**Project and Production Management**
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**Lecture - 24**
**Decision Trees and Risk Evaluation**

Good morning friends!

Today we are going to be talking about decision trees and risk evaluations. If you recall in the last lecture, we had talked about the financial appraisal of capital investments but there we had assumed that the cash flows involved were known with certainty, which is not necessarily true in practice. Therefore today we are going to be working with an example of a situation where cash flows are not known with certainty and we will see how we would like to evaluate such situations, we shall also talk about the evaluation of risk in capital investments. Basically all business decisions involve risk.

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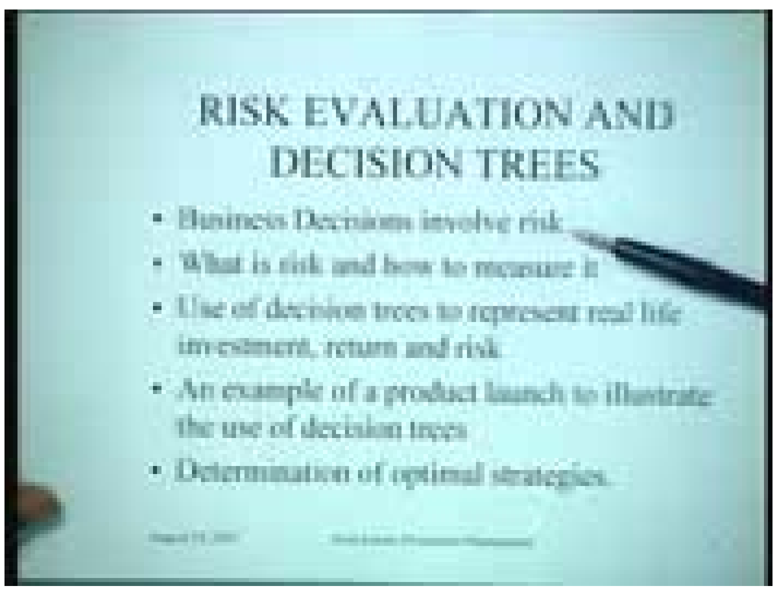


You must therefore understand what the risk is and how to measure it. A risky situation is one where you do not know what will happen. So uncertainty is an essential component of risk and once you do not know what is going to happen, you either know that the different things can happen and therefore you might not expect to get what you expected in life. That actually defines the risky situations. We will formally define risk, so that you can get an idea of how risk can be evaluated in life situations. What we will do is we will talk about a device known as decision trees to represent real life investments, real life returns and risks and then we will take an example of a product launch situation to illustrate the use of decision trees. We are talking about the product launch situations because this is the first stage in the life cycle of a production system and we are interested in finding out which product to launch. The environment is generally risky. So we are addressing that particular situation. Then considering the situations, we will talk about determination of optimal strategies as to how we determine what is best to do in risky situations.

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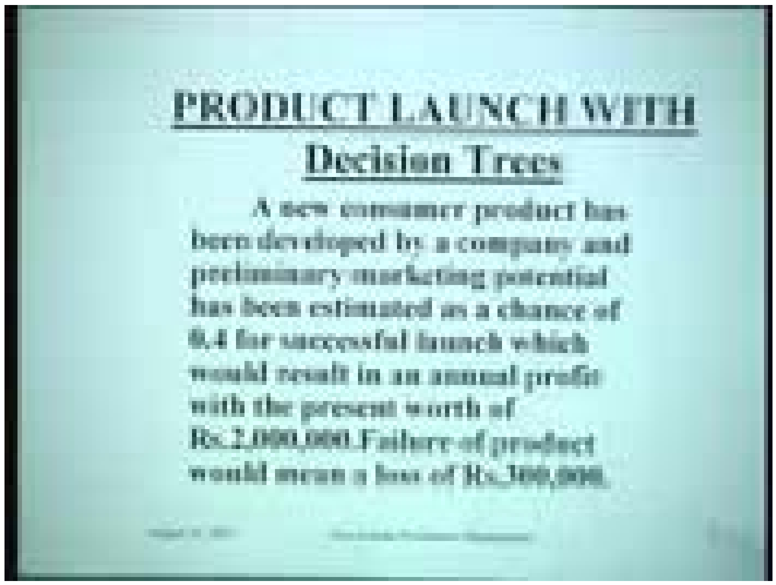


Let us present a situation and the situation is such a company is thinking of launching a new consumer product that has been developed by the company and preliminary marketing potential has been estimated as a chance of 0.4 for a successful launch. This would result in an annual profit with the present worth of 2 million rupees. The failure of the product would mean a loss of 3 lakh rupees. This is the situation that we are considering. We notice here that to some extent the company has an idea of this chance of 0.4 which is estimated as the probability of a successful launch for the new product. If the product is successfully launched, it is expected that it would yield profit and the net present value of that profit is expected to be 2 million rupees. If the product is a failure, it would mean a loss of 3 lakh rupees because if the product is a failure, what it means is that all the expenses that have gone into promotion and prototype development have actually been incurred. Therefore there is a loss to an extent of 3 lakh rupees and if it was doing well then it would be able to gain 2 million rupees. So these are some figures here and the chance of the successful launch has been estimated by the marketing department which is actually familiar with the state of the market, the types of customers and so on. So this is an estimate. It is a desian estimate rather than a classical estimate of probability. What the company wants to do essentially is to either drop the idea totally, do not to do anything.

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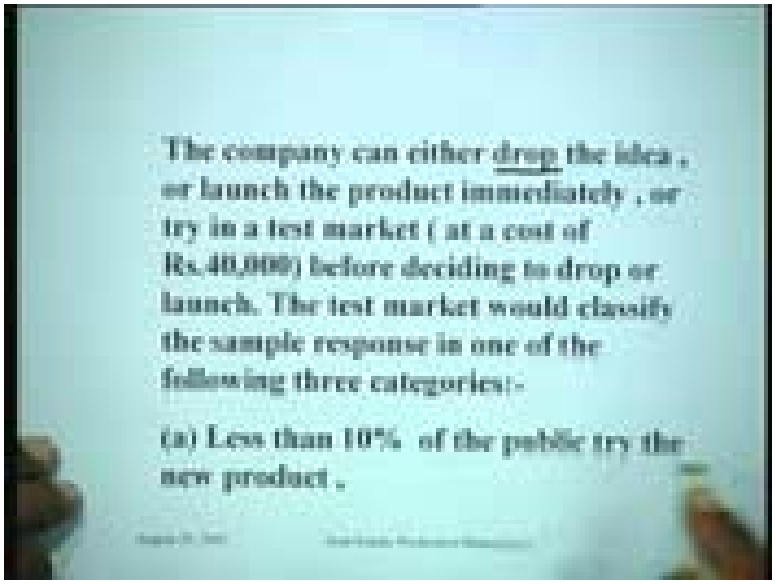


The company can decide to take a plunge and launch the product straight away. If it is a little more cautious, it might want to try a test market which can be done at a certain cost. The estimated cost here is 40,000 rupees. Before deciding to drop or launch the product, the test market would obviously give us greater information about the likely success or failure of the product. You can categorize the outputs of the test market into the following three categories: a, b and c. So when you are talking about a, this is the situation where less than 10 percent of public try the new product. So this is like a poor response. So the response a, would be the poor response of the test market. We may then have a situation where in b, we have more than 10 percent of the population that tries the product. But less than 25 percent of those who try the product buy it on a second or a subsequent occasion. So this is like a medium popularity of the product and in third case c, more than 10 percent of the people try the product and the repeat purchase rate is more than 25 percent. You see the true success of a product depends up on its repeat purchase. You might go to the market and buy the product just because a beautiful young lady is presenting it to you. However, the real success of that particular product would be determined if you go ahead and buy it the second time after the first exposure.

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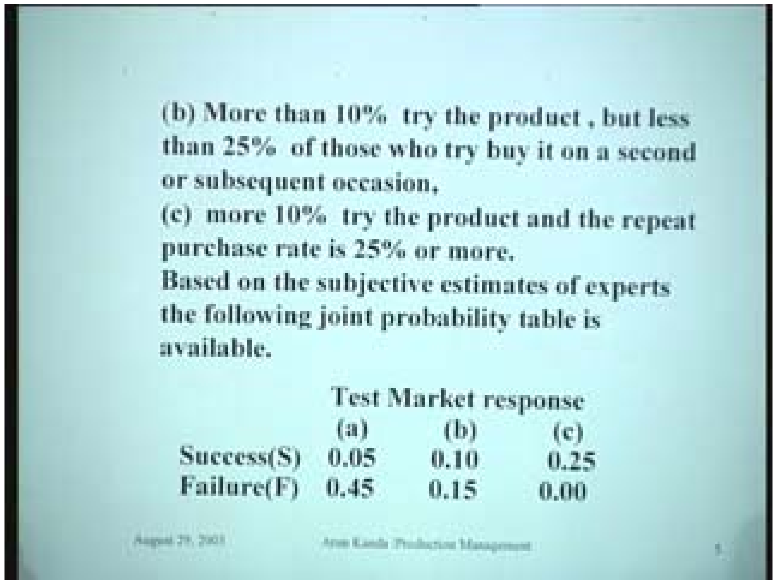


That is exactly what we are trying to capture here in responses to b and c. If the repeat purchase rate is less than 25 percent, we classify it as b and if it is more than 25 percent, we classify it as c. So a, b and c become statistical, which means they classify the response of the product in terms of its popularity at the test market. So we can sort of summarize the response of the marketing experts of the marketing departments in terms of the following probability table. The joint probability table of success and poor response is .05 and the joint probability of success and medium response is 0.10 and the joint probability of success and good response is 0.25. Incidentally, if you take the summation of this row, it leads to 0.4, so 0.4 is the unconditional probability of success. These are the joint probabilities of s union a, s union b and s union c in mathematical terms. Naturally, you would expect that these probabilities which are only estimates will have a smaller success rate if the test market outcome says poor. So this probability will be smaller (Refer Slide Time: 10:12), this should be relatively bigger and this should biggest in this particular row. So there is a logical way to estimate these probabilities and you can therefore look at this way. Similarly the probabilities are failure.

