Project and Production Management
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Lecture - 23
Financial evaluation of capital decisions

Good afternoon!

Today's lecture is titled financial evaluation of capital decisions. You would recall that in the last lecture we had talked about the role of models in production management and we had seen a variety of models that would help us take decisions pertaining to various aspects, at various stages in the whole life cycle of production management. One of the key decisions which have to be taken right at the beginning and also during the various stages of the life cycle is the decision of investing money and various capital equipments and therefore today we are going to talk about some of the fundamental principles of evaluating the financial investments. We shall be talking about the major criteria or effective, measures that can be used to find out if a particular investment is worthwhile or not.

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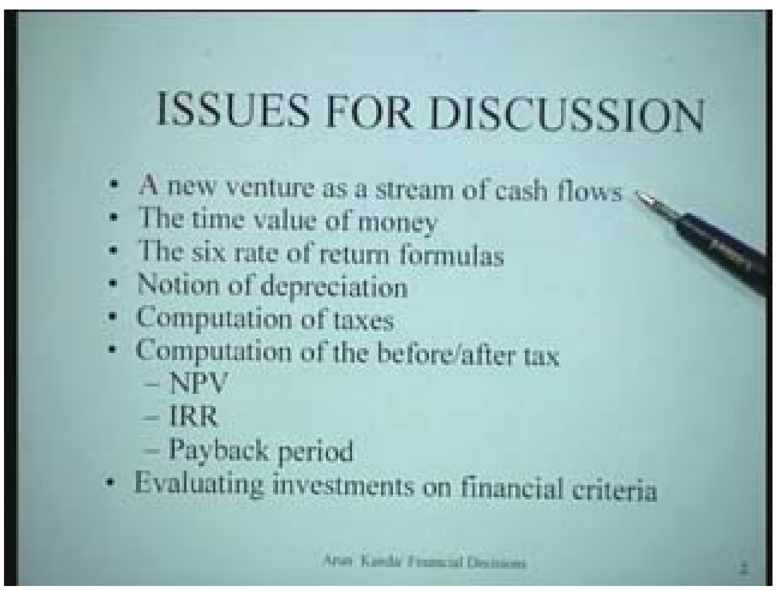

Some of the issues for discussion in today's lecture are, to look at any new venture, any new investment as a stream of cash flows. It involves some initial expenditure. It has some operating costs. It keeps some revenues and there might be salvage. So what is happening is that there is a stream of cash flows involved in every project of this nature. Next, we talk about the time value of money which is fundamental to evaluating such investments. We talk about the 6 rate of return formulas which help us to evaluate different types of cash flows. We will also talk about the notion of depreciation which is in fact central to the computation of taxes. We will see how taxes are computed in real life and then we will talk about computation of both before and after tax cash flows. Based on this, the 3 most important measures, the net present value, the internal rate of return and the playback period, which give us an idea of how effective the investment proposal is and then based on these criteria, we would an evaluation of the investment and find out whether the investment is really worthwhile or not. This is the general procedure which has to be adopted whenever we are talking about evaluating capital investments. Let us see for instance, how cash flows are generated. Take a simple example, just to illustrate the basic concepts.

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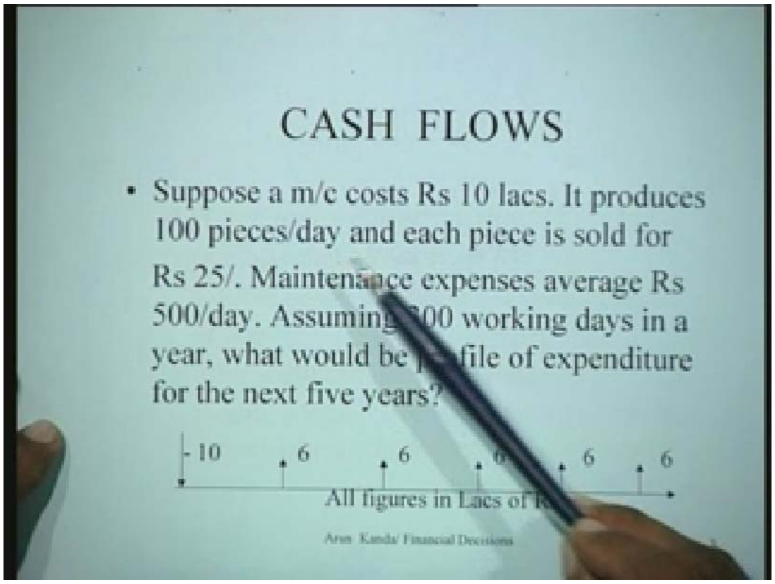

Suppose we are intending to buy a machine which costs 10 lakh. This machine produces, let us say 100 pieces per day and each pieces sold for rupees 25. We know that our daily is going to be 100 into rupees 25, that we know and the maintenance expenses is average rupees 500 per day. So if we assume 3 working days in a year, what would be the profile of expenditure for the next 5 years? We can easily say in the beginning of time 0, that our investment is 10 lakhs, so this is shown as –10 in terms of lakhs of rupees. Here in the beginning and subsequently in each year, we are getting net revenue of 6 lakhs of rupees. After accounting for the revenue and the maintenance expense, basically this is how we would convert a real problem into a series of cash flows. The cash implications of this particular new machines would be in terms this particular cash flow and we would then evaluate this cash flow to find out to whether the machine is worthwhile or not. Before we do that the fundamental concepts that we all must know is the notion of the time value of the money. We all would agree with this statement I guess. A rupee today is more valuable than a rupee a year, hence for instance somebody takes a loan from you of, let us say 100 rupees. Today you will not expect the money to be repaid but after one year or 2 years, you would. Why variety of reasons?

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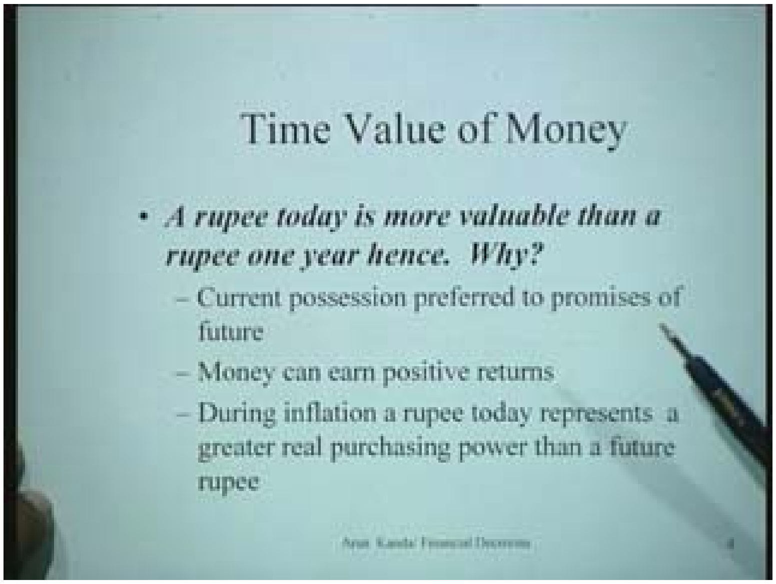

Some of the reasons are listed here for instance, the current possession of money preferred over promises made in the future. That is one thing. There are always uncertainties in the future and therefore you say a bird in the hand is worth 2 in the bush. So you have this logic. The second aspect is that you have money and can earn positive returns. If you have some money today, you can deposit in the bank and in the end of the year, you would have money, because the money has earned some interest on it. In fact next year, even the interest would now be capable of generating more money. Similarly, if you have a situation where there is inflation where a rupee today represents a greater real purchasing power than a future rupee. So all these kinds of reasons can impact the accommodated by assuming that money has the time value and depending up on the relative impact of these individual factors you can choose an appropriate value for the time value of the money and do the whole computations

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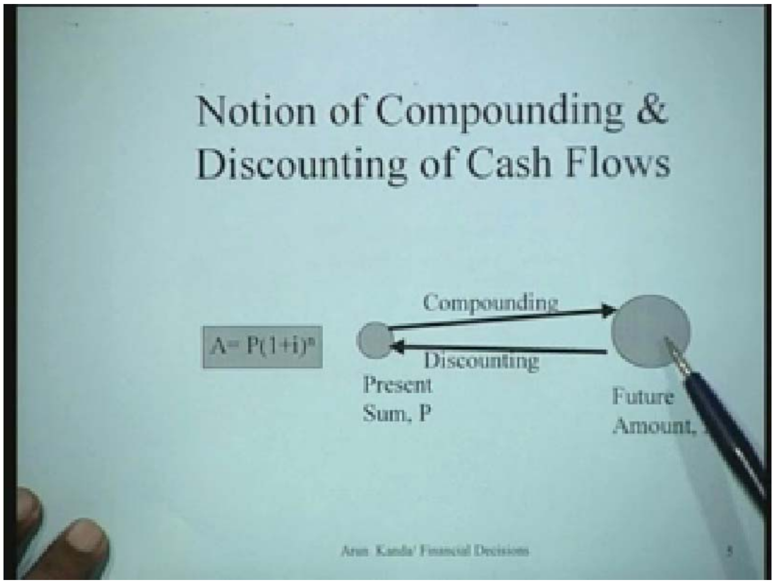

For instance we could say that the major thing to understand here is the radius and some of money at time p. This money can grow to a future amount a and you know if it is compounded at a rate of interest i, then you will have a = p into 1 + i to the power of n. That is the formula. So this process of going from the present to the future, it is called compounding and the reverse process of trying to find out the present worth of future sum of money is called discounting. Discounting and compounding would be just possible for using this general formula. You can use these 2 terms to find out what you have to do. If you have future streams of cash flows, you have to discount them to the future value and if you are interested in finding out what the amount would be worth after a number of years, you will have to compound the amount. This is how you would do the whole operation.

