Project Management for Managers
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Lecture - 27
Decision Tree Analysis- II

Hello friends. Welcome you all in this session. As you are aware in as you know that in previous session we were solving a question by decision tree analysis.

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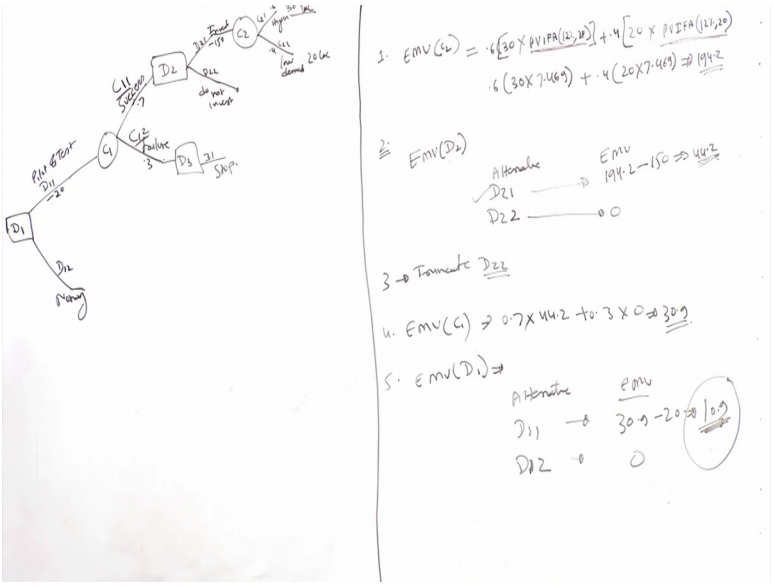

And this was the question, if we invest in a project then for pilot testing for pilot production test marketing you need to invest 20 lakh rupees. After this you need to take a decision whether if this is this step is successful then you should go for investment and the probability of successful is 0.7 the probability of failure is 0.3 right.

So, now once you are going for project then the investment would be 150 lakh otherwise you are not going for this particular investment, right. When you make investment did the probability that you would be having high demand is 0.6 and the low demand is 0.4, right. And you would be receiving 30 lakh rupees for next 20 years in case probability is high otherwise 20 lakh for next 20 years if demand is lower right. So, let us solve this particular question. Here we have to take a decision whether we should go for this particular project or not. So, first of all as I said you need to start from right hand side and you need to move towards left hand side. So, the first thing is you need to calculate

the expected monetary value. The first point is expected monetary value at point C 2 right. So, this is your first step expected monetary value here. So, what is expected monetary value? It is very simple just multiply 0.6 with this plus, one more thing in this question is that you have been given interest with that discounting factor as 12 percent. So, how to write this equation? Expected monetary value is 0.6 into 30 into 30 into what? You know discounting factor is 12 percent right. So, you need to run write present value.

This is present value let me write this 12 into 20, right. Isn't it? You need to because you are receiving 30 lakh for 20 years and this is was this is your discounting factor, right, 12 percent. So, this is this is 12 percent right, 12 percent comma 20. Now this is annuity right. So, this value you can directly write from annuity table plus, 0.4 into what 20 lakh, right. In 20 lakh into of course, similarly present value interest factor of annuities again 12 percent and for 20 years. Now you need this particular value, right and this particular value. So, how to get this value? You need to look at annuity table, right. Yeah this is the annuity table. So, rate is 12 percent.

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Present value of an annuity of ₹ 1 paid for period t at a rate $k = [1 - 1/(1 + k)^t]/k$

