“BAYESIAN AND SHRINKAGE ESTIMATION OF PARAMETERS OF DISTRIBUTIONS HAVING MONOTONE FAILURE RATES”

SUMMARY

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The present age of techno-scientific development touching upon almost the whole gamut of human activity has brought with it problems unknown or not cognized previously in full measure. One of the consequences of rapid industrialization and automation has been the multiplication of similar industries and the resulting flooding of products, sometimes, disproportionate to the market demands. Hence, the producer has in a way, perforce, constrained to compete in a buyer’s market. Besides, the rise in the level of education, formal and informal, has enabled the buyer to evaluate the alternatives available in the market to satisfy his needs. Hence, it has become imperative on the part of the producers to market those products which would appeal to the quality consciousness of the consumer. The producer could, no doubt, ensure quality through an internal process of quality control. When a unit is marketed, it is expected to provide its utility to the user for a specified period of time. A consumer regards the product reliable, only if it gives him the utility for at least a specific length of time. The concept of life-time became, therefore, a core topic in any production process and consequently, a lot of mathematical theories were woven around it.

Out of the studies of life times of the products, the theory of reliability emerged as a new discipline. The theory of reliability, in its earlier days, was mainly concerned with problems in engineering and medical fields, but now it has shown wider applications in other fields, where survival is studied. For example, the reliability concepts have made
inroads into the realms of biology, actuarial science, economics, business, and criminology. In its infancy, only the actuarial methods were employed for the revealed that the failure of units occurs in a random manner and a number of probability distributions were explored fit in real-life situations. The introduction of probabilistic models changed the entire concepts of reliability evaluation. The statistical reliability inference as a purposeful tool in assessing the performance of equipments or functional systems emerged in the mid years of the current century. The fundamental work of Epstein and Sobel laid down the foundation stone of the classical reliability inference and subsequently a good deal of work was done in this field. The application of Bayesian methods remained more or less neglected till 1967, when Bhattacharya took a lead in this direction. His work gave a further fillip to the research work in the field of reliability and the field continues to develop. In the meantime, nonparametric methods and empirical Bayes approaches were also developed in a big way in solving reliability estimation problems the main objective of the present thesis is to explore Bayesian and Robust Bayesian methods for analyzing various lifetime probability models.

Chapter 1 of the thesis discusses basic concepts and importance of reliability analysis. A review of literature on classical and Bayesian procedures for reliability analysis has been presented. The basic elements of Bayesian inference/decision theory and special functions have been discussed. Various lifetime models analysed in subsequent chapters and their properties have been presented. The chapter ends with an outline of the work done in the thesis.
Chapter II focuses on the Bayesian analysis of skewed Laplace and truncated skewed Laplace distributions. The posterior distributions of parameters have been derived under appropriate prior assumptions for both the parameters. For skewed Laplace distribution, the Bayes estimators for the parameters of the model have been obtained when observations are iid. However, for reliability/life testing data sets, the TSL distribution seems more appropriate. Considering For type I censoring scheme for TSL distribution, we derive the Bayes estimators for the parameters of the model, failure rate and reliability function under squared error loss function and LINEX loss function.

The main objective of chapter III is to carry out the Bayesian analysis of exponentially exponentiated truncated Poisson (EETP) distribution. The posterior distributions for the parameter of the model have been derived using appropriate prior assumptions under (i) complete set of observations (ii) Type I censoring. The Bayes estimators of mean life, reliability function and the failure rate have been derived under the squared error loss function and LINEX loss function.

Chapter IV considers the Bayesian analysis of Exponential logarithmic lifetime distribution proposed by Tahmasbi and Rezaei (2008) under appropriate prior assumptions. Find out the likelihood function of the EL distribution. analyze posterior analysis of EL distribution. The Bayes estimators of various parameters and reliability function have been derived under squared error and LINEX loss functions. The posterior analysis of EL distribution using under type I censoring has been carried out appropriate prior distribution. The Bayes estimator of various
parameters and reliability function have been derived under squared error loss function and LINEX loss function.

Chapter V comprises the Robust Bayesian analysis of Kumarswami distribution with type II censored data under the assumption of -contamination class of prior distributions for the mean life. The ML-II posterior distribution for the parameters the model has been derived. Under the squared error loss function and LINEX loss function, the Bayes estimators of mean life, the reliability function and the failure rate have been derive. For obtaining the posterior distribution and Bayes estimators, when both the parameters are unknown a Markov chain Monte Carlo algorithm has been given. The results of a simulation experiments have been prestated.