Behavioral and Personal Finance
Prof. Abhijeet Chandra
Vinod Gupta School of Management
Indian Institute of Technology, Kharagpur

Module - 01
Behavioral Economics and Finance
Lecture - 05
Decision Making Under Risk and Uncertainty

Hello, hello welcome back to the course Behavioral and Personal Finance, the world would have been a better place if we were homo economicus. But, fortunately or unfortunately we are homo sapiens and most of our decisions are based on the environment and the circumstances that we are in and that is where we deviate from the traditional economic decision making theories. Today we are going to discuss the decision making framework under the expected utility theory, where risk and uncertainty play an important role.

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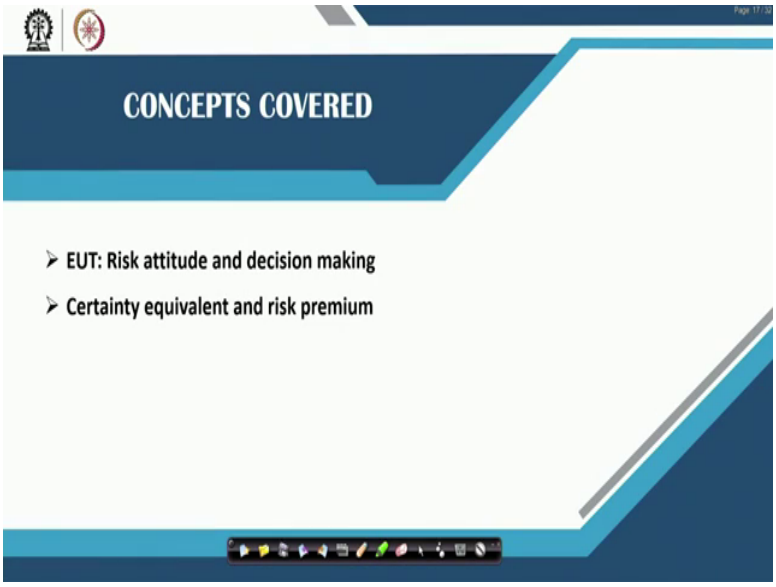

Today's topics for discussion are the examples of expected utility theory, where risk attitude of the economic agents and the decision making framework play a major role. At the same time we will also see how we incorporate those risk and uncertain situations in our decision making processes. So, far we have learned that our decisions where economic payoffs are associated are based on the utility derived from those payoffs.

For example: if you have an investment that is going to yield different payoffs with different probabilities, we will try to understand what should be our expected payoff from those outcomes and based on that we take our decisions. Let us have a look at the following example.

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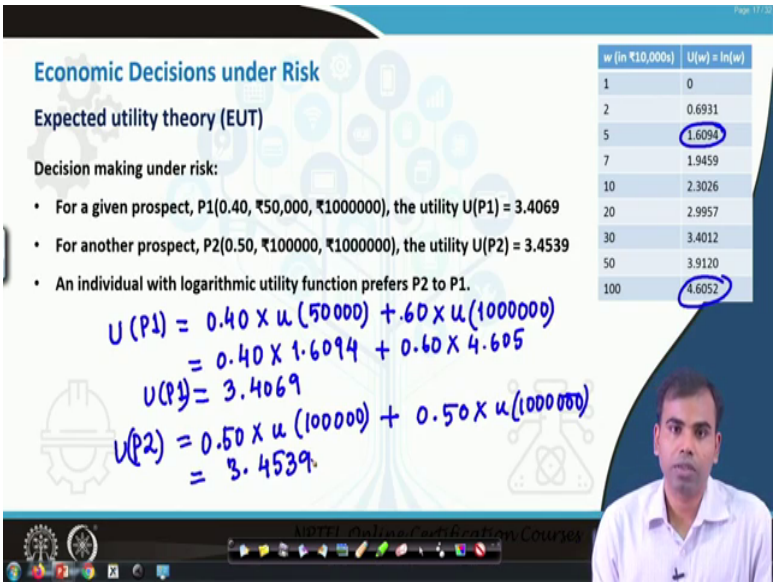

Suppose there are two prospects P1 and P2 and we assume that we follow logarithmic utility function which we discussed in previous session and the pay offs that prospect 1 has include 40 percent probability of having 50000 and 60 percent probability of having 10,00,000. At the same time we have a different prospect P2 which has 50 percent probability of having 1 lakh and remaining 50 percent probability of having 10,00,000Going by the expected utility theory proposed by von Neumann and Morgenstern; we would try to calculate the utilities associated with these prospects and then we come up with the ranking of these prospects to arrive at a decision.

