Financial Management for Managers
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Lecture 22
Capital Budgeting Part 6

Welcome all. So, we are in the process of learning about the internal rate of return and till the previous class discussion. We could discussed that, yes, internal rate of return can be calculated by say discounting the cash flows against a certain rate which can be calculated with the help of a trial and error method.

And we were talking about this particular say situation that in this case we have the inflows and outflows and when we are discounting it under the different rates means we tried first 20 percent, then we tried 24 percent, still the NPV is not coming down to 0 and when we increased it straight away from 24 percent to 28 percent then the NPV became negative. So, it means the idea we could get here is that the internal rate of return in this case is somewhere between 24 percent and 28 percent.

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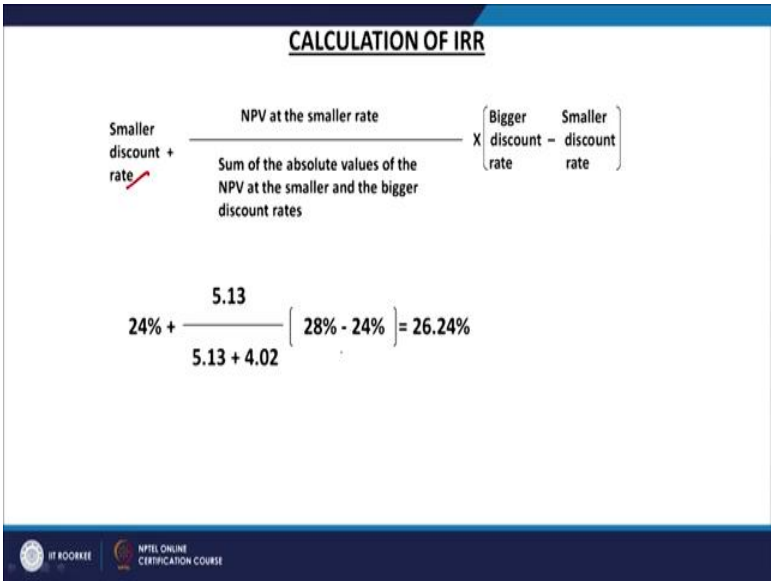

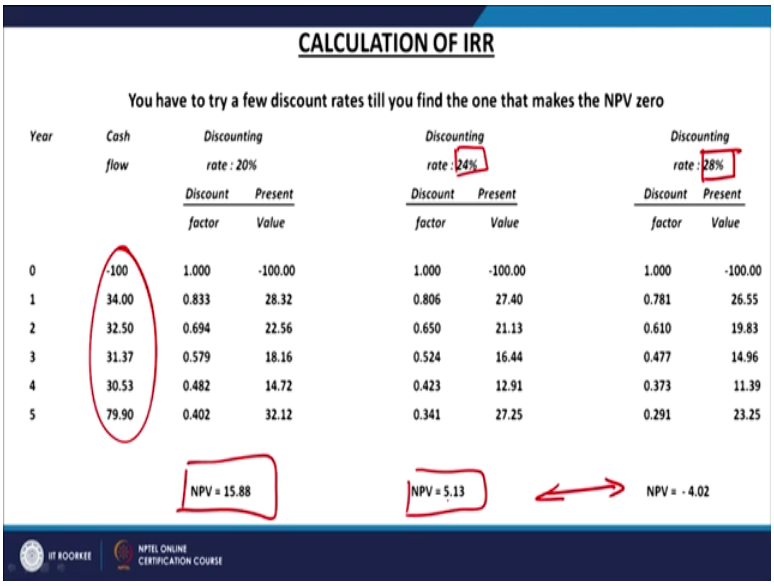

Now, how to calculate the exact rate that was the question we left the discussion in the previous class. And here it is the process for calculating the internal rate of return which is the exact rate if it is between the two rates. Because it is very common that any rate of interest cannot be certainly absolute rate that 12 percent or 13 percent or maybe 15 percent. It sometime say, something like that 12.37 percent, it can be sometime 12.54 percent or it can be 14.13 percent.

So, it is possible that because we are not talking about anything which is decided in advance that internal rate of return depends upon the cash inflows available from a particular project comparing those inflows with the outflows, so when you compare the inflows with the outflows and vice versa you can come out with any rate and that rate does not mean to be in the absolute value all the times, it can be somewhere in the fractions also.

So, when you are talking about this if we have seen 24 and 28 we have found out here is that now the formula is given to us, what is the formula, smaller discount rate, smaller discount rate in this case is what? That is 24 percent where the NPV is 5.13 it is not 0, but it is more than 1. So, smaller discount rate plus NPV at the smaller rate, NPV at the smaller rate is 5.13 and divided by the sum of the absolute values, sum of the absolute values of the NPV at the smaller and the bigger discount rates.

So, sum of the NPV, so what was NPV there? You have to simply forget the sign, the sign was there was minus 4.02, the sign there was minus 4.02. So, you have to forget this sign, this sign is

negative sign that we are getting the negative NPV minus 4.02, so you have to forget that while summing it up.

So, in this case, we are finding out the NPV at the smaller rate plus sum of the NPV at the two rates, you can call it as smaller and the bigger rate. So, at the smaller rate it is 5.13, at the bigger rate 4.02, it was minus 4.02, but simply forget this sign, multiply it by the bigger discount rate minus the say smaller discount rate.

So, what is a bigger discount rate? 28 percent, smaller is 24 percent. When you solve this entire process, so this becomes total this comes out as 5., first of all you calculate the ratio of the smaller value to the sum of the two and then you multiply by this and then you will get something.