The highest probability of failure should be for a product which has a poor response in the test market, which is 0.45 here and we would expect these probabilities to decline that means the failure probability is assumed to be 0, if the product has done very well in the test market c. This is very much like trying to say that if the candidate has done very well, he is likely to get a job in a100 percent probability. That is what we are trying to say here. Using this probability information and the information pertaining to the economics of the problem, let us see what we can do about this.

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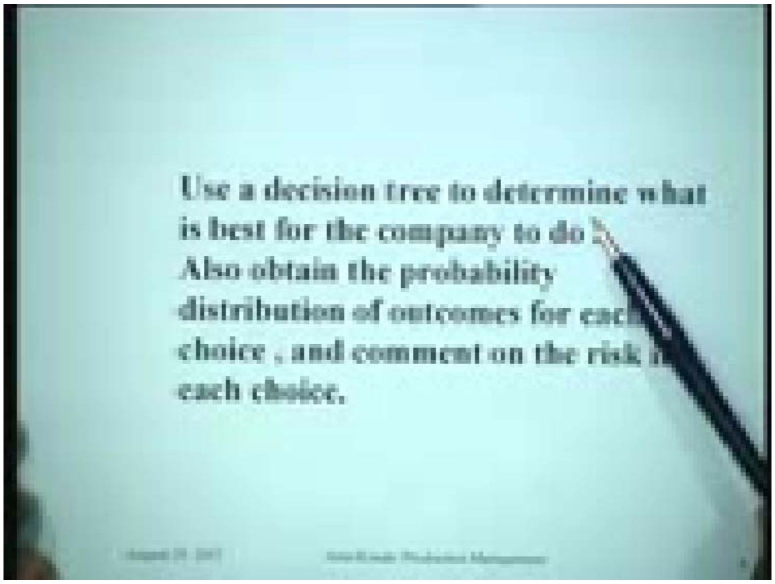


So the task at hand for the company is to use a decision tree to determine what is best for the company to do and also to obtain the probability distribution of outcomes for each choice and comment on the risk, in each case or in each choice. That is exactly what we are trying to do through this case study.

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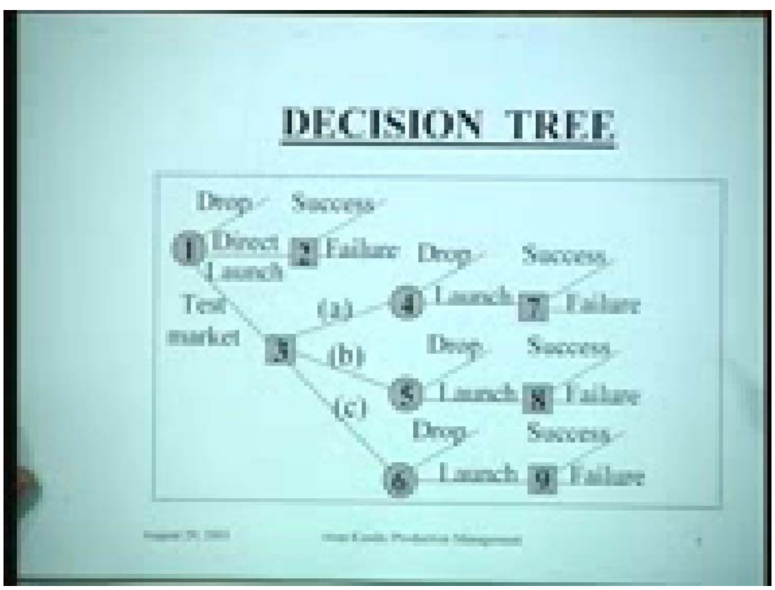


Many of you may be familiar with the notion of the decision tree but for this particular example, our decision tree would look something like this (Refer Slide Time: 11:59). Let us first comment on the structure of the tree. Notice for instance that we start here from a circular node which we call node one. Basically there are 3 options available to us. We can either decide to drop the idea or we can decide to do a directly launch or we can decide to do a test market. So there are 3 possible routes from 1 and we go here. If you come to node 2, we have used a square node rather than a circular node. The square node specifies that this is the chance node and anything can happen here. In fact there are 2 things which can happen here. The product can be either be a success or a failure. And this is the probabilistic phenomenon in this case. Similarly if you do a test market, the results of the test market can be poor, medium or good, the way we just describe them. When you come to these nodes, the circular nodes are referred to as decision nodes, which are the place where the decision maker can decide which road he is going to take, whereas if you come to square node, you do not know whether you will be thrown here or here. It depends up on the operation of a rule at wheel which determines whether you go to success or failure, according to a probability distribution. When you come here, if your test market response is a, then you can decide to either drop the product or launch the product. So this is the decision node and I can decide to do either ways depending up on whatever I want. However if I decide to launch the product, you encounter a chance node here and so you might land in either success or failure of the product. Similarly here in each of these cases, you can either decide to drop or launch and there would be success or failure if you launch drop launch and success and failure and so on.

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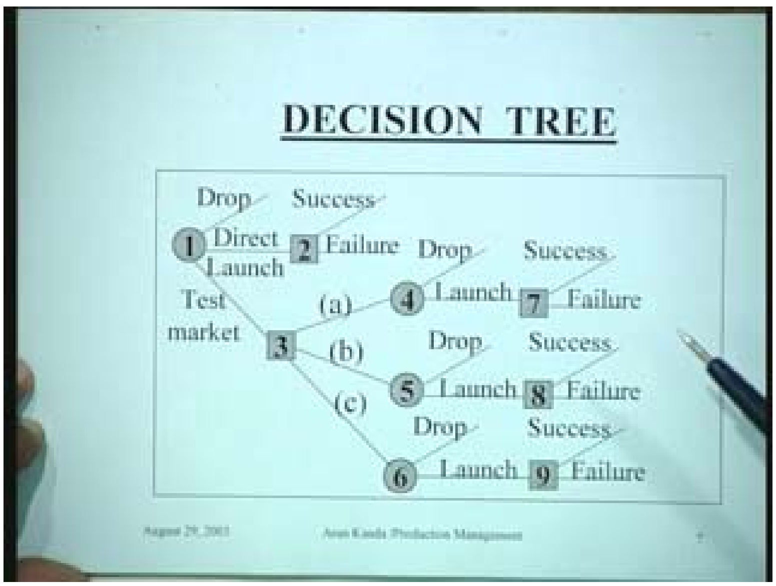


So this is the structure of the tree. The only thing is that we would have to super impose on the tree, 2 kinds of information. If you drop the idea of what is going to happen, what are the consequences, you get nothing, there is 0 here. What would happen is if it is successful, you gain 2 million. If it is a failure you lose 3 lakh of rupees. So you put that figure here, that would be the monitory information that would have to be entered everywhere on the tree. The next thing that would have to be done is to put down the probability estimate, of all the probabilistic nodes so that you can evaluate the tree. Now you can number the loads as 1, 2, 3, 4, 5, 6, 7, 8 and 9. The numbering is essential in the sense that we will have to evaluate each of these nodes. So as we go along, we will see how the individual node numbers can be evaluated. Incidentally this is the optimal decision tree. Let me explain this now. I will explain the calculations a little later because this is the final result and because students generally answer to know the final results without knowing what the intermediate calculations are. So I thought it would be a good idea just talk about the optimal solution before I go into the computations.

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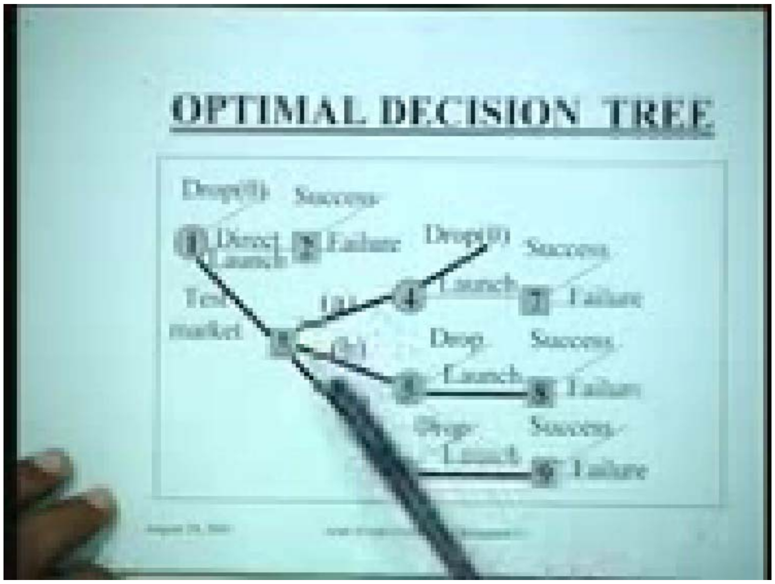


The optimal solution (is the one which is shown in dark lines here), really shows that it is best for the company to do the test market here and not to do the drop or the direct launch. Once the test market is done anything can happen. It can be poor, medium or good response. If it is a poor response, best is to drop the product. If it is say medium response, best is to launch the product. If it is a good response, it is best to again launch the product. So really speaking, the 3 major decisions are follow node 3 are DLL (drop-launch-launch). So we had actually defined a decision strategy. You must understand the difference between a decision and a decision strategy. A decision strategy here, defines for us the entire sequence of decisions that we would be taking under all possible circumstances. We do the test market. The test market can land you here or here or here (Refer Slide Time: 17:15) and we do not know where. Then from here, if you land up here, it is best to drop, and if land up here it is best to launch. This statement is a decision strategy. Decision strategy is the sequence of decisions for all possible outcomes and once the decision maker knows the optimal strategy, i.e., if he is equipped with all these information or he knows what to do under all circumstances. So the objective is primarily to determine this decision strategy from the information about the decision tree that we just talked about.

