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DISCUSSION OF KYBURG'S "BELIEVING ON THE BASIS OF THE EVIDENCE"

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In his paper, Kyburg describes an evidential theory of epistemic beliefs based on probability theory. He calls his theory "evidential probability." Given some background knowledge and some evidence, Kyburg defines inferring (or believing in) a proposition if the posterior probability of the proposition is at least $1 - \varepsilon$ for some fixed $\varepsilon > 0$, such that $1 - \varepsilon > 1/2$. Kyburg also sketches a decision theory based on evidential probability that is analogous to the MEU theory based on Bayesian probability theory.

As Spohn (1988) has pointed out this notion of epistemic belief is problematic. As per the notion of plain belief, if we believe in proposition A and we believe in proposition B, then we believe in proposition $A\&B$. This condition is not satisfied in evidential probability. As noted by Kyburg, having evidential certainty for A and evidential certainty for B, does not necessarily provide evidential certainty for $A\&B$. Kyburg attempts to fix this problem with the notion of "practical certainty." A proposition is practically certain if its posterior probability (given the background knowledge and evidence) is at least $1 - 2\varepsilon$. If A is evidentially certain, and B is evidentially certain, then $A\&B$ is practically certain. So now we have two corpora of knowledge—an evidential corpus and a practical corpus. This raises an entire new set of problems. If A is practically certain, and B is practically certain, what can we say about $A\&B$? More remains to be done on this problem before evidential probability becomes a practical calculus for uncertain reasoning.

An uncertainty calculus that does what Kyburg sets out to do is Spohn's theory of epistemic beliefs (Spohn 1988). In Spohn's theory, an epistemic state is represented by an ordinal conditional function. Spohn's theory includes a rule for revising beliefs in light of new evidence, and a rule for finding marginals. Goldszmidt and Pearl (1992a; 1992b; 1992c) have rediscovered Spohn's theory starting from logic and attempting to reason qualitatively with probability. Pearl (1991) has interpreted the values of Spohn's ordinal conditional functions in terms of infinitesimal probabilities. Hunter (1990) and Shenoy (1991; 1992) have shown that one can reason with Spohn's theory using local computation. In many ways, Spohn's calculus is probabilistic, and in other ways, it is nonprobabilistic (Spohn 1990; 1993). Unlike Kyburg's evidential probability, Spohn's theory suffers from the lottery paradox.

Reasoning with quantitative probability can be computationally intractable for real-world problems. Thus there is considerable upside potential in developing a tractable qualitative probability calculus. Kyburg's evidential probability theory and Spohn's epistemic belief theory make important contributions to uncertain reasoning that no student of artificial intelligence could ignore.

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