Written for those who have taken a first course in statistical methods, this book takes a modern, computer-oriented approach to describe the statistical techniques used for the assessment of reliability.

Analysis of reliability and risk is an important and integral part of planning, construction and operation of all technical systems. To be able to perform such analyses systematically and scientifically, there is usually a need for special methods and models. This book presents the most important of these. Particular emphasis has been placed on the ideas and the motivation for the use of the various methods and models. It has been an objective to compile a book which provides practising engineers and engineering graduates with the concepts and basic techniques for evaluating reliability and risk analysis using the Weibull distribution.
reliability and risk. It is hoped that the material presented will make them so familiar with the subject that they can carry out various types of analyses themselves and understand and make use of the more detailed applications and additional material which is available in the journals and publications associated with their own discipline. It has also been an objective to put reliability and risk analyses in context - how such analyses should be used in design and operation of components and systems. The material presented is modern and a large part of the book is at research level. The book focuses on analysis of repairable systems, not only non-repairable systems which have traditionally been given most attention in textbooks on reliability theory. Since most real-life systems are repairable, methods for analysing repairable systems are an important area of research. The book presents general methods, with most applications taken from offshore petroleum activities.

Two important wood properties are the modulus of elasticity (MOE) and the modulus of rupture (MOR). In the past, the statistical distribution of the MOE has often been modeled as Gaussian, and that of the MOR as lognormal or as a two- or three-parameter Weibull distribution. It is well known that MOE and MOR are positively correlated. To model the simultaneous behavior of MOE and MOR for the purposes of wood system reliability calculations, we introduce a bivariate Gaussian-Weibull distribution and the associated univariate pseudo-truncated Weibull (PTW). We note that theoretical arguments suggest that the strength distributions of grades of lumber are likely to be PTW rather than Weibull. We describe a Web-based program that fits bivariate Gaussian-Weibull data sets (and thus fits PTW distributions to MOR data). We present data that demonstrate that strength distributions of visual grades of lumber are not Weibull and do display at least some of the characteristics of PTW data. Finally, we demonstrate via simulation that if we fit a Weibull distribution to PTW data (as is often done), we can obtain very poor estimates of probabilities of failure.

This book is intended for the engineer or engineering student with little or no prior background in reliability. Its purpose is to provide the background material and guidance necessary to comprehend and carry out all the tasks associated with a reliability program from specification generation to final demonstration of reliability achieved. Most available texts on reliability concentrate on the mathematics and statistics used for reliability analysis, evaluation, and demonstration. They are more often suited more for the professional with a heavier mathematical background that most engineers have, and more often than not, ignore or pay short-shrift to basic engineering design and organizational efforts associated with a reliability program. A reliability engineer must be familiar with both the mathematics and engineering aspects of a reliability program. This text: 1. Describes the mathematics needed for reliability analysis, evaluation, and demonstration commensurate with an engineer's background. 2. Provides background material, guidance, and references necessary to the structure and implementation of a reliability program including: • identification of the reliability standards in most common use • how to generate and respond to a reliability specification • how reliability can be increased • the tasks which make up a reliability program and how to judge the need and scope of each; how each is commonly performed; caution and comments about their application.
Models with bathtub-shaped failure rate function are useful in reliability analysis and particularly in reliability related decision making and cost analysis. A modified Weibull distribution (MWD) was recently proposed by Lai et al. (2003) as a generalization of the two-parameter Weibull distribution. This distribution has both the two-parameter Weibull and the type I extreme value distributions as special cases. This lifetime distribution is able to model data with bathtub-shaped hazard rate, which is an important feature for engineering reliability analysis. Parameter estimation is crucial for the model to be built and is often a difficult problem, especially for distributions with more than 2 parameters. In this book, maximum likelihood estimation (MLE) is studied in detail. Several techniques regarding this estimation method are proposed to simplify computation. Another estimation method called Bayesian is used to estimate the parameters as well as some life parameters (reliability and hazard functions). We consider estimation of the modified Weibull parameters based on progressively Type II censored data, an adaptive progressively Type II censored data and upper record values.