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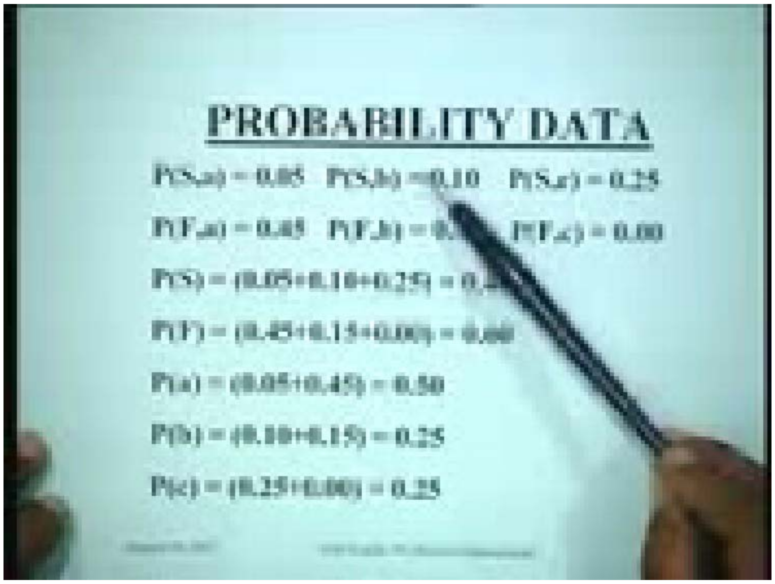


How this is done is you first manipulate the data. We have this information about joint probabilities of s and a, s and b, s and c which I showed you in the previous table. You have the information about joint probabilities of failure a, joint probabilities of failure and b and so on. This would the second row of the probability table. The interesting thing of course is that probability of success is nothing but is the sum of all these. So this figure we know comes out to be 0.4 here. In fact we are using what is known in probability and statistic, the theorem of probability. Similarly the probability of failure is given as the summation of the second row which is 0.6, which is what we knew. Similarly the probability of a, that is the probability of the test market out come being poor is the summation of these two probabilities and this figure is 0.5 and similarly probability of b will be 0.10 + 0.15 which is 0.25 and probability of c is also 0.25, which is the summation of these. Obviously this adds up to 1 and this also adds up to 1 as it shows. So we have actually determined the probabilities of success and failure and the probabilities of a, b and c. What it simply means is that if you look at the decision tree, what we have got here is the probability of success = 0.4 and the probability of failure is 0.6 here. And similarly we have been able to estimate these probabilities a, b and c as 0.25, 0.25 and 5 respectively, which is what we have obtained here. So from the probability data, for this case, we impose the information pertaining to the annual profits.

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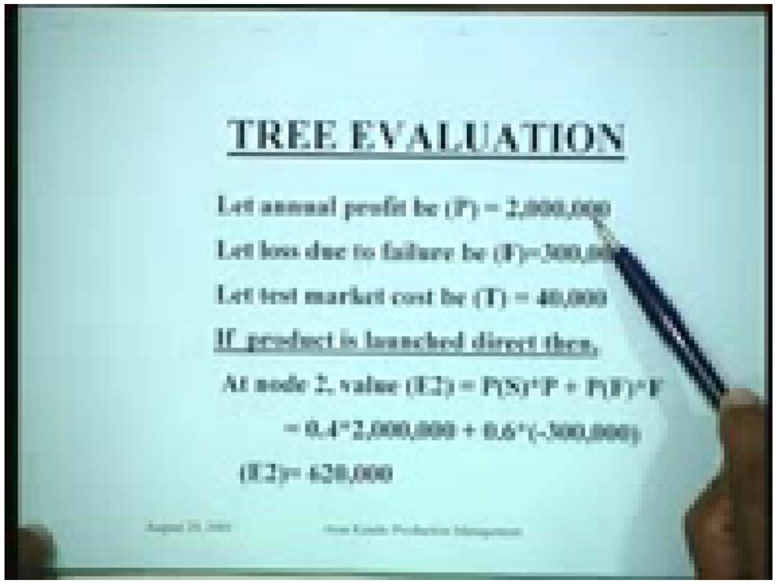


The annual profit p is 2 into 10 to the power 6 that is 2 million rupees. The loss due to failure is 3 into 10 raised to the power of 5, that is 3 lakh rupees and what we are saying is the test market costs 40,000 rupees to organize. So this is the cost involved in conducting the test market. If the product is launched straight away, what happens is then you can calculate the value of node 2. What is node 2? Look at this example here. So what we are interested in is the profit of 2 million multiplied with the probability of 0.4 plus the loss. So it will be – 300,000 multiplied with the probability of failure. That will be the expected value for node 2.

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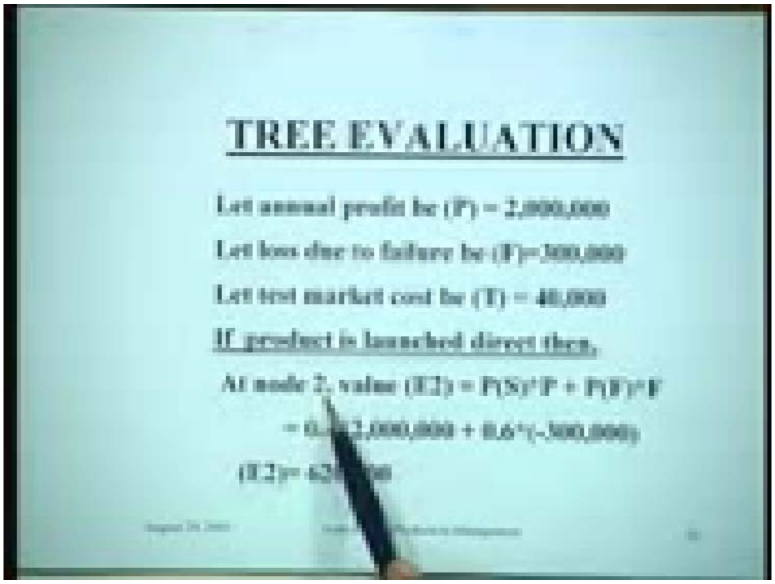


So this value which is the expected value for node 2, is therefore 0.4 into 2 million + 0.6 into – 300,000 because this is the loss and the expected value for node 2 is 6, 20,000 rupees. So it is a one way. We have computed the value for node. We will adopt a similar procedure to compute the values for node 3 to 9 in this particular problem. Consider the situation, if the test market of the product is done, then what will happen at node 9? What is node 9?

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Let us recall node 9. For instance consider this particular node here, calculating from the back, what is going to happen is the total monitory value or the return here, which is 2 million rupees multiplied with corresponding conditional probability of success. Here we are going to use conditional probabilities of success because this is the probability of that and you are on this (Refer Slide Time: 22:21) branch. So this is nothing but the probability of success, given c that has happened. This will be the probability there. If you compute these figures, you get the expected value for node 9, as 2 million rupees. Similar figures for node 8 are 620,000 rupees by a similar logic and for node 7, the values turns out to be negative. It is – 70,000 rupees. When we are computing from the back, nodes 7, 8 and 9, we find that the expected value for nodes 8 and 9 are positive but for node 7, it is negative.

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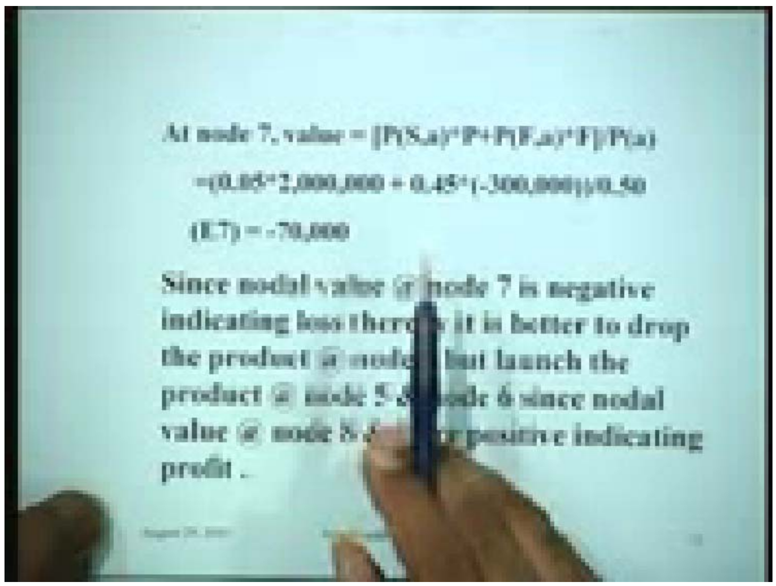


You can make a conclusion here and the conclusion is, since the nodal value of node 7 is negative, indicating loss, thereby it is better to drop the product at node 4 but launch the product at node 5 and 6, since nodal values of 8 and 9 are positive indicating profit. I hope this is understood. What we have simply said is the value at node 7 is negative and this drop is 0. So here you have a choice at node 4, a rational decision maker would choose 0, something better than –70,000. So you would prefer this road, rather than going here. If you happen to be at node 4, the optimal decision for you should be drop the product rather than launch the product. However if it happens to be here, it is better to launch the product because the values for these two are coming out to be positive. That is the logic for this, for instance, if you consider node 7, what is node 7? Node 7 is here (Refer Slide Time: 243:47). Here you would have conditional probability of success and the conditional probability of failure.

