
Estimating Causal Effects by Bounding Confounding

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Abstract

Assessing the causal effect of a treatment variable X on an outcome variable Y is usually difficult due to the existence of unobserved common causes. Without further assumptions, observed dependences do not even prove the existence of a causal effect from X to Y . It is intuitively clear that strong statistical dependences between X and Y do provide evidence for X influencing Y if the influence of common causes is known to be weak. We propose a framework that formalizes effect versus confounding in various ways and derive upper/lower bounds on the effect in terms of a priori given bounds on confounding. The formalization includes information theoretic quantities like information flow and causal strength, as well as other common notions like effect of treatment on the treated (ETT). We discuss several scenarios where upper bounds on the strength of confounding can be derived. This justifies to some extent human intuition which assumes the presence of causal effect when strong (e.g., close to deterministic) statistical relations are observed.