If we go by the standard utility theory, we calculate the utility derived from these two different payoffs and associated probabilities and thereby we come to a set of utilities associated with these two payoffs. Let me try to show how we derive the payoffs probabilities

and the associated utility, where we can rank these two prospects according to their utility derived from the utility theory. For referring to the expected utility function as suggested in previous sessions, we are referring to the table given at the top right and to calculate the utility is associated with these two prospects we are using the values given in the table.

So, if you try to calculate the utility associated with prospect 1 it will be looking like this, utility associated with prospect 1 will be probability associated with outcome 1 into utility associated with the payoff which is 50000. And, the remaining probability and the utility associated with the associated payoff. So, going by the logarithmic utility function we will have associated utilities as 1.6094 and for 10,00,000 we will have associated utility as 4.6052. If you can refer to the table given these are the values that we are referring here.

Going by this framework the utility of payoff 1 as explained earlier would be 3.4069. Similarly, for another prospect that is utility of prospect 2, the utility can be calculated as probability into utility of payoff and this will give us the utility of prospect 2 as 3.4539. Now, if we try to understand from the expected utility theory, we will take this example to a different context where the associated risk and uncertainty can be incorporated. But, going by the standard utility theory if a person faces these two prospects and he is indifferent in terms of the choices that he would be making.

The best prospect that he would go for would be prospect 2 because, the utility derived from prospect 2 is higher than the utility derived from prospect 1. This is what the standard utility theory explains. When we try to incorporate the risky situations which where the outcomes are known and associated probabilities are given, we can incorporate vNM framework of utility theory. And, we try to come up with payoffs or the out outcomes which will incorporate the probability as well as the risk and uncertainties. Let me try to show this with another example in the same context.

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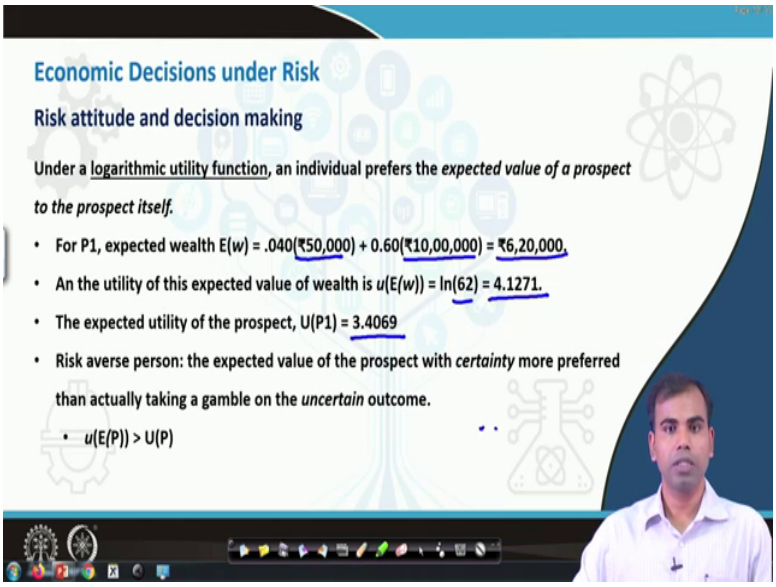

The vNM framework of expected utility theory says that, if a person is given two choices where one choice include the probability weighted, choices and another choice give offers a confirm outcome. Given that the person follows a lognormal utility function he would go for the sure shot or the certain outcome that is offered to him. Now this can be explained with the help of the following example, taking the information from the previous example of prospect 1 we will try to explain how this can be incorporated in an expected utility theory framework.

If you look at the information given the prospect 1 has two outcomes 50000 and 100000. So, these are the two outcomes of prospects 1 and these two outcomes have associated probability as 40 percent and 60 percent. And, if we try to find the expected wealth we can calculate by the given probabilities of expected wealth as 620000 that is the expected wealth of the prospect that is offered to the person.

Now, if we try to use standard utility theory, the expected utility expected payoff of these two values 50000 and 100000 will yield a utility of 3.4069 which we have just calculated in previous slide. The values are given here and if you try to calculate the utility of the expected wealth which is 620000 referring to the previous table. We will come up with a utility value of 4.1271.

