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Title:

Bayesian hypothesis tests with diffuse priors: Can we have our cake and eat it too?

Abstract:

We introduce a new class of priors for Bayesian hypothesis testing, which we name ``cake priors''. These priors circumvent Bartlett's paradox (also called the Jeffreys-Lindley paradox); the problem associated with the use of diffuse priors leading to nonsensical statistical inferences. Cake priors allow the use of diffuse priors (having one cake) while achieving theoretically justified inferences (eating it too). We demonstrate this methodology for hypotheses tests, including scenarios under which the one and two sample t-tests, linear models, and generalized linear models are typically derived.

We develop a novel construct involving hypothetical data-model pair to extend cake priors to handle the case where there are zero free parameters under the null hypothesis. The resulting test statistic takes the form of a penalized likelihood ratio test statistic. By considering the sampling distribution under the null and alternative hypotheses we show (under certain assumptions) that these Bayesian hypothesis tests are strongly Chernoff-consistent, i.e., achieve zero type I and II errors asymptotically. This sharply contrasts with classical tests, where the level of the test is held constant and as such are not Chernoff-consistent. Lindley's paradox is also discussed from a frequentist perspective.