Project Management for Managers
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Lecture - 23
Stand-Alone Risk Analysis- II

Good morning everyone. I welcome you all in another session of Project Management for Managers course. The topic which we have been studying is risk analysis for standalone project. And we have seen several methods like sensitivity analysis, scenario analysis, and breakeven point.

Let us look at one more analysis it is called simulation analysis. So, as I said in my earlier lecture that sensitivity analysis will give you how output will change by change in one variable, but it does not give you the probability of that change. And the managers and decision makers are interested in knowing what would be the probability of that change and that can be calculated using simulation analysis right.

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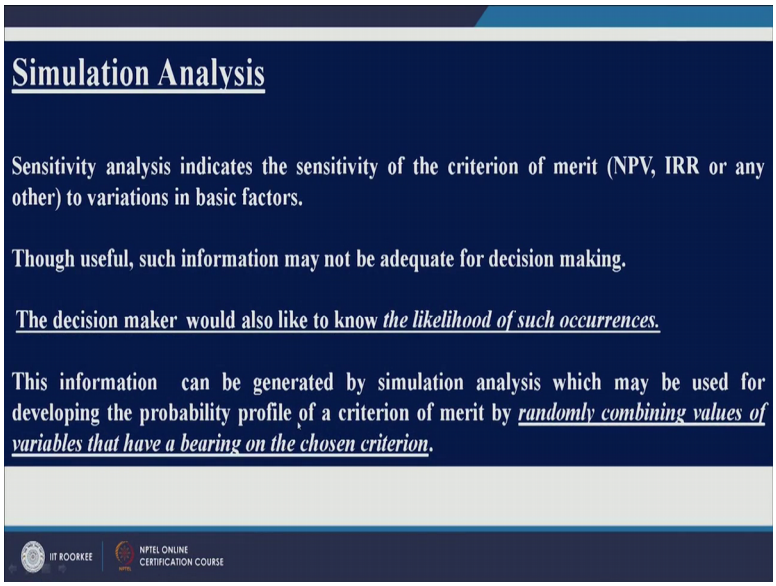

So, in this information means the information about likelihood of happening a particular change can be generated by simulation analysis which may be used for developing probability profile of a criterion of merit by randomly combining values of variables that have bearing on chosen criterion right. So, let us not discuss this analysis in detail, but we will we will move on to hillier model of risk calculation and before I go for hilliers

model let me remind you that what is risk, risk is the probability of happening an event and it is consequences, right? So, that is risk.

So, if you if you look at probability distributions then basically there are 2 types of probability distribution.

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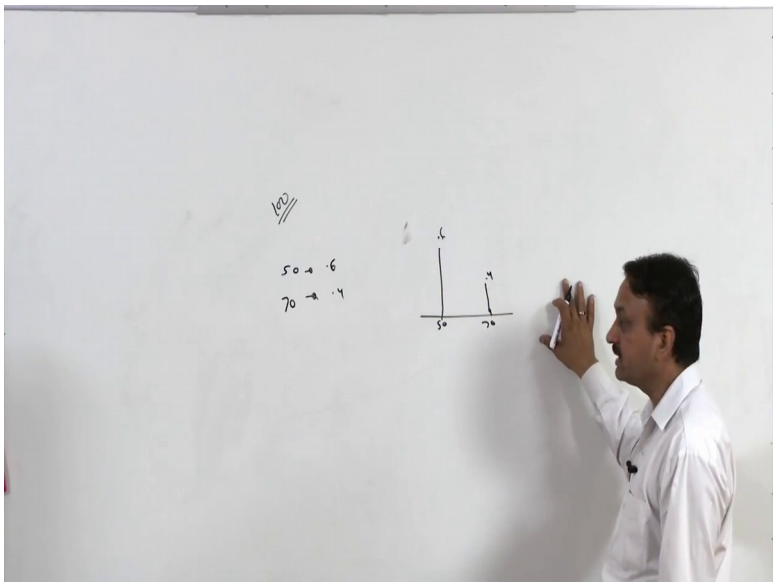

So, you should know what is probability distribution first of all, right? I will give you an example, let us say if I can test an election then I will get 50 votes let us say total electorates are 100 right. I will get vote of 50 people it is probability is 0.6, right? I will get vote of 70 percent start 70 people it is probability is 0.4 right. So, I can draw a probability distribution like this right; so 50 and 70. So, this let us say this is 0.6 and this is 0.4. So, this is nothing, but a kind of this is nothing, but probability distribution.

