Reader Report

Reading: Causal inference in statistics: An overview (Pearl,2009a)

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In section 2, this paper discusses the distinctions between association and causation and the ramification of which. The paper defines association as a joint distribution of observed variables whereas a causal concept cannot be defined using distribution alone. For instance, correlation, regression or conditional Independence etc are associational concepts. Instrumental variables, interventions, confounding are causal concepts. Pearl claims that behind any causal conclusion there must be some causal assumption, untested in observational studies. He refers to this as the golden rule.(Pearl, 100)

While the golden rule itself seems rather non-controversial, Pearl points out two consequences that comes alone with the claim. 1) Confounding bias cannot be detected or corrected by statistical methods alone. This also completely undermined a lot of the work done by Economists or Epidemiologists. 2) Simple probability calculus is not sufficient for expressing causal relationships. Thus Pearl proposes a new set of notations such as the do-calculus.

Section 4 discusses the potential outcome framework. This framework allows us to answer questions such as 'if treatment X had been x, what would be the value of outcome Y, $Y_x(u)$?' Although it seems like we need to work with hypothetical quantities, analysis can be done within the framework of probability theory. The "Black-Box missing data paradigm" is a way to convert structural approach to potential outcomes approach. Instead of trying to infer how the intervention changes **one** distribution, it views potential outcomes as two distributions that are loosely connected. Thus converting the problem in to inferring probabilistic properties through missing data. (Pearl 128)

Peals points out that problem formulation is a main drawback for the black-box approach. That is all problems have to be translated to the language of counter-factual before doing any analysis. However, translation itself is often one of the hardest problems and rather restricting. By using a graph-less structure, we have no guidance in covariates selections. Furthermore, when counter-factual variable is viewed independently of a deeper model, it is difficult to ascertain whether these judgments are sufficient, necessary, or self consistent.