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Tight tail probability bounds for distribution-free decision making. (English) Eur. J. Oper. Res. 299, No. 3, 931-944 (2022)

Summary: Chebyshev’s inequality provides an upper bound on the tail probability of a random variable based on its mean and variance. While tight, the inequality has been criticized for only being attained by pathological distributions that abuse the unboundedness of the underlying support and are not considered realistic in many applications. We provide alternative tight lower and upper bounds on the tail probability given a bounded support, mean and mean absolute deviation of the random variable. We obtain these bounds as exact solutions to semi-infinite linear programs. We apply the bounds for distribution-free analysis of the newsvendor model, stop-loss reinsurance and a problem from radiotherapy optimization with an ambiguous chance constraint.

MSC:
90Bxx Operations research and management science

Keywords:
applied probability; Chebyshev inequality; distributionally robust optimization; chance constraints

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