**Infrastructure Finance**
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**Lecture - 9**
**Analysis of Project Viability Time Value of Money**

Hi, welcome back to the course on infrastructure finance. So far you have looked at how do we actually use information in the company's balance sheet and try and analyze funds performance. Now, we will move further on and then we will talk about an essentially how do you analyze the project viability? Remember this course is all about infrastructure finance and we are really looking that how do we actually make a decision in term of financing a particular infrastructure projects.

So, an important decision the whole process to identify the project viability, so that is what you are going to spend some time on further next few sessions, but before we actually do that, we will try and discuss the thought questions that we put forward in the previous lecture.

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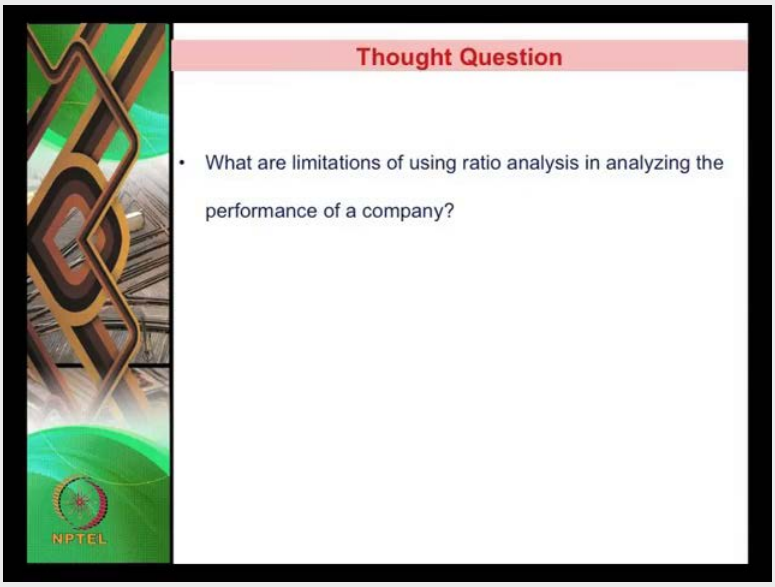


So, in the last lecture we ended with the question what are the limitations of using the ratio analysis in analyzing the performance of the company. No doubt ratio analysis is a very-very important part in analyzing the company's performance. And we can use information available in the balance sheet and the profit and loss account to analyze

performance across various parameters. It could be in terms of growth, it could be liquidity, it could be leverage, it could be efficiency, which largely includes turnover ratios, it can also in terms of profitability, it can also in terms of the company's valuation.

But when you are trying to use this ratio analysis, it is very important for us to understand that we all see some logic behind in this number. We should not a use it as what is called a Yuki cutter method and trying to blindly take the numbers from the financial statements and try to come out with different ratios. If you try and do that, you will not be able to get are do correct interpretations.

Let us take an example if you look at the case of the health care sector, it is very normal doctor to actually prescribe some laboratory test. And it is always indicated in that test results that, test results should actually be correlated with the clinical findings. So, that is the results of the tests should be seen in HIV, the symptoms the doctor sees in the clinical examination. Similarly, when you look at the ratio analysis, it is also very important to understand, what is the underlying rationale as to why the numbers or behaving in a way that we see in our analysis.

Let us take a simple example, let us assume for a particular year, the return on equity is grammatically lesser. So, what could be the reasons the return on equity can be grammatically lower for a particular year. If you simply compare the return on equity on two particular year and if you find that the return of equity is lower in the recent year that does not necessarily mean that the company's performance is been really bad. It could be because of other reasons that is why the return on equity as been lower.

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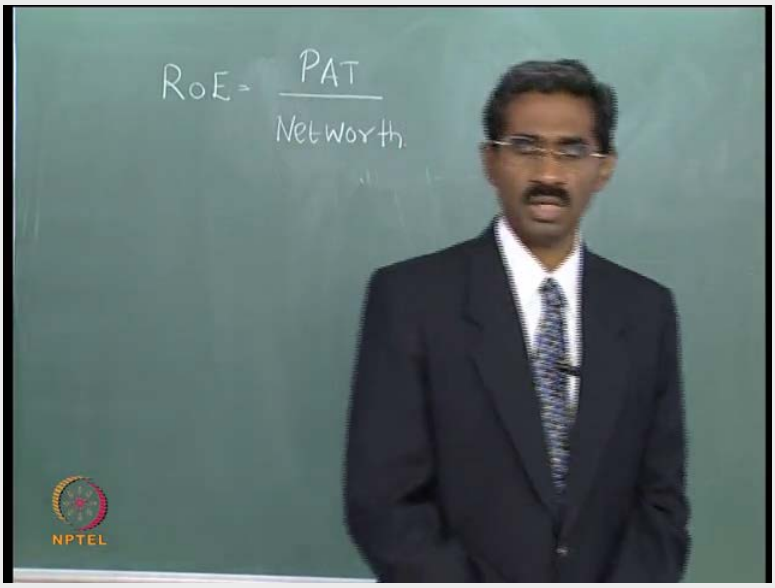


Now, what could be the other reasons, let us first look at what is return on equity? If you have two really look at the expression that is go something like, this return on equity is nothing but you are profit after tax divided by your total net worth. Now, return on equity can reduce because of two reasons, one is the profit after tax can reduced or second the net worth can have a very high increase, but not matched by the corresponding increase in profit after tax.

Now, let us look at the second case, the second case net worth is grammatically increased and the profit after tax has not increased in the corresponding manner. What could be the reason behind it? The reasons could be the company as actually implementing a very large project and because of that, it has taken substantial additional investment in terms of equity. And since, in an infrastructure project that takes a really long time for the project come in to operation that means, there is lot of destination time and only when the project gets into operation, there will be a corresponding increase in the profit after tax.

When the company starts getting revenues, there are various will need to profits and that will get reflected in your profit and loss account. Now, if you are looking at calculating the return on equity on particular year, where the investment is actually is happened in terms of equity, but the project has not come into operation and therefore, there is not be in a corresponding increase in profit after tax. Now, when you look at the kind of the

situation, we will actually find a return on equity to be lower for a particular year, which the company has taken substantial amount of investment.

Now, that does not necessarily mean to indicate the company is not performing well, it just the part of a regular business cycle. So, we have to really understand the reasons, why the return on equity as actually reduced for a particular result rather than simply saying that the companies performing as being bad. Similarly, if you look at in another reason why you could be lower ROE could be lower because let us say the profit after tax can be lower for a particular year.

