Business Analytics for Management Decision
Prof. Rudra P Pradhan
Vinod Gupta School of Management
Indian Institute of Technology, Kharagpur

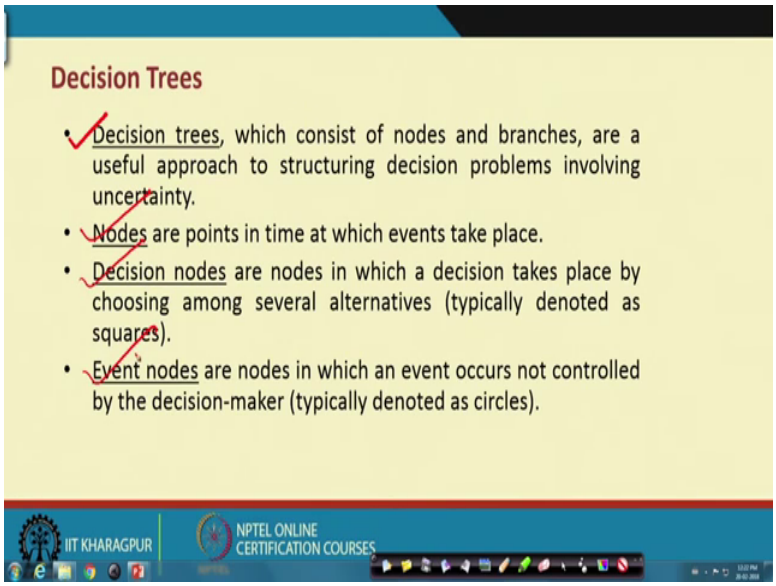
Lecture - 59
Decision Analytics (Contd.)

Hello everybody, this is Rudra Pradhan here. Welcome to BMD lecture series, today we will continue with Decision Analytics and the coverage is decision tree, we have already discussed this particular concept in the last lecture. And today we will continue with the same concept and we connect with you know different kind of examples.

So, technically decision tree is something different it is a similar kind of decision making process, with the particular you know business problem. We have lots of you know possible outcomes corresponding to different alternatives and different strategy and the idea when this particular process the decision making process is to find out the best outcome out of all possible outcomes, which can address the business problem more effectively and as the particular you know business requirement.

We have already discussed several decision making criteria, starting with you know aggressive strategy you know the kind of minimax principles, maximin principles through which you know you can we can pick up a particular you know outcome and which can address the business problems as per the requirement and now, decision tree will give you some kind of better visualizations, corresponding to all possible you know outcomes with respect to different alternatives and different you know business conditions.

(Refer Slide Time: 01:55)



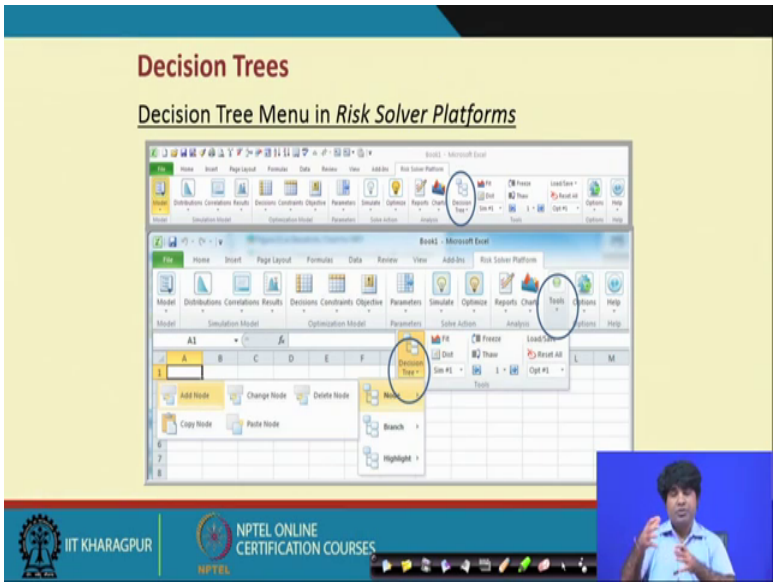
So, what we what we will you know like to know, what is exactly the decision tree concept and what are the things are there in the decision tree and, how is this particular technique can be visualize properly to address the a business problem. So, there are couple of thing in this particular you know structure.

So, first thing is what about the decision tree and it is connected with nodes and, then connected with the decision nodes and then event nodes. So, I have already highlighted what is this particular you know concept. So, it consist of you know nodes and branches and these are these are all very useful you know kind of concept, or the kind of approach to structuring the decision problems involving you know various you know uncertainty.

So, the nodes are points in time at which event takes place and decision nodes are nodes in which a decision takes place by choosing among several alternatives. Then finally, event nodes are nodes in which an event occurs; not controlled by the decision makers. So that means, with each you know items we will like to prepare a kind of decision tree and for that we need we need to have you know various alternatives and various situations and corresponding to these alternatives and situations, we have a different kind of outcomes and sometimes these outcomes are connected with the probability and these outcomes are connected with the without probability.

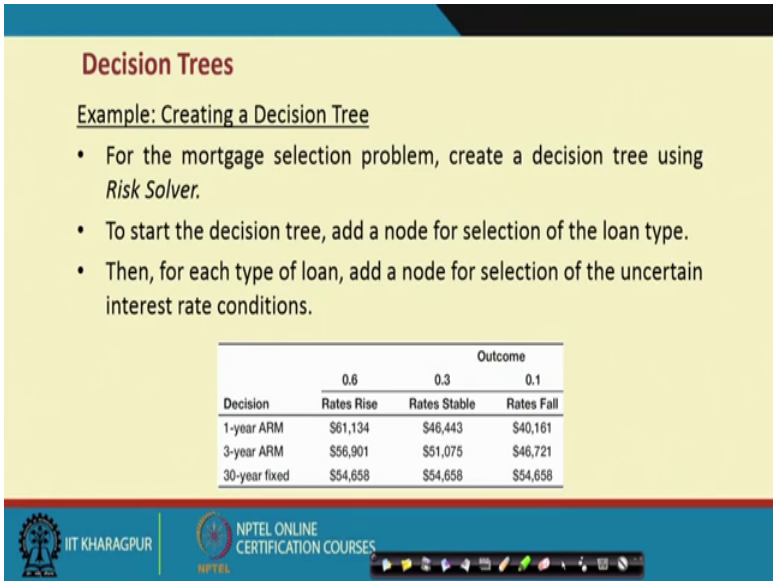
So, let us see how these particular you know structure and then we come with a kind of third process through, which you can address the business problem more accurately.

(Refer Slide Time: 03:44)



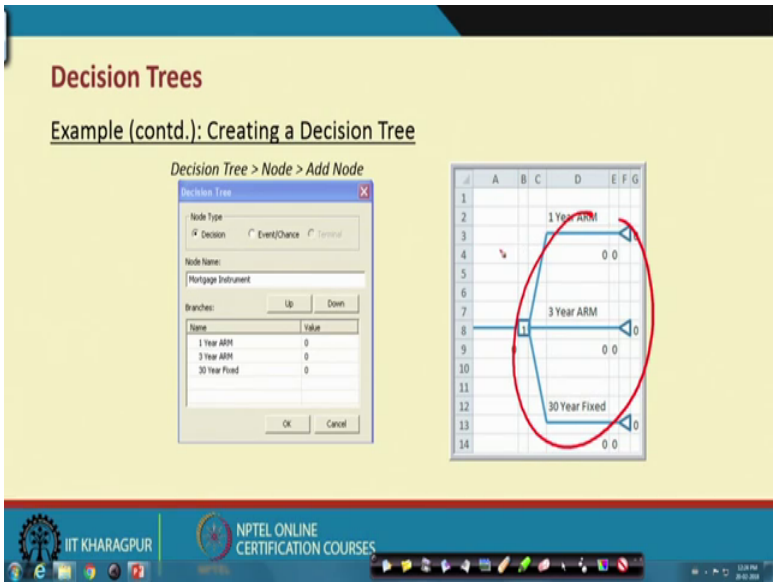
So now corresponding to these items; so, let us see how is this particular you know decision making process or decision tree. So, the kind of you know items means the decision tree is not something different. So, whatever we have discussed, but we try to bring all these you know alternatives and the kind of strategies and, outcomes in a kind of structure format only. So that means, it will give you know more practical kind of things or in a more visualization kind of things, through which you can you know understand the problems and, then come with a kind of decision through which you can a you know address the business problem you know more effectively.

