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Biometrika, Vol. 82, No. 4 (Dec., 1995), 690-692.

This raises the question as to how we can use scientific understanding and empirical data to construct the requisite causal model. By saying little about this specification problem, Pearl is in danger of being misunderstood to say that it is not important. To build either a distributional or a ~~counterfactual~~ causal model, we need to assess evidence on how interventions affect the system, and

what remains unchanged. This will typically require a major scientific undertaking. Given this

influence and implicitly representing hypotheses about conditional independence. We can connect the two dimensions, one causal and the other stochastic, by explicit mathematical axioms. For example, the causal Markov axiom requires that in the causal model, all the direct causes of a node X_i

G-computation algorithm for calculating the effects of interventions under causal hypotheses expressed as event trees, an extension of the Rubin approach; and Glenn Shafer's (1996) more recent

and somewhat different tree structure approach. Where both are applicable, they seem to give the same results as do procedures Pearl describes for computing on directed graphs. An advantage of the directed graph formalism is the naturalness of the representation of influence. Questions regarding the relative power of these alternative approaches are as follows.

- (i) Is the graphical approach applicable to cases where the alternatives are not, particularly when there are structures in which it is not assumed that every variable either influences or is influenced by every other?
- (ii) Is the graphical approach faster in some instances, because the directed graphs can encode independencies in their structure while event trees cannot?
- (iii) Can the alternatives, like the graphical procedure, be extended to cases in which the distribution forced on the manipulated variable is continuous?

As far as we can tell, none of the approaches to date has been able to cope with causal language associated with explanatory variables in proportional hazards models, where the nonlinear structure

does not lend itself naturally to conditional independence representations.

[Received April 1995]

Discussion of 'Causal diagrams for empirical research' by J. Pearl

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Causal inference with nonexperimental data seems unjustifiable to many statisticians. Pearl's