Business Analytics for Management Decision
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Lecture - 58
Decision Analytics (Contd.)

Hello everybody. This is Rudra Pradhan here, welcome to BMD lecture series. Today we will continue with the decision analytics in that to in the last class we have discussed about the kind of you know requirement, the kind of you know criteria through which we can address a business problems and then come with a kind of you know management decision as per the particular requirement. In fact, we have discuss several you know techniques in fact, you know the kind of you know tools through which you know we can come with a kind of you know outcome through which the decision making process this can be very effective and that to as per the particular business requirement or the kind of you know problem requirement.

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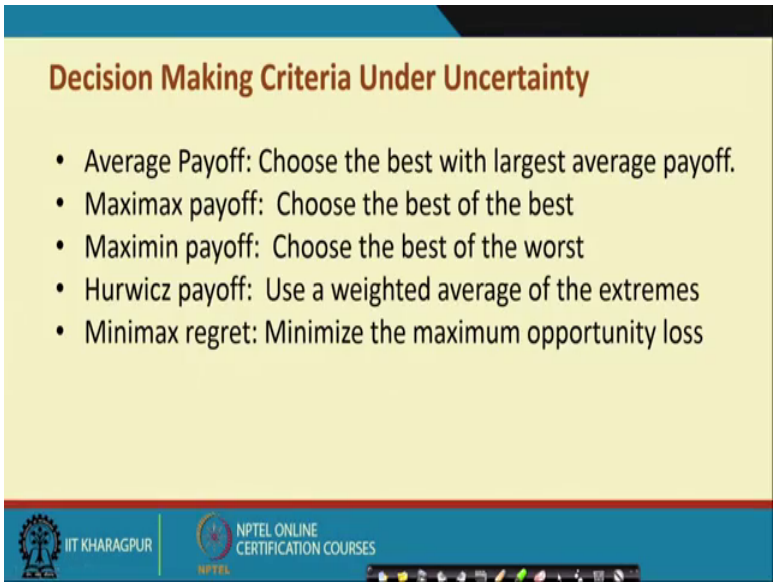

So, technically we have discussed you know couple of criteria, like you know average payoff criteria, maximax you know payoff criteria, maximin payoff criteria, Hurwicz payoff criteria and minimax regret criteria. So, that means, you know corresponding to a kind of you know problems you know we have kind of you know possible outcomes depending upon the a various alternatives and the kind of you know strategy. So, we

have a payoff metrics where the possible outcomes are there corresponding to alternatives and the kind of you know different strategies.

So, the idea is a, which particular outcome can outcome can be finally, picked up for the, you know decision making process or to address the problem as per the particular objective or the particular you know requirement. So, we have already discuss all these tools and we have also you know connected with the you know particular problems you know through which we can get to know that how this techniques can be use to pick up a particular outcome. That means, the best outcome through which we can come with a kind of you know management decision. So, now, in order to you know elaborate more about the, these techniques, let us take another examples and the, we can highlight these particular you know issue.

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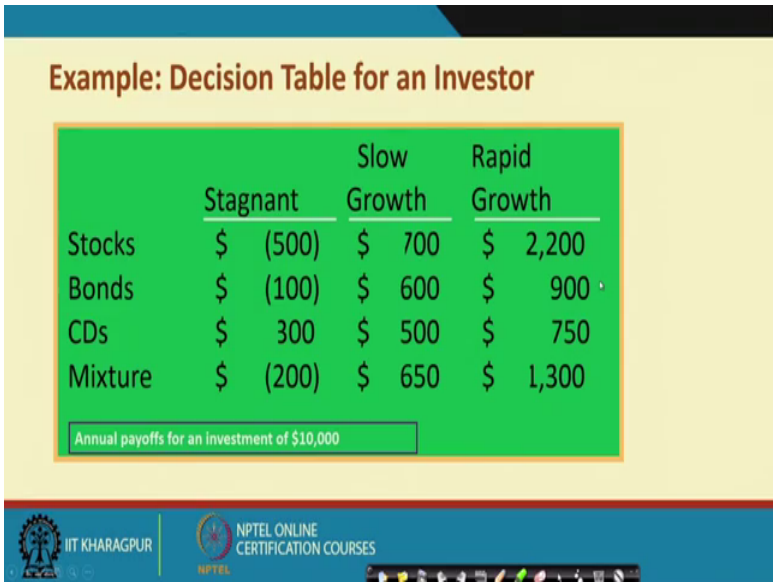

So, here is ah, the typical is problem is a we have a kind of you know a financial instruments and here there are 4 different financial instruments stocks, bonds CDs then the kind of you know mixture that the combination and then the, so far as a business environment is concerned. So, we have 3 different you know up and downs the stagnant slow growth and rapid growth. Compare to last examples we have as you know increasing trend stability and decreasing trend. So, here is in the similar fashion we have 3 different structure. So, where the, you know outcome can be predicted or you know can be generated and that to with you know 4 different options or you know alternatives.

So; that means, in the case of you know stocks what should be the possible outcomes against stagnant slow growth and rapid growth against through bonds what is the outcome with respect to stagnant slow growth and rapid growth, likewise a for CDs and mixtures.

So, we have altogether 4 into 3 you know different levels of you know outcome to address the particular you know problems so; that means, it is a kind of you know decision making process for the for the investors you know for any kind of you know financial you know investment what should be the you know typical output corresponding to different economic situations in like you know stagnant slow growth and rapid growth.

So, likewise it is the question of you know the annual payoff payoffs for an investment of 10000 dollar and then this is how the you know ah, you know predicted a outcome metrics or payoff metrics through which possible outcomes are there with respect to different instrument and different economic conditions. So, what is the you know best predicted output through which you can actually address this business problem.