(Refer Slide Time: 04:27)



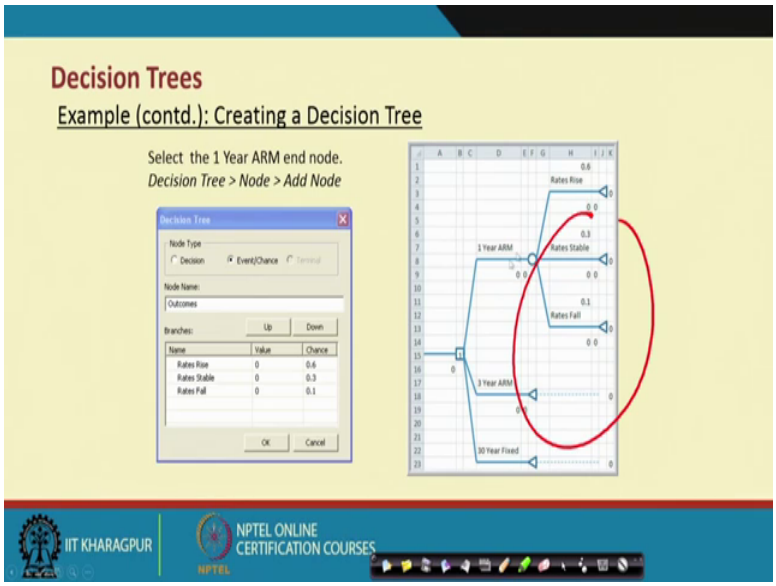
So, this is what you know risk solver package through, which you can actually work out the decision tree and for the kind of decision tree the typical requirement is the various alternatives and the various outcomes levels corresponding to these alternatives and the kind of situations.

(Refer Slide Time: 04:45)



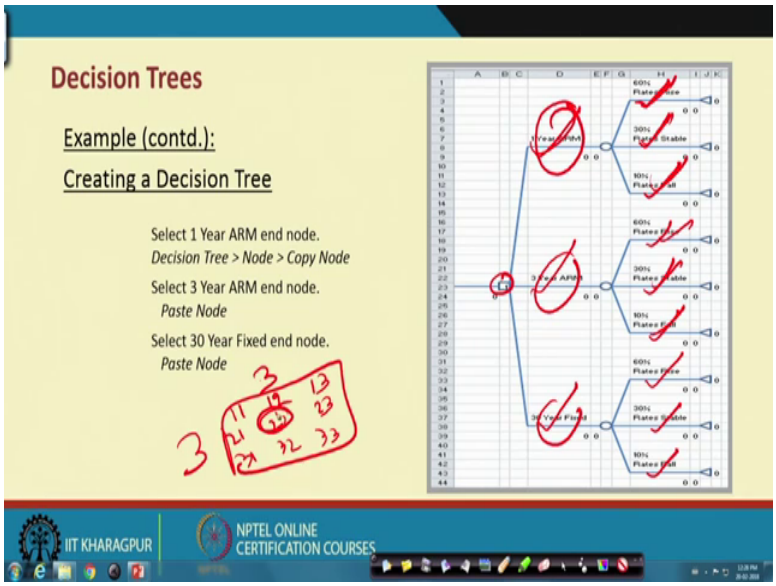
So, now so what we have already discussed so now, the in the case of you know decision tree. So, if you come with kind of structure this is how the particular you know structure which in fact, you know highlighted in the last lecture. So, now, when we have a problem here, you see here problem is here the kind of ok. So the kind of requirement is here, so these are all you know alternatives and then corresponding this three alternatives, we just you know plotting this particular you know decision making process, or the decision tree will give you more clarity that you know this is what the problem and it has a three different alternatives. So, 1 year ARM, 3 year ARM and 30 year fixed, then again against 1 year ARM we have three different options.

(Refer Slide Time: 05:30)



So, rates increase, rate stable and rates fall; similarly in the case of you know 3 year ARM we have also three options against 30 year fixed, we also have a 3 option. So that means, practically decision tree will not give you something you know different kind of output, but decision level of output which can produce a more accurately, or more clearly. So, that you know anybody can understand, and you know practically see kind of feasibility, then we can pick up a particular you know situation or outcome through which you can address these business problem. So, likewise so the complete you know the decision trees; so this is first node and then the complete metrics will be like this. So, starting actually we have a 3 different alternatives, alternative 1, alternative 2, alternative 3.

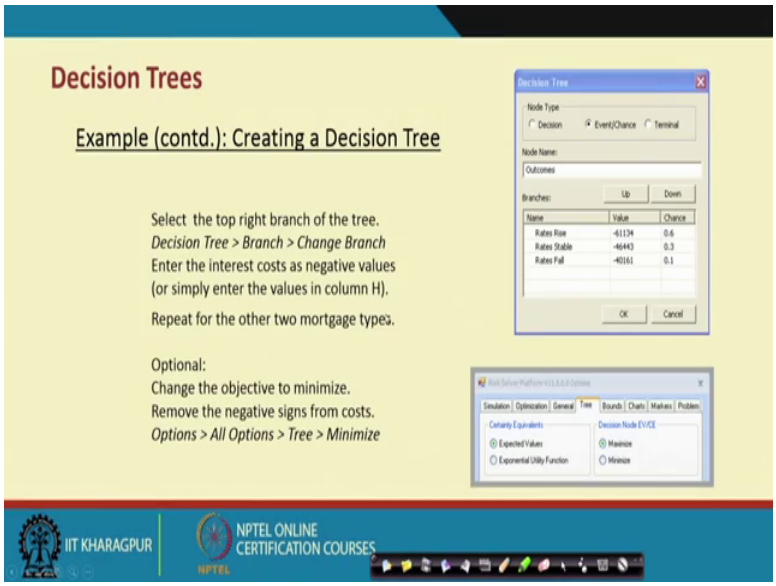
(Refer Slide Time: 06:19)



So, every alternatives have a outcomes corresponding to 3 different situations. Similarly for second alternatives so, you have a 3 difference you know situation. So, corresponding to 3 different alternative, we have 3 different outcomes under 3 different situation that is how the situation 1, situation 2, situation 3 for alternative 1 and then again situation 1, situation 2, situation 3 for alternative 2; again situation 1, situation 2, situation 3 for alternative 3. So that means, technically a corresponding to 3 alternatives and 3 different situations, we have a payoff metrics of you know 1 1 1 2 1 3, then 2 1 2 2 2 3, then 3 1 3 2 3 3. So, nine different outcome so these nine outcomes are actually projected here; so that means, decision problems we have already highlighted and applied different techniques a you know like aggressive strategy, conservative strategy, through which you can pick up a particular outcomes, let us say this ones to address this you know business problem.

But now you know connecting to these you know alternatives, the situation, the kind of outcome. So, decision tree will you know cover all these outcomes and project the kind of things more accurately and more effectively. So, that you know anybody can understand and you know we can compare each you know each case a perfectly so that you know the decision making process will be you know, you know more effective and you know give you more kind of clarity to address the business problem. So, this is how the decision tree will be very useful.

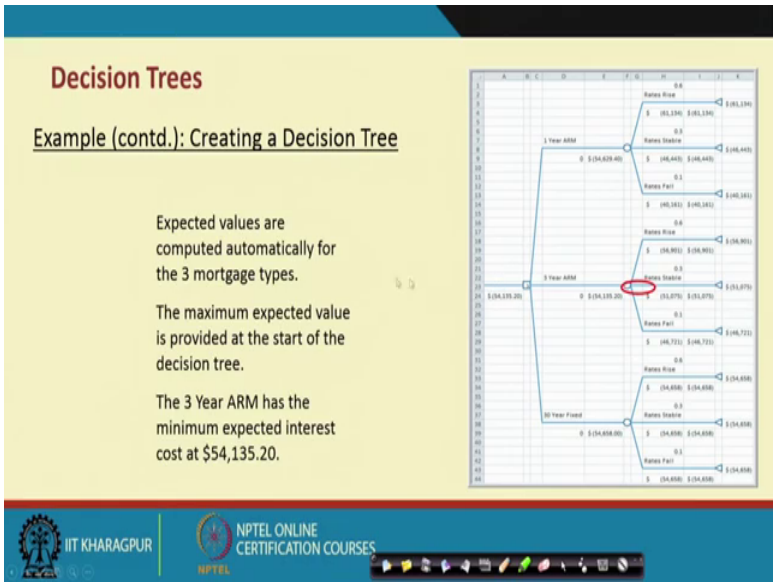
(Refer Slide Time: 08:14)



And then similarly so these are all different kind of options, if you know means technically you can manually draw this particular you know structure and then you know project the kind of environment, or else you know you can use the software the software will by default give you the same kind of flow chart.