Estimates of the Weibull distribution parameters were made employing the mean ranks estimator; the estimates were repeated using the median ranks estimator. These estimates were compared to known values of the Weibull distribution parameters. This made it possible to compare the results obtained using either estimator (mean ranks or median ranks) and to determine the relative merits of using either estimator. The study made use of a digital computer and employed Monte-Carlo techniques to simulate Weibull distributed failure times. These failure times may represent tank-automotive component failures.

A comprehensive perspective on Weibull models. The literature on Weibull models is vast, disjointed, and scattered across many different journals. Weibull models is a comprehensive guide that integrates all the different facets of Weibull
models in a single volume. This book will be of great help to practitioners in reliability and other disciplines in the context of modeling data sets using Weibull models. For researchers interested in these modeling techniques, exercises at the end of each chapter define potential topics for future research. Organized into seven distinct parts, Weibull Models: Covers model analysis, parameter estimation, model validation, and application. Serves as both a handbook and a research monograph. As a handbook, it classifies the different models and presents their properties. As a research monograph, it unifies the literature and presents the results in an integrated manner. Intertwines theory and application. Focuses on model identification prior to model parameter estimation. Discusses the usefulness of the Weibull Probability Plot (WPP) in the model selection to model a given data set. Highlights the use of Weibull models in reliability theory. Filled with in-depth analysis, Weibull Models pulls together the most relevant information on this topic to give everyone from reliability engineers to applied statisticians involved with reliability and survival analysis a clear look at what Weibull models can offer.

This book has been written to provide both students and industrial managers with a comprehensive description of the tools and techniques of Quality Management and also to provide a framework for understanding Quality Development. Central to the theme of this book is the idea that quality management is a developmental process which requires an understanding of the techniques, the people and the systems issues. The aims of quality development are to produce greater organizational consistency, to improve customer satisfaction, and to reduce the business process costs. In order to achieve these aims, managers are required to have an understanding of both the underlying theories and the methodologies for implementation. The aim of this book is to provide a coherent description of both the theoretical and implementation aspects of quality management. Since the halcyon days of the quality ‘revolution’ of the 1970s and 1980s, many organizations have realized that quality development represents an enormous management challenge. This challenge for continuous improvement requires the continuous development of systems, of techniques and of people. Like most serious business strategies, competitive improvement through quality development can only be achieved if the organization understands not only what the various quality ‘options’ are but also when a particular technique or approach is applicable. Quality development has no single blueprint but requires a learning organization which understands key concepts and methods of implementation.

Reliability is an essential concept in mathematics, computing, research, and all disciplines of engineering, and reliability as a characteristic is, in fact, a probability. Therefore, in this book, the author uses the statistical approach to reliability modeling along with the MINITAB software package to provide a comprehensive treatment of modelling, from the basics through advanced modelling techniques. The book begins by presenting a thorough grounding in the elements of modelling the lifetime of a single, non-repairable unit. Assuming no prior knowledge of the subject, the author includes a guide to all the fundamentals of probability theory, defines the various measures associated with reliability, then describes and discusses the more common lifetime models: the exponential, Weibull, normal, lognormal and gamma distributions. She concludes the groundwork by looking at ways of choosing and fitting the most appropriate model to a given data set, paying particular attention to two critical points: the effect of censored data and estimating lifetimes in the tail of the distribution. The focus then shifts to topics somewhat more difficult: the difference in the analysis of lifetimes for repairable versus non-repairable systems and whether repair truly "renews"
the system methods for dealing with system with reliability characteristic specified for more than one component or subsystem the effect of different types of maintenance strategies the analysis of life test data The final chapter provides snapshot introductions to a range of advanced models and presents two case studies that illustrate various ideas from throughout the book.

The Weibull distribution has been one of the most cited lifetime distributions in reliability engineering. Over the last decade, many generalizations and extensions of the Weibull have been proposed in order to provide more flexibility than the traditional version when it comes to modeling lifetime data in diverse fields. This book offers an update on these developments, presenting the essential properties of each model. Several plots of density and hazard rate functions are also included, and a brief outline of known application(s) for each model is also given.