	Rate																			
Period	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%	16%	17%	18%	19%	20%
1	0.990	0.980	0.971	0.962	0.952	0.943	0.935	0.926	0.917	0.909	0.901	0.893	0.885	0.877	0.870	0.862	0.855	0.847	0.840	0.833
2	1.970	1.942	1.913	1.886	1.859	1.833	1.808	1.783	1.759	1.736	1.713	1.690	1.668	1.647	1.626	1.605	1.585	1.566	1.547	1.528
3	2.941	2.884	2.829	2.775	2.723	2.673	2.624	2.577	2.531	2.487	2.444	2.402	2.361	2.322	2.283	2.246	2.210	2.174	2.140	2.106
4	3.902	3.808	3.717	3.630	3.546	3.465	3.387	3.312	3.240	3.170	3.102	3.037	2.974	2.914	2.855	2.798	2.743	2.690	2.639	2.589
5	4.853	4.713	4.580	4.452	4.329	4.212	4.100	3.993	3.890	3.791	3.696	3.605	3.517	3.433	3.352	3.274	3.199	3.127	3.058	2.991
6	5.795	5.601	5.417	5.242	5.076	4.917	4.767	4.623	4.486	4.355	4.231	4.111	3.998	3.889	3.784	3.685	3.589	3.498	3.410	3.326
7	6.728	6.472	6.230	6.002	5.786	5.582	5.389	5.206	5.033	4.868	4.712	4.564	4.423	4.288	4.160	4.039	3.922	3.812	3.706	3.605
8	7.652	7.325	7.020	6.733	6.463	6.210	5.971	5.747	5.535	5.335	5.146	4.968	4.799	4.639	4.487	4.344	4.207	4.078	3.954	3.837
9	8.566	8.162	7.786	7.435	7.108	6.802	6.515	6.247	5.995	5.759	5.537	5.328	5.132	4.946	4.772	4.607	4.451	4.303	4.163	4.031
10	9.471	8.983	8.530	8.111	7.722	7.360	7.024	6.710	6.418	6.145	5.889	5.650	5.426	5.216	5.019	4.833	4.659	4.494	4.339	4.192
11	10.368	9.787	9.253	8.760	8.306	7.887	7.499	7.139	6.805	6.495	6.207	5.938	5.687	5.453	5.234	5.029	4.836	4.656	4.486	4.327
12	11.255	10.575	9.954	9.385	8.863	8.384	7.943	7.536	7.161	6.814	6.492	6.194	5.918	5.660	5.421	5.197	4.988	4.793	4.611	4.439
13	12.134	11.348	10.635	9.986	9.394	8.853	8.358	7.904	7.487	7.103	6.750	6.424	6.122	5.842	5.583	5.342	5.118	4.910	4.715	4.533
14	13.004	12.106	11.296	10.563	9.899	9.295	8.745	8.244	7.786	7.367	6.982	6.628	6.302	6.002	5.724	5.468	5.229	5.008	4.802	4.611
15	13.865	12.849	11.938	11.118	10.380	9.712	9.108	8.559	8.061	7.606	7.191	6.811	6.462	6.142	5.847	5.575	5.324	5.092	4.876	4.675
16	14.718	13.578	12.561	11.652	10.838	10.106	9.447	8.851	8.313	7.824	7.379	6.974	6.604	6.265	5.954	5.668	5.405	5.162	4.938	4.730
17	15.562	14.292	13.166	12.166	11.274	10.477	9.763	9.122	8.544	8.022	7.549	7.120	6.729	6.373	6.047	5.749	5.475	5.222	4.990	4.775
18	16.398	14.992	13.754	12.659	11.690	10.828	10.059	9.372	8.756	8.201	7.702	7.250	6.840	6.467	6.128	5.818	5.534	5.273	5.033	4.812
19	17.226	15.678	14.324	13.134	12.085	11.158	10.336	9.604	8.950	8.365	7.839	7.366	6.938	6.550	6.198	5.877	5.584	5.316	5.070	4.843
20	18.046	16.351	14.877	13.590	12.462	11.470	10.594	9.818	9.129	8.514	7.963	7.469	7.025	6.623	6.259	5.929	5.628	5.353	5.101	4.870

This one and for period 20 years right. So, this is 20 years. So, this value is 7.649 right. So, 0.6 into 30 into what is that value? 7 point from this table this values 7.469, 7.469 this plus 0.4 into 20 into 7.469, right. This will this is 194.2 right. So, this is the expected monetary value at this point, right.

Now, what is the second step here? You need to evaluate EBM expected monetary value at D 2 point, right. Now since you know D 2 you can easily calculate D 2 right. So, let us say expected monetary value at D 2 right. So, at this point there are 2 alternatives, this was the first alternative and this the second alternative right.

So, let us let us say alternative 1 and alternative 2 right. So, the first one is let us say D 21 and D 22, right. These were our alternative right. So, since you are not going for this. So, what is the expected monetary value, in second case it would be 0, right. And in this case it what it was you have already calculated it, right. Which is 194.2 minus 150, because you are investing 150 million over here right. So, expected monetary value of D 2 D 2 would be this 44.2 right. So, we have reached at this point. 44.2.

