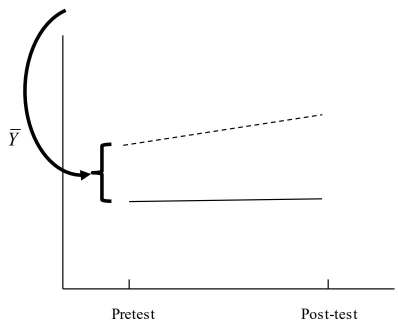
Propensity Scores

One application of logistic regression is the propensity score approach to equating groups in an experimental or quasi-experimental study (e.g., non-equivalent control group or case-control group design). When the treatment and control groups are not equal on the dependent variable initially, the most common analysis approach is an analysis of covariance (ANCOVA) in which the dependent variable measured at pretest is controlled when the post-test means are compared. If there is a still a significant difference at post-test after the pretest scores have been controlled, then the researcher concludes the treatment had an effect.



An alternative analytic approach proposed by Rosenbaum and Rubin (1983) is propensity score analysis. Propensity scores are typically estimated with logistic regression. A group of covariates thought to be related to the initial group differences are used to predict group membership (treatment vs. control). This is a standard logistic regression model where $Y = 1$ is membership in the treatment group. So, for example, if income was a factor in participants' self-selection into the treatment condition, then income is used to predict membership in the treatment or control group. Any number of covariates could be used. The logit, $P\left[\pi/\left(1-\pi\right)\right]$, is then used as a basis for matching cases in the treatment and control. Cases may be matched using several approaches (nearest neighbor method, subclassification groups, inverse probability of exposure, weighting). The propensity score is sometimes used in a subsequent linear regression as the only covariate, replacing all of the covariates used in the logistic model that predicted treatment/control membership. In general, statistical control is more precise than regular matching designs, because regular matching is practically limited to grouping by a small set of variables.

In general, propensity scores and ANCOVA/regression lead to similar results in most instances (e.g., Capeda, Boston, Farrar, & Strom, 2003). Propensity scores clearly have a potential advantage over traditional matching, because of greater precision in the weights used for matching and the ability to simultaneously match on many potential confounders at once. When nonlinear relationships and interactions between covariates exist, results can differ depending on the propensity score implementation approach (Freedman & Berk, 2008; Schafer & Kang, 2008). West and colleagues (West, Cham, & Thoemmes, 2015; West et al., 2014) argue that propensity scores have an advantage when there is a very large number of covariates. Unobserved heterogeneity (omitted variables in logistic regression can bias estimates even when the covariates are unrelated to the outcome), small sample bias with maximum likelihood, and practical limits on sample size relative to the number of covariates in logistic regression are other potential concerns with propensity score analysis.

References and Further Reading

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