Financial Management for Managers
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Lecture 28
Capital Budgeting Part 12

Welcome all. So, in the process of solving some capital budgeting related problems, we did 1 or 2 problems or rather 3 problems in the previous classes, two classes. And now we are going to do one more problem which is quite comprehensive and we are going to answer many questions here which are of say quite a good amount of interest for all of us.

And first important thing here is that these two projects are mutually exclusive. Mutually exclusive projects are those projects where you can take only one, if you take one, you cannot take other, if you can take second, you cannot take one.

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So, you are given here the information about the cash outflow and cash inflow of the two projects, project P and project Q. And these are the four questions which we have to answer here. We have to make the NPV profile of the two projects then we have to say calculate the IRR of the two projects, then we have to calculate the say, we answer the question which project would you choose, if the cost of capital is 10 percent and 12 percent, fine. And the last question is what is each projects MIRR if the cost of capital is 12 percent.

So, we have to answer these questions, these four questions and after doing this problem, I think most of the issues related to the capital budgeting as far as the practical problems are concerned will be clear to you. So, means the peculiar point if in this project, if you look at the project P, we have the cash outflows for the first 3 years, including 0 period, the current period, that is the period of building the project plus in the at the end of the first year also, we have the cash outflow, second year we have the cash outflow, third year we have the cash outflow, fourth year we are going to have the first inflow and fifth year also we are going to have the first inflow.

Though the say capital outflows in the year second and third are not very substantial, but still means it is a quite a good amount, which is, you can call it as, say 50 percent of the cash outflow in the year 1 that is happening in the year 2 and year 3, almost you can say that is say 25 percent of the cash outflow which has occurred in the year 0 or in the current period, which we have invested that is 1000 crores or 1000 lakhs or whatever it is, this figure is, these figures are given to us.

So, cash outflows and then the cash inflows, but again, you would not call these cash outflows and inflows means multiple cash outflows and multiple cash inflows as the non-conventional cash flows, these are the conventional cash flows because non-conventional means, when there is outflow, inflow, outflow, inflow then it is a conventional, then then it creates a problem there you have to apply the concept of MIRR, not the concept of IRR.

But in this case, because these all are the say outflows happening till the end of the third year, only in the fourth year, we have got the inflow first inflow, fifth year also we have got the first inflow. So, it means, this is a conventional problem and can easily be done. And here also you can calculate the IRR also not required to calculate the MIRR and NPV is very easy to say calculate in this case.

In this case the things are quite easy it is very conventional and simple situation. In this case, you can say that, in the current period 0 period, there are the cash outflows, 1600 rupees and in the subsequent 5 years there are the cash inflows that is 200, 400, 600, 800 and 100. So, these cash inflows are there.

So, we have the 5 cash inflows, one cash outflow. So, the problem is quite simple here, whereas in this case we have the 4 outflows, we have the four outflows and only two inflows. So, still the things are not very complex and the main basic and the positive point here is that these cash flows are conventional, not non-conventional.

So, simple NPV can be calculated and IRR can also be calculated. But the projects are mutually exclusive, so you have to answer the questions in terms of that if you take the project P you cannot take the project Q, if you take the project Q then we have to abandon the project P.

So, that is the meaning of the mutually exclusive projects. Let us solve these problems and then try to find out what is the NPV of these say different say two projects? So, if you want to calculate the NPV of these two, so we will have to calculate the, we have to prepare the NPV profile.

NPV profile you have to create of two projects, of two projects and for calculating the NPV we are going to take the different discount rates, this is the discount rate and these are in the percentage terms we are going to take these discount rates in the percentage terms and the discount rates for the project P, and the project P and project Q and we are starting with the discount rate of 0.

And then we are going to take the next one 5 you can take any discount rates, but we have assumed here that the discount rate is 0, the discount rate is 5, discount rate is 10, discount rate is 15 and discount rate is 20. Because we have taken two knowingly that one we have taken 10, then we have taken 20 also because it is asked in the question, we are asked in the question that which project would you choose if the cost of capital is 10 percent and 12 percent?

And in this case, we will have to now answer this question depending upon the number of say issues involved. And in the second case is, what is each project's MIRR if the cost of capital is 12 percent, if the cost of capital is 12 percent? So, in this case, when you have to choose the say projects out of this, out of these two.

