Water Economics and Governances
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Lecture – 41
Evaluation of Water Projects
Selection of Capital Budgeting Methods (Contd.)

Welcome friends. So, this week in the previous few sessions we have been talking about the different capital budgeting methods one by one and in this particular session we will see how some of them are used for comparing the projects.

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We did discuss all of these basic capital budgeting or the renowned capital budgeting approach is one by one. Now, based on if you recall our earlier sessions so, it was evident that net present value which is NPV and internal rate of return which is IRR are generally the more robust and more frequently used approaches for purpose of capital budgeting or selecting a project giving agreement to a project giving agreement to a funding decision. So, based on this actually the funding decisions are made in a large investment project and water sector has generally the projects of nature which required substantially large investment often.

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Now, since the NPV and IRR are the more common method more common approaches. So, let us see how they compare how they fit in with each other. Now we will go back to the; our earlier example what are the one that we considered for Surat municipal corporation for say. So, looking at that example again you know that we have already estimated the different cash flow after taxes and.

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Now if you see the, we have the final value of cash flow after taxes in the first line itself then if we take the different rate of returns we get the different net present values. So, at

a rate of return or a discount rate what we call 10 percent the NPV of the project is of the order of around 46 crore rupees then at 14 percent it is falling down to 28 at 18 percent around 1522 percent around 5 and 26 percent it is actually turning negative.

So, if my rate of return is 26 percent the NPV or net present value of the project is negative and if my expected return is of the order of 26 percent one should not recommend this project or the execution or the investment in this particular project if you recall the IRR for this project was somewhere between around 25 percent. So, that is why since my rate of return or my discount rate has exceeded IRR I am getting negative net present value for the project and; obviously, if it is negative at 26 percent it is further going down at 30 percent.

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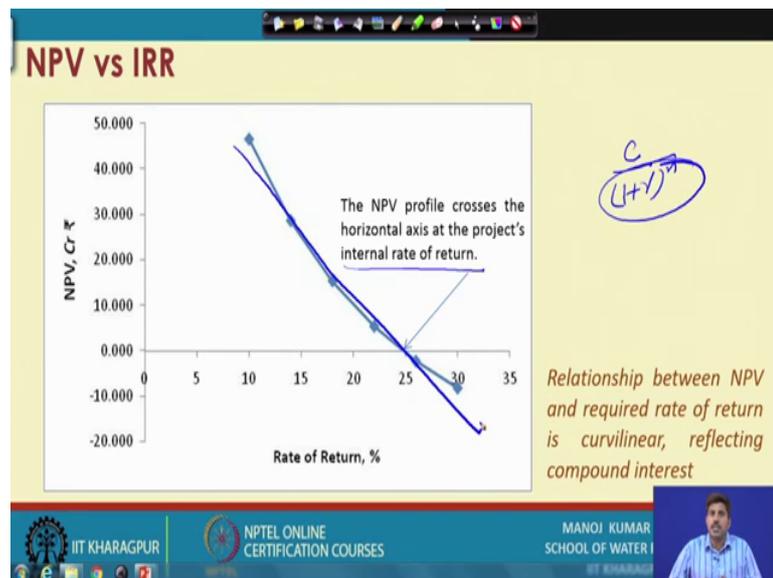
So, now if we see this NPV and IRR that way this is a plot between the NPV and IRR for between the NPV and rate of return not IRR actually between NPV and rate of return for this particular problem. So, you see that the as my rate of return is increasing my net present value is decreasing and this particular point where NPV profile crosses the horizontal axis of the project; that is what is my internal rate of return . So, this establish the typical relationship between NPV and IRR this relation is curvilinear because we have considered a compound interest if you recall how we estimated the how we applied the discount.

So, this is my let us say net cash flow. So, net cash flow 1 upon 1 plus rate of interest in to the power n. So, this is the compound interest compound discounting. So, if we are doing a discounting like this we are expected to have a to have a curvilinear nature of this net present value profile; however, if we go on to simple interest or straight way then this line could actually be straight line also for simple interest.

Generally, the discount rate or the invest the interest rate on the investments are considered a compound interest. So, often this profile will actually be curvilinear in the nature.

