PRINCIPLES OF BEHAVIORAL ECONOMICS

Prof. Sujata Kar

Department of Management Studies
IIT Roorkee

Week 23

Lecture 23

Thank you. Hello everyone, welcome back to the course on principles of behavioral economics. This is lecture 23, and in the previous module or lecture, I was discussing several axioms of expected utility theory, in short EUT. And how there is evidence on violations of EUT. So we listed out basically six axioms, out of which five have already been discussed. We have discussed the assumption of completeness, transitivity, continuity, independence, and monotonicity.

So next, I am going to discuss the assumption of substitution or axiom of substitution, which says that if B is preferred to A, Then for any probability mixture (B, p) should be preferred to (A, p). So basically, for any probability, that preference should remain consistent. In this context, one important concept is the certainty effect. People overweight outcomes that are considered certain relative to outcomes which are merely probable, which implies that people prefer outcomes that are considered certain.

The certainty effect portrays a violation of the substitution axiom. So, we will give you some examples which will clarify what exactly is meant by this substitution axiom and then how the certainty effect is observed. The best-known counterexample to expected utility theory, which exploits the certainty effect, was introduced by the French economist Maurice Allais in 1953. We have considered four alternative gambles. Again, the participants have to choose between either A and B or between C and D. There were 72 participants.

Option A or gamble A has these three options which are like you can win 2500 with a probability of 0.33, 2400 with a probability of 0.66 and whatever remains that is 0.01 probability of getting nothing As opposed to that gamble B offers certain amount of 2400 so as you can see the probability is 1 which means 2400 you are going to get with certainty and then between gamble C and gamble D you can see that gamble C offers 2500 with a probability of 0.33 and otherwise, nothing.

And Gamble D says that you can win 2400 with probability 0.34. Otherwise, nothing. And the preferences are also given here, which shows that B was preferred to A while C was preferred to D. Now, respondents were asked to choose between A and B and C and D. According to that theory with u(0) equals to 0, the first preference implies u(2400) that is u(2400) is greater than 0.33 multiplied by u(2500) plus 0.66 multiplied by utility from getting 2400. plus there is a 0 term which is not mentioned here.

$$u(2400) > 0.33u(2500) + 0.66u(2400)$$

So, what it implies is that following the expected utility theory by that theory we refers to expected utility theory u(0) equals to 0. We assume that say u(10) would be equals to 10 and so on. Then from here since B is preferred to A then utility from getting 2400 is preferred to utility from getting 2500 with a probability of 0.33, utility of getting 2400 with a probability of 0.66. So, this is basically gamble A and this is gamble B. B is preferred to A. Or we can also write it as there are 24 here as well as here, u(24).

So, if I take u(24) to the other side, then 1 minus 0.66 u(24) will make it 0.34 u(24) which would be greater than the number 0.33 u(2500). The second preference implies the reverse inequality because if you look at Gamble C and Gamble D then it says that 0.33u(2500) is preferred to 0.34u(2400). So, very clearly here 0.33u(2500) is preferred to 0.34u(2400) and here 0.34u(2400(is greater than 0.33u(2500). So, there is a clear contradiction, right?

There is a reverse inequality or preference reversal when we move from a choice between A and B to C and D. Problem 2 is obtained from Problem 1 by eliminating a 0.66 chance of winning 2400 from both prospects under consideration. So, the prospects are actually given here in the offset for convenience, so that you can relate it better. So, you can see that here, 2400, 0.66 was here now that this has been removed this when it comes to gamble C if i compare A with C then this portion is not here

Rather this option is merged with the 0 option, so now 0 is here with 0.67. Similarly, if I compare B with D, then again you can see that B was there with one probability, that is complete certainty, and then 0.66 has been removed from here in order to arrive at Gamble D. Evidently, this change produces a greater reduction in desirability when it alters the character of the prospect from a sure gain to a probable one than when both the original and the reduced prospects are uncertain. So, here people preferred it because this was a certain amount.

