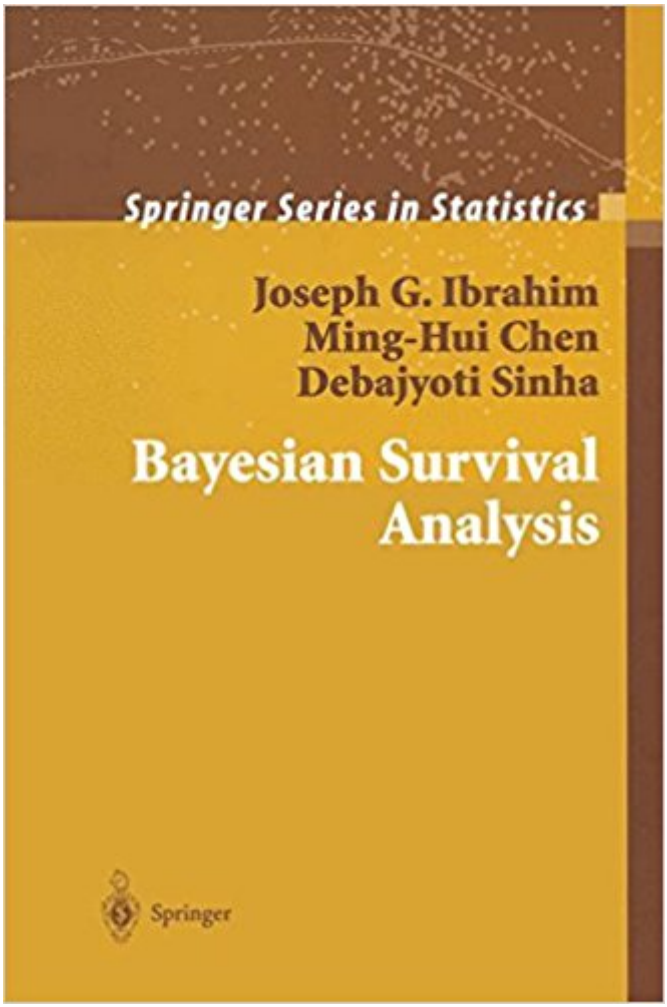
Bayesian Survival Analysis (Springer Series In Statistics)



Synopsis

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. It 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 from the health sciences, including cancer, AIDS, and the environment.

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Customer Reviews

From the reviews: "The analysis of time-event data arises naturally in many fields of study. This book focuses exclusively on medicine and public health but the methods presented can be applied in a number of other areas, including biology, economics and engineering. Although several previously published texts address survival analysis from a frequentist perspective, this book examines solely Bayesian approaches to survival analysis. Recent advances in computing and practical methods for prior elicitation have now made Bayesian survival analysis of complex models feasible. This book provides a comprehensive and modern treatment of the subject. In addition, the authors demonstrate the use of the statistical package BUGS for several of the models and methodologies discussed in the book. The authors provide a collection of theoretical and applied problems in the exercises at the end of each chapter."ISI Short Book Reviews, April 2002 "This is

