

Preface

People are often concerned with the reliability of products they use and of the friends and associates with whom they interact daily in a myriad of ways. Although the term “reliability” may not occur in the description of a given product or interaction, it is often the attribute that the individual means in expression of their concern. Schedule delays, inconvenience, customer dissatisfaction, and loss of prestige and even weakening of national security are common examples of results that are caused by unreliability of systems and individuals. Thus, both the government and private industry have had to recognize the importance of understanding and strengthening the concept of reliability. The growth, recognition and definitization of the reliability function were given much impetus during the 1960s. During those processes, three main technical areas of reliability evolved:

- (1) reliability engineering;
- (2) operations analysis;
- (3) reliability mathematics.

Each of these areas developed its own body of knowledge. This book is focused on the mathematics of reliability.

I have written this book on the basis of my previous work, both alone and in collaboration with colleagues. Our main goal is to introduce readers to functional analysis methods, in particular, time-dependent analysis, for reliability models. By using theory and methods of functional analysis, we discuss a model of a transfer line consisting of a reliable machine, an unreliable machine and a storage buffer with finite, or infinite, capacity. These are described by a group of integro-differential equations with integral boundary conditions, which comprise a special part of the theory of partial differential equations. As we introduce the relevant partial differential equations, we discuss the existence of a unique positive time-dependent solution and asymptotic behavior of that solution as time tends to infinity. Moreover, we discuss asymptotic behavior of some reliability indices.

The book is divided into five chapters.

Chapter 1 deals with the theory of functional analysis with the objective of providing limited, yet adequate, mathematical tools for analysis of most reliability models.

Chapter 2 provides a brief history of reliability theory and formally states the problems that we have chosen to study.

Chapter 3 is devoted to the dynamic analysis of a transfer line consisting of a reliable machine, an unreliable machine, and a storage buffer with finite capacity, which is described by a finite number of partial differential equations with integral boundary conditions.

Chapter 4 introduces a transfer line consisting of a reliable machine, an unreliable machine and a storage buffer with infinite capacity, which is described by an infinite number of partial differential equations with integral boundary conditions.

Chapter 5 explores some further research problems.

The most interesting mathematics in this book is the detailed analysis of spectra of infinite-dimensional tridiagonal matrices, which can be considered as interesting, albeit special, pseudo-differential operators.

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Finally, I wish to express my enormous and sincere appreciation to my family.

Despite my serious effort to catch them all, errors undoubtedly remain. I take full responsibility for these, and will greatly appreciate receiving information concerning any errors that readers notice.

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