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Bayesian Sample Size Determination for Longitudinal Trials with Attrition

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Bridging the gap between methodological advancements and application: Bayesian Sample Size Determination

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Abstract

When investigating the effects of an intervention over time, researchers often rely on longitudinal data. To analyze such data, multilevel/hierarchical models are fundamental as they account for the nested structure of the data. Inferences about treatment effects are drawn by testing hypothesis about the model parameters. Traditionally, this is done through null hypothesis significance testing (NHST) via p-values. However, in recent decades, methodologists and statisticians have increasingly advocated for Bayesian hypothesis evaluation (BHE) as an alternative. BHE offers several advantages, such as providing direct probabilistic statements about informative hypotheses and avoiding some of the drawbacks associated with NHST. Despite this, many applied researchers struggle to adopt BHE in more complex models such as multilevel models as they lack accessible tools and guidance.

For example, ethical committees and funding agencies require a motivation of the sample size by means of sample size determination (SSD) but in absence of closed-form equations for BHE, researchers must instead rely on Monte Carlo simulations. Available software that perform these simulations for BHE is often limited to simpler models such as t-tests and ANOVA, leaving researchers without a practical solution to perform SSD for their longitudinal trials.

To address these challenges, we present an open-source R software designed to carry out simulation-based Bayesian SSD in multilevel models for longitudinal trials in a user-friendly way. The software also accommodates various patterns of attrition (dropout), which are common in longitudinal studies and can significantly impact the power of these experiments. In addition, we provide a practical explanation of how to use and interpret the Approximate Adjusted Fractional Bayes Factor, an inferential tool for BHE that stands out for its simple and computationally inexpensive calculation.

By lowering the technical barriers to using BHE in multilevel models, we hope to contribute to bridging the gap between methodological advancements and practical application, enabling researchers to leverage the full potential of Bayesian methods in their work.

Keywords

Bayes Factor, Power, Multilevel, Attrition

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