Now, when there is uncertainty—so you win 2500 with 0.33, you win 2400 with 0.34—both are uncertain, and the probabilities are very close to each other. In that case, people would prefer 2500, a larger amount, over a smaller amount of 2400. So, the certainty effect is that there is always a greater preference for an amount which is ensured or which is certain to come. So, a simpler demonstration of the same phenomenon relates to a previously discussed problem under the axiom of independence where the two prospects were A3000 and B4000, 0.8.

And C 3000, 0.25 and D 4000, 0.2. Here also, you can notice that the probabilities in A and C are reduced by one-fourth. So it was from 1, it became 0.25. And similarly, the probabilities in B and D are reduced by one-fourth. It becomes 0.8 to 0.2.

The outcomes or the amounts remain the same when we compare A and C and B and D. Of the 95 participants, 80 percent chose A to B. This is an example of certainty effect that majority went for the certain outcome and 65 percent chose D to C. When both of them became probable cases, then 65 percent or majority chose D over C where basically the outcome is actually the amount is larger. If we assume that u(0) equals to 0, choice of B implies or choice of A over B implies that u(3000) by u(4000) is greater than 4 by 5, which is basically from here we can say that A is preferred to B so u(3000) is greater than 0.8u(4000) and therefore u(3000) divided by u(4000)

is greater than 0.8 by 1 which is ideally 4 by 5 while the choice of D implies the reverse inequality here the choice of D implies that when you are preferring 4000, 0.2 over 3000,0.25 then we have 0.25u(4000) is preferred to 0.2u(4000) is preferred to 0.25u(3000). Then this implies 0.2 divided by 0.25 is greater than u(3000) by u(4000). And this 0.2 by 0.25 is exactly equal to 4 by 5.

So, once it is greater than 4 by 5, once it is less than 4 by 5, right. So, there are complete contrasts or inconsistencies. The certainty effect is valid for non-monetary outcomes as well. Consider the following with N equal to 72. So, choose between A and B.

A 50% chance to win a three-week tour of England, France, and Italy. A one-week tour of England with certainty. So, this is a tour with certainty, and you can see that 78% preferred a tour with certainty. With a 50% chance of happening. Similarly, once asked to choose between C and D, where C says there is 5% chance to win a three-week tour of England, France and Italy,

Italy, and D says a 10% chance to win a one-week tour of England with certainty. Here, the probabilities are actually small in both cases. So people would generally prefer, you can see that 67% preferred C over D, which implies that larger number of people actually preferred a larger amount or here in this case a longer touring period of three week along with visiting more countries. So, the certainty effect is observed here as well.

Next, we talk about the concept of probability and possibility: the common ratio effect. The certainty effect is not the only type of violation of the substitution axiom. Another situation in which this axiom fails is illustrated by the following problems where there are again two gambles, gamble A and B. We have also referred to this gamble in a previous context, and there are gambles C and D as well. N equals 66, meaning there were 66 participants. Again, one would be asked to choose between A and B or

and C and D. So, what are the prospects? In A, you can win 6000 with a probability of 0.45. In B, you win 3000 with 0.9. You can see that a larger number of participants preferred B to A. In C and D, the amounts remain the same, but the probabilities are actually reduced in equal proportion.

So, here it was 0.45, and this is 0.9. So, the probability here is double for winning a smaller amount, or the amount is exactly half of this amount. Here also, it is the same situation. This is 0.001, and this is 0.002. So, you win half the amount with double the probability.

But the probabilities are, in both cases, very small. Now here, you can observe that 73% preferred C to D. When choosing between A and B, most people chose the prospect where winning is more probable. between C and D where winning is possible but not probable so since the probabilities are very small the chances of winning is very small. We call it a situation where it is possible but not much probable. Most people choose the prospect that offers the larger gain in this case. Now you can see that when the stake is large. Basically, when the amount is large, then there is a stronger preference when the possibilities or the probabilities are small in both cases.

Now, another violation is the reflection effect. We consider both positive prospects as well as negative prospects. And you can see that the negative prospects are just the mirror image of the positive prospects. So, we have considered eight alternative prospects. A, B, C, D are the positive prospects.

A prime, B prime, C prime, D prime are the negative prospects. And prospect details you can see. Here you win 4000 with 0.8 and 3000 with certainty. Here you lose 4000 with 0.8

and you lose 3000 with certainty. Instead of giving the exact percentage of preferences for A to B or B to A, I have just mentioned here.

