



# Modern Statistical Methods for Astronomy: With R Applications

*By Eric D. Feigelson, G. Jogesh Babu*

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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. 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. The book presents fundamental results of probability theory and statistical inference, before exploring several fields of applied statistics, such as data smoothing, regression, multivariate analysis and classification, treatment of nondetections, time series analysis, and spatial point processes. It applies the methods discussed to contemporary astronomical research datasets using the R statistical software, making it invaluable for graduate students and researchers facing complex data analysis tasks. A link to the author's website for this book can be found at [www.cambridge.org/msma](http://www.cambridge.org/msma). Material available on their website includes datasets, R code and errata. Visit the author's homepage at <http://astrostatistics.psu.edu> for more materials.

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## Modern Statistical Methods for Astronomy: With R Applications By Eric D. Feigelson, G. Jogesh Babu Bibliography

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## **Editorial Review**

### Review

"Feigelson and Babu, two of the leading figures in the new discipline of astrostatistics, have written a text that surely must be considered as the standard text on the subject. The book presents astronomers with an up-to-date overview of the foremost methods being used in astrostatistical analysis, providing numerous examples, as well as relevant R code, for how these methods can be used in their research. The text is useful to astronomers who are new to serious astrostatistical analysis, as well as to seasoned researchers."

Joseph M. Hilbe, Chair, ISI International Astrostatistics Network, Arizona State University/Jet Propulsion Laboratory

"This book covers in a single volume both the basic statistical material and more specialized material (clustering, classification, data mining, non-detections, time series analysis, and spatial point processes) that is essential for modern astronomers. "The astronomical context" sections, which provide motivation for the ensuing statistical development, are particularly valuable ... The decision to use R to illustrate the ideas, methods, and tools, and to apply them to real astronomical data sets, will significantly enhance the value of the volume. The discipline of astrostatistics is experiencing a dramatic blossoming, and this book will provide the necessary vehicle for the new generation of astronomers."

David Hand, Professor of Statistics, Imperial College London

"While many astrophysicists have deep training in statistical theory and great practical abilities, others have no or only elementary training in these areas, propagate old mistakes, and carry out sub-optimal data analysis. Modern Statistical Methods for Astronomy addresses this problem and will likely make a significant contribution. And just in time! The Age of "Digital Astronomy" - with its notoriously complex and huge data arrays - is already challenging our knowledge of advanced statistical methods and abilities to apply them in practice. Each chapter surveys statistical science relevant to a specific area in a way that should be easily comprehensible by all graduate and many undergraduate students, followed in most cases by selected applications in R. Serious readers of this text will be well-equipped to learn the most advanced techniques on their own."

Jeffrey D. Scargle, Space Science and Astrobiology Division, NASA Ames Research Center

"... this book is an excellent resource ... A great strength of this book is the set of statistics programs in the freely-available R programming language which accompany each chapter ... this is a book which would grace anyone's shelves."

Alan Heavens, The Observatory: Review of Astronomy

"... excellent effort at bridging the gap between astronomy and advanced statistical methods ... written with rigour but without excessive technical detail ... This book can be considered a timely and most welcome addition to the toolbox of any astronomer involved in data analysis."

Roberto Trotta, Mathematical Reviews

"... statistics textbooks for astronomy are surprisingly rare, so this book represents a welcome addition to the literature ... the text is written clearly and is easy to understand ... an excellent text. Graduate students would especially benefit from this book ... but seasoned researchers are likely to discover new methods for their research as well."

Jason C. Speights, Journal of the American Statistical Association

#### About the Author

Eric D. Feigelson is a Professor in the Department of Astronomy and Astrophysics at Pennsylvania State University. He is a leading observational astronomer and has worked with statisticians for twenty-five years to bring advanced methodology to problems in astronomical research.

G. Jogesh Babu is Professor of Statistics and Director of the Center for Astrostatistics at Pennsylvania State University. He has made extensive contributions to probabilistic number theory, resampling methods, nonparametric methods, asymptotic theory and applications to biomedical research, genetics, astronomy and astrophysics.

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