EC 438.01 Experimental Economics

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3 June 2022

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1. Introduction

Education plays an important part in growth and development, not just on a national level but also in a personal level. Developed countries seem to have better quality education systems. People who are members of those countries have a better chance of acting rationally when faced with difficult questions.

Than we raise the question “Does education and prior knowledge have an impact on people’s rational decision-making?” To assess this issue, we conducted an experiment with ---- people which consisted mostly of Bogazici University students. We take the set-up of Prospect Theory developed by Daniel Kahneman and Amos Tversky in 1979 to examine our main question. In addition to the impact of education we also test people’s behaviour described in Prospect Theory in our own experiment.

Prospect Theory states that people value gains and losses differently. Kahneman and Tversky asked people between two options in two different scenarios with same expected utilities. One scenario involved a sure return option and a possible higher return options while the other involved a sure loss option and a possible no loss option. Results show that they seem to be risk averse when there is a gain and risk loving when they are faced with a loss. We take this statement as a starting point for our experiment. Our experiment was conducted as a survey. Participants were divided into two groups after they answer a question asking them to pick either an odd or an even number. People who picked “even” were given information about the calculation of expected utility while people who picked “odd” read some information about Jane Austen (random text not related to our experiment). We aimed to test if people behaved differently (more rationally) when they were either educated or in some cases reminded of the Expected Utility theory presented by Daniel Bernoulli.

The paper is organized as follows. Part 2 of the paper outlines the experimental design procedures. Part 3 examines theory. Part 4 states our hypothesis. Part 5 presents the results and part 6 discusses the findings and draws some tentative conclusions and suggestions for further work

2. Theory

Our questions to measure the decision under risk in our game setup are based on measuring the Prospect Theory developed by Daniel Kahneman and Amos Tversky in 1979.

Before moving on to this theory, which also won the Nobel Prize for Daniel Kahneman in 2002, it would be more accurate to refer to the Expected Utility theory presented by Daniel Bernoulli. The Expected Utility theory is aimed at calculating the optimal decisions of rational decision makers under a given risk probability, and in these calculations, decision makers are considered as individuals who are rational and try to choose the maximum value. However, observations and experiments have shown that people do not adhere to this mathematical inference in real life.

Prospect theory developed by Kahneman and Tversky actually provides an explanation for the criticisms made to the expected utility theory. This theory shows the inconsistency of individuals' preferences between the options that are actually the same in risky choices, depending on the presentation of these options.

$$U(p) = \sum u(x_k)p_k$$

As we can see from the formula here, the Expected Utility formula is the weighted sum of the results obtained by multiplying the utility values with their respective probabilities.

Let's calculate this mathematical calculation by addressing the first question in our experiment:

1. Imagine you have a total of $0, which one do you prefer?

   Option 1: If you choose this option, you will definitely win $75.

   Option 2: If you choose this option, there is a 20% probability that you will win $0, and 80% probability that you will win $100.

1. Imagine you have a total of $100; which one do you prefer?

   Option 1: If you choose this option, you will definitely lose $75.

   Option 2: If you choose this option; There is a 20% probability that you will lose $0, 80% probability that you will lose $100.

Here, if we simply take the process and say $U(x)=x$ to understand its logic:

For question 1, the expected utility of Option 1 is 75, and Option 2 is (0.2)*0+(0.8)*100= 80.

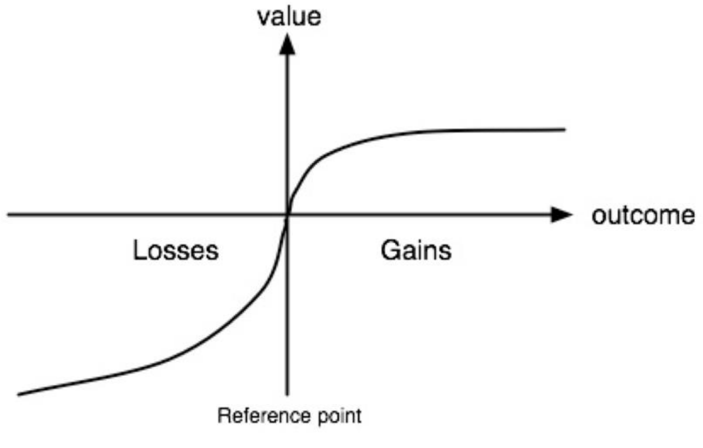
For question 2, while the expected loss of Option 1 is -75, it becomes (0.2)*0+(0.8)*(-100)= -80 for the second option.

Based on this theory, a decision maker trying to maximize his/her utility should choose Option 2 for Question 1 and Option 1 for Question 2. However, in real life, people may not act according to this rationality. As Daniel Kahneman and Amos Tversky observed, in our experiment, for example, we observed that people generally chose Option 1 for the first question and Option 2 for the second question. (We will elaborate on these inferences, our hypothesis, and our conclusions in the following sections.)

$$V= \sum w(p_i)*v(x_i)$$

In the specified equation, the probability of p outcome x is w(p) the probability weighing function and v(x) the value function. According to this function, according to the prospect theory of Daniel Kahneman and Amos Tversky, individuals tend to be risk-averse when it comes to gains, while they tend to exhibit risk-seeking behaviors when it comes to loss. In both these cases, individuals tend to choose the option with low expected value as we discussed in the example above, and when we examine these two options together, they tend to act inconsistent with the expected utility theory.

The fact that the Loss graph in Kahneman and Tversky's article is drawn more vertically than the gain graph is an inference that individuals give more importance to losses than gains.



In game theory mathematical inferences, it is assumed that all players are rational and have common knowledge. However, when we look at real life experiments, we can see situations where people cannot act rationally due to lack of knowledge.

The famous Allais paradox (1953) also argues that people's decisions at risk do not always adhere to the Expected utility theory and that they make irrational choices according to this theory. In order to examine the origin of these behaviors according to this inference, while teaching some of our experimental group the expected value calculation before going to the questions or creating a perception that they should remember this calculation if they already know, we had the rest of the participants read an article about Jane Austen, unrelated to our experiment. According to the “Allais for the Poor” paper (Hermann, Hübler, Menkhoff, Schmidt, 2016), they also find that inconsistent decisions made by individuals are related to being less able, that is, to being less educated. The conclusions of their experiments are better education, including improved numeracy, tend to reduce decision makers’ inconsistent behavior.

