αMaximin for Ambiguity with Probability Weighting: An Experimental Investigation

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Abstract

Although the standard model of rational choice under ambiguity, i.e., subjective expected utility, suggested using subjective probabilities to measure uncertainty, it is nowadays common knowledge that this claim is contradicted by Ellsbergs paradoxes and subsequent experiments. In his two-color paradox, Ellsberg argued that most decision makers prefer betting on a known urn containing 50 red and 50 black balls than betting on an unknown urn containing 100 black and red balls in unknown proportions. Formally, this means that people prefer the risky option giving a prize with probability $p = 0.5$ to the ambiguous option giving the same prize with $p \in [0, 1]$, i.e. the winning probability is somewhere between 0 and 1. Many subsequent Ellsberg-like experiments refined the initial two-color example by focusing on the general case where the winning probability p belongs to subintervals $[p_\star, p^\star]$.

The present paper reports the results of an experimental investigation that aims at understanding how decision makers evaluate probability-interval-based ambiguous bets within an Ellsberg-like setup. Ambiguous bets are not explicitly interpreted in terms of second-order risk as in many multiple-prior-based models of ambiguity. Instead, we primarily consider objects of choice $x_{[p_\star, p^\star]}y$ where the decision maker knows that she will get x with a winning probability lying somewhere between $p_\star$ and $p^\star$, and y otherwise. Additionally, we postulate that decision makers evaluate ambiguous bets $x_{[p_\star, p^\star]}y$ by subjectively combining the values of envelope (extreme) lotteries $L_\star = x_{p_\star}y$ and $L^\star = x_{p^\star}y$. The weight assigned to the upper (lower) envelope depends on the decision makers optimism/pessimism. Specifically, we assume that (i) the decision maker evaluates individual lotteries using rank-dependent utility (RDU); and that (ii) the value of an ambiguous bet $x_{[p_\star, p^\star]}y$ is given by the convex combination of RDU values of the envelope lotteries, i.e.,

$$\alpha RDU^\star(L^\star) + (1 - \alpha) RDU_\star(L_\star) \quad (1)$$

where notation $RDU^\star$ and $RDU_\star$ means appealing to a weighting function for upper bound probabilities and a possibly different weighting function for lower bound probabilities respectively. Ambiguity attitude is captured by the coefficient α. It reflects decision makers optimism/ pessimism.

We elicited this model in a laboratory experiment involving 62 subjects. All the components of the model are estimated at the individual level using discrete choice modelling.

Our results are consistant with previous research on ambiguity attitudes: subjects exhibit ambiguity aversion in the standard Ellsberg case, and their ambiguity attitudes vary with the size and location of the interval of probabilities. In terms of our model, we observe that probability weighting of the upper bound is radically different from probability weighting of the lower bound: the former is concave whereas the later is convex. This pattern receives the following psychological interpretation. Upper-probability weighting carries the possibility effect, whereas lower-probability weighting carries the certainty effect. Eventually, the convex combination of these two fonctions allows to recover the inverse-S shape probability weighting generally observed for risk. Therefore, our model not only explains ambiguity attitudes but also offers a new insight to understand the shape of probability weighting under risk.