Bilevel stochastic linear programming problem with quantile criterion and continuous random parameters

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Abstract. The bilevel stochastic programming problem with quantile criterion and continuous random parameters is considered. The lower level problem is linear. Properties of the bilevel problem are researched. To solve the problem, the confidence method is used.

Keywords: bilevel problem, stochastic programming, quantile criterion

The statement of the bilevel stochastic programming problem with quantile criterion and continuous discribution of random parameters is suggested. In this problem, there are two decision makers: the leader and the follower.

The follower selects his strategy solving the so-called lower level optimization problem. He knows the realization of the random parameters and the leader's decision. This problem is assumed to be linear in the follower's strategy. The coefficients of the linear follower's objective function depend on the leader's strategy and the realization of the random parameters.

The leader chooses his strategy solving the upper level optimization problem. This problem is called the bilevel problem. In this work, the leader solves a stochastic minimization problem with quantile criterion. The leader knows only the distribution of the random parameters. The quantile criterion provides the minimal leader's loss that cannon be exceeded with a given probability. The leader's problem contains a constraint on the optimality of the follower's strategy in the lower level problem. The leader takes into account the follower's strategy as a function of the leader's strategy and the random parameters.

Conditions guaranteeing that the lower level problem has a unique solution with probability one are presented. This means that so-called optimistic and pessimistic solutions to the bilevel problem coincide.

To solve the problem, the confidence method is used. It is shown that the follower's optimal strategy is a discrete random vector. The confidence method allows us choosing realizations of this random vector that ensure the given level of probability. Then an optimal or suboptimal solution to the bilevel problem is selected.

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