Which one has been observed to be preferred. For A, B and A prime, B prime, the number of participants were 95. For C, D and C prime, D prime, the number of participants were 66. Now, what it shows is that 4000, 0.8 was not preferred to 3000.

That is again, we observe the certainty effect. But when the prospects or the outcomes were negative, when the prospects became negative prospects, then a larger loss with some probability was preferred to a certain loss. In a similar fashion, we have already observed that 4000 with probability 0.2 was preferred to 3000 with probability 0.25. But when the probabilities are relatively small, then a smaller loss is actually preferred over a larger loss, and so on. In each of the four problems, the preference between negative prospects is the mirror image of the preference between positive prospects.

Positive Prospects		Negative Prospects		No.
A	(4000, 0.8) < (3000)	A′	(-4000, 0.8) > (-3000)	N = 95
B	(4000, 0.2) > (3000, 0.25)	B′	(-4000, 0.2) < (-3000, 0.25)	N = 95
C	(3000, 0.9) > (6000, 0.45)	C′	(-3000, 0.9) < (-6000, 0.45)	N = 66
D	(3000, .002) < (6000, 0.001)	D′	(-3000, 0.002) > (-6000, 0.001)	N = 66

This pattern is labeled as the reflection effect. The reflection effect implies that risk aversion in the positive domain is accompanied by risk seeking in the negative domain. In problem A', for example, the majority of subjects were willing to accept a risk of 0.8 to lose 4000 in preference to a sure loss of 3000, although the gamble has a lower expected value of 3200. The occurrence of risk seeking in choices between negative prospects was noted early by Markowitz.

Another study by Williams also reported data where a translation of outcomes produced a dramatic shift from risk aversion to risk seeking. His subjects were indifferent between 100, 0.65 to -100, 0.35 and 0 indicating risk aversion. They were also indifferent between -200, 0.8 and -100 indicating risk seeking. Now, this is a situation of risk aversion because you can see that here you win 100 with 0.65 probability and lose 100 with 0.35 probability.

So, the losing probability is much smaller. Nevertheless, one individual is indifferent between this prospect and 0. On the other hand, When people were asked which one they would prefer, by losing minus 200 with 0.8 and minus 100, then they were found to be indifferent. So, losing 200 with 0.8 probability and losing 100, they were indifferent, which showed some sort of indication of risk seeking.

It should be noted that the preferences between the positive prospects as well as the corresponding negative prospects are inconsistent with expected utility theory. So, here I have reproduced the positive prospects and the negative prospects for easy reference. For example, A prime and B prime, like A and B, demonstrate that outcomes which are obtained with certainty are overweight relative to uncertain outcomes. This is because if you look at the value of 0.8 of 4000, that is 3200.

So, the expected amount is 3200 from here. Nevertheless, people prefer a certain amount over an uncertain amount. In the positive domain, the certainty effect contributes to a risk-averse preference for a sure gain over a larger gain that is merely probable. And this could be true for all other preferences. So, if I look at the negative prospects, let us consider A prime, and then you can see that the loss is minus 3200, which is definitely a greater loss compared to minus 3000.

Nevertheless, it is preferred because there is this risk-seeking tendency in the domain of negative prospects. In the negative domain, The same effect leads to a risk-seeking preference for a loss that is merely probable over a smaller loss that is certain. The same psychological principle—the overweighting of certainty—favors risk aversion in the domain of gains and risk-seeking in the domain of losses. The reflection effect eliminates aversion for uncertainty or variability as an explanation of the certainty effect.

Consider for example the prevalent preferences for 3000 over 4000, 0.8 and 4000, 0.2 over 3000, 0.25. The example we have been repeatedly citing here. To solve this apparent inconsistency, one could invoke the assumption that people prefer prospects that have high expected value and small variance. Since 3000 has no variance while 4000, 0.8 has large variance,

the former prospect could be chosen despite its lower expected value. When the prospects are reduced, however, the difference in variance between 3000 and 0.25 and 4000, 0.2 may be insufficient to overcome the difference in expected value, as a result of which people end up choosing 4000, 0.2 over 3000, 0.25. On the other hand, minus 3000 has both a higher expected value and lower variance than minus 4000, 0.8.