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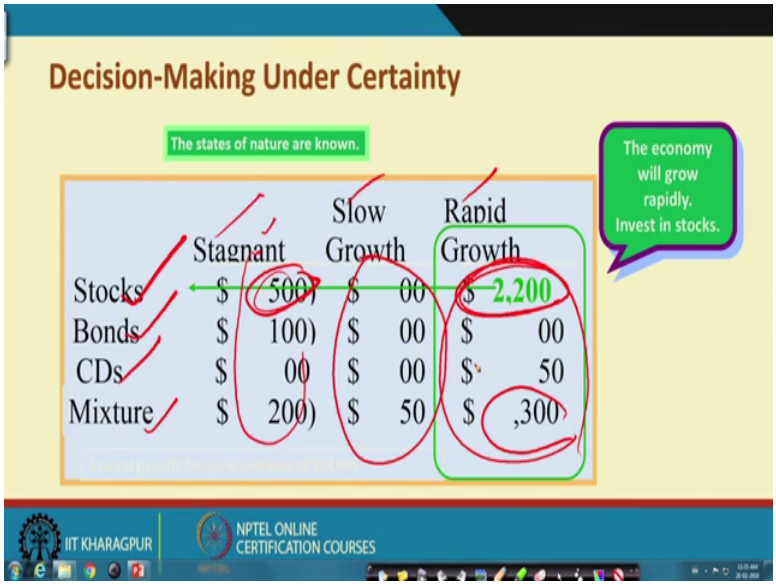

So, now start with simple structure. So, the criteria which we have discuss earlier is a business condition under certainty business condition under uncertainty and business condition under the risk you know scenario. So, that means, we have 3 different structure of the, you know business environment. So, corresponding to these instruments financial

instrument and the kind of you know economic conditions we have the payoff metrics and then we like to check what should be the possible outcome in the kind of you know business where there is a you know situation of in certainty and then same metrics use under the business environment where the things are uncertain and then we like to analyze the same problems under the condition where there is lots of you know risk involvement.

So, now under this certainty the guess is that you know all this things are you know known to us. So, as a result what should be the best outcome within the particular you know structure and corresponding to this particular structure. So, we have actually what we have discussed. So, these are all, these are all kind of you know outcomes. So, we have a stock, we have stocks we have bonds and we have CDs then the mixtures.

So, there are 3 different output means out label, output labels corresponding to the economic scenarios so stagnant slow growth and rapid growth. So, we have you know outcome corresponding to oh you know each case so; that means, in the case of you know stagnant the where we are stock bonds and CDs represents in this column and similarly you know in the case of you know slow growth this is the possible outcomes corresponding all these financial instruments, against for rapid growth these are the possible outcomes under the a you know financial instruments.

So, now you know since it is a kind of, you know investment. So, what should be the possible outcomes so; that means, the typical structure of investment is if you put like you know money. So, what should be the, you know returns or you know the kind of you know outcome so; obviously, we are expecting maximum. So, if they everything is certain. So, then out of all these you know outputs starting with you know 500 then ends with you know 300.

So, that means, the first output we are you know the condition is the stagnant and that to first instrument stocks. So, it is of 500 and last is the mixtures and that is with respect to rapid growth, let us say 3000, 300. So, obviously, so the typical structure is a that you know in the case of you know, you know kind of you know a requirement. So, the best strategy will be the a will be the case of you know stocks and that to in the case of you know rapid growths because it is the highest outcome corresponding to all possible outcomes in this particular you know metrics.

So, this is how the simple you know decision which you can have here you know to analyze this problems so; that means, the objective of this problem is a if you put if you like to put some kind of you know investment what is the possible returns under different situation under different financial instrument. So, now, our having all these financial instruments and different economic condition, we have possible outcomes and out of all these outcomes.

So, 2000, 200 is the best you know outcome where it is generated through stocks and that to in the case of you know rapid economic growth; that means, the particular behavior of you know stock can vary with respect to economic conditions, in the case of you know stagnant, in the case of you know slow growth and in the case of you know rapid growth. You can analyze this particular you know row so; that means, stocks can contribute or can give you the outcome of you know 500 dollars with respect to 1000 investment which we have highlighted earlier.

So, then in the case of you know stagnant. So, it will be 500 dollars, then in the case of you know slow growth it will be known outcomes that is 00 and then in the case of you know rapid growth it is 2200. So, as a result this is the best outcome corresponding to other instruments and corresponding to means a other instrument with respect to all the economic conditions and a by the way. So, these are the you know typical you know this was through which you can derive under the you know business you know where it is everything is certain and then we really like to know how is the kind of you know decisions in the case of you know uncertain situation.

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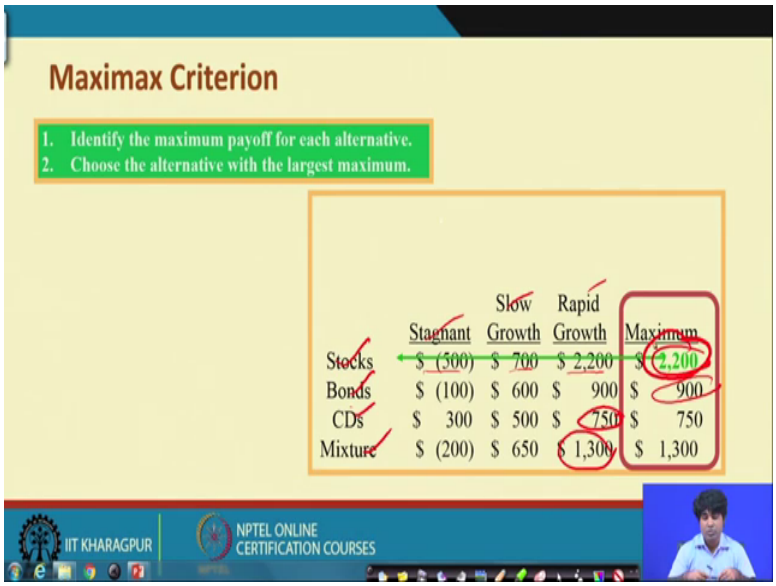

So, in that case we have discussed couple of technique starting with you know maximize criteria. So, in this case what is you know structures. So, we have the same, we have the same kind of you know metrics.

So, here is again this 4 you know instruments and these 3 economic condition and then. So, the according to this criteria so, against talk we have to find out which one is the maximum outcomes so; that means, we have 500, 700 into 200. So, then in this case so the possible outcomes will be 2200 that is maximum one, similarly in the case of you know bonds. So, the maximum out of you know 100 600, 900 is 900 and similarly for CDs. So, the maximum outcome is this a 750 and again in the case of you know mixture. So, it is the maximum outcome is 1300.

So, out of 200 and 650 so; that means, technically a all the financial instruments against each economic conditions generate you know maximum 2200, 900, 750 and 1300, again if you go by this maximax criteria. So, we have to find out which one is the maximum among these you know among these for maximum case against of stock bonds CDs and mixture. So, ah; obviously, so the best choice is the 2200. So, like in the case of you know certain in the case of uncertainty you know business environment, where maximax criterion also gives the same output that is 2200 and that is happening in the case of you know stocks and that to in the business environment to where there is a signal of you know rapid economic growth.

So, again come to the kind of you know second case that is the criteria of maximin.

