Modern Bayesian Statistics in Clinical Research
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The current textbook has been written as a help to medical/health professionals and students for the study of modern Bayesian statistics, where posterior and prior odds have been replaced with posterior and prior likelihood distributions. Why may likelihood distributions estimate uncertainties of statistical test results better than normal distributions? Nobody knows for sure, and the use of likelihood distributions instead of normal distributions for the purpose has only just begun, but already everybody is trying and using them. SPSS statistical software version 25 (2017) has started to provide a combined module entitled Bayesian Statistics including almost all of the modern Bayesian tests (Bayesian t-tests, analysis of variance (anova), linear regression, crosstabs, etc.).

First of all, Bayesian and traditional tests are different. Bayesian tests assess whether a new treatment is better than control. Traditional tests, in contrast, test whether a new treatment is not better than control and then try and reject this null hypothesis of no difference. A number of arguments in favor of Bayesian methodologies can be given. Bayesian tests work with 95% credible intervals that are usually somewhat wider than the traditional 95% confidence intervals, and this is fine, because it may reduce the chance of statistical significances with little clinical relevance. Also, maximal likelihoods of likelihood distributions are not always identical to the mean effect of traditional tests, and this may be so, because biological likelihoods may better fit biological questions than numerical means do. In addition, Bayesian not only uses likelihood distributions but also ratios of likelihood distributions (Cauchy distributions) rather than ratios of Gaussian distributions, the latter of which are notorious for ill data fit. Fourth, Bayesian integral computations are very advanced and, therefore, give optimal precisions of complex functions and better so than traditional multiple mean calculations of nonrepresentative subsamples do. Fifth, with Bayesian testing type I and II errors need not be taken into account. Obviously, all of this sounds promising, and in the past few years, many scientists including econo-, socio-, and psychometricians are rather satisfied with the result patterns of modern Bayesian data analyses.

The authors are frequentists and know all too well that many of the above are speculative. For now we will stay modest. The advantage of Bayesian may be that a
somewhat better underlying structure of your null and alternative hypotheses is
given. Otherwise, it looks of course much like traditional statistics: a very small
Bayes factor generally corresponds to a very small p-value. The problem for non-
mathematicians is that integral calculations are needed to compute precise areas
under the curve.

The current edition will begin with a brief review of the past and some explana-
tory chapters of modern Bayesian statistics. Then, step-by-step analyses will be
given of clinical data examples according to SPSS’ s recipes. Also Bayesian MCMC
(Markov Chain Monte Carlo) samplings and the current search for causal relations-
ships with Bayesian structural equation modeling will be addressed as methods
where Bayesian statistics successfully helped fostering the deepest enigma of man-
kind, the proof of causality. We should add that each chapter can be studied as a
stand-alone without the need for information from the other chapters. Both real data
and hypothesized self-assessment data files are in extras.springer.com. We do hope
that the current edition will be helpful to the medical and health community for
which the dedication to the search for causalities is more vital than it is for most
other disciplines.

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