This book equips the reader with a compact information source on all the most recent methodological tools available in the area of reliability prediction and analysis. Topics covered include reliability mathematics, organisation and analysis of data, reliability modelling and system reliability evaluation techniques. Environmental factors and stresses are taken into account in computing the reliability of the involved components. The limitations of models, methods, procedures, algorithms and programmes are outlined. The treatment of maintained systems is designed to aid the worker in analysing systems with more realistic and practical assumptions. Fault tree analysis is also extensively discussed, incorporating recent developments. Examples and illustrations support the reader in the solving of problems in his own area of research. The chapters provide a logical and graded presentation of the subject matter bearing in mind the difficulties of a beginner, whilst bridging the information gap for the more experienced reader. The work will be of considerable interest to engineers working in various industries, research organizations, particularly in defence, nuclear, chemical, space or communications. It will also be an indispensable study aid for serious-minded students and
A substantial amount of research has been conducted on consecutive k-out-of-n and related reliability systems over the past four decades. These systems have been used to model various engineering systems such as the microwave stations of telecoms network, oil pipeline systems, and vacuum systems in an electron accelerator. As such, studies of reliability properties of consecutive k-out-of-n structures have attracted significant attention from both theoretical and practical approaches. In the modern era of technology, the redundancies are employed in the various industrial systems to prevent them from failure/sudden failure or to recover from failures. This book is meant to provide knowledge and help engineers and academicians in understanding reliability engineering by using k-out-of-n structures. The material is also targeted at postgraduate or senior undergraduate students pursuing reliability engineering.

This book contains extended versions of 34 carefully selected and reviewed papers presented at the Third International Conference on Mathematical Methods in Reliability, held in Trondheim, Norway in 2002. It provides a broad overview of current research activities in reliability theory and its applications. There are chapters on reliability modelling, network and system reliability, reliability optimization, survival analysis, degradation and maintenance modelling, and software reliability. The authors are all leading experts in the field. A particular feature of the book is a historical review by Professor Richard E Barlow, well known for his pioneering research on reliability. The list of authors also includes the plenary session speakers Odd O Aalen, Philip J Boland, Sallie A Keller-McNulty, and Nozer Singpurwala.

Contents: Reliability Theory in the Past and Present Centuries; General Aspects of Reliability Modelling; Reliability of Networks and Systems; Stochastic Modelling and Optimization in Reliability; Modelling in Survival and Reliability Analysis; Statistical Methods for Degradation Data; Statistical Methods for Maintained Systems; Statistical Inference in Survival Analysis; Software Reliability Methods. Readership: Graduate students, academics and professionals in probability & statistics, reliability analysis, survival analysis, industrial engineering, software engineering, operations research and applied mathematics research.
simulations. With its numerous hands-on examples, exercises, and software applications, Using the Weibull Distribution is an excellent book for courses on quality control and reliability engineering at the upper-undergraduate and graduate levels. The book also serves as a valuable reference for engineers, scientists, and business analysts who gather and interpret data that follows the Weibull distribution.

“Failure Rate Modeling for Reliability and Risk” focuses on reliability theory, and to the failure rate (hazard rate, force of mortality) modeling and its generalizations to systems operating in a random environment and to repairable systems. The failure rate is one of the crucial probabilistic characteristics for a number of disciplines; including reliability, survival analysis, risk analysis and demography. The book presents a systematic study of the failure rate and related indices, and covers a number of important applications where the failure rate plays the major role. Applications in engineering systems are studied, together with some actuarial, biological and demographic examples. The book provides a survey of this broad and interdisciplinary subject which will be invaluable to researchers and advanced students in reliability engineering and applied statistics, as well as to demographers, econometricians, actuaries and many other mathematically oriented researchers.

This book provides readers with an overview of recent theories and methods for machinery diagnostics applied to machinery maintenance. Each chapter, accepted after a rigorous peer-review process, reports on a selected, original piece of work discussed at the International Congress on Technical Diagnostic, ICDT2016, held on September 12 – 16, 2016, in Gliwice, Poland. The book covers a broad range of topics, including machines operating in non-stationary conditions, and examples from different industrial fields of mechanical, civil, computer and electronic engineering as well as the medical, food, automotive, and mining industries. By presenting state-of-the-art diagnostic solutions and discussing important industrial issues the book offers a valuable resource to both academics and professionals as well as a bridge to facilitate communication and collaboration between the two groups.

The statistical variation of load and strength is described by a three parameter Weibull distribution. The Weibull parameters are evaluated by a least square analysis and a method is presented which allows confidence bounds to be assigned to these quantities. A Monte Carlo analysis is used to calculate the reliability of the structure from the load and strength distributions. (Author).