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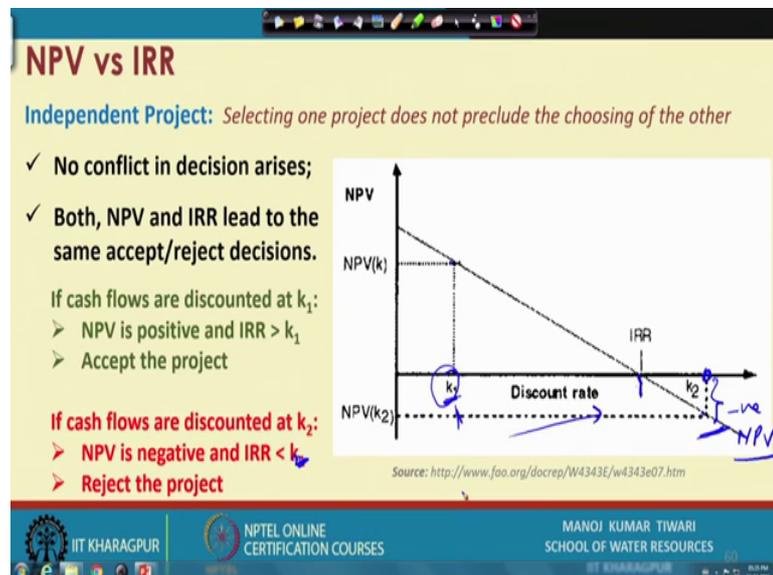
Now, so, far we have been talking about how we can assess a project whether it is profitable or not what about we if we are having multiple projects. So, if you recall in the beginning of this week we discussed that the projects could be of two different natures one is independent project; where if there are multiple projects the projects are independent to each other if I am selecting a particular Project A it is not hampering or it does not mean that I cannot select the Project B also.

So, there is a possibility of selecting more than one project each project are independent of each other. Generally, when we have large corpus of budget then we can actually have we can consider more number of projects for example, you take the that NNCG has or the ministry of Ganga reservation has substantial amount of fund and it can invest multiple development projects across the river for the improvement of water quality for

the improvement of river ecology for the improvement or the possibility of investigating navigation. So, there are possibility of investing in different projects and if there are substantial budget. So, it is not that if the ministry is funding a project to let us say analysis or analyze or say the modeling of river water quality from a.

For example let us say Haridwar to Kanpur. So, it will not fund from Kanpur to Varanasi your from Varanasi to Patna that is it if ministry has sufficient budgets it can fund a project for all through different sectors of the river or let us s ay it can fund a project on to the river water quality improvement on to the one some money on to the sewage treatment or preventing sewage disposal into the river some on to the enhancing the flowing to the river some on to the control of the meandering or river channel some on to the improving ecology of the river.

So, there is a possibility of funding into the different sections these types of projects are independent project. So, for independent project there is no conflict in decision arises whether we use one technic or another technic, because one project has to be selected. So, whatever technique we are choosing we will see whether it is in agreement to the outcome of that and if that project gives us let us say for example, we are choosing NPV So, if the project gives us a positive NPV we will say that let select this project there is nothing to be compared with other projects ok.

So, even if we are let us say using IRR; if IRR is greater than my desired IRR I will say let us this project . So, both NPV and IRR will lead to the same accept reject decision if cash flows are discounted let us say at rate k one here ok. So, for if my k one is the rate of discount I can see that my NPV is positive I will select that project I will accept that project from IRR also IRR is this much which is greater than the desired IRR I will accept this project if my expected discount rate is k 2.

So, then I will see at k two this project is giving me negative NPV and let us not select this project based on the criteria of NPV. So, this has to be k 2 it will be rejected and based on IRR also if I will figure out that my expected rate of return is k 2 and my IRR for this project is less than k 2. So, based on IRR criteria also the project will be rejected.

So, the decision is same whether I am using NPV or I am using IRR; however, this when we move away from the independent project to the mutually exclusive project then there might be conflicting decision at times.

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So, mutually exclusive project as we discussed earlier are the projects where only one option can be selected right for example, that that could be any reason there could be let us say limitation of fund. So, I have limited fund and I can only fund just one particular project or the nature of project itself could be mutually exclusive ok.

So, then which project to select and which not to select that for decision making of that let us take an example let see this with an example. So, we have two different projects Project A and Project B the initially investment in project is let us say 50 lakh rupees and in Project B is 150 lakh rupees and this is my net inflow cash at the end of here 1, 2 and 3 from the two projects.

Now, for these two projects if I calculate net present value at certain discount rate let us assume my discount rate is 10 percent. So, 10 percent discount rate the net present value of the projects are like this. So, Project A is leading NPV of around 13.5 right lakh rupees while Project B is leading NPV of around let us say 15.6 lakh rupees . So, Project B is giving me the higher NPV value NPV of Project B is greater than NPV of project A. So, I should choose a higher NPV projects. So, I should choose project B, but if we take the IRR criteria if we estimate the IRR for this projects. So, IRR for Project A turns out to be 24.47 percent and IRR for Project B turns out to be 15.33 percent.