So, you can have different probabilities over here, but the sum of the probabilities should be one right. So, this is probability distribution. So, you can have 2 types of probability distributions you can have discrete probability distribution and continuous probability distribution. And there are several discrete probability distributions for example, let us say binomial distribution is basically a discrete probability distribution, you have got poison distribution and if you if you talk about continuous distribution then normal distribution is a continuous distribution.

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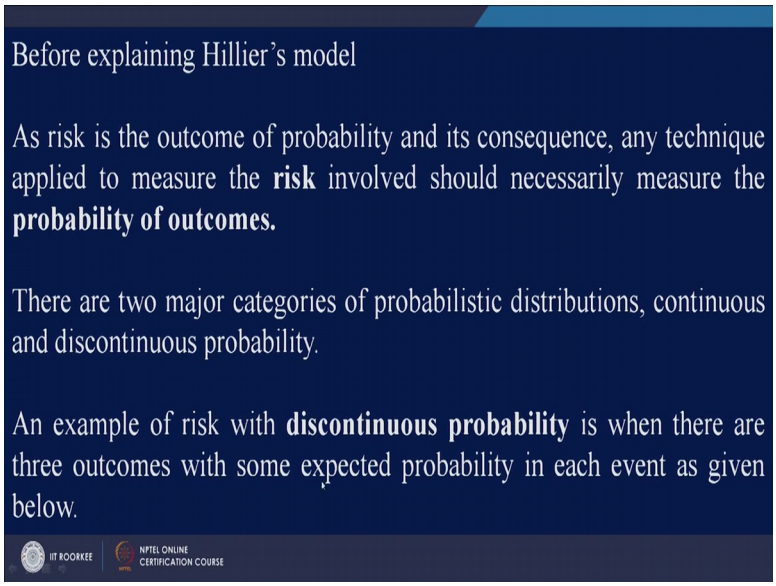

So, let us look at an example of risk with discontinuous probability or discrete probabilities. When there are 3 outcomes with some expected probabilities in each event has given in next slide, right?

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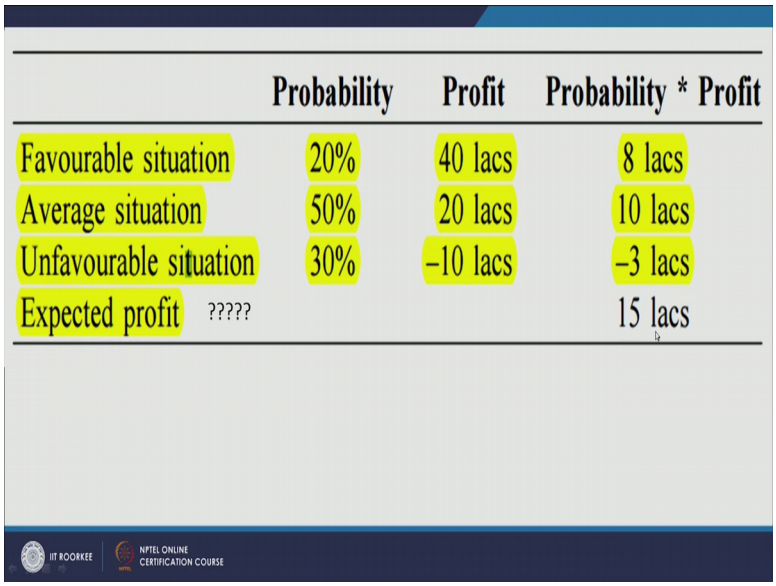

So, we have to calculate total profit or expected profit right. So, here again 3 scenarios have been taken. So, when situation is favourable profit from a project is 40 lakh rupees, right? And it is probability is 20 percent, average situation profit would be less than 40 lakh and in this case it is 20 lakh, right? And an unfavorable situation profit rupee is. In

fact, there is no profit; so loss of 10 lakh rupees, right? And probability is 30 percent right.