Now, the next step is should we should we go for this decision or this distance naturally will go for this is decision right. So, we will truncate this particular decision, right. So, third step we can say that we will we will truncate D 22, right. Now calculate expected monetary value at C 1 expected monetary value at C 1. How to do this? It is very simple since, you know what is the what is the expected monetary value at D 2. So, point 0.7 into 44.2 plus 0.3 into 0, right, this one 0.3 into 0. So, this is equal to, this is equal to it is 30.9, right. Now we are at this point right. So, till this point we are getting 30.9 million rupees, right. Now let us see what happens at this point.

You know that at C 2 point we were getting 194 million here you were getting one, here we were getting 44.2 million here now we are getting 30.9 hundred, this is what happens over here right. So, the fifth point is let us find out expected monetary value at D 1 right. So, again there are 2 decisions, you have got let us say alternative D 1 1 and D 1 2, right. And expected monetary values are for first for D 1 1 it is this 30.9 minus 20 it is 10.9, right. Because you are spending 20 million in pilot production and test marketing. So, whatever money you are getting here, this amount is to be subtracted from the money which you are getting from here, right. And second option is 0, right. You are not doing anything.

So, finally, what is the decision? Should you go for this project, yes you should go for this project and you will have this much expected monetary value right, this very simple example on decision tree. We will take up one more example on decision tree and then

we will move on to some other topic. So, let us look at a case with the help of this case we will be able to make a decision using decision tree analysis.

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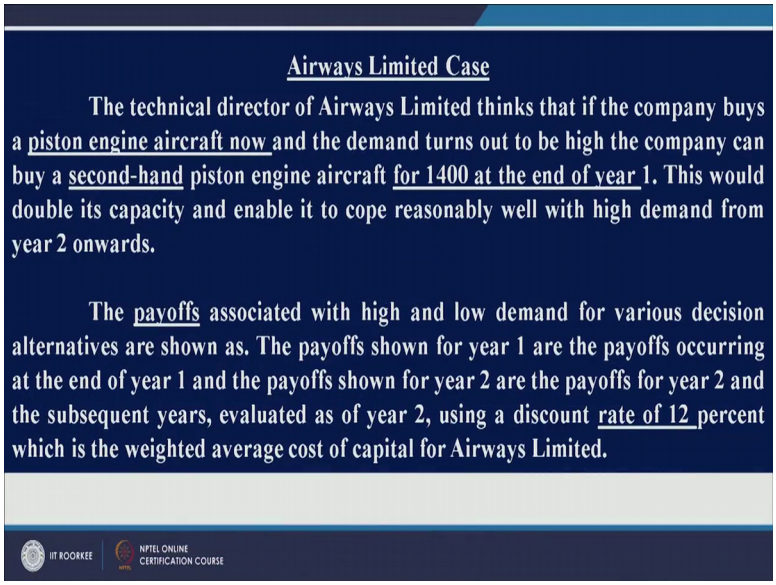

So, the case is very simple. There is an airline company which is to buy 2 types of aircraft in 30 days to take a decision, whether it should buy a piston engine aircraft or the other aircraft. The other one is turbo engine aircraft right. So, let me go through this case first.

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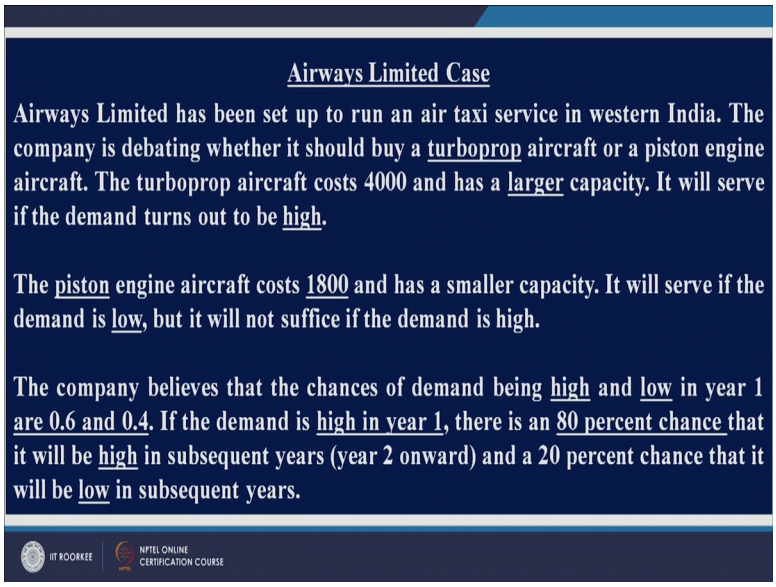

So, the technical director of airways limited things that if the company buys piston engine aircraft, which has got cost of 1800 and has smaller capacity, but there is one more aircraft which is turboprop aircraft.