definitely a worthwhile read for any statistician specializing in survival analysis. It is pitched so that part of it is readily usable by the medical statisitciann, but it will also provide stimulation for statisticians involved in methodological development or the writing of new software for survival analysis." International Journal of Epidemiology "Many books have been published concerning survival analysis or Bayesian methods; Bayesian Survival Analysis is the first comprehensive treatment that combines these two important areas of statistics. Ibrahim, Chen, and Sinha have made an admirable accomplishment on the subject in a well-organized and easily accessible fashion." Journal of the American Statistical Association "This is one of the best combinations of advanced methodology and practical applications that I have ever encountered." Technometrics, May 2002 "This is a book by three authors who are well-known for their contribution to Bayesian survival analysis. Ã¢â ¬Â¦ It is a good book with many areas of strength. Ã¢â ¬Â¦ There are several new methods, ideas, results, some of which are due to the authors. There is a good discussion of historical priors Ã¢â ¬Â¦ . Other things that strike me as new are a good technical discussion of frailty and cure models Ã¢â ¬Â¦ . I have learnt a lot and enjoyed reading the book." (Jayanta K. Ghosh, Sankhya: The Indian Journal of Statistics, Vol. 65 (3), 2003) "This book illustrates several Bayesian techniques to analyze survival data in biology, medicine, public health, epidemiology, clinical trials, and economics. Ã¢â ¬Â¦ It could be used as a textbook in a graduate level course. Ã¢â ¬Â¦ In particular, I enjoyed the presentations of cure models and cancer vaccine trials. Biostatisticians will like reading this book from the Bayesian points of view." (Ramalingam Shanmugam, Journal of Statistical Computation and Simulation, Vol. 74 (10), 2004) "This book offers an excellent and thorough summary of an exciting methodological development since the seventies of the last century. Ã¢â ¬Â¦ The authors offer a gentle journey through the archipelago of Bayesian Survival analysis. They combine in a pleasant way theory, examples, and exercises. Ã¢â ¬Â¦ I hope that this stimulating book may tempt many readers to enter the field of Bayesian survival analysis Ã¢â ¬Â¦ ." (Ulrich Mansmann, Metrika, September, 2004) "It offers a presentation of Bayesian methods in Survival Analysis that is, at a time, comprehensive and suitably balanced between theory and applications; many relevant models and methods are illustrated and most of them are provided with detailed examples and case studies drawn from the medical research. Ã¢â ¬Â¦ The book offers a quite up-to-date view of Bayesian Statistics and accounts extensively for Monte Carlo-based sampling methods and for the various methods of prior elicitation, suitable to cope with non-parametric as well as with semi-parametric models." (Fabio Spizzichino, Statistics in Medicine, Vol. 23, 2004) "This is not an elementary book. Ã¢â ¬Â¦ The book develops methodology and does this at a high level, because the reader is presumed to have a mathematical statistics

background in both classical and Bayesian methods. Happily, the book is replete with examples. This is one of the best combinations of advanced methodology and practical applications that I have encountered. Ã¢â ¬Â¦ Computing support for the book comes from the package called BUGS Ã¢â ¬Â¦." (Technometrics, Vol. 44 (2), 2002) "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 Ã¢â ¬Â¦. 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." (LÃ¢â ¬â„¢Enseignement MathÃƒÂ©matique, Vol. 48 (1-2), 2002) "The book is about Bayesian survival analysis which is illustrated with examples that mostly use the BUGS software package. Ã¢â ¬Â¦ this is definitively a worthwhile read for any statistician specializing in survival analysis. It is pitched so that part of it is readily usable by the medical statistician, but it will also provide stimulation for statisticians involved in methodological development or the writing of new software for survival analysis." (Margaret May, International Journal of Epidemiology, Vol. 31 (2), 2002) "This book focuses exclusively on medicine and public health but the methods presented can be applied in a number of other areas, including biology, economics and engineering. Ã¢â ¬Â¦ This book provides a comprehensive and modern treatment of the subject. In addition, the authors demonstrate the use of the statistical package BUGS for several of the models and methodologies discussed in the book. The authors provide a collection of theoretical and applied problems in the exercises at the end of each chapter." (C. M. OÃ¢â ¬â„¢Brien, Short Book Reviews, Vol. 22 (1), 2002) "Ibrahim, Chen and Sinha command over a rich experience in both Bayesian and survival analysis. Drawing from this experience they have put together a comprehensive description of Bayesian methodology in survival analysis. The book is written for researchers and graduate students. Ã¢â ¬Â¦ The book is a useful tool for practitioners who analyze survival data using Bayesian methods." (Mathias Schaller, Statistical Papers, Vol. 47, 2005)

