

# Bayesian Survival Analysis Using Log-Linear Median Regression Models

Jianchang Lin, Debajyoti Sinha, Stuart Lipsitz, and Adriano Polpo

**Abstract** For the analysis of survival data from clinical trials, the popular semi-parametric models such as Cox's (1972) proportional hazards model and linear transformation models (Cheng et al. 1995) usually focus on modeling effects of covariates on the hazard ratio or the survival response. Often, there is substantial information available in the data to make inferences about the median/quantiles. Models based on the median/quantiles (Ying et al. 1995) survival have been shown to be useful in for describing covariate effects. In this paper, we present two novel survival models with log-linear median regression functions. These two wide classes of semiparametric models have many desirable properties including model identifiability, closed form expressions for all quantile functions, and nonmonotone hazards. Our models also have many important practical advantages, including the ease of determination of priors, a simple interpretation of the regression parameters via the ratio of median survival times, and the ability to address heteroscedasticity of survival response. We illustrate the advantages of proposed methods through extensive simulation studies investigating small sample performance and robustness

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# Bayesian Survival Analysis Bayesian Survival Analysis

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## **Bayesian Survival Analysis Bayesian Survival Analysis:**

**Bayesian Survival Analysis** Joseph G. Ibrahim, Ming-Hui Chen, Debajyoti Sinha, 2013-03-09 Survival analysis arises in many fields of study including medicine biology engineering public health epidemiology and economics This book provides a comprehensive treatment of Bayesian survival analysis Several topics are addressed including parametric models semiparametric models based on prior processes proportional and non proportional hazards models frailty models cure rate models model selection and comparison joint models for longitudinal and survival data models with time varying covariates missing covariate data design and monitoring of clinical trials accelerated failure time models models for multivariate survival data and special types of hierarchical survival models Also various censoring schemes are examined including right and interval censored data Several additional topics are discussed including noninformative and informative prior specifications computing posterior quantities of interest Bayesian hypothesis testing variable selection model selection with nonnested models model checking techniques using Bayesian diagnostic methods and Markov chain Monte Carlo MCMC algorithms for sampling from the posterior and predictive distributions The book presents a balance between theory and applications and for each class of models discussed detailed examples and analyses from case studies are presented whenever possible The applications are all essentially from the health sciences including cancer AIDS and the environment The book is intended as a graduate textbook or a reference book for a one semester course at the advanced masters or Ph D level This book would be most suitable for second or third year graduate students in statistics or biostatistics It would also serve as a useful reference book for applied or theoretical researchers as well as practitioners **Bayesian Survival**

**Analysis** Joseph G. Ibrahim, Ming-Hui Chen, Debajyoti Sinha, 2014-01-15 *Bayesian Survival Analysis* Keith Rowland Abrams, 1992 **Bayesian Survival Analysis for Prognostic Index Development with Many Covariates and Missing**

**Data** Xiaohui Zhao, University of Newcastle upon Tyne. School of Mathematics and Statistics, 2010 **Computational Methods in Biomedical Research** Ravindra Khattree, Dayanand Naik, 2007-12-12 Continuing advances in biomedical research and statistical methods call for a constant stream of updated cohesive accounts of new developments so that the methodologies can be properly implemented in the biomedical field Responding to this need Computational Methods in Biomedical Research explores important current and emerging computational statistical methods that are used in biomedical research Written by active researchers in the field this authoritative collection covers a wide range of topics It introduces each topic at a basic level before moving on to more advanced discussions of applications The book begins with microarray data analysis machine learning techniques and mass spectrometry based protein profiling It then uses state space models to predict US cancer mortality rates and provides an overview of the application of multistate models in analyzing multiple failure times The book also describes various Bayesian techniques the sequential monitoring of randomization tests mixed effects models and the classification rules for repeated measures data The volume concludes with estimation methods for

analyzing longitudinal data Supplying the knowledge necessary to perform sophisticated statistical analyses this reference is a must have for anyone involved in advanced biomedical and pharmaceutical research It will help in the quest to identify potential new drugs for the treatment of a variety of diseases

**Bayesian Survival Analysis with Missing Data Using Integrated Nested Laplace Approximation** Muhammad Irfan bin Abdul Jalal,2020

**Modelling Survival Data in Medical Research** David Collett,2023-05-31

Modelling Survival Data in Medical Research Fourth Edition describes the analysis of survival data illustrated using a wide range of examples from biomedical research Written in a non technical style it concentrates on how the techniques are used in practice Starting with standard methods for summarising survival data Cox regression and parametric modelling the book covers many more advanced techniques including interval censoring frailty modelling competing risks analysis of multiple events and dependent censoring This new edition contains chapters on Bayesian survival analysis and use of the R software Earlier chapters have been extensively revised and expanded to add new material on several topics These include methods for assessing the predictive ability of a model joint models for longitudinal and survival data and modern methods for the analysis of interval censored survival data Features Presents an accessible account of a wide range of statistical methods for analysing survival data Contains practical guidance on modelling survival data from the author s many years of experience in teaching and consultancy Shows how Bayesian methods can be used to analyse survival data Includes details on how R can be used to carry out all the methods described with guidance on the interpretation of the resulting output Contains many real data examples and additional data sets that can be used for coursework All data sets used are available in electronic format from the publisher s website