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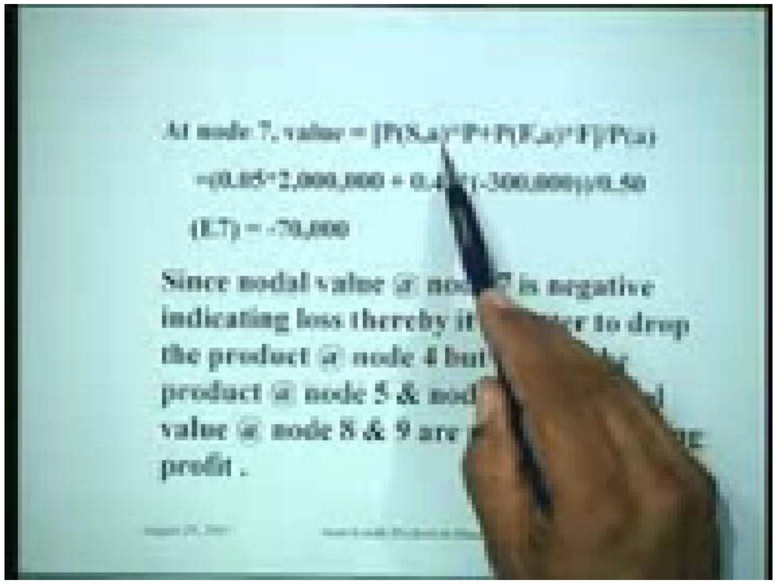


What are these conditional probabilities of success and failure? This is S a divided by probability a, F a divided by probability a, so this is the conditional probability of success, when divided by p (a) of success given a, has happened, conditional probability of failure given a, has happened. These 2 probabilities which are nothing but you know 0.05 divided by 0.5 and 0.45 divided by 0.5. They are multiplied with the corresponding values that you have for various profit and failure here. So 2 million rupees and 300,000 rupees which is the loss and so you get the expected value for node 7 is – 70,000. Exactly similar logic is followed for the other nodes 8 and 9. We have expected values with us and then we got this information pertaining to values which has now been computed for all the nodes. We start from the back that is, we computed these values from 7, 8 and 9 and then we go back and from these values, we can then compute the values for node 6, node 5 and node 4.

What we mean here is we look at the tree again (Refer Slide Time: 26: 35). If you want to compute the value for node 4, what you should do is to compare the outcome here which is 0 with the negative outcome here. The value for this node will be the maximum of these values. The value for node 4 is 0, in the sense that we are assuming that you are a rational decision maker and you will therefore not be suicidal in making these decisions. Similarly here drop is 0 and launch was positive, so whatever the positive value was that would be the value for node 5. (Refer Slide Time: 27:05)

Similarly when you look at this particular situation, this is 0. When you drop, you do not get any profit. When you launch the profit you will get a certain expected values which we computed for node 9, so that would be the value for node 6 that is precisely what we are saying here.

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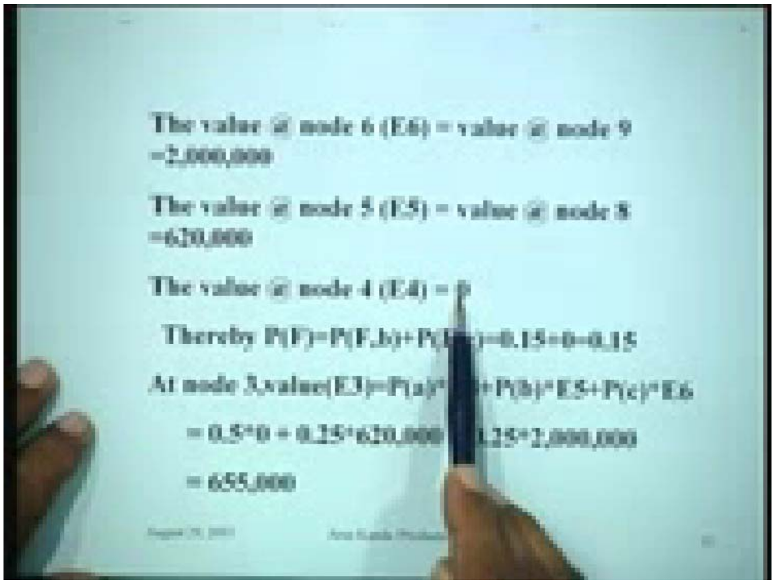


So the value for node 6 is just the value for node 9, which is 2 million. The value for node 5 is nothing but the value for node 8 which is 6, 20,000 and the value for node 4 is 0 because this is a better thing to do. Therefore we can directly find out the corresponding values. This was node 4, now you find it out for node 3. Node 3, if you recall, in the tree is this (Refer Slide Time: 27:54) particular node. So since we have computed the values of nodes 4, 5and 6 multiply them with respective probabilities here and you get the value for node 3, because this is the probabilistic load. So at this node we have probability multiplied with the values for these individual nodes and the values that we get is 6, 55,000 rupees. This is the process of computation. Now if you summarize the results so far, what we have concluded is we have been actually able to determine in the decision tree. These are the 3 basic options that you have (Refer Slide Time: 28:47) we have been able to determine the value for node 3. We can similarly determine the value for node 2. This will be 2 million into probability of success, which is 0.4 and –300, 000 into probability which is0.6, so that will be the expected value for node 2. You will get node 3, node 2 and also from this particular branch. So the conclusions here is that if the company drops the idea, then the expected return is rupees 0 which is obvious.

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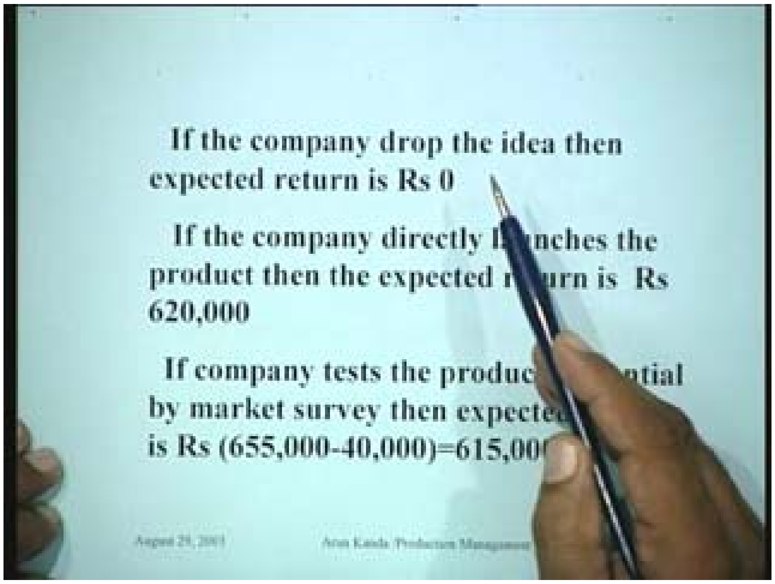


I decide to do nothing I say status quo and I do not introduce anything so this is not a risky thing, because I get 0 for sure. Fairly, if the company directly launches the product, then the expected return is likely to be 6, 20,000 rupees. If the company tests the product's potential by a market survey, then the expected return is likely to be 6, 55,000 which was the value and –40,000 which is the cost of the test market. This cost of the test market that you have here (Refer Slide Time: 30:00), the moment you decide to do the test market, you have to pay 40,000 rupees. So the tool tax that you pay for crossing the road, the tax on the Noida Bridge is exactly in the same manner. No matter what the outcome of the test market is, you have to pay that amount. So that is why this is extracted here and you get an expected value of 615, 000 rupees.

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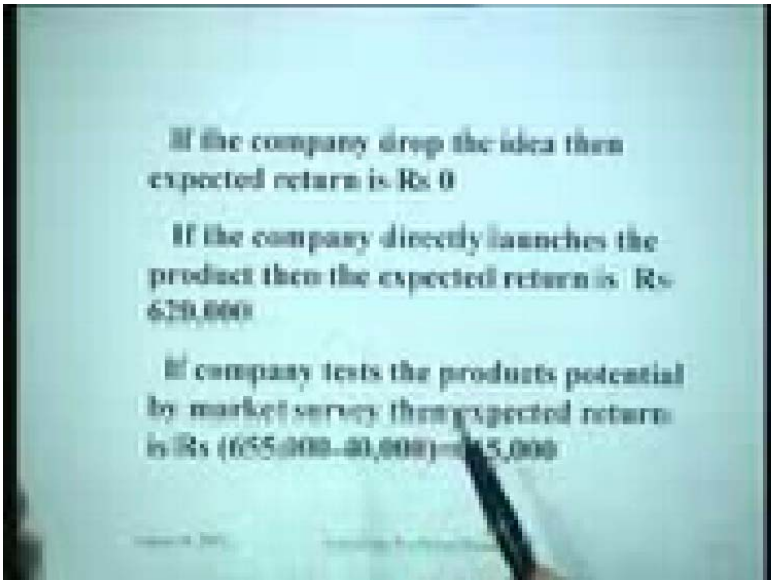


So essentially what we have done so far is, we have been able to evaluate the expected outcomes from these 3 possible courses of action. You either drop the idea or launch the product or may be do a test market. What you will find here is that there is a lot of difference between this (Refer Slide Time: 30:53) and this. This is 620,000, expected value and this is 615,000, expected value and since there is a lot of difference, I mean in the beginning, you might be tempted to opt for this one because this is the largest out of the expected value of the 3. You might say that the direct launch is the most profitable option but this option is a very risky option. This option is much less risky. We will now do the investigation of the risk to find out exactly as to what we should be doing in a situation of this nature.

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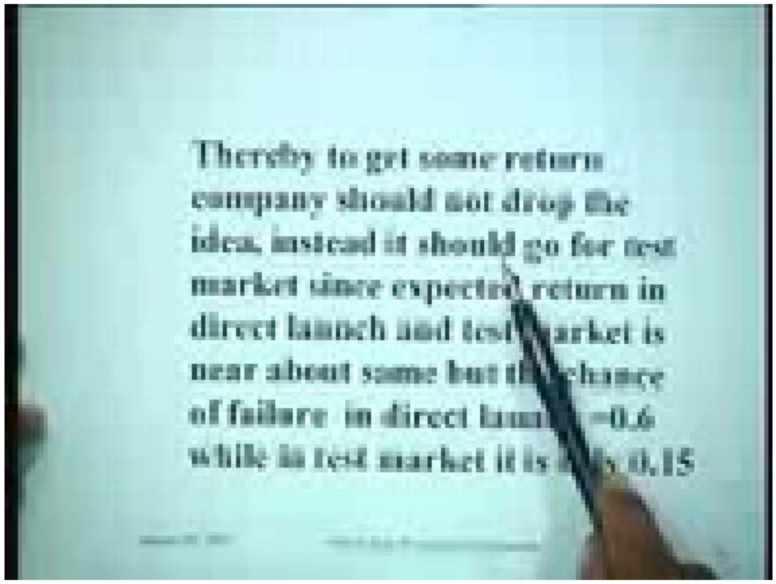


Of course our basic idea is to get some return. The company should not drop the idea. This is obvious because if we drop the idea, you do not get anything. So both the other option leads to some money, to some earnings and instead it should go for test market since expected return in direct launch and test market is about the same. But the chance of failure in the test market, quantifies risk in the direct launch. The chance for failure is 0.6 while in the test market it is only 0.15 in the test market. This speaks a lot about how risky these individual proposals are what you find here is that if you launch the product straightaway, the chances of losing is 60 percent, so that is a risky situation. Now at this stage, we can define risk. What is risk? Because we said one of our objectives in this lecture was to define risk and understand how to measure it, we can define risk as the probability of the negative.