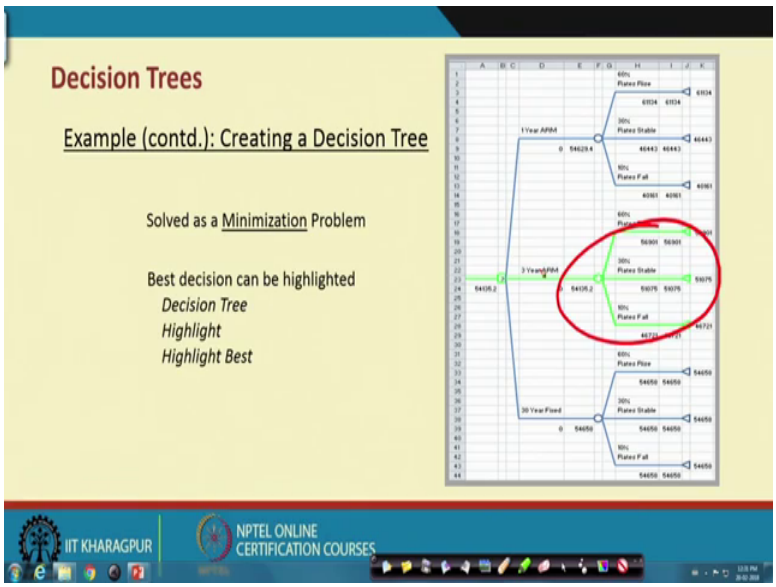
So, the idea then this kind of you know structure that to the with the help of you know decision tree, it will you know project the entire you know business problems with you know all such you know alternate you know alternatives you know outcomes. So, then you know I am we are you know in fact, sometimes confuse that you know how the best outcome is a you know detected, or the kind of observe through which you know address the business problem, but here it will give you some kind of comparative kind of analysis and that too, when you pick up a particular decisions, it will be give you some kind of indication that yes; this is how the best and that to that is how we can address the business problem effectively.

(Refer Slide Time: 09:21)



So, likewise this is similarly kind of visualization. Now through plotting; so we can have this particular you know decision tree and that too now apply the minimization so that means, manually you can do and give the indication, or else in the it is solvers you can give the indication about the minimization by default by default this will this will be clearly highlighted.

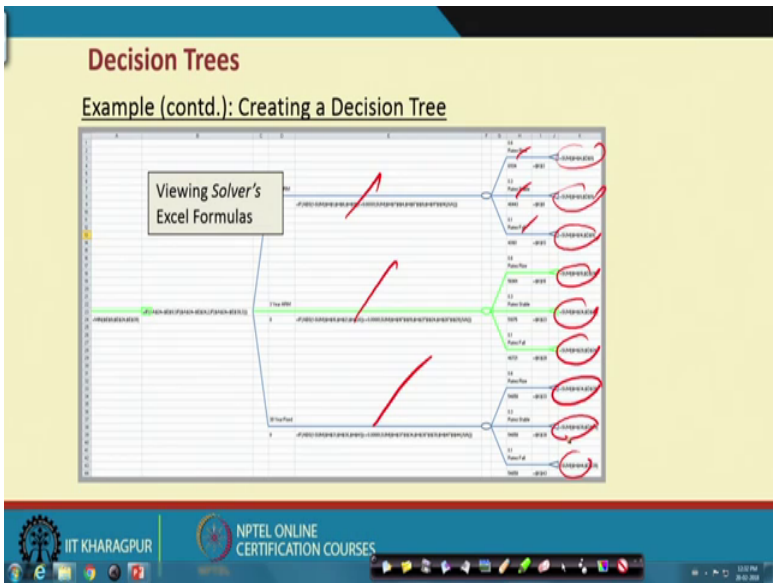
(Refer Slide Time: 09:25)



So that means, technically you know compare to the previous scenarios. So now this outcome is actually more accurately specified. So, that you know it will give you better understanding, better visualizations, compare to the previous kind of structuring.

So, that is how this kind of situation, where you know we need actually to you know have a decision making process, that too with the help of you know various alternatives and you know different situation. So, decision tree is the best kind of structure through which you can project the outcome as per the particular you know business requirement. So, that means, technically it is a kind of platform through which you can you know present all such outcomes corresponding to different alternatives in different you know situation. So, after projecting all this things we can actually pick up a best strategy through which you can you know visualize the problem more effectively. So, that that is how that is why the case through which you can you know address and a similarly this is more a kind of restructuring through which you can address the similar kind of process.

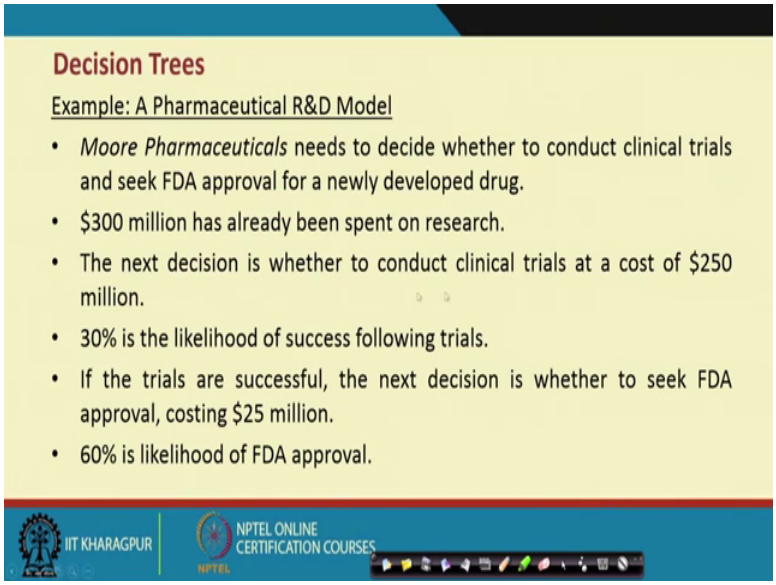
(Refer Slide Time: 10:53)



In fact, you know let us say we have actually a you know a you know consider the kind of weighted average kind of concept; that means, corresponding to you know 3 different options, we have a three different situations and sometimes you know corresponding to probability, we can find out the mean value and we can project the mean value here. So that means, after you know reporting the kind of structuring.

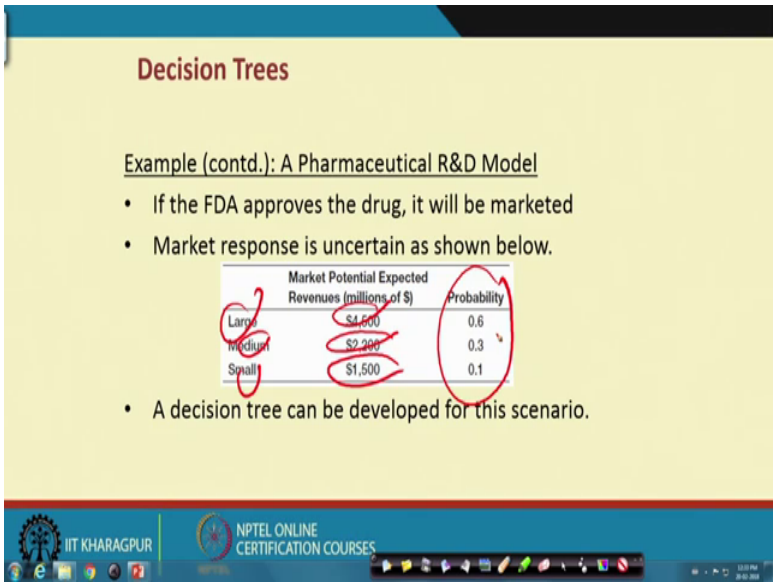
so you can apply the particular tree, then the kind of structure against this platform can give you more you know more much better visualization and more practical kind of understanding; through which you can address the business problem; and that too so, it is actually very clear and that too, we can actually you can you know pick up the particular outcome through which you can address the business problems.

