Security Analysis and Portfolio Management

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Lecture No. # 32

Bond Pricing and Yield

In the previous class, we started the discussion on the bond portfolio management. So, what we discussed up to now, that is, there are certain characteristics, there are certain features and there are certain concepts which are related to the bond or bond as an asset for investment. So, after discussing these things, the next topic or the next issue - the researcher or the academicians or the investor should know how the pricing of the bond is done and how the yield of the bond is calculated, because the pricing and the yield these are the two concepts; these are the two things always highly involved or highly important whenever we talk about the bond portfolio management in a real world situation.

So, as you remember, whenever we discussed this bond characteristics, there are certain things we have given the emphasis - one is your coupon because bond has a fixed return what always we get, and also it has a, whenever we go for investing in the bond, it has a par value, and also we have the yield to maturity, what is the return we are getting or another one also we are getting the term to maturity. These are the, the, different features of a bond. Always whenever we discuss the bond, this four aspects always, comes, come to our minds.

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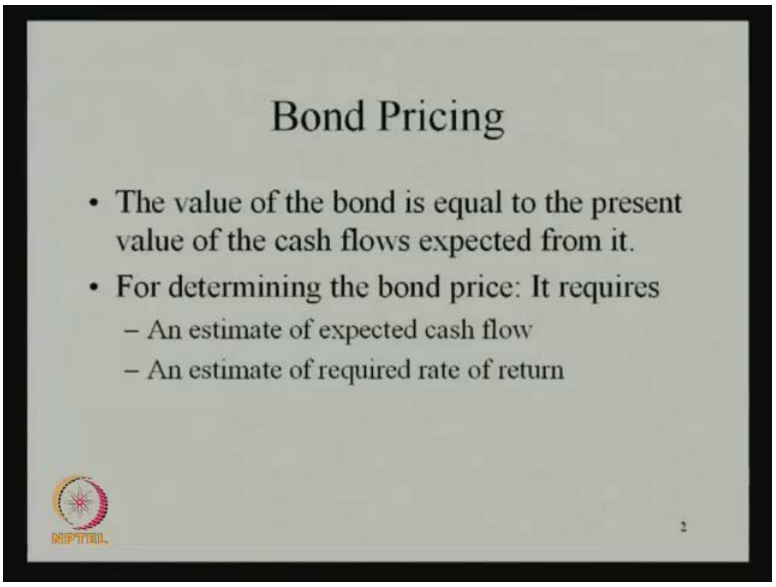

So, within this framework, whenever we discuss the bond portfolio management or whenever we discuss about the bond as an asset for financial investments, we should see that how the pricing of the bond is done and what exactly the bond pricing is. Like your equity valuation, whenever we do the equity valuation, what we have done? We have done that there is a cash flow in this particular asset, which is basically the dividends what we got from the literature and as well as the discount rate or the cost of equity whatever we have. Then, whatever we discount, this cash flows, regular cash flows what we are getting from this equity with this discount rate, then we can calculate the present value of that particular asset or particular equity in a particular period of time.

Like that, whenever we calculate the price of a bond, how the price of the bond is calculated? It is basically the, the, value the bond is equal to the present value of the cash flows expected from it. For determining the bond price, it requires an estimate of the cash, excepted cash flow, then on estimate of required rate of return.

These are the two things they are interest rate and the cash flow. These are the two things which are very much essential for any valuation purpose. So, if we can measure the expected cash flows, what we are going to get from this bond and as well as the discount rate in this particular period at which the bond will be discounted, then it will be easy for us to calculate the value of the bond.

