Comparison of Methods of Estimation for Use in Goodness of Fit Tests for Binary Multilevel Models

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Abstract : It can be frequently observed that the data arising in our environment have a hierarchical or a nested structure attached with the data. Multilevel modelling is a modern approach to handle this kind of data. When multilevel modelling is combined with a binary response, the estimation methods get complex in nature and the usual techniques are derived from quasi-likelihood method. The estimation methods which are compared in this study are, marginal quasi-likelihood (order 1 & order 2) (MQL1, MQL2) and penalized quasi-likelihood (order 1 & order 2) (PQL1, PQL2). A statistical model is of no use if it does not reflect the given dataset. Therefore, checking the adequacy of the fitted model through a goodness-of-fit (GOF) test is an essential stage in any modelling procedure. However, prior to usage, it is also equally important to confirm that the GOF test performs well and is suitable for the given model. This study assesses the suitability of the GOF test developed for binary response multilevel models with respect to the method used in model estimation. An extensive set of simulations was conducted using MLwiN (v 2.19) with varying number of clusters, cluster sizes and intra cluster correlations. The test maintained the desirable Type-I error for models estimated using PQL2 and it failed for almost all the combinations of MQL. Power of the test was adequate for most of the combinations in all estimation methods except MQL1. Moreover, models were fitted using the four methods to a real-life dataset and performance of the test was compared for each model.

Keywords : goodness-of-fit test, marginal quasi-likelihood, multilevel modelling, penalized quasi-likelihood, power, quasi-likelihood, type-I error