(Refer Slide Time: 11:50)



So now in order to understand the particular you know structure. So, we can start with another examples so this is a pharmaceuticals R and D model and again so it is a kind of investment decision.

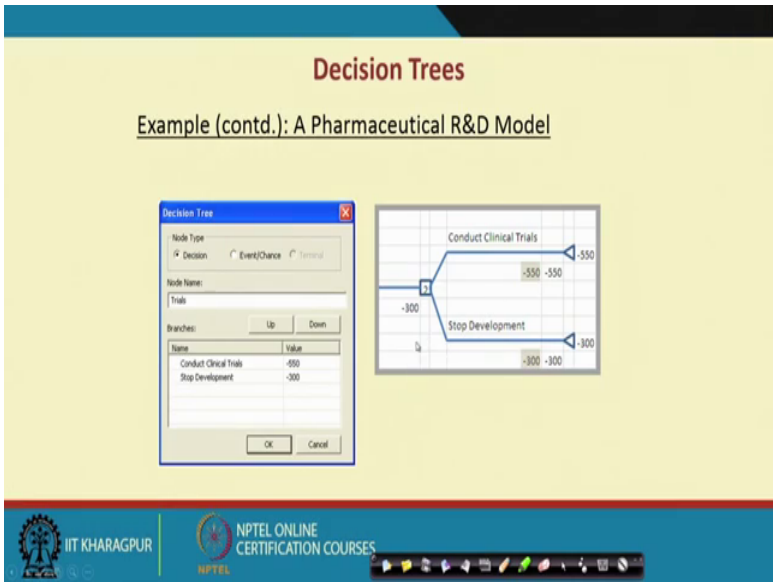
(Refer Slide Time: 12:06)



So now the investment decision is having actually the kind of three different alternatives large medium and small and again market, potential, expectation revenues 4500 and dollars and 2200 dollar and 1500 dollar. And corresponding to these you know potential outcomes revenue so we have a corresponding probability, because it is actually business which is not actually clearly certain. So, it is uncertain; that means, most of the you know instances business is very dynamic and there is a there is a lots of you know uncertainty and (Refer Time: 12:44) So, that is how always you know probability will connected to address this you know, this type of you know problem while taking some kind of management decision.

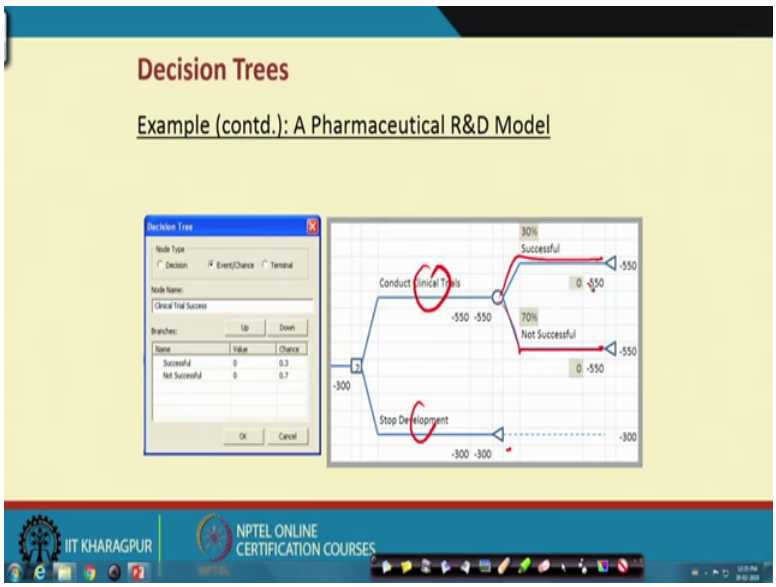
So, now so with this you know 3 different alternatives in the outcomes; so decision tree can be also developed so that means, actually decision tree is not something different so it is a kind of concept having the inputs and outputs. So, we like to actually a you know putting a kind of platform, or you know kind of path diagrams, or the kind of branching through which you can you know it will give you know better visualization. So, it is a completely kind of flow chart concept starting with inputs, to the kind of output and then we like to see which particular outcome will be the best outcomes corresponding to a particular you know problem.

(Refer Slide Time: 13:46)



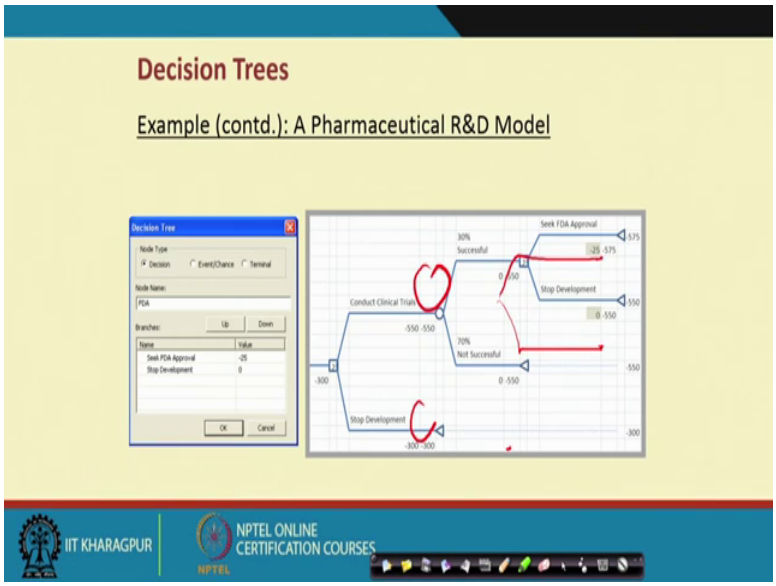
So this is how the [FL] kind of case. So now with these inputs so the typical you know you know decision tree will be like this. So, this is how the kind of case. So we have since it is actually a 3 different case so, we can have the concept like this and then the particular structure can be again you know let us say this is start with you know a conduct technical trials and then stop development.

(Refer Slide Time: 13:56)



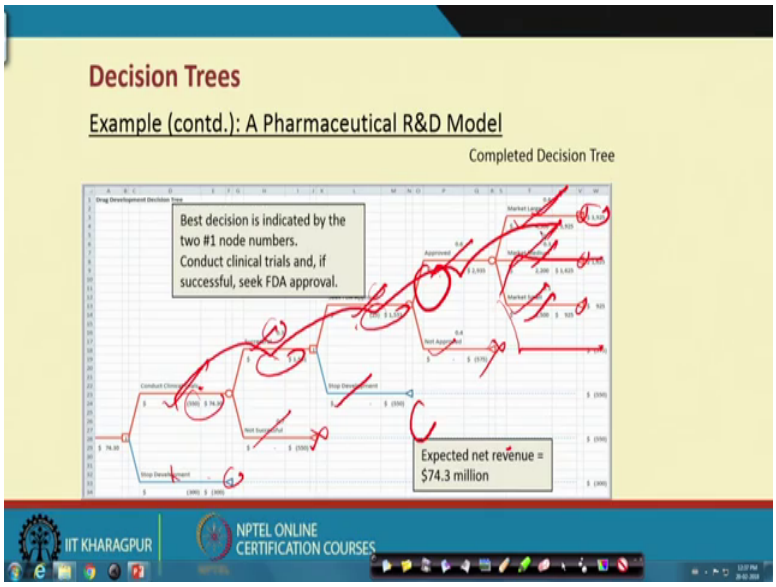
So, this is how the starting process now, if this is a actually stopped here this will continue.

(Refer Slide Time: 14:21)



So, now one side continuation is successful and not successful right. So, again so we have 2 different branching and then again so, again this can be a further you know branch, like you know so if not successful you can stop here and this part can continue.