This account entails that the shear loss should be preferred contrary to the data. Thus, our data are incompatible with the notion that certainty is generally desirable. So, certainty is not always desirable, but only in the domain of gains. Rather, it appears that certainty increases the aversiveness of losses as well as the desirability of gains. Consider another example which are presented to two different groups of subjects.

In statement 1, in addition to whatever you own, you have been given 1000. You are now asked to choose between A, which offers 1000 with 0.5 probability and B, 500 with certainty. The number of participants were 70. Statement 2, in addition to whatever you own, you have been given 2000, you are now asked to choose between C, which is a loss of 1000 with probability 0.5 and D, assured loss of 500, the number of participants 68.

It was observed that 16% preferred participants A while or opted for A while 84% opted for B. So, we can see that there has been clear preference for B over A and similarly very clear preference for C over D. These preferences confirm to the reflection effect which exhibits risk aversion for positive prospects and risk seeking for negative ones. However, note that when viewed in terms of final states, the two choice problems are identical because specifically A is equal to 2000, 0.5; 1000, 0.5. You remember the way we posed the problems, the statements were you in addition to whatever you have, you have been given 1000.

So, we begin with an endowment of 1000, and then In A, you have the probability of getting another 1000. So, that makes it a total of 2000, and B is basically making it 1500 with certainty. On the other hand, when it comes to statement 2, you have been given 2000 and you have a loss of minus 1000 which means Again, you are coming back to 1000 with the probability of 0.5, and then this is 1500 with certainty.

So, that is why we say that A is 0.5 and 1000, 0.5. So, 2000 with certainty because 1000 you already have been given. So, with 0.5 probability, if you get 1000, then you arrive at 2000. 0.5 probability is there that you are not going to get anything; then you stay at 1000. And that is exactly the same as C. In C, you lose 1000 with 0.5.

Which means if you lose 1000 with 0.5, you will be here, and if you do not lose 1000, then you are actually here because you were given 2000 to begin with. In a similar fashion, as discussed, B and D are also the same, where you arrive at a final amount of 1500 with certainty. In the case of B, you have 1000, and you add 500 to it. In the case of D, you are given 2000, and then 500 is subtracted from it. So, you can see that A and C, B and D are identical.

And as a result of which, the expected utility would say that if you prefer B to A, then you should prefer D to C. We saw or observed that people preferred B to A, but people preferred C to D. This shows that there is basically the reflection effect, which exhibits risk aversion for positive prospects and risk-seeking for negative ones. Evidently, the subjects did not integrate the bonus with the prospects. The bonus did not enter into the comparison of prospects because it was common to both options in each problem.

The pattern of results observed is clearly inconsistent with utility theory. In that theory, for example, the same utility is assigned to a wealth of $100,000, regardless of whether it was reached from a prior wealth of $95,000 or $105,000. Consequently, the choice between a total wealth of $100,000 and even chances to win $95,000 or $105,000 should be independent of whether one currently owns the smaller or the larger of these two amounts.

Because, as you can see, even chances to own $95,000 or $105,000 implies that the expected value is actually equal to $100,000. So, this is what it says that the choice between a total wealth of $100,000 and even chances to win $95,000 or $105,000 should be independent of whether one currently owns the smaller or the larger of these two amounts because, ideally, the expected values are the same for both prospects, and one should be indifferent between the two. With the added assumption of risk aversion, the theory suggests that the certainty of owning $100,000 should always be preferred to the gamble. So, this is what the behavioralists look at—their perspective about it.

However, the results from the gambles with negative outcomes suggest that this pattern will be obtained if the individual owns the smaller amount but not if he owns the larger amount. The apparent neglect of a bonus that was common to both options implies that the carriers of value or utility are changes in wealth rather than final asset positions that include current wealth. With this, I conclude this lecture or module. on the substitution effect, substitution axiom, and reflection effect. In the next part, I will continue with some other anomalies observed in the literature of behavioral economics and also introduce prospect theory.

Thank you.