So, expected profit would be very simple, right? You just multiply these 3 values. So, 0.2 into 40, 8 lakh 0.5 into 20 it is 10 lakh; so 8 plus 10, 18 minus 3.

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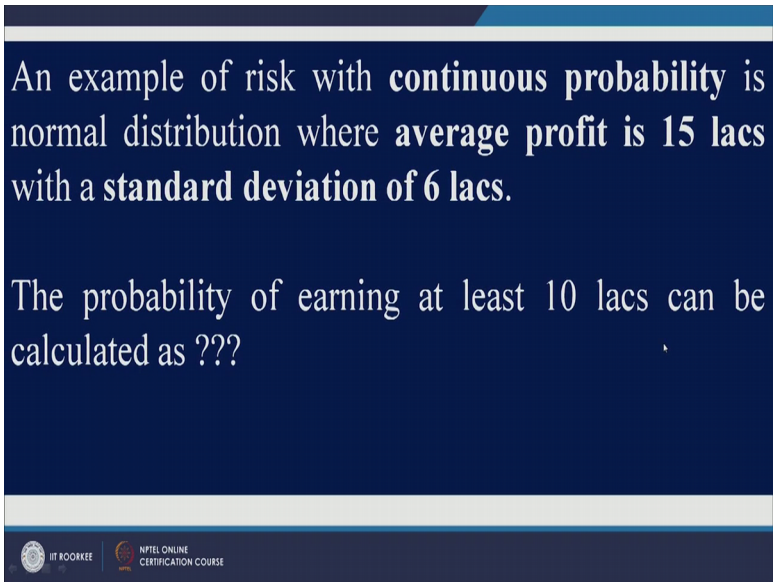

So, expected profit would be 15 lakh right. So, this is kind of a discrete probability distribution right. So, this is your expected profit, right? Now let us take an example of risk with continuous probability and a continuous probability distribution like normal distribution, generally we represent normal distribution through mean And standard deviation.

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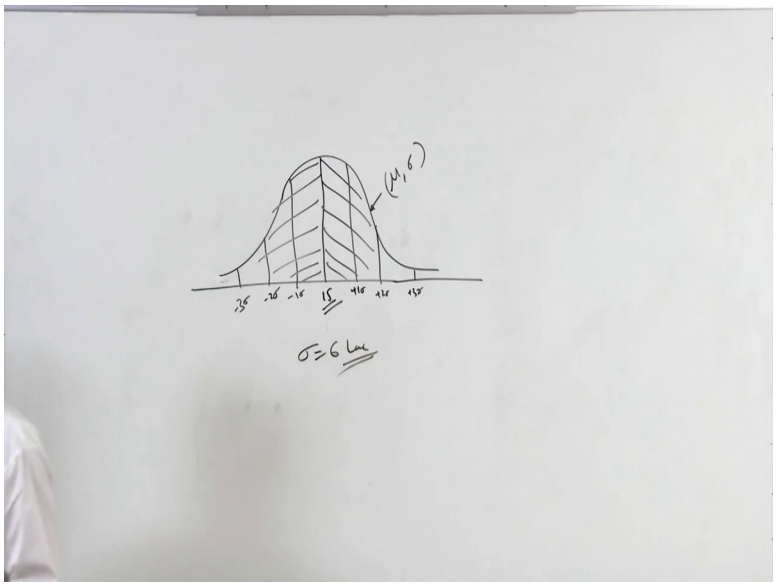

So, this is mean and standard deviation, right? This is how we represent our normal distribution. So, mean is this, right? This is your mean and you will have different limit is here let us say this is go in sigma limit right. So, plus 1 sigma, plus 2 sigma and plus 3 sigma, right? This is minus 1 sigma, minus 2 sigma and minus 3 sigma right.