(Refer Slide Time: 14:30)



And this part continue with you know seek f FDA approval and then stop development. So that means, technically this is a this is the kind of this is this is the kind of another entry and here so, approved not approved then again you know having market large, market medium and market small; so that means you so this is a typical kind of

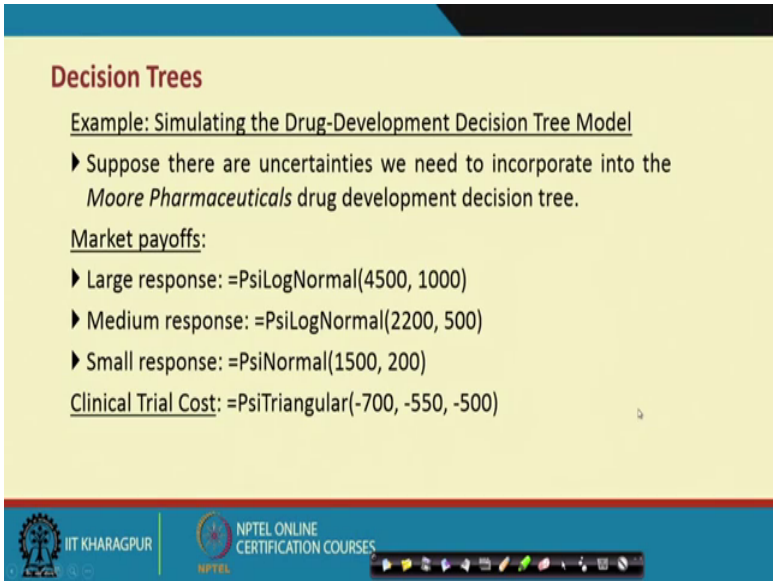
structures where, we start with 2 different branching; so this is active, this is not active so we can stop here.

Again with this particular you know items so we have successful option unsuccessful option. So, unsuccessful option we can stop here, then this will continue we need actually approval, if it is successful and then not approved; that means stop develop stop development and then successful, then approved, then after that you know approval accepted and not accepted. So, this will be again a close here and once it is a approved so then the outcome will be generated here with market large, market medium and market small.

So, now so the loop can be ended here and these are all possible actually output possible output with corresponding you know probability. So that means, it is a kind of you know kind of conditional kind of situation. So, that is how sometime we use conditional probability to address this kind of problem.

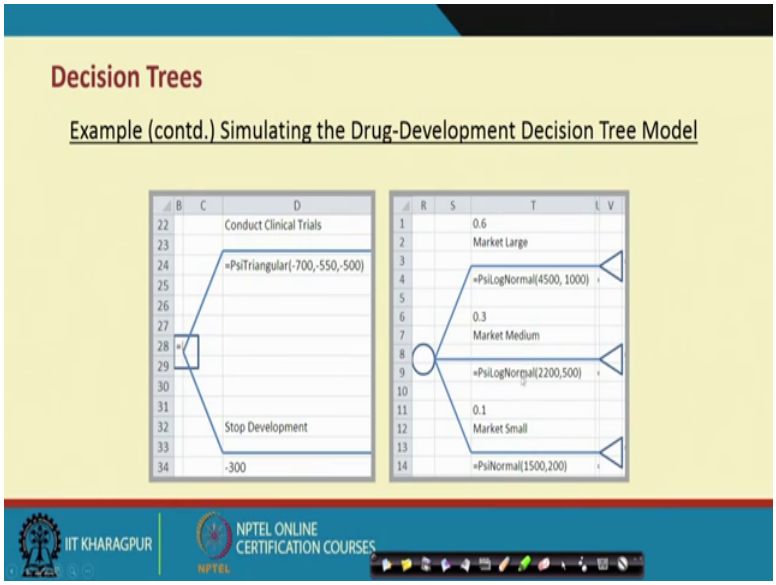
So, now so ultimately so this outcome will be this condition with you know these these these and these. So this is how the kind of connections and that too you know to address this particular you know you know problem. So, means it is a kind of practically, it is more visual visualization structure through which you can understand the problem, more accurately and come with a kind of outcome which can address the business problem as per the particular you know requirement.

(Refer Slide Time: 16:28)

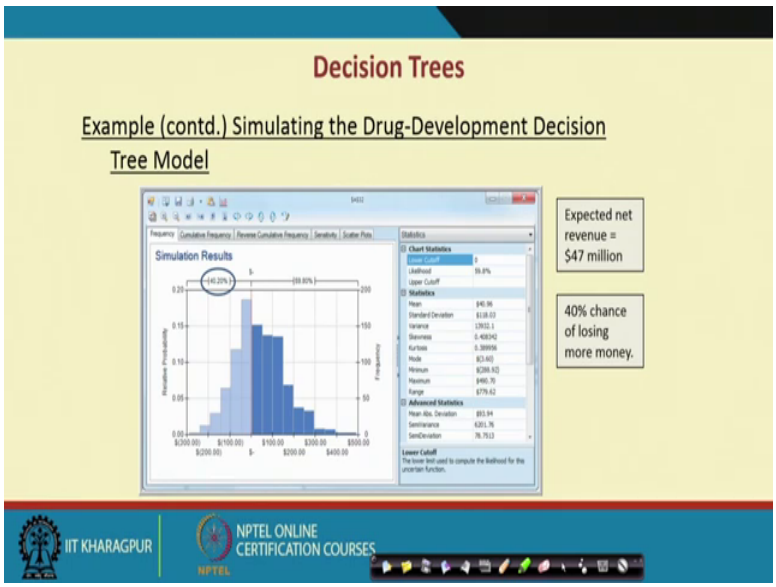


So, now and this is another examples and similarly we can have different options and a again so you know these are all various descriptive statistic about this problem.

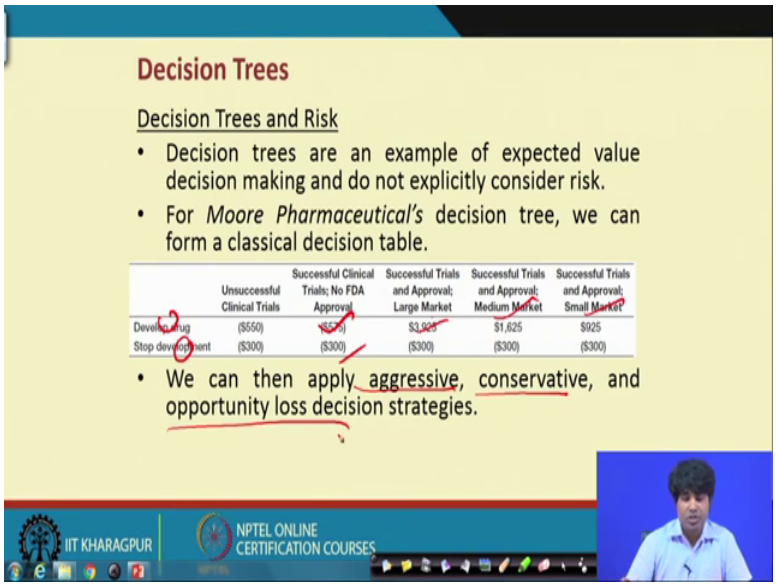
(Refer Slide Time: 16:32)



(Refer Slide Time: 16:36)

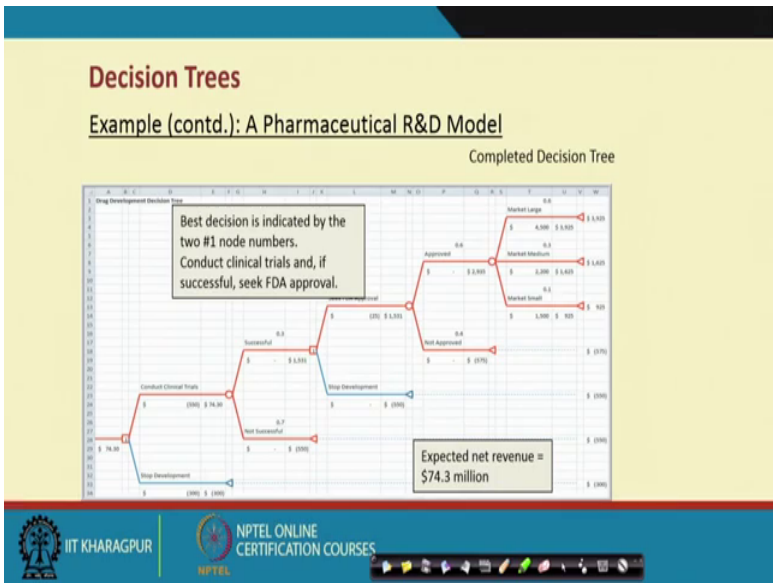


(Refer Slide Time: 16:40)



So, now so what we can do here so decision tree has two different structure the first part it will give you the kind of visualization; that means corresponding to various alternatives like, which we have here only. So, corresponding to various alternatives so we have the complete you know picture.