So, what we have to do here is that we will have to calculate the cost of capital, we have to discount these projects and after discounting these say the cash inflows available from these projects. We have to try to find out the answer for the question that how we can answer these questions or how we can calculate the total cost out of it. So, it means we are going to find out these.

So, in this case, we are given the say different options available here. So, what we are going to do here is that we are going to evaluate the projects and in the one case, we are going to try to find out which project would you choose if the cost of capital is 10 percent and in the second case, the cost, this cost of capital is 12 percent.

Here one weak, dimension we can add up here also that if for example, the cost of capital is 20 percent, then which project we will be choosing? So, we will answer these questions while say means calculating certain values and after calculating these values, we will have to find out the solution for these questions.

So, in this case, when we have to calculate the NPV for these two projects project P and Q, you know the process very easily and for example, if you want to calculate the NPV of the two projects, and applying the discount rate and the discount rate is 0. So, for this case is simple NPV will come up, in this case is how much is outflow because the value of outflow and inflow will be same because discount rate is 0.

So, you will not be means 1 plus R when you do so, 1 plus 0 you will be doing so, it means we are assuming that whatever the cash outflows are going to be there and whatever the cash inflows are going to be there values are going to be same.

So, in this case, we have to do here is one thing that is the say, what is the cash outflow here in the first 3 years including 0 current period, the cash flow is going to be 1000, then 1200 is 2200, 2800 and then it is 3050, the total amount is 3050 and out of this if you say subtract this inflow, inflow is 2000 and 4000.

So, this becomes 6000. So, if you, from the 6000 or this inflow of the 2000 will be taken as 2000, 4000 will be taken as 4000, so total becomes 6000. From the 6000, which is the present value of the inflows, if you subtract the present value of the outflows, so, you are left with one something which is called as NPV and NPV of this project comes up here as 2930, sorry 2950 because it is 50. So, this comes up as 2950.

So, very simple because almost you can say we are not discounting it and we are discounting, so, we are saying that even the discounted values will also be same. So, the discount rate we have applied here is that is the 0 percent and the NPV of the project is coming up as 2950 and in the second case the NPV of the project is coming up here as the 500s. So, it means 2950 and 500 are the two NPV which we have to calculate by discounting the cash inflow and outflow at 0 discount rate.

Similarly, if you follow the discounting process, what we discussed in the previous class and if you calculate, so you will find out the NPV is here in this case at the 5 percent discount rate, you will find in case of the project P, this will come up as 1876. In the second case, if you calculate detail, go for the detailed calculation of the NPV because the cash flows are conventional, so easily you can do it, this will come up as 208. In this case this will come up at 1075 and in this case it will come up as minus 28, this will come up as minus 28.

And in this case, you have to means at the 15 discount rate if you want to find out this comes up as 471 and this comes up as minus 222; 222 is the NPV and as the discount rate 20 if you want to find out this is 11 and this is minus 382. This is 382. **11:16**

So, this is the NPV profile of the two projects, project P and project Q, so easily now you can answer different questions on the basis of it because if the discount rate is 0 again the say project P is better as compared to project Q, though it was looking like if you look at the cash flows, so we are finding out that for the first 3 years, including 0 period, we are only incurring the cash outflows, but when the cash inflows start coming in, and when we calculate the NPV, so NPV of the project P is far means more as compared to project Q where the NPV is only 500.

In case of the discount rate 5 percent again, the NPV of the project P is higher as compared to project Q. And when the discount rate increases to 10 percent again the same situation even in case of the project Q, NPV becomes a negative and 15 and then the 20, NPV is further more negative. So, it means your NPV from this project means every angle you look it at from that project P seems to be the better option as against the project Q.

So, it means if you take the NPV net present value as a criteria and look at the cash inflow and outflows available from the two projects and discounted them at the different rates at every rate the answer comes up as project P is better than the project Q. So, this is the first question we have answered.

What is the internal rate of return for each project? Now, we have to calculate the internal rate of return for the each project and for calculating the internal rate of return for each project means we have to calculate the R for the project Q. And we have to say calculate the project for say R for the project P that is the internal rate of return for the P and for the project Q.