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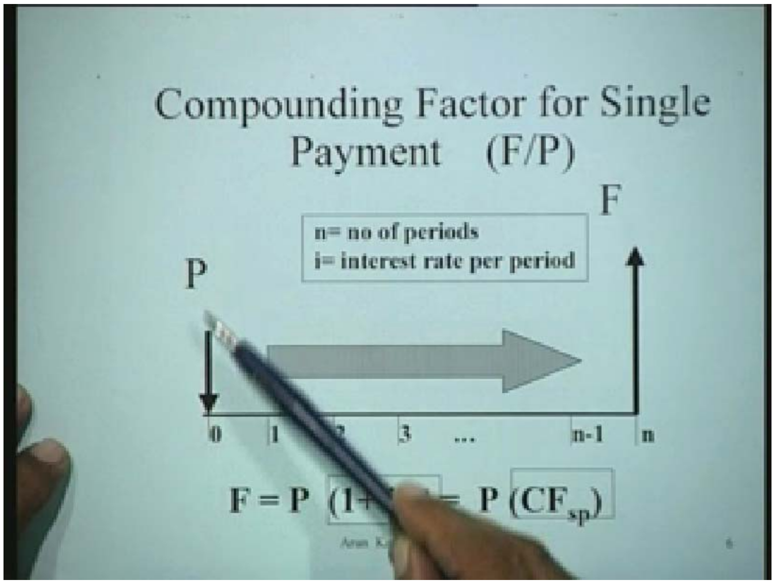

Let us talk about the 6 major formulas for making these investments. You see, the first in the simplest formula is that you are given the present sum p, which is suppose, this (Refer Slide Time: 08:47) is the cost of the machine, at present, or this is the amount that you want to put in the bank right now. Then what would be the amount f that you would get in the future after n periods. This amount is simple f = p into 1 + i into the power of n. So this is actually a compounding process and this factor here in the rectangle 1 + i to the power n is actually the compounding factor of a single payments. It means you can multiply a single payment p with this particular factor and get the future sum of that particular amount which would finally workout too. This is called 1 + i to the power n, which is called the compounding factor for single payment. That is the name of this particular factor.

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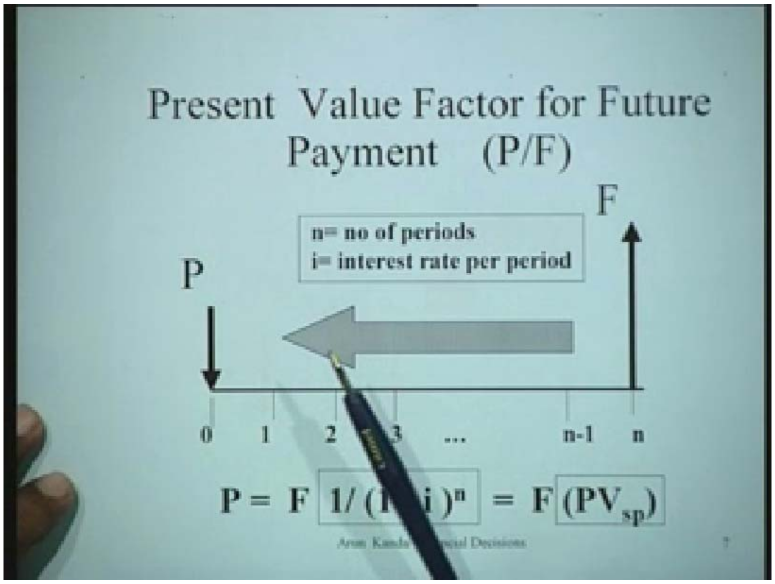

You might like for instance the second situation to find out the present value of a future sum so if you are getting let us say 5 lakh rupees at the end of 10 years. You would be interested to find out what is that money worth right now. Basically you are interested in finding out the value of p and p = f into 1 upon 1 + i to the power of n, hence this factor. Now in the rectangle, it is nothing but the present factor for single payment. When you multiply this future amount, you get the present value of that particular value. So that is the second formula that is commonly used in these connections.

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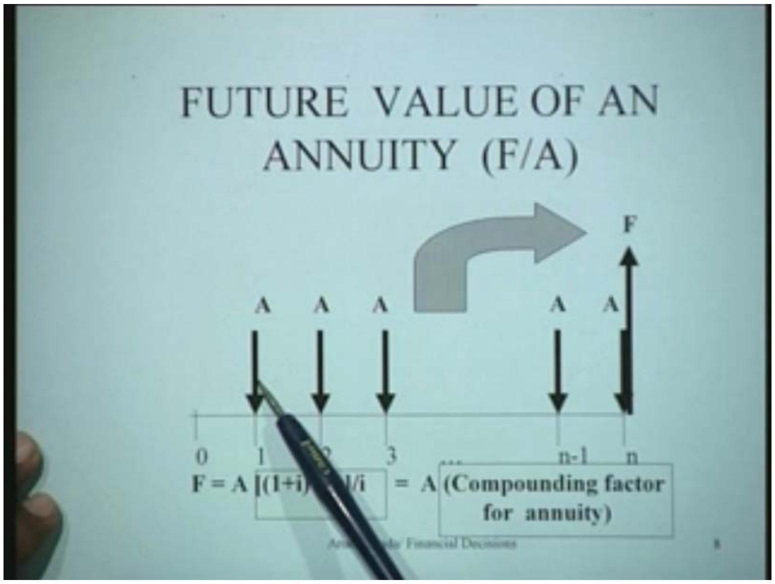

Quite often, what happens is that, you have streams of cash flows with equal amount of installment being paid or being crude annually. You can say that you keep on depositing in a recurring deposit amount say 1000 amount each year. You want to find out the future value of the sum at the end of n year, without going into detail mathematics of this. It is pretty simple because this amount has to earn interest for n – 1 years followed by interest for n – 2 years, for n – 3 years and so on. If you sum up the geometric, series you get that f, the future sum is equal to a into 1 + i to the power n – 1 divided by i and this particular factor within the rectangle is typically known as compounding factor for annuity.

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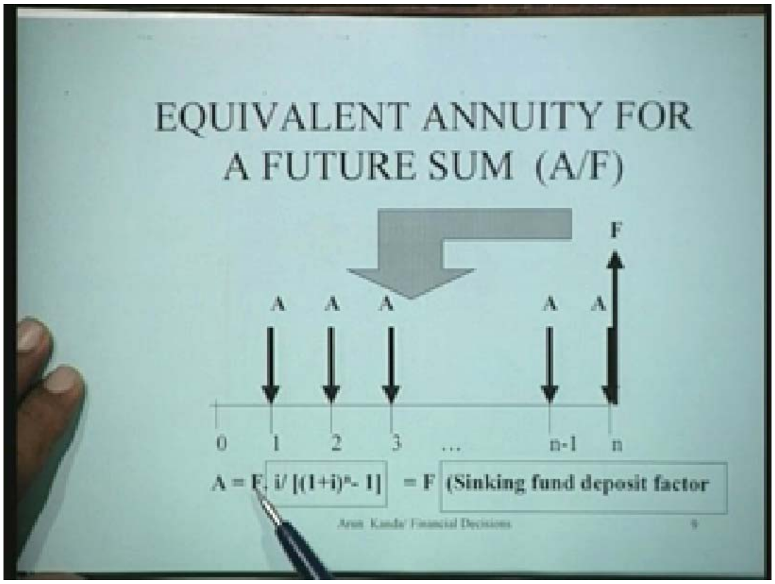

Thus, the equal annual payment is called an annuity and the future worth of that is the compounding factor for the annuity. So this is the factor that we had. You can very easily derive from the principle that I have just mentioned. Then the next formula is the formula where you want to know the equal annuity for the future sum which is in fact just the reverse to the one that we just see. So basically you want to find out if at the end of 10 years I want accumulate 10 lakhs of rupees, what should be the amount that I should invest annually? So this is a, so a, would be then just the reverse of the previous factor a, would be f into i divided by 1+ i to the power of n – 1 and this factor is known as the sinking fund deposit factor. It is equivalent to saying that you have to sink in this much of fund annually to get the final future sum f in that order, so you can easily determine this particular factor.

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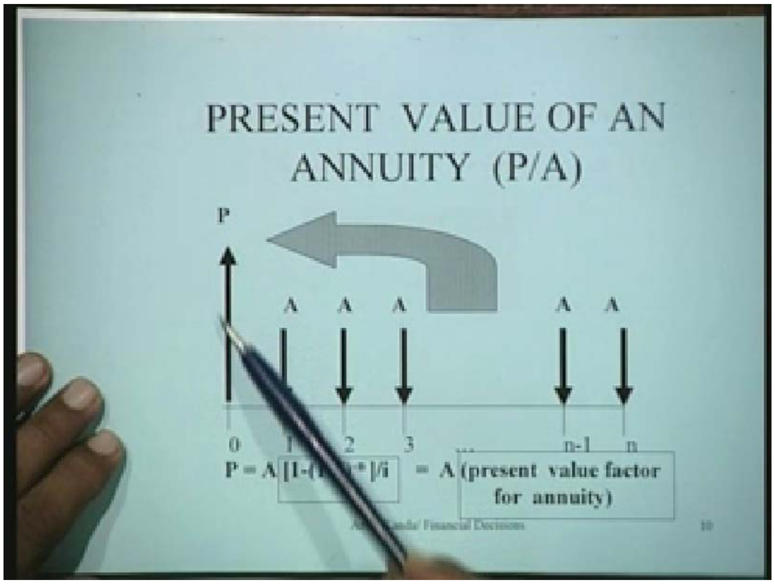

Then we might have a situation where we have a present worth p or a present expenditure p and we may want to pay it n equal installments. This would happen, for instance if you want to buy an automobile or a loan you want to get. Let us say you want to get a loan of 5 lakhs of rupees and you want to pay it in 5 or 10 installments as the case may be and so you are interested in finding out for instance, both. In this case we are interested in finding out what is the present worth of this stream of this annuity figures. So that value here would be p = a multiplied by 1–1 + i to the power of – n divided by i and the factor here is referred to as a present value factor for an annuity. If you are given an annuity that means, the equal sum of payments if multiplied with this present value factor for annuity, you get the present worth of that particular amount. This would be the factor that is typically used by all the banks when they compute your installments and try to find out what exactly it is and how much due to on a certain rate. It is 1 + i to the power – n. This one (Refer Slide Time: 14:26). Finally we can look at the reverse problem.