We created our experiment based on these theories and this research in the literature.

3. Research Hypotheses

3.1. Decision makers are prone to risk-averse behaviors when the given question is expressed in terms of gain, but risk-seeking when expressed in terms of loss at the same rate.

This hypothesis is based on the fact that people do not give consistent answers to the risks in terms of gain and loss, according to the Prospect theory, which we have mentioned in detail in the theory part of our article. Although the main difference of our game setup is to examine the effect on the decisions of the participants depending on whether we show the expected value calculation in front of them, we want to test this inference in the literature on our own participants, since we express the questions in our survey in different ways in terms of gain and loss. While people tend to choose the option with a risk-free return on the earnings side, in case of loss, they may overestimate the fact that they do not lose anything by choosing to take risks in order not to lose their endowment.

3.2. *Decision makers, who are taught or reminded of expected value calculation, are expected to give consistent answers according to the expected utility theory.*

If we attribute the fact that people do not act according to the expected utility theory to the fact that they are less educated or lack of knowledge, as we have examined in the literature, we hypothesize that their answers will become rational by closing this gap. In this context, the focus of our hypothesis is that the group, who was taught or reminded to calculate the expected value according to the "even number" answer to the question about the thrown dice, gave more rational, consistent answers in accordance with the expected utility theory than the group that was taught the Jane Austen story.

4. Experimental Design Procedures

This experiment was conducted by preparing a questionnaire and using the questionnaire online. The questionnaire was open for three days and was delivered to people in the very different backgrounds by the people who carried out this project. The experiment was conducted online via a questionnaire. 162 people participated in the experiment. 119 of these individuals are in the range of 18-25 years, 22 of them in 25-45 age range, 14 of them 45-65 age range, 5 of them 65 years old and above, 2 of them 0-18 age range. In addition, 84 of the participants are men, 76 are women, and 2 are people who do not want to specify their gender. In addition, the education levels of these participants are as follows: 129 of them are undergraduate, 15 of them are graduated, 13 of them are high school graduate, 2 of them are elementary school graduate and 3 of them are PhD level. We asked the participants two different questions before starting the experiment. We asked if they had taken a game theory course before or if they had any prior knowledge about game theory. 58 percent of the participants stated that they did not have any information about game theory, and 42 percent of them said that they had some information about game theory. On the other hand, we asked the participants about their levels of risk-taking and asked them to score between one and ten. 0 indicates the least, 10 indicates the most risk-taking level. Six people had chosen level 10, two people had chosen Level 9, twenty people had chosen Level 8, forty-five people had chosen levels 7, thirty-two people had chosen Level 6, twenty-five people had chosen 5 Levels, nineteen people had chosen level 4, twelve people had chosen level 3, two people had chosen Level 2 and one person had chosen level 2.

In the experiment, we randomly divided the participants into two groups. We gave a group a tutorial on calculating the expected value and showed a simple example question and answer. We had the other group read a text about Jane Austen that was unrelated to the expected value calculation. In this way, we have either taught or reminded a group to calculate the expected value. As for the other group, we actually had no effect on this second group in terms of the expected value calculation.

Then we asked 8 different questions to both of these groups. There are 4 of these 8 different problems in the gain domain and 4 of them in the loss domain. In each question, we gave the participants two options. For example, in the gain domain, we said that people will earn $75 for sure as the first option, people will earn $100 with an 80 percent probability, people will earn $0 with a 20 percent probability, as the second option. And in the loss domain, we told people that they had a budget of $ 100. Then we presented two option again that they would for sure lose $75 as the first option, and they would lose $100 with an 80 percent probability, they would lose $0 with a 20 percent probability, as the second option. We asked the same questions for each gain and loss domain with different probability values. These probability values are 70, 75, 80 and 85 percent. We asked one gain and one loss domain questions with the same probability value and asked people to select one option for each question.

Therefore, our treatment in this experiment is whether people learn or remember the expected value calculation. A group of people answered these questions by reading the expected value calculation text, that is, it means that they were either learning it or remembering it. The other group answered these eight questions without learning or remembering any information about the expected value calculation. Thus, we tried to measure whether we could change the options that participants would normally choose by teaching them or reminding them to calculate the expected value.

84 people of the participants were exposed to reading the page about the expected value calculations, while 74 people were exposed to reading the text about Jane Austen.