So, let us calculate for these. So, we will calculate the internal rate of return, internal rate of return for project P, IRR, project P. So, we are going to calculate it project P, IRR for the project P. So, in this case what this amount comes up as? We have to now the say outflows and we have to start with outflows.

So, what is outflow given here? It is starting with 1000 going up to the 1200, so like that. So, in the first case, it is going to be how much? This is going to be something like minus 1000 because it is the first year's cash outflow, then it is again minus 1200 into now, we have to discount it, and we have to discount it means at rate, so rate is not known to us, we are going to find out that rate, because it is the internal rate of return. So, you have to discount it.

So, what can you do is? You can write here the one option is 1 plus R and year is 1, so this becomes 1 and this R is not known to us. So, this R is going to we are going to find out, so this is the one way. So, what can you do is? Means you can do this way also you can calculate it also or you can apply the trial and error method also. So, if you apply the trial and error method because ultimately you have to apply the trial and error method, so if you calculate with the help of trial and error methods, so what we can do is?

We can means make use of the present value say this interest factor and if you take the present value interest factor so it is PVIF we have to take so 1200 is the cash outflow and at

the end of the first year, it is taking place. So, PVIF you have to take multiply it by and R and year is 1, so we have to take up this, rather than calculating it, we can pick up the value from the table directly.

In the next case, it is minus 600 and then we have to take here as R into the year is which one is 2. So, we have to calculate the value of the R for the year 2 we have to find out and then we have to go for the means this is a PVIF. You can write it here also as that is the, we will properly write it let us write it like this that so that it is clear to you.

We can take here 1200 into PVIF, PVIF and it is the R year 1 then it is minus 600 into PVIF here we take the, so this is 600 into PVIF and this is for how much R and it is for the year 2, we are going to calculate for the PVIF for this, this is the amount of the year 2.

So, first is the minus 1000, second is the minus 1200 PVIF, R 1, second is the 6, third is a 600 and then it is into PVIF, R 2 and then it is again minus 250 into PVIF into R 3, into R 3 PVIF R 3. And then we have to make it as the plus this is 2000 into PVIF again we have to take here as PVIF, we have to take here is as and this is for the year R 4 and then it is plus what was the remaining?

The remaining is 4000 and 4000 into if you take PVIF and then you have to say take the R 5. So, this is a total project profile if you want to make it as if you put all the values here. So, we are first taking up to this point we are taking only the cash outflows.

These are the cash outflows in the first 0 period, the cash flow of the 1000 in the first year, the cash flow is 1200, second year 600, third year 250, 250 and R is for the third year and then we have to go for the 2000 means how many years we are taking, 1, 2, 3, 4 there are the cash outflows are 4, first is 1200, 600 and 250. And then we have started means getting the cash inflows. And if you take the cash inflows here, so this comes up as 2000 into PVIF, for this R 4 years and 4000 is the PVIF into this is the say next amount that is R 5.

And this amount has to be finally equal to how much? This should be equal to this finally, everything should be equal to 0. So, if you want to calculate it here, now what you have to do is? You have to find out this value of R. So, for calculating the value of R here, what you have to do is? The answer is the trial and error method you have to apply the trial and error method.

So, that finally, sum total of this, total these minus means outflows and the discounted value of the inflows becomes equal to 0 that will be our internal rate of return and for calculating that with the help of trial and error method, if you want to find out, you will find out here if you do it, you will find out some rate and that rate will come up here as 20.13 percent, 20.13 percent.

If you solve it and use the trial and error method, you will find out the one rate that rate will come up here as 20.13. If you discount all these cash inflows and outflows for 20.13, you will find out that the total discounted value of the cash outflows and inflows will be 0 and in this case, the 0 is the NPV and NPV is a 0 here and that to add the rate of 20.13 percent, 1.

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Now, we have to do like this for the second one also and we have to calculate the IRR for the next IRR for project Q, IRR for the project Q we have to calculate and in this case, but we are starting with the this project, so only in the first year there is a negative cash flow or the cash outflow that is 1600 over the next say 5 years if you look at we have the inflows only so again, very simple, means simpler than the first one you can say. So, you have to take here it as that we have to calculate the value of IRR.