For example, in this case what we have got here is? We have got here is 24 plus 2.24, we have got is 2.24. If you solve this, if you first of all calculate this ratio and multiply then by 4 that ratio multiplying with the help of that ratio the difference of these two and that comes up as the 4 percent. So, the value must have come up as 2.24.

So, it means the total interest rate which comes up here as this 26.24 percent, if you use the 26.24 percent for discounting of all these cash inflows here cash inflows and say comparing it with the present values of the cash outflow NPV will certainly be 0, you can apply the check also. So, if we apply the check and we use the 26.24 percent as the interest rate certainly the NPV will become 0.

So, now I will discuss here with how this entire process works, it is in a very summarized form given here, but we will do a problem and then we will try to learn that how this say discount rate can be calculated in a situation particularly when the exact internal rate of return lies between the two absolute values say discount rates, if it is to be in the fractions how to calculate that.

So, what we are doing here is, for example, there is a project and it has the foreseeable life of 4 years, so we make investment in the say 0 year in the current period which is 0 and say 4 inflows are available first at the end of the first year, second at the end of the second year, third at the end of the third year, forth at the end of the fourth year. So, if you have the 1 outflow and 4 inflows

and if we have to find out the internal rate of return, we do not know the cost of capital at what we should discount them so that the NPV becomes 0.

So, if we have to find out the internal rate of return from that kind of the inflows and comparing them with outflows how to do this process and if particularly the discount rate falls between the two absolute values then how to calculate it in the exact in terms of the say, absolute plus from fractions.

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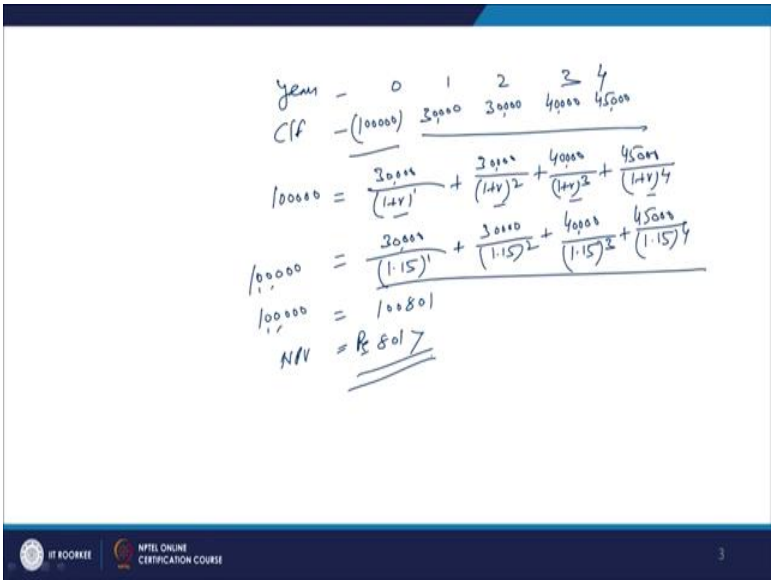

So, we are taking here is as the in this case for example we take here is as years and then we take here is as the cash flow. So, years are 0, 1, 2, then it is 3 and then it is 4 these are the 4 years and cash flow when we take here is as in the 0 year the cash flow, out flow is going to be 1 lakh rupees that is 100,000 I am putting in the bracket because it is negative.

So, in the first year, at the end of the first year we are getting back how much? 30,000 rupees, in the end of second year also we are getting back 30,000 rupees, then we are getting here as the on the third year we are getting 40,000 rupees and then we are getting here as back as 45,000 rupees. So, this is the out flow and these four are the inflows available.

Now, making these two equal to each other in terms of the present value if you want to make them equal to one in the present value. So, it means how we can do that, for doing it we have to

now discount it against a certain rate and for discounting against a certain rate we will have to now find out that discount rate.

So, how can you do it? So, normally the formula here is we are going to find out the norm, formula is for discounting this is the putting the cash out flow on this side. This is rupees 1 lakh has to be equal to how much? This is the first in flow, this is 30,000 and it has to be discounted against something which is known as 1 plus r because it is only 1 year.

So, it is only you can call it as, put it as a 1 also but sometime we not put anything which means 1, then second is plus 30,000 second year and here again we have to discount it against this 1 plus r power 2 because it is for the 2 years period. Discounting is for the 2 years period of time. Then in this case you have to is 40,000 and you have to discount it 1 plus r power 3 and then it is 45,000 and discount it with the something which is known as 1 plus r power 4. So, you have to now discount it against a certain discount rate which is r this is not r is not known to us, r is not known to us.

So, now we will be doing it, we will start doing it, if you start doing it, for example, we assume this r is say in this case if you take the r you can take it as 10 percent, 15 percent, 16 percent or anything. Let us take it here is as the 15 percent. So, if you take it as 15 percent so what will you do is 30,000 divided by 1.15 power 1.

And in the second case it is 30,000 we have to take this as 30,000 and divided by 1.15 power 2 this is one. I think this has become something else. So, you may not misread it. So, I will make it again 1 so this is 1.15 power 1 then this is 1.15 power 2 30,000 plus, 40,000 divided by 1.15 power 3 and then plus 45,000 divided by 1.15 power 4.

And we have to now calculate make it equal to this the discounted value of this equal to 1 lakh rupees or the 100,000 rupees. So, if you say, discount these cash flows so this will become 100,000 is equal to a 100,801. This value of all these total calculation if you do it this value becomes 100,801 rupees.

So, if you calculate the NPV what will be the NPV here? If you calculate the NPV, NPV will be rupees 801 which is greater than 0, in this case it means NPV is positive greater than 0 it means

this discount rate of the 15 percent will not do, you have to, now what you have to do is. Since because the NPV is positive it is 801 it is positive not 0 it is more than 1.

