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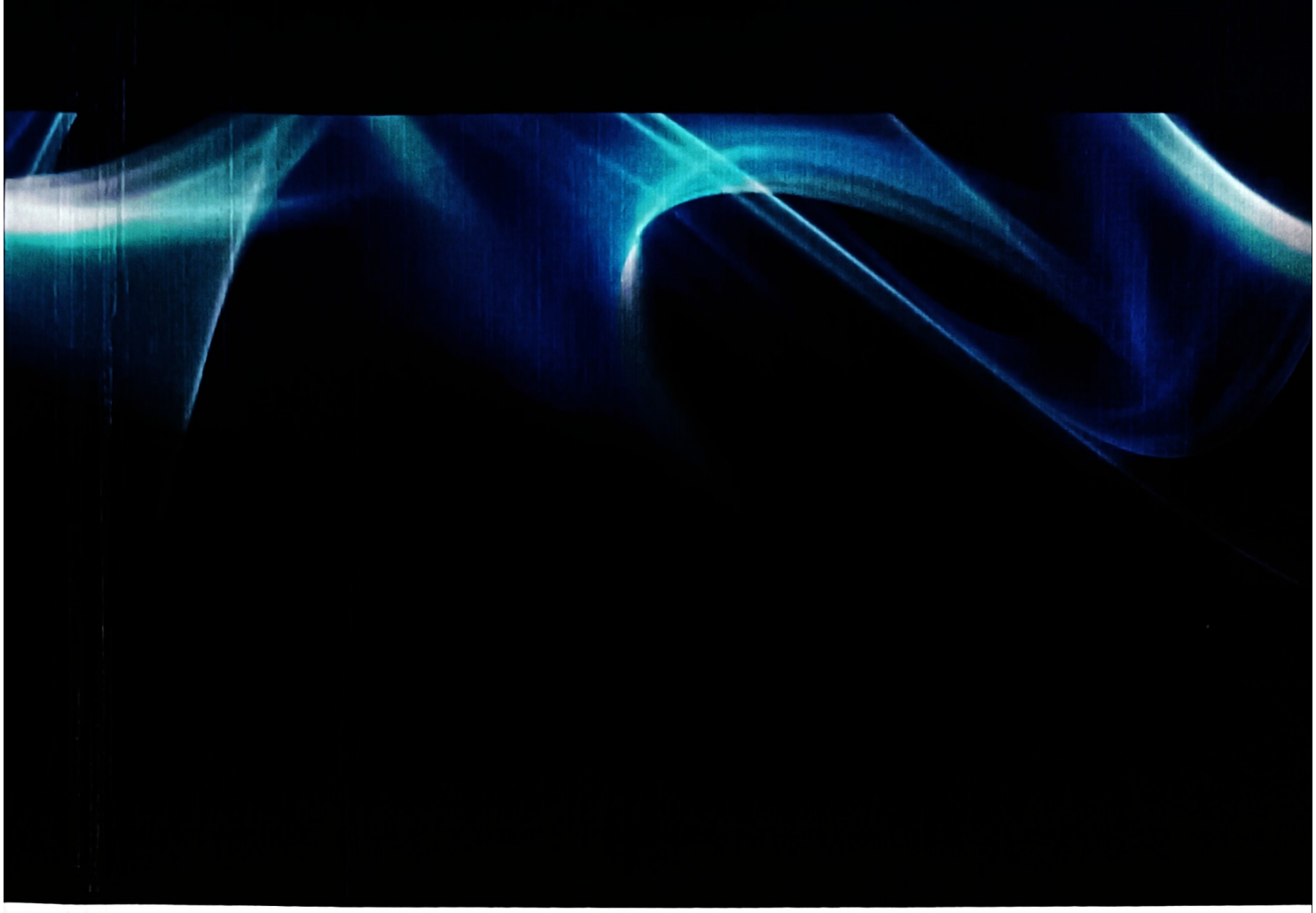

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Nagarjunanagar,

March, 2012. **(J. PRATAPA REDDY)**

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PREFACE

This thesis entitled **"QUALITY CONTROL METHODS AND RELIABILITY ESTIMATION BASED ON INVERSE RAYLEIGH DISTRIBUTION"** submitted for the award of Ph.D in Statistics is carried out by me at the instance of Dr. K. Rosaiah, Professor of Statistics, Acharya Nagarjuna University and is motivated by a desire to study the probability model – Inverse Rayleigh Distribution with reference modeling of data in some live situations in Industry. This is simpler for statistical and mathematical treatment, in view of its analytical expressions.