So, we have to start with this 1600 and again you have to say discount it, so 1600 is equal to 1600 and the first year the inflow is 200 into PVIF present value interest factor and for R here it is 1, this is for the year 1 you have to take. Second is the inflow is 400 and then it is PVIF into 1, sorry R 2 and then you have to take here as 600 and in this case you have to take the PVIF, PVIF and then you have to take R it is 3 for the third year PVIF R 3 that is 600 PVIF R 3 and next inflow how much, 800, 800 into PVIF into R. In this case R 4 and then we are going to get the next inflow and that will next inflow is 100 and 100 into PVIF present value interest factor and then it is R 5.

So, if you take these all outflows and inflows and you try to discount them so that NPV of the project becomes 0. So, this value is becoming 1600 which is the outflow in the 0 period. Other years we are getting how many, 1, 2, 3, 4 and 5 these are the inflows available. So, PVIF R 1, PVIF R 2, PVIF R 3, PVIF R 4 and PVIF R 5 we are going to find out and we are going to discount these inflows for some discount rate. And if you talk about the discount rate, again the issue here is we do not know what is the discount rate?

So, again you have to find out the say trial and error method and with the help of trial and error method, the internal rate of return if you calculate from this particular problem, you will be able to find out that at 9.34 percent, the NPV of these cash outflows and inflows, of means all the NPV of this project will be 0 at 9.34 percent, at 9.34 percent the NPV will be 0. So, from the previous project, we found out the internal rate of return is 20.13 percent. In this case, we have found out the internal rate of return is 9.34 percent.

So, in this case, we have to now answer the next question and the next question here is we have answered the first 2 questions, construct the NPV profile for the two projects and then what is the IRR for each project we have calculated. Third question is which project would you choose if the cost of capital is 10 percent, 12 percent or we add here one more dimension that is 20 percent.

So, we will try to find out the answer from which that is the NPV profile we have worked out here. Now, for example if you take this 10 as the say discount factor cost of capital is 10 percent. So, we have got these 2 NPV, first NPV is 1075 and the second NPV is minus 28. So, obviously which project would you choose? The project P at the cost of capital or the discount rate given to us here is the cost of capital is 10 percent. We are going to choose the project P because NPV is far more as compared to the project Q when the NPV is negative.

And if you take the say for example, the cost of capital is 20 percent. Again, the answer is the project P though the NPV has come down from say 1075 at 10 percent to only 11,000 crore, lakhs whatever you want to consider it as to only 11, but if you look at the NPV of the project Q it has become further more negative and that has risen up to 382, 382 rupees lakhs, crores whatever it is.

So, it means in every case you can find out and at the say the cost of capital 12 percent you can calculate yourself that you can find out again all cash outflows and inflows are given, if you discount them in between somewhere it will be because I have discussed the two extremes 10 percent and 20 percent, at 10 percent, NPV is 1075 whereas, it has come down to 11 but if you increase it 2 for example, to 12 so, it means NPV will come down. But certainly it will be say far more than 11 or in this case it will be negative again because at 10 itself it is negative.

So, at say 12 also it will be negative and that will go up, but will not go up to means this level where it has reached up to 382 minus 382 at the say cost of capital of 20 percent. So, this is

the means 12 percent level you can calculate yourself and you can then find out the answer for this particular question.

Now, next thing is, what is the next question? Next question is what is the, what is each project's MIRR, what is each project's say, you can call it as the modified internal rate of return. So, for this particular purpose, for calculating the say MIRR for this, we can easily try to find out the MIRR out of it and for calculating the MIRR, modified internal rate of return, we can see that we know the formula and how to calculate it that we have to first of all calculate the present value of these all say, what is we call it as the inflows and outflows we have to calculate the present value of all the cash outflows. So, that is the formula.

So, if you look at the formula, what is the formula here? We can say here that is for calculating the MIRR, modified internal rate of return so what is the formula? Present value of the cost is equal to terminal value of the cash inflows and divided by 1 plus MIRR and power it is n here.

So, it means, we have to calculate the present value of the cost, we have to calculate the terminal value of all the inflows by compounding them against the given cost of capital and then we have to from this we have to find out the MIRR. So, for means following or calculating MIRR, we will be means following the same process and if you follow the same process of what we do is?

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What's the internal rate of return of the following cash flow streams?

| Year	Cash flows
0	(3000)
1	9000
2	(3000)

Problem4.