Now, the relationship profit after tax can also be attributed to various reasons, many of which could be let say beyond on the companies of control. It could be for example because of sudden reduction in the market price for the product in the service with the company is producing and so on. So, we also really understand the reasons behind the reduction in the ROE without simply attributing into a poor performance of the company.

And if this reason seems sufficiently valid then we will have to wait and watch how the company is able to come back to its original performance metrics after the registration period is over. So similarly, for each and every ratio, you can identify the various reasons that could actually affect of the company is performance machine. And we will have to be cognizant of this reason, when we are actually also doing the ratio analysis. Now, let us go back to the topic of the day, which is to talk about project viability and in this session we will talk about the time value of money.

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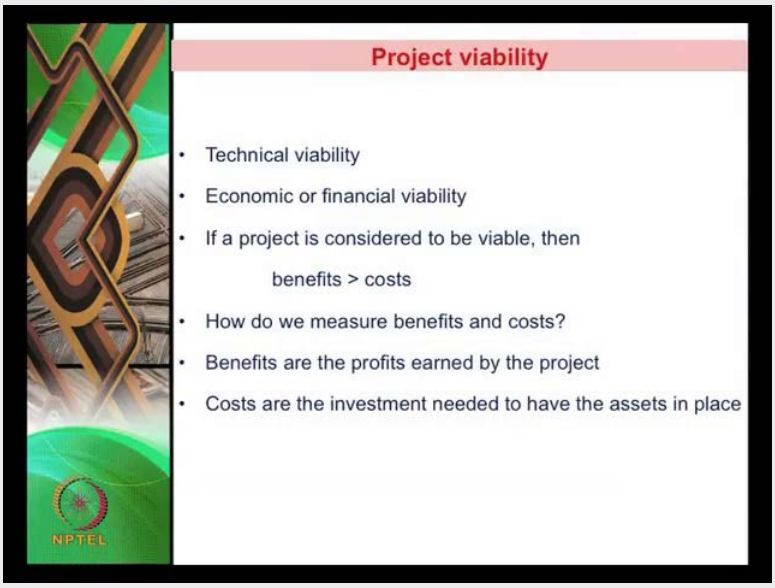


So, project viability broadly can be looked at from two prospective, one is the technical viability and the second the economic or financial viability. So, technical viability is largely dependent on the technical features of the project. So, essentially we are trying to see this project, is a technology available today, adequate for us to be able to complete the project as per what we have budgetary form? So, do you really have the technical know, how do you really have a project management skills?

Do you really have the construction methodology properly developed, to ensure that the project would be the project will be developed, the project would be constructed as per what we have planned? So, in many cases for routine projects technical viability is not really a major issue. For example, if you are constructing roads on a regular train, today we have many-many years of experience of constructing roads. So, it is not going to be a major question mark on technical viability.

But let us say for example, we are constructing a difficult project that involves constructing the bridge over water surface, or it involves constructing tunnels in a mountainous area, or it involves constructing a roads a very difficult train then they have to be a lot of backgrounds studies that is needs to be undertaken before we can actually determined, that whether it is technically feasible to actually develop of the project. Whether do we actually have the adequate wherewithal the engineering's skills to develop the project?

Then the next dimension of viability, your economic or financial viability so economic or financial viability simply means that does a project give adequate returns, so that you are able to a recover the cost. So, is the project financially viable so there the investors able to recover is capital and also get an adequate return on the capital that he has investors. So, that is that dimension of economic or financial viability. Now, in this course of infrastructures finance, we are going to be primarily concerned about the economic or financial viability.

We assume that the technical viability is given; in fact if you look at as a sequence, the first measure of project viability is always a technical viability. Only when the project passes the viability, the technical viability test do you actually perform what is called as economic or financial viability. Since, we have a really going to focus about the economic or financial viability, let us assume that the technical viability is given, so that means that test been already conducted and the project as passed the technical viability test.

So, there are several projects, which can be technically constructed, but it may not be commercially viable for a variety of reasons. Now, we have to really determined, technical viability he does not mean that, it is also automatically economically viable. So, we will have two separately conduct tests determined the economic or the financial viability of the project. Now, in a very broad sense, what do we actually mean by viability and when we say the project is viable or do you actually mean by that?

So, many say the project is viable, we are simply indicating that benefits that we actually get from the projects is more than the cost that incurred the developing the project so that is the very simple expression to determined the project viability. If the benefits are lesser than the cost, so that is means the project is not financially viable, if the benefits are more than the cost then the project is financially viable. Now, in a more accurate sense, we also have to talk about, we do not really have one benefit or two benefit essential you are talking about a summation of benefits.

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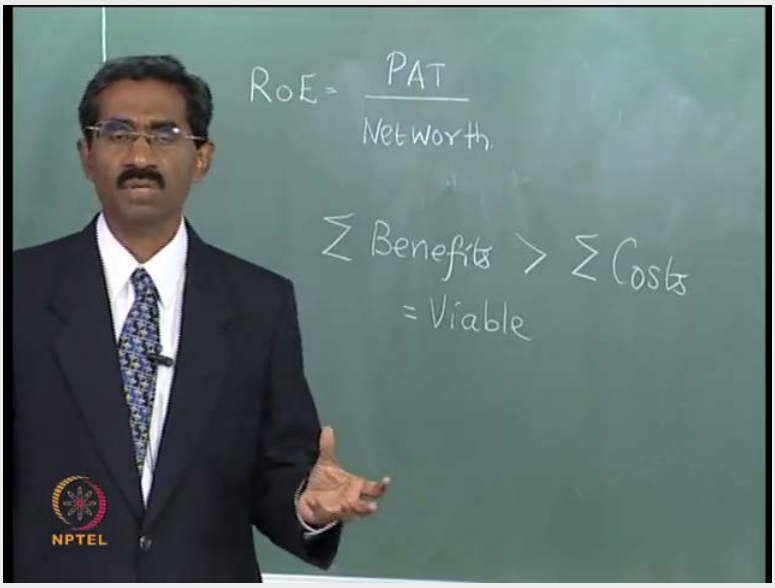


So, if you are talking about summation of all the benefits is greater than the summation of all the cost return incurred then the project is consider to be viable. So, the next question is we have to identify the different benefits and costs. And a after having identify different benefited and costs, how do you actually measure the benefit and costs? Now, we also have to understand that this course is all about infrastructure finance and essentially how do you actually measure the benefits in terms of financial in terms of something as to be used in the word of finance.