Modelling Survival Data in Medical Research Fourth Edition is an invaluable resource for statisticians in the pharmaceutical industry and biomedical research centres research scientists and clinicians who are analysing their own data and students following undergraduate or postgraduate courses in survival analysis

*Shrinkage Estimation in Nonparametric Bayesian Survival Analysis* Kamta Rai,Vyaghreswarudu Susarla,John Van Ryzin,Rand Corporation,1979

**Handbook of Survival Analysis** John P. Klein,Hans C. van Houwelingen,Joseph G. Ibrahim,Thomas H. Scheike,2016-04-19

Handbook of Survival Analysis presents modern techniques and research problems in lifetime data analysis This area of statistics deals with time to event data that is complicated by censoring and the dynamic nature of events occurring in time With chapters written by leading researchers in the field the handbook focuses on advances in survival analysis techniques covering classical and Bayesian approaches It gives a complete overview of the current status of survival analysis and should inspire further research in the field Accessible to a wide range of readers the book provides An introduction to various areas in survival analysis for graduate students and novices A reference to modern investigations into survival analysis for more established researchers A text or supplement for a second or advanced course in survival analysis A useful guide to statistical methods for analyzing survival data experiments for practicing statisticians

**Bayesian Inference and Computation in Reliability and Survival Analysis** Yuhlong

Lio,Ding-Geng Chen,Hon Keung Tony Ng,Tzong-Ru Tsai,2022-08-01 Bayesian analysis is one of the important tools for statistical modelling and inference Bayesian frameworks and methods have been successfully applied to solve practical problems in reliability and survival analysis which have a wide range of real world applications in medical and biological sciences social and economic sciences and engineering In the past few decades significant developments of Bayesian inference have been made by many researchers and advancements in computational technology and computer performance has laid the groundwork for new opportunities in Bayesian computation for practitioners Because these theoretical and technological developments introduce new questions and challenges and increase the complexity of the Bayesian framework this book brings together experts engaged in groundbreaking research on Bayesian inference and computation to discuss important issues with emphasis on applications to reliability and survival analysis Topics covered are timely and have the potential to influence the interacting worlds of biostatistics engineering medical sciences statistics and more The included chapters present current methods theories and applications in the diverse area of biostatistical analysis The volume as a whole serves as reference in driving quality global health research

### **Bayesian Thinking, Modeling and Computation**

,2005-11-29 This volume describes how to develop Bayesian thinking modelling and computation both from philosophical methodological and application point of view It further describes parametric and nonparametric Bayesian methods for modelling and how to use modern computational methods to summarize inferences using simulation The book covers wide range of topics including objective and subjective Bayesian inferences with a variety of applications in modelling categorical survival spatial spatiotemporal Epidemiological software reliability small area and micro array data The book concludes with a chapter on how to teach Bayesian thoughts to nonstatisticians Critical thinking on causal effects Objective Bayesian philosophy Nonparametric Bayesian methodology Simulation based computing techniques Bioinformatics and Biostatistics

**Bayesian Modeling in Bioinformatics** Dipak K. Dey,Samiran Ghosh,Bani K. Mallick,2010-09-03 Bayesian Modeling in Bioinformatics discusses the development and application of Bayesian statistical methods for the analysis of high throughput bioinformatics data arising from problems in molecular and structural biology and disease related medical research such as cancer It presents a broad overview of statistical inference clustering and c

*Case Studies in Bayesian Statistical Modelling and Analysis* Clair L. Alston,Kerrie L. Mengersen,Anthony N. Pettitt,2012-10-10 Provides an accessible foundation to Bayesian analysis using real world models This book aims to present an introduction to Bayesian modelling and computation by considering real case studies drawn from diverse fields spanning ecology health genetics and finance Each chapter comprises a description of the problem the corresponding model the computational method results and inferences as well as the issues that arise in the implementation of these approaches Case Studies in Bayesian Statistical Modelling and Analysis Illustrates how to do Bayesian analysis in a clear and concise manner using real world problems Each chapter focuses on a real world problem and describes the way in which the problem may be analysed using Bayesian methods

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**Bayesian Nonparametric Data Analysis** Peter Müller,Fernando Andres Quintana,Alejandro Jara,Tim Hanson,2015-06-17 This book reviews nonparametric Bayesian methods and models that have proven useful in the context of data analysis Rather than providing an encyclopedic review of probability models the book s structure follows a data analysis perspective As such the chapters are organized by traditional data analysis problems In selecting specific nonparametric models simpler and more traditional models are favored over specialized ones The discussed methods are illustrated with a wealth of examples including applications ranging from stylized examples to case studies from recent literature The book also includes an extensive discussion of computational methods and details on their implementation R code for many examples is included in online software pages