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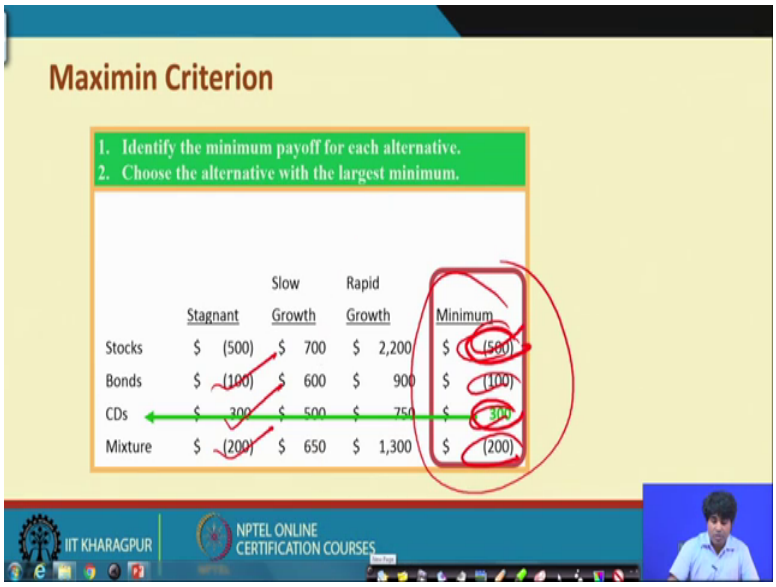

So, in this case we have to find out the minimum against you know all the financial instruments and that to with respect to you know 3 business you know business condition that this stagnant slow growth and rapid growth. So, in the case of you know stock stocks out of 500, 700 to 2200 the minimum one is the 500 and then again in the case of you know bonds the minimum is hundred and in the case of you know CD the minimum one is 300 and in the case of you know mixture. So, it is 200.

So, as a result it could be some summarize then. So, 500, 100, 300 and 200, but our criteria is maximin so; that means, technically. So, we like to find out now. So, what is the you know minimum of all these kind of you know requirement so; that means, technically what is the maximum numbers out of the these you know minimum condition. So, that is what actually 500 and if it is minimum criteria and then this will be 3 300. So, the these this is how the kind of you know structure which you can derive in the case of you know maximin criteria, maximix criterion and and that to to generate kind of you know out outcome through which you can you know address this particular you know investment decision.

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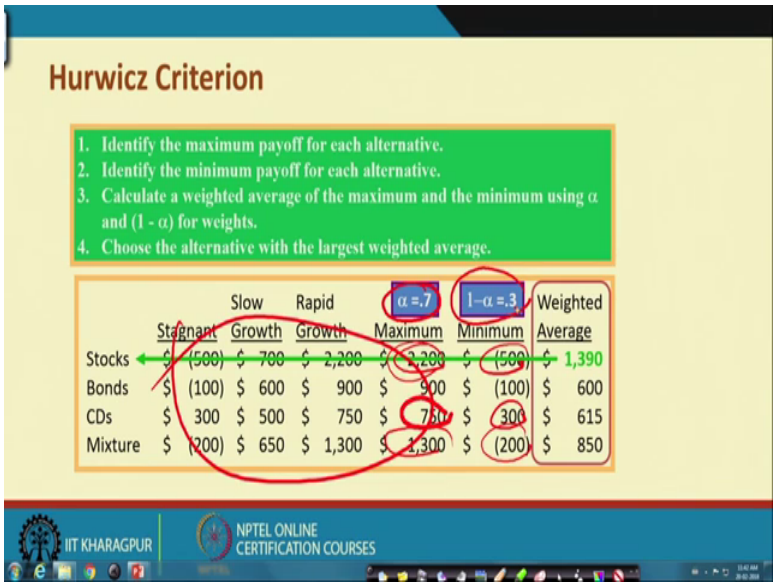

And the other criterion and here is a to find out to the kind of you know structure through which you know the in this particular criterions we have little bit you know complexity, but it is a very interesting to reads the conclusion and to draw the kind of you know outcome which can you know address the investment decision more accurately more effectively.

So, in this case we have actually same, same kind of you know out you know metrics input, metrics that is the payoff metrics and what will you do. So, in the previous case we try to find out the maximum one first, then we try to find out the minimum one first and we look for the maximum or you know in the case you know minimum. So, what we will do in the case we can just you know club this 2 criterion.

So, what we will do so again stock we have to find out what is the maximum returns and again what is the minimum returns out of these 3. So, 2200 is the maximum and 500 is the minimum and in the case of you know bonds 900 is the maximum 100 is the minimum, in the case of CDs. So, 750 is the maximum and 300 is minimum, similarly in the case of a mixture 1300 is the maximum and minimum is a 200. So, now, what we will do actually. So, we try to find out the maximum among you know all these financial instrument and minimum among all the financial instruments with respect to all the economic conditions and having maximum and minimum. So, in this criterion what we

will do we try to find out weighted average of you know maximum and minimum these outcomes against stocks, bonds, CDs and mixture.

So, what we will do we like to you know apply first way. So, the corresponding way to in such a way that you know the total probability will be exactly equal to one. So, that mean technically if you start with you know let us say alpha equal to 0.7 and; obviously, the 1 minus alpha will be 0.3. So, as a result alpha plus 1 minus alpha is equal to 1. So, this actually means you know we like to extract what is the weight against the maximum or what is the weight against the minimum and you know we try to have weight in such a way so there is some kind of you know difference. So, otherwise you know it will be equal weightage there is now 0.2 you know club differently. So, in these case having these weight alpha equal to 0.7 and 1 minus alpha 0.3 which apply in the case of you know minimum and the alpha equal to 0.7 which apply in the case of you know maximum.

So, as a result so the weighted average is a in the case of you know stock will be 1390 then against bond 600 and against CD 615 and then under mixture it is 850 so; that means, technically the process to have this figures like this. So, it is 0.7 into 2200 plus 0.3 into 500 that will give you1390 and again 0.7 into 900 plus 0.3 into 100 it it can give 600. Likewise you can have you know value for CDs that is 615 and the value of you know mixture that is a a you know 850. So, now, we like to pick up which one is the best depending upon you know, you know maximum criteria or minimum criteria, if we apply maximum criteria then this will be the a final outcome and this is the best decision if it is minimum criteria then you know this will be the you know best kind of you know decision since it is a investment we are expecting more returns. So, so the maximum choice is the, a right kind of you know indications as a result. So, this is the best outcome a through which this you know financial investment can be more effective to address this you know business problem.

So, now corresponding to these you know criterion we can you know little bit highlight more about this one.