XYZ Ltd. is considering two mutually exclusive investments, Project P and Project Q. The expected cash flows of these projects are as follows:

Year	Project P	Project Q
	Cash flows	
0	(1000)	(1600)
1	(1200)	200
2	(600)	400
3	(250)	600
4	2000	800
5	4000	100

Required:

a) Construct the NPV Profiles for the two projects.
b) What's the IRR for each project?
c) Which project would you choose if, the cost of capital is 10 percent and 12 percent?
d) What's each projects MIRR if, the CoC is 12 percent?

We take here the project P, if you take the project P here, so we have to calculate the PVC present value of the cost for first of all, so for calculating the present value of the cost, what you have to do here is? You have to now, say take 1000 and if you take the 1000 during 0 period, so you would say here, that is the PVIF into 12 and the year is 0 because 1000 in the current period is equal to 1000 we are taking it as 0.

Second thing is the 12 second, second part is what? 1200 into PVIF present value interest factor into this amount will be become 12 percent and for the year 1 and then it will become plus. How much is the next cash outflow? Cost means 600 into PVIF, so here it is again 12 into 2 means 12 for the 2 years and last cash outflow is how much? First one is 1,000, second is 1200, third is 600 for PV for 12, 2 and then it is a 250 into PVIF and then it is 12 and it is for the years how many, 3. So, first 3 years including 0 period, we have the cash outflow. So, these are the 4 cash outflows.

So, if you calculate the PVC this comes out as 2728, rupees 2728 is the present value of the cost. Then we have to calculate the terminal value of the cash flows whatever the total cash flows, we are going to have here, we have to calculate the terminal value of these cash flows. And if you calculate the terminal value of these cash flows, so, what is here, first cash flow inflow 2000 and you have to compound it for at the rate of 12 percent and for how many periods? 1 year.

And then second is the 400, so 4000. So, these are the 2, one is a 2000 compounded for 1 year's period of time at the rate of 12 percent and the second cash flow is coming at the end of the last year, whose value is equal to 4000. So, if you calculate this, this works out as

rupees 6240, this comes up as rupees 6240. So, now you can apply the same model which I discuss with you. What is the present value of the cost? 2728, present value of the cost is 2728 and then what is a terminal value? Terminal value is 6240 divided by one plus MIRR and power is n, so n is how many number of years? Total it is 5.

What is the life of the project? Total number of years given to us is the 5. So, we have taken this and if you solve this equation, it will become something like this 2728, if you take this 2728, so what you have to do is? In a way you can try to find out here it is that means you can write it like this also 2728 and then it is 6240, 6240 into PVIF present value interest factor of MIRR for 5 years, MIRR for 5 years and this we have to calculate or even if you calculate, means by say cross multiplication, so you can solve this also.

So, finally, this value if you want to take it up as this becomes how much? 1 plus MIRR power 5 becomes if you take this, this value becomes 2.2874 and if you want to calculate the value of MIRR out of it, this value becomes how much? 18 percent, if you want to solve it, if you want to solve it, this value comes up as 18 percent. So, this is called as the modified internal rate of return, this is called as the modified internal rate of return.

So, similarly you can calculate the modified internal rate of return for the project, second project also and the second project if you try to find out here is then the MIRR for the second project will be here in this case will come up as for the project Q. MIRR for the say project P and for the project Q, if you calculate MIRR for the project Q. So, MIRR is equal to if you calculate it comes up as 10.41 percent means not I am solving it, you can solve it yourself.

Again you have to calculate the present value of the cost of the there and you have to calculate the present value terminal value of the cash flows. So, in that case if you look at the present value of the cost in this case, this is 1600. No need to calculate anything and if you calculate the present value of the say the sorry this compounded value terminal value or the compounded value of the cash inflows.

