The Average Value-at-Risk Criterion for Finite Horizon Semi-Markov Decision Processes

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Abstract: In this talk, we introduce the average value-at-risk (AVaR) criterion for finite horizon semi-Markov decision processes (SMDPs). Via an alternative representation of AVaR, we reduce the problem of minimizing the AVaR of the finite horizon cost to two sub-problems: one is to minimize the expected-positive-deviation of the finite horizon costs from some level over policies, which itself is a new and interesting problem in the finite horizon SMDP setting; the second is an ordinary problem of minimizing a function of a single variable. For the first sub-problem, we will show that the value function is a minimum solution to the optimality equation (OE), and an optimal policy exists under suitable conditions. Furthermore, we will show that the value function is the unique solution to the OE under additional conditions. Based on the solution of the first sub-problem, the existence and computation of an AVaR optimal policy are established by solving the second sub-problem. To facilitate practical implementation of our results, we derive a value iteration algorithm and a policy improvement algorithm for computing an AVaR optimal policy. We perform complexity analysis of the value iteration algorithm, and discuss Monte Carlo simulation as a method of minimizing AVaR for a finite horizon SMDP. To demonstrate our results, two examples about a maintenance system and a cash-flow system are provided.

References

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