INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

Name of the Student	:	Shilpi Biswas
Roll Number	:	196123009
Programme of Study	:	Ph.D.
Thesis Title	:	Statistical Analysis of Load-sharing Systems
Name of Thesis Supervisor(s)	:	Dr. Ayon Ganguly
Thesis Submitted to the Academic Division	:	Mathematics
Date of completion of Thesis Viva-Voce Exam	:	29/10/2025
Key words for description of Thesis Work	:	Load-sharing, Bayesian, Frailty, Component Lifetimes, EM algorithm, Bootstrap, Confidence interval, WAIC, MTTF, MRT, RMT

SHORT ABSTRACT

Many real-life systems are made up of several components that work together in different ways. When one component fails, the remaining components usually have to carry an extra load, which changes their lifetime behavior. Such systems are known as load-sharing systems. Analyzing these systems is difficult because of the complex dependence between components and the change in their failure rates after one fails. This thesis deals with three problems related to the analysis of load-sharing systems. Chapter 1 introduces the basic definitions, background, and motivation of the study. It also describes three datasets and presents a detailed review of the related literature. In Chapter 2, a Bayesian estimation framework is developed for the Generalized Freund Bivariate (GFB) distribution to study the reliability of a two-component load-sharing system. Independent gamma priors are used, and Markov Chain Monte Carlo (MCMC) methods are applied for posterior analysis. Simulation studies and the analysis of two real datasets - a two-motor system and a nuclear power plant show that the proposed method performs well. Chapter 3 introduces a doubly flexible GFB–GG model, where the GFB distribution is used as the baseline and the generalized gamma (GG) family represents the shared frailty between components. This model provides a flexible way to analyze two-component load-sharing data and shows better fitting performance than existing models. Important reliability measures such as reliability at mission time (RMT), mean time to failure (MTTF), and mean residual time (MRT) are also estimated. The effectiveness of the model is demonstrated using simulation studies and a real dataset. In Chapter 4, a flexible and data-driven model is proposed by approximating the cumulative hazard functions of component lifetimes using piecewise linear functions. This model does not depend on restrictive parametric assumptions. Estimation procedures for model parameters and reliability measures are discussed in detail. The performance of the model is evaluated through simulation and analyses of two real datasets - the two-motor system and a three-player basketball data. Finally, Chapter 5 concludes the thesis and highlights some possible directions for future research.