Kojadinovic, Ivan
Modeling interaction phenomena using fuzzy measures: On the notions of interaction and independence. (English) Zbl 1017.28011
Fuzzy Sets Syst. 135, No. 3, 317-340 (2003).

Fuzzy measures characterize the strength of coalitions of elements in several domains such as game theory or multicriteria decision making. The information contained in a fuzzy measure can be exploited to quantify several properties and relationships of elements and of sets. Recall, e.g., the importance index of Shapley (1953), the interaction index of Murofushi and Soneda (1993) or the marginal interaction index of Grabisch et al. (2000). In this paper, several new quantitative characteristics are introduced and studied. First of all, the marginal interaction index is generalized from couples of elements to couples of disjoint subsets (p-tuples of subsets). Several properties of this generalization are studied, especially for some distinguished classes of fuzzy measures (sub- or super-additive, sub- or super-modular, k-monotone, k-additive). Next, interaction indices among pairwise disjoint subsets are defined and investigated. Finally, measures of marginal amount of interaction, marginal mutual independence, measures of marginal complementarity, etc., are discussed. All introduced quantities bring new lights into description of information concentrated in fuzzy measures. Their applications, especially in the game theory and multicriteria decision making can be expected in the near future.

Reviewer: Radko Mesiar (Bratislava)

MSC:
28E10   Fuzzy measure theory

Cited in **14** Documents

Keywords:
non-additive measure; discrete fuzzy measures; marginal interaction; marginal mutual independence; measures of marginal amount of interaction; marginal complementarity

Full Text: DOI

References:

[1] Choquet, G., Theory of capacities, Annales de l'institut Fourier, 5, 131-295, (1953) · Zbl 0064.35101

[2] Cover, T.; Thomas, J., Elements of information theory, (1991), Wiley New York

[3] Dubois, D.; Prade, H., Possibility theoryan approach to the computerized processing of uncertainty, (1988), Plenum Press New York, NY

[4] Grabisch, M., Fuzzy integral in multicriteria decision making, Fuzzy sets and systems, 69, 279-298, (1995) · Zbl 0845.90001

[5] Grabisch, M., Alternative representations of discrete fuzzy measures for decision making, Internat. J. uncertainty, fuzziness knowledge-based systems, 5, 5, 587-607, (1997) · Zbl 1232.28019

[6] Grabisch, M., \textit{k}-order additive discrete fuzzy measures and their representation, Fuzzy sets and systems, 92, 167-189, (1997) · Zbl 0927.28014

[7] Grabisch, M.; Marichal, J.-L.; Roubens, M., Equivalent representations of set functions, Math. oper. res., 25, 157-178, (2000) · Zbl 0982.91009

[8] Grabisch, M.; Nicolas, J.-M., Classification by fuzzy integralsperformance and test, Fuzzy sets and systems, 65, 255-271, (1994)

[9] Grabisch, M.; Roubens, M., An axiomatic approach to the concept of interaction among players in cooperative games, Internat. J. game theory, 124, 547-565, (1999) · Zbl 0940.91011

[10] Klir, G.; Yuan, B., Fuzzy sets and fuzzy systemstheory and applications, (1995), Prentice-Hall Englewood Cliffs, NJ

[11] J.-L. Marichal, Aggregation operators for multicriteria decision aid, Ph.D. Thesis, University of Liege, Liege, Belgium, 1998.

[12] Marichal, J.-L., An axiomatic approach of the discrete Choquet integral as a tool to aggregate interacting criteria, IEEE trans. fuzzy systems, 8, 6, 800-807, (2000)

[13] Marichal, J.-L.; Roubens, M., The chaining interaction index among players in cooperative games, (), 69-86 · Zbl 0960.91015

[14] Mikenina, L.; Zimmermann, H.-J., Improved feature selection and classification by the 2-additive fuzzy measure, Fuzzy sets

and systems, 107, 195-218, (1999) · Zbl 0958.68147

[15]   T. Murofushi, S. Soneda, Techniques for reading fuzzy measures (iii): interaction index, in: Proceedings of the 9th Fuzzy System Symposium, Saporo, Japan, 1993, pp. 693-696.

[16]   Owen, G., Multilinear extension of games, Manage. sci., 18, 64-79, (1972) · Zbl 0239.90049

[17]   Rota, G., On the foundation of combinatorial theory I, theory of Möbius functions, Z. wahr. verw. gebiete, 2, 340-368, (1964) · Zbl 0121.02406

[18]   M. Roubens, Interaction between criteria and definition of weights in MCDA problems, in: Proceedings of the 44th Meeting of the European Working Group Multicriteria Aid for Decisions, Brussels, Belgium, 1996.

[19]   Shapley, L.S., A value for \textit{n}-person game, (), 307-317 · Zbl 0050.14404