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Mixture of Pathway Weibull Model and Mellin Convolutions

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Abstract: The efficiency of the pathway idea in modeling heterogeneous real-life data is illustrated in this paper. Usually mixture models are used for modeling heterogeneous data. Here we introduce a finite mixture of two pathway Weibull models, denoted by WM_q (or $_qWM$ or W_qM). Properties of this new model are examined and identifiability is proved. Some important special cases of WM_q are given. Stress-strength reliability is found by using the Mellin convolution technique. With the help of a real heterogeneous data set, it is shown that the proposed model fits the data better than all other popular models in the literature.

Keywords: Pathway Weibull model; Fox H-function; mellin convolution; finite mixture distribution.

AMS Subject Classification : 03H05, 33C60, 60E99, 60E05.

1- Introduction :

Mixed failure populations are commonly encountered in life testing, reliability and quality control problems. A mixture model is a compounding of statistical distributions, which arise when sampling is done from heterogeneous populations with a different probability density function in each component. It has been considered for long-time as a flexible and powerful statistical modeling technique, especially to account for unobserved heterogeneity. Applications of mixture models are common in physics, biology, medicine, economics, finance and insurance among others. These models provide a framework not only for heterogeneous population but also a rationale for some thick-tailed distributions.

Mixture models received considerable attention in the area of survival analysis and reliability. In many real-life applications, the use of mixture models becomes inevitable when the data are not available for each component of the mixture rather for the overall mixture as described in Everitt and Hand (1981). In life-testing and reliability estimation problems, the underlying failure time distribution need not be homogeneous but can be a mixture of several distinct lifetime distributions. Each of these distinct lifetime distributions can represent a different type of cause of failure for the population. For instance, we assume that the survival function of treated cancer patients is a mixture of two sub populations; one which die due to their disease with a given proportion and