Robust incorporation of external information in hypothesis testing

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When designing a clinical trial, external information about the control and/or treatment arm effect is often available. The Bayesian approach allows borrowing of such external information through the adoption of informative prior distributions. It is well known that borrowing can improve the trial's test error rates if external information is consistent with the current trial's data-generating process, while losses can be severe otherwise. Several robust approaches have been proposed to limit the impact of potentially heterogenous external information. However, it has been shown that no power gains are possible if strict control of type I error rate is desired [1]. Moreover, such approaches require the choice of tuning parameters and/or distributions which are often not intuitively related to their induced frequentist operating characteristics. We propose a method which explicitly aims at achieving a compromise between full and no borrowing in terms of type I error rate according to a selected weight parameter. The compromise is achieved by tuning test decision thresholds, and is applicable to both one and two-arm trials. When the selected test-decision threshold is data-dependent, in a two-arm situation and/or due to the data-dependence of the weight, the correspondence between the weight and type I error rate inflation is only approximate. However, an explicit upper bound on type I error rate can still be enforced. Such an upper bound may be of advantage in a regulatory setting and may improve the transparency in communicating the trial design. Simulations are performed to show the properties of the approach under various prior-data conflict and prior informativeness configurations.

[1] A. Kopp-Schneider, S. Calderazzo, M. Wiesenfarth, *Biometrical Journal*, 62(2):361–374.