Now, the cost of this aircraft is 4000 and has a larger capacity. So, when it has got a larger capacity it will serve if the demand turns out to be high, but if you go for piston engine aircraft it cannot be used for higher demand right. So, the company believes that the chances of demand being high and low in air one are 0.6 and 0.4. So, from the past data the company has concluded that the demand being high and low in year one would be 0.6 and 0.4. If the demand is high in first year there is an 80 percent chance that it will be high in subsequent years as well. And 20 percent chance that it would be low in subsequent year's right.

The technical director of the aircraft company things that if the company buys a piston engine aircraft now, and if the demand turns out to be high. Then they may go for second hand piston engine aircraft at the rate of rupees 1400 at the end of first year, right. This would double it is capacity because they are going for second hand piston engine aircraft, and unable to cope reasonably well with high demand from second year onwards. Now apart from this information the payoffs associated with high and low demand for various decision alternatives are shown in the tree diagram which I would be drawing. The payoffs shown for first year are the payoffs occurring at the end of first year. And the payoff shown for the second year are the playoffs for year 2 and the subsequent years. Evaluated as year of as of year 2 using a discount rate of 12 percent which is the weighted average cost of capital for airways limited, we have to take a decision what type of aircraft the company should buy, right. Should they go for turbo type or piston engine type right.

So, before I start solving this question let us look at what are the other payoffs available with this particular question. So, we have to take a decision whether should we go for turbo probe type aircraft or piston engine type aircraft, right.

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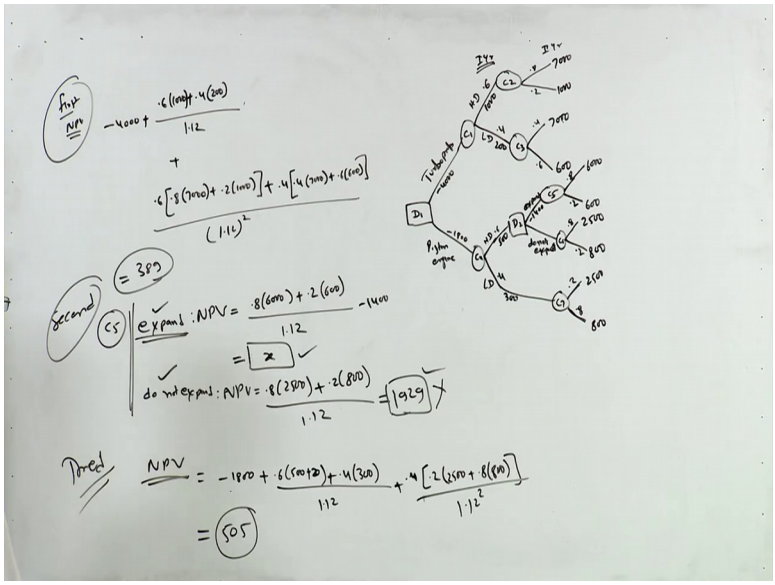

So, here we have to take decision, right. So, you can go for turbo turboprop, turboprop or you can go for piston engine, piston engine. When you go for this turboprop what is the outflow it is minus 4000, right. And for this piston in engine it is minus 1800, right. Now here this is your point C 1 and this is another point. Let us call it C 4 in fact, first will branch this particular point.

So, when you go for turboprop if the demand is high, then it is probability is 0.6 and the amount which you would be getting is 1000 rupees. So, this is high demand HD, let me write it like this is low demand, right. And it is probability is 0.4 and the money which you are getting is 200 rupees, right. Now this is for first year, this is for first year, right. Now what happens in second year? Now this is C 2 point, this is C 3 point. Now in second year what is happening this is second year. So, you can have 2 options here in second year we have been given that the demand would be high is 80 percent and it would be low is 20 percent, right. And this is the payoff for second year when demand is high and this the payoff for second year and demand is 20 percent, right.

Now, if you look at C 3 point, the demand is high again 0.4 low 0.6 and the payoffs are is 7000 and this is 600. So, this is this the decision tree for first option these are different you know, branches. Now when you look at the piston engine, then if the demand is high which is 0.6 high demand HD is 0.6, right. Low demand LD, I am writing it like this. So, this is 0.4. Now when demand is high this is yours payoff. Now we have to as I said in

the beginning we have to take a decision. Should we go for turboprop or piston engine type.