So, area under this normal curve is unity that is one, right? In other words we can say that this area is 50 percent, in this area is 50 percent right. So, just keep in mind this point and then we will solve our question right. So, an example of risk with continuous probability is normal normally distributed where average is average profit is 15 lakh with standard deviation of 6 lakh right. So, mean is 15, right? In this case 15 lakh and standard deviation is 6 lakh right.

What is the probability of earning at least 10 lakh can be calculated or you have to calculate what would be the probability of earning at least 10 lakh rupees profit from this particular project right. So, how to solve this question? So, this is mean 15 lakh and standard deviation is 6 lakh, right? What we have to calculate? What is the probability the probability of earning; at least 10 lakh rupees.

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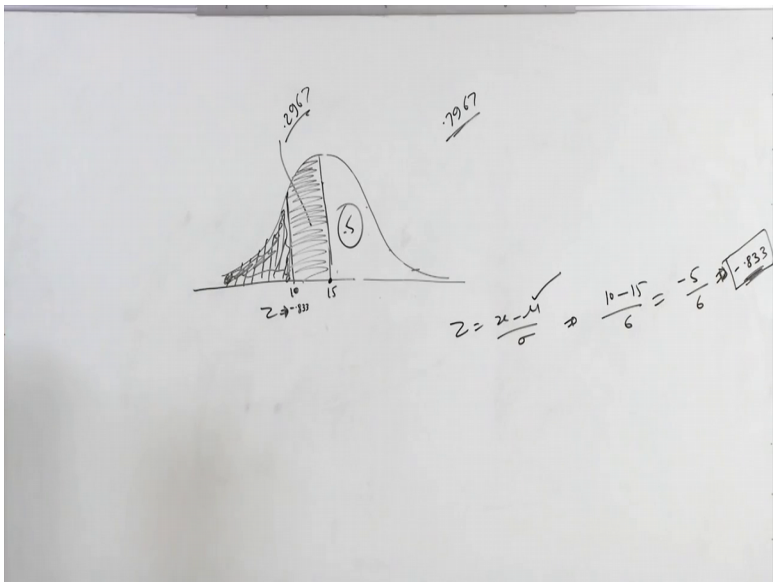

So, 10 lakh would be somewhere here; this 10 lakh right. So, we want to calculate area under this shaded portion, right? And we also know that this particular area this particular area this particular area is point 5, right? And this is point five. So, how to find out this particular area this one for this you need to use z table, right? And this is z table.

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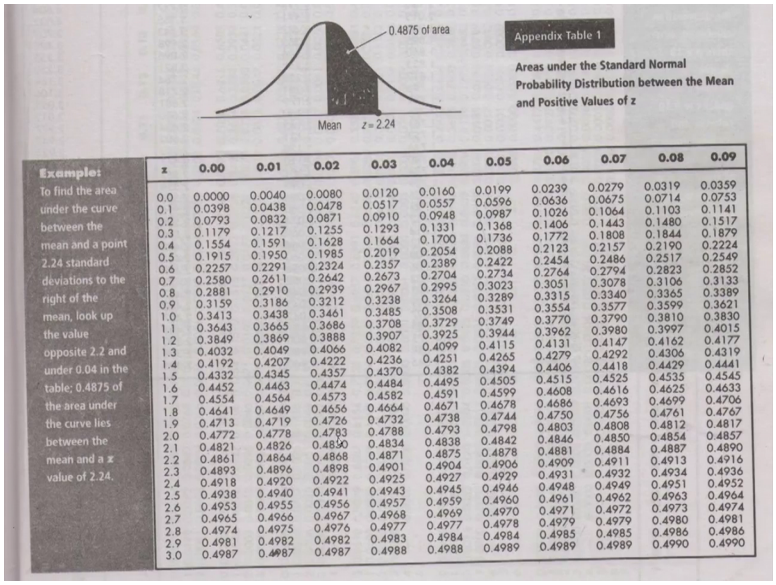