So, if you really talk about benefit or costs in the world of finance, the common denominator in within going to measure anything is in terms of what is called as a cash flow. So, benefits we measured in terms of the cash flows, the cost the measure in terms of cash flows. So, what are benefits? So, benefits are essentially we look at it from a cash flow prospective, the benefits are the profits that all earned by the project. Now, there are different ways in which you can look at benefits. Benefits can also be lived at a very broader prospective, let us say from social angle.

Social angle benefit from not necessarily only in terms of profits, but also it could be in terms of welfare is that it provides to the society as the whole. But let us not really talk about social welfare in this course; we are really talking about economic viability. And therefore, you look at economic viability; it is simply the profits that the project is able to generate it for investors. And what are costs, seen in the same prospective, costs are

nothing but that investment that is needed to have assets in place for, essentially investment that is needed to have the project developed. So, that could be in terms of construction costs, which could be in terms of land acquisition costs, it could be an investment needed for various machinery equipments and so on and so forth. So, ultimately we will have to identify the various benefits, sum it up and net of these bills actually determined, whether the project is viable or not.

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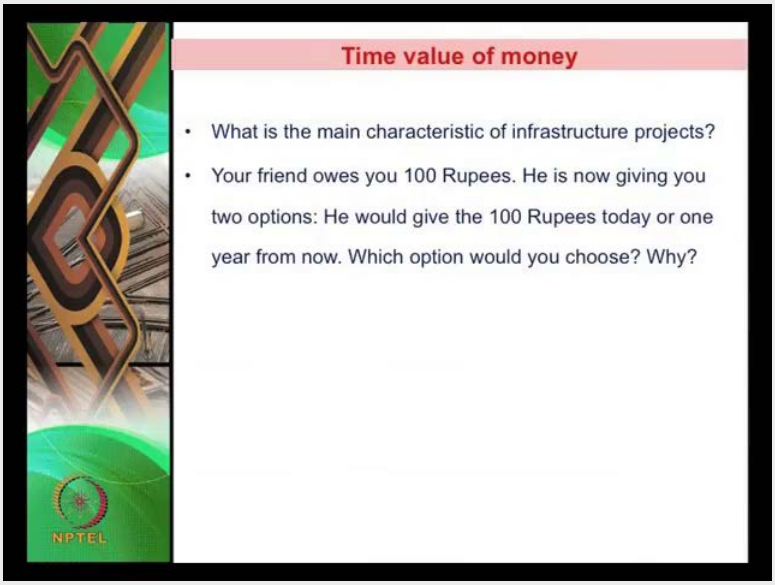


Before we are actually look into how we sum up the various benefits or how do we sum up the costs, we need to understand very important aspect, you would have financed, which is ever time value of money. I will start with the simple question, what are the main characteristics of infrastructures projects? There are several characteristics, but for the topic that we are going to discussed today, the main characteristics that we should be aware of fact that infrastructure projects have very-very long life.

And the second important characteristics that is the very long gestation period. So, there are two important thing it as a very long life, so when we talking about long life, that is essentially means that the benefits that we are going to get from the project is going to come a very-very long duration. So, normally we are talking about infrastructure projects having let say tens of years off lifetime. So, if you are looking at bridge a bridge can have a life time between 20 to 30 years.

And if you are talking about that license that we are normally given to the infrastructure operators, the license varies anything between 30 to 60 years. So, first long as the license is valid, the infrastructure developer will have access to the profits from the particular projects. Therefore, the life of the infrastructure projects is going to be fairly long and therefore, a benefit are also going to accrue for a longer is valley longer timeframe. And the second is gestation of the project is relatively longer, so it is take many years before the projects comes into operation.

So, that means all the investment that is needed for developing of the project, it take place over many years. So, development of a project take place in two years, for construction of a very complicated bridge may take 3 to 4 years and airport project may take about 2 to 3 years. So, the investment is again spread over many years, therefore, we will have to really considered the fact that there is a time aspect associated with which these benefits as well as costs are incurred.

Now, what is theirs time aspect of money? So, let us start with the simple example, let us your friends owes you 100 rupees and giving you two options, option number 1 is you will give you hundred rupees today and the option number 2 is you will give you hundred rupees 1 year from now. Now, among this two options, which are will you, which of those of you actually choose and why? If the relational human being normally choose in the first option whereby, to prefer to get a hundred rupees today rather than wait to get the same amount of money one year from now. Why?

Because of the simple reason fact that you know in English normally we have a proverb, which says that a bird in the hand is worth to in the bush that means anything that you get today is more valuable, what you get sometime in the future. Simply because of the fact that the person who promise due to give to something today might actually go back the promise with time, but therefore, you would prefer to actually get what is available today rather than wait for it are to be coming in the future, that is one. The second aspect is the fact that what you have today actually being more valuable in the feature; let us talk about that now.

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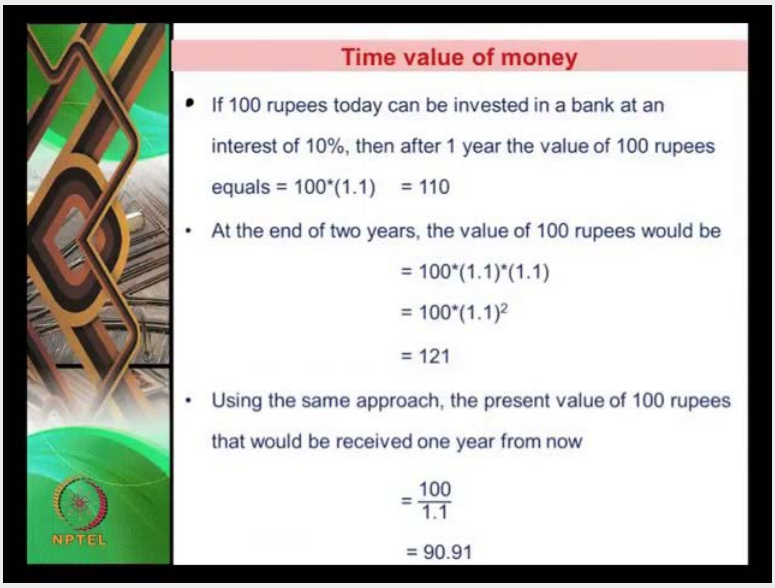


Let us say, you get hundred rupees today that can actually be invested to the bank at an interest rate of 10 percent. And therefore, the total value of investments and at the end of 1 year will be your original amount that you have invested plus the interest that the investment earns, when you actually make the deposit in the bank. Therefore, the total value of rupees hundred that you deposit today would actually be worth 110 one year from now.