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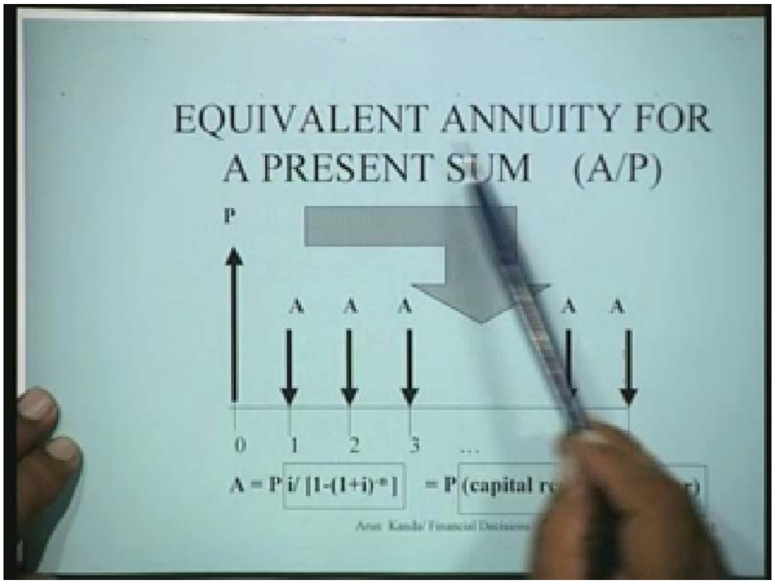

In the reverse problem, for instance, you want to find out what is the equivalent annuity for a present sum. This is a problem, where you are saying that you are taking a loan of p and you want to find out what should be the cash installment a, to recover that amount. So you can see here, this would be a = p (Refer Slide Time: 14:56), i divided by 1– 1 + i to the power – n and this would be equal to p into (Refer Slide Time: 15:06), this factor is typically called the capital recovery factor. So by using these 6 formulas, it generally becomes much more convenient to convert any stream of cash flows into the either the present worth or the future worth or for purpose of analysis. So these are the basic 2 units that you require for dealing with a stream of cash flows. Let us now take an example and let us try to illustrate how you would use these concepts and similar concepts to basically determine the worthiness of the project, so just the sample project.

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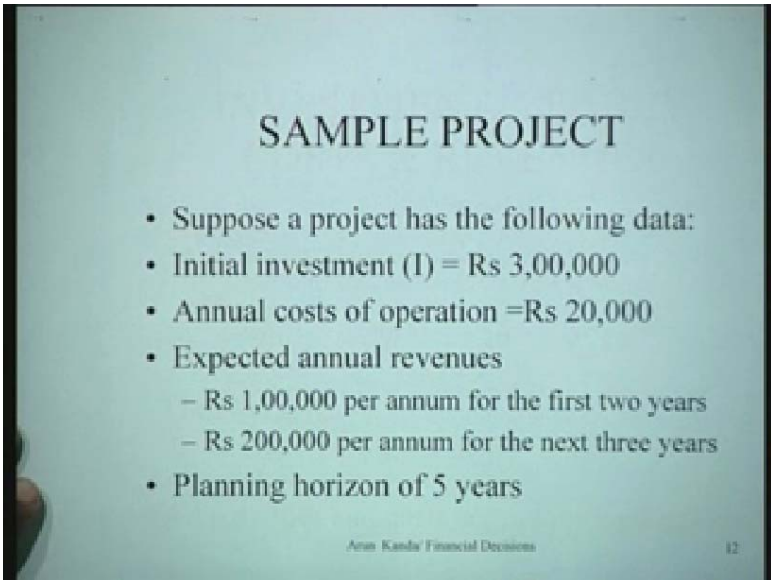

Suppose the project is following the data, we need an initial investment. Let us say the initial investment in the project is a sum of 3 lakhs. The annual cost of operation is 20,000 rupees. The expected annual revenues by selling whatever the project does are assumed to be variable. We take it to be 1 lakh rupees per annum for the first two years and subsequently it is 2 lakh rupees per annum for next 3 years and the planning horizon that we are considering is 5 years. Let us consider a situation for a project that we have generated, which is realistic enough, so that we can use this data to see what kinds of financial parameters this particular project has.

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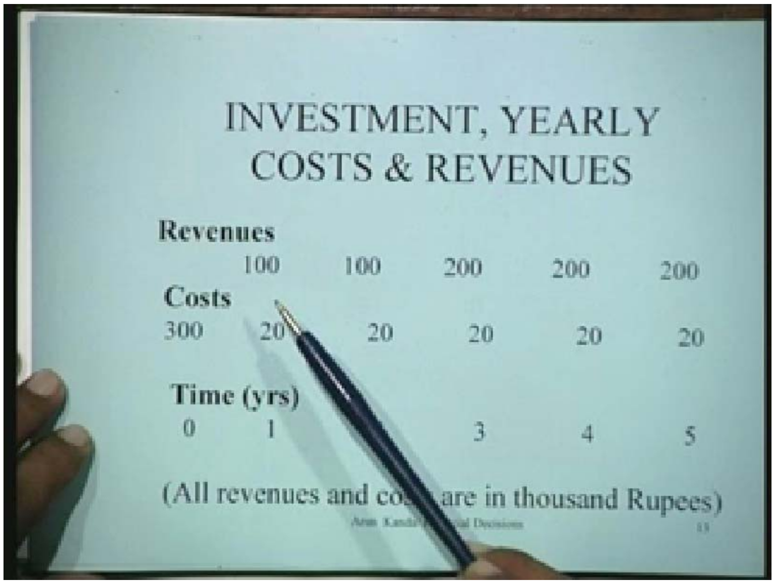

The first thing that has to be done is for instance, is to talk about the investment, the yearly costs and the revenues for this particular project. We had seen that the revenue in the first year was 100,000 rupees in the second year it was 100,000 rupees in the 3 subsequent years it was 200,000 rupees and so on. This could be because of the maturing of the project and there could be some initial reasons for having low revenues and then subsequently when things stabilized, you get higher revenues and when we talk about cost, there is the cost of investments in the initial period which is at time 0, 300,000 rupees or 3 lakhs and then subsequently the operational cost is 20,000 rupees for each of the 5 years. This is our planning horizon for 5 years. We have listed out on a time scale our revenues and the cost in that manner. We can now determine the stream of cash flows for this particular situation.

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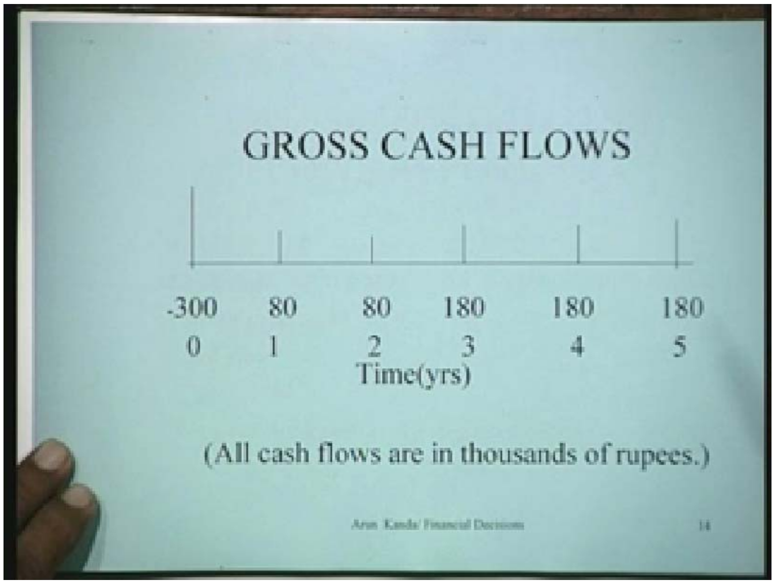

So what would happen is that the gross cash flows for this project would be – 300,000 in the beginning which is the investment. The net revenues after taking into consideration, the various types of costs, is 80, 1000, 80,000, 180,000, 180,000, 180. So this is always the first step that is involved in evaluating any project to determine the gross cash flows. So we have determined the gross cash flows in this case. All cash flows are in thousands of rupees these are gross figures.

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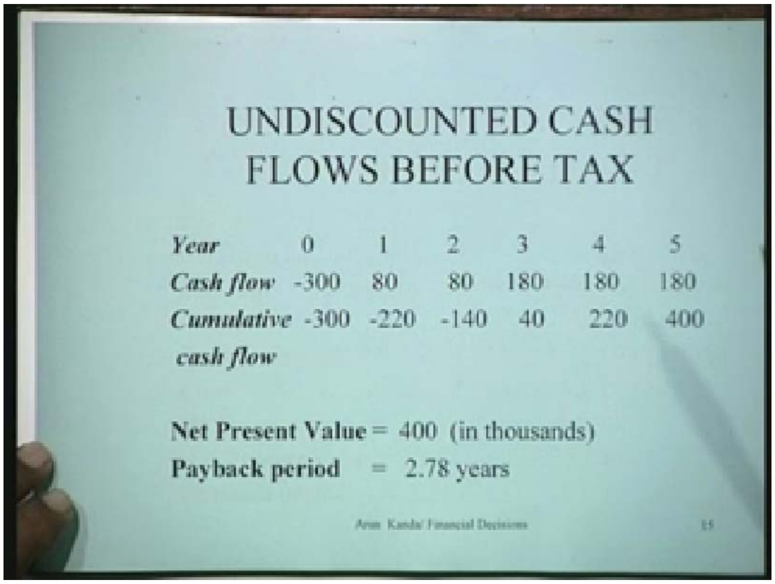

What we can do after this for instance is to compute what we call the undiscounted cash flows before tax undiscounted. It means we are not taking the time value of money into the consideration or we are assuming that the interest rate for time discounting is 0. That is what it means. Undiscounted cash flows before tax would be therefore –300 in the investment at the time 0, 80, 1000, 180,000, 180,000, 180,000. We can calculate the cumulative cash flow. The cumulative cash flow would be – 300 which is the expense we have in the beginning and –300 + 80, which is what you recover in the first year. So at the end of the first year you have – 2, 20,000 that is your balance. Again 80,000 is being recovered in the second year. So, cumulative cash flow is now 1, 40,000. Similarly at the end of the third year the cumulative cash flow is 40, it is becoming positive only in the third year up to this.