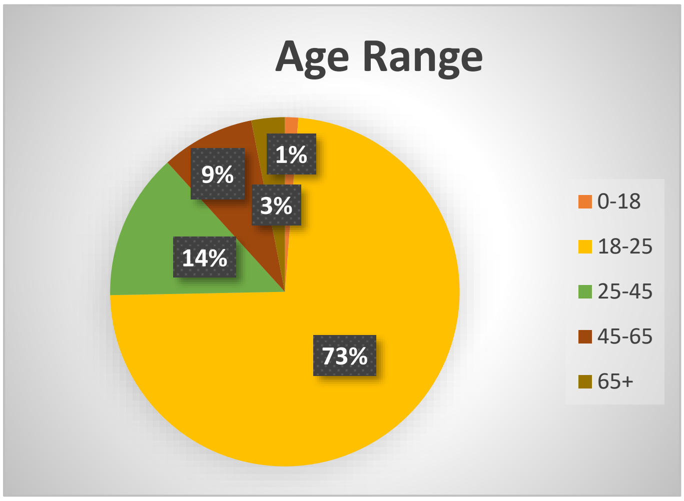
5. Results

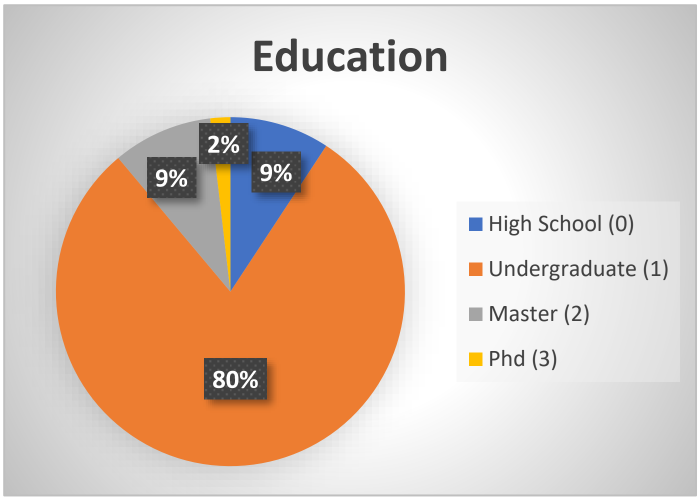
Summary Statistics

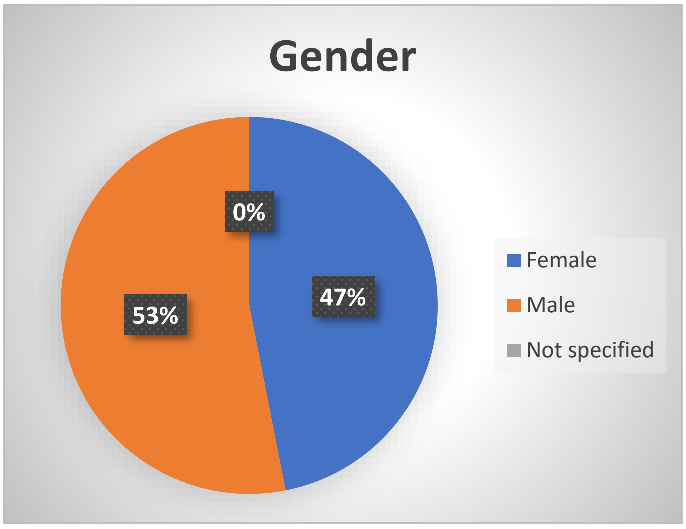
A total of 162 people filled out the questionnaire we created to collect data. 78 of these people are in the control group and 84 of them are in the treatment group. Age, education level and risk perception distributions of the people in the sample can be seen in the graphs below and in table 1 in summary statistics.

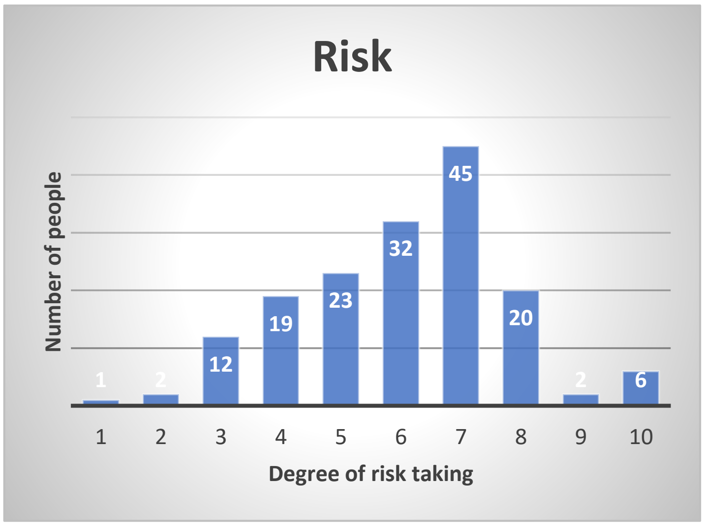
Table 1. Summary Statistics

	Treatment			Control			Total		
	N	**Mean**	**Std. Dev.**	**N**	**Mean**	**Std. Dev.**	**N**	**Mean**	**Std. Dev.**
Question 1	84	0,80	0,40	78	0,67	0,47	162	0,73	0,44
Question 2	84	0,26	0,44	78	0,32	0,47	162	0,29	0,46
Question 3	84	0,67	0,47	78	0,62	0,49	162	0,64	0,48
Question 4	84	0,38	0,49	78	0,31	0,46	162	0,35	0,48
Question 5	84	0,50	0,50	78	0,63	0,49	162	0,56	0,50
Question 6	84	0,45	0,50	78	0,38	0,49	162	0,42	0,50
Question 7	84	0,26	0,44	78	0,36	0,48	162	0,31	0,46
Question 8	84	0,69	0,47	78	0,65	0,48	162	0,67	0,47
risk	84	5,88	1,85	78	6,19	1,67	162	6,03	1,77
education	84	1,11	0,64	78	1,00	0,53	162	1,04	0,51
age	84	1,25	0,58	78	1,54	0,95	162	1,39	0,79
Game Theory (1 if Yes)	84	0,46	0,50	78	0,36	0,48	162	0,41	0,49





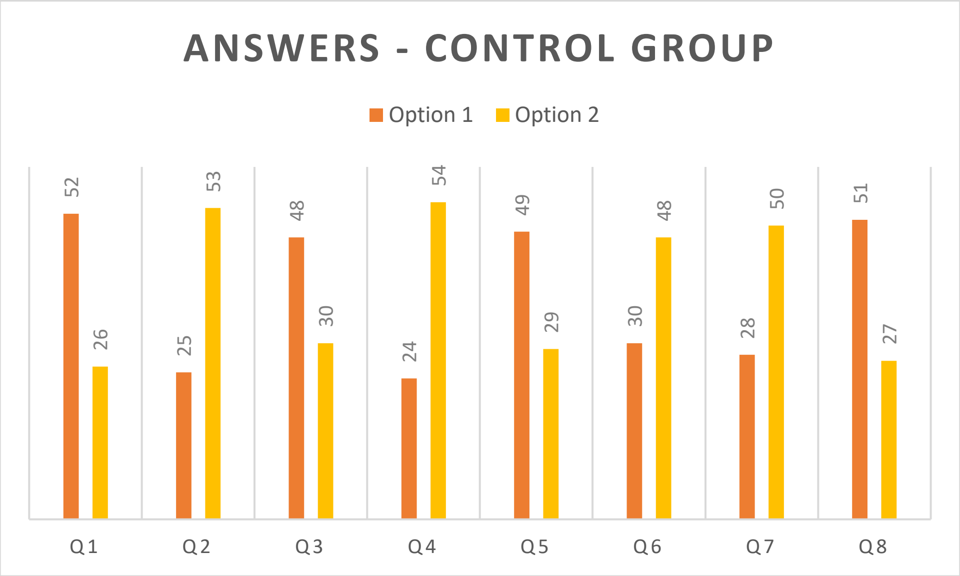




According to the graphics, the degree of risk taking in our sample varies between 3 and 8, 7 of which is the most indicated, our sample mostly consists of university students or graduates, 47% are women, 52% are men, 1% do not want to specify their gender. Although there are people from each of the 0 - 65+ age ranges in the sample, the majority of them are in the 18 -25 age range.