So, this value has been calculated referring to the previous table that we had shown earlier and this is this 62 is actually coming from 620000 because the table has values in terms of 10000 dollars or rupees. Now, if we compare these two values the utility derived from the prospect of two outcomes with two different probabilities 40 percent and 60 percent and another prospect which is a sure shot calculated value of 620000. Under normal circumstances an individual who would go for the one which has higher utility and in this case the prospect with 620000 of expected wealth is giving a higher utility for the individual and that is why he would prefer this choice.

Now this leads to a very interesting observation, which implies that the individuals under normal circumstances tend to prefer the prospect itself rather than the expectation of prospect; which means they behave such that they prefer the shore short outcomes which means the certain outcomes rather than going for the outcomes which have certain risk component or uncertain components. For example in the P1 we had two possibilities and these two possibilities have certain probabilities of 40 percent and 60 percent and that is why they were uncertain.

So, a person would not go for uncertain choices rather he would go for the choice that is offering him sure shot expected wealth of 620000. This particular characteristic of individual decision makers is known as risk aversion. Now, an individual can be risk averse which means he would not like to take risk or he can also become risk seeker; which means he would like to take risk given certain circumstances or he can be risk neutral which implies that he is indifferent between risky or certain situations.

When we try to understand the decision making process in terms of individual behavior such as risk averse risk seeker or risk neutral. We will start with our focus on risk averse behavior. In financial decision making we often observe that people do not want to take risk, which implies they do not want to take decisions with uncertain outcomes. And, if they are forced or they are likely to take decisions which are uncertain or the decisions which have certain risky outcomes. The individual would like to be paid of a reward or to be compensated for the risk that he or she is assuming this is where the expected utility theory comes into the picture.

It also suggests that when a person is willing to assume a risk what should be the level of reward or the compensation that should be given to him for taking the risk that is assuming in the decision making. We will try to understand this with the help of another example where we will try to calculate the extra payoff or additional payoff that a person would like to get where he or she is taking an additional risk. When we talk about decision making under risk and uncertainty we try to understand.

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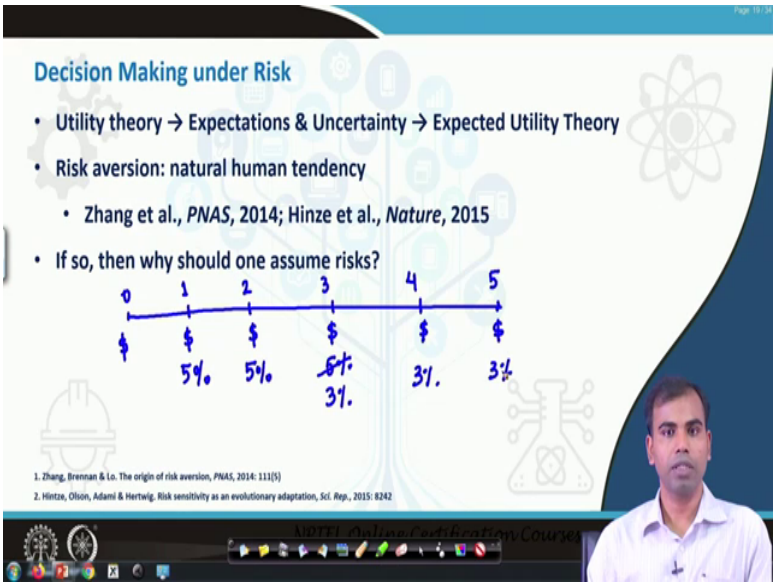

That decision making is largely based on the expected outcomes which are to be occurring in future and there is certain likelihood or probability associated with each of those outcomes. And, we try to incorporate the possibilities or likelihood of those outcomes in our decision making framework and that is where we use expected utility theory in our decision making processes. As we discussed risk aversion is a natural human tendency empirical and scientific research over the years have shown that individuals as human being or economic agents tend to be risk averse by design they do not want to take any uncertain decisions or those decisions which include uncertain payoffs.

Let us say for example, a person has certain amount of money and that money can be invested in different investment avenues. Now, given the natural choice of individual human being, the money can be invested in most safe investment avenues such as bank deposits or fixed

deposit. And, if the person is risk seeker it can be invested in different risky investment avenues, such as share market or bonds or mutual funds. Depending on what level of risk seeking behavior the individual is exhibiting the in money can be invested in different risky investment avenues. This framework is actually based on the expected utility theory under VNM framework, where they incorporate risk aversion as an natural characteristic of individual decision maker. And that is where they try to explain how this disk decision making process can be improved.