Therefore, from a purely time prospective your able to get the additional return, if you are able to get hundred today over a period of one year. So therefore, if your friend promises hundred today and hundred one year from now then you are mostly likely to choose hundred today, simple reason the time value of money makes hundred more valuable one year from now as compare to wants today. So, on the other hand if your friend promises 110 one year from now hundred today, so both of them are equal because you are going to get 110, if your deposit this rupees hundred in a bank at the rate of 10 percent interest.

Now, by the same token that assume that you are going to deposit hundred now, at the end of two years the value hundred rupees is going to be 121 because you are going to get is interest for 2 years at a rate of 10 percent per year. So, if you use the same approach, the present value hundred there is going to get hundred from now hundred divided by 1.1 that is 90.912. In a sense what we are trying to say the value of 101 year

from now is actually going to be in present terms as only 9.91. So, this essentially is what is called as you are time value of money.

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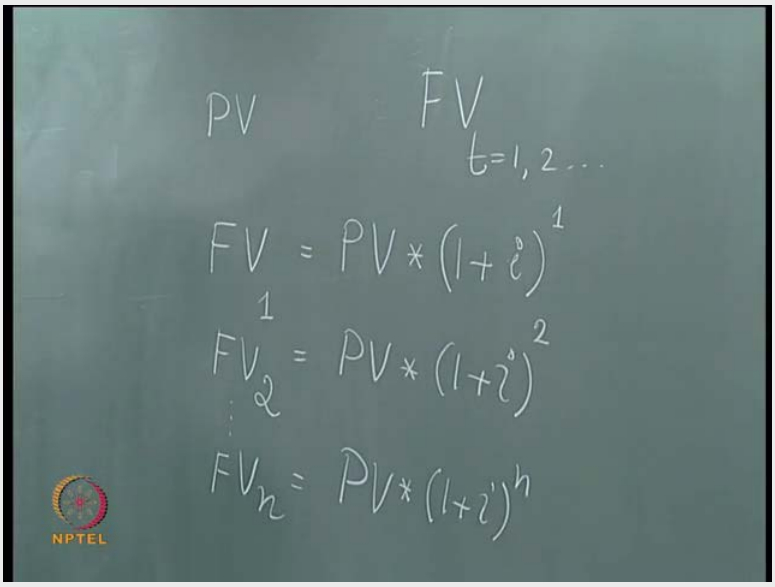


So, let us quickly summit up, let us say when we talking about the present value, we are talking about the value today, we are talking about values time is equal to 0 and then you have what is called as or future value. So, future value could be at any particular time, future value could be at time t is equal to 1 2 and so on. Now, what is the relationship between the present value and the future values? So, the future value is nothing but present value multiplied by one plus i, which is your interest rate.

Now, feature value at the end of your one is nothing but the present value multiplied by 1 plus i raise to the power of 1. Future value in year 2 is nothing but present value multiplied by 1 plus i raise to the power of 2. And then you go by same trend, future value the end of the year now nothing but present value end of when multiplied by one plus i raise to the power of n.

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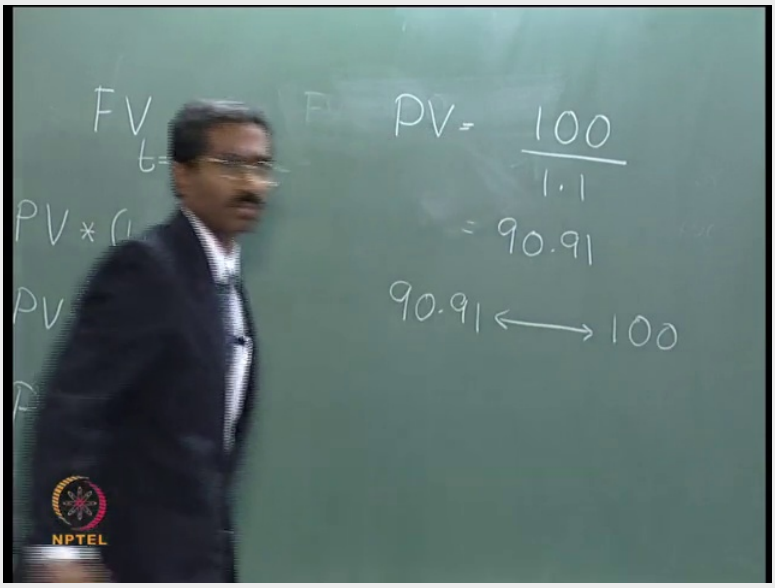


So, if you get 101 years from now 101 year from now that is your feature value is going to be hundred, so the present value of that is nothing but divided by 1.1, since 10 percent is your interest rate. So, present value is nothing but hundred divided by 1.1 and this is going to be 90.91. So, if you are in an investor, you are in different between getting 90.91 today are getting 100 one year from now. So, the value of hundred is not the same today as what you are going to get 1 year from now, so this is your present value of money concept.

Now, when we are going to add the benefits over a period of time, we cannot directly add the benefits that are going to occur for many years in the future because they are simply not equal. As we seen that hundred today is not equal 101 year from now, the benefits occurring in different years is not considered to be equal. So, we can add in the world of math's only if they have equal attribute. So, in a sense when we can really add, what we mean that we can only brought down to the present value.

