Improving and benchmarking of algorithms for decision making with lower previsions

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Maximality is a well-known criterion for decision making under severe uncertainty using lower previsions. To determine whether a gamble is maximal or not, in Jansen et al.'s algorithm [1], one can solve a single linear program, while in Troffaes and Hable's algorithm [4], one can solve a sequence of smaller linear programs. Troffaes and Hable [4] suggested that (i) if some maximal gambles in the sets are known, then we should compare the remaining gambles against those maximal gambles first, (ii) if a gamble is not maximal in a given iteration, then it can be excluded from all future iterations, and (iii) sorting all gambles in advance, e.g. by expectation, could help the algorithm to perform better.

In this poster, we present a new fast algorithm for finding maximal gambles that incorporates these suggestions, and compare its performance to these two existing algorithms. To do so, we propose a new method for generating random decision problems with pre-specified ratios of maximal and interval dominant gambles. This work closely follows [3] which was recently submitted.

Based on our earlier work [2], we apply efficient ways to find common feasible starting points in our proposed algorithm and in Troffaes and Hable's algorithm [4]. We then exploit these feasible starting points to develop early stopping criteria for the primal-dual interior point method, further improving efficiency. We find that the primal-dual interior point method works well for this case as it simultaneously solves primal and dual problems.

We also investigate the use of interval dominance, which is another criterion for decision making, to eliminate non-maximal gambles. This can make the problem smaller, and we observe that this benefits Jansen et al.'s algorithm but, perhaps surprisingly, not the other two algorithms. We find that our algorithm, without using interval dominance, outperforms all other algorithms in all scenarios in our benchmarking.

References

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