Now, that we know risk aversion is a natural tendency, why should an individual take an additional risk. For example, if you know that there is a set career path which means there is no uncertain future outcomes you would not like to take any risky career choices. Or for example, if an individual knows that going by a certain career choices he or she would make a better future, why would he go for more risky choices such as entrepreneurship. Similarly, an investor if he or she knows that the money can be safely invested in certain instruments such as bank deposits or government bonds, why would he or she be investing money in stock market instrument or other similar risky instruments.

The answer is they would be compensated for the risk that they should be assuming. Now, what should be the extent of compensation or the payoff that should be rewarded in terms of the risk premium. Suppose you have x amount of return to be expected from an investment. For example, you have an investment horizon of 5 years, which means if you invest money today you will be expecting some amount of money as returned in future for next 5 years. But you are not sure whether the future is going to be as stable as present or as certain as you believe so.

So, if you expect that you are going to get certain amount of return let us say 5 percent of return from your investment in some investment avenues. So, for first two years you get 5 percent of return and suddenly there are certain changes in economic policies or global market scenario or any other macroeconomic factors. And, the return that you are hoping to get from your investment would fall from 5 percent to 3 percent. So, earlier you were expecting 5 percent, but now this is going to be 3 percent. And this is very common maybe if

you observe around you would find people who had invested 10 years back, hoping that they would get a certain amount of return every year to support their livelihood.

But over the years they realized that the return on their investment have started falling down from what they had expected, because of several macroeconomic factors or other reasons. Now, if you are trying to go for traditional methods of equal utility theory, you would have incorporated this payoff with associated probabilities to come to the conclusion where you would have some utility derived and then that utility can be used to make the decision whether to invest or not. Now in a change scenario where the rate of return have fallen from 5 percent to 3 percent, the calculations that you had done earlier would be required to improvised,

And, now the utility that you had derived in the beginning would be revised as well. This is where you need to understand the amalgamation of traditional economic theories along with the more sophisticated financial calculations and the implications of behavioral and psychological factors in financial decision making. An implication of such scenario would can be seen in different stock market context.

For example: if you try to understand or observe a behavior of an individual investor, the investor has invested in the stocks of a company and he had expected certain return from that investment. Now, after some time of the investment decision the investor realized that the return on the stock that he owns has started falling down, which is basically the result of the price fall. Now, the situation could be the investor should sell the stocks that he owns or he can continue holding that stock, so that he can get whatever he is getting in terms of share stock returns.

Now, if he is a very normal individual a very traditional human being, the change in return would essentially reflect in his decision making and he would be likely to sell off his shares. But if you try to understand from the psychological point of view you would notice that most of us do not want to sell such assets. Essentially when we have certain assets or investment that have started losing values, we want to stick to this investment and try to hope that the

investment would recover value in coming future and once it reaches the price at which we had bought we would be selling it off.

This tendency is also known as anchoring in behavioral finance theory, but to understand it from the expected utility framework we know that unless we revise our utility derivation or the value of utility that we had derived initially, our decisions would be flawed and we would not be making a sensible and financially feasible decisions.

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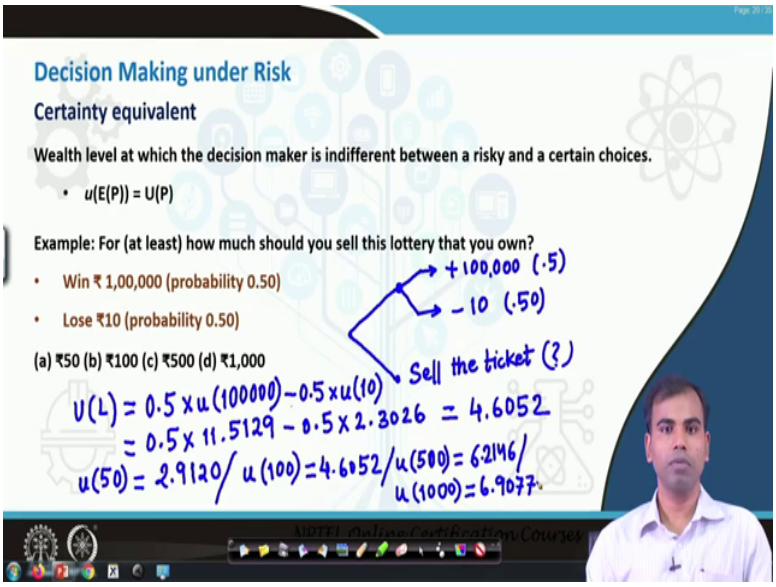