The chance that you lose some money is a good measure of risk; chances of losing some money are a risk. For instance if I am stuck in the lottery, I spend 10 rupees. I either get nothing or I can win a maruthi car worth 3 lakh of rupees. But the chances of winning would be 0.00001 and the chances therefore of losing would be 0.9999. So this is a very risky adventure. If it is a big drop, the chances of losing money are very high. It is a risky proposition but it also depends up on the quantum of the loss. In a simple lottery situation you would mind losing 10 rupees because you can afford to lose it. Risk is the probability of negative payoff. The next thing is whether the company is willing to take that risk. Are you willing to lose that money? If you are able to take that risk, after all companies have to take risk to make money. It is an important aspect but kind of quantification.

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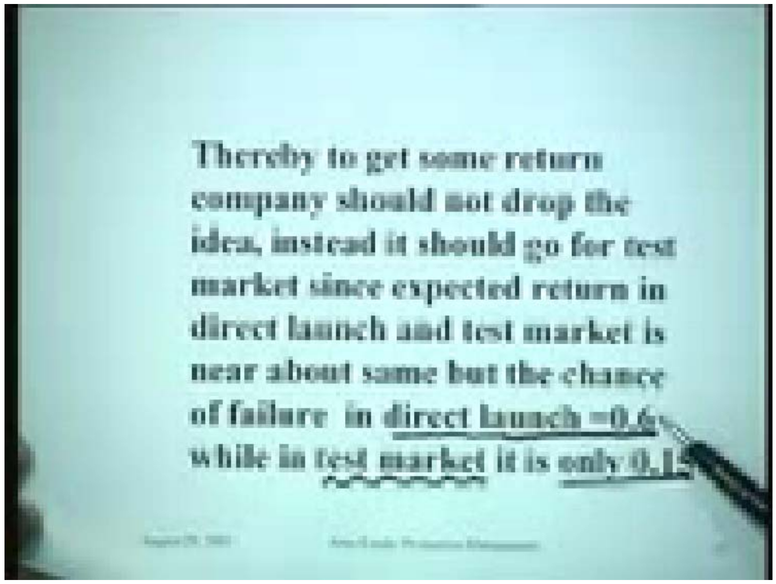


So in this case, the risk associated with the direct launch is 60 percent and the risk associated with the test market is only 0.15. We will see how this is calculated. I think an interesting point that can be discussed at this stage is I indicated to you that it is not really appropriate to talk about expected values in the evaluation of various risky options. Why do you think so? For instance take the example of the risk we were talking about, 10 rupees. You get a ticket for a car and you get a car for 3 lakh of rupees with a very low probability and for a very high probability, you will lose your 10 rupees. Whatever it is if you calculate the expected value of this gain, what will happen? 10 rupees into 0.9999 is the probability of losing that plus the probability of 3 lakh. But probability of that money is 0.000001 and therefore you would get an expected value which would be close to 10. Let us say it will be between 10 and 3 lakhs technically, depending upon the values of profit and loss probabilities, you can manipulate these values or whatever they are now, and the issue here is that expected value means nothing to you because at no circumstance, we shall get the expected value of money.

You will either lose rupees 10 or gain 3 lakh rupees for the car. You will never get the expected value. You will get the expected value only if this experiment is repeated indefinite number of times. If it was a repetitive situation then the expected value has a meaning. If you are doing this experiment only once, you will never get the expected value and therefore expected values are very misleading for situations which are not repetitive. That is exactly what I meant by saying that the probabilities that we are dealing with are actually Bayesian probability and not classical probabilities. When you are dealing with Bayesian probabilities you should at best treat them like estimates of experts and the expected value analysis that we have done actually has no meaning. What is the right thing to do under such a situation? For this example, we will see that we can do the evaluation of the optimal strategy by constructing the entire probability distribution of outcomes. If you know the probability distribution of outcome for a strategy, it would give the manager enough information of what all can be done and with probabilities, we just use that information for the sole purpose of taking the decision.

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We now talk about enumeration of all strategies. In this case, our basic strategies are the three: drop of status quo which is one of the options, direct launch which is another option or a test market.

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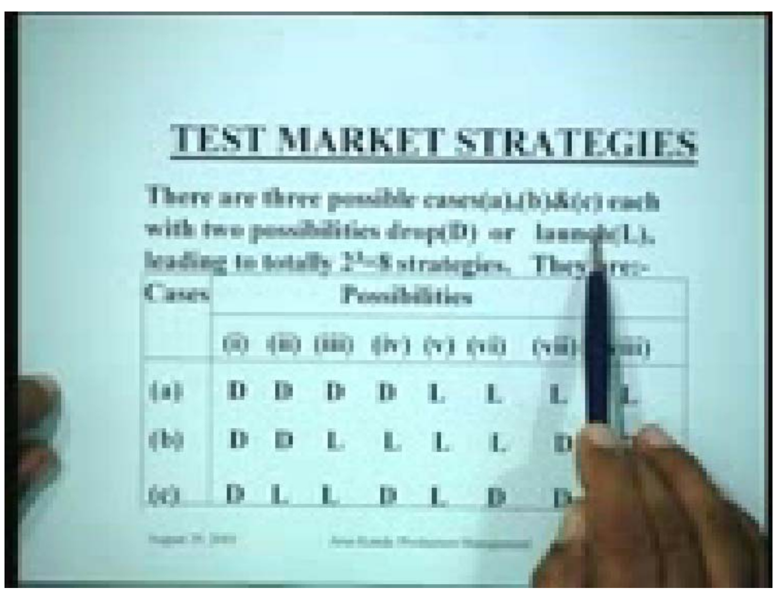


So in this case let us see the possible strategies. The 2 strategies are directly of course, drop and launch. Moreover there is also the option of doing a test market and in the test market; you can easily see that we can enumerate 8 possibilities. Because under each of the cases a, b and c for the test market, you can decide to either launch or drop the product, two decisions, so 2 raised to the power 3 is 8 strategies and the 8 strategies are listed here. The first strategy could be drop- drop- drop irrespective of the outcome of the test market which is like dropping the product all together. Then it could be drop drop drop (launch DLL) and so on. So what we will do is we will try to investigate the nature of these strategies in terms of their probability distributions and then make some comments on what the company should be doing.

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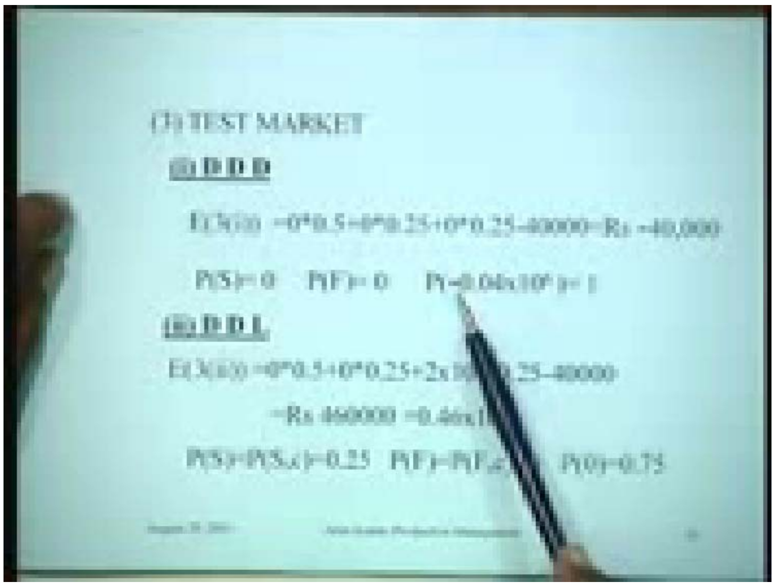


So we can talk about the first strategy which is drop or status quo which is very simple and that has the probability of success and failure. There is nothing like that. So it just 0 expected return in this particular case and in the direct launch of course, what we are doing here is there is a probability of 0.4 of success and probability of 0.6 of failure and that is what it is in terms of particular strategies. These 2 strategies then take the test market strategies. So when you look at the test market strategies for instance, if you take the drop- drop- drop situation scenario, it means you do a test market but decide in advance that no matter what the consequence of the test market is we are not going to launch the product. In fact it is pointless to do a test market in such a situation, if you are going with such a bias. But let us take this strategy and obviously for this particular strategy, the probability of the success would be the 0 and probability of failure would be 0. What we are losing in this particular situation is the amount of money that you spend on the test market which is 40,000 rupees.

The probability of that is 1, so you are about to lose this money without gaining anything else. Similarly if you look at the other strategy d d l, that is drop- drop- launch situation, then in this case, the consequence is there is a probability of 0.5 of not gaining anything. There is a probability of 0.25 of not gaining anything and there is a probability of 0.25 of gaining 2 million rupees in this particular stage. Of course in all these cases, there is a loss of 40,000 rupees. This is the cost of conducting the test market here. What we are basically trying to do here is to determine actually the probability distributions of all these strategies. Also the expected values will be used for purposes of guidance rather than for decision making.

