

Preface

Reliability theory is originally to investigate the properties of randomness because most failures occur at random times. Maintenance theory is basically how to protect reliability systems from such failures by effective and practical methods. It has been well-known generally in maintenance theory that (a) preventive replacement should not be done when the failure time is exponential, and (b) optimum replacement is nonrandom [1]. This book is written mainly based on our original work for exploding the above-established theory (a) and (b) under reasonable conditions.

I have now already published four monographs *Maintenance Theory of Reliability* [2], *Shock and Damage Models in Reliability Theory* [3], and *Advanced Reliability Models and Maintenance Policies* [4] in which I have surveyed a great part of maintenance policies, using the research results of the author and my colleagues. Most of the three books have been written based on theory of stochastic processes and their mathematical tools. As the elementary text book by which a number of graduate students, researchers, and engineers can learn readily reliability theory, I have published my fourth monograph *Stochastic Processes with Applications to Reliability Theory* [5]. This was written in an easy style on stochastic processes, and all examples are quoted fittingly from reliability and maintenance models. Making good use of such writing experiences, I have now published my fifth monograph *Random Maintenance Policies* in which our recent published papers studied on random maintenance have been collected and new results are added.

The main object of this book is to write down the standard and usual maintenance theory to random maintenance theory: Some typical measures such as reliability, failure rate, and availability are defined at random times, and random age replacement and three kinds of periodic replacements are introduced in Chap. 1. New three kinds of replacement policies such as replacement first, replacement last, and replacement overtime are proposed in Chaps. 2 and 3. In particular, replacement last is a new type of replacement policies and could be expected to be used in some practical fields when a replacement cost after failure is not so high. Optimum inspection and backup policies with random checking times are derived in Chaps. 4 and 5.

Furthermore, another object of this book is (c) to form stochastically random reliability models. Parallel systems with a random number of units are proposed, and their optimization problems are discussed in Chap. 6. Using such random parallel systems, a variety of scheduling problems with random working times are solved in Chap. 7. Finally, four random reliability models are taken up, and their optimum policies are discussed in Chap. 8. In Appendix A, modified and extended types of failure rates appeared in this book are collected, and their properties are investigated theoretically. Unfortunately, there is no concrete examples of random maintenance and random systems at present, however, they would be applied certainly to actual reliability models by individual and collective efforts of practitioners and engineers in near future. In addition, several examples are cited in each chapter, and some problems given at the end of chapters with asterisk would offer a good study of research subjects to graduate students.

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References

1. Barlow RE, Proschan F (1965) Mathematical theory of reliability. Wiley, New York
2. Nakagawa T (2005) Maintenance theory of reliability. Springer, London
3. Nakagawa T (2007) Shock and damage models in reliability theory. Springer, London
4. Nakagawa T (2008) Advanced reliability models and maintenance policies. Springer, London
5. Nakagawa T (2011) Stochastic processes with applications to reliability theory. Springer, London



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