This volume presents recent results in reliability theory by leading experts in the world. It will prove valuable for researchers, and users of reliability theory. It consists of refereed invited papers on a broad spectrum of topics in reliability. The subjects covered include Bayesian reliability, Bayesian reliability modeling, confounding in a series system, DF tests, Edgeworth approximation to reliability, estimation under random censoring, fault tree reduction for reliability, inference about changes in hazard rates, information theory and reliability, mixture experiment, mixture of Weibull distributions, queuing network approach in reliability theory, reliability estimation, reliability modeling, repairable systems, residual life function, software spare allocation systems, stochastic comparisons, stress-strength models, system-based component test plans, and TTT-transform.
The true reliability and the fatigue life of a connecting link made of low-alloy high-strength steel have been estimated from go-no-go fatigue test. Tests were conducted on a sample size of 130 randomly selected from a population of different heats. Test results were statistically evaluated using binomial, log-normal, and Weibull distributions; the sample reliability was compared with the reliabilities estimated from all three of these distributions. It was observed that for a go-no-go test binomial distribution is preferred for more conservative estimation of the true reliability. The results also show that the life of the link follows a Weibull distribution.

Statistical Analysis for the Reliability Engineering Professional Effectively conduct reliability analysis using the world's leading statistical software. Reliability Analysis with Minitab outlines statistical concepts and applications, explains the theory of probability, reliability analysis, and quality improvement, and provides step-by-step instr

Reliability analysis using the Weibull, log normal, and gamma distributions for non-electronic components is complicated by non-standardization, small lot sizes, and the interaction between components. The Weibull distribution is useful in the failure analysis of structures, ball bearings, brittle beams, and spin gyros. The log normal distribution is used in the failure analysis of aircraft structures and helicopter blades, while the gamma distribution is useful in failure analysis of aluminum strips. It can also be shown that data for a particular example may be fitted to one or more of the distributions with equal success. (Author).

The analysis of the reliability and availability of power plants is frequently based on simple indexes that do not take into account the criticality of some failures used for availability analysis. This criticality should be evaluated based on concepts of reliability which consider the effect of a component failure on the performance of the entire plant. System reliability analysis tools provide a root-cause analysis leading to the improvement of the plant maintenance plan. Taking in view that the power plant performance can be evaluated not only based on thermodynamic related indexes, such as heat-rate, Thermal Power Plant Performance Analysis focuses on the presentation of reliability-based tools used to define performance of complex systems and introduces the basic concepts of reliability, maintainability and risk analysis aiming at their application as tools for power plant performance improvement, including: · selection of critical equipment and components, · definition of maintenance plans, mainly for auxiliary systems, and · execution of decision analysis based on risk concepts. The comprehensive presentation of each analysis allows future application of the methodology making Thermal Power Plant Performance Analysis a key resource for undergraduate and postgraduate students in mechanical and nuclear engineering.

A complete revision of the classic text on reliability engineering, written by an expanded author team with increased industry perspective Introduction to Reliability Engineering provides a thorough and well-balanced overview of the fundamental aspects of reliability engineering and describes the role of probability and statistical analysis in predicting and evaluating reliability in a range of engineering applications. Covering both foundational theory and real-world practice, this classic textbook helps students of any engineering discipline understand key probability concepts, random variables and their use in reliability, Weibull analysis, system safety analysis, reliability and environmental
stress testing, redundancy, failure interactions, and more. Extensively revised to meet the needs of today’s students, the third edition fully reflects current industrial practices and provides a wealth of new examples and problems that now require the use of statistical software for both simulation and analysis of data. A brand-new chapter examines Failure Modes and Effects Analysis (FMEA), and a greatly expanded chapter on Reliability Testing, while new and expanded sections cover topics such as applied probability, probability plotting with software, the Monte Carlo simulation, and reliability and safety risk. Throughout the text, increased emphasis is placed on the Weibull distribution and its use in reliability engineering. Presenting students with an interdisciplinary perspective on reliability engineering, this textbook: Presents a clear and accessible introduction to reliability engineering that assumes no prior background knowledge of statistics and probability Teaches students how to solve problems involving reliability data analysis using software including Minitab and Excel Features new and updated examples, exercises, and problems sets drawn from a variety of engineering fields Includes several useful appendices, worked examples, answers to selected exercises, and a companion website. Introduction to Reliability Engineering, Third Edition remains the perfect textbook for both advanced undergraduate and graduate students in all areas of engineering and manufacturing technology.