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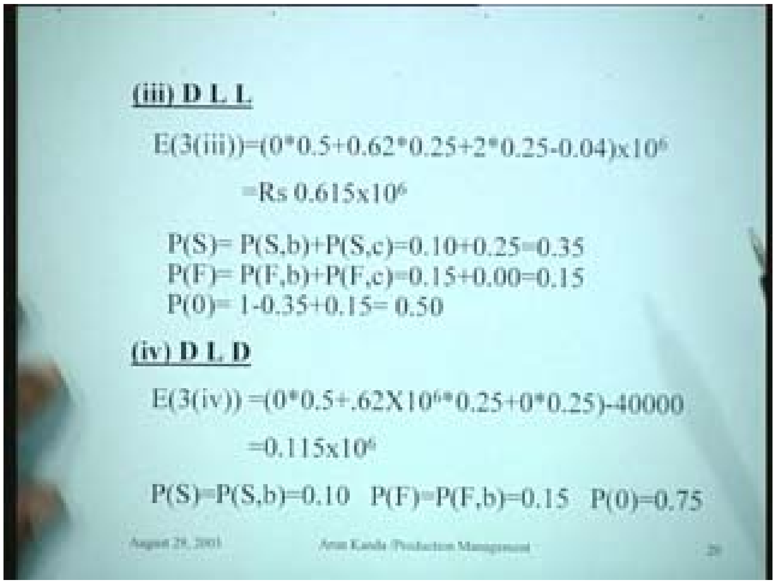


Something similar can be done for the third strategy which is DLL that is drop-launch-launch. If you drop- launch- launch, it means once again essentially this can happen with the probability of 50 percent that you will not gain any money. There is a probability of 25 that you gain 0.62. You have a probability of 0.25 that you will gain 2 million rupees and of course there is loss of test market which has to be accounted for. You can find out in this case again the probability of success happens to be 0.35. The probability of failure happens to be 0.15 and 0 probability. This is neither gaining nor losing any money. It is 0.5 for this particular strategy. We would do this exercise for all the possible strategies that we have.

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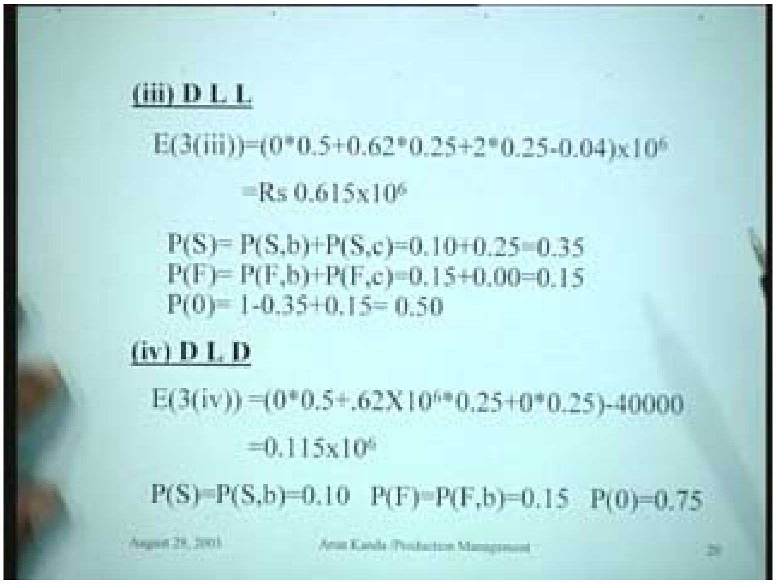


For instance let us take strategy D L and D, what it means is let me explain to you, how we got this figure. If you drop the idea, the test market outcome is a. If you launch, it is b and if you drop, then it is c. Then obviously the chances of a happening a poor is and is 0.5 and you are dropping it. So you get 0.Then if you have this specific option here of taking the launch strategy, the expected value would be 0.62. So many millions of rupees and of course you could have the probability for this which would be 0.25. The probability for the third option is you know we have 3 possibilities, 0.5, 0.25 and 0.25 in this particular situation and so you have it here. You have the probabilities of success 0.10, probabilities of failure 0.15, probabilities here which is 0.75. Here we are not talking about the comparison right at the moment. We are only doing the computations and when we compile the computations then you can be guided by both the expected value and the risk computations.

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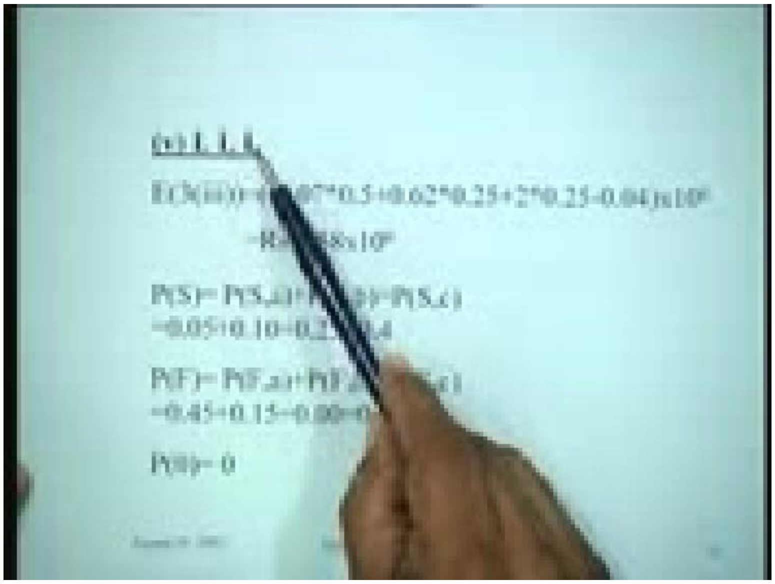


We are at the moment merely compiling the figures for all eight strategies that we have, like if it is all launch- launch- launch strategy it means that in this particular situation, your expected value would be something like 0.58 into 10 to the power of 6 and the probability of the success is 0.4 and probability of failure is 0.6. It is equivalent to direct launch situation without test. So that is how it works out. If we have these values, (Refer Slide Time: 46:11), you have a probability of success which 0.4, probability of failure, which is 0.6. A little loss in revenue is there because of the cost of the test market. p0 means there could be a success there could be a failure and if you do not do anything then you will not get anything. So the probability of 0 is 0.

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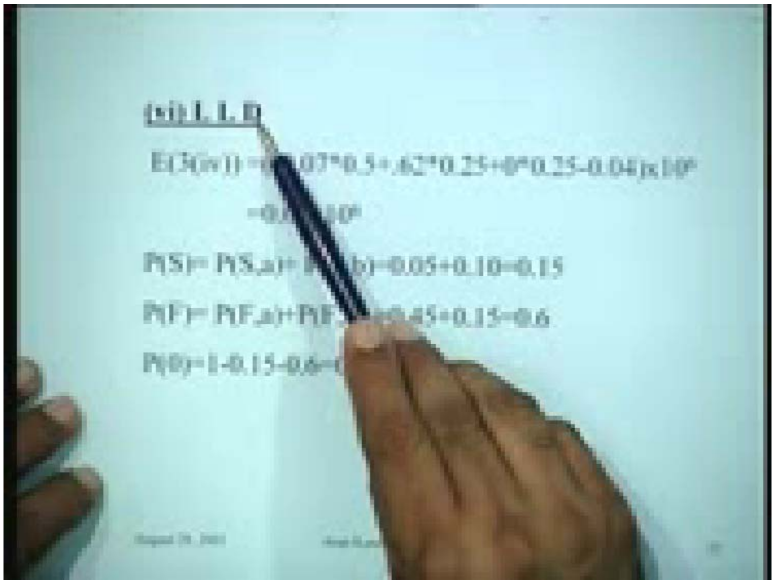


Look at the 6th strategy, it is launch- launch-drop and quite obviously this is going to be a suicidal strategy. If the test market says poor, you launch it. If the test market says medium, you would still launch it. If the test market calls it good, you drop it. You are deliberately dropping something with the test market. Look at this one, you find for this particular strategy. The expected value works out only at 0.08 into 10 to the power 6 and the probability of success failure and 0 are 0.15, 0.6 and 0.25 that is what is right. These are now calculations which are very similar to what we have done for the other cases. Let us now see what would happen here.

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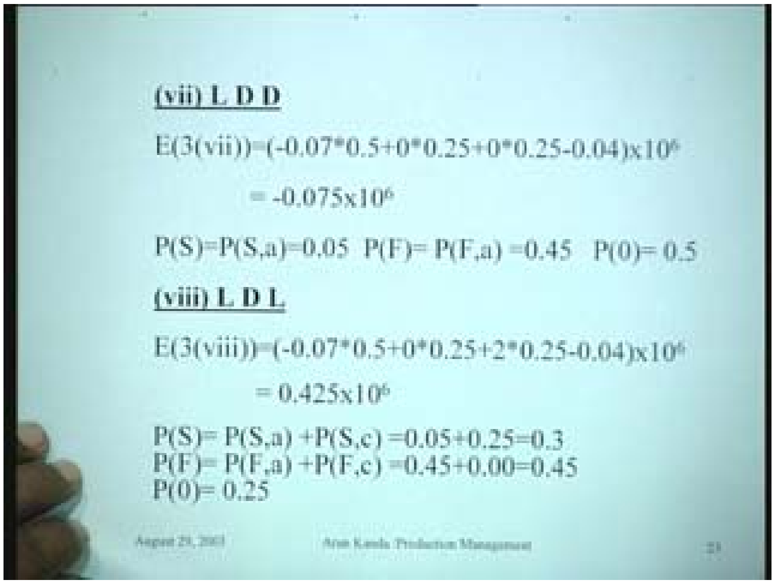


Look at this strategy again. It says this is the worst strategy. If the test market outcome is poor, you have heard of the story of a man who always used to do something opposite to what his friend said. It is like saying if the test market outcome is poor, he will launch it and when it medium or good he says I will drop. If you do this, this is one of the strategies. The net expected value comes out to be 0.75. This is what we expect into 10 raised to power 6. And the probability of success is only 5 percent. The probability of failure is 0.45 and the probability of getting nothing; neither success nor failure is the tune of 0.5. So success and failure here refers primarily to getting the profit or getting the loss and 0 is there because you might decide to withdraw and get neither a profit nor a loss. If you remember what we said in the optimal strategy, earlier if you were at node 4, you would rather drop the idea rather than go ahead with launch. You would have got 0 returns, so that is the 0 take one LDL possibility again. This is 0.425 and the corresponding probabilities are shown here. Why I am showing this is the manner in which the various probabilities can be computed. The information that we have calculated can be plotted on the graph and it look like this.