It was negative and then similarly in the fourth year, you have 220 and then you have 400,000 in the fifth year. So what you find is the final cumulative value which is 400, is called the net present value of this project, so the net present value is 400,000 of rupees here and what you find is that where the cumulative cash flows changes sign from negative to positive, mainly up to end of the second year, you were still losing money. At the end of the third year, you have gained some money. It shows that somewhere between the second and third year, you have the time period where you have recovered your initial investments. You can do linear interpolation between these values and you can get for instances the payback period of 2.78 years. So this is to illustrate to you the basic notation of net present value and the payback period for this kind of problems. This gives you an idea that an investor would like to have as low as a payback period as possible because this is the amount of time in which the initial investments is recovered. So the higher it is, the veracities the shorter it is and better it is.

The net present value of course is equivalent to the net worth of the project, ultimately after doing all this jhamela, the entire project is worth 400,000 rupees. So it like saying that you get so much money in hand after doing this project that is the implication of the undiscounted cash flows. Let us see the effect of discounting.

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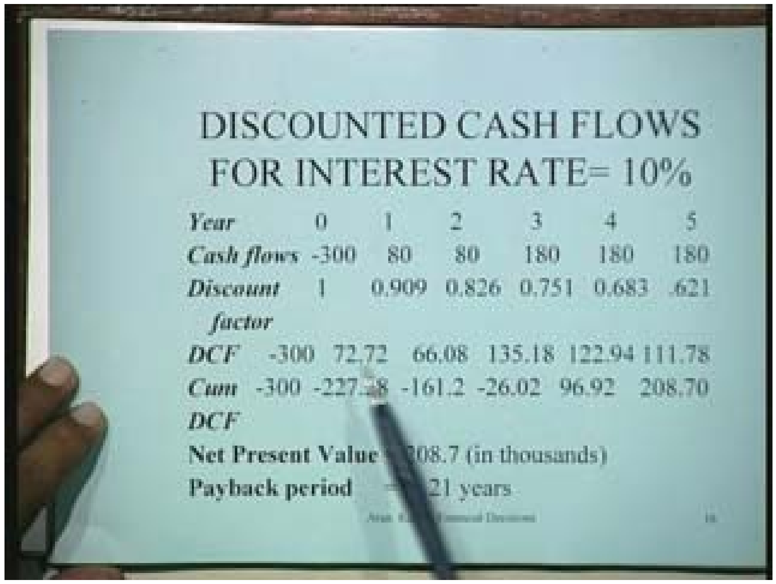

We might want to discount the cash flow, for instance at an interest rate of 10 percent. So the procedure is similar except that now you have a discount factor which is nothing but 1 upon 1 + i to the power of n. This is the discount factor at time 0, which is 1. Here it is 10.909 and here it is 2.826. So it is like saying that the present worth of a rupee available to me, 2 year's ends is only 0.826 and so on. All that you have to do is you have to calculate the discounted cash flows so the discounted cash flow is obtained by multiplying the discount factor with the corresponding cash flows so 1 into – 300, 80 into 0.909, 80 into 0.826, 0.751 into180, .683 into 180 and 0.621 into 180. What you find is that the discounted cash flow is not constant or it is not step function of this nature but it is changing, 72, then 66 then 135 and so on so forth. In the same manner if you compute the cumulative cash flows what you find is – 300 + 72.72 is – 227.28 and so on. You keep doing this and what you find now is that the cumulative discounted cash flow becomes negative for the third year and becomes positive in the fourth year. So somewhere between the third year and fourth year would work out to 3.21 years and the net present value, in fact this final value which is 208.7. This is the discounted cash flow for an interest rate of 10 percent as we have calculated.

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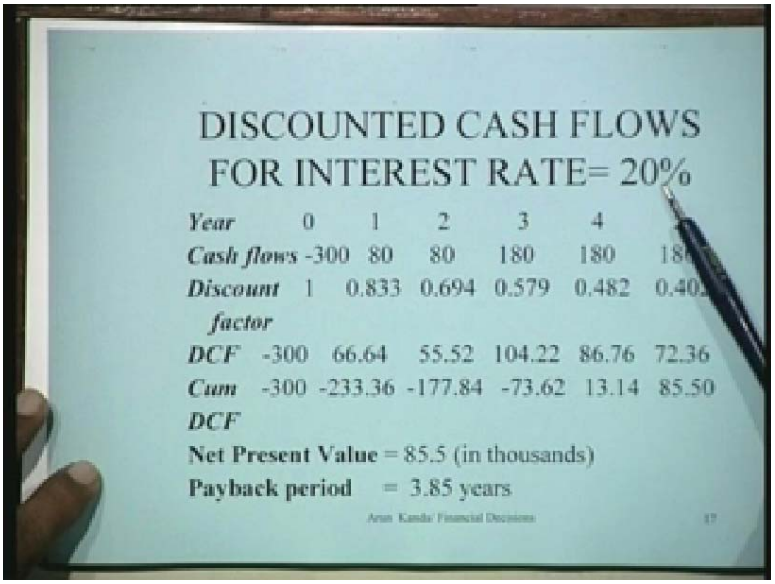

You could do it for other rate of interest, for instance for 20 percent rate of interest. We can again calculate the discount factor which will now be 1 for time 0, 0.833 for time 1, 0.694 for time 2 and so on. It will be 0.402 for year 5, this value as we know is nothing but 1 upon 1 + i to the power of n. So for different values of n for i = 20 percent, this is what you get. Often you can refer to tables for finding out these discount factors. They tabulated generally in all financial counting text books. Then you calculate the discounted cash flow which is – 300, 66.64, 55.52, 104.22, 86.76 and 72.36 which is the multiplication of the cash flow with the corresponding discount factor. Having got these figures you could again compute the cumulative discount flow discounted flow and – 300, – 233 again – 300 + 60.64 gives you – 233.36, – 177.84 –73.62. These are values in thousands of rupees and here again it is 13.14 and the final net present value now comes to 85.5 here.

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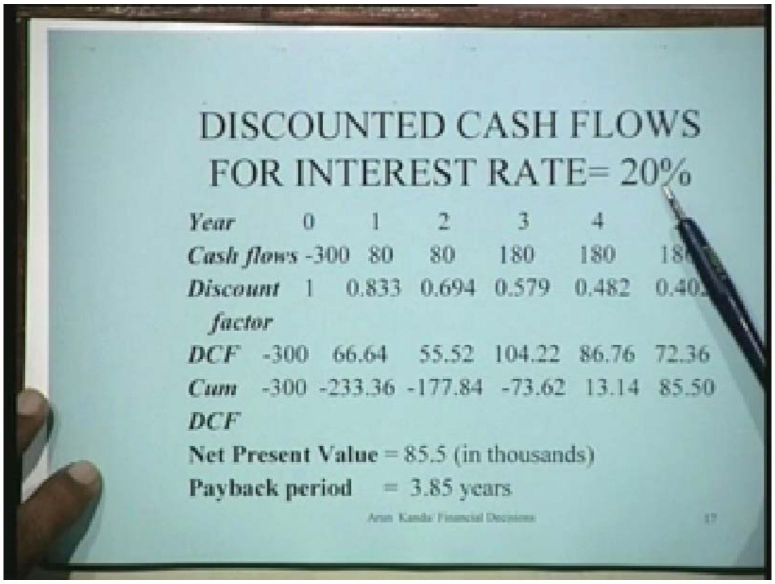

The interest rate for purpose of discounting depends primarily on the bank rate and also other factors like inflations and so on. That means it would have to determine by a company depending up on its own situation for instance for a company has been doing very well and it is earning rate of returns on its investments of let us say 15 percent whereas the bank rate of interest is on the 8 percent, probably it would expect a minimum rate of return of 15 percent. Then it would have to be adjusted for inflations. This might take 16 or 17 percent as the minimum acceptable rate of return. That is how the value of the rate of return is applicable to the firm will have to be found. It would take into consideration all the factors that we considered for the time value of the money. But for convenience purpose, one rough way of identifying the rate of interest is the bank rate adjusted for inflation and something higher than the bank rate. So what you find here is again the cumulative discounted cash flow lies between third and fourth year. If you interpolate you get a value of 3.85 years for this particular thing. So this would be a general procedure that can be adopted to determine the discounted cash flows and the NPV and the payback period. We have not talked yet about the internal rate of return and why we are doing these computations for different rate of interest is essentially to find out the internal rate of return.

