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Randomization devices and the elicitation of ambiguity-averse preferences

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Abstract

In random incentive mechanisms agents choose from multiple problems and a randomization device selects a single problem to determine payment. Agents are assumed to act as if they faced each problem on its own. While this approach is valid when agents are expected utility maximizers, ambiguity-averse agents may use the randomization device to hedge and thereby contaminate the data.

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1. Introduction

Experimental economists often ask subjects to choose from several different problems simultaneously. One of these problems is then randomly drawn; the subject's choice from this problem determines the outcome of the experiment. The agent might, for example, be asked to report choices from six different sets of bets, with the experimenter then rolling a die to determine which of the six choices is payoff-relevant. Any experimental design which uses a randomization device to elicit choices from several problems is a **random incentive mechanism**.

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If a subject's choice from each separate problem is identical to his choice from the same problem when it appears as part of a random incentive mechanism, the mechanism has many advantages over separate single choice experiments. First, large sets of data can be elicited with one payment. Second, payments do not accrue; so the later choices in an experiment are not affected by the agent's earlier earnings or losses. Finally and most importantly, to check for behavioral regularities we must elicit choices from various problems; a single choice experiment carries no information about the consistency of an agent's behavior. But if an agent's behavior in a random incentive mechanism differs from his behavior in separate choice situations it is not clear how one should interpret the data generated by the mechanism.

Random incentive mechanisms have been used widely in the experimental literature on ambiguity aversion (Camerer and Weber, 1992; Halevy, 2007 and Ahn et al., 2014). However, there are no theoretical results on the incentives for ambiguity-averse agents to reveal their true preferences in such mechanisms. The present study argues that random incentive mechanisms stand on shaky ground when agents are ambiguity-averse. Consider a mechanism that is designed to elicit preferences over ambiguous acts. Let all acts that the agent can choose in the mechanism be conditioned on a set of possibly ambiguous events. If this set of events is independent of the randomization device then the agent can use the randomization device to hedge against the ambiguity associated with his choices. Preference reversals, where agents behave differently in random incentive mechanisms and in single choice experiments, will occur.

Example *(An urn and a coin).* There is an urn filled with 30 blue balls and 60 green and red balls in unknown proportion. We are interested in an agent's preferences over "urn-acts" $f = (f(B), f(G), f(R))$ where $f(B)$, $f(G)$ and $f(R)$ denote the agent's utility-payoffs in the events B, G, and R that a blue, green, or red ball is drawn.[1] Let the agent choose among a "blue act" that delivers utility 5 when a blue ball is drawn from the urn, a "green act" that delivers utility 9 when a green ball is drawn and a "red act" which also delivers 9 when a red ball is drawn. Represent these acts as $\mathit{blue} := (5, 0, 0)$, $\mathit{green} := (0, 9, 0)$ and $\mathit{red} := (0, 0, 9)$.

Assuming our agent believes that the probability of a blue ball is $\frac{1}{3}$ the preference $\mathit{blue} \succ \mathit{green} \sim \mathit{red}$ is inconsistent with expected utility theory. If our agent was an expected utility maximizer he would have to believe that either R or G occurs with a probability of at least $\frac{1}{3}$. Consequently his preferred act among *red* and *green* would have to deliver an expected utility of at least $\frac{1}{3} \times 9$ whereas *blue* delivers only $\frac{1}{3} \times 5$. But an ambiguity-averse agent might well prefer the objective lottery *blue* to the acts *green* and *red* that leave winning probabilities uncertain. Would an ambiguity-averse agent reveal the preference $\mathit{blue} \succ \mathit{green} \sim \mathit{red}$ in a random incentive mechanism?

To pose this question concretely, let the preference $\succsim$ over acts f be represented by a maxmin expected utility $U(f) = \min_{\pi \in C} \sum_{\Omega} f(\omega)\pi(\omega)$. Unlike an expected utility maximizer our agent holds a set of beliefs C on the state space Ω, not a single prior. He calculates an expected utility with respect to every prior in C and evaluates his overall utility as the lowest among these. To match our assumption that the agent believes a blue ball is drawn with probability $\frac{1}{3}$, let $\pi(B) = \frac{1}{3}$ hold for all $\pi \in C$. To reflect the agent's uncertainty about the probabilities of green and red

[1] The assumption that acts map to lotteries over outcomes is more common. If we assume that an agent's preference over objective lotteries has an expected utility representation, we can derive acts f which directly map states to utilities from more basic acts g which map to lotteries over outcomes by letting $f(\omega) = u(g(\omega))$ for every state ω.