So, in this case what we have to do is we have to now to reduce the NPV value from 801 to 0 we have to increase the discount rate and if you increase the discount rate maximum what can you do is? You can make it something you increase it by 1 percent and if you increase it by 1 percent it will become say for example 16 percent.

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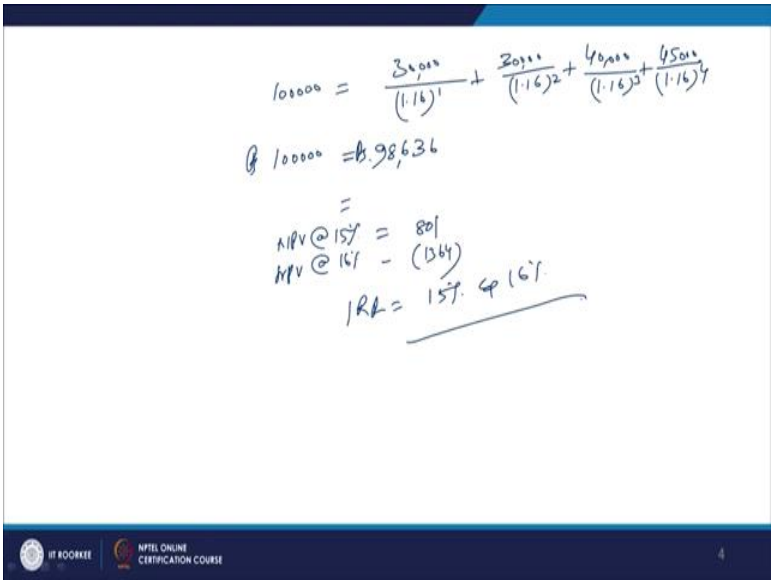

So, what it will become like? 1 lakh is equal to first year cash inflow is how much? 30,000, so you discount it against 1.16 power 1. Second is 30,000, then it is divided by 1.16 power 2, then plus 40,000 divided by 1.16 power 3 and then it is 45,000 and divided by 1.16 power 4. We have increased the discount rate and once you calculate it this become something like 1 lakh is the out flow this is equal to 1 lakh and this value comes up as 98,636 rupees.

This is rupees 1 lakh is the investment and it is rupees 98,636 is the discounted value of all the cash inflows, when they are discounted at the rate of 16 percent. So, it means now there is a gap when you calculate this so you can say NPV at 15 percent is how much? That is 801 and NPV at 16 percent is how much? That is minus 13 this is this minus this is how much it comes up as?

This comes up as 1364, this is negative, one is positive, one is negative it means the internal rate of return from this project is IRR in somewhere it is 15 percent and 16 percent but exact we have

to find out our job is to find out the exact discount rate and that has to be say somewhere between 15 and 16 percent and we have to find out this. Now, how can we find out this we have a process for this.

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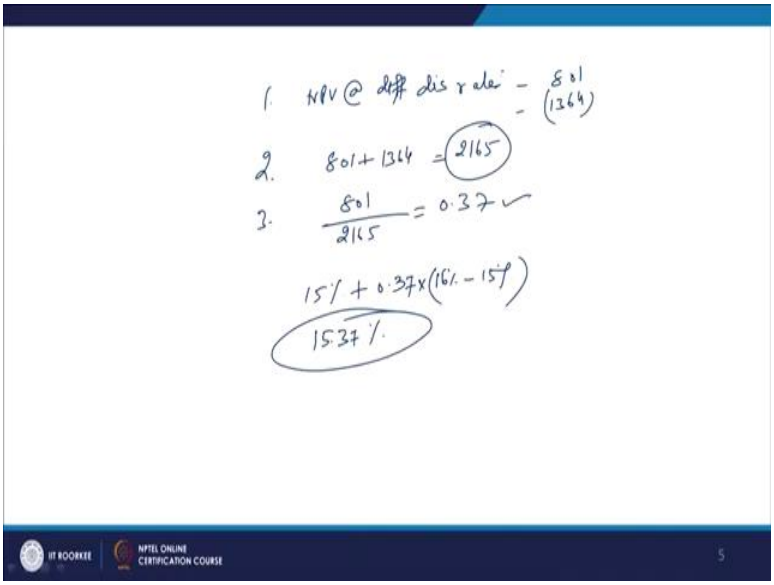

