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New Development of Uncertain Theory

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Two types of inherent uncertainties often occur in the real-world applications, namely, randomness and uncertainty. To handle randomness, probabilistic methods can be expectedly used in condition that the sample data size is sufficiently large to estimate the corresponding probability distribution. When the sample size is too small (even no-sample), one in general needs turn to the uncertainty theory for more efficient methodologies. After the uncertainty theory was founded by Prof. Baoding Liu in 2007, this mathematical branch has been further developed by many researchers and applied to a variety of practical applications. Following up the 11th International Conference on Information and Management Sciences, held in Dunhuang, China, August 3-8, 2012 (in Celebration of the 60th Birthday of Professor Shu-Cherng Fang), this special issue aims to provide the readership with the recent and significant research on the theoretical results in the framework of uncertainty theory and their applications in real-world problems, including economics, finance, management problems, etc.

Since the announcement of the CFP in late April, 2012, this special issue attracted tremendous attention from a lot of researchers. A total of more than 20 manuscripts were received before the submission deadline. All the submissions are intended to deal with either theoretical or practical problems. After a rigorous review process, we finally selected 8 papers for publication in this special issue. The first paper by Yuhan Liu provided an analytic method to solve a particular class of nonlinear uncertain differential equations and gave the examples to illustrate the effectiveness of the proposed method. The second paper by Baoding Liu and Kai Yao generalized the uncertain integral from single canonical process to multiple ones, and moreover, some relevant mathematical properties, including the fundamental theorem of uncertain calculus, were proved. The third paper by Xiaowei Chen and Dan A. Ralescu proposed a B-spline method to estimate empirical uncertainty distribution based on the experts experimental data. They also specified how to form the expert's experimental data without historical data. The fourth paper by Zixiong Peng and Kakuzo Iwamura proved that the product uncertain measure is actually an uncertain measure, which finally verifies that the product axiom can be consistent with other axioms in uncertainty theory. The fifth paper by Fengye Wang et al. defined a class of cooperative fuzzy game with infinite players, and proposed the Aumann-Shapley values for the games with fuzzy coalitions with the form of Choquet integral. The relationship between the fuzzy Aumann-Shapley value and the fuzzy Shapley function was also shown. The sixth paper by Yuanguo Zhu established an approach for uncertainty distribution of function of an uncertain variable based on the uncertain measure. Additionally, uncertain simulation algorithms were also proposed for approximating the uncertainty distribution, optimistic value and expected value, which aim to integrate with genetic algorithms to solve uncertain expected value models and uncertain chance-constrained programming models. The seventh paper by Yan Sun proposed a sparse AR approximation to the ARFIMA process based on the penalized conditional likelihood. Simulation study shows that the proposed method leads to better model flexibility and prediction accuracy. The proposed method was applied to analyzing a foreign exchange rate data and the results are very satisfactory. The eighth paper by Yixuan Liu and Zhongfeng Qin defined the semi-absolute deviation for uncertain variables, and then established the corresponding mean semi-absolute deviation models for the portfolio optimization problem in uncertain environment. Numerical examples were also presented to demonstrate advantages of the proposed approach.

Finally, we would like to thank Editor-in-Chief, Prof. Yan-kui Liu, for his kind support for the organization process of this special issue. Our sincere gratitude also goes to all the reviewers for their rigorous reviews and all the authors for their submissions.

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