(Refer Slide Time: 16:56)



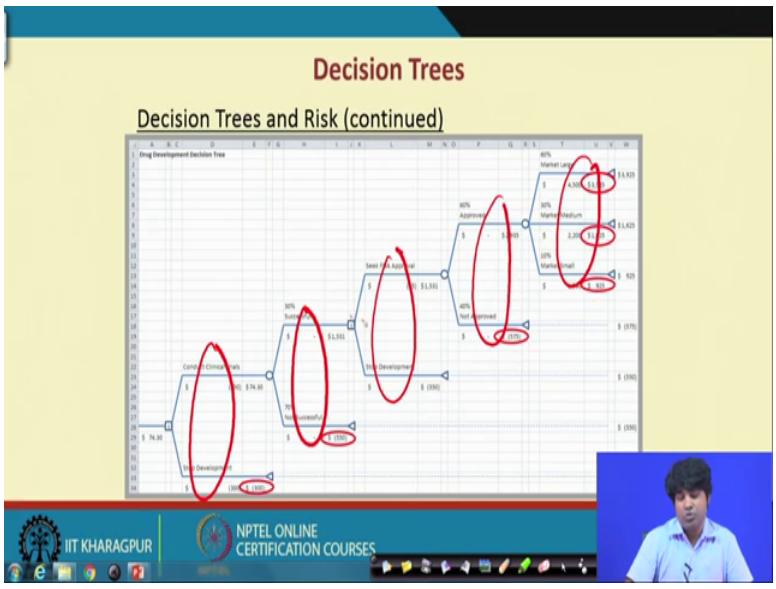
So, earlier it was in a kind of a tabular format. So now it is in a kind of diagrammatic format or you know the kind of flow chart format or the kind of branching format; through which you can see the actuals you know possible outcomes, under you know

different situation and different conditions and then the issue is after visualization the typical issue is which one is the finals (Refer Time: 17:26) for that the ultimate requirement is to pick up a particular technique, through which you can take the kind of decision. So, that means so now so we have a actually different option here see here. So, these are all developed you know you know stop development so that means, a developed drug and stop development.

So, if you if you go to the in a previous slides, so you will find so let us say lets the case here stop development and approved. So, this is the case here and then in this case after these we have a different current kind of structures. So corresponding to unsuccessful so these are the possible outcome, then the kind of ahs in the case of you know successful this these are the possible outcomes. So, likewise we have a different possible different levels of outcomes, then this is under large market, medium market and small market. So, now we have a different kind of outcome and then we can apply aggressive strategy or conservative strategy or opportunity loss decision strategy so that means to pick up a particular actually in the outcomes under different possible out outcomes.

So, we have to apply a particular strategy and then a pick up a outcome which can address the business problem. And that too help the decision makers to you know workout the problem as per the particular management requirement.

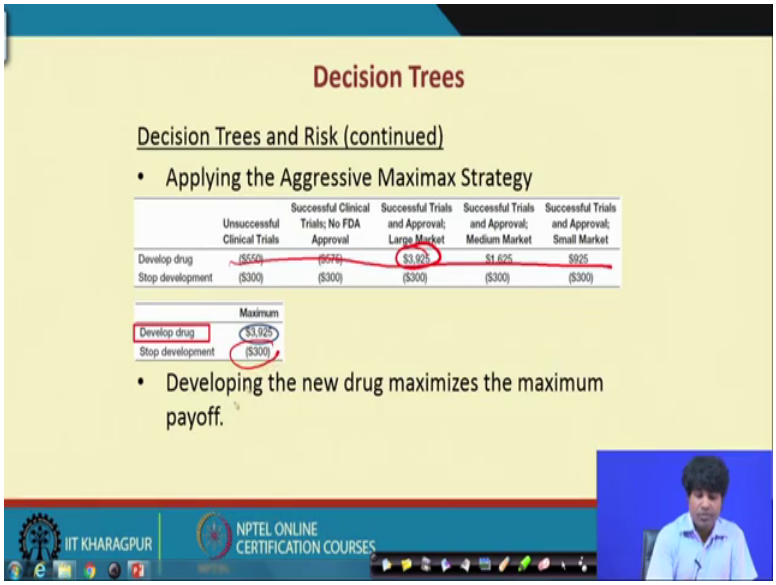
(Refer Slide Time: 18:56)



So, now likewise we can actually again you know follow the particular you know path and here so this is how this the kind of stop development case and then not successful case, then this is a not approved case and then under 3 different market conditions. So this is how the kind of structure and the same structure we have plotted here with you know different kind of options. So that means we start with you know develop drug and stop development.

So, this is the first node and for that so this is how the typical structures so that means, a corresponding to the first column so this is how we are here; then corresponding to the corresponding to the kind of second options; now with respect to the second option so now what we will have here the second node so that means, technically so we are here early. So similarly again for third node here, then fourth node here, fifth node here; so this is how the typical you know development. And then finally, we can project actually different level of outcomes corresponding to different strategy and different options. And then finally, we have to pick up a particular outcome and on the basis of you know a particular you know strategy.

(Refer Slide Time: 20:10)

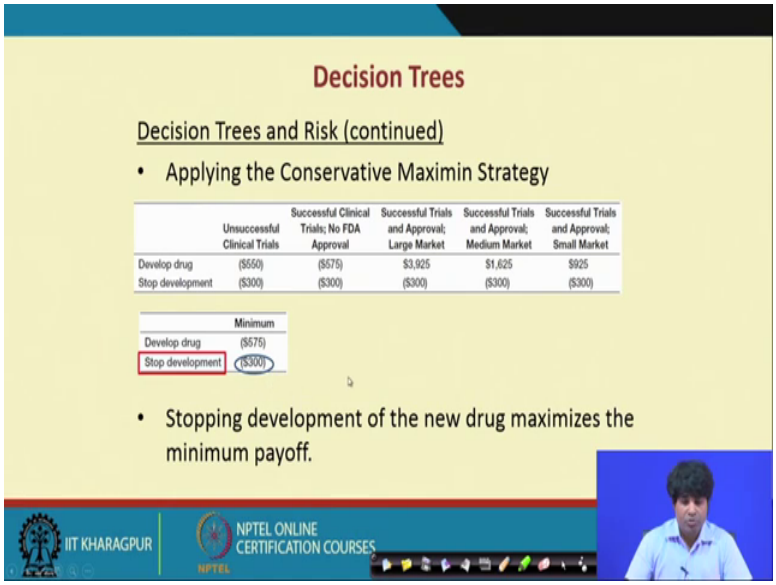


So, in this case if you apply you know maximize Maximax strategy; that is you know aggressive Maximax strategy. So, what we will do? So we have to find out maximum amount all these outcome and then you know accordingly you have to take the decision. So, here develop drug so 3925 and then again stop development it is a 300. So,

technically so that means, in this case if you apply this you know maximax criteria. So, the first option is the out of all possible outcome, which one is the maximum? So this is the maximum 1 and then in the case of stop development so this is actually the maximum then between these two so you have to pick up which one is the best finally. So that means we have different kind of option. So, it is the step by step process.

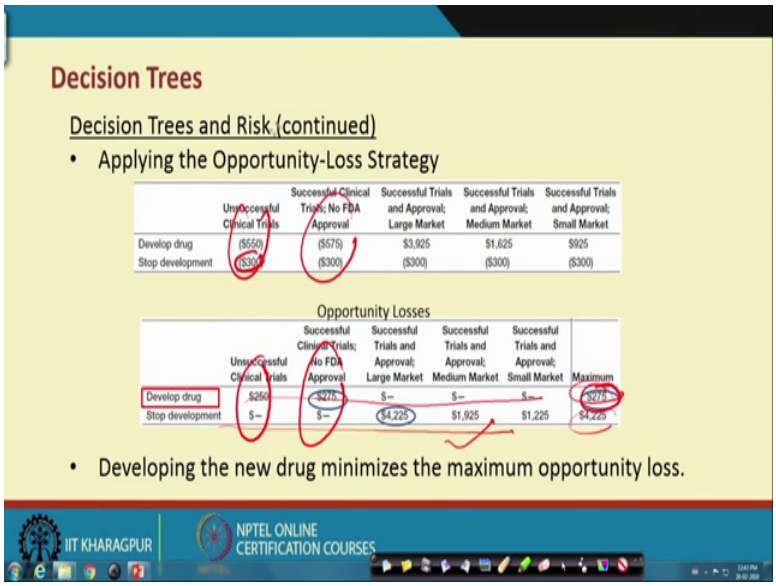
So, ultimately we need a single outcome through which you can actually address these business problem. So, initially start with you know various alternative, various situation, then we will have a various projected outcomes, then with the different levels of you know processing, application of different strategy, will steam line to a particular you know labels where, single the choice will be the single outcome and that to that to the situation where we can address the business problem more effectively and that is how the a typical requirement of the decision tree.