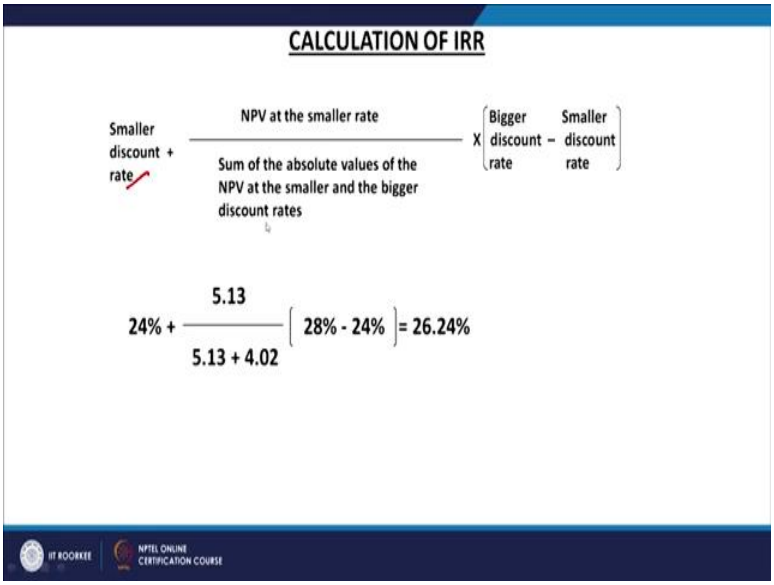

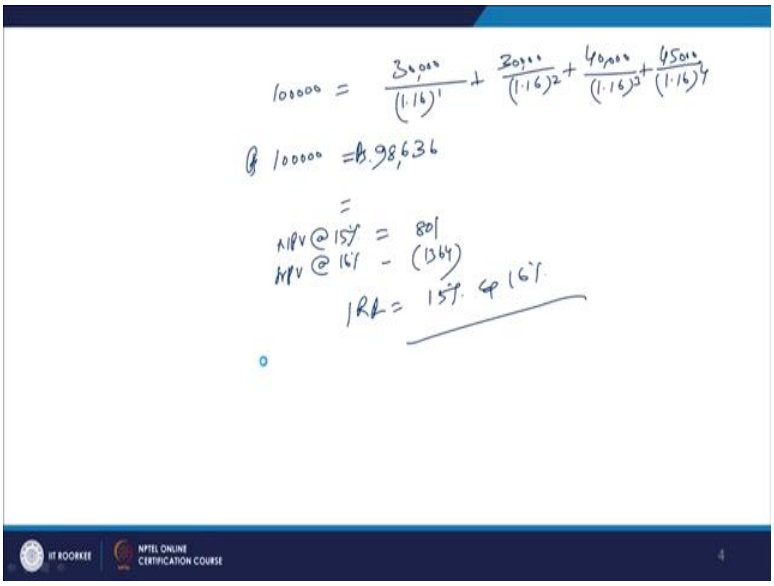

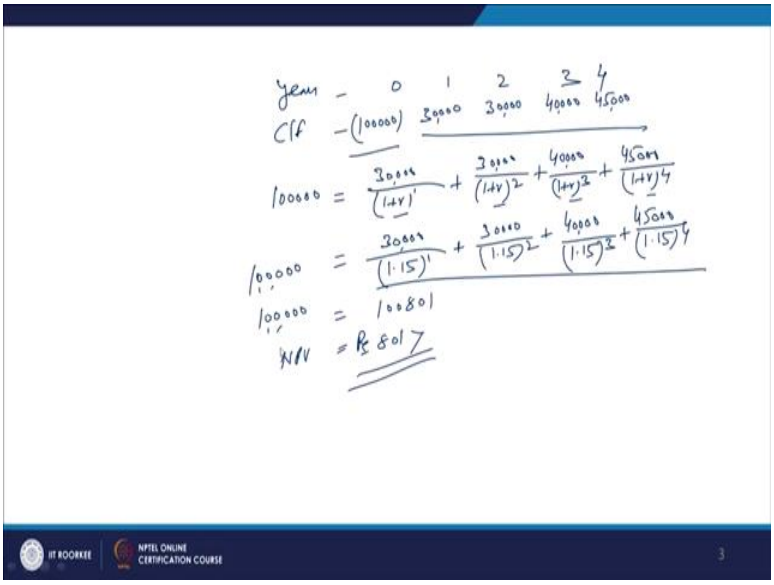

So, first of all say, we have what is a process involved in this? The process involved in this is the first step is calculate NPV at different interest rates, at different discount rates. So, this is the first step which we have already calculated and when we calculated the NPV at this, at one it was 801, in the second case it was 1364 and that was negative. So, we have calculated, this is a first step in calculating the exact rate of internal rate, exact interne rate of return which will be making the NPV 0.

And the step number two is now you sum it up. If you sum it up what you have to do is you have to sum it up and what is this, this is 801 plus the now you have to again forget the sign it is minus

1364 but forget the sign and you make it 1364. So, this will become how much? This will become as 2165. This will become as 2165.

And in this case it will be something like this now just let us call back, this is the say, formula which we are going to make use now and when we are making use of this so we have calculated the sum and now after this we have to calculate now the ratio, first of all we have to calculate the ratio. So, ratio of this is 801 divided by 2165 and this ratio comes up as how much? This ratio comes up here as 0.37, 0.37 percent.

So, what was the formula? Formula was smaller interest rate that is 15 percent. I am taking you back to that formula 15 percent smaller discount rate where the NPV is positive and that is 15 percent in this case and then plus, we take it as plus 15 percent plus this ratio, this ratio is going to be how much? 801 divided by 2165 this ratio became 0.37 here this ratio is this much and multiply it by, multiply it by what was there? Say, bigger discount rate where the NPV is negative minus smaller interest rate where the NPV is positive.

So, bigger discount rate where the NPV is negative has become negative that is 16 percent in this case and the smaller discount rate where the NPV is positive 15 percent. So, this becomes 1, if you try to find out so what will be here? Finally, the interest rate, exact rate of discount or the discount rate in this case will be how much? 15.37 percent, this will be known as 15.37 percent.

So, very simply, in a very simpler manner you can easily calculate the discount rate and if you calculate this discount rate 15.37 percent because we were calculating here 15 percent is giving you a positive NPV 801 and at 16 it becomes negative 1364, minus 1364 it means we are sure about that discount rate at which NPV of between the cash flow, inflow and outflow will become negative, sorry the NPV between the two cash flows will become 0 that is somewhere between 15 and 16 percent.

So, to find it out there is a process so we could see the process with the help of this formula also this model is given to us and simply by applying this model you can find out the say the exact discount rate, but if you want to know the process that how it all has happened. So, what you have to do is? You have follow the three important steps.