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The authors have prepared a very nice survey-style treatment of Bayesian model building and

specification with applications to the Cox theory of hazard models. The text is quite accessible; however, there isn't a lot of theory here. You'll need a little background material before jumping into this book. Reasonable prerequisites are Hosmer & Lemeshow'sÃ Â Applied Survival Analysis: Regression Modeling of Time to Event DataÃ Â andÃ Â Bayesian Data AnalysisÃ Â by Gelman, et al.In Chapter 1, the authors provide a quick review of survival analysis before setting up the Bayesian modeling paradigm. For the Bayesians, the problem of inference of an unknown parameter is broken down into two components (thanks to Bayes' Theorem). The first component represents the contribution from the observed data set (the likelihood function). The second, and often troublesome, component comes from an assumption about the distribution of the unknown parameter, called the prior distribution. The two components combine in a natural way to give the inference. This it the so-called posterior distribution and is the goal of a Bayesian analyst.We can therefore think of the Bayesian modeling problem as the need to acquire observed data, make a model selection and choose a prior distribution. Given these three elements, it is a straightforward application of Markov Chain Monte Carlo techniques (e.g. Gibbs Sampler) to fit the model and obtain parameter estimates.Chapter 2 begins the survey of available Bayesian models for survival data by considering parametric survival models. This chapter gives a nice illustration of Bayesian model fitting techniques for some basic survival model techniques. Readers of the Cox theory may find themselves thinking that the parametric models presented have not one parametric item (the form of the hazard function) but two, the prior distribution of the beta coefficients.The focus of Chapter 3 is a survey of semi-parametric models. These models are semi-parametric in the sense that the over-all form of the model is selected (usually some variation of the Cox Model), but the baseline hazard is unspecified by the standard theory. The Bayesian theory approaches the problem of the unspecified baseline by assuming its prior distribution changes with time as some identified stochastic process. The authors focus on the Gamma distribution and the Gamma process (a type of Levy process) for the first part of the chapter. Beta process models and their generalization, Dirichlet process models are presented next, but notably the treatment here isn't flexible enough to allow the model to include subject-specific covariates.It is often the case in fitting survival data to a Cox model that one finds the proportional hazard assumptions fail to hold. Chapter 4 discusses this heterogeneity, called subject specific frailty, and surveys the Bayesian approach to fitting frailty models. Models using the Gamma distribution to encode frailty are examined from the finite variance perspective. The failure of these models to recapture the proportional hazards assumptions is discussed and the infinite variance positive stable distribution is discussed as technique to recapture proportionality into the model. The chapter ends with section discussing

frailty from the point-of-view of competing risks models (multivariate survival models).Chapter 5 is a short, but nicely prepared chapter on cure rate models. These are a family of models which incorporate recovery rates in the classical fatality time models. The authors discuss parametric and semi-parametric models from the cure rate perspective.A collection of Bayesian model comparison techniques are offered in Chapter 6, including Bayes Factors, calculating posterior model probabilities, the Bayesian Information Criterion, the Conditional Predictive Ordinate along with the L measure tests. These tests can be used as part of a covariate selection scheme for a particular model or in a hypothesis test comparing two different models.Chapter 7 discusses handling time-varying covariates and motivates this with longitudinal data modeling. Joint models are discussed and the EM algorithm is mentioned as the estimation technique of choice for fitting this models. A detailed exposition on this technique can be found in MacLachlan & Krishnan'sÃ Â The EM Algorithm and Extensions.In the last three chapters, the authors turn to the problem of actually using Bayesian models in a real-world environment. Practical considerations such as missing data, model diagnostics, goodness-of-fit and questions of sample size are addressed. The Polya Tree process (a generalization of the Dirichlet process) is discussed as a way to address the shortcomings that the Dirichlet process prior models have with regards to subject-specific covariates.The book contains HTTP links to download the data sets analyzed in this text. The authors also provide links to freeware code sources for the BUGS implementation of the Gibbs sampler the authors used throughout to fit their models.