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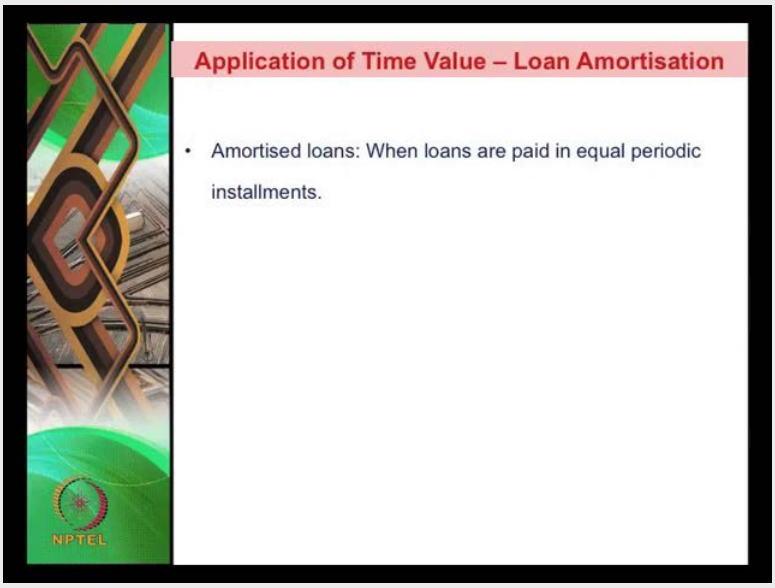


So, let us take a simple case, so let us assume that a project has the following cash flows and in year 1 the project gets the cash flow of hundred, in year 2 it is 200 and in year 3 it is 300 so.

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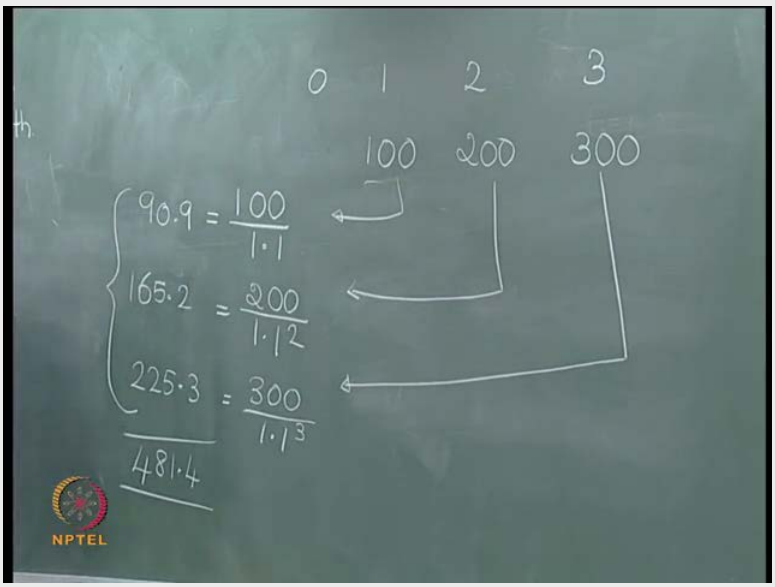


Now, we will have to calculate the sum of all the benefits and we cannot directly add 100 plus 200 plus 300 simply, because they are occurring in different periods in time. And because there occurring in different periods of time, the present value of each of this benefit is going to be different. Therefore, they would have to be broad down to the

present; they could have to be discounted to time 0, before we can actually add them up, to find out what is the total sum of benefits.

So, let as now discount all of them to the present so 101 year from now, if your discount at this present, it will give a value of 100 divided by 1.1. Two hundred when it is discounted to the present since, it is a cash flow stream that is coming 2 years from now, the present value of that is nothing but 200 divided by 1.1 whole square. Three hundred occurs from now and it is discounted to the present is nothing but 300 divided by 1.1 powers of 3. Now, we can calculate the values of each of those, so this is nothing but 90.9 and 200 by 1.1 whole square nothing but 165.2 and 300 divided by 1.1 raise to the power of 3 is nothing but 225.3.

So, now all of them this summed up because there are in a present value terms and therefore, when you actually sum it up, the total value of all these benefits terms out to be 481.4. So, the summation of benefits for the project of this type is 481.4. On the other hand, you are able to directly add cash flows then we will get a figure of 600, which is not correct because we are talking about benefits occurring over many periods and this cannot be directly added up. Now, if the project is considered is viable that means the summation of the costs that are needed for developing the project should be lesser than 481.4. If it is lesser than 481.4 then it is considered to be viable. Now, we are looking at the very genetic expression of calculating of present value.

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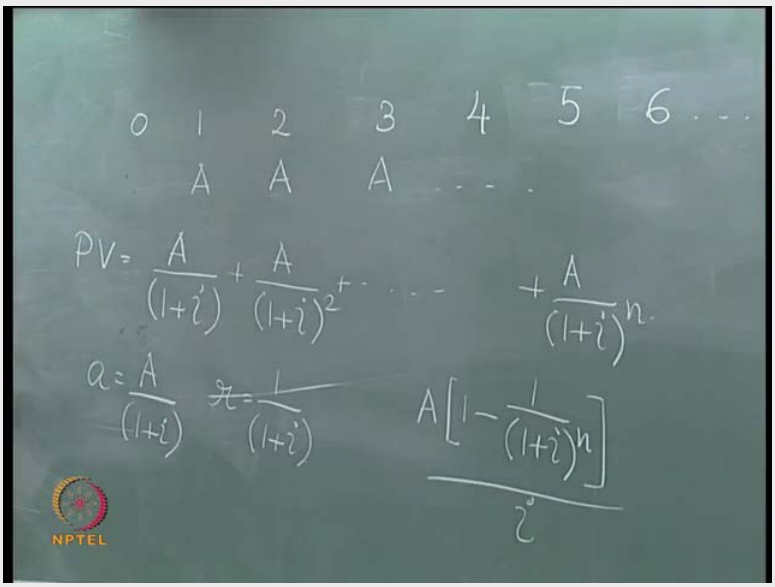

So, let us assume that the project has life of many years, let us say it has the life of n years. And each year, the project makes let us say profit of equal amount, which we call it as A. Now, the present value of this benefit is needs to be calculated, so the present value of its cash flow stream is nothing but A. If you assume that the rate of interest is i, it is going to be A divided by 1 plus I, A divided by 1 plus i whole square so on. So, it will be given by A divided by 1 plus i power of n.

Now, if you look at it this summation is as simple geometric progression and we can use the expression to calculate the sum of the geometric progression to determine the value of this expression. So, this is nothing but a geometric progression with an initial term A is equal to A by 1 plus i and the different between two ratios is nothing but 1 by 1 plus i. Now, the summation of this nothing but A 1 minus 1 plus i raise to the power of n divided by i.