So, here I see that written on Project A or IRR of Project A is higher as compared to IRR of Project B and this tells me that I should be going for Project A I should prefer Project

A or Project B. Now these two approaches giving me the conflicting results ok. So, they do not rank the projects in NPV is ranking B preferable to A whereas, IRR is ranking a preferable to B based on the NPV and IRR value now NPV IRR calculation are the similar as we did earlier. So, I am not going to into the detail of how we calculate NPV and IRR again the question is what which one to choose now again if you see that.

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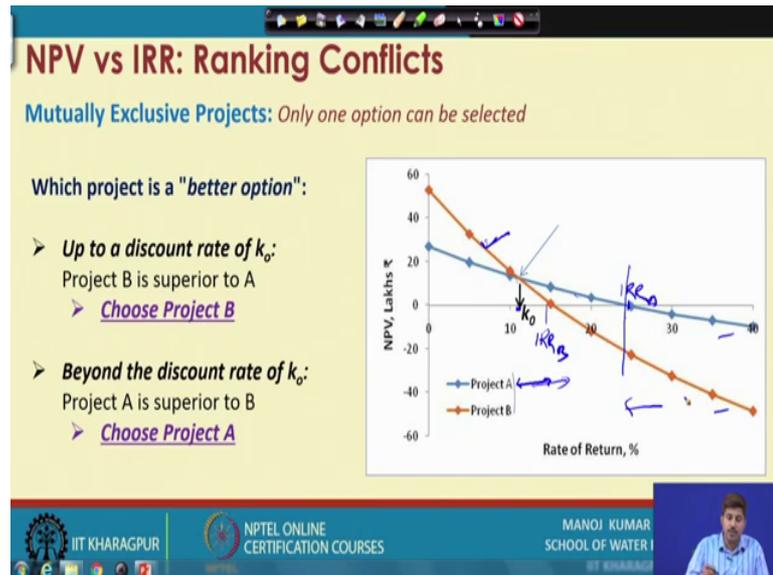
This is my profile this is my profile for Project B this is my profile for Project A if I plot let us say NPV and these are the IRR for project this is Project A and this one is the IRR for proj project B right.

Now, this projects are intersecting here ok. So, if I if I see that my desired discount rate or my desired rate of return is up to k 0 up to this rate of return I am happy with. So, then my Project B is giving me higher NPV as compared to Project A and I should choose project B; however, if my expected rate of return is higher than this value higher than k 0 then or for beyond the discount rate k 0; I see that my Project A is giving me the higher net present value as proposed to the Project B and I should choose Project A of course, beyond this none of the project is good to basically invest on So, my decision here or which project is a better option will depend on what kind of rate or what kind of discount rate I am applying or what kind of rate of return I am expecting on this projects . So, that is what basically will be looked upon.

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Such problem arises when there is in basically multiple cases and one such case is when we have differences in the scale of investment.

Now, you see the same projects the Project A and Project B that we were considering one has an initial investment of 50 lakh rupees while another has an initial investment of one 50 lakh rupees. So, there is almost like three times higher investment in the Project B in order to see whether because this project if you see if you compare Project A Project B we earlier see that we can choose Project A and Project B based on discount rates and all that, but if you take up it an a different way let us say instead of choosing mutually; because these are mutually exclusive projects we have to either choose Project A or choose project B, but here the investment in Project B is much higher as a post to investment in Project A and that in the difference in investment is 100 rupees 100 lakh .

So, this 100 lakhs investment in Project B is it justified; because this is also giving you the net present value positive and we earlier see that up to certain discount rate we can go for choosing Project B over Project A. So, is this actually the further investment of 100 crore is justified that we can see that let us consider that when we are choosing Project B we are choosing Project A plus another Project B minus A with these additional hundred crore exp investment so; that means, the using Project B is actually equivalent to choosing Project A plus another hypothetical Project B minus A because my investment

if you see my investment in a plus investment in B minus A is going to be my investment in B.

So, since my investment in B is equal to basically carrying out two project instead of just one we can carry out the Project A as well as carry out the Project B sorry Project B minus A. So, that in combination gives me this. So, now, I have a possibility of assessing whether these both are satisfying the criteria or whether these both whether this additional 100 lakh rupees investment that I am going to make if I am choosing Project B; how this how is the return expected on this particular incremental investment because remember this Project B minus A is the incremental investment that is being made while choosing Project B over project A.

So, I should because I independently saw that Project A is fine Project B is also fine Project A is giving me a higher return and good NPV value as well, but Project B although giving little higher NPV value, but how it compares when I am actually on a scale of like when I am looking at the additional investment. So, that 100 lakh rupees or 1 crore rupees additional investment that is being made is giving me this return. So, this is nothing, but subtraction of B minus A ok. So, this is actually B minus A similarly B minus A and similarly B minus A

So, now these are my returns and if I discount these further by the let us say ten percent discount rate. So, 1.1 to the power 1 and then 1.1 to the power 2 and 1.1 to the power 3 so, that is what I am getting and IRR for this particular additional investment is 11.03 percent where as NPV is 2 percent. So, as you are discussing earlier choosing Project B is equivalent to choosing Project A plus B minus A ok. So, at 10 percent discount rate NPV of this Project B minus A is also greater than 0. So, that indicates that the incremental investment that we are making is justified. So, in a Project B the incremental investment that we are madding making over Project A that is also justified and that suggest that we should actually choose Project B based on the NPV criteria ok.

