Causal Mediation Analysis with Multiple Time-varying Mediators

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Abstract

The mediational g-formula is a crucial method for evaluating causal mediation effects in longitudinal studies with time-varying exposures and mediators. However, current methodologies based on the mediational g-formula are only capable of dealing with a single mediator, rendering them unsuitable for many scenarios. This presentation introduces a novel methodology that extends the mediational g-formula to cover cases with multiple time-varying mediators. The proposed estimation method comes in two variants, each tailored to a specific set of assumptions and effect definitions, and presents nonparametric identification results for each variant. It also demonstrates how complex causal mechanisms, characterized by the presence of multiple time-varying mediators, can be disentangled. The method is applied to investigate the intricate causal mechanism underlying the progression of chronic obstructive pulmonary disease. The results reveal that the effects of lung function impairment mediated by dyspnea symptoms accounted for 14.6% of the total effect, while the effect mediated by physical activity accounted for 11.9%. This finding highlights the power of this approach, providing evidence for the mediating roles of dyspnea and physical activity on the causal pathway from lung function impairment to health status.