Hypothesis 1

Our 1st hypothesis predicts that the 1st option, that is, the risk-free option with a definite result, will be preferred more in the questions expressed with a gain, and the 2nd option, that is, the risky option that does not give a definite result, will be preferred more in the questions expressed with a loss. In our survey, odd numbered questions (Q, Q3, Q5, Q7) represent gain domains, even numbered questions represent loss domains. Graph 1 shows the distribution of people's preferences in the control group for each question. If we look at the graph, we can say that we got the result we expected for first six question, but we can see that we got the opposite of the results we expected in the 7th and 8th questions where the probability of gain is 85% and probability of loss is 15%.



We used one sample t-test to test the significance of the interpretations we made by looking at the graph. The variable Question# takes value 1 if Option 1 is selected, 0 otherwise. Our hypotheses in this test are as follows:

H_0: In even or odd numbered questions, the proportions of people choosing the 1st option and the 2nd option are equal.

H_A: For odd-numbered questions, more people chose option 1. --> Mean > 0.50 (For even numbered questions, people mostly chose option 2-- > Mean < 0.50)

Following tables show the results for Question 3 and 4, as examples the results for all other questions are given in Appendix Part 1.1.

```
One-sample t test

Variable |  Obs      Mean    Std. Err.  Std. Dev.   [95% Conf. Interval]
Questi~3 |   78   .6153846   .0554423   .4896532    .5049849    .7257843

    mean = mean(Question3)                                  t =   2.0812
Ho: mean = 0.50                            degrees of freedom =       77

   Ha: mean < 0.50          Ha: mean != 0.50           Ha: mean > 0.50
 Pr(T < t) = 0.9796    Pr(|T| > |t|) = 0.0407      Pr(T > t) = 0.0204
```

```
One-sample t test

Variable |  Obs      Mean    Std. Err.  Std. Dev.   [95% Conf. Interval]
Questi~4 |   78   .3076923   .0525972   .4645258    .2029579    .4124267

    mean = mean(Question4)                                  t =  -3.6562
Ho: mean = 0.50                            degrees of freedom =       77

   Ha: mean < 0.50          Ha: mean != 0.50           Ha: mean > 0.50
 Pr(T < t) = 0.0002    Pr(|T| > |t|) = 0.0005      Pr(T > t) = 0.9998
```

According to the ttest results, the p-values we found for each question are small enough to reject our null hypothesis at a 95% confidence interval. However, while we expect the average value to be above fifty percent in the 7th question, we see that it is statistically significantly below, and in the 8th question, while we expect the average to be below fifty percent, we see that it is statistically significantly above. The fact that the probability of winning $100 in the 5th question increases from 70% to 85% in the 7th question, and the probability of losing everything from 70% in the 6th question to 85% in the 8th question may have an effect on people's risky behavior in the gain domain and risk-averse behavior in the loss domain.

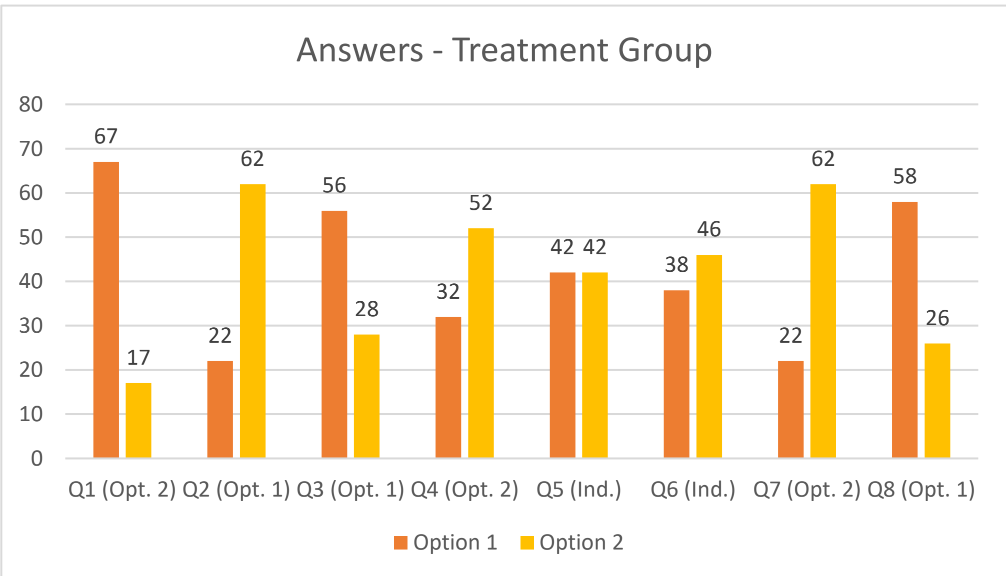
Regardless of whether the data has a normal distribution or not, and as a nonparametric alternative to the one sample ttest, we applied Wilcoxon test. The test gave us similar results with the one sample ttest. Our hypotheses for the Wilcoxon test are the same as for the ttest, and the results for questions 3 and 4 are given below as an example. Other results are shared in appendix Part1.2.

```
Sign test

        sign |    observed    expected
-------------+------------------------
    positive |          48          39
    negative |          30          39
        zero |           0           0
-------------+------------------------
         all |          78          78

One-sided tests:
  Ho: median of Question3 - 0.5  = 0 vs.
  Ha: median of Question3 - 0.5  > 0
      Pr(#positive >= 48) =
         Binomial(n = 78, x >= 48, p = 0.5) =  0.0268

  Ho: median of Question3 - 0.5  = 0 vs.
  Ha: median of Question3 - 0.5  < 0
      Pr(#negative >= 30) =
         Binomial(n = 78, x >= 30, p = 0.5) =  0.9846
```

```
Sign test

        sign |    observed    expected
-------------+------------------------
    positive |          24          39
    negative |          54          39
        zero |           0           0
-------------+------------------------
         all |          78          78

One-sided tests:
  Ho: median of Question4 - 0.5  = 0 vs.
  Ha: median of Question4 - 0.5  > 0
      Pr(#positive >= 24) =
         Binomial(n = 78, x >= 24, p = 0.5) =  0.9998

  Ho: median of Question4 - 0.5  = 0 vs.
  Ha: median of Question4 - 0.5  < 0
      Pr(#negative >= 54) =
         Binomial(n = 78, x >= 54, p = 0.5) =  0.0005
```