(Refer Slide Time: 21:43)



So, now corresponding to this you know outputs then finally, so if you apply the Maximin criteria so ultimately so this will be the a minimum. And then finally, you to find out which one is the best requirement as per the minimum payoff. So as a result so 300 will be the best rates as per the particular you know requirement.

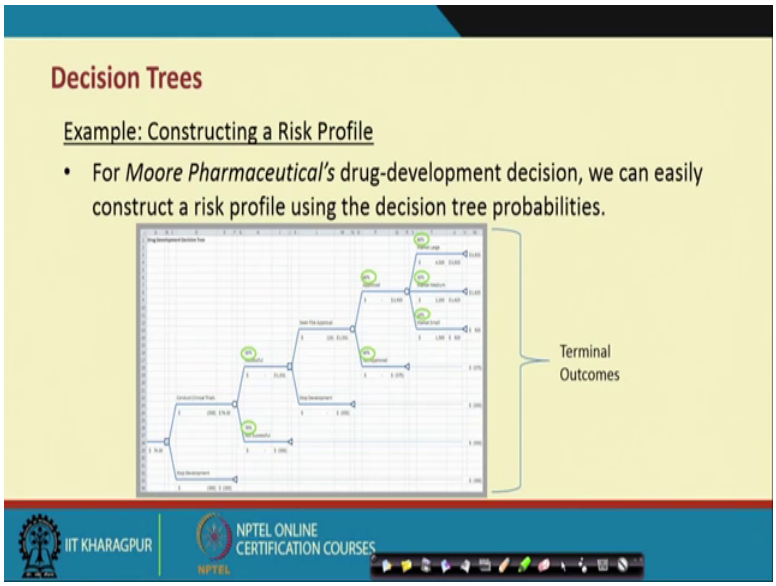
(Refer Slide Time: 22:01)



Again having the same you know input tables here, so we can apply opportunity loss strategy then you know pickup the decision. So, here we have to find out the minimum and then for instance this case the minimum is 300. So, ultimately so this particular column will transfer to this one. Similarly here 300 is the minimum so this will be transferred metrics. Then finally, the entire metrics will be transferred into this metrics and then again we pick up the maximum one out of all these possible you know cases, again we have to find out the a maximum one out of all these possible cases. So, then we like to find out the minimum of you know all this maximum possibilities. So, which will give you the kind of the value, where we have only 275.

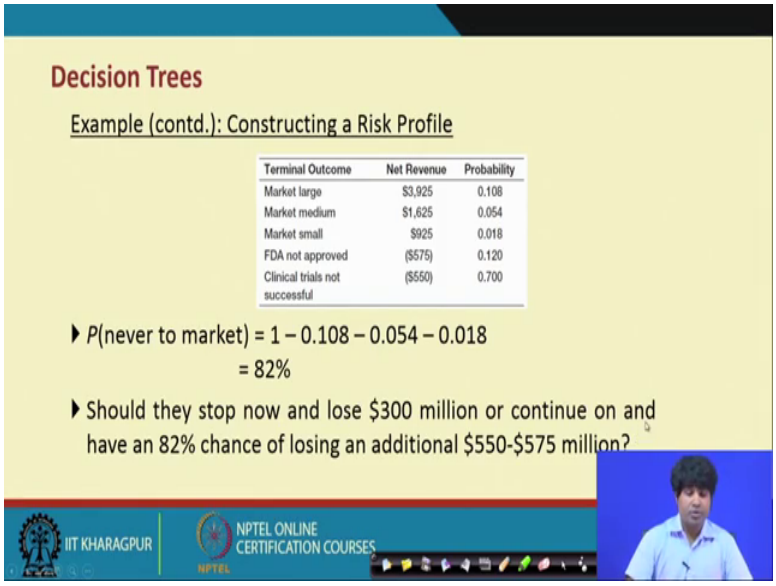
So that means, technically so this is a kind of process through which we can address the business problem more accurately and then come with a kind of decision through which you can project the business environment more effectively.

(Refer Slide Time: 23:03)



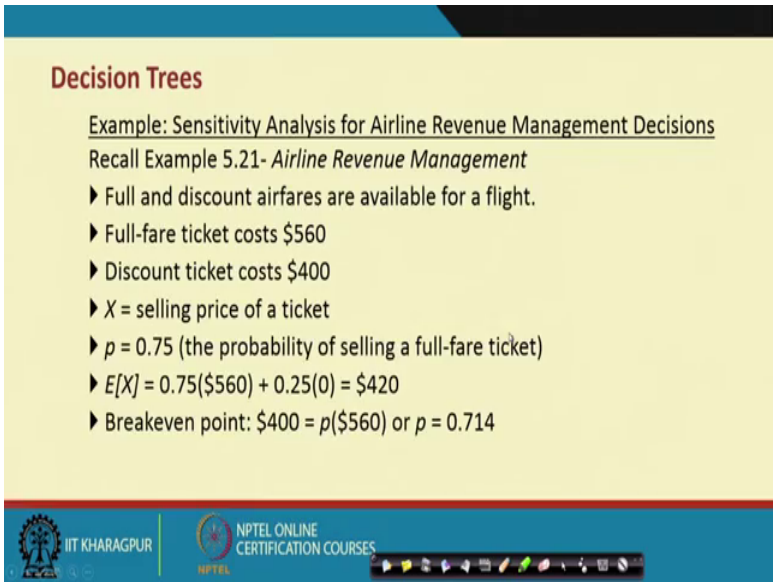
And similarly this is another kind of structure through which, it will give you more kind of visualization. So, that is called as you know terminal outcomes so that means, with respect to different branching corresponding to different alternatives and situation. We will also sort you know outcomes so all these outcomes will be gathers then finally with a particular technique you to pick up a you know outcome which can address the business problem; that too as per the particular you know requirement.

(Refer Slide Time: 23:42)



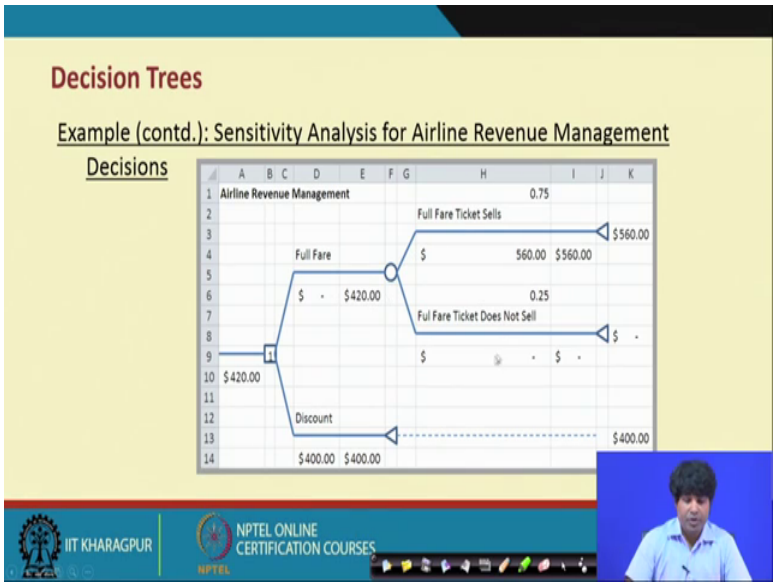
So, now so likewise we have a different you know different kind of problems, and a corresponding to a kind of problems. So, we can prepare a decision tree, which can give you more clarity and more visualization to address the business problem and allow the decision makers to pick up a particular outcome though which you can say management decision will be more effective. So, this is how the decision tree helps lot to address the business problem as per requirement.

