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Skewed noise ☆

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Abstract

We study the attitude of decision makers to skewed noise. For a binary lottery that yields the better outcome with probability p, we identify noise around p with a compound lottery that induces a distribution over the exact value of the probability and has an average value p. We propose and characterize a new notion of skewed distributions, and use a recursive non-expected utility to provide conditions under which rejection of symmetric noise implies rejection of negatively skewed noise, yet does not preclude acceptance of some positively skewed noise, in agreement with recent experimental evidence. In the context of decision making under uncertainty, our model permits the co-existence of aversion to symmetric ambiguity (as in Ellsberg's paradox) and ambiguity seeking for low likelihood "good" events.

JEL classification: D80; D81

Keywords: Skewed distributions; Compound lotteries; Recursive non-expected utility; Ambiguity aversion and seeking

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1. Introduction

Standard models of decision making under risk assume that individuals obey the reduction of compound lotteries axiom, according to which a decision maker is indifferent between any multi-stage lottery and the simple lottery that induces the same probability distribution over final outcomes. Experimental and empirical evidence suggest, however, that this axiom is often violated.[1] Individuals may have preferences over the timing of resolution of uncertainty, or they may distinguish between the source of risk in each stage and thus perceive risk as a multi-stage prospect, or they may care about the number and order of lotteries in which they participate.

The effect of such violations of the reduction axiom on behavior depends on the compound lotteries under consideration. Halevy (2007) and Miao and Zhong (2012), for example, consider preferences over two-stage lotteries and demonstrate that individuals are averse to the introduction of symmetric noise, that is, symmetric mean-preserving spread into the first-stage lottery. On the other hand, Boiney (1993) found a significant effect of skewed noise, where majority of the subjects in his experiments opted for positively skewed noise, but rejected negatively skewed noise. Specifically, his subjects had to choose one of three prospects, in all of which the overall probability of success (which results in a prize $\overline{x}$) is p, and with the remaining probability $\underline{x} < \overline{x}$ is received. In Option A the probability p was given. Prospect B (resp., C) represents a negatively (positively) skewed distribution around p in which it is very likely that the true probability slightly exceeds (falls below) p but it is also possible, albeit unlikely, that the true probability is much lower (higher). Boiney's main finding is that most subjects prefer C to A and A to B. Moreover, these preferences are robust to different values of $\overline{x} > \underline{x}$ and p.

In Boiney's experiment, the underlying probability of success p was the same in all options. In recent experiments, Abdellaoui et al. (2013) and Abdellaoui et al. (2015) found strong evidence that aversion to compound risk (i.e., noise) is an increasing function of p. In particular, their results are consistent with a greater aversion to negatively skewed noise around high probabilities than to positively skewed noise around small probabilities.

In this paper we propose a model that can accommodate the behavioral patterns discussed above. For a binary lottery $(\overline{x}, p; \underline{x}, 1-p)$ with $\overline{x} > \underline{x}$, we identify noise around p with a two-stage lottery that induces a distribution over the exact value of the probability and has an average value p. We introduce and characterize a new notion of skewness, and use a version of Segal's (1990) recursive non-expected utility model to outline conditions under which a decision maker who always rejects symmetric noise will also reject any negatively skewed noise but may seek some positively skewed noise.

We apply our model to the recently documented phenomenon of some ambiguity seeking in the context of decision making under uncertainty. The recursive model was first suggested by Segal (1987) as a way to analyze attitudes towards ambiguity. Under this interpretation, ambiguity is identified as a two-stage lottery, where the first stage captures the decision maker's subjective uncertainty about the true probability distribution over the states of the world, and the second stage determines the probability of each outcome, conditional on the probability distribution that has been realized. Our model permits the co-existence of aversion to symmetric ambiguity (as in Ellsberg's (1961) famous paradox) and ambiguity seeking in situations where the decision maker anticipates a bad outcome, yet believes that there is a small chance that things are not as bad as they seem. Simple intuition, as well as some experimental evidence, suggests

[1] See, among others, Kahneman and Tversky (1979), Bernasconi and Loomes (1992), Conlisk (1989), and Harrison et al. (2012).