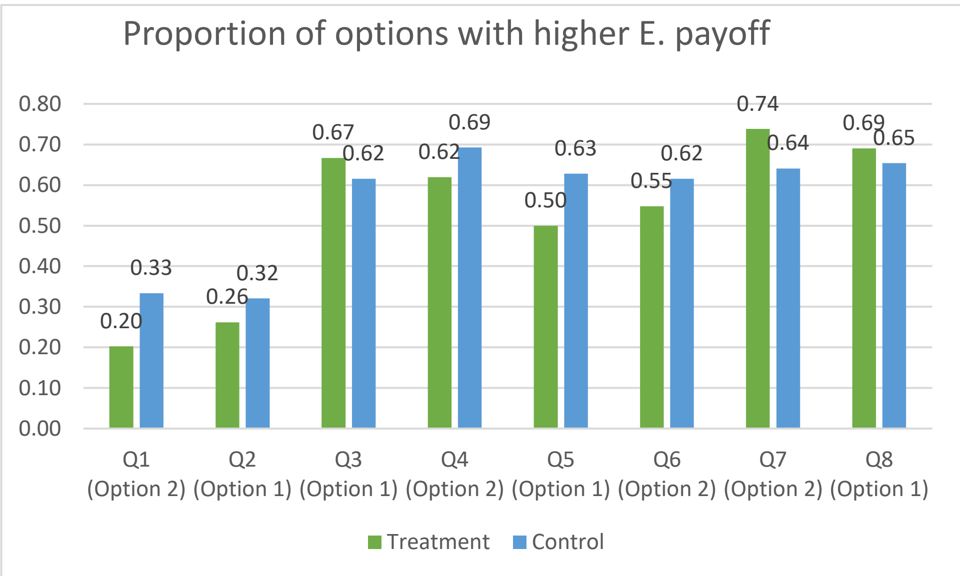
Hypothesis 2

In this hypothesis, we will look at whether the fact that people in the treatment group have seen the screen about calculating the expected value has an effect on their choice. We will compare this group's answers within themselves before comparing them to those in the control group. According to our hypothesis, people in the treatment group should have chosen the option with a high expected return or a low expected loss at a higher rate. Graph 2 shows the choices of people in the treatment group for each question. (For each question, the option with higher expected return/lower expected loss is indicated in parentheses. → Ind.= İndifferent between two options.)



According to this graph, some in some of the question people actually chose the option with higher expected return or lower expected loss, but their choice are also parallel with the ones in the control group. In other words, for example in Question 3, people in the treatment group are expected to choose option 1 as its expected return is higher, but we can also see that also in the control group, more people chose option 1. So we cannot clearly say that if the results are caused by the treatment or people chose option 1 because the question is asked in gain domain and option 1 is the riskless choice. In addition, in almost all questions which people behaved similar to the people in control group, so we cannot clearly see the effect of the treatment here. One difference between the results in control vs. treatment group is at Q5 and Q6. More people in the control group chose option 1 in Q5, but we expect the people in treatment group to be indifferent between two choices as their expected returns are equal (75$) and we can see that people in the treatment group are divided equally between option 1 and option 2, which may be parallel to our hypothesis.

The next graph shows what percentage of people in the control and treatment groups chose the option with the higher expected payoff. (Expected payoffs for Q5 and Q6 are equal, which option will be included in the chart for these questions was chosen randomly.). Looking at this graph, we can say that in the treatment and control groups, similar proportions of people chose the same option, so we cannot see a clear effect of the treatment.



Welch test

In order to see if there is a statistically significant difference between the answers between the two groups, we first applied the Welch test, since the sample sizes were not equal. Our null and alternative hypothesis are as follows :

H_0: In even or odd numbered questions, the proportions of people choosing the 1st option are equal for treatment and control groups

H_A: For Q2 Q3 and Q8 the difference in means of treatment and control groups are higher than zero, for Q1 Q4 and Q7 the difference is lower than 0

The results for Q1 and Q2 are given below as examples, the other results are in the Appendix.

Question 1:

Two-sample t test with unequal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	78	.6666667	.0537215	.4744557	.5596934	.7736399
1	84	.797619	.0441005	.4041878	.7099049	.8853332
combined	162	.7345679	.0348	.4429322	.6658445	.8032913
diff		-.1309524	.0695044		-.2682599	.0063551

```
    diff = mean(0) - mean(1)                                      t =  -1.8841
Ho: diff = 0                                Welch's degrees of freedom =  153.654

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.0307         Pr(|T| > |t|) = 0.0614          Pr(T > t) = 0.9693
```

Question 2:

Two-sample t test with unequal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
0	78	.3205128	.0531824	.4696943	.2146131	.4264125
1	84	.2619048	.0482602	.4423118	.1659172	.3578923
combined	162	.2901235	.035766	.4552264	.2194925	.3607544
diff		.0586081	.0718151		-.0832257	.2004418

```
    diff = mean(0) - mean(1)                                      t =   0.8161
Ho: diff = 0                                Welch's degrees of freedom =  159.129

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.7922         Pr(|T| > |t|) = 0.4157          Pr(T > t) = 0.2078
```

For the first question, we can reject the null hypothesis at a 90 percent confidence interval. We can say that the difference between the means is smaller than 0, that is, proportionally more people in the treatment group choose option 1, which is the option with higher expected values. For other questions, we can say that we fail to reject the null hypothesis and there is no statistically significant difference between the answers of the two groups.

For this hypothesis, we applied the Mann - Whitney U test as a non-parametric test, our hypotheses are the same as the welch test. According to the results, we can only reject the null hypothesis for the first question with 90 percent confidence interval.

Two-sample Wilcoxon rank-sum (Mann-Whitney) test

treatment	obs	rank sum	expected
0	78	5928	6357
1	84	7275	6846
combined	162	13203	13203

```
unadjusted variance     88998.00
adjustment for ties    -36938.09
                       ----------
adjusted variance       52059.91

Ho: Questi~1(treatm~t==0) = Questi~1(treatm~t==1)
             z =  -1.880
    Prob > |z| =   0.0601
```

Finally, we applied logistic regression to see whether being in the treatment group has an effect on the answers to the questions. Variable descriptions and regression results for all questions are given in Appendix.

