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Fuzzy Real Numbers and Its Applications of Fuzzy Structure

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Abstract

We establish computational method to assess the membership degree of any given Bayes point estimate of reliability identity. We discuss the role of Bayesian method for the fuzzy parameters i.e., fuzzy random variables through fuzzy prior distributions. The Bayesian estimation methods are applied to create the fuzzy Bayes point estimator of testing reliability of transportation system by a suitable technique known as 'Resolution Identity' in fuzzy sets theory. The classical problems into a nonlinear programming and classified into some significant case.

Keywords: Fuzzy Set, Fuzzy Parameters, Membership Function, Resolution Identity, Transportation system

1. Introduction

The fuzzy set theory provides a suitable tool in modeling the imprecise models in view of its mexactness for assigning. In the survival probability an exact real number. The survival probability is regarded as a fuzzy real number, when the number of failures and duration are not recorded or measured precisely due to the human faults or some unexpected situations. we investigate the technique fuzzy Bayesian of consistency analysis. Martz and Waller presented methodology for selecting the appropriate Beta prior distribution and Gamma prior distribution.

The concept of fuzzy random variable for include to determine the fuzzy Bayes point estimator. 'Resolution Identity' in fuzzy sets theory. we discuss here the fuzzy Bayes point estimators for survival probability, failure rate and reliability of an item. The generalized method for suitable application of the fuzzy sets theory to Bayesian reliability analysis in transpiration system is developed structure on fuzzy reliability analysis mathematically. Let X be a general set and A be a subset of X: let us define a characteristic function XA : X →{0; 1} with respect to A by

$$X_A(a) = \begin{cases} 1 & if\, a \in A \\ 0 & if\, a \notin A \end{cases} \qquad \ldots(1.1)$$

2. Concept of membership function

Zadeh presented the concept of fuzzy subset $\tilde{A}$ of X by extending the distinctive function. A fuzzy subset $\tilde{A}$ of X is defined by its membership function $\xi_{\tilde{A}}: X \to [0,1]$which is considered as an delay of characteristic function. The value $\xi_{\tilde{A}}(a)$might be interpreted as the membership degree of a point a in the set A: It is imposed upon the membership function and such case the fuzzy set is then termed as a fuzzy real number. The fuzzy real number $\tilde{a}$ corresponding to a interpreted as 'around a'. The membership function $\xi_{\tilde{a}}(x)$= 0 and $\xi_{\tilde{a}}(a) = 1$. Hence, the membership degree $\xi_{\tilde{a}}(x)$is close to 1 when x is close to a:

(i) Fuzzy real number

The traditional consistency of a system is characterized in terms of probability measures. We customize the membership function to model their extent of fuzziness. The membership degree considered by the membership function indicates a subjective viewpoint of preference of a decision maker within a given tolerance. It is not always be sure of the exact functioning probability owing to incomplete information. we identify that the functioning probability is approximately equal to p: the phrase 'approximately equal to p' is modelled as a fuzzy real number with membership function which indicates a subjective degree of belief or experience.

(ii) Interval of confidence

Let $\tilde{a}$ be a fuzzy subset of R: The α-level of $\tilde{a}$; for α∈ [0, 1], is defined by $\tilde{\alpha}_\alpha$ = { x∈R : $\xi_{\tilde{a}}(x)$≥α}. In case subset $\tilde{a}$ is termed as a fuzzy real number, its-level set $\tilde{a}$ become a closed interval. Cheng and Mon derived methods by using the α-level sets of fuzzy real numbers, known as interval of confidence. We modify the notion of confidence interval as follows. We derive the a-level set for a arranged value α∈ [0, 1]. Chen and Chowdhury derived the membership for any given system reliability. Chen considered structure of three-sided fuzzy real numbers by using 'Extension Principle' proposed by Zadeh. we derive solution of the nonlinear programming problems expressed in term of the 'Resolution Identity' theorem in fuzzy set theory which extend L. Zadelis extension Principle.

3. Possibility Measures vrs Fuzzy Measures

We discuss here fundamental concepts of traditional fuzzy reliability in transportat6ion system.

(i) (Binary state assumption)
(ii) (Probability assumption): It is characterized in the context of probability measures.

However, the probability statement are of important use if and only if the following premises are taken into account.

(a) The event in an experiment is definite or occurred precisely;
(b) A large amount of collected data is characterized using the law of large numbers theoretically)
(c) Probabilistic repetitions constitute the basic frame for the collected data when the event behavior is observed.

The notion of possibility measures was studied by Dubois and Zadeh. The so-called possibility measures are considered and later on modified by Dubois and Prade Zadeh discussed. Possibility measures are extended to fuzzy situations to established reliability of transpiration system.