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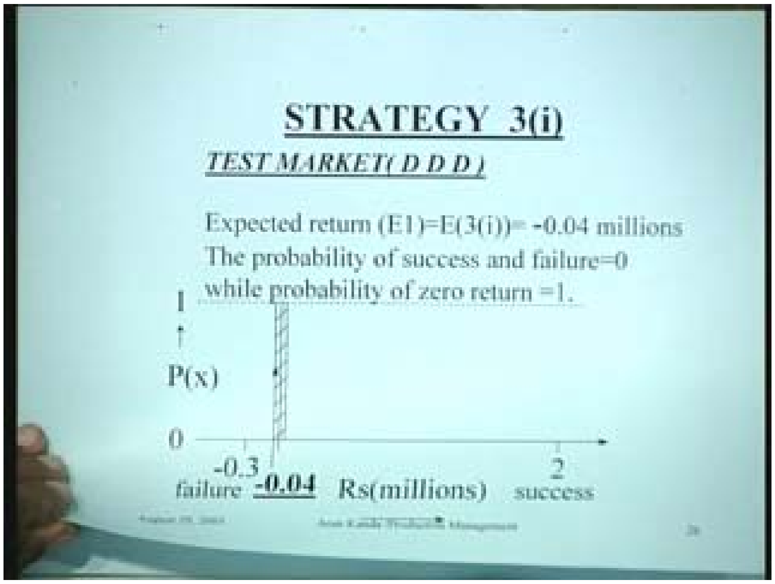


If you look at the first strategy which is drop or status quo, it is very simple. You will not gain 2 million rupees, you will not lose 0.3 million rupees you will get 0 with 100 percent probability. So this is the pure risk less situation. So we see the probability distribution of all the 8 strategies. What we find is for strategy 2, which was the direct launch, a strastic strategy because the probability of negative payoff is 0.6, the sum of all the probabilities, spike on the side will give you 0.6 in this particular case. So that is the risk and the expected value is 0.62. This shows that, although we never get this money, we either get this much or lose this much. That is what is being shown. Strategy 3 which was d d d again, is dropping everything, but there is the cost here so the expected value was 0.04.

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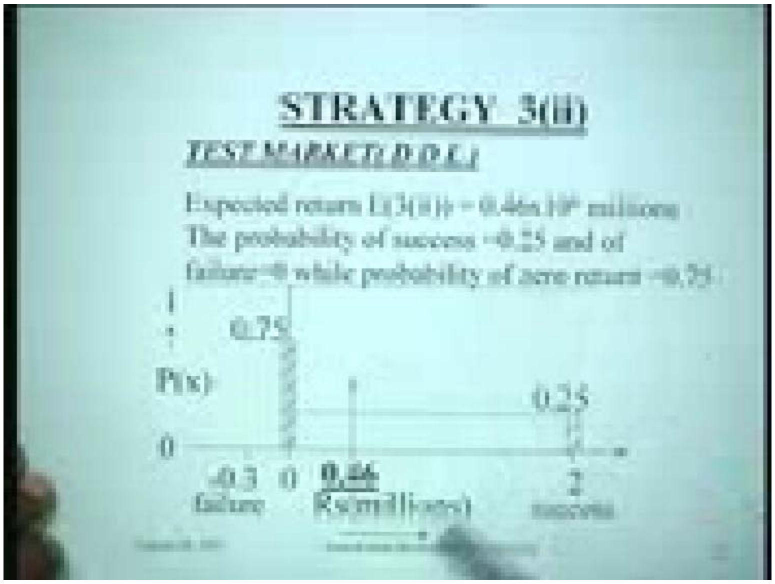


The test market is d d l which we considered because we enumerated all the strategies. Here this is 0, so the risk in this case is 0. There is a 75 percent chance that you will get 0 and a 25 percent chance that you will get 2 million rupees. In that sense, the risk is only 0.25 for this strategy.

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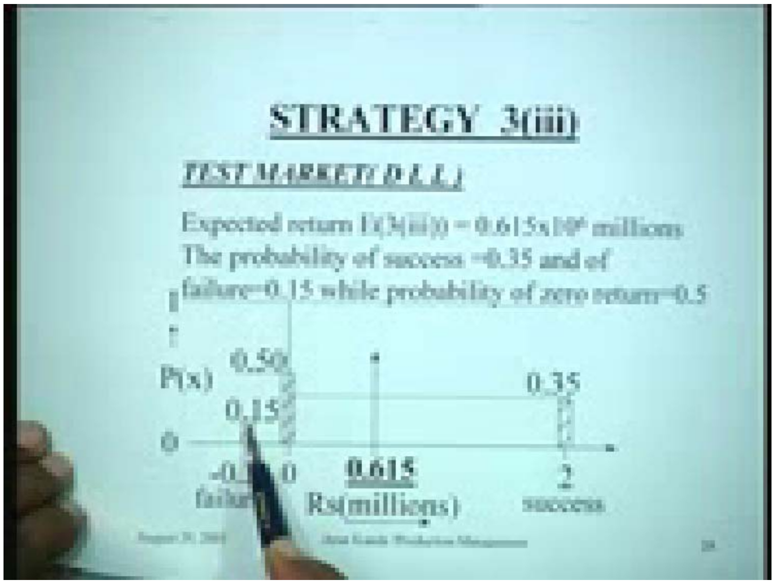


The test market DLL strategy, again the risk is 0.15 because there is a probability spike here. These are the 3 probabilities that were computed.

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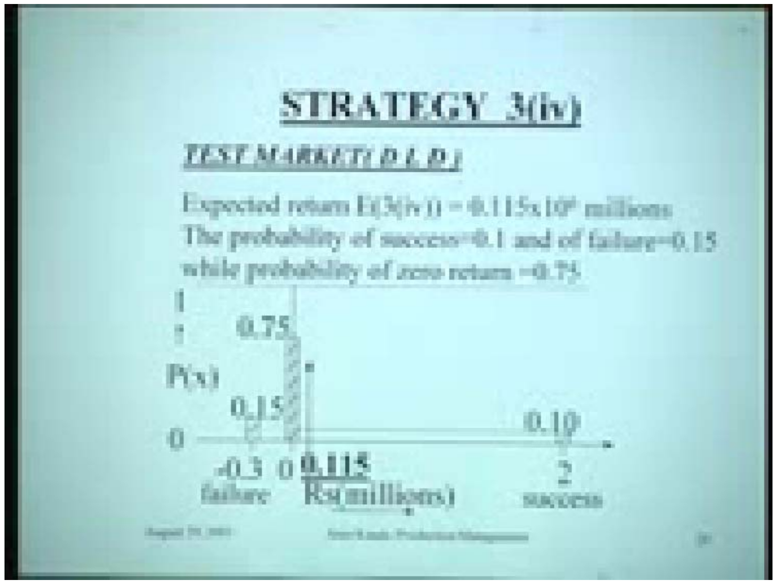


For the test market strategy, DLD, the risk is only 15 percent.

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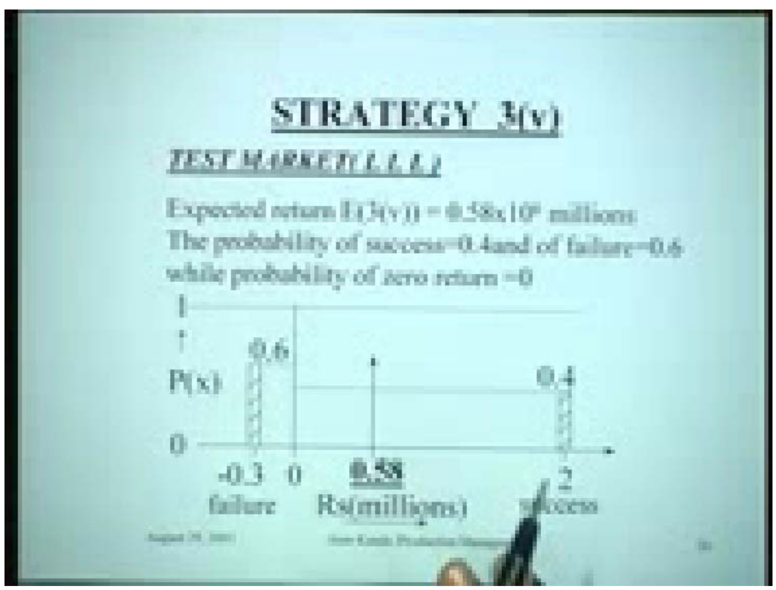


For the test market strategy, LLL that is if you launch, it is again equivalent to risk of 60 percent.

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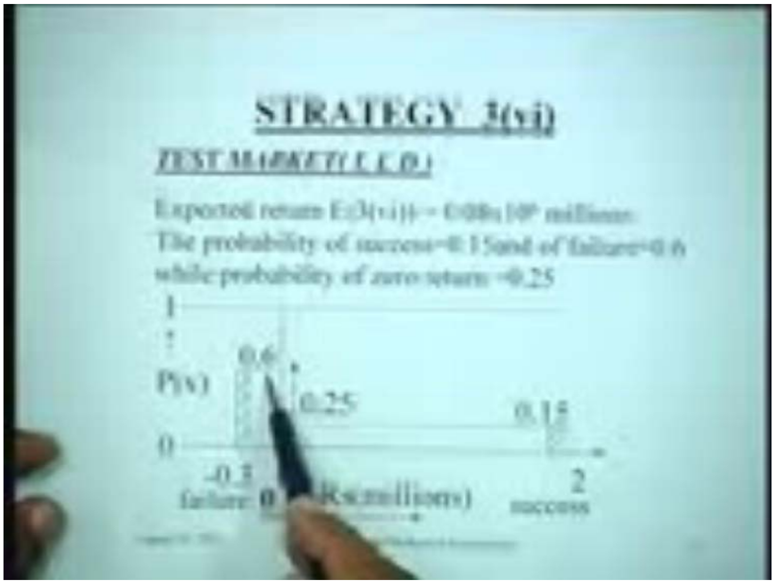


For all these, the 6th strategy was a very risky strategy. It holds a 60 percent chance of losing the money. It was suicidal; you had launching the product was no good.

