

國立中正大學數學系
暨應用數學碩士班、統計科學碩士班
學 術 演 講

From linear structural equation modeling to generalized multiple mediation formula

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Abstract

Causal mediation analysis is advantageous for mechanism investigation. In settings with multiple causally ordered mediators, path-specific effects (PSEs) have been introduced to specify the effects of certain combinations of mediators. However, most PSEs are unidentifiable. Interventional analogue of PSE (iPSE) is adapted to address the non-identifiability problem. Moreover, previous studies only focused on cases with two or three mediators due to the complexity of the mediation formula in large number of mediators. In this study, we provide a generalized definition of traditional PSEs and iPSEs with a recursive formula, along with the required assumptions for nonparametric identification. This work has three major contributions: First, we developed a general approach (that includes notation, definitions, and estimation methods) for causal mediation analysis with an arbitrary number of multiple ordered mediators and with time-varying confounders. Second, we demonstrate identified formula of iPSE is a general form of previous mediation analysis. It is reduced to linear structural equation model under linear or log-linear model, to causal mediation formula when only one mediator. Third, a flexible algorithm built based on g-computation algorithm is proposed along with a user-friendly software online. This approach is applied to a Taiwanese cohort study for exploring the mechanism by which hepatitis C virus infection affects mortality through hepatitis B virus infection, abnormal liver function, and hepatocellular carcinoma. All methods and software proposed in this study contribute to comprehensively decompose a causal effect confirmed by data science and help disentangling causal mechanisms when multiple ordered mediators exist, which make the natural pathways complicated.

Keywords: causal inference, mediation analysis, multiple mediation, SEM, counterfactual, interventional approach.

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地 點:本校數學館 527 教室 (嘉義縣民雄鄉大學路 168 號)

茶 會: 15:30~16:00 數學館四樓 409 室舉行

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