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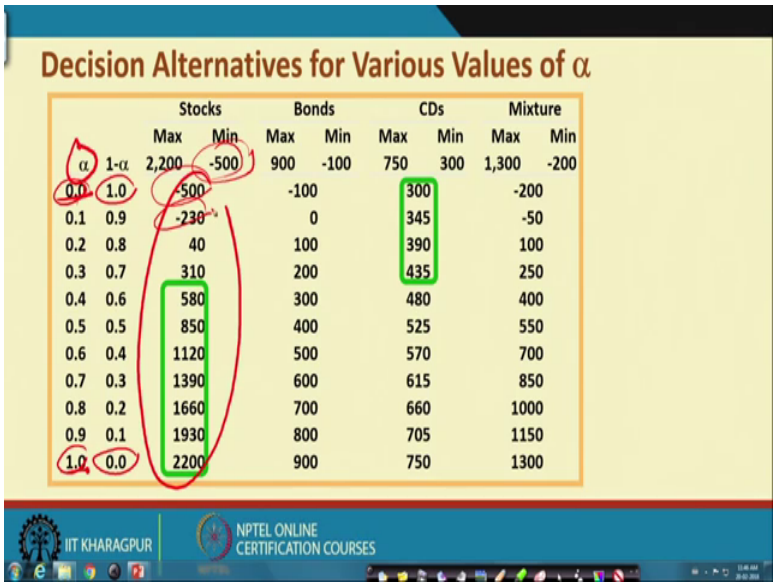

So, for that what we will do, yeah it is the game between actually the alpha and 1 minus alpha for that you know we have already discuss here by fixing alpha equal to 0.7 and alpha equal to one minus alpha equal to 0.3 so; that means, if you change the alpha value less than 0.07 and more than 0.07 0.7 then; obviously, 1 minus alpha value will also change. So, it can go maximum 2 1 and if it is 1 then minimum by default will be 0 the weight for minimum will 0 and if it is a actually 0 then the minimum means weight for the minimum will 1 is the 1.

So, we try to have weight in a such a way it should not be 0 and one case it will be in between. So, that you know the the kind of you know requirement is you know can be more visualize and the the decision can be more effective and for that you know we we try to start with you know alpha 0.00 0.21 then finally, it will be 1.0. So, that means, so this is the kind of you know alpha value. So, this is the minimum and this is the maximum when it is the minimum that is the 0.0 that is one extent. So, in that case 1 minus alpha equal to 1.0. So, when alpha equal to 1.0 then by default this will be 0.0. So, now, having alpha and 1 minus alpha.

So, we have you know you know case of you know stocks, we have a case of you know bonds, we have a case of you know CDs and we have a case of you know mixtures and in each case we have already, we have already actually derive the kind of you know maximum and minimum. So, we have to just report maximum and minimum against all

you know financial instruments and then try to find out the kind of you know ah, the kind of you know weight means weighted average. So, that means, technically so this is here 0.0 into 2200 then plus 1.0 into minus 500. So, this will give you minus 500 and again 0.1 into 2200 flows 0.9 into minus 500. So, it will give you minus 2.30 like this.

So, we can have also for bonds and we have also case of you know CDs and we have a case of you know mixture, then corresponding to change of you know alpha we have change of you know 1 minus alpha. And accordingly according the value of you know the means the weighted you know outcome against of stocks bonds and CDs and mixtures are available corresponding to each alpha entries starting with you know 0.02, 1.0 ; that means, we have again plenty of you know options or plenty of flexibility to pick up a kind of you know outcome through which you can you know address the business problem or investment decision more effectively more accurately and more efficiently.

So, that is mean a it is a kind of you know interesting criteria which you address these business problem and for that you know this particular you know ah, you know tools this particular tools can you know give you know better indications through which you can address this business problem. So, in some this is a fantastic analytical tool through which you know we can you know take a we can come to a kind of you know decision which is more effective more practical and you know kind of you know best for the a you know particular you know problem. So, now, corresponding to this examples and then again we have the kind of you know structure here.

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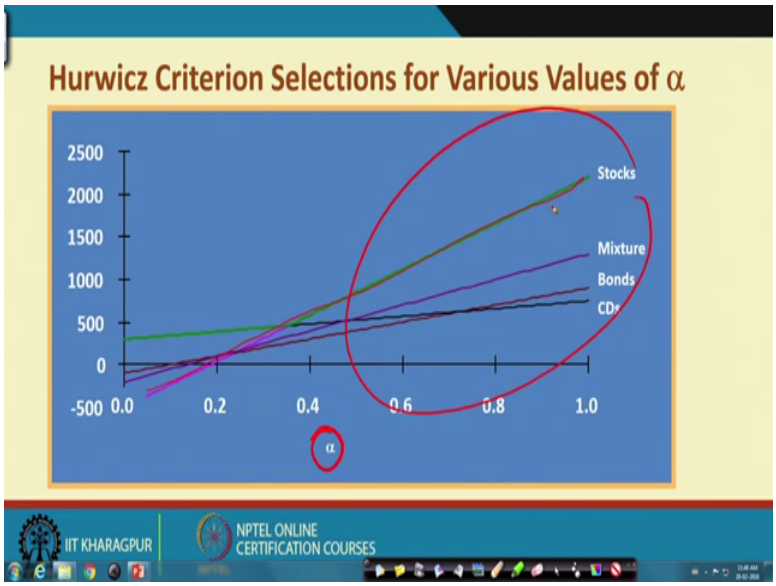

So; that means, technically if you apply this you know alpha change and then against stock, bonds and CD and mixtures. So, if you plot because it it is now generated as series.

So, starting with you know alpha variations. So, what is the you know expected outcome against stocks, bonds and CDs and mixture. So, we can actually graphically plot and then we can get to know how is this particular you know structures, the moment will put here actually a alpha. So, by default we can get the 1 minus alpha. So, then we can have the weighted average weighted in a maximum, minimum and that to having the alpha value and one minus alpha.

So, now, if the put so you know the overall structure is that you know in the this stock that is the financial instrument is a you know highly you know, you know effective or you know it is a kind of you know produce best outcome for this a financial investment compare to the outcome receipt from CDs bonds and you know mixture. In fact, mixtures it is little bit you know above the in comparison to bonds and CDs, but slightly lower to you know stocks out outcome or you know stocks return.

So; that means, it is a kind of you know effective environment or you know effective decision making process through which you can actually address this problem and come with a kind of you know outcome which can you know give you know better kind of you

know judgment to you know think about it and to address these problems as per the particular you know business requirement.

