

System Reliability Modelling and Evaluation

C. Singh and R. Billinton

Preface

The general area of reliability engineering is extremely wide and in fact encompasses all aspects of engineering technology. Conventional intuitive approaches to the evaluation of system adequacy are not sufficient in modern engineering applications and are gradually being replaced by consistent quantitative techniques. A basic and common requirement in any quantitative procedure is the development of a suitable mathematical model to describe the system. The model may be relatively simple or extremely complex and should be capable of numerical manipulation. This book is devoted entirely to this area and deals with the concepts, philosophy and techniques for reliability model building and evaluation.

The book begins by outlining the elements of reliability planning and discusses the role of modelling in the reliability program plan. Chapter 2 reviews the basic probability theory required in subsequent chapters with emphasis on utilization in system reliability modelling and evaluation. The reader will find that some previous background in probability mathematics is helpful but not necessary. Chapter 3 is the key chapter in the book and discusses the concepts of the frequency balancing approach. These concepts have been used with considerable success in the reliability analysis of repairable systems. This chapter emphasizes the calculation of several measures of system reliability. Chapter 4 is concerned with determining the system reliability characteristics from the statistical information available on the failure and repair cycles of the constituent components. Non-maintained systems have been discussed extensively in the available literature and, therefore, this book is directed towards maintained systems. The theory and procedures are, however, quite general and can be equally applied to non-maintained systems. Chapter 5 is devoted to the utilization of these concepts in the reliability analysis of relatively large systems and some possible problem areas and solutions are presented. The available books generally assume constant transition rates and give a cursory treatment to non-Markovian models. Chapter 6 is devoted to non-Markovian modelling with special emphasis on the device of stages which is a very practical approach. The emphasis in the book is on direct analytical methods. A discussion of system reliability modelling would, however, be incomplete without a discussion on simulation methods as given in Chapter 7.

The scope of application of the concepts outlined in the book encompasses virtually all engineering disciplines. The book is therefore intended as a general treatise and is not aimed at any specific area of application.

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Contents

Preface	viii		
1 Introduction	1		
Introduction. Reliability Planning. Definition of System Reliability. Overall Target and Allocation to Subsystems. Reliability Modelling and Evaluation. Testing and Data Collection. Evaluation of Alternative Designs. Reliability Report. Scope of This Book.			
2 The Preliminaries	7		
Introduction. Sample Space. Events. Random Variables. Probability Laws. Expectation. Variance. Covariance. Moments. Coefficients of Skewness and Excess. Transform Methods. Some Special Distributions (Exponential, Normal, Log-normal, Weibull, Gamma). Stochastic Processes. Probability Distributions. Markov Chains. Equilibrium Distribution. Time Specific Behaviour. First Passage Times. Alternative Approach to First Passage Times. Continuous Parameter Markov Chains. Transient Behaviour. Equilibrium Probability Distribution. First Passage Times. Exercises. References.			
3 Frequency and Associated Concepts	63		
Introduction. Interstate Transition Rate. The Concept of Frequency. Time Specific Domain. Methods of Calculation. Steady State Domain. Time Specific Probabilities. Steady State Probabilities. Alternative Interpretation of Mean Cycle Time, Mean Duration and Mean Frequency. The Relationship to Average Values. The Concept of Equivalent Transition Rate. References.			
4 System Reliability	89		
Introduction. Definition and Description of the System and its Requirements. Failure Modes and Effects Analysis. State Space Approach. Series System. Parallel Systems. Decomposition Using the Conditional Probability Approach. Network Approach. Network Reduction Procedure. Cut Set or Tie Set Methods. Tie Set Manipulation. Cut Set Manipulation. Frequency Calculation Using the Cut Set Approach. Algorithm to Determine Minimal Cut Sets. Exercises. References.			
5 Techniques for Large Systems	132		
Introduction. The Problem Areas. Equivalent Transition Rate and Conditions of Mergeability. Components Subject to Fluctuating Environment. State Space Truncation. Sequential Truncation. References.			
6 Reliability Modelling in Non-Markovian Systems	164		
Introduction. The Difficulty with Non-Markovian Processes. Method of Supplementary Variables. Semi-Markov Processes. Device of Stages. References.			
7 Simulation	211		
Introduction. Basic Procedure. Random Number Generation. Simulation Model. Timing Controls. Random Sampling. Estimating Reliability Measures. Equilibrium Conditions and Sample Size. Variance Reducing Techniques. References.			
8 Conclusions	225		
9 Appendices	227		
Appendix I	227		
Solution of Simultaneous Linear Equations			
Appendix II	230		
Shape of the Hazard Rate Function of Two Series Stage Combinations in Parallel			
Appendix III	233		
Hazard Rate Shape of Series Stages in Series with a Distinctive Stage			
Appendix IV	234		
Series Stages in Series with Two Parallel Stages			
Appendix V	239		
Moments of Stage Combinations			
Appendix VI	242		
Calculation of the Jacobian Matrix			
Index	245		

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