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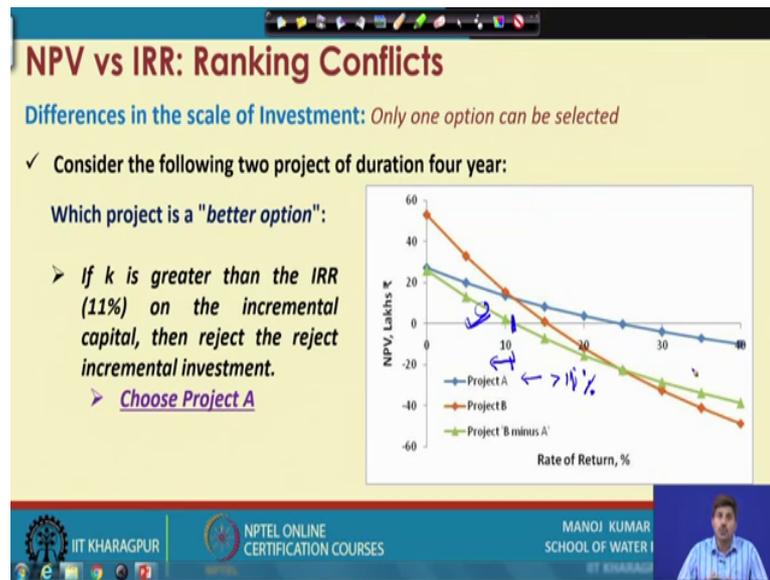
Now, this can be seen graphically as well here. So, we have now three lines here this the same earlier problem. So, we have already the Project A blue line and Project B orange line. Now the green line added reflects the Project B minus A now you see that up to this up to your this k value particularly or 11 percent whatsoever I IRR was coming for this 11 percent.

So, up to this 11 percent if my expected rate of return is less than this 11 percent I should actually that by incremental investment is justified this is the incremental investment is giving me the positive cash flow or the net present value is positive. So, I should basically be selecting this; however, if my discount rate is exceeding is like greater than 11 percent my expected discount rate or the my expected return is greater than the IRR for this incremental capital is greater than 11 percent. So, that I see that my actually the incremental investment is giving me the negative net present value.

So, beyond this point I should not go for choosing a particular like choosing Project B the rather I should choose Project A because what is ever incremental investment I am making is giving me negative rate of return . So, this way one can actually make a decision how we can incorporate or how we can consider the additional investment options as well or how we can choose the projects in case of particularly mutually exclusive projects which are with different with different degree of initial investment.

Now, interestingly if you see here this analysis the way we analyzed net present value of fairly easily for the incremental investment as well as for the two projects if you recall our earlier discussions the computation or the calculation of IRR not that easy it is an basically trial and error approach IRR is a trial and error approach and the decisions also that is being made based on the IRR may not truly of course, like if we want to convert NPV to IRR they are if we want to convert it pro from one form to another we can convert and we can accordingly justify your decisions as well, but it is for more easy and for more approachable to make a decision based on the NPV in this cases based on the NPV we can actually realize this is the point this is my let us say based on NPV or NPV profile we can say or NPV at desired rate we just if we go back to the earlier slide.

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We see that the NPV at my 10 present was positive even for Project B minus A. So, it automatically tells us the additional investment that I am making is justified over here.

Now, what if is still IRR we will I will get some IRR value I will get some this value, but what if my NPV here is let say coming minus 1.5 for example, let say if my NPV for the incremental this thing is coming minus 1.5 I automatically just based on my NPV can see ok. Now this is additional investment that is being made is not actually justified or the return on this additional investment being made incremental investment is being made is not giving the positive NPV value or at expected return.

So, this investment is actually not justified. So, the decision making is rather more simple with NPV as compare to IRR and that is why the net present value is more preferred in such scenarios for making decision over IRR just for individual projects estimation or if you are having independent projects then whatever technique we can we want to adopt is fine, but when basically for particularly comparing different projects or ranking projects and those to the projects which are mutually exclusive nature because of whatever reason it is better to go for net present value over IRR we will take a few other cases where we will compare the net present value and IRR in the next class we will end this here and in the subsequently next session we will discuss few more cases on to these ranking conflicts between NPV and IRR.

Thank you.