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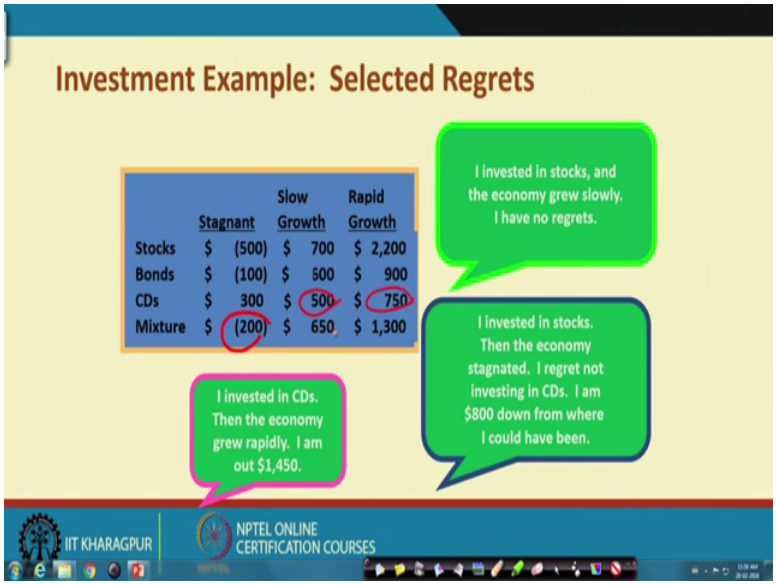

So, then the last technique which you have already, you know we have already discussed. So, that is again having you know you know payoff metrics. So, what we will do we like to extract actually the minimum among you know each column so; that means, technically. So, here the minimum minimum is a 200, then this is minimum here is a 500 and minimum is here is 750.

So, now this 200 will be subtracted you know against you know all instruments and that to under stagnant against slow growth and rapid growth. So, that means, to the series will be the enter payoff metrics will be now you know transport to 500 minus 200 minus 200, 300 minus 200 and 200 minus 200. Similarly in the case of you know slow growth 700 minus 500, 600 minus 500, 500 minus 500 again 650 minus 500 like this you can also have in the case of you know rapid growth then finally, finally.

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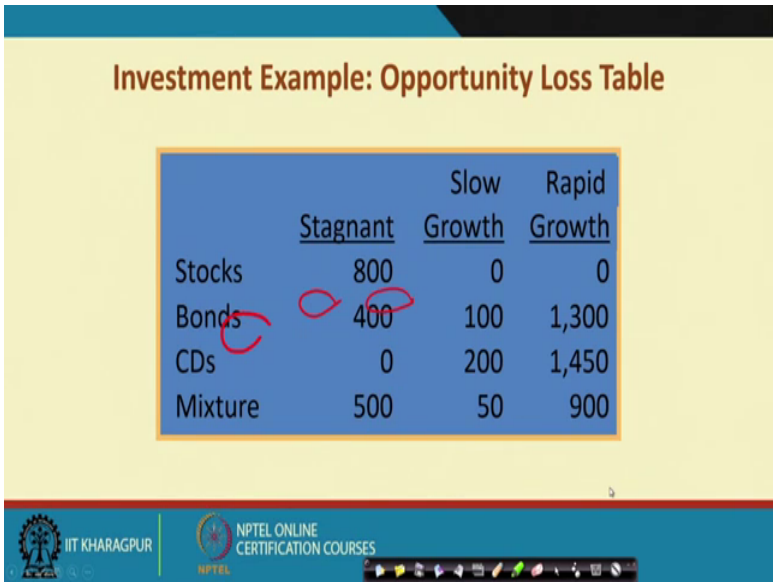

So, the, the structure will be transferring to like this and this is what the you know intermediate payoff metrics against we like to find out the you know the kind of you know opportunity loss and that to we have again what we will do find out the maximum against you know stocks bonds and CDs and mixture.

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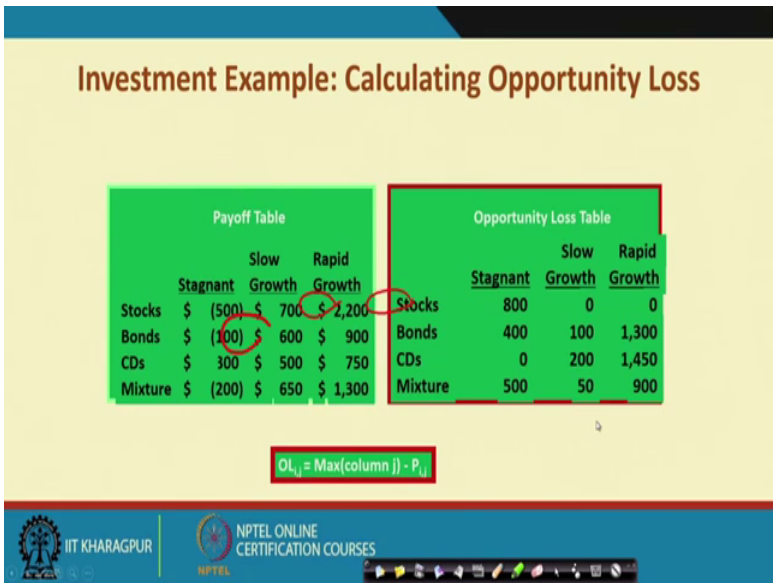

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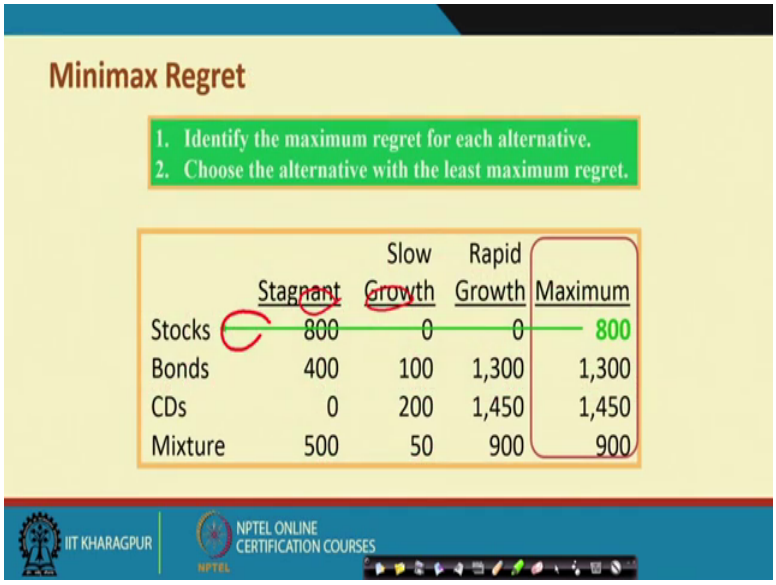

And that to oh you know derive from the opportunity loss tables that is that is a actually obtained from the original payoff metrics by a subtracting the minimum payoff from the you know stagnant case slow growth case and rapid growth case. So, as a results we have this particular you know metrics finally, and again depending upon the you know criteria.