First step here is calculate the NPV of the smaller discount rate and the bigger discount rate means where it is positive, and where it becomes negative, two discount rates. Second step then you sum them up all the, both the NPV positive as well as the negative, ignoring the negative sign and you calculate the sum total value which is 2165 in this case. At the step 3 you calculate the ratio between the say two say NPV, one is NPV at the smaller rate of interest, and second is the means the denominator has to be the sum of the two that is NPV at the smaller discount rate and the NPV at the higher discount rate.

So, that is a step number 3 calculate the ratio between the NPV at the smaller discount rate and the sum of the two NPV. So, you calculate this ratio, this is the third step and after this you place all these values in the formula. So, it means what will be there? Lower discount rate, the lesser discount rates, smaller discount rate at which the NPV is positive plus that is ratio and multiplied by the say bigger discount rate, higher discount rate minus smaller discount rate.

So, you multiply that ratio with the difference of these two and add it up into the discount rate which is coming up or which is a smaller discount rate. So, finally you will be able to find out the exact discount rate, if you discount. Now, for example, in this case if you discount these cash flows all these cash flows at the rate of 15.37 percent certainly this NPV that is the 1 lakh 100,000 cash out flow will be equal to the 100,000 of the cash inflow some total of all the inflows if discounted with the help of 15.37 percent then some total of all the 4 cash inflows will be equal to the 100,000 present value of the 100,000.

So, 100,000 cash out flow and 100,000 is the discounted value of all the total four cash inflows put together, summed up at the rate of, discounted at the rate of 15.37 percent will be 0 and that is the objective that is internal rate of return we want to find out and that is how we can do it. So, we can, where means in one go if we are able to find out as absolute rate 15 percent, 16 percent, 17 percent, fine, very good, but in there is any problem or the rate is coming between 2, it means it has to be infractions 15.37 percent, 15.40 percent.

So, for that purpose calculate two NPV at the smaller and the higher rate of interest and with the help of this model you can find out the exact rate. So, in this case we have found out the exact rate 15.37 percent and we have explained the steps also how to do it. First of all calculate two NPV, then you sum them up then you calculate the ratio between the sum and the smaller NPV,

means NPV at the smaller discount rate and then you apply all the values you put into this model that is smaller discount rate plus the ratio between the two and then multiply it by the difference of the two discount rates.

You will find out the exact, in this case we have found out is 26.24 and in the our new means this other problem which we did here we have found out is it was lying somewhere between 15 and 16 and when we applied this concept it is clearly found out as 15.37 percent.

So, exact internal rate of return can be found out with the help of this say process, so ultimately what is the internal rate of return at which the net present value of the two cash flows, out flow and inflow, the present value we are talking about becomes 0 where the NPV becomes 0 that rate of return or that discount rate is called as the internal rate of return. How you have to take the decision, whether to accept the project or you not to accept the project by using the internal rate of return.

Simple here is the that you compare the internal rate of return available from the project against the cost of capital, against the cost of capital. For example, our cost of capital is 13 percent and the in this say calculation we did our internal rate of return available from the project is 15.37 percent accept the project because IRR is greater than the cost of capital.

But if the reveres happens that the cost of capital is 16 percent and IRR available is 15.37 percent then you reject the proposal that is not possible and when it is equal, it means the cost of capital is equal to internal rate of return again we are at the state of say indifference we can a go for it or we may not go for it.

Then the decision will depend upon that this IRR we are calculating which is making its IRR equal to the cost of capital just on the basis of the foreseeable cash flows but if we talk about the future cash flows which we are not now taking into account. So, if you take those into account at the latter stage it may be possible that internal rate of return say, becomes more than the cost of capital.

So, it means we have to decide on the basis of that but if it is more than the cost of capital, clear cut decision go for it, but if it is less than that simply reject it, if it is equal then we are at the

point of indifference. So, this is the basically the internal rate of return and the decision criterion depends upon the comparison between the cost of capital and the internal rate of return.

Now, there are some problems with the IRR, some problems with the IRR which should be clear about and what are the problems because those are best criterion means I told you that as compared to NPV benefit cost ratio hardly we use. Either we use NPV or we use IRR but still IRR is much say highly used rate of return as compared to the NPV and for that purpose say, means still some limitations are there but we should be clear about that though we are using IRR at the say best possible extent or in most of the projects but still some limitations are there what are those limitations?

So, that if we know the limitations associated to IRR will be probably in a better position to use this particular criterion of say discounting the cash flows or calculating the say the net present value or evaluating the capital budgeting proposals.

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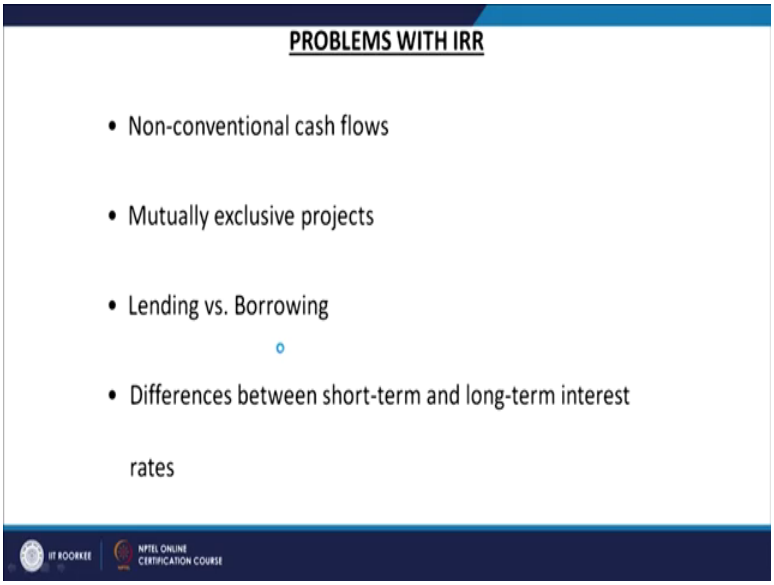

