



Some properties of fuzzy alternating renewal processes

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ABSTRACT

By letting on times and off times be unrelated convex fuzzy variables, an alternating renewal process only with fuzziness is established. Using the α -pessimistic value and the α -optimistic value of fuzzy variables, the asymptotic behaviors of on time per unit time and off time per unit time are given.

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1. Introduction

The alternating renewal process is one of the renewal processes in renewal theory. It is widely used in inventory systems and queueing systems. In classical alternating renewal processes, one of the assumptions is that the on times and off times are independent random variables.

The notion of a fuzzy set was introduced by Zadeh [1] who defined it as a generalized characteristic function. Recently, fuzzy sets theory has been widely developed and used to renewal processes. Popova and Wu [2] studied renewal reward processes with random interarrival times and fuzzy rewards. The concept of fuzzy random variables provided by Kwakernaak [3,4] and Puri and Ralescu [5] is a particular fuzzy set. Hwang [6] considered a renewal reward process with fuzzy rewards and interarrival times in the fuzzy sense by using a metric and proved a proposition which showed that the long run average fuzzy reward with interarrival times in the fuzzy sense was just the expected reward earned during a cycle divided by the expected length of the cycle in the fuzzy sense. Based on the relationship between the interarrival times and renewal number, Zhao and Liu [7] studied a renewal process with fuzzy interarrival times and rewards. They provided an elementary renewal theory in the fuzzy sense. Wang [8,9] et al. discussed fuzzy random renewal process and renewal reward process under hybrid uncertainty of fuzziness and randomness and applied them to queueing system. In the above mentioned papers, only one state (interarrival times) was taken into account in the renewal process and renewal reward process.

Using random fuzzy theory introduced by Liu and Liu [10], Shen et al. [11] established an alternating renewal process with two states: on times and off times. They provided a theorem on the limit value of the average chance of a given random fuzzy event in terms of system being on at time t by letting on times and off times be random fuzzy variables. As another extension of classical alternating renewal processes, an alternating renewal processes only with fuzziness is established in this paper by characterizing the on times and off times as unrelated convex fuzzy variables. Furthermore, using the α -pessimistic value and the α -optimistic value of fuzzy variables, the limits of the average on time per unit time and the average off time per unit time are given.

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