z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990

Now, if you look at this particular table this point is mean, right? And this point is 2.24. So, z value is 2.24 and area from mean to z equal to 2.4, 2.24 is 0.4875, right? This point clear, let me repeat. This is your mean value and let us says a z values 2.24. So, area

under curve would be 0.4875, how did how did you get this 0.4875? 2.24. So, look at z value of 2 first this is 2, right? Then 2.24, right? This is 2.2 this is 0.4783 the next one is 2.3, 2.3 is this. 2.3 is 0.4871, right? And 2.24 is this one, 2.24 this one right. So, 0.4875 is written here in this table, right?

You need to look at this value very carefully right. So, if I ask you what is this area the remaining one? You just subtract this area from 0.5 right. So, let us calculate z value first z is nothing, but standardized, standardized normal distribution right. So, how to calculate z for this? This question z is equal to z is equal to x minus mu divided by standard deviation right. So, here x is nothing, but this 10 lakh value, right? Mu is 15, right? Sigma is 6. So, this is 10 minus 15 divided by 6; so this minus 5 by 6 right. So, minus 5 by 6 is what minus 5 by 6 you just calculate. So, this is let us say 0.8 minus 0.83 is not it; so minus 0.833.

Now, let us look at what is the area under curve when z is minus 0.833 right. So, this in other words this is your z value, right? It is minus 0.833, right is not it? So, we have converted this value into z value, right? Let us look at what is z value. So, when z is 0.83. So, 0.8?; is this and 0.81, 0.82, 0.82, 0.83. So, this is 0.2976. So, this is 0.5 this side of the curve is 0.5, this side of the curve is 0.5, we want to know what is the area from here to here, right? And read this area is what is what we have calculated from table, what we have said it is 0.83, right? It is 0.2967. So, this area is 0.2967, right? Let me put it like this, this area is 0.2967. What you want to calculate? We want to know what this area, right is this area.

So, how to do that? It is very simple, right, we know this we know that the area under curve is 1 minus 0.5, 0.5 plus 0.29. So, this becomes point, point, 0.7967 right. So, this area is 0.967. So, the probability that the project will earn less than 10 lakh rupees is this no it is 1 minus, it is 1 minus this and probability that it will make more than 10 lakh rupees is 0.7967. So, this is how you can solve this question right. So, this 0.7967 is the answer right. So, at least less than 10 lakh rupees it is probability is this one and more than that is 0.7967. So, this is how you can solve a question very easily right.

Now, let us look at hilliers model of risk calculation. Now this is very simple model first of all, the plus point of this model is it can be used for both continuous distributions as

well as for discrete distribution. We need to convert first of all the given values and probabilities we will find NPV and then standardized NPV right.

So, let us look at this question; very important question. A project with initial investment of 100 lakh with the life span of 4 years has the following probabilistic out comes in different years right.

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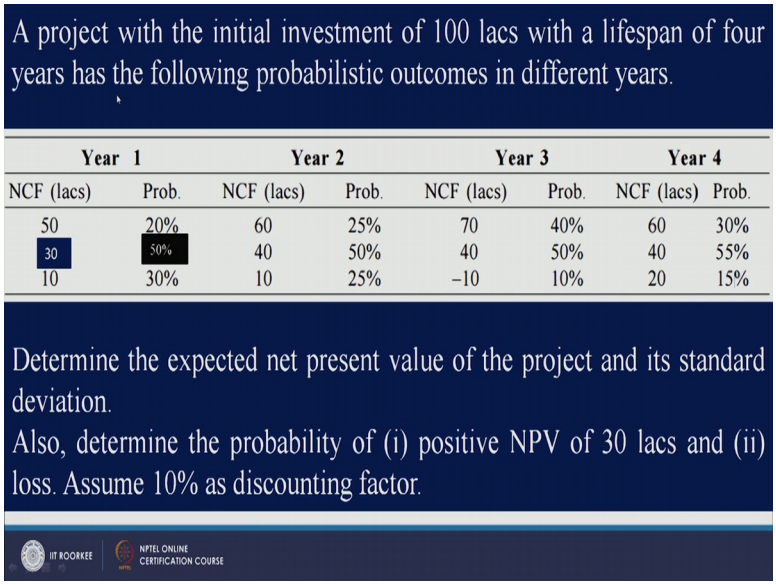

