The interaction between fuzzy variables and random variables

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Abstract

There are two important sources of uncertainty: randomness and fuzziness. Randomness models the stochastic variability of all possible outcomes of a situation, and fuzziness relates to the unsharp boundaries of the parameters of the model. Clearly, randomness and fuzziness are complementary and so a natural question is how fuzzy variables could interact with type of random variables. This article focuses on one important dimension of this issue: fuzzy random variables (FRVs).

Keywords: Probability Theory, Possibility Theory, Fuzzy Random Variables (FRVs)

1. Introduction

Probability theory is used for prediction of the result of a random event in future, an event which is going to happen in the future and its result is unknown at the moment. Therefore, probability theory is related to random events, whereas fuzzy theory is related to unsharpness and unsharp concepts which are dealt with in daily life and it is not always related to an event. So, fuzzy theory supports random uncertainty. Therefore, there is an important question: where is the boundary between random uncertainty and fuzzy uncertainty? In some cases, uncertainty includes both probable and fuzzy uncertainty. For example, consider this sentence: "tomorrow, the weather will be a little bit rainy."

In this sentence, the phrase "a little bit" can be attributed to unsharpness, and in continue, it predicts the "probability" of the chance of occurrence of the mentioned situation. Also, the phrase "high probability" is unsharp, so it has a fuzzy concept, because it is not obvious that "high probability" includes what extent of probability. Therefore, there are many cases in which probable and fuzzy concepts and both of them enter into the model. So, the combination of these two concepts in modeling and analyzing natural phenomena is a very popular research area in science. According to the above statements, we can say:

$$
\text{Natural phenomena}
\begin{cases}
\text{Certain} \\
\text{Uncertain}
\begin{cases}
\text{Random} \\
\text{Fuzzy} \\
\text{Random and fuzzy}
\end{cases}
\end{cases}
$$