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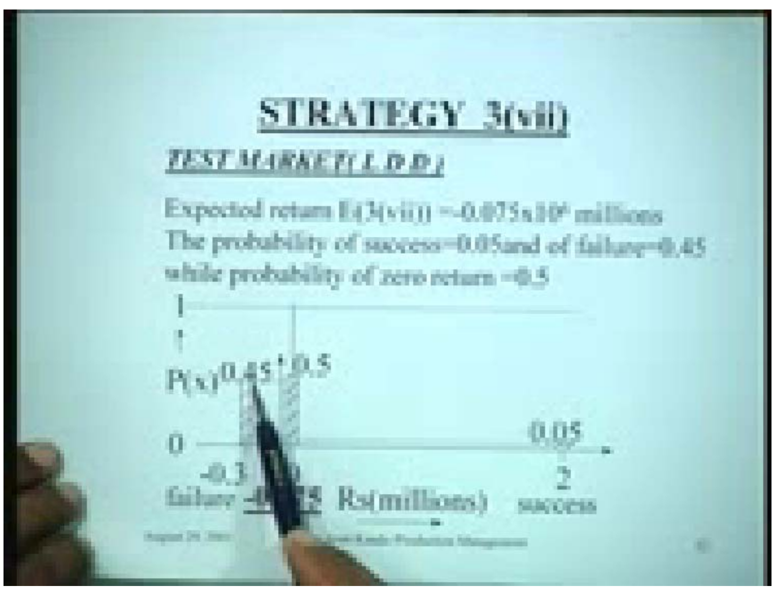


In the strategy of launch and drop here, the risk was 0.45. This is the probability distribution of outcomes.

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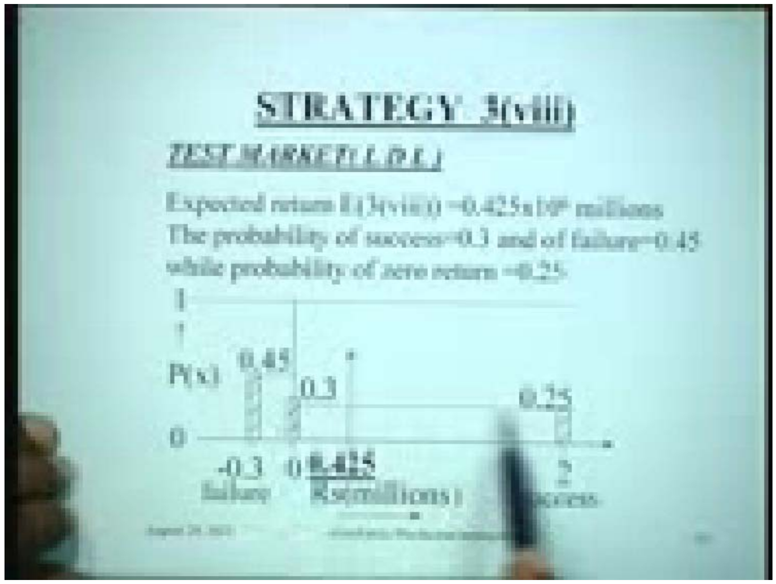


For the last strategy we have the probability distribution of outcomes LDL and the probability distribution of outcomes itself gives very valuable information about the strategy to the decision maker. This is because it tells you what you can get and with what probability. Also this itself is very useful than the expected value because the expected value does not tell anything.

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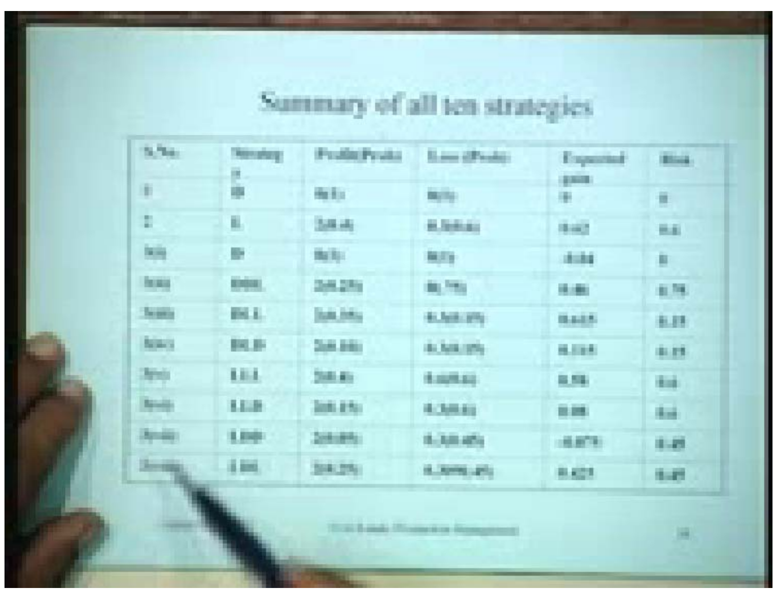


Let us look at the summary of all the strategies we have computed. These 10 strategies which are listed here, drop-launch-drop-launch and all the individual strategies. We have the profit here and the loss here. This (Refer Slide Time: 53:01) is the probability and this can happen with a probability of 0.4. This can happen with a probability 0.6, so you have these figures. This can happen. The expectation of each strategy is calculated here and we have also compiled the risk value for each strategy. Naturally, the risk value strategies are these 2 strategies (Refer Slide Time: 53:21). The do nothing strategies, with 0, 0 risk. If you do not do nothing you will not get anything. If you do not venture of your house, you are sure not to be hit by a car. So sell is a risky strategy. That is the kind of risk associated with these 2 strategies and then subsequently we have this (Refer Slide Time: 53:42) as the strategy which is most risky. 0.75 is 75 percent chance of losing some money. This was when we went against the voice of the experts i.e., the marketing experts. Otherwise these (Refer Slide Time: 54:00) are 2 strategies which have the least risk, 0.15 and 0.15. If you compare these 2 strategies, obviously this is much higher on the expected value rather than this one.

We prefer this to this one. Here again you can see what is the gain and loss. You find that the optimal strategy in this case works out to be this one that is the one I showed you in the beginning. It has a very little risk and it has a profit of 2 million rupees with the chance of 0.35. And it has a loss of 0.3 with the probability of 0.15. There is some risk involved in there but it is much lower than the risk. Let us say the direct launch was 60 percent. So this is the systematic strategy that you can adopt for the purpose of evaluation of risk. The basic idea here is to determine the probability distribution of outcomes for the strategy. We did it for all possible strategies. You need not do it for all possible strategies. You could determine this for one for the most promising strategies. If it would has been for instance, 0.2 then obviously again depending on these values this would become quite attracted. The idea is really that you are minimizing the risk but at the same time you would like to have a high expected value, though expected value is something fictitious. It just tells you that how your distribution is placed and that is why we talk about the entire distribution. It is like saying you make a choice and you know when you want to get it.

During marriage you look for a girl who is beautiful and intelligent and when you are looking for this kind of combination, you tend to compare. It is like saying these are very much those 2 objectives you will rarely find. In a beautiful and an intelligent girl you would find that either the intelligent level is high or the beauty level is high. In the same situation here if you look at this example, this has a very high risk based on the expected value, highest expected values but we load the expected value slightly and we load the risk considerably. So you have to compromise on something. Similarly on choice for a partner in marriage, you would probably look for compromise. You probably will not get a beauty queen and therefore you would like to sacrifice on one objective to get the other. Something similar happens here. It is a choice, a tradeoff between the various things.

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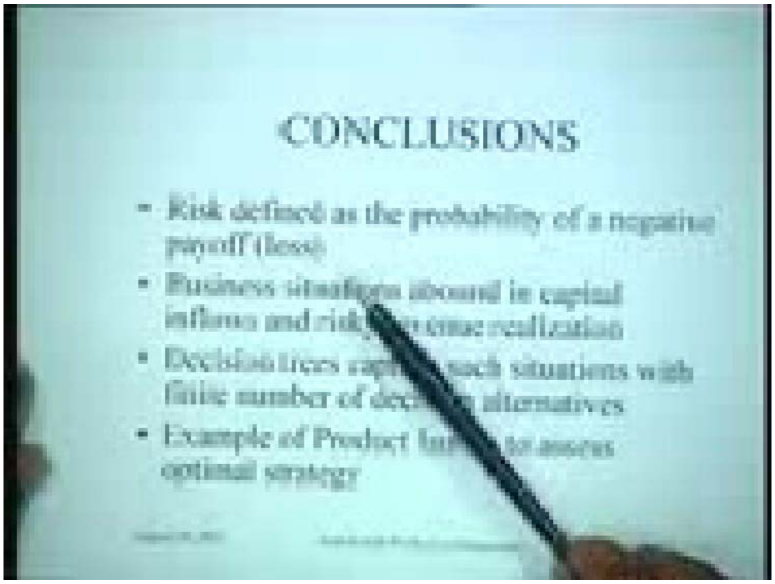


So let us conclude by and large in this lecture, we have tried to define the risk as the probability of negative payoff that is one thing. Business situations abound in capital inflows and risky revenue realizations- so the kind of methodology that has been proposed here using decision trees can be applicable to those risky business situations and decision trees capture a situation with a finite number of decision alternatives. That is another thing and in this lecture we took the example of a product launch to assess the optimal strategy. We conclude here.

Thank you!