According to the logistic regression results, we have a result parallel to our hypothesis only for the first question, the probability of choosing the option with the higher expected value in the treatment group increases significantly only for Q1. There is no statistically significant effect supporting our hypothesis for the other questions. In other words, we can say that teaching people how to calculate the expected value or making them think of it did not lead to a change in risk averse or risk seeking behavior of people. According to the regression results, we can say that the probability of people choosing the 1st option increases significantly as the age range increases in the even numbered questions, that is, the questions in the loss domain. In other words, as the age range increased, people preferred to lose some of their money for sure, rather than risking losing everything they had. At the beginning of the survey, the participants' self-declared degree of risk taking was significantly effective in odd-numbered questions: people who reported higher degree of risk taking are less likely to choose riskless choice (option1) in odd numbered questions. While gender was significantly effective only in the first question, it had no significant effect in any other question. Education and knowledge of game theory did not affect people's risk preference significantly according to our results.

6. Conclusion

Our paper was set to examine prospect theory and see if people would act rational if they were given an education of expected utility. We have used regression analysis, conducted t-test and welch test to test our hypothesis and reach our results. Our findings show that while our first hypothesis was confirmed, our second hypothesis was rejected.

According to our t-test and Wilcoxon test, our results for the first 6 questions show that people act according to Prospect Theory. Even though they have higher expected value of earning more money in the risky option, they seem to be risk averse. But when looked at the question where they have higher expected value of losing money, they choose to be risk loving. This was not the case for the last two questions however this can be explained by the 85% probability of gain and 15% probability of loss.

Our second hypothesis, which was about the impact of education on rational decision making was rejected. Our treatment group did not act significantly different than our control group. There can be number of reasons for this outcome. Our subjects mostly consisted of people of similar ages and similar backgrounds. They were either university students or graduates; people without education was very few. We also see this in our survey question "Have you ever taken an game theory course or do you posses any knowledge about it" half of our participants answered "yes". Another reason for this can be that people may have skipped reading our expected utility definition or because they didn't care enough for it to think over it since they do bit face a gain/loss in real life.

We can use the inference we made from this experiment to emphasize the importance of choosing the right word in the field of marketing. People are influenced differently when they are told similar thing in different ways. This experiment can be further improved with a wider range of data and higher incentives for successful investments. Better ways to explain expected utility can be found such as conducting this experiment face to face where the participants level of understanding can be tested successfully.

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Appendix

Part 1.1 One Sample Ttests for Hypothesis 1

One-sample t test

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
Questi~1	78	.6666667	.0537215	.4744557	.5596934	.7736399

mean = mean(**Question1**) t = 3.1024
Ho: mean = 0.50 degrees of freedom = 77

Ha: mean < 0.50 Pr(T < t) = 0.9987
Ha: mean != 0.50 Pr(|T| > |t|) = 0.0027
Ha: mean > 0.50 Pr(T > t) = 0.0013

One-sample t test

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
Questi~2	78	.3205128	.0531824	.4696943	.2146131	.4264125

mean = mean(**Question2**) t = -3.3749
Ho: mean = 0.50 degrees of freedom = 77

Ha: mean < 0.50 Pr(T < t) = 0.0006
Ha: mean != 0.50 Pr(|T| > |t|) = 0.0012
Ha: mean > 0.50 Pr(T > t) = 0.9994

One-sample t test

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
Questi~5	78	.6282051	.0550753	.4864121	.5185361	.7378741

mean = mean(**Question5**) t = 2.3278
Ho: mean = 0.50 degrees of freedom = 77

Ha: mean < 0.50 Pr(T < t) = 0.9887
Ha: mean != 0.50 Pr(|T| > |t|) = 0.0225
Ha: mean > 0.50 Pr(T > t) = 0.0113

One-sample t test

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
Questi~6	78	.3846154	.0554423	.4896532	.2742157	.4950151

mean = mean(**Question6**) t = -2.0812
Ho: mean = 0.50 degrees of freedom = 77

Ha: mean < 0.50 Pr(T < t) = 0.0204
Ha: mean != 0.50 Pr(|T| > |t|) = 0.0407
Ha: mean > 0.50 Pr(T > t) = 0.9796

One-sample t test

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
Questi~7	78	.3589744	.0546669	.4828045	.2501188	.46783

mean = mean(**Question7**) t = -2.5797
Ho: mean = 0.50 degrees of freedom = 77

Ha: mean < 0.50 Pr(T < t) = 0.0059
Ha: mean != 0.50 Pr(|T| > |t|) = 0.0118
Ha: mean > 0.50 Pr(T > t) = 0.9941

One-sample t test

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
Questi~8	78	.6538462	.0542159	.4788222	.5458884	.7618039

mean = mean(**Question8**) t = 2.8377
Ho: mean = 0.50 degrees of freedom = 77

Ha: mean < 0.50 Pr(T < t) = 0.9971
Ha: mean != 0.50 Pr(|T| > |t|) = 0.0058
Ha: mean > 0.50 Pr(T > t) = 0.0029

