

# Updating Probabilities with Data and Expectation Values

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## Abstract

The two preeminent updating methods are the ME method and Bayes' rule. The choice between the two methods has traditionally been dictated by the nature of the information being processed (either constraints or observed data) but questions about their compatibility are regularly raised. Our first objective is to quickly review how data is introduced into the ME method following [1].

Next we point out the potential pitfalls of ME updating when applying more than one constraint. One may get different results if the information is *not* used *simultaneously*. This is illustrated by way of picture and proof. The proof is similar to that of Karbelkar. It is important to note that it may be impossible to maximize constraints simultaneously if the situation is that one cannot retrieve one's original information (prior, constraint, etc.) due to some *irreversible* process such as *erasure*.

The main result of this paper is to show a general example of updating with two different forms of information, expectation values and observable data. The final solution will resemble Bayes' Rule. The difference between this solution and the traditional Bayes form results from using the expectation value constraint. This constraint modifies the usual Bayesian likelihood. In an effort to put some names to these pieces we will call the standard Bayesian likelihood the *likelihood* and the part associated with the expectation value the *constraint-likelihood* so that the product of the two gives the *modified-likelihood*.

It is critical to note that, as is shown in the examples that will follow, any work done with Bayesian techniques can be implemented into the ME method directly and *as is*. There is no need to 'reinterpret' the distributions obtained by Bayesian methods for use in ME, all Bayesian work can be directly applied.

## References:

[1] A. Caticha and A. Giffin, "Updating Probabilities", *Bayesian Inference and Maximum Entropy Methods in Science and Engineering*, ed. by Ali Mohammad-Djafari, AIP Conf. Proc. **872**, 31 (2006) (<http://arxiv.org/abs/physics/0608185>).

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