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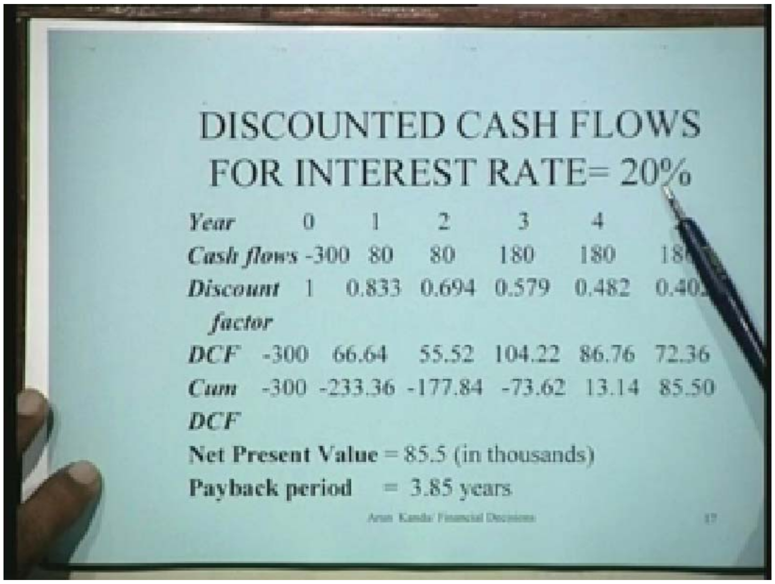

For instance if you take the interest rate to be 25 percent again, you calculate the discount factors which will now be 1, 0.8, 0.64, 0.512, 0.410, 0.328 etc and then the discounted cash flow could be computed as shown (Refer Slide Time: 28:08) and then the cumulated discounted cash flow could be computed as shown here (Refer Slide Time: 28:14) and finally, you find that the net present value has come down to only 40.4 thousands of rupees. Another thing you find is that now the payback period lies between year 4 and 5 and if you interpolate, you find that the payback period is now 4.32 so this is understandable. Because if you keep on increasing the rate of interest obviously the net present value is going to comedown and the payback period is going to increase in this fashion. If we do the same analysis let us say for i = 30 percent, what you find is you would find for instance that the discount factors in this case are given here. The discounted cash flow would be obtained as shown here (Refer Slide Time: 29:07). The cumulative discounted cash flow would of course come here. What you are noting here is the present worth of the NPV has now become only 2.2 thousand and the payback period would lie somewhere between four and fifth year, and in this case the value is 4.95 or very close to 5 because this is almost close to 0. Let us try to find out the discounted cash flow for an interest rate of 35 percent.

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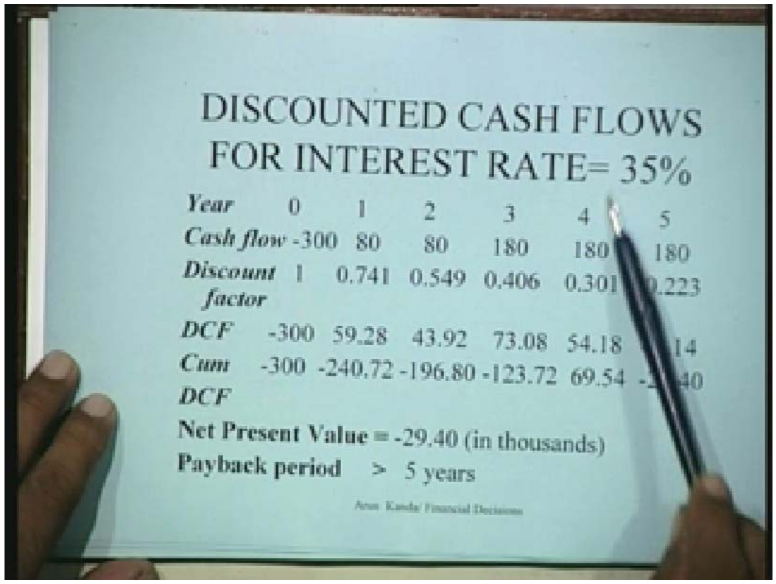

We increase the interest rate to 35 percent. If we do that again by following the same procedure what you find is that the discounted factors are 1, 0.741, 0.549, 0.406, 0.301 and 0.223 as we have shown here. The discounted cash flow now becomes simply this into this (Refer Slide Time: 30:22) into this, 80 into 0.741 which is 59.28 and so on. You have these values and you take the cumulative discounted cash flow and when you take the cumulative discounted cash flow what you find is the all these values are negative and even at the final term, the net present value is negative ie., – 29.40 in thousands of rupees. You must be wondering as to why we are performing these repetitive calculations and what the intention of doing all these was. The intention was to show that progressively the net present values are going down till the situation comes. The net present value could in fact become negative and the payback period in this case would be greater than 5 years because it is still negative. So this would throw some light on the notion of what we call the internal rate of return.

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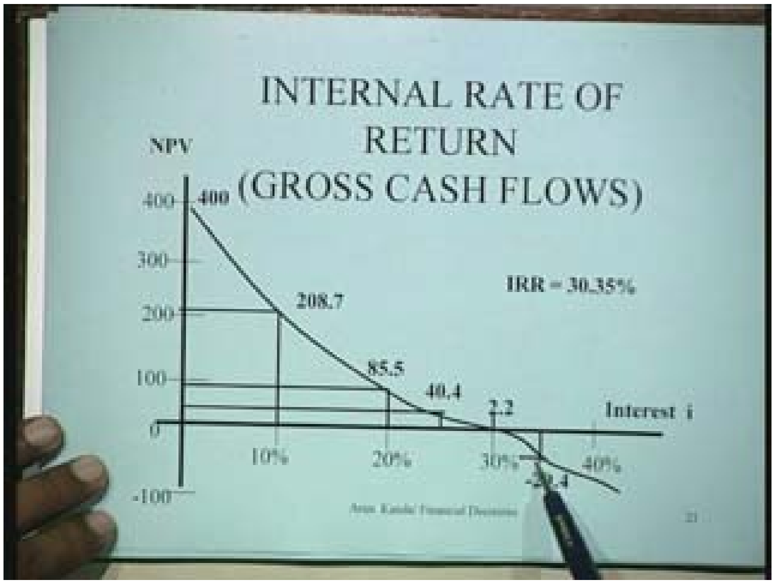

We have calculated for instance this is a plot on the interest on the x axis and NPV on the y axis. What we find is that roughly when we deal with the gross cash flows, which is what we are dealing with, at the interest is equal to 0, we were close to 400, when the interest was made 10 percent, they were close to 208.7, when it was 20 percent it came to 85.5 and when it was 25 percent it came to 40.4, for 30 percent it came to 2.5 and for 35 percent it came to – 29.4. So, it became negative. The points that we have just calculated 1, 2, 3, 4, 5 and 6, is joined with a smooth curve like we have tried to do here (Refer Slide Time: 32:31), this actually shows how the NPV varies with the rate of interest.

We have only done it for limited number of 6 points and what you find is the stage at which the NPV is equal to 0, that particular value of i, for which the NPV is equal to 0, can easily be determined from this graph. In this case this value is 30.35 percent. So 30.35 percent is called the internal rate of return. The internal rate of return is essentially defined as that particular value of i which makes the NPV equal to 0. Quite often in practice this graphical procedure is a common and convenient method of computing the internal rate of return. For this particular sample project of hours, we now know that depending up on the interest rate we can calculate what NPV is. For instance if the interest rate is 10 percent then the NPV for this project is 208.7 which is what we have calculated, but NPV is something which is depended up on the value of i. We have tried to map here the variation of NPV for all particular values of i and also in the process, defined IRR which happens to be that particular value of i for which the NPV is equal to 0. So this i I think fundamental to the illustration of the 3 concepts that we are talking about, namely the net present value, the payback and the internal rate of return and how you compute them.

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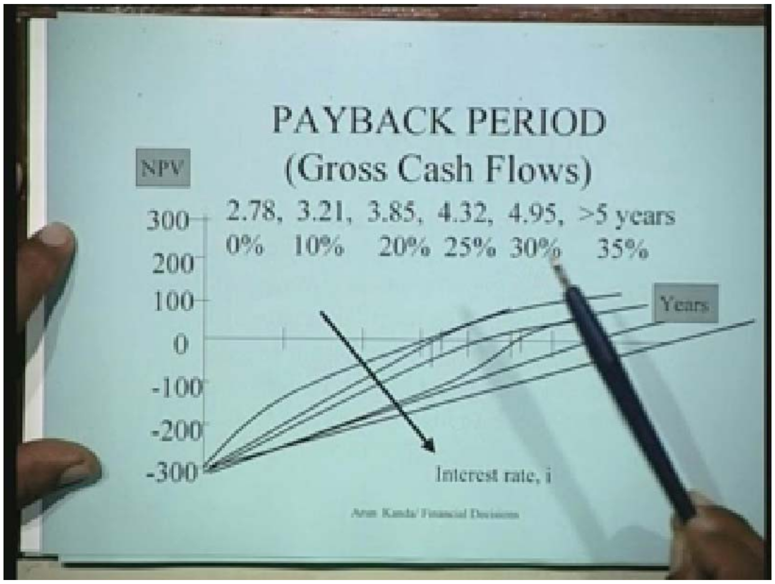

Similarly you would have noticed when you looked at the payback period, something interesting has happened. If we take an interest rate of 0 percent, we found that the payback period was 2.78 years. If the interest rate was 10 percent the payback period was 3.21 years and 20 percent it was 3.85, 25 percent, it was 4.32 that is what we calculated. For 30 percent it was 4.95, for 35 percent we found that the payback period was greater than 5 years.

So essentially speaking, if I again plot the cumulative NPV versus number of years, what you find in this particular situation is you find that in each case, the time 0, the unrecovered capital is the investment which is 300,000 rupees. So you have –300,000 and gradually depending upon the type of cash flows, you keep on recovering more and more. When this curve cuts the axis, it is the point where that is in fact the indication of the payback period. For instance for 0 percent it was 2.78 would be somewhere here (Refer Slide Time: 35:57). The next one would be somewhere here, little more than that 3.21 and so on. So in effect what you find is that the point where these curves intersects these axis, it will keep on increasing in this fashion and this will in fact be a function of interest rate i, so this is corresponding to 0 percent interest rate, 10 percent and finally 35 percent interest rate where the payback period is again (Refer Slide Time: 36:22). This is again a graphical interpretation of significance of the payback period and also how you can compute the payback period for different cash flows investments for this particular situation here. Let us now move over to something very important in investment appraisal and that is the notion of taxes tax considerations.

