

Estimation of Function Ratio and Applications

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Abstract

Estimation of the ratio of two functions is often quite useful to solve various machine learning tasks. The density ratio, i.e., the ratio of two probability densities, is applied to covariate shift adaptation, outlier detection, feature selection, conditional probability estimation, transfer learning, etc. Also, the log-density derivative, i.e., the ratio of the density derivative and the density itself, enables us to reveal lower-dimensional structures hidden in data such as mode clustering and density ridge estimation. In this talk, we present a basic idea for directly estimating the ratio of functions and investigate its fundamental statistical properties, including a non-parametric convergence rate and closed-form solutions. The numerator and denominator in the ratio can often be separately estimated. We show that the direct ratio estimator is revealed to be more stable for moderate dimensional data. Some experiments demonstrate the usefulness of our approach to a variety of data sets.