If you are going for turboprop you would be taking decision at the beginning. And no further decisions would be taken. But if you are going for piston engine then let us say if demand turns out to be very high in second year then you need to buy a secondhand piston in engine aircraft right. So, this is a point which to be noted in this case right. So, this is D 2 point here we have to take a decision, right. And this decision would be taken whether it should be expand it or we should not expand it right. So, when we go for expansion. So, this is expansion expand and this is do not expand, right. Do not expand, right. This do not expand.

Now, this is C 5 in C 5 if the demand is high again this is high demand. So, this is 0.8 and 0.2 and the payoffs are this 6000 and this is 600. If you do not expand then this is 0.6 you can have again high demand which is 0.8 and 0.2, right. And the payoffs are 2500 and 800. And if the demand is, if the demand is low then this is just one more node over here. So, high demand 0.2 low demand 0.8. In fact, it is not necessary that high demand will always have higher probability right. So, the probability that the demand would be highest point to and demand would be low is 0.8, right. And these are different payoffs.

So, this is your decision tree for this particular example. And payoff for this is 300 when you go for expansion you need to incur this much money, right. Now we will calculate NPVs of different options. So, let us first calculate NPV for this option, for turboprop engine type of aircraft, right. And this is as I said this is the very first decision you to make. No further decisions would be required in this case. So, the NPV for this case is, you can easily calculate. So NPV so, the first one is NPV for turboprop is, you know this is your outflow. So, this minus 4000 plus. In the first year the demand is high. So, this is your payoff demand is low this your payoff right. So, 0.6 into 1000 plus 0.4 into 200 divided by it is 1.12, right. Which is your discounting rate, right?

Now, when you go for second year, you need to incorporate these values in calculation. So, this plus or let me write it here because we do not have sufficient space this side. So, minus this plus this now plus 0.6 into 0.8 700, it is 7000 plus 0.2 into 1000 plus 0.4. In fact, what we have done here is 0.8 into 7000 0.2 into 1000 and multiplied by 0.6, right. Similarly for this portion also right. So, this 0.4 into this 0.6 into this multiplied by 0.4

right. So, this is 0.4 into 7000 plus 0.6 into 600 is divided by 1.12 square right. So, when you solve this particular equation you will get NPV is equal to 389.

So, if you go for this particular type of buying if you buy this particular type of aircraft this would be your NPV, right. Now let us look at this particular option, piston engine option. Now if you look at, and as I have already said in piston engine option you have to take one more decision after one year right. So, let us take first let us calculate NPV for piston engine. So, NPV for piston engine first for expansion decision and for do not expansion decision. So, for C 5 node and which is expand we will expand our capacity and the NPV is, NPV is 0.8 into 6000 plus 0.2 into 600 divided by 1.12. And what is our out outflow it is minus 1400 right. So, NPV is 2993. If you go for do not expand option let us calculate what is NPV.

So, we will go for do not expand option NPV, NPV is equal to 0.8 into 2500, right. This into this plus this into this plus 0.2 into 800, right. Divided by 1.12 this is 1929. So, out of these 2 NPVS if you look at these 2 NPVS, you will certainly not go for this option, isn't it? Because this one is smaller than this. So, what we have decided here that will expand our capacity, right. And when we go for expansion of our capacity this is our NPV available with us, right. 2993. Now let us look at let us look at this option, right. Low demand option let us look at this option and find out what is the NPV. So, NPV now is. So, we are calculating third time NPV, this was the first time, right. This is our second time, second time NPV calculated for these 2 options, right. Expand and do not expand and third time we are calculating now, right.

So, the NPV would be now since we are going for piston engine this is our outflow. So, this minus, minus 1800 plus 0.6 into 500 plus 299, 2923 this is this is 2923, let me check it once again, 2993. In fact, you need to check this value. So, for the time being let me keep it x, right. Now whatever is this value you just put it here. Plus 0.4 into 300 divided by this portion is to be divided by 1.12, plus 0.4 into, plus 0.4 into 0.2 into 2500 plus 0.8 into 800 1.12 whole square. Now when you solve this particular equation it becomes 505. Now out of these 2 options should we go for turboprop type aircraft or should we go for piston engine type aircraft, we will definitely go for piston type aircraft because NPV here is 505. So, this how you can solve a question using decision tree analysis. So, with this I complete this particular question we will continue with next point in this particular session.

Thank you very much.