Now, one thing that we need to remember in this expression is that we are talking about cash flows or the profits being equal in each of the years. When we have this kind of a situation, we can use this expression to calculate the present value, but if you have cash flow that are varying with each and every year then we will have to discount each of this cash flows manually to the present and then sum it up. In previous example that we saw where, we are unequal cash flows each of the years and when we have this unequal cash flow then we will have to be discounting each of the cash flows to the present and then adding it up.

But if you have equal cash flows then we can use this expression to calculate the present values. Now, in real life there are several projects, which more or less or equal have cash flows and when you have this kind of cash flow as they are called as annuities. Annuities essentially mean that, we have equal cash flows occurring over regular periods, so the periods are regular between two cash flows and when we have this kind of a situation, you can use this expression to calculate the present value. So, one of the simple applications of time value of money is what is called as the loan amortization. What is the loan amortization? When we actually take a loan and when these loans are paid in equal periodic installments, this is called as loan amortization.

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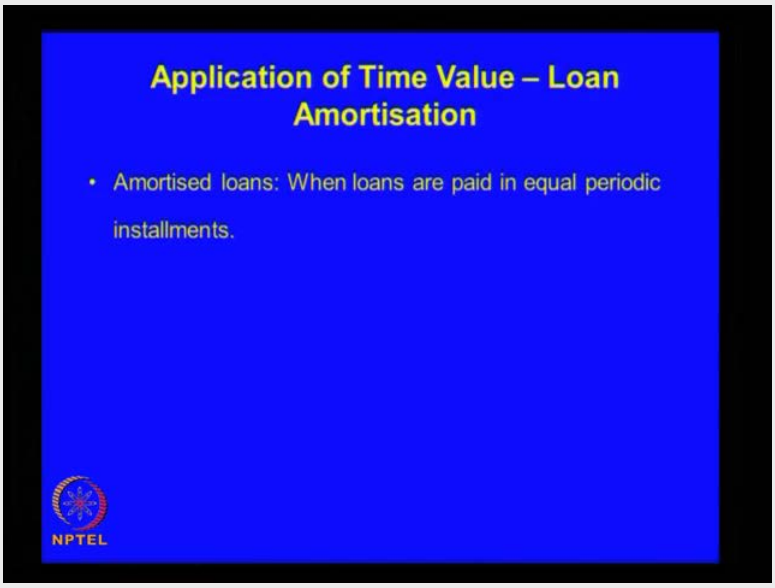


Now, again take an example of a loan amortization to see how we are actually going to use the present value of money concept.

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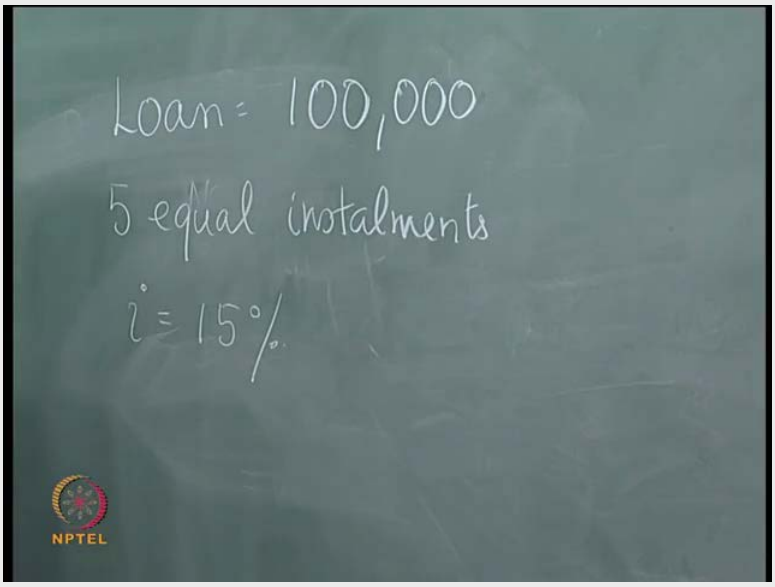


Let us assume that we are taking the loan of 100,000 and this out to be paid in 5 equal installments. It could be over 5 years, it could be over 5 months, whatever the case may be that high equal installments and the installments are occurring at regular periods and then the rate of interest is 15 percent. So, the question here is what should be in each

installment, what will be the value of each installment? So, simply taking we are trying to find out the value of every installment whose present value is 100,000.

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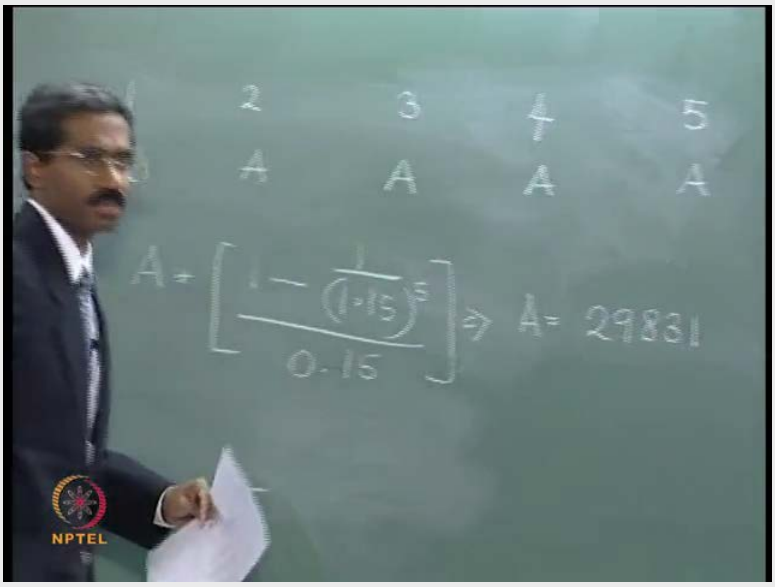


So, if we put it in a year wise format, so the present value that we have is 100,000, so we have actually taken a loan of 100,000. So, this is the present value after loan that we have today and this present value is equal to and equal amounts A, that we will have to pay over 5 periods. And in this case it is assume 5 years at an interest rate of 15 percent a year what is actually it? So, we use the expression that we derived that previously to calculate the value of A, that means 100,000 is equal to a multiplied by 1 minus 1.15 raise to the power 5 divided by 0.15.

So, with this we can get the value of A to be 29831. So, if you want to repay the loan of 100,000 in 5 installments that mean each and every installment would be valued at 29831, so that is the first part. Now, how can we use this information to determined one of the other aspects? So, we can use this information to construct what is known as your amortization table. So, you will construct what is called as your amortization table, which will be something like this.

