Preface

Reliability theory has taken rapid strides in the last four decades to become an independent discipline that influences our daily lives and schedules through our dependence on good and reliable functioning of devices and systems that we constantly use. The extensive literature on reliability theory, along with its applications, is scattered over various disciplines including statistics, engineering, applied probability, demography, economics, medicine, survival analysis, insurance and public policy. Life distributions specified by their distribution functions and various concepts and characteristics derived from it occupy a big portion of reliability analysis. Although quantile functions also represent life distributions and would facilitate one to carry out all the principal functions enjoyed by distribution functions in the existing theory and practice, this feature is neither fully appreciated nor exploited. The objective of this book is to attempt a systematic study of various aspects of reliability analysis with the aid of quantile functions, so as to provide alternative methodologies, new models and inferential results that are sometimes difficult to accomplish through the conventional approach.

Due to the stated objective, the material presented in this book is loaded with a quantile flavour. However, all through the discussion, we first present a concept or methodology in terms of the conventional approach and only introduce the quantile-based counterpart. This will enable the reader to transfer the methodology from one form to the other and to choose the one that fits his/her taste and need. Being an introductory text in quantile-based reliability methods, there is scope for further improvements and extensions of the results discussed here.

The book is biased towards the mathematical theory, with examples intended to clarify various notions and applications to real data being limited to demonstrate the utility of quantile functions. For those with interest in practical aspects of quantile-based model building, relevant tools and descriptive data analysis, the book by Gilchrist would provide a valuable guidance.

This book is organized into nine chapters. Chapter 1 deals with the definition, properties and various descriptive measures based on the quantile functions. Various reliability concepts like hazard rate, and mean residual life, in the conventional form as well as their quantile equivalents, are discussed in Chap. 2. This is followed, in Chap. 3, by a detailed presentation of the distributional and reliability aspects of

quantile function models along with some applications to real data. Different ageing concepts in quantile versions are described in Chap. 4. Total time on test transforms, an essentially quantile-based notion, is detailed in Chap. 5. As alternatives to the conventional moments, the *L*-moments and partial moments in relation to residual life are presented. In Chap. 6, the definitions, properties and characterizations of these concepts are explained along with their use in inferential methods. Bathtub hazard models are considered in Chap. 7 along with their quantile counterparts and some new quantile functions that exhibit nonmonotone hazard quantile functions. The definitions and properties of various stochastic orders encountered in reliability theory are described in Chap. 8. Finally, Chap. 9 deals with various methods of estimation and modelling problems. A more detailed account of the contents of each chapter is provided in the Abstract at the beginning of each chapter.

Within the space available for this book, it has not been possible to include all the topics pertinent to reliability analysis. Likewise, the work of many authors who have contributed to these topics, as well as to those in the text, could not be included in the book. Our sincere apologies for these shortcomings. Any suggestion for the improvement in the contents and/or indication of possible errors in the book are wholeheartedly welcomed.

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