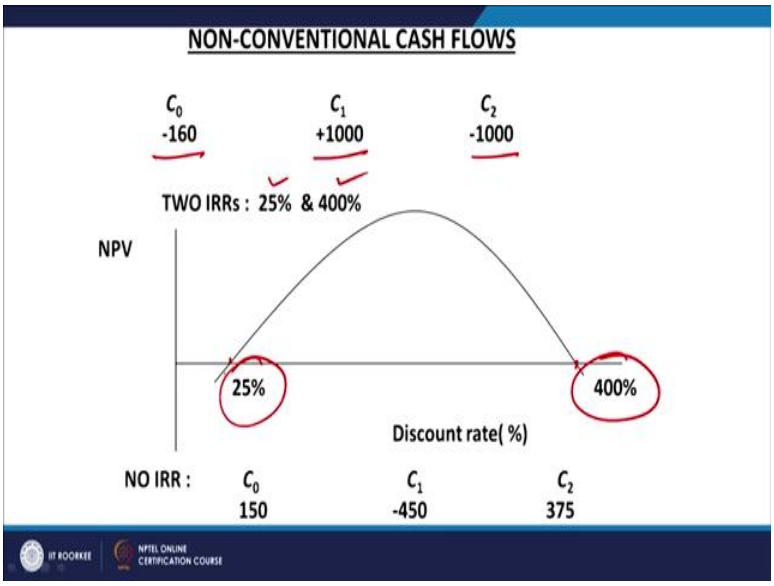

So, first limitation is first problem is the non-conventional cash flows, non-conventional cash flows. Now, what is the non-conventional cash flows? This is the non-conventional cash flow, this is the non-conventional cash flow, here now, what is a non-convention, here it is the cash out flow minus 160 for hundred sixty thousands then is a cash inflow 1000 and then it is the again cash out flow. So, one is cash out flow, cash inflow, cash out flow, this is not a conventional cash flow.

In the conventional cash flows what happens? First we have the cash out flow in the first or second year or in the initial period and after that there is no cash out flow, total cash out flow in the present period in the current period and over the subsequent years there are only inflows. So, that is a conventional.

But when it is non-conventional it means you have first out flow, then inflow, then out flow, inflow it means regularly the investment is required to be made it is not one time investment, it has to be made regular investment time and again we have to make investments and inflows are also coming and out flows are also going. So, in that case it becomes the unconventional, non-conventional cash flow how to calculate the internal rate of return.

Now, in this case for example, if you discount these cash flows you are getting two discount rate 25 percent and the 400 percent, means at this point also here NPV 0, at this point here NPV is 0, which one out of the two you have to accept? That is a problem because here we have non-

conventional cash flows. So, two IRR is coming up, one is 25 percent and other is 400 percent, at this point also NPV is 0, then it starts going up and further it comes down at the 400 percent also this NPV is becoming 0.

So, it means because of this basic limitation what we have to do is that we have to now find out that which discount rate to use it is not possible whether to go for 25 percent or to go for the 400 percent that creates the problem. So, this is a first important limitation of the internal rate of return which reduces its use.

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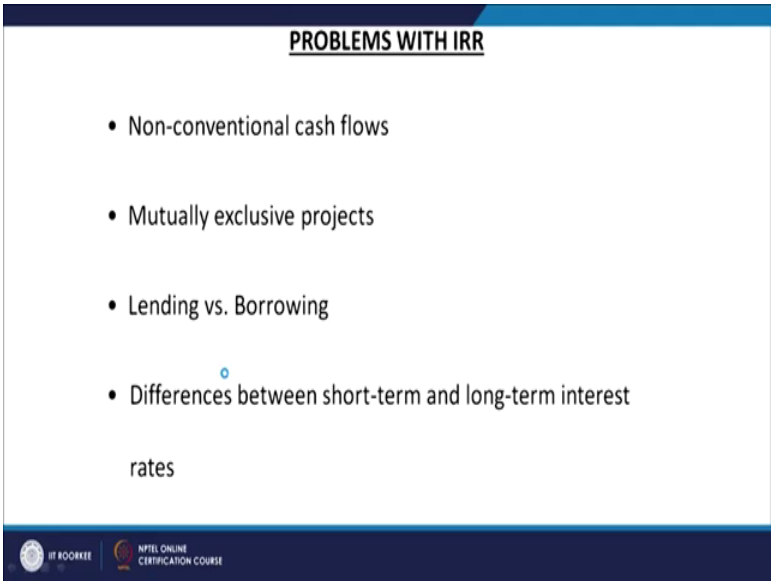

