Measuring the Degree of Ambiguity about Probability: Experimental Evidence[*]

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Abstract

Different from previous studies that use a best estimate, interval, or sets of probabilities, we represent the degree of ambiguity through levels of information provided to subjects. The willingness to pay is higher when more amount of information is provided.

Key words: experiments, ambiguity, uncertainty, probability

JEL-classification: C92

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[*] We would like to thank Mark Machina for a very stimulating conversation on modeling degree of uncertainty.

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1. Introduction

Different representations of probabilistic ambiguity are used in experiments: a best estimate of the probability (Einhorn and Hogarth, 1985), an interval of probability (Hogarth and Kunreuther, 1989), and the sets of probabilities (Gardenfors and Sahlin, 1982; Sarin and Weber, 1993). These representations can be used to estimate many different theoretical models (Di Mauro and Maffioletti, 2001, page 201). It is not clear which representation method is better to use for theoretical estimation in the experiments. Some scholars could not confirm that expanding the interval range of probabilities increases ambiguity avoidance (Curley and Yates, 1985; Larson, 1980), contrary to Becker and Brownson's (1964). In Highhouse (1994), however, presentation of an interval estimate leads to ambiguity seeking and presentation of a point estimate leads to ambiguity avoidance. Di Mauro and Maffioletti (2001) concluded that in general there is no salient difference among the three representations.

This paper aims to experimentally investigate how individual willingness to pay for a lottery is affected by using a new way of representing of probabilistic ambiguity. Thus we can see how individual valuation reacts to *different degrees of ambiguity* probability information provided to subjects. That way, we can also eliminate "anchoring and adjustment" problem of best estimate or interval representations (Einhorn and Hogarth, 1985) and selection of unreliable probabilities of sets of probabilities representation (Gardenfors and Sarin, 1982).

The paper is organized as follows: the experimental design is explained in the next section followed by the results and conclusions in section 3.

2. Experiment

The experiment was run in December 2005 at the experimental economics laboratory of The Strategic Interaction Group at the Max Planck Institute of Economics in Jena. The software of the computerized experiment has been developed in z-Tree (Fischbacher, 1999). 64 students from Jena University were recruited to participate in the experiment using the ORSEE software (Greiner, 2004). Participants received written instructions after being seated at a computer terminal.[3] The age of the 39 females and 25 males ranged respectively from 19 to 31 with an average of 24.64 years, and from 18 to 30 with an average of 22.97 years. The average earnings amounted to 10.97 Euro (sd = 3.43 Euro) for a duration of 60 minutes.

In the experiment, each of the 25 lottery (figure 1)[4] is represented to all 64 subjects by presenting them 20 balls in a row with colors of Green (☒) and Red (☒).If red ball comes up, they will get nothing, if a green ball comes up they will earn €10. If all 20 balls are colored, then subjects have full probability information, if some of the balls are uncolored, we say that they have incomplete probability information. Further, as the number of uncolored (☐) balls increases, the degree of uncertainty increases. Then they are asked to indicate their maximum buying price, for each lottery where their monetary

[3] The original instructions were in German. Both, German instructions or an English translation are available on request.

[4] There are 18 lotteries with uncertain probabilities and 7 with certain probabilities (0.5, 0.25, 0.75, and 0.8). It is important to note that participants were shown the lotteries with uncertain probabilities before the ones with certain probabilities to eliminate the anchor effect.

endowment is 10€. At the end of the experiment, one lottery is selected randomly to play for real what determines the cash payments.[5]

Figure 1

3. Results and Conclusions

According to the results in Table 1, the average willingness to pay for high probabilities of gain is lower than for a lottery with certain probability, and decreases further as the uncertainty of the probability increases (number of uncolored balls increases).

Table 1

Moreover, we measure uncertainty attitude by the ratio of WTP for uncertain probability to WTP for certain probability. Individuals are uncertainty averse for high probability of gain and uncertainty seekers for low probability of gain, consistent with the result of Di Mauro and Maffioletti (2004).

