Policy analysis

We adopt the view of economist [James Heckman][1] that policy analysis seeks to understand effects of policy through three types of queries.[^2]

[1]: <http://heckman.uchicago.edu/>

[^2]: [1]

Types of policy analysis

One type of query is concerned with the difference in outcome between groups of patients that happen to have been exposed to alternative policies. These queries could be answered through an observational study, i.e., a study in which the investigator has no control over setting the policy alternatives.

Another type of query is concerned with determining, through a controlled experiment, changes in outcome following a change in policy. The distinction between the two types of queries matters, because it would not necessarily be possible to reproduce observed differences in outcomes between groups of patients that happen to have been exposed to different policies by deliberately setting those policies. For example, if clinical outcomes were found to improve when revascularization happened to occur within the recommended time, it cannot be concluded that providing the procedure within the recommended time will improve outcomes.

The third type of query relates to the extent to which past events might have occurred differently if a policy had been different. Answering such a query necessitates a comparison of potential outcomes of policy alternatives if they had been implemented in the same patient population. For example, answering the attribution question for delays and outcomes requires us to estimate the chance that death would not have occurred in the absence of treatment delays, given that delays did in fact occur.

Counterfactual queries

Causality can be demonstrated by experimental studies. However, not all causal questions can be answered with data, even if well-designed experiments are conducted. For example, questions of attribution (What proportion of deaths are caused by exposure?), questions of susceptibility (What fraction of the unexposed population would have acquired disease had they been exposed?), and questions of treatment effect (What is the effect of treatment in patients who have been treated?) cannot be answered with data alone. Such questions require counterfactual analysis of the observed data, since only one of potential outcomes can be observed for a given patient. The objective of our study is to answer an attribution question about the patients who died after CABG who could have survived had they been treated within the recommended time.

The connection between causal questions and counterfactual quantities has prompted computer scientist Judea Pearl to consider counterfactual queries directly in terms of a structural equation model, i.e., a set of equations in which each outcome variable is assigned a value by an explicit function of other variables in the study. To perform an analysis of counterfactual queries, Pearl suggested the following extensions of the statistical analysis:

- graphical causal models representing assumptions linking causes and effects;
- structural equations representing the dependency of outcome variables on their causes; and
- analysis of counterfactual outcomes computed from the structural equations.

[1] undefined