Concepts of Reliability Theory and Their Relationship with the Economic Inequality indicators

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Extended Abstract

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Introduction

One of the intersecting aspects of the reliability theory and economics is investigating non-negative data generally skewed (lifetimes and income), extrapolation of a suitable model for the data and finding their characteristics.

The concepts of inequality measures play an important role in economic, social sciences and the other areas. In recent years, various inequality curves have been developed or investigated as the descriptors of income inequality. The Lorenz curve is a strong tool extensively used in economics to consider the inequality of income distributions and wealth. It is the graphical display of wealth distribution created by the American economist, Max Lorenz, in 1905. It plots the percentage of the total income obtained by various portions of the population when the population is ordered by the size of its income. Several alternative inequality curves have been proposed in the literature. The alternative inequality curves are considered as competitors of the classical Lorenz curve as descriptors of income inequality. The Bonferroni curve and the Zenga-2007 curve appear to be essentially the function of the Lorenz curve.

Reliability is a broad concept. It is applied whenever we expect something to behave in a certain way. It is one of the metrics that are used to measure quality. The notion of reliability, in the statistical sense, is the probability that an equipment or unit will perform the required function under the conditions specified for its operations for a given period of time. The primary concern in reliability theory is to understand the patterns in which failures occur, for different mechanisms and under varying operating environments, as a function of its age. This is accomplished by identifying the probability distribution of the lifetime represented by a non-negative random variable. Accordingly, several concepts have been developed that help in evaluating the effect of age, based on the distribution function of the lifetime random variable and the residual life X. Concepts of aging describe how a component or a system improves or deteriorates with age; and they are very serious in the reliability analysis. In reliability, several aging classes of life distributions have been presented to explain the various forms of aging.

Different order relations have been developed using measures in connection with many fields such as reliability, economics, queuing theory, survival analysis, insurance, operations research, etc.

Material and methods

In this paper, we provide a brief review of the widely used income inequality measures, their inter relationships and their properties and we discuss on basic reliability concepts such as hazard rate, mean residual life, reversed hazard rate and reversed mean residual life in distribution function frame work.

The main aim of this paper is finding the relationship between the indices of economic inequality and reliability theory. For example, Zenga curve shall be interpreted as the difference in average age of components which has survived beyond age X from those which has failed before attaining age X, expressed in terms of average age of components exceeding age X. Therefore, we present some of the important results about the relationship between aging concepts and several important theorems have been proved in this subject that actually are novelty of the paper. We also present some characterizations of the reliability concept by using the Lorenz curve. In this article, first, the relationship between inequality indices and reliability indices which have a very close relationship are discussed. In fact, proofing of several propositions to express these connections is the main novelty of this article. In addition, some of the ageing concepts can be expressed through inequality indices. Finally, to gain better understanding of the basic idea the Iranian income and expenditure data between the years 1388 to 1393 are numerically studied.

Results and discussion

In the present work, we have examined the connection between the other existing inequality measures, the relationship of the concepts of inequality indices with certain reliability concepts are exploited to obtain characterization results for probability distributions. Further some results on a stochastic order using inequality curves are also established. Finally some numerical results were given in order to indicate the usefulness. There are many reasons to study the relationship between the reliability concepts and the inequality measures. For example, the study of the relationship between inequality indices and measurement standards of reliability makes it possible to use each of these two concepts for studying the other one. We are able to set some other criteria for exponentiation based on the Lorenz curve and Gini index. Also, we can obtain some new properties for the Lorenz curve, the Gini index, and the other inequality indices. Moreover, we are able to indicate that the Lorenz curve can be expended to create a variant explanation of lifetime data and vice versa and, as well, to determine the bound of the class of lifetime distributions in terms of its Lorenz curve and the other index inequalities.

Conclusion

The following conclusions were drawn from this research.

- The bound of the class of lifetime distributions are determined in terms of its Lorenz curve and the other index inequalities.
- Some interesting relationships that exist between commonly used notions in reliability theory and economic theory and reliability.
- Some new properties for income inequality are obtained.

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