(Refer Slide Time: 24:12)



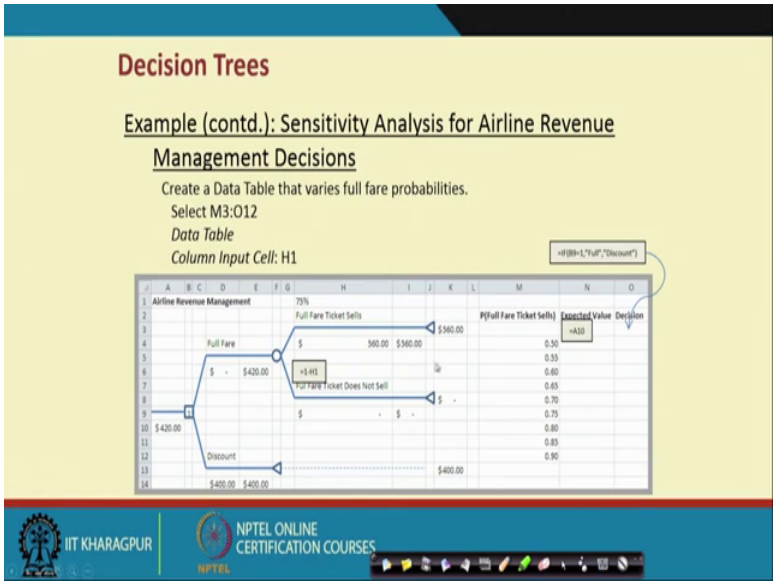
So, this is another you know problems that is connected to airline revenue management these are all inputs.

(Refer Slide Time: 24:22)



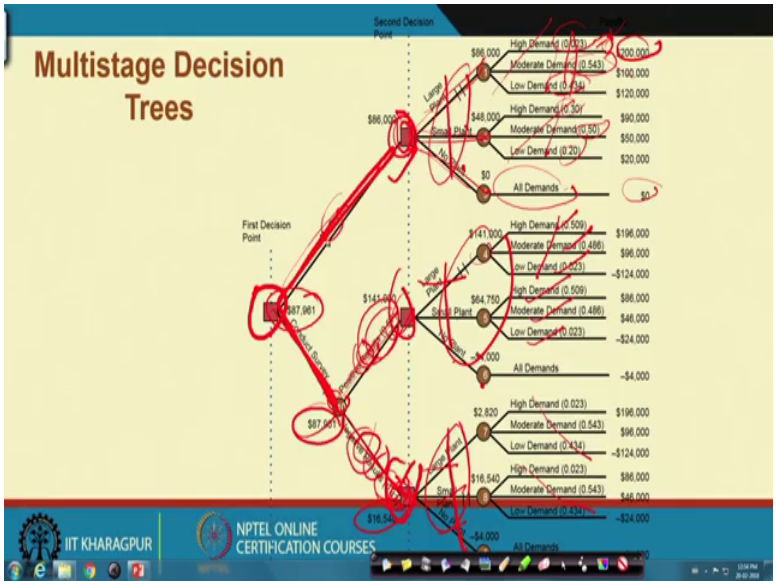
Then now, we can prepare a actual decision tree; that means, actually so the whole idea about the decision tree is that you know it will give you some kind of structure where, we have actually a possible outcomes corresponding to different alternatives and different situations and you know in fact, we are very much here that you know a particular outcomes under different you know possibilities can be the best through which you can visualize the problem more accurately.

(Refer Slide Time: 24:55)



So, likewise in this case we have the platform like this and then again we have to pick up a particular structure as per the requirement.

(Refer Slide Time: 25:00)



So, now likewise it is a complete it you know it is a very interesting structure, through which you can you know address the business problems as per the particular you know requirement. And in fact, the problem which we have discussed till now is a kind of simple structure and now when the problem is very complex; for instance we have a more number of alternatives, more different situation under each different situation.

We have a you know different options altogether so that means, it is branching upon, branching upon branching so, like that you know every case, we have a different kind of options and corresponding to different options, we have a different level of you know outcomes. For instance this is what the sighted example here, and this is what it is called as you know multi stage decision trees. So that means, we start with here kind of examples.

So, the first decision point will be here now and in this is how the kind of structures so the first decision point so the on the first decision point is here and then it has a two options and no survey and have a survey. So, now this is how the initial kind of investment and with no survey, then ultimately we reach this point and with the survey we reach this point. So, with survey so the total outcome will be like this and here, the total outcome will be like this. Then again this will give you some kind of first end

decision making process. So after the first end decision making process so we have another kind of branching. So that means so first level of branching is you know survey with survey, without survey.

So, this is first branching; then we know with no survey so this will be against large plants, small plant and no plant. So this second level branching and again with survey so we have a positive results and we may have actually negative results; since it is actually no survey, so the positive results and negative results are not appearing here. So, with survey we can have positive result and we can have a negative results.

So, then again so with respect to you know no survey where no question of positive results and negative result. So, as a result the branching will start with you know three different plants; large plant, small plant and no plant and again with survey we have two different branching again so with positive result and with negative result; for positive results so the percentage of probability weight is here 0.57 and here the probability range is 0.43. So that means, technically so this outcomes corresponding to this you know outcomes it will generate the typical you know final outcome this much and that is 16540.

So, now the second level of branching will start from here so this is first level branching no survey, so then the second level branching will apply with large plants, small plant and no plant, but in with survey we have actually two different cluster altogether before you go for you know branching against large plant, small plant and no plant. So, so technically with survey we have actually six different options; one option with positive result, that will generate three different outcomes and another with you know negative result that will again give three different you know outcomes.

So, now ultimately without survey it will give you three different outcomes against large plants, small plant and no plant. Again with survey we have two different branching positive results, negative results and each case we have a three different outcomes against large plant, small plant and no plant again with the negative results; we have again large plant, small plant and no plant. Then finally, if you go by you know large plant you know kind of clustering, it has again three options; high demand, moderate demand and low demand so that means, technically we start with two and the first one is

a having a only one options because, there is no survey, then the second one is having two different options; positive results, negative results.

Then ultimately after the end of the first decision which we which we have actually three different nodes further to you know extent. So, as a result we have a three different nodes here and this nodes can be again apply under you know three different situation that is the large plant, small plant no plant and as a result so against three different nodes, we have actually a three-three case ultimately again 9 different outputs here and each case we have the kind of outcome.

And again a in each case we have 2-3 different levels of you know outcome corresponding to high demand, moderate demand and low demand and for that we have also probability 0.023, 0.543 and 0.434 and this will give you the total probability exactly equal to 1. And similarly in the case of you know small plant and not necessarily the probability will be same.

So, it will be definitely different because, high demand you know it is a case of you know large plant, and it is case of you know small plant; again in the case of you know no plant so there is no demand at all. So obviously, there is no demand so that means, the there is no further branching here. And so as a results so large plant we have a three different options and small plant again we have a three different option.

Similarly the second node can generate actually three different out output against large plants, small plant and no plant and further extents on large plant will produce three different outcomes corresponding to high demand, moderate demand and low demand and similarly small plant can produce three different level of output against high demand, moderate demand and low demand and finally, a again against 3 node so we have a actually 2 different levels of output large plant, small plant 3 different levels of output large plant, small plant and no plant. And again so, we have a 3 different outputs against high demand, moderate demand and low demand and this also equilate true in the case small plant and no demand against actually no plant.

So, ultimately a so the node will be close here and in fact a depending upon the business environment and the kind of business dynamics and the kind of business requirement so this not can further extend, if you apply some kind of further criteria or the kind of constrains.

So, technically this is this is lots of you know flexibility and every times with respect to a particular you know alternatives and the kind of remarks and constants, we can have a different kind of branching and corresponding to the inputs under each alternative and each different situation, we can have the outcome and these outcomes are connected with different probability then finally, you can pick up the particular outcomes which can you know address the business problem, more effectively and that too as per the particular you know requirement.

So, ultimately so this is how the complete you know structure and these are all the final outcome against each different you know options corresponding to the second node and the first node. So that means, it is a kind of conditional probability kind of environment, through which we can address the business problem more effectively. So, there are you know you know lots of probability theorem through which you know conditional probability can be applied; in this kind of situation and then predict the business environment as per the as per the particular you know management requirement.

So, so that means technically what I like to say that you know decision tree is a kind of effective tool, through which a we can analyze the business situations more effectively and that to bring with you know various outcomes corresponding to various alternatives and different strategy and then with respect to a particular criteria decision making criteria; we have to pick up a particular outcomes which can be considered as the best outcome as per the various alternative, various situations. And then that will address the business problem more accurately, more efficiently and more effectively and that to as per the management requirement. With this we will stop here.

Thank you very much. Have a nice day.