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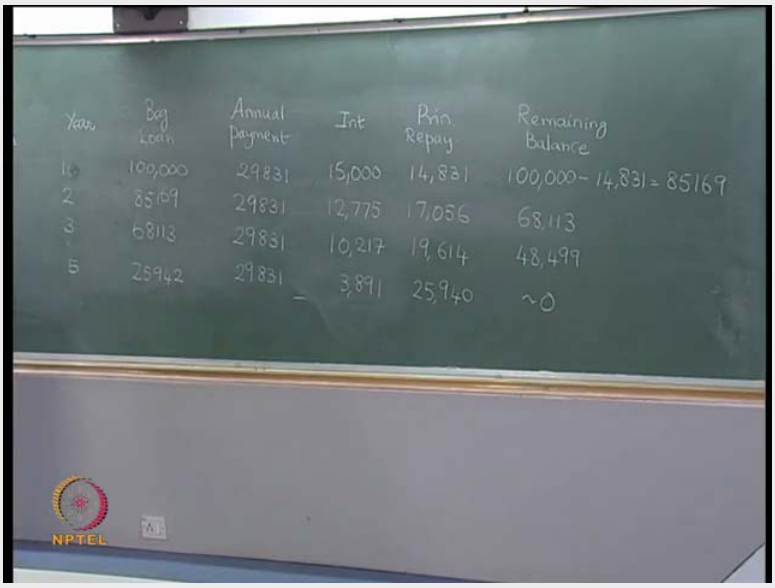


If you lock at in year 1, we are starting with loan of 100,000 so that is your beginning loan. And in the first year we pay 29831, we also pay interest and principle, so this annual payment it is towards meeting the principle as well as your interests for a particular year. The interest is always paid on the beginning balance of the loan. So, in this case interest for the year is going to be 15 percent of the beginning loan of 100,000 therefore, it is going to be 15000.

So, out of their annual payment of 29831, 15000 towards interest payment the balances is towards therefore, principal repayment. Principal repayment is nothing that the difference between animal payment and interest due for the year. And the remaining balance will be the opening balance of 100,000 minus the principle that we paid during the year 14831 and this equals that it is 85169. Now, the remaining balance at the end of first year becomes the opening balance for the second year and then we continue the entire process what we did for the first year.

So, 29831 is the interest is annual payment for the year 2 and out of which 12775 is towards interest and 17056 towards principal repayment and the remaining balance is 68113. And in year 3, the opening balance becomes 68113, the annual payment is 29831, the interest on the opening balance is 10217, the principal payment therefore is 19614 and the remaining balance is 48499. So, like that you can continue to do for all the years I will skip here 4 and state year for 5.

In year 5 the opening balance of the loan will be 25942 and then we pay 29831 out of which 3891 towards interest payment and then the principle payment is 25910 and the remaining balance is close to 0. There may be small error because of rounding, but otherwise we assume that the loan of completely paid by the end of year 5. So, what we have here is a situation, the loan is continuously being paid in 5 years in equal installments and in each year, the payment is towards payment of interest as well as principals.

And we have by constructing a amortization table, we able to identify how much interest are we paying every year and how much principal are we paying every year. Now, why is this important? Why we important that we will have that to construct this amortization table. Remember when we talked about the ratio analyses we also looked at let us say an interest coverage ratio. A interest coverage ratio is an important leverage indicator, which indicates that what is a margin that the company has in terms of paying the interest.

Now, if we are able to identify the interest that is being paid in various years, we will be able also calculate the interest coverage ratios for the different years. So, it is very important because lenders constantly monitor, the lenders constantly seeks a particular level of interest coverage ratio in different projects. So, identifying the interest component in a loan repayment will help us to calculate what will be the interest coverage ratio in various years in the futures.

Second we also seen that interest help us to pay lesser tax because the interest income, the amount that we pay actually as interest qualifies for tax exemption. So, when you are calculating the profit after tax it is very important for us to know how much of interest that the company pays, so that the tax paid can be calculated accordingly. So therefore, for us also estimate the profit after that a tax is very important for us to identify than the interest that we paid for each and every year. So, this loan amortization is a good example of where do we actually use time value of money on regular basis in different projects.

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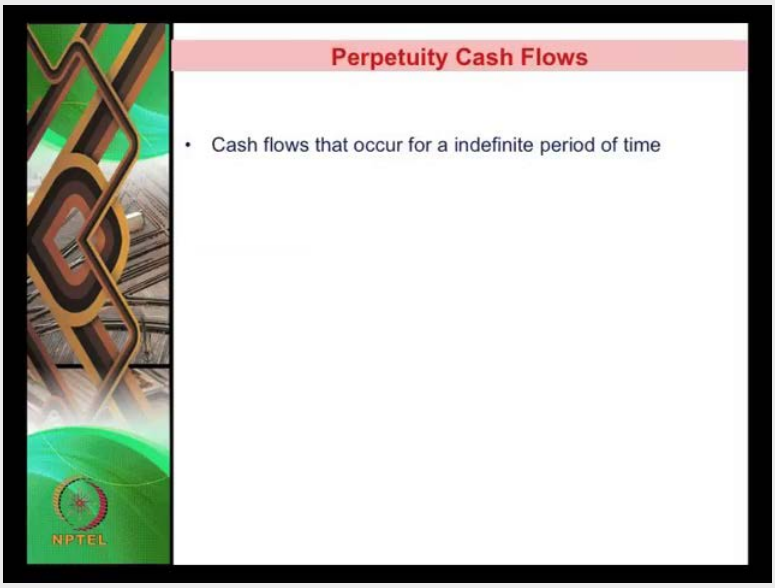


Now, another example that we normally encounter is let us say what is called as your perpetual cash flows. What are perpetuity cash flows? Perpetuity cash flows are defined as the cash flows that are occur for an indefinite period of time. So, we have cash flows that occur for a very long period, it is a very difficult to find projects that are going to give benefits for an indefinite period, but if we are able to identify the projects, which we are giving benefits for a very long period of time that we can safely assume that to be for a definite period of time. Let us say for example, today we have concession given for private airports for as long as 60 years. So, 60 years is fairly long duration, so projects of this nature or cash flows of this nature can be consider being as perpetual cash flows. They may not be actually perpetual, but they can be approximately as perpetual cash flows.