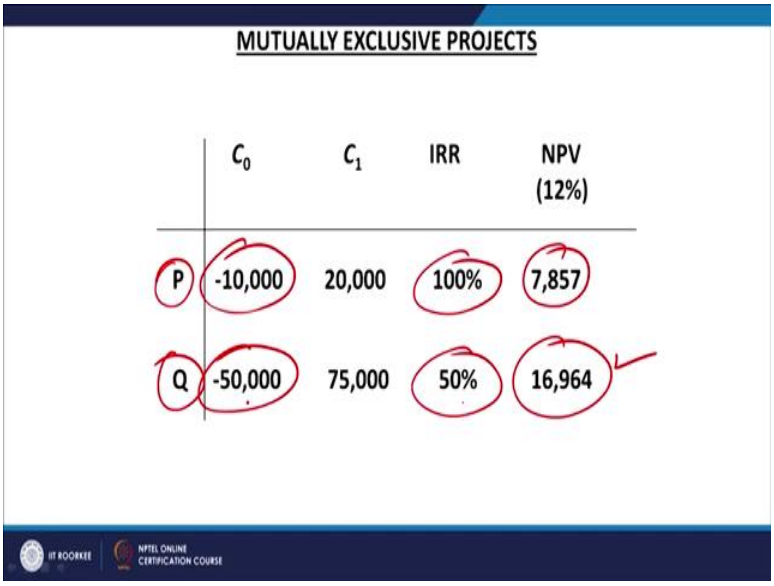

Then second is the mutually exclusive projects. For example, there are two projects under NPV how we evaluate the projects, under NPV we simply evaluate the projects on the basis of the NPV higher the NPV better the project. Though there is a also a limitation there that we do not make the relative comparison, relative comparison in terms of the investment.

Sometime as I gave you the example in some previous class while talking about the NPV that in one project the NPV is 2500, 2500 but the investment is 10,000 and in the other the NPV is 5000 but the investment is 50,000 but under the NPV criterion we will accept the project which is given you the NPV of the 5000.

So, we are not comparing there the projects with the investment with the outflow. So, that limitation is also there but here in this case mutually exclusive projects for example, now this is a situation mutually exclusive projects. We have got project P and project Q two projects are here. Two projects are here and in these two projects, here one is the giving this is a cash outflow 10,000 and then this is the cash inflow 20,000 and then if you calculate this the second one is 50,000 cash outflow, and inflow is 75,000 C1 in the say, year 1 and at the end of the first year.

IRR is coming up here as 100 percent and this is coming up as 50 percent. Whereas, when they are discounted at the rate of these cash flows are discounted at the rate of 12 percent which may be the cost of capital. This comes up as this and this value comes up as this.

Now, under the internal rate of return criterion project P is better because it is giving you the 100 percent IRR, under the NPV criterion for example, if you look at this is giving you the better return that is 16,964. So, though there is a limitation the NPV also that here the you are getting the higher NPV but the investment is also very high, here you are getting lower NPV so investment is also low.

But in this case mutually exclusive projects which are giving you lower NPV means the limitation here is the projects which give the lower NPV sometimes IRR selects them indicating that here the internal rate of return is higher as compared to the other project which is giving you the higher NPV but the IRR coming up is the lower. So, it means in this case we are proving it that though the NPV is lower as the 12 percent but the internal rate of return is 100 percent.

So, that limitations is with both the method because they are not comparing it with the investment here, but say if you look at the say your NPV criterion then the project Q is better under IRR project P is better whereas NPV under the project or from the project P is in the absolute value is lesser than the much lesser as compared to the project in the say as compared to the project Q.

So, this limitation is there that sometime say you can call it as not very clear results are there, confusing results are available because of the say lack of clear cut values interest rate, so internal rate of return coming up comparable with the net present value. So, this is a second limitation.

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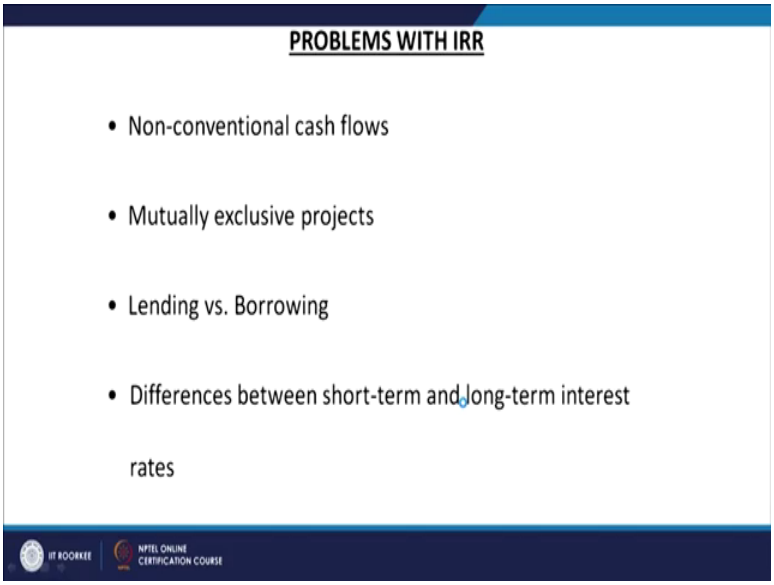

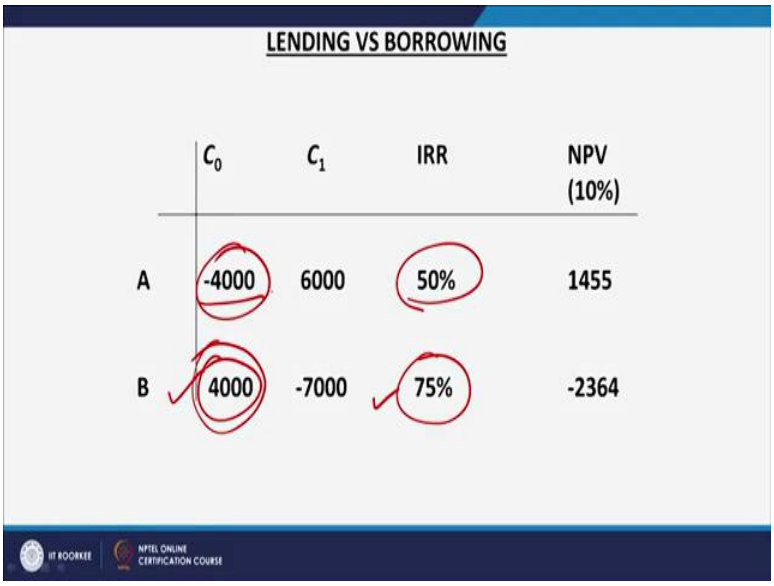

And lending and borrowing, next thing is when talk about the next thing is now you look at this situation if you look at this situation here. Now, this project is we are investing 4000 and the internal rate of return available is 50 percent, here we are borrowing 4000 same amount and the internal rate of return is 75 percent.

