

# Scenario Tree Reduction via Wasserstein Barycenters

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Scenario tree reduction techniques are essential for achieving a balance between an accurate representation of uncertainties and computational complexity when solving multistage stochastic programming problems. In the realm of available techniques, the Kovacevic and Pichler algorithm (Ann. Oper. Res., 2015) stands out for employing the nested distance, a metric for comparing multistage scenario trees. However, dealing with large-scale scenario trees can lead to a prohibitive computational burden due to the algorithm's requirement of solving several large-scale linear problems per iteration. This study concentrates on efficient approaches to solving such linear problems, recognizing that their solutions are Wasserstein barycenters of the tree nodes' probabilities on a given stage. We leverage advanced optimal transport techniques to compute Wasserstein barycenters and significantly improve the computational performance of the Kovacevic and Pichler algorithm. Our boosted variants of this algorithm are benchmarked on several multistage scenario trees. Our experiments show that compared to the original scenario tree reduction algorithm, our variants can be eight times faster for reducing scenario trees with 8 stages, 78125 scenarios, and 97656 nodes.

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