

Uncertainty Theory and Its Applications

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In order to deal with indeterminacy mathematically, two axiomatic systems have been founded, namely, probability theory and uncertainty theory. When we have enough samples of the possible outcomes of the indeterminate quantity, we can obtain the probability distribution of the indeterminate quantity from the frequency of the outcomes. In this case, probability theory will work well. When we have no sample of the possible outcomes of the indeterminate quantity, we have to invite the experts to evaluate the uncertainty distribution of the indeterminate quantity according to their experiences. In this case, uncertainty theory will work well.

Following up the 13th International Conference on Information and Management Sciences, held in Zhangji-ajie, China, August 3-8, 2014 (in celebration of the 70th birthday of Professor Mitsuo Gen), this special issue aims to introduce the recent research results in the framework of uncertainty theory, especially its applications in optimization and finance.

After a rigorous review process, seven papers were selected for publication in this special issue. The first paper is by Kai Yao. It presents an uncertain integral of a matrix of uncertain processes with respect to multi-dimensional Liu process, and proposes a concept of multi-dimensional uncertain differential equation. The second paper is by Ke Wang and Quan Yang. By means of uncertain expected cost minimization model and uncertain α -cost minimization model according to different decision criteria, it optimizes the hierarchical facility location strategy for designing reverse logistics network in the uncertain environment. The third paper is by Jing Liu, Shuya Zhong, and Mingxuan Zhao. It describes the relative importance of customer requirements and the relationship matrix between customer requirements and engineering characteristics via uncertain variables, and presents an expected value-based method to determine the importance of engineering characteristics. The fourth paper is by Xiangfeng Yang and Jinwu Gao. It reviews the recent developments of uncertain set theory from the theoretical and practical aspects. On the one hand, the concepts of uncertain set and its membership function have been recast, and the conditional uncertain set has been further studied. On the other hand, uncertain logic and uncertain inference have already been proposed based on uncertain set theory, and their usefulness and effectiveness have also been demonstrated. It is believed that uncertain set and its applications will become hot research points in the following years. The fifth paper is by Mingfa Zheng, Yuan Yi, Zutong Wang, and Long Yan, and the sixth paper is by Zutong Wang, S. Mahmoud Taheri, Mingfa Zheng, and Pengtao Zhang. The emphases of two papers are put on the concepts of solutions of uncertain random multi-objective programming model, and the methods to obtain these solutions. The last paper is by Zhiqiang Zhang and Weiqi Liu. It provides some pricing formulas for the geometric average Asian option of Liu's stock model, enriching the uncertain finance theory.

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