**Population Ecology in Practice** Dennis L. Murray,Brett K. Sandercock,2020-02-10 A synthesis of contemporary analytical and modeling approaches in population ecology The book provides an overview of the key analytical approaches that are currently used in demographic genetic and spatial analyses in population ecology The chapters present current problems introduce advances in analytical methods and models and demonstrate the applications of quantitative methods to ecological data The book covers new tools for designing robust field studies estimation of abundance and demographic rates matrix population models and analyses of population dynamics and current approaches for genetic and spatial analysis Each chapter is illustrated by empirical examples based on real datasets with a companion website that offers online exercises and examples of computer code in the R statistical software platform Fills a niche for a book that emphasizes applied aspects of population analysis Covers many of the current methods being used to analyse population dynamics and structure Illustrates the application of specific analytical methods through worked examples based on real datasets Offers readers the opportunity to work through examples or adapt the routines to their own datasets using computer code in the R statistical platform Population Ecology in Practice is an excellent book for upper level undergraduate and graduate students taking courses in population ecology or ecological statistics as well as established researchers needing a desktop reference for contemporary methods used to develop robust population assessments

*Design and Analysis of Clinical Trials with Time-to-Event Endpoints* Karl E. Peace,2009-04-23 Using time to event analysis methodology requires careful definition of the event censored observation provision of adequate follow up number of events and independence or noninformativeness of the censoring mechanisms relative to the event Design and Analysis of Clinical Trials with Time to Event Endpoints provides a thorough presentation o

Bayesian Evaluation of Informative Hypotheses Herbert Hoijtink,Irene Klugkist,Paul Boelen,2008-09-08 This book provides an overview of the

developments in the area of Bayesian evaluation of informative hypotheses that took place since the publication of the first paper on this topic in 2001 Hoijtink H Confirmatory latent class analysis model selection using Bayes factors and pseudo likelihood ratio statistics *Multivariate Behavioral Research* 36 563-588 The current state of affairs was presented and discussed by the authors of this book during a workshop in Utrecht in June 2007 Here we would like to thank all authors for their participation ideas and contributions We would also like to thank Sophie van der Zee for her editorial efforts during the construction of this book Another word of thanks is due to John Kimmel of Springer for his confidence in the editors and authors Finally we would like to thank the Netherlands Organization for Scientific Research NWO whose VICI grant 453-05-002 awarded to the first author enabled the organization of the workshop the writing of this book and continuation of the research with respect to Bayesian evaluation of informative hypotheses

*Resampling Methods for Dependent Data* S. N. Lahiri, 2013-03-09 This is a book on bootstrap and related resampling methods for temporal and spatial data exhibiting various forms of dependence Like the resampling methods for independent data these methods provide tools for statistical analysis of dependent data without requiring stringent structural assumptions This is an important aspect of the resampling methods in the dependent case as the problem of model misspecification is more prevalent under dependence and traditional statistical methods are often very sensitive to deviations from model assumptions Following the tremendous success of Efron's 1979 bootstrap to provide answers to many complex problems involving independent data and following Singh's 1981 example on the inadequacy of the method under dependence there have been several attempts in the literature to extend the bootstrap method to the dependent case A breakthrough was achieved when resampling of single observations was replaced with block resampling an idea that was put forward by Hall 1985 Carlstein 1986 Kiinsch 1989 Liu and Singh 1992 and others in various forms and in different inference problems There has been a vigorous development in the area of resampling methods for dependent data since then and it is still an area of active research This book describes various aspects of the theory and methodology of resampling methods for dependent data developed over the last two decades There are mainly two target audiences for the book with the level of exposition of the relevant parts tailored to each audience

Model Assisted Survey Sampling Carl-Erik Särndal, Bengt Swensson, Jan Wretman, 2003-10-31 Now available in paperback this book provides a comprehensive account of survey sampling theory and methodology suitable for students and researchers across a variety of disciplines It shows how statistical modeling is a vital component of the sampling process and in the choice of estimation technique The first textbook that systematically extends traditional sampling theory with the aid of a modern model assisted outlook Covers classical topics as well as areas where significant new developments have taken place

*Unified Methods for Censored Longitudinal Data and Causality* Mark J. van der Laan, James M Robins, 2012-11-12 During the last decades there has been an explosion in computation and information technology This development comes with an expansion of complex observational studies and clinical trials in a variety of fields such as medicine biology

epidemiology sociology and economics among many others which involve collection of large amounts of data on subjects or organisms over time The goal of such studies can be formulated as estimation of a finite dimensional parameter of the population distribution corresponding to the observed time dependent process Such estimation problems arise in survival analysis causal inference and regression analysis This book provides a fundamental statistical framework for the analysis of complex longitudinal data It provides the first comprehensive description of optimal estimation techniques based on time dependent data structures subject to informative censoring and treatment assignment in so called semiparametric models Semiparametric models are particularly attractive since they allow the presence of large unmodeled nuisance parameters These techniques include estimation of regression parameters in the familiar multivariate generalized linear regression and multiplicative intensity models They go beyond standard statistical approaches by incorporating all the observed data to allow for informative censoring to obtain maximal efficiency and by developing estimators of causal effects It can be used to teach masters and Ph D students in biostatistics and statistics and is suitable for researchers in statistics with a strong interest in the analysis of complex longitudinal data



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