The first reviewer of this book seems to be knowledgeable about the subject but in my view overly harsh. The book is not intended for researchers without background in statistics. In fact, the authors state that the text is an advanced text for graduate students requiring as a prerequisite a course in mathematical statistics and one in Bayesian statistics at the level of Box and Tiao. The authors do claim to place a balance between theory and applications. Although I do feel this is an advanced text that is heavy on theory, there claim is somewhat justified in the sense that they provide several motivating examples particularly from the area of cancer research right upfront in chapter 1 even before discussing the basics of survival analysis and Bayesian methods.An attractive feature of the text is that many topics are covered in book form for the first time. I found the coverage of cure rate models particularly interesting. Another reviewer criticized the use of piecewise models for hazard rate modelling as esoteric. However I find the exploration of these new and somewhat complicated techniques rather fascinating. The Cox proportional hazard rate model has been a mainstay in survival analysis since introduced by Cox in the 1970s. But experience has shown many

applications where the proportionality assumption is not valid. Generalizations such as those in Therneau's book and the ones that Ibrahim et al. introduce here should be welcomed. The authors illustrate their applications of these techniques throughout the book. Future use will determine the degree of applicability of these techniques and issues of overparameterization needs to be addressed, but the authors should be praised for making the attempt.The text is not just an advanced book on the authors' research. It also includes a wealth of discussion and references to the growing literature on MCMC, survival analysis and specialized topics such as cure models, frailty models and methods for comparing models.The reference list is authoritative, scholarly and extensive, providing reference to the very early articles from the 1950s (e.g. Berkson and Gage) as well as the most recent from the 1990s and 2000-2001.In the first chapter the authors make a strong case for the advantages of the Bayesian approach through the use of MCMC. I would only caution that the real issue between the Bayesian and frequentist inference schools lies in the appropriateness of prior distribution in inference and whether or not subjective probability is more appropriate than objective probability. These are deeper philosophical issues and seemed to be glossed over a little by the authors. However, MCMC has allowed the use of richer classes of prior distributions and the ability to look at the sensitivity of the prior modeling assumptions. For this reason many statisticians are accepting the Bayesian approach and are doing data analysis using both paradigms.Bayesian methods are seeing growth in clinical trials particularly regarding the choice of sequential rules for stopping a trial. This has been particularly true in the medical device area where FDA statisticians have even encouraged its use in the design of trials.With the publication of this book we can only hope to see greater use of it in survival analysis.My one disappointment is that I would have liked to have seen a more systematic account of the various MCMC algorithms explaining their differences, limitations and advantages. The current literature on MCMC is suitably referenced including the fine tutorials on Gibbs Sampling and the Metropolis-Hastings algorithm. I just wish this book had been a little more self-contained from the MCMC point of view. Perhaps that will come in a second edition a few years hence.The authors do jump into advanced topics and this can be frustrating for the novice. However its intended aim is for research statisticians and graduate students in statistics and with the prerequisites in hand, the book is very valuable. It does achieve its intended goal.The theory is well covered but to make it an easier reference source, mathematical proofs are left to appendices. Other advanced topics not commonly found in text books and worthy of note are Dirichlet priors and multivariate survival models. Other recent texts that include such advanced topics as extensions to proportional hazards and multivariate surival models are respectively the text by Therneau and Grambsch and the text by

Hougaard.

The back cover says this should be a usefulreference text for applied researchers, however thosewho are interested in really applying Bayesian methodsto survival analysis will find this a very frustratingbook to read.A strength of Bayesian techniques is the ability tovary hyperparameters in the prior to control inference.However, you can also have too much of a good thing,a trap that the authors clearly fall into. Much of the bookseems devoted to selecting hyperparameters in whatappear to be overly complex models. Mostchoices seem ad-hoc at best and readers who want to usethe authors methods will quickly feeloverwhelmed by the seeming complexity. Even theproportional hazards model takes pages to getthrough and will try even the most ambitious reader.Another major weakness of the book is the use ofpiecewise hazard models --- the backbone of the authorsapproach. No justification is given for why this techniqueshould work and no definitive method for partitioningthe time axis is discussed. This is like many other partsof the book where key points seem brushed aside in thehaste to get to esoteric ideas based on publishedpapers by the authors. For readers who are not sowell versed it will be difficult to tell what isimportant and what isn't.Save your money. This one will go out of print quicklyanways.

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