

Contextual Distributionally Robust Optimization under Streaming Data: An Alternating Optimization Method

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We consider data-driven decision-making that incorporates a prediction model within the 1-Wasserstein distributionally robust optimization (DRO) given joint observations of uncertain parameters and covariates using regression residuals in a streaming-data setting. In this setting, additional data becomes available and allows decisions to adapt to the growing knowledge of the underlying uncertainty. The ambiguity set shrinks as more data is observed. We propose an efficient online optimization method for this streaming-data contextual DRO setting, which iteratively alternates between optimizing the decision and determining the worst-case distribution. We analyze the asymptotic convergence properties of this algorithm and establish dynamic regret bounds to certify the performance of online solutions. Through numerical experiments, we validate our theoretical findings and demonstrate that our approach significantly enhances computational efficiency while maintaining high solution quality under streaming data.

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