

Causal Statistical Decision Theory|What are interventions?

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September 1, 2021

There are several different approaches to causal inference. Two of the most popular are based on causal Bayesian networks and potential outcomes respectively. ? This paper clarifies the relationship between the two approaches. We do this building on the decision theoretic approach to causal inference explored by (Dawid, Heckerman, Rohde & Lattimore), and introduce “see-do models”, a generalisation of regular statistical models. Potential outcomes and graphical causal models are different approaches to the difficult problem of relating observations (“see”) to consequences (“do”). The potential outcomes approach posits that observations and consequences together form a sequence of identically distributed “potential outcome functions” with fixed domain and codomain which are not fully observable, while graphical causal models posits that observations and consequences share a collection of conditional probabilities, but in general the elements of the collection may not be known. The assumption of exchangeable potential outcome functions implies a shared collection of conditional probabilities, but in general potential outcomes models have additional structure besides. In particular, we show how sequences of “non-deterministic” potential outcome functions are equivalent to “see-do-imagine models”, which are see-do models with extra handles, along with the assumption of *functional exchangeability*. As there is generally no requirement to model “imagine” handles, it is possible to construct causal models like Causal Bayesian Networks

See-do models themselves are motivated by a decision theoretic approach to causality, and are similar but not identical to previous work in this area. The decision theoretic approach emphasises building models that are suitable for solving problems over adopting particular kinds of causal primitives. Nonetheless, as we show here, it can shed light on the nature of causal primitives that appear in other approaches.

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References

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