors as invited or special topics in astrostatistics papers at the ISI World Statistics Congress 2011 Dublin Ireland The opening chapter by the editor was adapted from an invited seminar given at Los Alamos National Laboratory 2011 on the history and current state of the discipline the second chapter by Thomas Loredo was adapted from

his invited presentation at the Statistical Challenges in Modern Astronomy V conference 2011 Pennsylvania State University presenting insights regarding frequentist and Bayesian methods of estimation in astrostatistical analysis The remaining monographs are research papers discussing various topics in astrostatistics The monographs provide the reader with an excellent overview of the current state astrostatistical research and offer guidelines as to subjects of future research Lead authors for each chapter respectively include Joseph M Hilbe Jet Propulsion Laboratory and Arizona State Univ Thomas J Loredano Dept of Astronomy Cornell Univ Stefano Andreon INAF Osservatorio Astronomico di Brera Italy Martin Kunz Institute for Theoretical Physics Univ of Geneva Switz Benjamin Wandell Institut d Astrophysique de Paris Univ Pierre et Marie Curie France Roberto Trotta Astrophysics Group Dept of Physics Imperial College London UK Phillip Gregory Dept of Astronomy Univ of British Columbia Canada Marc Henrion Dept of Mathematics Imperial College London UK Asis Kumar Chattopadhyay Dept of Statistics Univ of Calcutta India Marisa March Astrophysics Group Dept of Physics Imperial College London UK body

Modern Statistical Methods for Astronomy Eric D. Feigelson, 2012 Modern astronomical research is beset with a vast range of statistical challenges ranging from reducing data from megadatasets to characterizing an amazing variety of variable celestial objects or testing astrophysical theory Yet most astronomers still use a narrow suite of traditional statistical methods Linking astronomy to the world of modern statistics this volume is a unique resource introducing astronomers to advanced statistics through ready to use code in the public domain R statistical software environment [Astronomical Data Analysis Software and Systems IV](#) Richard A. Shaw, Harry Edward Payne, Jeffrey John Edward Hayes, 1995

Modern Statistical Methods for Astronomy Eric D. Feigelson, 2012 Modern astronomical research is beset with a vast range of statistical challenges ranging from reducing data from megadatasets to characterizing an amazing variety of variable celestial objects or testing astrophysical theory Yet most astronomers still use a narrow suite of traditional statistical methods Linking astronomy to the world of modern statistics this volume is a unique resource introducing astronomers to advanced statistics through ready to use code in the public domain R statistical software environment [Quarterly Publication of the American Statistical Association](#), 2005 **Astronomical Data Analysis Software and Systems XV** Carlos Gabriel, 2006 **Astronomical Data Analysis Software and Systems XVII** Robert W. Argyle, Peter S. Bunclark, James R. Lewis, 2008 [Astronomical Data Analysis Software and Systems VIII](#) David M. Mehringer, Raymond L. Plante, Douglas A. Roberts, 1999 [European Southern Observatory Scientific Preprint](#), 1992 **Encyclopedia of Statistical Sciences: In-L**, 2006 *Preserving Astronomy's Photographic Legacy* Wayne Osborn, Lee Robbins, 2009

AMSTAT News American Statistical Association, 2004 *Astrostatistics* Guttu Jogesh Babu, E.D. Feigelson, 1996-08-01 Modern astronomers encounter a vast range of challenging statistical problems yet few are familiar with the wealth of techniques developed by statisticians Conversely few statisticians deal with the compelling problems confronted in astronomy Astrostatistics bridges this gap Authored by a statistician astronomer team it provides professionals and advanced

students in both fields with exposure to issues of mutual interest In the first half of the book the authors introduce statisticians to stellar galactic and cosmological astronomy and discuss the complex character of astronomical data For astronomers they introduce the statistical principles of nonparametrics multivariate analysis time series analysis density estimation and resampling methods The second half of the book is organized by statistical topic Each chapter contains examples of problems encountered astronomical research and highlights methodological issues The final chapter explores some controversial issues in astronomy that have a strong statistical component The authors provide an extensive bibliography and references to software for implementing statistical methods The marriage of astronomy and statistics is a natural one and benefits both disciplines Astronomers need the tools and methods of statistics to interpret the vast amount of data they generate and the issues related to astronomical data pose intriguing challenges for statisticians Astrostatistics paves the way to improved statistical analysis of astronomical data and provides a common ground for future collaboration between the two fields Studies of Substructure in Clusters of Galaxies Jeffrey Robert Kriessler, 1997

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