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An Introduction to Bayesian Evaluation of Informative Hypotheses

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1.1 Bayesian Evaluation of Informative Hypotheses

Null hypothesis significance testing (NHST) is one of the main research tools in social and behavioral research. It requires the specification of a null hypothesis, an alternative hypothesis, and data in order to test the null hypothesis. The main result of a NHST is a p-value [3]. An example of a null hypothesis and a corresponding alternative hypothesis for a one-way analysis of variance is:

$$H_0 : \mu_1 = \mu_2 = \mu_3$$

and

$$H_a : \mu_1, \mu_2, \text{ and } \mu_3, \text{are not all equal,}$$

where μ_1, μ_2, and μ_3 represent the average score on the dependent variable of interest in three independent groups. The implication of the null hypothesis has been often criticized. Cohen [1] calls it the "nil hypothesis" because he finds it hard to imagine situations, especially in psychological research, where "nothing is going on," and three means are exactly equal to each other. The meaning of the alternative hypothesis can also be criticized. If H_0 is rejected, and thus H_a is implicitly accepted, we find ourselves in a situation that can be labelled "something is going on but we don't know what." Knowing that three means are not all equal (H_a) does not tell us which means are different or what the order of the means is. Stated otherwise, the null hypothesis describes the population of interest in an unrealistic manner, and the alternative hypothesis describes the population of interest in an uninformative manner.

In this book we will introduce and exemplify the use of informative hypotheses. An informative hypothesis can be constructed using inequality ($<$ denotes smaller than and $>$ denotes larger than) and about equality ($\approx$) constraints. Two examples of informative hypotheses are

$$H_{1a} : \mu_1 > \mu_2 > \mu_3$$