Conditional AIC for linear mixed effects models

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Abstract

We show that for a linear mixed effects model where the question of interest concerns cluster-specific inference the commonly-used definition for AIC is not appropriate. We propose a new definition for this context, which we call the conditional Akaike information criterion (cAIC). The cAIC is obtained from first principles, and we show that the penalty for the random effects is related to the effective number of parameters, rho, proposed by Hodges and Sargent; rho reflects a level of complexity between a fixed-effects model with no cluster effects, and a corresponding model with fixed cluster-specific effects. We provide finite-sample results for the linear mixed-effects model with known random effects variances, and an asymptotic approximation for a special case with unknown random effects variances. We compare the conditional AIC with the marginal AIC (in current standard use), and we argue that the latter is only appropriate when the inference is focused on the marginal, population-level parameters. A pharmacokinetics data application is used to illuminate the distinction between the two inference settings, and the usefulness of the conditional AIC. Extensions to generalized linear mixed model and proportional hazards mixed effects models, based on asymptotic arguments, are also considered.