So, this is our question. What we have to find out? Determine the expected net present value of the project and it is standard deviation. 2 things we need to calculate first, then in second part of the question determine the probability of positive NPV of 30 lakh and what is the probability of project going in loss, right? Assume 10 percent as discounting factor right. So, this the question which we will be solving.

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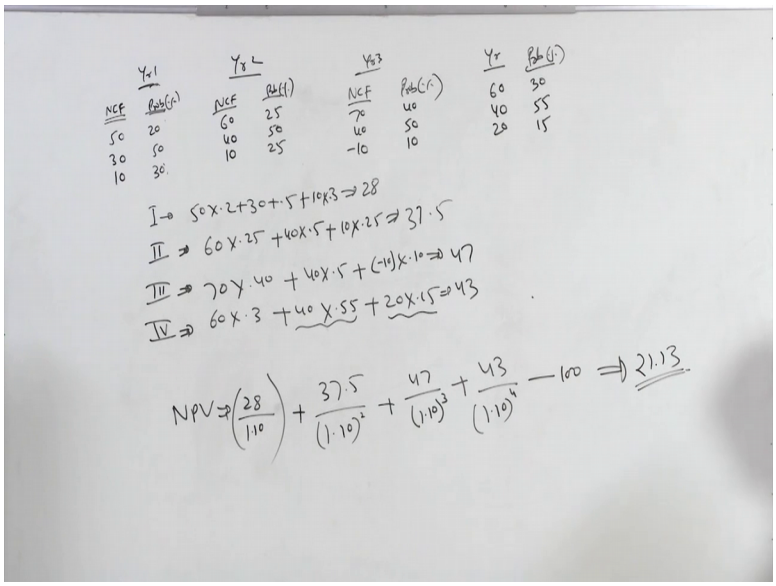

So, let us look at first year 1 net cash flow is given n c f net cash flow 50 lakh, 30 lakh and 10 lakh. Probability of achieving this much cash flow is 0.2 or 20 percent 50 percent and 30 percent. Just keep in mind that this total is 100 percent, right? This for first year, right? For second year you have got net cash flow as 60, 40 and 10. 60 40 and 10 and probabilities are 25 probabilities are 25, 50 and again 20 right. So, this is in terms of percentage; so probability in terms of percentage. Third year net cash flow probability in terms of percentage it is 70, 40 and minus 10. 70, 40 and minus 10. And probabilities are 40, 50 and 10. 40, 50 and 10, right? And for fourth year this is 60 40 and 20 and probabilities are again in terms of percentage you have got 30 and 55 and 50, 30 55 and 15. So, this total is again 100.

So, what is the question determine the expected net present value of the project and it is standard deviation right. So, how to determine expected net present value of the project in first year? What you should do? 50 into 0.20 plus 30 into 0.5 then 10 in to 0.3; so this how you can calculate NPV. So, let us let us do it. So, in first year in first year is 50 into 0.2 plus 30 in to 0.5 plus 10 into 0.3, this is equal to what? This is 10 lakh, 15 lakh 25 lakh, plus 3, 28 lakh right.

Similarly, second year 60 into 0.25 plus 40 into 0.5 plus 10 into 0.25 what this value would be? So, this is 15 lakh this is 20 lakh 35 and this is 2.5, 32.5 lakh, right? It is it is it is 32.5 just check this is this is 15 this is 20, 35 plus 2.5 it is 37.5, right? For third one it

is 70 into 0.4 plus 40 into 0.5 plus minus 10 into 0.10 right. So, this is 28 lakh plus 20 48 minus 1 it is 47. So, for third year it is 47 lakh, right? For fourth year what this would be it is 60 into 0.3 plus 40 into 0.55 plus 20 in to 0.15. So, this is 18 lakh, 18 lakh and this you need to calculate and this is 3 lakh right. So, this total would be I will give you answer this 43 lakh right. So this is how you can calculate NPV of each of those 4 years.