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$$PVC = Rs. 1600$$
$$TV = 2624$$
$$1600(1+MIRR)^5 = 2624 \checkmark$$
$$MIRR = 10.41\%$$

NPV Profile of Two Projects-

Dis. rate (%)	P	Q
0	2950	500
5	1876	208
10 ✓	1075	-28
15	471	-222
20 ✓	11	-282

IRR Project P
$$= -1000 - 1200 \times Pvif(r,1) - 600 \times Pvif(r,2)$$
$$- 250 \times Pvif(r,3) + 2000 \times Pvif(r,4) + 4000 \times Pvif(r,5)$$
$$= 0$$
$$IRR = 20.13\%$$

IRR for Project Q

$$-1600 + 200 \times Pvif(r,1) + 400 \times Pvif(r,2) + 600 \times Pvif(r,3)$$
$$+ 800 \times Pvif(r,4) + 100 \times Pvif(r,5)$$

$$IRR = 9.34\%$$

MIRR
$$PVC = \frac{TV}{(1+MIRR)^n}$$

So, you can calculate say present value of the cost in this case becomes how much? Rupees 1600, 1600 here and terminal value if you calculate the terminal value will come out here as 2624. I am calculate giving you the final values, you have to calculate yourself and if you want to apply this the formula here, so it becomes 1600 into 1 plus MIRR power how many years are there? 5 and this becomes 2624 it is the terminal value.

This is a present value of the cost, this is a terminal value. And if you want to calculate out of this if you solve it, so MIRR comes up here as that is 10.41 percent. So, means we have calculated all the things, we have calculated IRR also, we have calculated MIRR also and we have already calculated the NPV also.

And NPV we have calculated not for only one level, for multiple rates 4, 5 rates, discount rates, we have calculated or cost of capital we have calculated and if you want to now say take a decision on the basis of all these criteria, if you talk about the NPV at every level means 0 to 20 percent we have calculated at every level the NPV of the project P is more than the project Q. So, if you want to take one out of the two, then the project P is better.

Looking at the internal rate of return, if you look at the internal rate of return, project P gives you 20.13 percent and the project Q gives you 9.34 percent, so no comparison. Again the project P is better than the project Q.

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Then you talk about the MIRR, if you calculate the MIRR, in one case the MIRR is coming up as 18 percent. In the second case, the modified internal rate of return is coming up as 10.41 percent and again there is no point of comparison.

So, it means at every step if you want to see, if you want to evaluate to any mutually exclusive projects, if you want to try to find out the solution of this kind of the say answers, or the answer to this kind of the questions, you have to go for the detailed analysis, you have to apply different say discounted criteria, NPV, IRR, MIRR if it is required.

And then on the basis of that you have to find out because ultimate objective of every firm is that to maximize the value of the firm, and that is only possible where every project contributes in terms of the positive NPV's, highest NPV's towards the total value of the firm's, so that say value maximization or maybe the say wealth maximization objective of the firms can be achieved.

So, after means solving these 3, 4 problems, one more problem is given here, which is homework to you can do. A problem number 5, other 3 problems are here, problem 5, problem 6, problems 7, these problems you can solve yourself. And if there is any question with regard to these problems, you can discuss with me during the say when the course, will start at the discussion forum, you can raise these questions.

I do not see any problem here that you will not be able to solve these problems. You can easily solve these problems and for any means difficulty, any kind of the clarification you want to see, you can refer to the books on the Financial Management and the best book I as I say repeatedly telling you is that "Financial Management by Prasanna Chandra", so you can refer to that book I have taken these problems from that book only.

So, you can refer to that book, you can see these problems there. There are the, solved problems also, unsolved problems also and then you can try to see that how to apply the discounted and not discounted criteria for evaluating the capital investment proposals.

So, with this total discussion till now, what we had for the last number of classes, till now what we could discuss that was the detailed exhaustive discussion on the capital budgeting process. And we learned in this that if any capital investment proposal, if any capital expenditure proposal has to be evaluated, how to evaluate it, what are the different ways, techniques, methods, different criteria is available, and we discuss everything at length.

And for any doubt, any further clarification, any further discussion or any further reference you can refer to the say any good book on Financial Management and the book which I am referring "Financial Management by Prasanna Chandra" would certainly solve all your problems and resolve all your issues.

So, with this I stopped the discussion on the capital budgeting now. And now, next part of discussion means in the next class onwards, we will start talking about the estimation of the cash flows. So, whatever the cash flows we are used here in case of the capital budgeting, we thought that they are readily available with us, but these cash flows are not readily available, we have to work out these cash flows.

The process is very lengthier, there is a very long lengthier background process involved in working out the cash flows. So, how to estimate the cash flows? What are the important factors to be kept in mind? And all other say issues relating to the estimation of the cash flows, I will discuss with you in the next class. Thank you very much.