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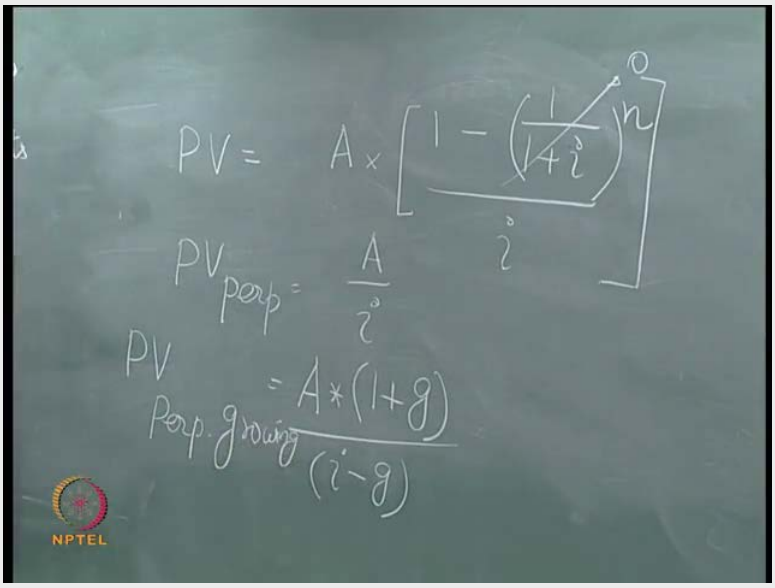


Now, when we have perpetual cash flows what will be the present value of this cash flow. So, we have calculated the percent value of a cash flow of A for n periods of time as follows. Now, when we are talking about perpetuity n is really large so therefore, this term will be close to 0. So, if n is really large, the denominator will become a very large and this will become too close to 0.

And therefore upon simplification, the present value that perpetuity therefore simply becomes A by I, that is the annual installment that you get divided by interest rate; it gives you present value of a perpetuity cash flow statement. Now, there is a slight modification you may also come back and tell me that cash flows may not be same, if you are really looking about a very long duration. So, cash flows might change from one year to the other or one period to the other and we actually calculate a present value of cash flow stream, which changes by constant amount.

For example, if we have actually have perpetual cash flow stream that grows in the x percent every period then what will be the percent value of such stream. So, perpetual cash flow stream that can be approximated to grow at a constant rate for every period it is nothing but a multiplied by g, which is your growth rate divided by i minus g. So, this expression gives you the present value of a perpetuity stream, which is growing at a constant rate. So, there are many projects were cash flow stream might grow and growth might not be a very large, but growth might be a very nominal.

In many cases we assume that the growth is almost equal to the rate of inflation and when we have this kind of scenario, we can simply use the percent value expression for a growing perpetuity to calculate the sum of all the benefits in present value terms. So, we will end this lecture with this thought question, we have talked about a different types of cash flow stream.

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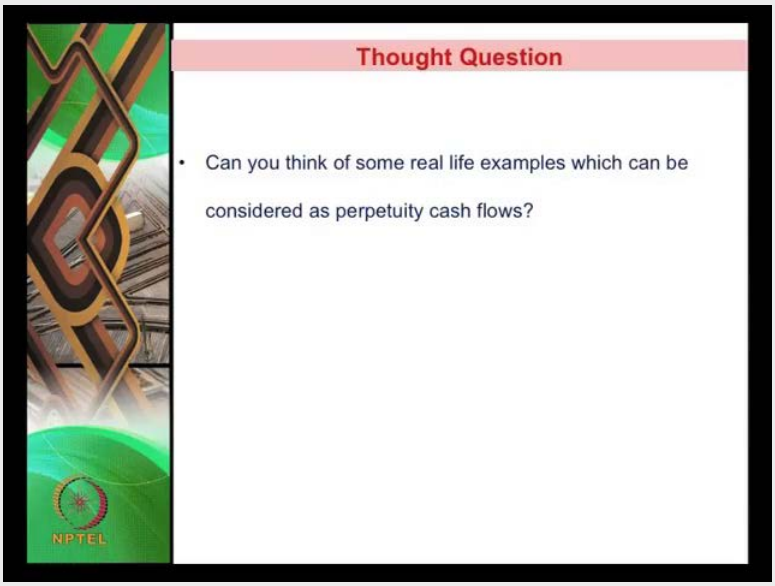


In this lecture we talked about annuity and modification of an annuity is a perpetuity cash flow stream. The question that we have is can you think of real life of examples, which can be consider as perpetual cash flows. So, think of examples, look for data in various papers or in internet and identify some examples, which from a calculation perspective can be modeled as perpetuity cash flow.

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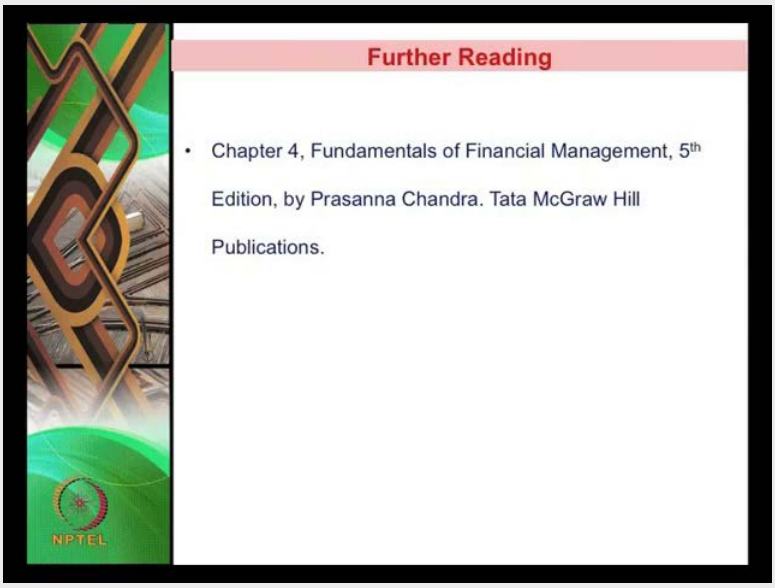


And for reading material on the other time value money you can look at chapter 8 in this text book of Prasanna Chandra. And in the next class we will look at additional aspects related to analyzing project viability.