Now, coming back to the question how should we incorporate the additional risk that we are assuming in our decision making, so that we should be compensated enough for the risk that we have taken. One approach is to understand the Certainty equivalent, certainty equivalent is essentially a factor or an approach that suggests that. The wealth level of the decision maker is indifferent between a risky and a certain choice. So, if you have two choices where one

choice is risky and another choice is another choice is certain. The wealth level of these two choices becoming equal implies that this is certainty equivalent situation.

If you try to understand with the help of an example suppose you have a lottery and that lottery have. Suppose that you have purchased a lottery ticket and the lottery has two possible outcomes outcome one is you can win 100000 rupee and outcome two is you lose 10 rupees. Now, these two outcomes have equal probabilities that is 50 percent in each cases. Now, what should be the minimum amount at which you should be selling this lottery ticket to anyone. The situation here is you can either hold on to the lottery ticket which is a gamble or an uncertain choice or you could sell this off to anyone for a price which is certain.

Again you have two choices so either you can so this is the decision point, you can keep holding the lottery ticket and this will be taking you to two different choices or rather two different outcomes. One is 100 1000 rupees of gain and another is ten rupee of loss and in these two cases you have 50 percent probability for each of the outcomes. Another outcome is or another choice that you have is sell the ticket that you have, sell the lottery ticket that you have for a price. Now what should be the price now what should be the price that you should be selling it off.

If we go by the standard utility theory framework we will first try to find the utility derived from the first option that we have, which means if we hold on to the lottery ticket the uncertain situation should yield in certain utility and that utility can be calculated as follows. So, you can have the utility of lottery ticket as the probability of these two outcomes into utility of the associated payoff. If we refer to the table that we had started with today, you would get to see the value associated with these two numbers.

And, the values are for the first outcome of the lottery ticket that is winning of 100000 rupees the values are 11.5129 and another outcome is you would be likely to lose 10 rupees with a probability of 50 percent. Apparently, this 10 rupee is a loss so we need to revise this value as a negative value because you are likely to lose money. So, you have to reduce the extent of utility that you would be deriving. So, 0.5 that is the probability associated with second

outcome and utility of ten is 2.3026. If you calculate these values the utility that you will be getting is essentially 4.6052.

So, this is the utility that you are likely to get when you hold on to the lottery ticket. Now certainty equivalent principle says that the utility of the wealth level or the outcome should be equal when you are trying to calculate the certainty equivalent which means at the point where the wealth level or the utility value of these two wealth levels are equal you should be indifferent between the choices of risky in nature and certain choice.

So, utility of this lottery ticket is 4.6052 and the choices that you have in order to sell your tickets are 50 rupees 100 rupees 500 rupees and 1000 rupees. So, if you try to calculate the utility of these payoffs which are certain, we can refer to the table again and we see that the value of the each of these utility of the first price that you have an option is basically 2.9120 another choice you have to sell your ticket is 100 rupees. So, utility of this 100 rupees will be 4.6052 for utility of 500, you have 6.2146 and similarly for utility of 1000, the value will be 6.907. Now, you may ask where do these value come from these values are actually coming from the logarithmic utility function table, which we had discussed in the beginning and these values are nothing but the natural log value of the numbers given in the brackets.

So, if you observe the prices that are available 50 rupees 100 rupees 500 rupees and 1000 rupees, the utility of the second option which is 100 rupees of price is exactly same as the utility that you are deriving from holding the tickets for future which means the payoff or the utility that you are going to get out of these two options. Option a is hold on to the ticket with 50 percent probability of winning 100000 rupees and 50 percent probability of losing 10 rupees. And, another option as sell the ticket right now for 100 rupees the utility levels in these two cases are same and this is where you can be indifferent between holding on to the ticket vis a vis selling it off for 100 rupees.

So, this is one point where you could understand about the extent of risk that can be mitigated in terms of finding the wealth level at which the utility is as much as the utility associated with a risky choice. And, this is where we try to start incorporating more from practical

implication in terms of decision making and this is where the expected utility theory can be incorporated in our decision making framework from a more realistic point of view, for now this is it.

Thank you very much.