سامية محمد مصطفى

بسم اللّه الرحمن الرحيم

شبكة المعلومات الجامعية

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سامية محمد مصطفى

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جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

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بعض الوثائق

الأصلية تالفة

PROBABILISTIC METHODS OF CALCULATING THE LIFETIME DISTRIBUTION OF THE RELIABILITY FUNCTION FOR SOME REDUNDANT SYSTEMS

DISSERTATION

Submitted In fulfillment of the Ph. D. Degree in Applied Statistics

By

Mohamed Swelam El-Said Hamed

Department of Statistics, Faculty of Commerce, Zagazig University, Benha Branch

Supervisors

PROF. DR. GAMAL SAMY MOKADDIS

Prof. of Mathematical Statistics
Department of Mathematics, Faculty of Science, Ain Shams Univ.
An Active Member of The New York Academy of Science.

PROF. DR. ABD-ELFATAH M. KANDEEL

The Head of the Statistics Department, Faculty of Commerce, Zagazig University, Benha Branch.

PROF. DR. YOSEF SABRY AWAD

Prof. of Statistics, Department of Statistics, Faculty of Commerce, Zagazig Univ.,
Benha Branch

2002

بسم الله الرحمن الرحيم

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﴿إن أريد إلا الإصلاح ما استطعت وما توفيقي إلا بالله
عليه توكلت وإليه أنيب﴾

صدق الله العظيم

آية (٨٨) سورة هود

ACKNOWLEDGEMENT

First, I would like to acknowledge my deepest gratitude and thankfullness to ***Prof. Dr. Gamal Samy Mokaddis,*** Prof. of Mathematical Statistics in the Mathematics Department, Faculty of Science, Ain Shams University, an active member of the New York Academy of Science, for suggesting the topic of the thesis, for his kind supervision and for his valuable help during the preparation of the thesis.

Then, I do thank and appreciate ***Prof. Dr. Abd-Elfatah Mohamed Kandeel,*** The Head of the Statistics Department, Faculty of Commerce, Zagazig University, Benha Branch, for his good manners and too much knowledge that I saw during supervising this thesis. Also for his essential role in Facilitating the necessary procedures.

After that, I wish to express my deepest appreciation and gratitude and thankfulness to ***Prof. Dr. Yosef Sabry Awad,*** Prof. of Statistics in Department of Statistics, Faculty of Commerce, Zagazig University, Benha Branch for his instant encouragement and kind help.

Also, I present my deepest than and appreciation for ***Mr. Mohamed Nagi Osman*** for helping is the grammatical revision for the thesis. And I con't forget thanking and appreciating the excellent working team in ***the scientific center for Kalubia Medical Syndicate*** for helping in printing the thesis.

Finally, I would like also to record my great thanks to all my Colleagues in the Statistics Department, Faculty of Commerce, Zagazig University, Benha Branch, for encouragement and providing the necessary facilities.

CONTENTS

PREFACE

PREFACE

As a result of the development of present technology, a high level for the reliability of systems is required. This thesis studies; the methods of estimating the parameters for some important distributions used in the lifetime distribution of the reliability function for some redundant systems, probabilistic analysis of a reliability functions in life testing for a multivariate case, probabilistic analysis of a two-unit warm standby redundant systems with single – server and probabilistic analysis of two – unit cold standby redundant systems with three types of repair facilities.

The thesis consists of five chapters :

The first chapter presents some basic concepts, definitions and laws for the reliability theory. Five ways of representing the distribution of a continuous nonnegative random variable T are used extensively in the reliability literature; the probability density function, the reliability (survival function), the hazard rate, the cumulative hazard function, and the mean residual life function. Properties, identities and intuitive interpretations of the five representations are discussed, such as normalized mean residual life for studying replacement policies. These five distribution representations have surfaced as tools for representing a lifetime distribution. The choice of which distribution representation is to be used whether, the representation has a tractable form and intuition is gained concerning the distribution by seeing a plot of the representation. Redundant and non – redundant system, loaded or nonloaded and lightly loaded system with and without renewal.

The second chapter presents the methods of estimating the parameters for the Weibull distributions used in redundant systems; the first method deals with the maximum likelihood estimation (MLE) technique for estimating the 2-parameter Weibull distribution from interval data. Interval data consists of adjacent inspection times that surround an unknown failure time. Censored interval – data bound the unknown failure time with only a lower time. By the second method we obtain Bayes estimates of the parameters and reliability function of a 3-parameter Weibull distribution and compare posterior standard – deviation estimates with the corresponding asymptotic standard – deviation estimates of their maximum likelihood counterparts. The third method presents estimation of the parameters from a mixture of two Weibull distributions. The weighted least – squares method is used to estimate the parameters of the mixed model when data are grouped and censored and the fourth method is a graphical estimation of mixed Weibull parameters in life testing. A mixture of two Weibull distributions, each representing sudden type failure (the failure types is sudden or delayed) is proposed and a simple graphical method for estimating the parameters of mixed Weibull distribution is described.

In the third chapter The probabilistic analysis of a *k*-variate normal distribution model as used in life testing context is considered with respect to the estimation problem of the reliability function of a system. In addition, it is pointed out that there exists a close relationship between the problem of estimation of reliability and the construction of Bayesian upper tolerance regions.

In the fourth chapter a single – server and two – unit partially energized standby system is studied under the assumption that the repair times of online unit and standby unit are arbitrarily distributed while the failure time distribution of online unit is Weibull and that of the standby unit is arbitrary. The system is observed at suitable regenerative epochs to obtain the following system characteristics; expected number of repairs in $(0, t]$, expected number of repairs in $(0,t]$ from online and standby and expected frequency of failures in $(0, t]$. Results pertaining to the case when all distributions are Weibull have been obtained. Also, the expressions in terms of Laplace transforms are given when both repair time distributions are two – stage Erlangian and the failure time of the standby is Weibull.

The fifth chapter develops three models for cold standby redundant systems, consisting of two identical units. These models are different in the sense that different types of repairman are employed; in model 1, the repairman is always with the system; in model 2, he comes immediately at the failure of a unit, while in model 3; he takes some random time in reaching the system.

Profit is evaluated in each case. Comparisons of these profits are done in two parts. Part 1 considers the comparison of different models. In part 2 a comparison is done by taking different criteria for evaluating the profit for the same model. Computer programs for these comparisons are also given in the Appendix.

The appendix consists of computer programs for some systems in this dissertation.