Threshold policies for two-stage adjustable robust optimization problems

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Abstract

In this paper, we consider the problem of designing near optimal tractable policies for the two-stage adjustable robust optimization problems with covering constrains. It has been shown that this class of problems is hard to approximate within a factor $O(\frac{\log n}{\log \log n})$ (Feige & al. [**?**]). piecewise affine policies are known to be optimal, however, the number of pieces can be exponential. We consider a particular class of piecewise affine policies, namely threshold policies, and show that they give a $O(\tau(\mathcal{U}) \log n + \log m)$ approximation to the two-stage problem for many important sets including permutation invariant sets and separable sets, where $\tau(\mathcal{U})$ is a geometric factor of the uncertainty set smaller than $\log m$. Furthermore, we show that the optimal threshold policy can be compute efficently by simply solving an LP. For example, for the hypersphere uncertainty set, our policy gives a $O(\log n + \log m)$ approximation while affine policies give a $O(\sqrt{m})$ approximation and the best known tractable peice-wise affine policy gives a $O(m^{\frac{1}{4}})$ approximation.