



# Bimodal Information Clustering Methods

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**Abstract.** A large variety of clustering methods exist including the deterministic, probabilistic and fuzzy clustering methods. However, these methods are devoted to handling different types of uncertainty. No works exist on clustering taking into account a confluence of probabilistic and fuzzy information termed as a bimodal information. Indeed, real-world information is characterized by partial reliability of sources, uncertainty, incompleteness and imprecision of data.

In such cases, reliability of extracted knowledge is an important issue to be studied. Prof. Zadeh introduced the concept of Z-number,  $Z = (A, B)$ , to formalize reliability of information under combination of fuzzy and probabilistic uncertainties. The first component, A, is a fuzzy restriction on the values of a random variable, X. The second component, B, is a fuzzy-valued measure of reliability of A.

In this study we suggest an approach to Z-number valued clustering of large data sets to describe reliability of data-driven knowledge. The clustering problem is formulated in terms of bimodal distribution. An objective function that compounds fuzzy clustering and probabilistic clustering criteria is used. A differential evolution optimization based method is used for solution of the formulated clustering problem.

A numerical example of Z-valued clustering of two-dimensional data is considered to compute reliability of knowledge extracted. The obtain results confirm validity of the proposed method.