Poster Snapshot

Conditional Ball Divergence: Test of conditional independence between two continuous random vectors

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We investigate the problem of testing conditional independence between two continuous random vectors X and Y given another continuous random vector Z. Firstly, we propose a new measure of conditional independence which we call conditional ball divergence. It is non-negative and takes the value zero if and only if X and Y are conditionally independent given Z. We construct a consistent estimator of this measure using kernel averaging and study its large sample properties under very general assumptions. We use this estimator as the test statistic and reject the null hypothesis of conditional independence for higher values of it. We investigate the properties of our tests under different test calibration frameworks, namely the model-X and local bootstrap framework. Under the model-X framework, we show that our test is a valid test, and it is consistent even when the distribution of $X \mid Z$ is specified up to a location shift, rotation or homogeneous scale transformation. We also propose a novel smooth bootstrap algorithm that gives a valid and consistent as well. This algorithm resamples from a smooth estimate of the distribution of $X \mid Z$. We demonstrate the performance of different test calibration methods through simulations. This exhibits the superiority of our proposed smooth local bootstrap method over the model-X framework even when the sample size is small. Extensive simulation studies are carried out and a benchmark data set is analysed to compare the performance of our test with some of the state-of-the-art methods.