Part 1.2 Wilcoxon tests for Hypothesis 1

```
Sign test

        sign |    observed    expected
-------------+------------------------
    positive |          52          39
    negative |          26          39
        zero |           0           0
-------------+------------------------
         all |          78          78

One-sided tests:
  Ho: median of Question1 - 0.5  = 0 vs.
  Ha: median of Question1 - 0.5  > 0
      Pr(#positive >= 52) =
         Binomial(n = 78, x >= 52, p = 0.5) =  0.0022

  Ho: median of Question1 - 0.5  = 0 vs.
  Ha: median of Question1 - 0.5  < 0
      Pr(#negative >= 26) =
         Binomial(n = 78, x >= 26, p = 0.5) =  0.9990
```

```
Sign test

        sign |    observed    expected
-------------+------------------------
    positive |          25          39
    negative |          53          39
        zero |           0           0
-------------+------------------------
         all |          78          78

One-sided tests:
  Ho: median of Question2 - 0.5  = 0 vs.
  Ha: median of Question2 - 0.5  > 0
      Pr(#positive >= 25) =
         Binomial(n = 78, x >= 25, p = 0.5) =  0.9995

  Ho: median of Question2 - 0.5  = 0 vs.
  Ha: median of Question2 - 0.5  < 0
      Pr(#negative >= 53) =
         Binomial(n = 78, x >= 53, p = 0.5) =  0.0010
```

```
Sign test

        sign |    observed    expected
-------------+------------------------
    positive |          49          39
    negative |          29          39
        zero |           0           0
-------------+------------------------
         all |          78          78

One-sided tests:
  Ho: median of Question5 - 0.5  = 0 vs.
  Ha: median of Question5 - 0.5  > 0
      Pr(#positive >= 49) =
         Binomial(n = 78, x >= 49, p = 0.5) =  0.0154

  Ho: median of Question5 - 0.5  = 0 vs.
  Ha: median of Question5 - 0.5  < 0
      Pr(#negative >= 29) =
         Binomial(n = 78, x >= 29, p = 0.5) =  0.9916
```

```
Sign test

        sign |    observed    expected
-------------+------------------------
    positive |          30          39
    negative |          48          39
        zero |           0           0
-------------+------------------------
         all |          78          78

One-sided tests:
  Ho: median of Question6 - 0.5  = 0 vs.
  Ha: median of Question6 - 0.5  > 0
      Pr(#positive >= 30) =
         Binomial(n = 78, x >= 30, p = 0.5) =  0.9846

  Ho: median of Question6 - 0.5  = 0 vs.
  Ha: median of Question6 - 0.5  < 0
      Pr(#negative >= 48) =
         Binomial(n = 78, x >= 48, p = 0.5) =  0.0268
```

```
Sign test

        sign |    observed    expected
-------------+------------------------
    positive |          28          39
    negative |          50          39
        zero |           0           0
-------------+------------------------
         all |          78          78

One-sided tests:
  Ho: median of Question7 - 0.5  = 0 vs.
  Ha: median of Question7 - 0.5  > 0
      Pr(#positive >= 28) =
         Binomial(n = 78, x >= 28, p = 0.5) =  0.9956

  Ho: median of Question7 - 0.5  = 0 vs.
  Ha: median of Question7 - 0.5  < 0
      Pr(#negative >= 50) =
         Binomial(n = 78, x >= 50, p = 0.5) =  0.0084
```

```
Sign test

        sign |    observed    expected
-------------+------------------------
    positive |          51          39
    negative |          27          39
        zero |           0           0
-------------+------------------------
         all |          78          78

One-sided tests:
  Ho: median of Question8 - 0.5  = 0 vs.
  Ha: median of Question8 - 0.5  > 0
      Pr(#positive >= 51) =
         Binomial(n = 78, x >= 51, p = 0.5) =  0.0044

  Ho: median of Question8 - 0.5  = 0 vs.
  Ha: median of Question8 - 0.5  < 0
      Pr(#negative >= 27) =
         Binomial(n = 78, x >= 27, p = 0.5) =  0.9978
```

Part 2.1 Welch test for Hypothesis 2

```
. ttest Question3, by(treatment)welch

Two-sample t test with unequal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
       0 |      78    .6153846    .0554423    .4896532    .5049849    .7257843
       1 |      84    .6666667    .0517434    .4742358    .5637512    .7695821
---------+--------------------------------------------------------------------
combined |     162    .6419753    .0377835     .480906    .5673601    .7165906
---------+--------------------------------------------------------------------
    diff |           -.0512821    .0758368               -.201051    .0984869
------------------------------------------------------------------------------
    diff = mean(0) - mean(1)                                      t =  -0.6762
Ho: diff = 0                     Welch's degrees of freedom =  160.192

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.2499         Pr(|T| > |t|) = 0.4999          Pr(T > t) = 0.7501

.
```

```
Two-sample t test with unequal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
       0 |      78    .3076923    .0525972    .4645258    .2029579    .4124267
       1 |      84    .3809524    .0533038    .4885376    .2749332    .4869715
---------+--------------------------------------------------------------------
combined |     162     .345679    .0374817    .4770638    .2716599    .4196981
---------+--------------------------------------------------------------------
    diff |           -.0732601     .074885              -.2211373    .0746171
------------------------------------------------------------------------------
    diff = mean(0) - mean(1)                                      t =  -0.9783
Ho: diff = 0                     Welch's degrees of freedom =  161.911

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.1647         Pr(|T| > |t|) = 0.3294          Pr(T > t) = 0.8353
```

```
. ttest Question5, by(treatment)welch

Two-sample t test with unequal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
       0 |      78    .6282051    .0550753    .4864121    .5185361    .7378741
       1 |      84          .5    .0548821     .503003    .3908417    .6091583
---------+--------------------------------------------------------------------
combined |     162    .5617284    .0391041    .4977135    .4845054    .6389514
---------+--------------------------------------------------------------------
    diff |            .1282051    .0777518              -.0253344    .2817447
------------------------------------------------------------------------------
    diff = mean(0) - mean(1)                                      t =   1.6489
Ho: diff = 0                     Welch's degrees of freedom =  161.736

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.9494         Pr(|T| > |t|) = 0.1011          Pr(T > t) = 0.0506

.
```

```
. ttest Question6, by(treatment)welch

Two-sample t test with unequal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
       0 |      78    .3846154    .0554423    .4896532    .2742157    .4950151
       1 |      84     .452381    .0546327    .5007166    .3437188    .5610431
---------+--------------------------------------------------------------------
combined |     162    .4197531    .0388947    .4950487    .3429435    .4965627
---------+--------------------------------------------------------------------
    diff |           -.0677656    .0778369               -.2214743    .0859432
------------------------------------------------------------------------------
    diff = mean(0) - mean(1)                                      t =  -0.8706
Ho: diff = 0                             Welch's degrees of freedom =  161.569

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.1926         Pr(|T| > |t|) = 0.3853          Pr(T > t) = 0.8074
```

```
. ttest Question7, by(treatment)welch

Two-sample t test with unequal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
       0 |      78    .3589744    .0546669    .4828045    .2501188      .46783
       1 |      84    .2619048    .0482602    .4423118    .1659172    .3578923
---------+--------------------------------------------------------------------
combined |     162     .308642    .0364054    .4633654    .2367483    .3805357
---------+--------------------------------------------------------------------
    diff |            .0970696    .0729212               -.0469575    .2410967
------------------------------------------------------------------------------
    diff = mean(0) - mean(1)                                      t =   1.3312
Ho: diff = 0                             Welch's degrees of freedom =  157.871

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.9075         Pr(|T| > |t|) = 0.1851          Pr(T > t) = 0.0925
```

```
. ttest Question8, by(treatment)welch

Two-sample t test with unequal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
       0 |      78    .6538462    .0542159    .4788222    .5458884    .7618039
       1 |      84    .6904762    .0507437    .4650739     .589549    .7914034
---------+--------------------------------------------------------------------
combined |     162    .6728395    .0369763    .4706312    .5998184    .7458606
---------+--------------------------------------------------------------------
    diff |             -.03663    .0742583               -.1832809    .1100208
------------------------------------------------------------------------------
    diff = mean(0) - mean(1)                                      t =  -0.4933
Ho: diff = 0                             Welch's degrees of freedom =  160.287

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.3112         Pr(|T| > |t|) = 0.6225          Pr(T > t) = 0.6888
```