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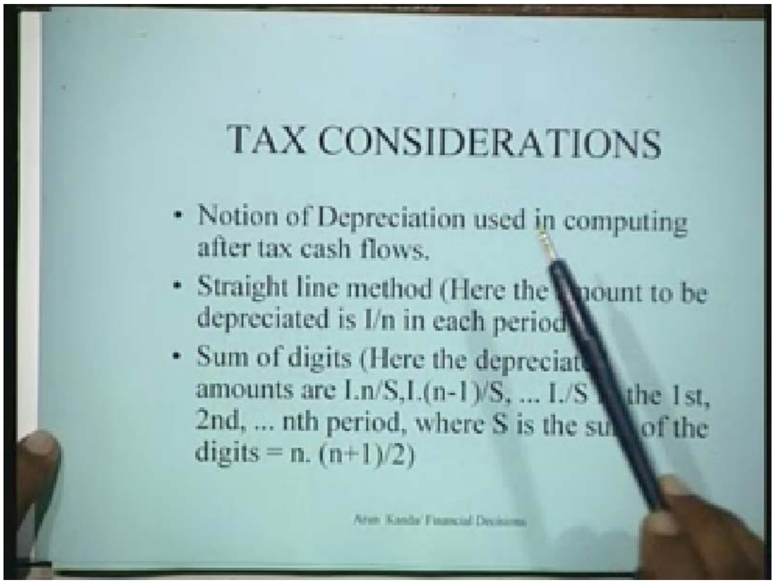

How do you compute the taxes for any particular situation? For this basically the notion of depreciation is very crucial. Depreciation is used in computing after tax cash flows that means we have so far dealt with before tax cash flows or gross cash flows. But after the company plays a certain tax on its revenues, cash flows would be called the after tax cash flows. So how exactly computations are performed basically will be talked about here with three different methods of depreciations. They are commonly used. One is called the straight line method. In the straight line method what happens is that suppose you have an initial investment i in each year, you assume that the amount depreciated is i/n, so that at the end of n years the whole amount is depreciated. It is like saying I have a machine for 100 rupees or 100,000 rupees as the case may be and in each year suppose I want to depreciate in 4 years, I will say the depreciation for the machine would be 25,000 rupees in each year, so that at the end of the 4 years the book value of the machine would be 0. This is the straight line method which assumes essentially that the total amount of depreciation is same in each year.

Although this is the common method of depreciation it is generally not preferred by industrialist. Why it is not preferred is the generally preferred other method of depreciation. We have what is called the sum of digits method here. What happened is the amount of depreciation that keeps on varying from period to period. What happens is the total amount of depreciation that you have for instance, the amount i. So what you do is in the first year, you depreciate a sum = i into n/ s, s is the sum of the digits. So if there are n digits, the sum of the digits would be n into n + 1/2. i into n/s. Then the next year it will be i into n – 1/s then it will be i/s in the last year. So the basic idea here is that the maximum depreciation is allowed in the first year, lesser in the next year, lesser in the next year and so on. You might wonder as to what is the basic advantage of this. The basic advantage of this is that the investor gets the maximum advantage here. He gets the maximum advantage in the first year because the depreciation is maximum, he gets lesser advantage in the next year and so on. Because money has the time value therefore you would prefer to get the, if I have to give you same amount of benefit, rather than giving you 50-50 benefit in 2 years, it is better to get 80 percent benefit in the year and 20 benefit in the year because this would ensure that if you take the net present value of money into consideration, you get the maximum advantage. That is the reason, why this kind of depreciation scheme is generally more popular with industry. Also recognizing the fact, the government allows either this or this (Refer Slide Time: 40:38) or the third kind of depreciation which is known as the declining balance.

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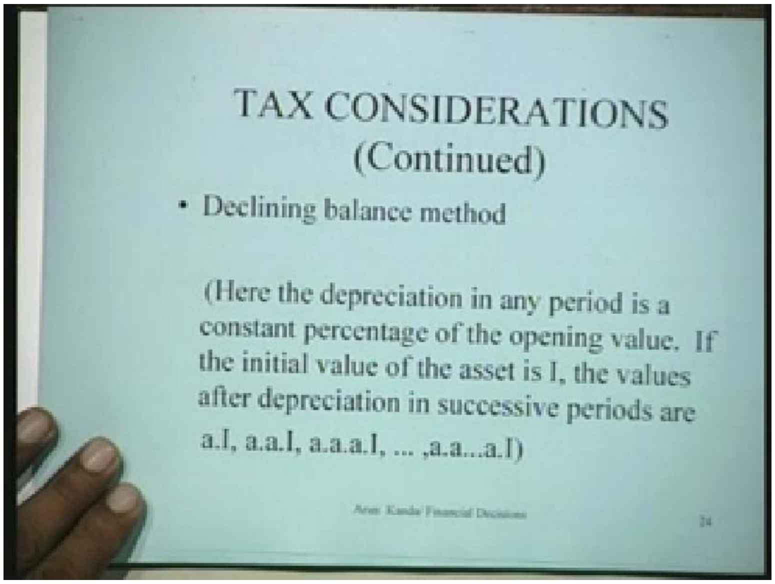

There could be variation of this; there could be a declining balance, a double declining balance and so on. But essentially here the depreciation in any period is a constant percentage of the opening value. If the asset is worth 1000 rupees in the first year, let us say we have 10 percent factor which is constant, that means you would depreciate by 100 rupees in the first year, so the value of the machine would be 1000– 100 which is 900 rupees at the end of the first year then in the next year, you again take 10 percent of that 90 rupees that would be the depreciation and so on so. Here again the quantum of depreciation tends to decline with time, that is the desirable feature as far as the industries are concerned. So the initial value of the asset is i, the values after the depreciation in successive periods are ai, a square i, a cube i and so on. That is what it would be. Whatever method of depreciation you use, you might ask a question as to which method of depreciation you would use. Normally depreciation is used primarily for purpose of computing taxes and therefore for a certain class of equipment, the government or the taxation body would have specified that this is the kind of depreciation that you can be allowed for. So you have to conform to the requirement of law in this case.

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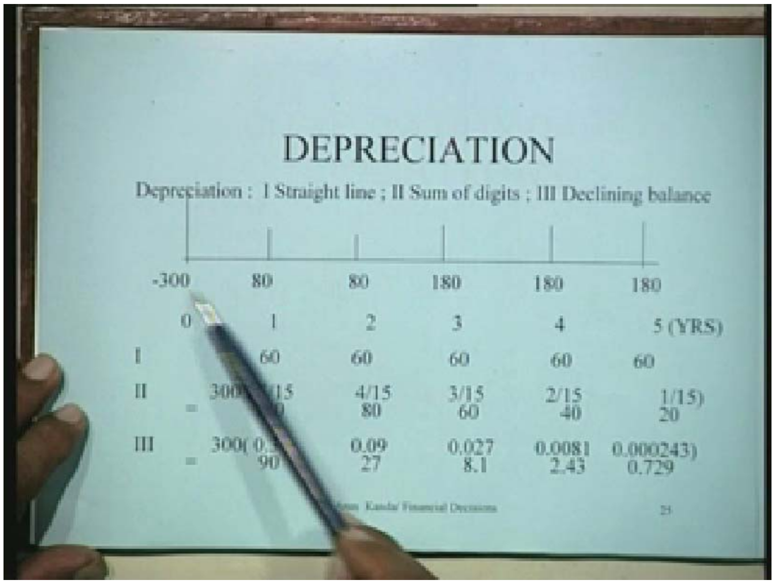

Let us take our example of the project. What you find here is there is an initial investment of 300,000 and net cash flow or gross cash flows are 80,000, 80,000 and 180,000 in the 5 years that we have for this. If we consider depreciation by all the 3 methods, the first one is the straight line depreciation, the second one is the sum of digits, and the third is the declining balance. What it would amount to is this machine is worth 300,000. At the end of 5 years, each year, you have to depreciate by 60,000, 300/5. So in the first case, the depreciation would be 60, 60, 60, 60, 60 1000 in each year, that is the straight line method. In the sum of digits it would be 300 which is the total amount of depreciated the sum of the digits in this cases 15 so 5, 15, 4/ 15 3 / 15, 2/15, 2/15 and 1. This adds up to 1, if not, it is the total amount of depreciation that is going to be the same. What we have here is the depreciation here would be 100, 80, 60, 40 and 20. This is what we mean by the sum of digits, depreciations and finally in the declining balance, suppose this particular percentage was 0.3, 30 percent of the amount, so in the first year you would depreciate by 90, then in the next year it would be 27, in the next year it would be 8.1 and so on. So these are depending up on the type of depreciation that is allowed for a particular situation. You can adopt that and calculate the depreciation and the advantage then would be how you use this information to calculate our net cash flows. We have calculated the gross cash flows.

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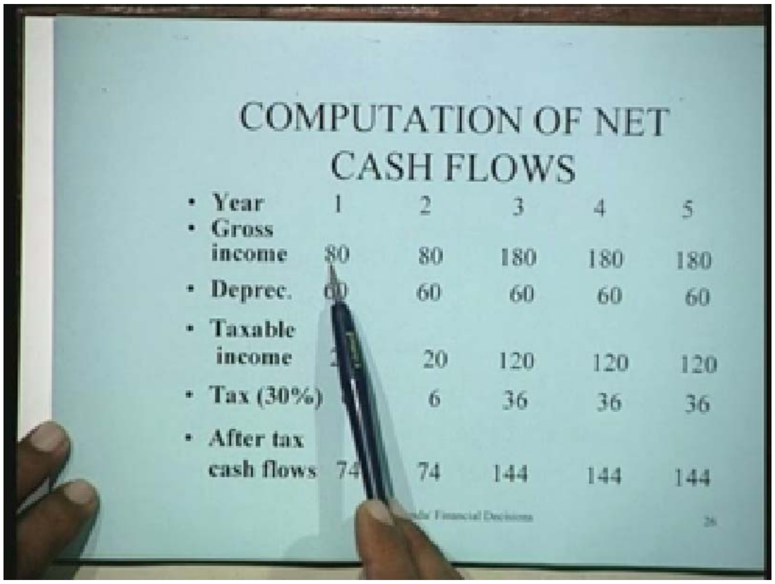

These are our gross cash flows. We are talking about total investment of 300 and then 80, 80, 180, 180, 180. So if you talk about straight line depreciation then the depreciation is 60 each time. So your taxable income each year will be 80 – 60 = 20, 20, 120, 120, 120 and suppose the tax rate was 30 percent, would be any tax rate, then you say 30 percent of this is 6, 6, 36, 36, 36 so this becomes the tax. Now after tax cash flows this is the gross income, 80 – 6 is 74 and this is 180 – 36 is 144 and so on. So this becomes my after tax cash flows. So this is how you make the transition from the gross income to the after tax cash flows after taking into consideration the appropriate amount of depreciation in that case. We will be looking at the computation of taxes and finally the computation of the net cash flows.