4. Non fuzzy membership function

Let us assume that a system has n (non-fuzzy) states U = {s1, s2,…, sn}. The fuzzy success state $\tilde{S}$is well-defined as a fuzzy subset of U with membership function given by $\xi_{\tilde{S}}(s_i)$ for i = 1, 2,…, n, denoted as $\tilde{F} = \left\{\left(s_i, \xi_{\tilde{F}}(s_i)\right) : i = 1, 2, \ldots, n, \right\}$. The fuzzy failure state $\tilde{F}$is clear as a fuzzy subset of U with membership function given by $\left(\xi_{\tilde{F}}(s_i)\right) for i = 1, 2, \ldots, n.$ denoted as $\tilde{F} = \left\{\left(s_i, \xi_{\tilde{F}}(s_i)\right) : i = 1, 2, \ldots, n, \right\}$. For the continuous case, let us assume that U = {x : α≤ x ≤ b}: The fuzzy success state $\tilde{S}$ is defined as a fuzzy subset of U with membership function $\xi_{\tilde{S}}(s_i)$ for α≤ x ≤ b, denoted as $\tilde{S} = \left\{\left(x, \xi_{\tilde{F}}(x)\right) : \alpha \leq x \leq b, \right\}$ The fuzzy failure state $\tilde{F}$ is defined as a fuzzy subset of U with membership function $\xi_{\tilde{F}}(x) for \alpha \leq x \leq b$, denoted as $\tilde{F} = \left\{\left(x, \xi_{\tilde{F}}(x)\right) : \alpha \leq x \leq b, \right\}$.The following two assumptions considered by Zadch and Wen.

(i) (Fuzzy state assumption): It is understood that system failure and success are not exactly defined in a reasonable way. Hence, only fuzzy success state or in fuzzy failure state are considered instead of binary state assumptions.

(ii) (Possibility assumption): The system performance is fully characterized in the context of possibility measures.

5. Demerits of Binary state of computer application

The demerits of binary state assumption in a computer system that consists of three independent processing units are functioning simultaneously but when all three processing units are unsuccessful completely. However, when just one or two processing units failed, the system operate in a degraded situation. It means the system is neither fully functioning or fully failed, but in some intermediate states. This implies that the binary state assumption for describing system failure and success may be no longer appropriate. Consequently, it is important earlier assumption for system failure by fuzzy system to illustrate them in terms of the fuzzy sets.

6. Merits of possibility measure in reliability under fuzzy assumptions

Cai and Wen studied the fuzzy success state and fuzzy failure state in which a transition between two fuzzy states are regarded as a fuzzy event. They discussed a comparison between two additional policies, i.e. the block additional policy under a nonfuzzy environment and the periodic replacement policy without reparation at failures under a fuzzy environment. They found that the fuzzy system reliability is based on the binary state assumption and possibility assumption. However, the fuzzy system reliability is based on the three-state assumption and possibility assumption. According to Utkin the fuzzy system reliability was developed on the basis of fuzzy state assumption and probability assumption both. We study here the system reliability for coherent system based on the fuzzy state assumption and probability assumption instead of fuzzy system reliability based on the binary state assumption based on availability.

(i) A fuzzy convenience is a possibility that the system is in functioning state at time t; and a fuzzy unavailability is a possibility that the system is in repair at time t: The fuzzy accessibility and unavailability are characterized by possibility distribution functions.
(ii) A fuzzy operative availability is a possibility that the system is in functioning state at time t and continues to function short of failures during a fuzzy time interval [t, t + $\tilde{s}$]. where $\tilde{s}$ is a fuzzy real number. A fuzzy operative unavailability is a possibility that the system is in repair at time t and continues to be under repair during a fuzzy time interval [t, t + $\tilde{s}$]. Fuzzy operative availability and unavailability are considered as possibility distribution functions.
(iii) Fault tree analysis and Trapezoidal Fuzzy system. Fault tree is additional method to evaluate the probability of an accident that is resulting from sequences of faults and failure events. The fault tree is useful for understanding the mode of occurrence of a chance logically. Hence, given the failure probabilities of system components, the probability of the top event may be considered. The simple way for formulating a reliability problem is to use the standard Boolean operators AND, OR and NEG. All logical functions are expressed in terms of these elementary operators. It is identified that the two operators OR and NEG, or AND and NEG are sufficient by using the De Morgan's rule of inference.

In conventional fault tree analysis, the failure probabilities of system components are treated as exact values. However, for many systems. It is hard to estimate the precise failure rates or probabilities of individual components or failure events in the quantitative analysis of fault trees from the past occurrences. It happens under a dynamically changing environment or in systems where available data are incomplete or insufficient for statistical inferences. Therefore, in the absence of exact data, it may be necessary to work with rough estimations of probabilities. Under these conditions to use the conventional fault tree analysis for computing the system failure probability is most appropriate to advance a formalism to include the subjectivity and the imprecision of failure data for use in the fault tree analysis in view of the probability of failure, the exact probability values of components are categorized by fuzzy real numbers.

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