ABDUCTED BY BAYESIANS

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This paper discusses the role of theoretical notions in Bayesian statistical inference. Let us say that the observational content of statistical hypotheses is given by their likelihoods, and that any distinction between hypotheses that is not reflected in a difference in likelihoods is based on a theoretical notion. Typical examples of such theoretical notions are simplicity and explanatory force: two hypotheses may predict the observations according to identical probability models, yet the one hypotheses may be simpler, or associated with a better story on the underlying mechanism, than the other. The aim of this paper is to elucidate the use of these theoretical notions. It will be argued that even within Bayesian statistical inference, such notions can play an active role. These considerations lead to the claim that the underdetermination resulting from theoretical notions is better seen as a methodological tool, and that the use of theoretical notions in statistical inference determines a Bayesian model of abduction.

The paper first discusses Bayesian inference of predictions using statistical hypotheses. Because the statistical hypotheses are supposed to differ in likelihood, the notion distinguishing the hypotheses is, according to the foregoing, not theoretical. But on the other hand, the likelihoods are typically associated with the rather theoretical notion of chance, and using De Finetti's representation theorem it may even be argued that the hypotheses concerning these chances can and must be eliminated from the scheme. Against this view, I argue that hypotheses on chances serve a specific purpose. They express the chance mechanism that is supposed to underlie the observations, and additional knowledge of these mechanisms can be expressed conveniently in a prior probability over them. Finally, in many cases the use of hypotheses allows for an easier calculation of the conclusions of the statistical inference.

The paper then shifts attention to inferences using two exactly identical partitions, distinguished by the entirely theoretical notion that they posit different mechanisms underlying the observations. At first sight, it seems pointless to use such duplicate partitions. However, I will argue that the underlying mechanisms may motivate different prior probabilities over these two partitions. So the reason for using theoretical notions, thereby creating duplicate partitions, is that these notions facilitate the expression of knowledge of underlying mechanisms in the overall prior. The upshot is thus the same as the upshot of the first part of the paper: theoretical notions, such as chance and mechanism, are useful for translating our knowledge into the prior probabilities that serve as input to a Bayesian statistical inference, and further for efficiently deriving the conclusions of the inference.

In the final part of the paper, these considerations are tranferred to scientific methodology more generally. The first claim deriving from this is that theoretical concepts offer a better grip on experimental testing in the two ways suggested above, namely by facilitating the expression of knowledge of underlying mechanisms in priors, and by carving up statistical inference in manageable parts. In other words, the underdetermination created by theoretical notions serves a specific purpose in scientific method. The second claim follows from the observation that in cases like the above one, Bayesian statistics provides the reasons for choosing between hypotheses that are only theoretically distinct. Such choices are usually considered to involve abductive inference. We may therefore argue that the above cases determine a Bayesian model of abductive inference.