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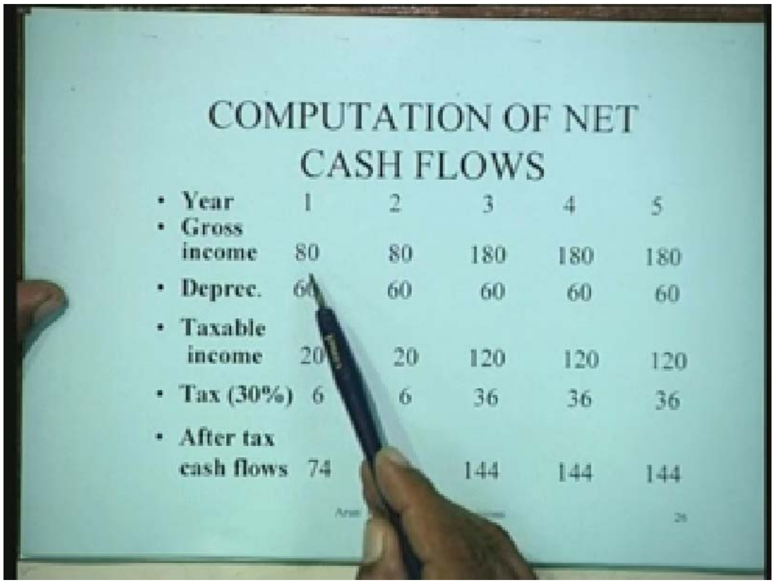

So what you find is if you take the example that we were considering, the gross income was calculated as shown here 80,000, 80,000, 180,000, 180,000, and 180,000. Then what you do is, the amount of depreciation that is to be allowed depends up on the kind of depreciation that we use. So for instance if we use a straight line depreciation, the amount of depreciation in the year would be 60,000 in each year. Remember if we use different type of depreciation, these amounts could be appropriately altered but we are going to just discuss the computation with the straight line depreciation. What you find is that if this (Refer Slide Time: 46:28) is the depreciation then this was the revenue or the income you got in the first year. So 80,000 – 60,000 becomes a taxable income. Similarly taxable income in the second year, third fourth and fifth years would be 180,000 – 60, that means you are allowed or permitted by low to pay taxes only on this much because it is assumed that you have incurred this much of depreciation in terms of wear and tear of machinery etc whichever is recognized by the government. So you can then calculate the tax. The tax is simply the amount on the taxable income and the tax percentage, so 0.3 multiplied with 20 would be 6, so 6,000 is the tax that you incur in the first year. This is the tax that you incur in the second year. 36 would be the tax that you incur here, 120 into 0.3 and 36 in the fourth year. Having computed these taxes quite often, one common mistake that beginners make is that they subtract from this taxable income, and show the after tax cash flows 14, 14 and so on. But this is not correct because the taxable income is generated only for the purpose of computing the taxes. So this is the actual tax and this is your actual gross revenue, so from the gross revenue you subtract the tax. This was the intermediate device to calculate the taxes. Ultimately the after tax cash flows can be obtained by directly in this manner.

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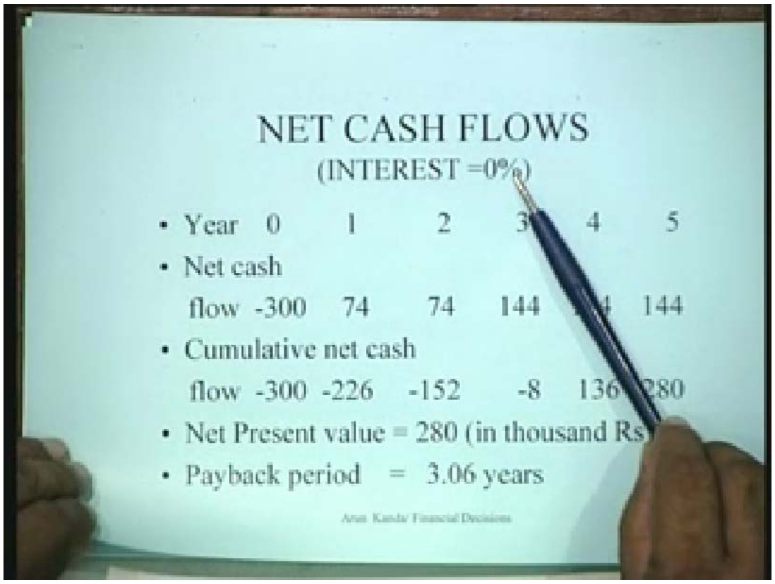

For an interest rate of 0 percent the net cash flows can be computed exactly in the same manner. You can calculate the cumulative net cash flow and the net present value is now 2, 80,000. Similarly the payback will be somewhere between the third and fourth year. It will be 3.06. Something similar can be done for different interest rates in the same manner that we did for the earlier example for the gross cash flows. So if you work with 10 percent rate of interest you can get the after tax cash flows, the discount factor, the discounted cash flows, the net present values in the same manner. So these were the net cash flows. Instead of working with gross cash flows, we are now working with net cash flows.

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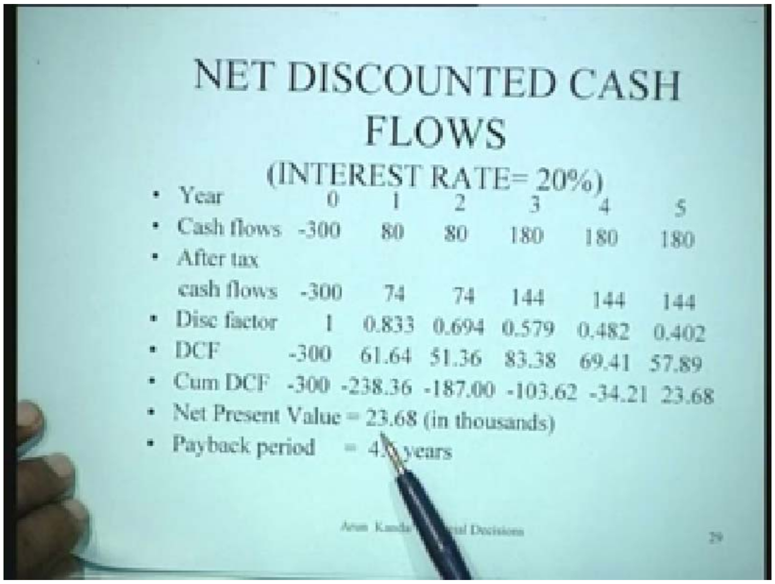

Something similar could be done for 20 percent where the net present value will be 23.68 in thousands of rupees and the payback period would be simply 4.6 years.

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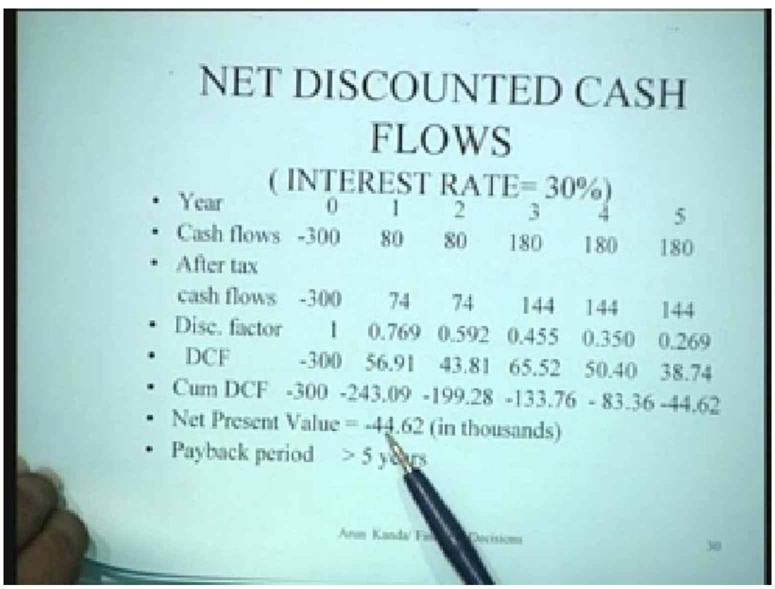

Similarly for a rate of interest of 40 - 30 percent, the net present value now becomes negative 44.62 and the payback period is greater than 5 years just as it happens in the earlier case.

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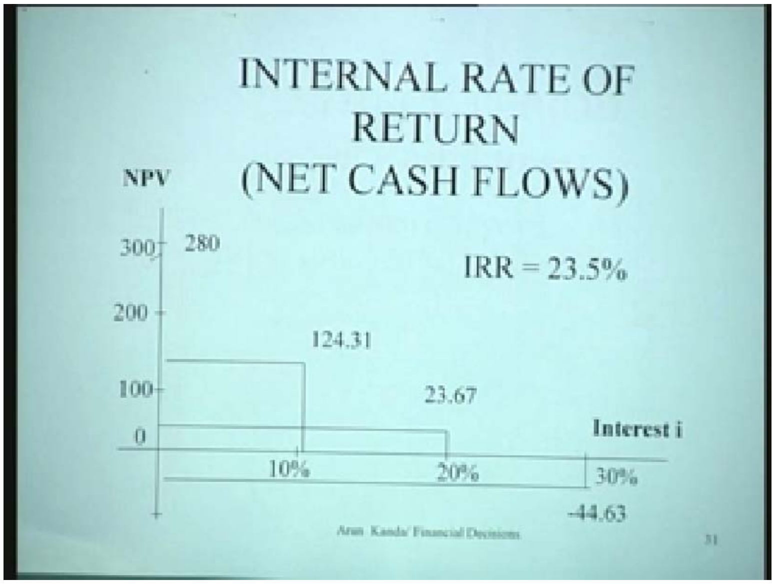

What happens in this particular situation is again if you plot the net present value versus the interest, we have calculated the NPV of 280 and that means this point (Refer Slide Time: 50:05), 124.31 and then finally it becomes negative for i = 30. You can tend to join these things with a curve of the same type (Refer Slide Time: 50:18).

