AND IF YOU WERE A BAYESIAN WITHOUT KNOWING IT?

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Abstract

Many statistical users misinterpret the p-values of significance tests as "inverse" probabilities ($1 - p$ is "the probability that the alternative hypothesis is true"). As is the case with significance tests, the frequentist interpretation of a 95% confidence interval involves a long run repetition of the same experiment: in the long run 95% of computed confidence intervals will contain the "true value" of the parameter; each interval in isolation has either a 0 or 100% probability of containing it. Unfortunately treating the data as random even after observation is so strange this "correct" interpretation does not make sense for most users. Ironically it is the interpretation in (Bayesian) terms of "a *fixed* interval having a 95% chance of including the true value of interest" which is the appealing feature of confidence intervals. Moreover, these "heretic" misinterpretations of confidence intervals (and of significance tests) are encouraged by most statistical instructors who tolerate and even use them. For instance Pagano (1990, page 288), in a book which claims the goal of "*understanding statistics*", describes a 95% confidence interval as "an interval such that the probability is 0.95 that the interval contains the population value".

The literature is full of Bayesian interpretations of frequentist p-values and confidence levels. All the attempts to rectify these interpretations have been a loosing battle. In fact such interpretations suggest that most users are likely to be Bayesian "without knowing it" [2] and really want to make a different kind of inference [3].

References:

[1] Pagano, R. R., *Understanding Statistics in the Behavioral Sciences* (1990, 3rd edition), West, St. Paul, MN.

[2] Lecoutre B., Et si vous étiez un bayésien "qui s'ignore"? *La Revue de Modulad* 32 (2005) [http://www-rocq.inria.fr/axis/modulad/archives/numero-32/lecoutre-32 /lecoutre-32.pdf].

[3] Lecoutre, B., Lecoutre, M.-P. & Poitevineau, J., Uses, abuses and misuses of significance tests in the scientific community: won't the Bayesian choice be unavoidable? *International Statistical Review* 69 (2001), 399-418.

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