Statistical Inference on the Linear Transformation Model Based on Maximum Rank Correlation Estimator

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Abstract

We address the issue of statistical inference on the linear transformation model based on maximum rank correlation (MRC) estimator, in this paper, we establish the likelihood ratio (LR), Wald and Rao score tests, we treat the object function being associated with MRC estimator as a "log-likelihood", as a result, it is a U-statistic, we prove that Wald and Score tests converges to chi-square distribution and they are asymptotic equivalent, however, for LR test, the Wilks' phenomenon fails to hold in this setting and the limiting distribution is a weighted sum chi-squared distribution with unknown weights. In order to avoid further computational burden, we propose a smoothed object function and a resulting smoothed MRC estimator, and we prove that the LR test based on the smoothed MRC estimator converges to the same distribution as the non-smoothed case. Under the smoothed object function, we propose a simple and consistent estimate of the variance matrix which does not involve numerical gradient, after we obtain the consistent estimate of the weights based on the consistent variance estimator, we employ two methods to approximate the null distribution by scaled-shift chi-square distribution, simulation studies show that both approximation methods perform well. For the Wald and Score test, we find that the Wald test is too generous — it always leads to a larger size than nominal level, whereas the Score test is too conservative — it consistently causes a smaller size. We propose a method to compromise this. Also, we find that the LR and Wald test (Score test cannot work rightly) is very robust to various error distributions and various models. We also apply the proposed method to a real dataset.

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