So, we like to find you know maximum among these particular you know you know you know financial instruments and then finally, we have to find out what is the minimum against all these you know maximum. So, obviously, in this case so 800 is the maximum case and that to, that to the case of you know the case for you know stocks and again 1300 against the case of you know bonds. Similarly 1450 in the case of CDs and again a 900 in the case of you know mixture. So, now, we have to find out the minimum among these you know for maximum. So, by default 800 is the best choice a for this you know criteria and that to address these financial decision against stocks bonds CDs and mixture and that to under 3 different economic scenarios that is stagnant, slow growth and rapid growth.

So, likewise you know likewise we can have similar kind of you know problems and we can apply all these techniques a or the criterian through which you can come with a kind of you know best outcome.

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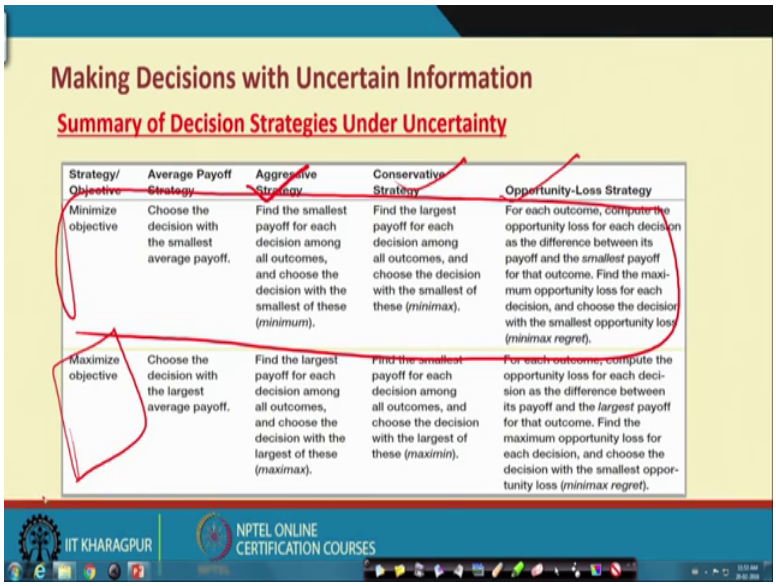

Through which you can address the business problem more effectively as per the particular you know business requirement and a. In fact, if I if we like to summarize. So, what I have mentions the strategy and objective can be minimize objective can be maximize objective and then we have a different kind of you know criteria starting with you know average payoff, average payoff and then the kind of you know the kind of you know, the kind of you know aggressive strategy the conservative strategy that is minimax criteria then opportunity loss strategy.

So, so this is what the kind of you know environment ah. So, the first part is with respect to minimum minimization of objective function and the second one is the maximization of objective function. But, you can apply by different criteria starting with average payoff aggressive strategy and conservative strategy a then accordingly we can find out the best output from the payoff metrics a that is you know obtain through the you know possible alternatives and different kind of you know business you know environments and ah.

So, decision making process is very interesting kind of you know situation through you for the kind of you know tool box through which actually you can pick up a best outcomes as per the particular you know business requirement or the kind of you know problem requirement. So, so with this you know, you know we can move to the kind of you know component what is call as you know decision trees.

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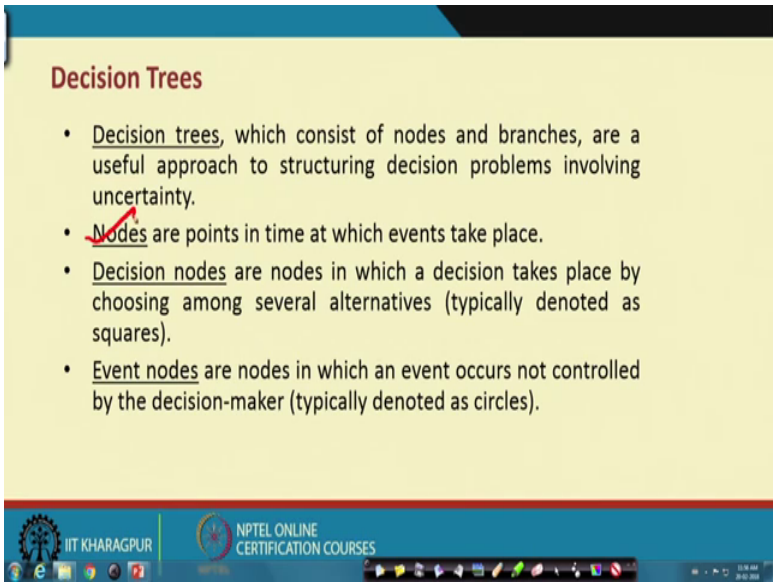

So; that means, whatever you know you know criteria which we have already discussed against a particular business problems depending upon the number of alternatives number of strategy we have seen a there is a possibility of two you know bring a kind of you know optimality structure. Where we have a different kind of you know outcomes and a through a particular technique we have to find out or we have to choose a best outcome through which you can address the business problem more effectively and that to as per the particular you know requirement.

So, now this same thing we can actually analyze and that to the a the game with you know kind of you know concept call as you know decision trees and a; that means, a the concept decision tree is like you know it is a kind of you know branch and bound structures. So; that means, it is a like you know branching or its kind of you know tool box or it will give you kind of you know flow chart through which you know this same problems can be correctly recognize and correctly specified and through which you can visualize and then you can pick up a particular you know structure as per the particular you know business requirement.

So, that means so the decisions tree can be design corresponding to the particular you know alternatives and the strategy through which the payoff metrics can you know generate the outcomes and then decision tree will be give you the some kind of you know accuracy a and to give the kind of you know clarity through which the decision

making process will be more effective. So, what is the concept of you know decision tree altogether. So, this is this consist of you know nodes and branches and that are useful approach to structuring the decision problems, where you know there is a involvement of you know uncertainty and the nodes are the nodes are typically and the nodes are typically the points in time at which events takes place and decision nodes are nodes in which decision takes place by choosing among several alternatives event nodes are nodes in which an event occurs not controlled by the decision maker typical.

