Abstract

Frailty models in survival analysis help to assess the effect of unknown heterogeneity on the hazard function or survival time in an individual or group of individuals. These models may be univariate, multivariate, shared or correlated. The distributions of random vectors which represents lifetimes of individuals or components are defined with the help of multivariate frailty models. Comparison of these vectors are carried out with the help of various stochastic orders. Our aim here is to obtain sufficient conditions for usual stochastic order to hold between two multivariate shared reversed frailty models and also between their corresponding vectors of inactivity times. Next, we consider two random vectors where lifetimes are represented by a generalized multivariate reversed frailty mixture model and give conditions for stochastic order, likelihood ratio order and weak reversed hazard rate order to hold among them. The study is also extended to derive an alternate condition for weak reversed hazard rate ordering. For a particular case where the distribution function is represented in terms of copula, we gave conditions for stochastic order and lower orthant order to hold among lifetime vectors.

Information Theory is a branch of applied mathematics which deals with the problems like processing, storage, retrieval, utilization and decision-making of information. Shannon entropy was first introduced to quantify information. Various generalizations of Shannon entropy like Renyi entropy, Varma entropy, Tsallis entropy etc. have been proposed for more flexibility purposes. We contributed to this area by defining weighted versions of residual and past Varma entropy and studying their characterization results, monotonicity behaviour, defining a new partial order based on the notion of uncertainty i.e. weighted Varma entropies. We also discussed some of the properties of dynamic cumulative past Tsallis entropy and its weighted version defined recently in the literature. The intuition of uncertainty reduction on reduction of interval is not true in general. Researchers have derived necessary and sufficient conditions under which this proposition is true. In this regard, we considered two measures-conditional cumulative past entropy and convolution of extropy and derived the conditions for the uncertainty reduction in an interval. Extropy is an alternative measure of uncertainty and the complimentary dual of entropy. Both share similar mathematical properties but extropy has some conceptual superiority in certain situations. We proposed weighted extropy, weighed residual extropy and studied their monotone properties, bounds and characterization results for the order statistics and k-record values. We also carried out these studies for past extropy (defined in the literature).

Keywords: Multivariate reversed frailty models; Stochastic comparisons; Order statistics; k-record values; Uncertainty; Entropy; Extropy; Varma entropy; Weighted distributions; Weighted entropy; Weighted extropy; Partial monotonicity.