Corrigendum for "A Practical Solution to the Pervasive Problems of p Values", *Psychonomic Bulletin & Review, 14*, 779–804

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This corrigendum points out two mistakes in the original article (Wagenmakers, 2007) and also shows how to use the R program for statistical computing (R Development Core Team, 2004) to automatically obtain BIC values for a wide range of different models.

Notation

In the original article, all stochastic quantities —whether discrete or continuous— were preceded by "Pr", falsely suggesting that $\Pr(\theta)$ and $\Pr(\theta|D)$ (i.e., the continuous prior and posterior densities for a parameter θ) denote probabilities. This suggestion is false because for continuous densities, the probability of any single value is zero. The probability of θ lying in an interval, say between a and b, is given by the area under the density ranging from a and b. Therefore, in the case of these continuous densities, it would have been correct to write, say, $p(\theta)$ and $p(\theta|D)$.

Multiplication of BICs

In Wagenmakers (2007, p.796–797), I stated that

> "For instance, if data from an experiment yielded $\text{BIC}(H_0) = 1211.0$ and $\text{BIC}(H_1) = 1216.4$, the Bayes factor in favor of H_0 would be $\exp(5.4/2) \approx 14.9$. With equal priors on the models, this would amount to a posterior probability of H_0 of $14.9/15.9 \approx .94$ (...) Now consider a similar experiment that finds

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> BIC(H_0) = 1532.4 and BIC(H_1) = 1534.2. For this experiment, the Bayes factor in favor of H_0 equals $\exp(1.8/2) \approx 2.5$. The Bayes factors from these two experiments can be combined into an overall Bayes factor by simple multiplication: $BF_{01}(\text{total}) = 14.9 \times 2.5 = 37.25$. This corresponds to a posterior probability of H_0 of $37.25/38.25 \approx .97$ (...)"

Despite its intuitive plausibility, this statement is false. The BIC uses an implicit prior (i.e., the unit information prior) and when the BIC is calculated for the second experiment this implicit prior is effectively used twice. This violates the principles of Bayesian updating, who prescribe that priors are changed by the data, so that the prior before seeing the data from the second experiment is the posterior after seeing the data from the first experiment.

Denote Experiments 1 and 2 by E_1 and E_2, respectively, and denote the Bayes factor in favor of H_0 over H_1 by BF_{01}. Then, the Bayes factor for the complete data set, $BF_{01}(E_1, E_2)$ is given by (O'Hagan & Forster, 2004, p. 186):

$$BF_{01}(E_1, E_2) = BF_{01}(E_1) \times BF_{01}(E_2|E_1). \tag{1}$$

Calculation of BIC

Since the publication of the original article, several researchers have contacted me with questions on how to compute the BIC for specific designs. Although SPSS–users can follow the prescription in Glover and Dixon (2004), another option is to carry out the analyses in the R package for statistical computing (R Development Core Team, 2004). In R, the package `nlme` contains the command "BIC", which returns the desired BIC value for any model that is fit by maximum likelihood.

Specifically, after installing R, and after installing the R package `nlme` (Pinheiro & Bates, 2000), you can execute the following code to make the nlme package available:

```
> library(nlme)
```

It is then easy to follow the examples and compute BIC values for a wide range of different models.

References

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