So; that means, technically. So, it is the kind of you know you know structure through which all these you know possible outcomes against alternatives and different strategy can be correctly a specified and the visualization and specification can give you better kind of you know judgment or give you a kind of you know clear cut understanding to the decision makers.

So, that you know ah, you know one can you know pick up a best strategy or best outcome through which you can address the business problem more effectively so; that means, technically. So, this is the, this is the effective tool through which you can actually address the business problem more accurately as per the particular you know problem requirement. So, you know.

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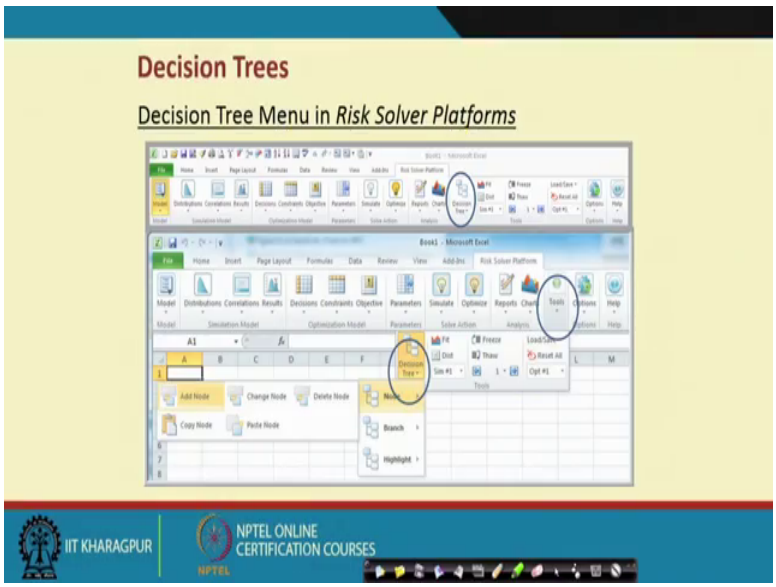

So, for solution is concerned we have already highlighted in a kind of you know situations the first step of the process is to find out payoff metrics corresponding to

alternatives and the different kind of you know business environment or you the kind you know strategy. Then after having the complete payoff metrics which may not be you know by default in a kind of you know structure frame you know format of course, by applying some kind of you know criteria.

We can pick up the best outcomes out of you know all possible outcomes in the payoff metrics and that best outcomes can address the business problem more effectively and come to a conclusion that you know, you know decision makers can effectively apply the particular outcome to highlight the problem or to address the business problem you know decision tree again help you or you know help us to get the kind of you know you know similar kind of you know structure.

So; that means, have more you know all such possible outcomes it will give you some kind of you know structure you know its kind a like you know path diagram type situation through which can correctly you know visualize that you know this is how the you know possible outcomes against all alternatives and you know the kind of you know difference strategy. And then you can actually correct the pick up a particular one as per the you know best requirement or the kind of you know management requirement. So, typically the decision making process you know is like this, we can actually use risk solver package in the you know excel through which actually we can actually get this decision tree.

So; that means, the outcome which you have already and the kind of you know choice or the kind of you know the you know payoff metrics all are there, but it will be just you know use this criteria and have the payoff metrics then decision making decision tree will give you more you know kind of you know accuracy to understand the particular situations and then pick up a particular outcome as per the you know best decision so as per the best requirement so now,

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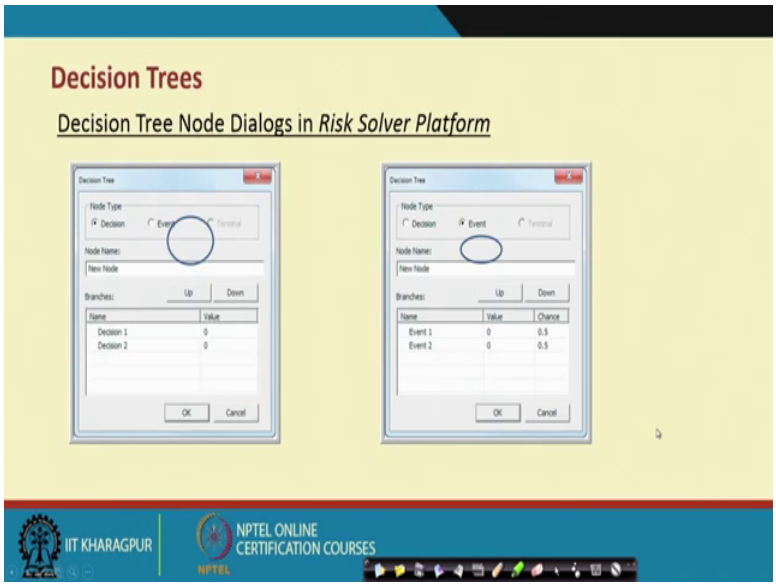

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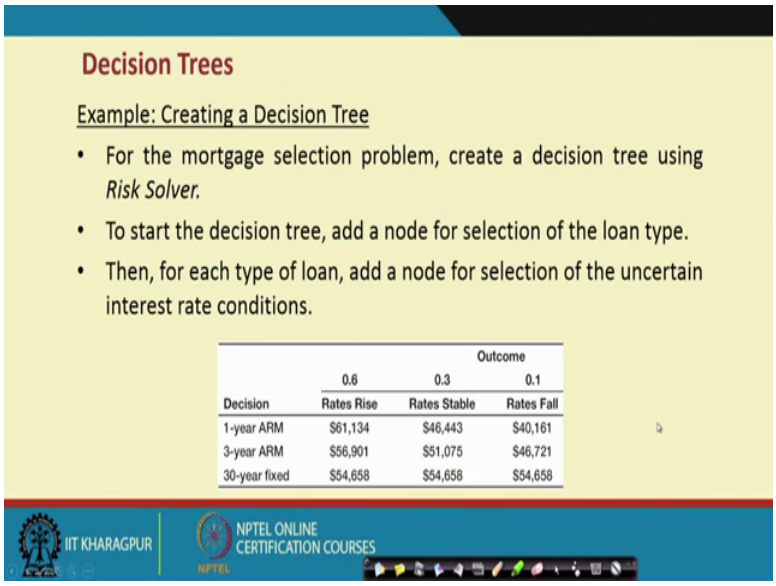

So, this is how the you know risk solver structure through which you can come into the kind of you know conclusion and to understand the particular you know structure we can come with you a come with a kind of you know example which we have already discussed. So, again this is a kind of you know financial decision. So, we have a 3 different alternatives, 1 year a r m 3 year a r m and 30 year fixed and then against we have you know increasing rates stable rate and decreasing rate and that to we have a probability, the probability is 0.6 against you know increasing rate stable case 0.3 and

against decreasing its 0.1 and if you add up this probability it is coming exactly equal to 1.

