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Relative Density-Ratio Estimation for Robust Distribution Comparison

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Divergence estimators based on direct approximation of density-ratios without going through separate approximation of numerator and denominator densities have been successfully applied to machine learning tasks that involve distribution comparison such as outlier detection, transfer learning, and two-sample homogeneity test. However, since density-ratio functions often possess high fluctuation, divergence estimation is still a challenging task in practice. In this paper, we propose to use relative divergences for distribution comparison, which involves approximation of relative density-ratios. Since relative density-ratios are always smoother than corresponding ordinary density-ratios, our proposed method is favorable in terms of the non-parametric convergence speed. Furthermore, we show that the proposed divergence estimator has asymptotic variance independent of the model complexity under a parametric setup, implying that the proposed estimator hardly overfits even with complex models. Through experiments, we demonstrate the usefulness of the proposed approach.

Subjects: **Machine Learning (stat.ML)**; Statistics Theory (math.ST); Methodology (stat.ME)

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