

Abstract

In practice, we use different kinds of systems that are structurally equivalent to various well-established systems available in the literature, namely, ordinary coherent systems, ordinary r -out-of- n systems, sequential r -out-of- n systems, fixed weighted coherent systems, fixed weighted r -out-of- n systems, random weighted coherent systems, random weighted r -out-of- n systems, etc. In this thesis, we study different reliability aspects of these systems under various scenarios.

In most real-life scenarios, the components of a system work in the same environment and share the same load. As a consequence, there may exist two different types of dependencies between the components of a system, namely, interdependency and failure dependency. The interdependency structure between the components of a system is usually modeled by a copula. The family of Archimedean copulas is commonly used to serve this purpose as it describes a wide spectrum of dependence structures. On the other hand, the failure dependency for a system means that the failure of one component has an effect on the lifetimes of the remaining components of the system. This failure dependency is often modeled by assuming distributional changes in the lifetimes of the remaining components, upon each failure, of the system. The sequential order statistics (SOS) and the developed sequential order statistics (DSOS) are two models that are commonly used to describe the failure dependency of a system. There is a one-to-one relationship between order statistics and the lifetimes of systems. For example, the lifetime of an ordinary r -out-of- n system is the same as the $(n - r + 1)$ -th order statistic of the lifetimes of the components of the system. Similar relationships exist for SOS and DSOS. Thus, the study of order statistics is the same as the study of the lifetimes of systems. In this thesis, we study various ordering and ageing properties of ordinary r -out-of- n systems formed by dependent and identically distributed components, where the dependence structure is described by an Archimedean copula. Further, we study the ordering properties of the developed sequential order statistics (DSOS) with the dependence structure described by the Archimedean copula. Similar to the DSOS model, we introduce the notion of developed generalized order statistics (DGOS) which is an extended generalized order statistics (GOS) model formed by dependent random variables. This model contains all existing models of ordered random variables. We study various univariate and multivariate ordering properties of the DGOS model governed by the Archimedean copula. Further, we consider the SOS model with non-identical components and study several univariate and multivariate stochastic comparison results.

The basic structures of many real-life systems match with random weighted coherent systems. The performance of a random weighted coherent system is usually measured by its total capacity. However, the major drawback of this measure is that it does not take into account the structure of a system. To overcome this drawback, we introduce a new structure-based performance measure, namely, the survival capacity. Based on this measure, we define three survival mechanisms (namely, Types-I, II and III) for random weighted coherent systems. We develop a methodology to evaluate the reliability of a random weighted coherent system, and provide a signature-based reliability representation for this system. Further, we study different reliability importance measures for the components of a random weighted coherent system. We study the optimal allocation strategy of active redundancies and the optimal assembly method of random weights in a random weighted coherent system. By developing the results for random weighted coherent systems, we generalize many well-established results available for ordinary coherent systems and weighted coherent systems in the literature.