The book provides details on 22 probability distributions. Each distribution section provides a graphical visualization and formulas for distribution parameters, along with distribution formulas. Common statistics such as moments and percentile formulas are followed by likelihood functions and in many cases the derivation of maximum likelihood estimates. Bayesian non-informative and conjugate priors are provided followed by a discussion on the distribution characteristics and applications in reliability engineering.

Presenting a radically new approach and technology for setting reliability requirements, this superb book also provides the first comprehensive overview of the M/F-FOP philosophy and its applications. * Each chapter covers probabilistic models, statistical and numerical procedures, applications and/or case studies * Comprehensively examines a new methodology for problem solving in the context of real reliability engineering problems * All models have been implemented in C++ * The algorithms and programming code supplied can be used as a software toolbox for setting MFFOP * Case studies are taken from the nuclear, automotive and offshore industry to provide ‘real-world’ applications.

This addendum details the statistical procedures used in preparing the report, Decision Risk Analysis for XM 204, 105mm Howitzer, Towed Reliability/Durability Requirements (AD-763 204). A computer program was developed for this study to simulate DT/OT II testing analysis of data, the decision made based on this analysis, and the funding implications of this decision. A two-parameter Weibull family was assumed to describe durability failures. The test results were used to estimate the two parameters for each subsystem: carriage, recoil system, tube, and breech. This was followed by a test of hypothesis which tested whether sufficient information was available to reject the hypothesis that the required durability had been obtained. The subsystem durability was then used to compute replacement requirements over the system lifetime.

The Most Comprehensive Book on the Subject Chronicles the Development of the Weibull Distribution in Statistical Theory
and Applied Statistics Exploring one of the most important distributions in statistics, The Weibull Distribution: A Handbook focuses on its origin, statistical properties, and related distributions. The book also presents various approaches to estimate the parameters of the Weibull distribution under all possible situations of sampling data as well as approaches to parameter and goodness-of-fit testing. Describes the Statistical Methods, Concepts, Theories, and Applications of This Distribution Compiling findings from dozens of scientific journals and hundreds of research papers, the author first gives a careful and thorough mathematical description of the Weibull distribution and all of its features. He then deals with Weibull analysis, using classical and Bayesian approaches along with graphical and linear maximum likelihood techniques to estimate the three Weibull parameters. The author also explores the inference of Weibull processes, Weibull parameter testing, and different types of goodness-of-fit tests and methods. Successfully Apply the Weibull Model By using inferential procedures for estimating, testing, forecasting, and simulating data, this self-contained, detailed handbook shows how to solve statistical life science and engineering problems.

Understand and utilize the latest developments in Weibull inferential methods While the Weibull distribution is widely used in science and engineering, most engineers do not have the necessary statistical training to implement the methodology effectively. Using the Weibull Distribution: Reliability, Modeling, and Inference fills a gap in the current literature on the topic, introducing a self-contained presentation of the probabilistic basis for the methodology while providing powerful techniques for extracting information from data. The author explains the use of the Weibull distribution and its statistical and probabilistic basis, providing a wealth of material that is not available in the current literature. The book begins by outlining the fundamental probability and statistical concepts that serve as a foundation for subsequent topics of coverage, including: • Optimum burn-in, age and block replacement, warranties and renewal theory • Exact inference in Weibull regression • Goodness of fit testing and distinguishing the Weibull from the lognormal • Inference for the Three Parameter Weibull Throughout the book, a wealth of real-world examples showcases the discussed topics and each chapter concludes with a set of exercises, allowing readers to test their understanding of the presented material. In addition, a related website features the author's own software for implementing the discussed analyses along with a set of modules written in Matlab®, and additional graphical interface software for performing simulations. With its numerous hands-on examples, exercises, and software applications, Using the Weibull Distribution is an excellent book for courses on quality control and reliability engineering at the upper-undergraduate and graduate levels. The book also serves as a valuable reference for engineers, scientists, and business analysts who gather and interpret data that follows the Weibull distribution.

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