Now, we need to calculate NPV because we have been given discounting factor of 10 percent right. So, what you should do it is 28 you need to discount this value, right? And discounting factor is 10 percent right. So, 1.10, 28 divided by 1.10 plus 30 7 0.5 divided by 1.10 square of this, right? This is what we have seen when we calculated discounted payback period method, right? The next one would be 47 divided by 1.10 cube, then you have got 43 divided by 1.10 to the power 4 right. So, this is your NPV. And of course, since your initial investment is 100 lakh right. So, minus 100 you will get NPV and this value you can calculate it may give this value is 21.13.

So, now let us calculate standard deviation of each of those 4 years. Before calculating standard deviation let me summaries what we did in this session. We have seen how to find out first of all we have seen simulation analysis. We use simulation analysis in highly uncertain situation and it gives us probability values of occurrence of an event, right? Then we have seen hillier hillers models and we have also seen how to calculate probability at a particular the we have also seen what is the area under curve at a given z value.

And in normal distribution the center point is mean and it is distribution be represented it by standard deviation. And keep in mind that the each side because it is it is it is a symmetric curve right. So, and the area under curve is 1. So, area under one half is 50 percent and other half it is 50 percent. So, we have seen how to calculate probability when z value is given and what is z? Z is standardized normal distribution. And how to calculate z value; it is x minus mu divided by standard deviation.

So, let us, I do not think we have sufficient time to calculate variance for all the projects. Anyway let us try to understand; what is the variance for first year.

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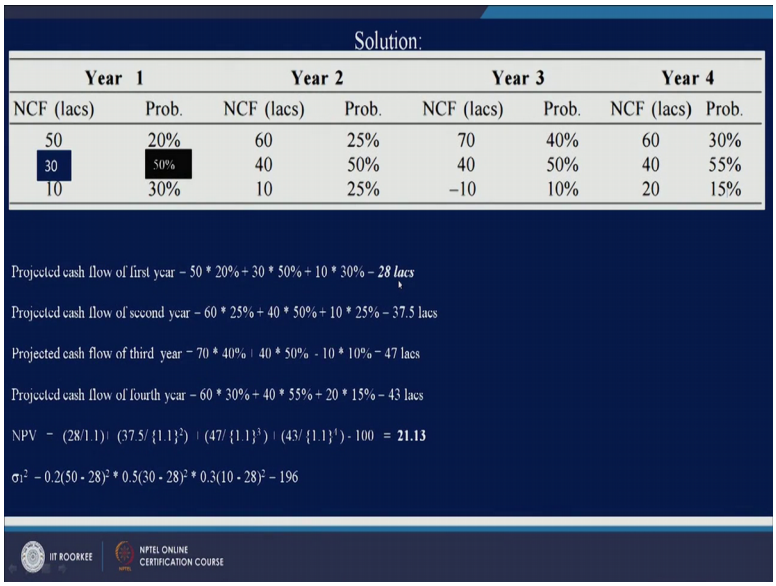

So, this is probability 0.2 multiplied by 50 into NPV of first year, right? Then probability 0.5 this one multiplied by what it is multiplied by 30, right? Minus projected cash flow of second year, right? Similarly for first year and third value it is 0.3 into net cash flow minus projected cash flow, 28 whole square. So, you will get one ninety 6 in similar way you can calculate sigma 2 square, sigma 3 square, sigma 4 square, right? And after calculating all those variances these are nothing, but variances, right? We should calculate the z value because we want to know what would be the NPV what a what is positive NPV of 30 lakh.

So, we need to calculate that probability. So, you need to calculate z value for this and one more time you will have to calculate z value for this one, right? Once z values are obtained look at area under the curve and find out what is exact probability.

So, we will do that thing in next session. Thank you very much for watching this particular lecture.

Thank you.