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Andrea Stupňanová, Martin Dyba, Viktor Pavliska

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The classical Sugeno integral remains one of the most prominent nonadditive integrals ever. Many researchers have studied and generalized the Sugeno integral in various directions, aiming to preserve its original desirable properties while enriching it with additional ones suitable for diverse applications. A promising approach, proposed by Boczek et al. in [1], extends the original concept through the introduction of the upper and lower n-Sugeno integrals.

The upper n-Sugeno integral of a measurable function $f\colon X \to [0,\infty]$ with respect to a monotone measure μ on X and an admissible fusion map $\circ\colon [0,\infty]^2 \to [0,\infty]$ is defined recursively by

$$\mathbf{Su}_{n+1}(\mu, f) = \sup_{t\in[0,\infty]} \{(t \circ \mathbf{Su}_n(\mu, f)) \wedge h_{\mu,f}(t)\},$$

where $h_{\mu,f}(t) = \mu(\{x \in X : f(x) \geq t\})$. Building on the results of Chitescu [2], we demonstrate that the computation of the upper n-Sugeno integral can be reformulated as the problem of finding the midpoint of a level measure. This perspective allows us to derive several sufficient conditions for its evaluation. Furthermore, it reveals new connections between Sugeno-type integrals and nonlinear equations arising in informetrics.

In our contribution, the upper n-Sugeno integral plays a central role in introducing the so-called Hirsch-Sugeno operator, which is derived from the upper 2-Sugeno integral by replacing $\mathbf{Su}_1(\mu, f)$ with the Hirsch index, that is, the Sugeno integral with respect to a counting measure [3]. We discuss potential applications of the Hirsch-Sugeno operator as a new scientometric tool. We show that this operator unifies a broad spectrum of existing indices and their modifications, offering a flexible and conceptually coherent mathematical framework for assessing scientific impact within the theory of fuzzy integrals.

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Fuzzy relations in some decision-making and expert systems

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Fuzzy relations are carriers of imprecise relationships in models of a decision-making or expert system. They enable the formal representation of human preferences, dependencies, and subjective judgments.

An important application of relations in decision-making processes is through preference relations, which capture the subjective preferences of the decision maker. The decision-making process is then guided by the aggregation of these preference relations. In expert systems, fuzzy relations model expert judgments, or they may replace or supplement rules.

Our aim is to consider relations at other levels of modeling, for instance, at the level of the universe. One such example is to consider a value of a linguistic variable expressing temperature and the relation between temperature degrees, and then, based on that information, construct a modified value of a linguistic variable. The

construction of such modifiers (hedges) is provided by De Cock and Kerre in [1].

Moreover, it is possible to study the influence of relationships among experts in multi-round decision or voting systems, for example using the Delphi method – an iterative process of systematically collecting and aggregating expert opinions to achieve consensus under conditions of uncertainty.

We aim to select an appropriate method and investigate the role of relations in systems modeled by fuzzy sets and their generalizations, such as interval-valued or intuitionistic fuzzy sets.

Acknowledgement Funded by the EU NextGenerationEU through the Recovery and Resilience Plan for Slovakia under the project No. 09I03-03-V05-00009.

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Uncertainty in Idea Management with Elements of Game Theory

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In [3], idea management is a sub-process of innovation management focused on systematically generating, evaluating and selecting ideas to turn those ideas into actionable solutions. It structures the flow and decision-making around ideas to increase the efficiency and success of innovation implementation. One of the stages of the idea management process is the acceptance, deferment and rejection of ideas. Idea generators (for example, employees of a company) are viewed here as a single player who generally offers many ideas. Idea acceptors (for example, company managers) are the second player who makes a decision on each proposed idea. They may have common goals, but they may also have different opinions. The payoffs of these players are generally uncertain. We will develop a possible interpretation and solution for decision making from a game theory perspective.

Game theory is a crucial tool for modeling competitive interactions among decision-makers in various fields, including engineering, economics and idea management. Classical game theory assumes complete information, where all payoffs are known with certainty. Evaluating ideas is associated with uncertainty, making classical methods inadequate. We propose to evaluate ideas using extensive-form games with uncertain payoffs (see [4]) or bi-matrix-form games with uncertain payoffs. One option is to describe the uncertain payoffs with uncertain intervals. Various descriptions of such an approach can be found in the literature, see [5,1,2] and the references cited therein. The paper [2] concluded that the idea generators themselves play a significant role in the evaluation of ideas. The main issue of the article presented here is finding Nash equilibrium under uncertainty and interpreting the resulting equilibrium in the context of idea management.

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