CONDITIONAL GENERALIZED ESTIMATING EQUATIONS FOR THE ANALYSIS OF CLUSTERED AND LONGITUDINAL DATA

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Standard inference for population-averaged or random-effects models can lead to biased estimates for the causal effect of cluster-varying exposures on outcome when there are unmeasured cluster-level confounders. To accommodate this problem, we will propose a new theory for the analysis of linear and loglinear marginal models for clustered and longitudinal data. It enables consistent estimation of the causal effect of cluster-varying exposures in the presence of unmeasured cluster-level confounders, and in addition, consistent estimation of the association of remaining cluster-level variables with outcome. Efficient estimators are obtained by solving a set of so-called conditional generalized estimating equations (CGEE). These exploit the comparibility of observations within clusters similar to conditional likelihood methods, but they extend the latter by allowing arbitrary covariance structures and estimation of cluster-level effects. We will compare our method to a recent alternative by Neuhaus and Kalbfleisch (Biometrics, 1998), who proposed to separate exposure effects into within-cluster effects and between-cluster effects. Furthermore, we will illustrate our findings through the analysis of a longitudinal psychiatric study and through simulations.