How to test hypothesis using Bayes Factor in behavioral sciences

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Recent times have seen a surge of Bayesian inference across the behavioral sciences. However, the process of testing hypothesis is often conceptually challenging or computationally costly. This tutorial provides an accessible, non-technical introduction that covers the most common scenarios in experimental sciences: Testing the evidence for an alternative hypothesis using Bayes Factor through the Savage Dickey approximation. This method is conceptually easy to understand and computatioanlly cheap.

Keywords: statistics, Bayes, Bayes Factor, Savage Dickey, hypothesis testing, ROPE

1 Introduction

To date, the most common quantitative approach across the experimental sciences is to run an experiment with one or more predictors and statistically test if there is evidence that these predictors affect the measured variables. Traditionally, this process has been done by form of null hypothesis significance testing. Over the last decade or so, however, we have seen more and more statistical approaches within an alternative inferential framework: Bayesian inference. Testing hypothesis within the Bayesian framework is often considered either conceptually challenging, computationally too costly, or both. This tutorial provides an accessible, non-technical introduction to Bayesian hypothesis testing that is easy to understand and computationally cheap.

2 Motivation and intended audience

This tutorial provides a very basic introduction to the topic using R (R Core Team, 2025). We wrote this tutorial with a particular reader in mind. If you have used R before and if you have a basic understanding of linear regression, and Bayesian inference, this tutorial is for you. We will remain mostly conceptual to provide you with a conceptual tool to approach hypothesis testing within Bayesian inference.

We just want to give you an impression of how a Bayesian regression analysis looks and feels. The tutorial covers the essential concepts and explains how to run and interpret the out- put of a Bayesian regression analysis using the wonderful R package brms written by Paul Buerkner (2016). If you don't have any experience with regression modeling, you will probably still be able to follow, but you might also want to consider doing a crash course. To bring you up to speed, we recommend the excellent two-part tutorial by Bodo Winter (2013) on mixed effects regression in a non-Bayesian — a.k.a. frequentist— paradigm. In a sense, this tutorial could be considered part three of the series started by Winter. We will for example use the same data set. To actively follow this tutorial, you should have R installed on your com- puter (https://www.r-project.org). Unless you already have a favorite editor for tinkering with R scripts, we recommend to try out RStu- dio (https://www.rstudio.com). You will also need some packages, which you can import with the following code:

2.1 Bayesian inference

Evaluating evidence quantitatively

2.2 Goals

2.3 What is Bayes Factor

2.4 Approximating BF with Savage Dickey

Politeness Data

2.5 BF for point null

2.6 Sensitivity analysis for different priors

2.7 BF for a Region of Practical Equivalence (ROPE)

2.8 How to chose a ROPE?

- theoretically derived?
  - communicatively relevant?
- standardized effect sizes?

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The authors have no conflict of interest to declare.
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2.9 Sensitivity analysis for different priors and ROPEs

2.10 Write up

Do's Do think think about sensible priors think about sensible ropes think about the smallest effect sizes of interest instead of testing point-0

Don'ts Don't fall into the trap of discrete thresholds. Don't hack ropes