A simplified Kenward-Roger approximate F test with application to block designs

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Abstract

For data following a balanced mixed Anova model, the standard Anova method typically leads to exact F tests of the usual hypotheses about fixed effects. However, for most unbalanced designs with most hypotheses, the Anova method does not produce exact tests, and approximate methods are needed. One approach to approximate inference about fixed effects in mixed linear models is the method of Kenward and Roger (1997), which is available in SAS and widely used. In this paper, we strengthen the theoretical foundations of the method by clarifying and weakening the assumptions, and by determining the orders of the approximations used in the derivation. We present two modifications of the K-R method which are comparable in performance but simpler in derivation and computation. Also, we show the difficulties in developing a K-R type method using the conventional, rather than adjusted, estimator of the variance-covariance matrix of the fixed-effects estimator. A simulation study is conducted to assess the performance of the K-R and proposed methods for block designs. The K-R and proposed methods perform quite similarly in most cases.

Keywords

Kenward and Roger's approximation, testing fixed effects, mixed linear model.