In summary, our representation of ambiguity about the probability with different degress of probability information can be used as an alternative method to no information or just one point information (such as best estimate probability) or one range of information (such as an interval of probabilities) in the experiments on individual valuation (choice) towards uncertainty.

[5] In order to play the uncertain lotteries for real, we generated random numbers between 0 and 20 to determine the number of red balls on a row.

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Probability of gain	Degree of uncertainty (uncolored/total)	Expected Value	WTP-certain probability	WTP-uncertain probability	WTP-uncertain prob./WTP-certain prob.
0.8	15/20	8	4.325	1.800	0.416
0.8	10/20	8	4.325	2.722	0.629
0.8	5/20	8	4.325	3.386	0.783
0.75	16/20	7.5	5.625	3.067	0.545
0.75	12/20	7.5	5.625	2.770	0.493
0.75	8/20	7.5	5.625	3.002	0.534
0.75	4/20	7.5	5.625	3.145	0.559
0.5	20/20	5	4.080	3.538	0.867
0.5	18/20	5	4.080	2.820	0.691
0.5	14/20	5	4.080	2.314	0.567
0.5	10/20	5	4.080	3.233	0.792
0.5	6/20	5	4.080	2.848	0.698
0.5	2/20	5	4.080	2.286	0.560
0.25	16/20	2.5	0.422	1.117	2.648
0.25	12/20	2.5	0.422	1.667	3.952
0.25	8/20	2.5	0.422	2.116	5.015
0.25	4/20	2.5	0.422	1.292	3.063

Table 1: Subjects Attitude Toward Uncertainty

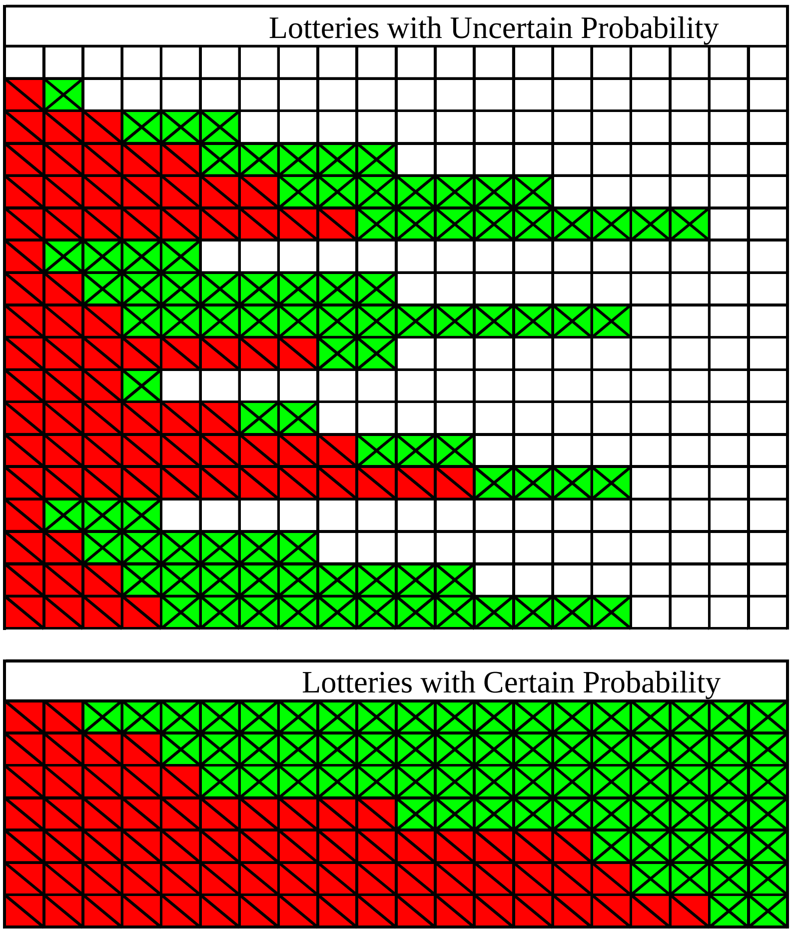

Figure 1: Representation of the Lotteries