So, this must be satisfied because it and the particular metric is in the form of a kind of you know a probability structure as a result whatever outcomes will be there and when you connect with a kind of you know weight. So, that must be you know consistent must be the satisfied. Otherwise you know the particular prediction and the kind of you know decision making process will not be you know correct ones as a result. So, the choice of a particular outcome to address the business problems may not be may not very accurate. So, that you know, you know there is a problems for the decision makers to pick up a particular outcome and to address the business problem more effectively.

So, it is; obviously, let us say this is the case and the typical structure will be like this. So; that means, technically. So, this process will be like this. So, let us say we start with a kind of you know decision making process.

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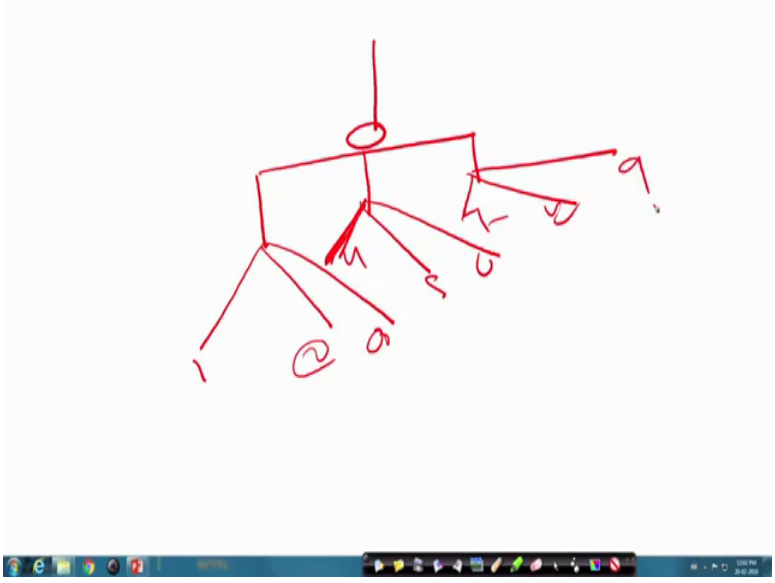

So, like the example which we have already highlighted. So, it is the 3 different situation altogether and then you know against 3 different situation we like to find out what are the possible alternatives again. So, like this you have a find out various alternatives again so; that means, we have a actually 3 into 3 kind of you know structure and this is a kind of you know path diagram it is not exactly the decision tree, but it is a kind of you know

path diagram which can give you the indication that you know within a 3 kind of you know alternatives and with 3 different strategy.

So, we can have altogether 9 different outcomes starting with a this 1, then the second, third, fourth, fifth, 6, 7, 8, 9. So, this is how the kind of you know outcome which can have, but when we have a, you know the kind of you know outputs corresponding to all these flexibility and the current strategy. So, we can prepare a decision tree which can give you know correct specification correct understanding correct visualization.

So, that you know you know the investors or decision makers can you know visualize properly understand the reality and then address the problems as per the particular you know requirement, to know more about this, what we can. So, let us start with like this.

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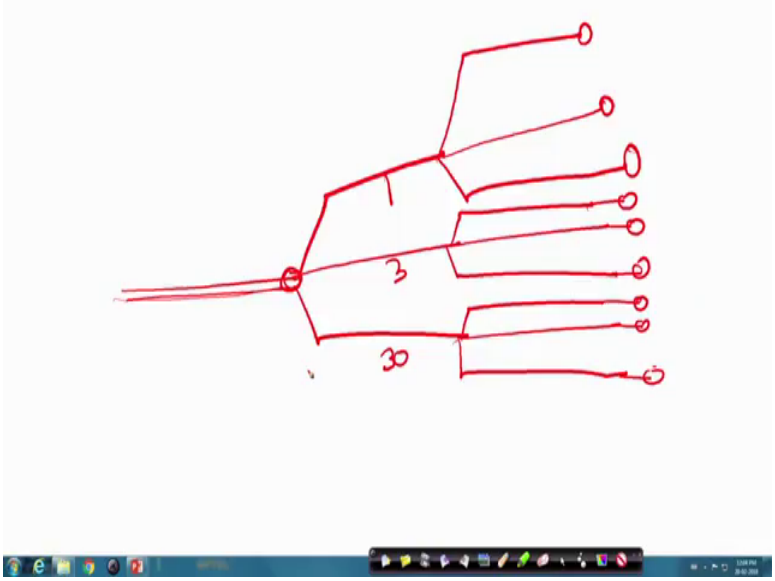

So, this is this is what the a starting so; obviously, we have a 3 different option altogether. So, this is the first option, this is the second options and this is the third options. So, 1 year, 3 year and 30, 30 year fixed. So, that is how the 3 different alternatives we have and against you know is alternative we have a 3 different outcomes. So, this could be this could be the kind of you know outcomes. So, like this so again this could be the final outcome and then this could be the another outcomes again this could be the outcomes and then this could be the outcomes. So, this is how. So, that can be close here, not can be close here, not can be close here and this can be close here, this can be close here, this can be close here, this can close here, this can be close here.

So, that means, technically the problem which we will already highlighted ah. So, whatever outcomes we have corresponding to all these 3 alternative against thee different situations. So, ultimately we have 3 different, I means 9 different outcomes and a decision tree give you more you know such you know more kind of you know effective structure and the same payoff metrics can be visualize correctly and understand correctly as per the particular you know investment requirement.

So, if you talk about the decision tree. So, this will be the kind like you know it a kind of you know branching problem and the kind of you know path diagram through which you can address the business problems as per the particular requirement and that too under various alternatives and under you know various you know different strategies. And then we have to pick up the best once as per the particular you know requirement, it is a you know its it is like you know you know branch and BBM branch and bound mechanism which we have already discuss in the case of you know prescriptive analytics in the case of you know you know linear programming problems. So, it is also similar kind of you know structures.

So, the idea is you know having all strategy and different economic situation or different kind of you know strategy we have possible outcome. So, these outcome should be properly structured and then every every possible outcomes can be evaluated and then with you know every possible outcomes can be the, you know typical you know item which can address the business problem. But out of out of all these possible outcomes we have pick up a best outcome which can visualize the business problem more effectively and of course, to pick up a particular best outcome we have to apply a particular you know criteria through which you can address these business problem more accurately, and with this we will stop here.

Thank you very much.