Test for conditional independence with application to conditional screening

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Abstract: Measuring and testing conditional dependence are fundamental problems in statistics. Imposing mild conditions on Rosenblatt transformations (Rosenblatt, 1952), we establish an equivalence between the conditional and unconditional independence, which appears to be entirely irrelevant at the first glance. Such an equivalence allows us to convert the problem of testing conditional independence into the problem of testing unconditional independence. We further adopt the Blum–Kiefer–Rosenblatt correlation (Blum et al., 1961) to develop a test for conditional independence, which is powerful to capture nonlinear dependence and is robust to heavy-tailed errors. We obtain explicit forms for the asymptotic null distribution which involves no unknown tunings, rendering fast and easy implementation of our test for conditional independence. With this conditional independence test, we further propose a conditional screening method for high dimensional data to identify truly important covariates whose effects may vary with exposure variables. We use the false discovery rate to determine the screening cutoff. This screening approach possesses both the sure screening and the ranking consistency properties. We illustrate the finite sample performances through simulation studies and an application to the gene expression microarray dataset.