

The posterior probability of a null hypothesis given a statistically significant result

Daniel Schad

University of Potsdam, Potsdam, Germany

Shravan Vasishth

University of Potsdam, Potsdam, Germany

Abstract

When researchers carry out a null hypothesis significance test, it is tempting to assume that a statistically significant result lowers $\text{Prob}(H_0)$, the probability of the null hypothesis being true. Technically, such a statement is meaningless for various reasons: e.g., the null hypothesis does not have a probability associated with it. However, it is possible to relax certain assumptions to compute the posterior probability $\text{Prob}(H_0)$ under repeated sampling. We show that the intuitively appealing belief, that $\text{Prob}(H_0)$ falls when significant results have been obtained under repeated sampling, is in general incorrect and depends greatly on: (a) the prior probability of the null being true; (b) Type I error, and (c) Type II error. Through simulation we quantify uncertainty and find that uncertainty about the null hypothesis often remains high despite a significant result. To help the reader develop intuitions about this common misconception, we provide a Shiny app (<https://danielschad.shinyapps.io/probnull/>).