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**A cognitive framework for normative reasoning under uncertainty, and reasoning about risk, and implications for educational practice.**

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Summary: Clarifying what is normative or appropriate reasoning under various circumstances provides a valuable reference for guiding what should be taught, and, in contrast, what should not be. This paper proposes a cognitive framework for viewing normative reasoning and behavior under uncertainty, including the applying of knowledge of probability and statistics in real world situations; and identifies implications for educational practice. Factors relevant to normative reasoning under uncertainty that are addressed within the framework include: risk of misapplying statistics knowledge, involvement of mathematical and non-mathematical reasoning, knowledge of real world domains and situation/application detail, and existence of expert consensus. The cognitive framework is illustrated using examples of reasoning about risk, including industry standards for risk management. The work of *A. Tversky* and *D. Kahneman* ["Judgment and uncertainty: heuristics and biases", *Science* 185, 1124–1131 (1974)], *G. Gigerenzer* ["On narrow norms and vague heuristics: a reply to Kahnemann and Tversky", *Psychol. Rev.* 103, 592–596 (1996)], and others is related to and contrasted to the framework presented.

*Classification:* K70 K90 M40 C30 D70

*Keywords:* risk; stochastics; statistics; probability theory; learning objectives; real life mathematics; risk management; reasoning under uncertainty; statistical reasoning; probabilistic reasoning; teaching; errors; misconceptions; statistics application; goals of mathematics education; stochastic thinking  
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