

Aggregations of Associated Statistics in Interactive MADM under p,q -Rung Orthopair Fuzzy Information

Irakly Parshutkini

irakly.parshutkin@tsu.ge

Faculty of Exact and Natural Sciences

Department of Computer Sciences

Applied Informatics

Ivane Javakhishvili Tbilisi State University

In order to systematize statistical analysis in Interactive multi-attribute decision making (MADM) models, the concept of “Monotone expectation” is considered for the expansion of classical statistics in the p,q -rung orthopair fuzzy (p,q -ROF) environment, concretely, the probability mean (expectation), variance, covariance, and correlation coefficient. In the classical view, the operations of subtraction and division are not defined in p,q -ROF values. The operations of pseudo-subtraction and pseudo-division are introduced to define the covariance and correlation coefficient. The algebraic properties of these operations are presented. The extensions of the aforementioned statistics are studied for the p,q -ROF environment, when the uncertainty index in Interactive MADM is described by a monotone (fuzzy) measure instead of an additive, probabilistic measure. Based on the Choquet finite integral, a new concept of definitions of monotone statistics such as monotone expectation, monotone variance, monotone covariance and monotone correlation coefficient for the p,q -ROF environment is presented.

With respect to the fuzzy measure associated probabilities class (APC), the classes of associated statistics are considered: associated probability averaging class, associated variances class, associated covariances class and associated correlation coefficients class. The relationship between monotone and associated statistics is studied. It is established that each monotone statistics can be represented by one corresponding associated statistics if there is a partial ordering between the arguments of the statistics, as between the p,q -ROF values. That is, the remaining $(n/-1)$ associated statistics of the corresponding associated class, where n is the number of interacting attributes, become useless in the definitions of monotone statistics. This means that in the interactive MADM environment, in decision-making modeling, the aggregations of monotone statistics cannot fully reflect all possible degrees of interaction of attributes. In more detail: the aggregations with monotone statistical parameters under p,q -ROF environment used in interactive MADM models take into account interactions of the focal elements of only one consonant structure from the $n!$ consonant structures of attributes.

The extensions of monotone statistics, called F -associated statistics, which take into account the degrees of interaction of elements of all $n!$ consonant structures of attributes in aggregations are defined. The issue of the correctness of the extension is discussed. The values of monotone and F -associated statistics coincide if there is a partial ordering between the arguments of the statistics and the Choquet second-order extreme capacities are taken in the role of a fuzzy measure.

A calculation scheme for monotone and F -associated statistics is constructed for a simple interactive MADM model. A simple numerical example is presented to illustrate the obtained results.

Keywords: Fuzzy Statistics, Fuzzy Measure, Choquet Integral, Associated Probability, Monotone Statistics, Associated Statistics, F -Associated Statistics, MADM.