Statistical Inference for Linear Mediation Models with High-dimensional Mediators

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Abstract:
Mediation analysis draws increasing attention in many scientific areas such as genomics, epidemiology and finance. In this paper, we propose new statistical inference procedures for high dimensional mediation models, in which both the outcome model and the mediator model are linear with high dimensional mediators. Traditional procedures for mediation analysis cannot be used to make statistical inference for high dimensional linear mediation models due to high-dimensionality of the mediators. We propose an estimation procedure for the indirect effects of the models via a partial penalized least squares method, and further establish its theoretical properties. We further develop a partial penalized Wald test on the indirect effects, and prove that the proposed test has a χ^2 limiting null distribution. We also propose an F-type test for direct effects and show that the proposed test asymptotically follows a χ^2-distribution under null hypothesis and a noncentral χ^2-distribution under local alternatives. Monte Carlo simulations are conducted to examine the finite sample performance of the proposed tests and compare their performance with existing ones. A real data example is used to illustrate the proposed methodology.

Keywords:
Mediation Analysis; Penalized Least Squares; Sparsity; Wald test