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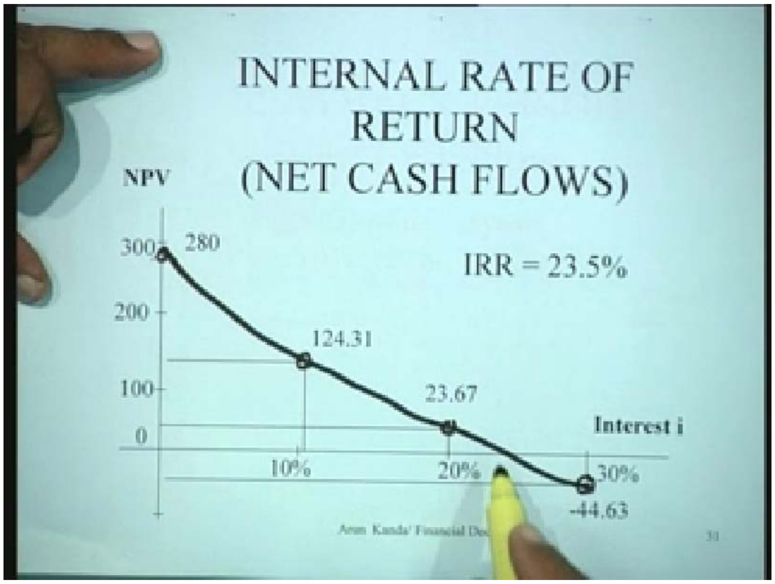

The point where this NPV becomes 0 somewhere here (Refer Slide Time: 50:29), is the interest IRR of 23.5 percent. So what you find here is if you compare this now with the internal rate of return for gross cash flows which was more than 30 percent, the internal rate of return for net cash flows works out only 23.5 percent. This I think completes the example.

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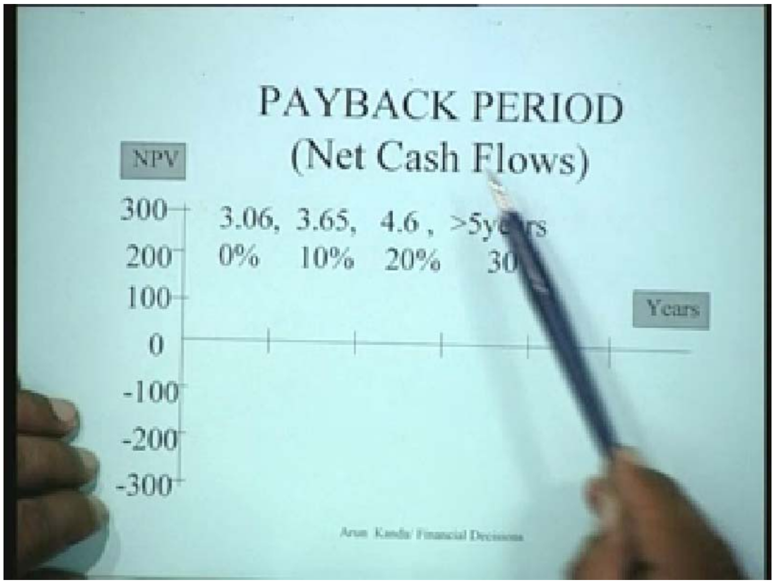

Similarly we have this possibility of computing the payback period and graph can be drawn in the same manner where for 0 percent, rate of interest, the payback period was 3.06 years. For 10 percent it was 3.65 years, for 20 percent it was 4.6 years and for 30 percent it was greater than 5 years. So there is a similar type of behavior but in this case the payback period was increasing. They were higher than the value because now it takes more time really so this is the summary of the results.

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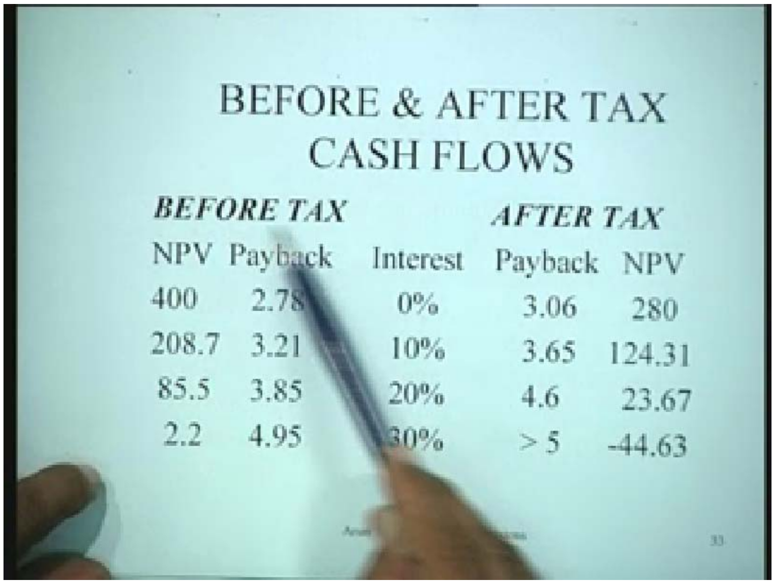

What you find is that before tax if we do the calculations, interest rate is 0 percent, 10 percent, 20 percent and 30 percent. This is what we consider. The NPV here was 400. The NPV here is 280 (Refer Slide Time: 51:45); the NPV here with 10 percent was 208.7 and here it was 124.31. For 20 percent; it was 85.5 here and 23.67 here and for 30 percent, it was 2.2 here and – 44.63 here. So this gives us an idea and similarly in the payback periods,

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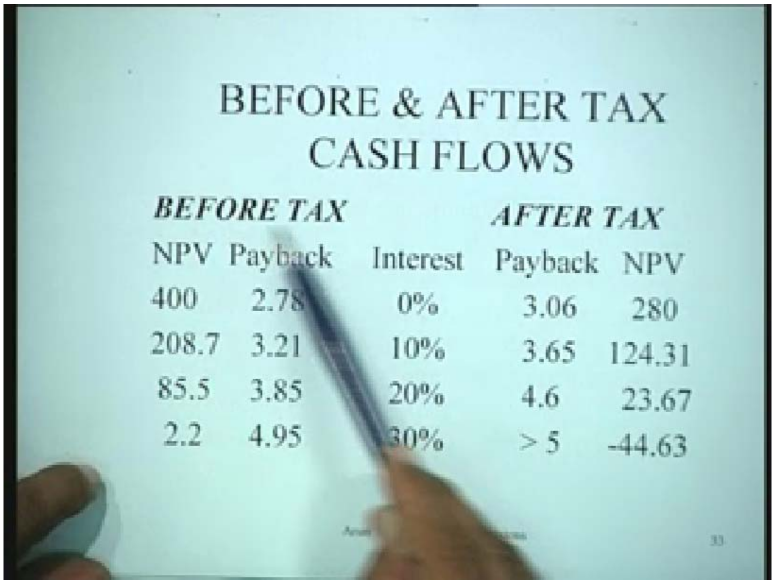

You will find that after tax the payback period for each is higher. A 10 percent rate of interest before tax, you could recover the money and 2.78 years here, here you are recovering within 3.06 years and so on. The same pattern is actually being debated.

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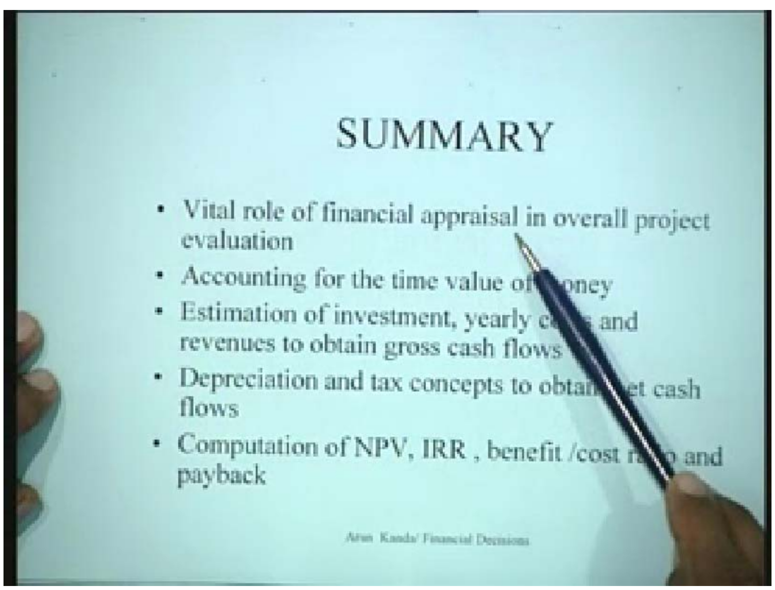

Finally to conclude our lecture in this particular lecture, we have seen the vital role of financial appraisal in over all project evaluation and project evaluation is something that has to be done. Whether it is the overall project or whether it is machine procurements in all cases, essentially the process is same. Then we have seen that accounting for the time value of the money is important because money has the time value and the rate of interest discounting has to be chosen carefully to account for those factors. Then we have seen how we have to basically do the estimation of investments, yearly costs and revenues to obtain the gross cash flows. So that is the basic step that we followed and after having obtain the gross cash flows you can use depreciation and tax concepts to obtain the net cash flows and the computation of the NPV, IRR or the benefit to cost ratios and payback could then be done easily for either the gross cash flows or the net cash flows. So I think this is a very important topic. In the next lecture we shall explore the possibilities of accounting for uncertainty in project evaluation or in financial evaluation. Whatever we assumed here was deterministic. We shall account for uncertainties and risk in the next case and see how the notion of decision trees is very valuable for evaluating investment proposal in this context.

Thank you!