A Fuzzy Cardinality Based Method to Aggregate Decisions in IVFS Environment

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We present a new approach to making decisions in IVFS (interval-valued fuzzy set) environment based on fuzzy cardinality. A motivation to prepare a new method was implementation of our medical decision-making system OvaExpert supporting the diagnosis of ovarian tumors (see [1]). In this system, malignancy prognosis is based on the fusion of information from multiple predictive models, in which decisions are represented epistemically (cf. [2]) with IVFSs. An uncertainty of individual decisions may be caused by a lack of data in the input to these models. Incomplete, or missing, data can occur for many reasons, including malfunction of data-collecting equipment, a survey respondent's failure to respond to a question, insufficient resources (time, money) to collect all the data, and others. In recognition of this problem, missing data analysis and decision-making under incomplete information has recently become an important area of research [3, 4]. There are many different diagnostic models for ovarian tumor, and we wish to use this fact to improve the effectiveness of diagnosis. In our previous research we observed that different diagnostic models use different attributes describing the patient, and are therefore subject to different levels of uncertainty (cf. [5]). The main idea is thus to improve the final diagnosis by taking advantage of the models' diversity. The main objective is to decide whether a given case of tumor is malignant or not. Also very important is the highest quality of the decision.

The natural way for humans to make decisions based on many sources (or many experts) is the strategy of counting. By counting, people determine how many sources or experts vote for and how many vote against the given option, and then they choose the decision for which most of them have voted. Since the decision in our case is taken on the basis of multiple source decisions represented as intervals, it seems natural to estimate the maximum and minimum possible confidence towards particular decision. Such approach suggests to use cardinality of fuzzy sets representing the limits of both intervals: supporting and rejecting the decision. An upper decision estimation can be assumed as FGCount of upper ends of decision intervals (i.e. how many experts at most vote in favor) and as FLCount for lower limit (i.e. how many experts at least vote in favor). Similarly we proceed with the decisions of voting against. As a result, we get two fuzzy cardinaities of FECount type, which comparison allows us to make a final decision. An example of the interval input decisions and their fuzzy cardinalities is presented on Fig.1.

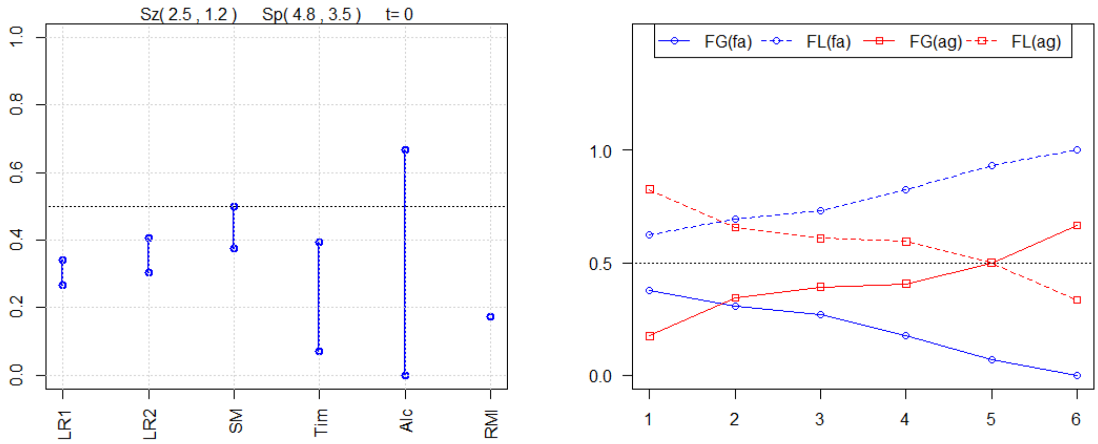

Figure 1: Example of input decisions and their fuzzy cardinalities

More information on cardinality theory of fuzzy sets and intelligent counting can be found in [6].

A preliminary evaluation of the new method seems to be very promising.

References

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