Part 2.2 Mann Whitney U Test for Hypothesis 2

Two-sample Wilcoxon rank-sum (Mann-Whitney) test

treatment	obs	rank sum	expected
0	78	6549	6357
1	84	6654	6846
combined	162	13203	13203

unadjusted variance 88998.00
adjustment for ties -34008.00

adjusted variance 54990.00

Ho: Questi~2(treatm~t==0) = Questi~2(treatm~t==1)
z = 0.819
Prob > |z| = 0.4129

Two-sample Wilcoxon rank-sum (Mann-Whitney) test

treatment	obs	rank sum	expected
0	78	6189	6357
1	84	7014	6846
combined	162	13203	13203

unadjusted variance 88998.00
adjustment for ties -27628.96

adjusted variance 61369.04

Ho: Questi~3(treatm~t==0) = Questi~3(treatm~t==1)
z = -0.678
Prob > |z| = 0.4977

Two-sample Wilcoxon rank-sum (Mann-Whitney) test

treatment	obs	rank sum	expected
0	78	6117	6357
1	84	7086	6846
combined	162	13203	13203

unadjusted variance 88998.00
adjustment for ties -28605.65

adjusted variance 60392.35

Ho: Questi~4(treatm~t==0) = Questi~4(treatm~t==1)
z = -0.977
Prob > |z| = 0.3288

Two-sample Wilcoxon rank-sum (Mann-Whitney) test

treatment	obs	rank sum	expected
0	78	6777	6357
1	84	6426	6846
combined	162	13203	13203

unadjusted variance 88998.00
adjustment for ties -23264.35

adjusted variance 65733.65

Ho: Questi~5(treatm~t==0) = Questi~5(treatm~t==1)
z = 1.638
Prob > |z| = 0.1014

Two-sample Wilcoxon rank-sum (Mann-Whitney) test

treatment	obs	rank sum	expected
0	78	6135	6357
1	84	7068	6846
combined	162	13203	13203

unadjusted variance 88998.00
adjustment for ties -23966.35

adjusted variance 65031.65

Ho: Questi~6(treatm~t==0) = Questi~6(treatm~t==1)
z = -0.871
Prob > |z| = 0.3840

Two-sample Wilcoxon rank-sum (Mann-Whitney) test

treatment	obs	rank sum	expected
0	78	6675	6357
1	84	6528	6846
combined	162	13203	13203

unadjusted variance 88998.00
adjustment for ties -32024.09

adjusted variance 56973.91

Ho: Questi~7(treatm~t==0) = Questi~7(treatm~t==1)
z = 1.332
Prob > |z| = 0.1828

Two-sample Wilcoxon rank-sum (Mann-Whitney) test

treatment	obs	rank sum	expected
0	78	6237	6357
1	84	6966	6846
combined	162	13203	13203

unadjusted variance 88998.00
adjustment for ties -30223.30

adjusted variance 58774.70

Ho: Questi~8(treatm~t==0) = Questi~8(treatm~t==1)
z = -0.495
Prob > |z| = 0.6206

Part 2.3 Logistic Regression

Variable descriptions

Variable	Description
Question#	=1 if Option 1 is selected, = 0 otherwise
treatment	=1 if treated, = 0 otherwise
female	=1 if female, = 0 otherwise
age	=0 if 0-18, =1 if 18-25,=2 if 25-45, =3 if 45-65,=4 if 65+
risk	Degree of risk taking (ranged 1 to 10)
game_theory	=1 if familiar with game theory, = 0 otherwise
education	=0 if high school, =1 if University,=2 if master, =3 if Phd

VARIABLES	(1) Question1	(2) Question2	(3) Question3	(4) Question4
treatment	0.809**	-0.0688	0.202	0.629*
	(0.393)	(0.374)	(0.355)	(0.370)
female	-0.908**	0.00194	-0.538	-0.222
	(0.393)	(0.368)	(0.354)	(0.356)
age	0.286	0.560**	0.0909	0.683***
	(0.248)	(0.221)	(0.223)	(0.232)
risk	-0.319***	0.0577	-0.366***	-0.117
	(0.120)	(0.104)	(0.110)	(0.0988)
game_theory	-0.0877	-0.296	-0.122	-0.552
	(0.394)	(0.378)	(0.359)	(0.366)
education	0.551	0.0869	0.454	0.0253
	(0.420)	(0.335)	(0.362)	(0.338)
Constant	2.168**	-1.998**	2.460***	-0.954
	(0.965)	(0.847)	(0.879)	(0.795)
Observations	162	162	162	162

VARIABLES	(1) Question5	(2) Question6	(3) Question7	(4) Question8
treatment	-0.554	0.311	-0.296	0.331
	(0.342)	(0.335)	(0.383)	(0.353)
female	0.163	0.0307	0.0140	-0.381
	(0.337)	(0.329)	(0.374)	(0.351)
age	0.324	0.234	0.861***	0.231
	(0.238)	(0.211)	(0.240)	(0.248)
risk	-0.264***	-0.0861	-0.166	-0.0790
	(0.0999)	(0.0929)	(0.105)	(0.0989)
game_theory	-0.167	-0.00336	-0.133	-0.468
	(0.340)	(0.335)	(0.381)	(0.350)
education	0.0355	0.101	0.329	-0.376
	(0.344)	(0.322)	(0.363)	(0.361)
Constant	1.658**	-0.415	-1.214	1.499*
	(0.802)	(0.753)	(0.821)	(0.817)
Observations	162	162	162	162