As the data of quality control and reliability are non negative in nature, probability model of a non negative valued random variable is always desirable and inverse Rayleigh distribution is one such model. We are motivated to model soft failure data, life testing experiment's data, quality control data of variable quality characteristic, by inverse Rayleigh distribution and study the advantages of such modeling. In this context we have made an attempt to investigate probabilistically, the random phenomenon of the situations – number of failures a developed software experienced in a given period of time of testing phase, variable quality measurements of an online production process, sampling inspection plan to decide up on whether or not to accept a produced lot of items on the basis of observed number of failures in a sample from the lot and evaluation of stress-strength reliability in single and multi-component systems with reference to inverse Rayleigh distribution. The findings of our research study are presented in various charters of this thesis.

Chapter-I is of general introduction in nature along with a survey of relevant literature and the problems traced for our study. In Chapter-II we use inverse Rayleigh distribution to develop ML and Modified ML estimation, reliability estimation and reliability study. Chapter-III contains the application of inverse

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Rayleigh distribution in constructing variable control charts useful in statistical quality control along with Analysis of Means (ANOM). In Chapter-IV inverse Rayleigh distribution is used as life time variate to develop variable sampling plans using sample on lifetime data. In Chapter-V – the last chapter, the stress-strength reliability estimation in single component as well as multi-component systems where stress, strength variates are assumed to follow inverse Rayleigh distribution is presented.

The numerical tables computed along with the listings of the computer programs are presented towards the end of respective chapters. The lists of references arranged alphabetically are provided towards the end of the thesis. Reprints of publications out of this research study are appended towards the end of this thesis.

Nagarjunanagar,

March, 2012.

(J. PRATAPA REDDY)

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CHAPTER – 1

GENERAL INTRODUCTION AND SURVEY OF LITERATURE

1.1 Introduction

In reliability and survival studies, many life distributions are characterized by monotonic failure rate. Trayer (1964) introduced the inverse Rayleigh distribution. The probability density function (pdf) and cumulative distribution function (cdf) of standard inverse Rayleigh distribution (IRD), respectively, are given by

$$f(z)=\frac{2}{z^3}\exp(-\frac{1}{z^2}), \qquad z>0 \qquad (1.1.1)$$

$$=0 \quad , \qquad z\le 0$$

$$F(z)=\exp(-\frac{1}{z^2}), \qquad z>0 \qquad (1.1.2)$$

$$=0 \quad , \qquad z\le 0$$

If a scale parameter $\sigma>0$ is introduced, the pdf and cdf of inverse Rayleigh distribution are respectively, given by

$$f(t;\sigma)=\frac{2\sigma^2}{t^3}\exp(-\sigma^2/t^2), \qquad t>0,\ \sigma>0 \qquad (1.1.3)$$

$$=0 \quad , \qquad t\le 0$$

$$F(t;\sigma)=\exp(-\sigma^2/t^2), \qquad t>0,\ \sigma>0 \qquad (1.1.4)$$

$$=0 \quad , \qquad t\le 0$$

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The findings of our research study are presented in the form of this book, which are summarized in five chapters. Chapter-1 is of general introduction along with survey of literature on inverse Rayleigh distribution and related distributions. In Chapter-2, ML and Modified ML estimation and reliability estimation of inverse Rayleigh distribution are discussed. In Chapter-3, we constructed the variable control charts along with Analysis of Means (ANOM) for inverse Rayleigh distribution. In Chapter-4, we developed variable sampling plans based on inverse Rayleigh distribution and also illustrated the method using lifetime data. In Chapter-5, we have presented the estimation of stress-strength reliability in single component as well as multi-component systems, where the stress, strength variates are assumed to follow inverse Rayleigh distribution. The numerical tables computed along with the listings of the computer programs are presented towards the end of respective chapters. The references are appended alphabetically at the end of this book.

Prof.K.Rosaiah has completed M.Sc. Statistics in 1982 and got Ph.D. in Statistics in 1990 from Acharya Nagarjuna University, Guntur, India. Joined as Lecturer in the Department of Statistics, Acharya Nagarjuna University in 1985 and promoted as Professor in 2002. Published 64 research articles and also published one text book.

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