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Probability inequalities for decomposition integrals

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Abstract

Recently, in mathematical economics, Even and Lehrer introduced the decomposition integral as a generalization of Choquet integral with respect to capacities [Economic Theory (2014) 56:33-58]. In this paper, general versions of some well-known probabilistic inequalities for the decomposition integrals and the superdecomposition integrals are discussed that are still open for research. The main results of this paper generalize some previous results for particular integral inequalities obtained by several researchers in generalized probability theory.

Keywords: Choquet integral; Decomposition integral; Superdecomposition integral; Probability inequalities; Capacity; Generalized probability theory.

1 Introduction and motivation

Optimization theory is a branch of applied mathematics which is used in numerous applications in engineering, economics and statistics [6, 37, 40, 43, 47, 46]. Probabilistic inequalities are very important in optimization and approximation theory [34, 15, 12, 13]. We recall some important inequalities in probability and measure theory: Hölder's inequality, Minkowski's inequality, Chebyshev's inequality and Jensen's inequality.

Given a probability space $(\Omega, \mathcal{A}, \mathbf{P})$, consider two $\mathcal{A}$-Borel measurable functions X and Y.

Theorem 1.1 *If $p > 1$ and $\frac{1}{p} + \frac{1}{q} = 1$, then Hölder's inequality*

$$\int_\Omega |XY| \, d\mathbf{P} \leq \left(\int_\Omega |X|^p \, d\mathbf{P} \right)^{\frac{1}{p}} \left(\int_\Omega |Y|^q \, d\mathbf{P} \right)^{\frac{1}{q}}$$

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