Now, if we do not know the background and means not make the entire analysis in the light of the total information available. So, what we will do? We will take a decision in the favor of project B that the project B is better as compared to project A because project A's IRR is 50 percent and project B's IRR is 75 percent.

So, we will go for the project B, but you see the meaning of it is clear from these two values, this value and this value, here you are investing and the internal rate of return from that investment is 50 percent, here we are borrowing and this rate is not say, the rate of return rather this is a rate of payment. This is the borrowing rate and this is the lending rate. So, we are lending at the rate of 50 percent. So, we are earning this return and we are paying this cost here.

So, it does not differentiate, it only gives you certain percentage and in this case it is 50 percent, 75 percent. So, it is does not differentiate whether it is a lending rate or a borrowing rate so you have to have a complete background information available for arriving at a very logical conclusion. So, that confusion is always there with the internal rate of return.

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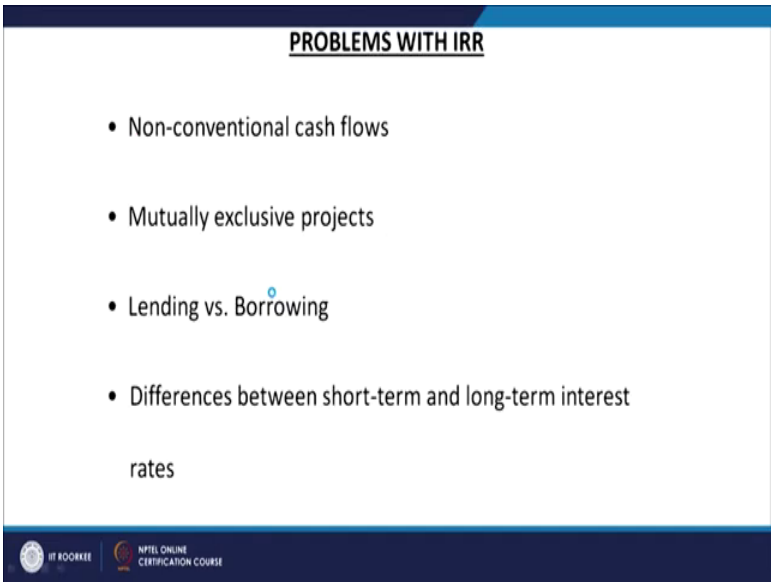

And one more limitation here is that is with regard to the difference between the short-term and the long-term interest rates. Sometimes what happens because for the short-term borrowing interest rates are different and the long-term borrowing interest rate are different. So, it means which cost of capital you have to take as a common denominator to compare the internal rate of return because cost of capital changes, cost of capital changes.

So, when you change the cost of capital for the short-term borrowing you are, because both the funds are invested in the business, funds from the short-term sources are also invested, funds for the long-term sources are also invested and because of the term structure of interest rate these days the moment say maturity of the loan increases or the borrowing increases, interest goes up.

So, here cost of capital is one is lesser, another is more, so which one to means take as a base rate for comparing the internal rate of return that also is a confusion, but I tell you one important thing here despite all these limitations, all these short comings internal rate of return is the much preferred say way of or the method of evaluating capital investment proposals or the capital expenditure proposals.

And as compared to NPV it commutates the better results or means results in the sense that when you talk in the percentage terms, because all other comparable items are in the percentage terms,

inflation is in the percentage terms, your interest rates are the percentage terms, your growth rate of any organization in the percentage terms.

So, since this internal rate of return is also in the percentage terms and it is comparable to the cost of capital which is also in the percentage terms and. So, despites two, three important limitations associated to this method, this method is more in use is in (())(32:38) as compared to the net present value method because there you get the say result in the absolute value. Sometime the comparison of the absolute value with the percentage becomes difficult, it becomes difficult.

So, if it is both the things cost of capital and internal rate of return if both are in the percentage terms it is the better way of comparing of two things and if facilitates a better comparison. So, this is the process of internal rate of return and this is how we can make use of this criterion, this method.

So, here now the question arises is there any improvement over the internal rate of return which can be done or these limitations which are associated to the internal rate of return, can these say limitations be removed? Is there any method, is there any way out available for that? Yes, the way out is available and these days rather than using the simple internal rate of return we use the modified internal rate of return which we call it as MIRR - modified internal rate of return MIRR.

And with the help of MIRR, most of limitations of this that non-conventional cash flows problem can be tackled there. Mutually exclusive projects can be also say taken care off because under the MIRR the results of MIRR and of the NPV are comparable they are almost same and there the problem of lending and borrowing also does not come into the picture and since we get only one interest rate.

So, one discount rate, so short-term and the long-term say interest rates problem is also resolved. So, we have some solution but ultimately it is a internal rate of return whether it is internal or it is modified internal rate of return. It is a much better criterion as compared to the NPV because the say internal rate of return, modified internal rate of return can be calculated in the form of the percentage terms.

So, what is a modified internal rate of return, how to calculate that and how to take decision with the help of that with regard to the acceptance or rejection of a one particular capital investment proposal that I will discuss with you in the next class. Thank you very much.