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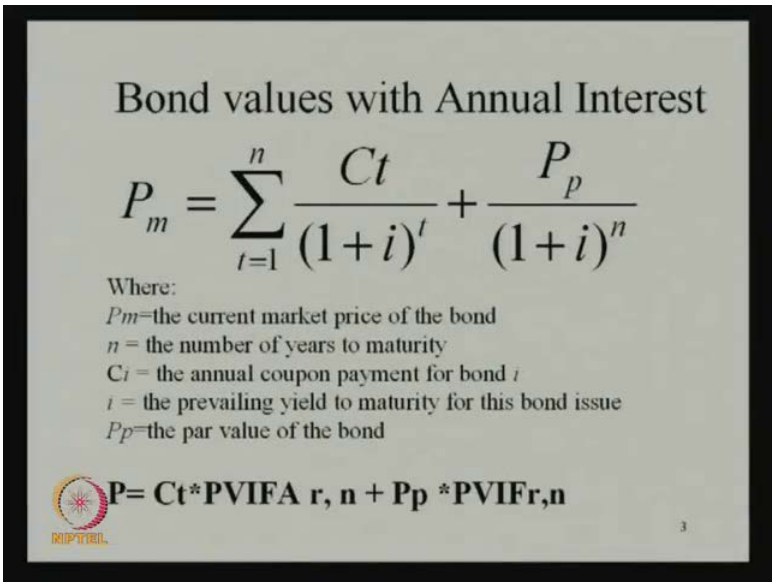

Then the next question arises that what exactly this expected cash flow is or what exactly this calculation means or the value of the bond means? So, if you see here using this formula, whenever we, basically in the various literature if you see that the value of the bond is calculate, either it is, the market value of the bond is calculated either it is annually or semiannually; that means, the, on the basis of the interest payment, this calculation on semiannual or the annual thing depends.

So, here, what we have seen? If you remember this formula, it is basically nothing but this market value of the bond or the price of the bond in particular time is equal to basically your summation t is equal to 1 to n c t by 1 plus i to the power t plus the P p by 1 plus i to the power n. What that basically means the C means what is the coupon; that means, this is the regular cash flow what we are getting.

Then, your i represents the interest rate, market interest rate in that particular time. This is your par value of the bond; n is equal to your term to maturity or the number of years. So, in this contest, what we can see? You just take this example, then it will be more clear for you that how this value of the bond is calculated. If you see that let your coupon is eight percent, then the term to maturity is 20 years. Let the par value of the bond, par value of the bond, is 1,000 and the yield to maturity is10 percent in that particular time.

So, here, in this case, if you want to calculate this value of the bond in this, then how you calculate both, we say that, let this is your annual interest is 8 percent; it is the annual interest. So, either you can use this annual interest or you can use the semi annual interest.

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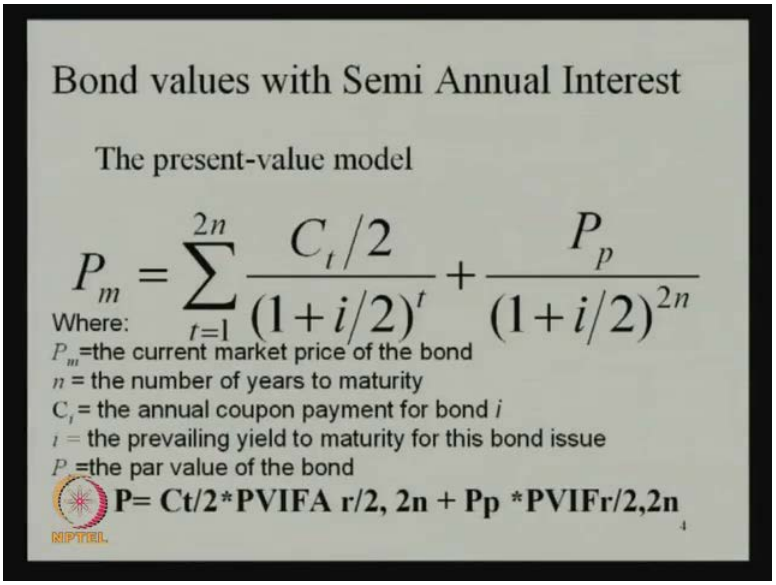

So, if you go by the semiannual interest, what is the basic difference between these two? The basic difference between these two is basically you are you are dividing the interest payments and increasing your number of years accordingly, then it will be instead of a n, it will be 2 n. Then your coupon will be divided by 2; then your interest also divided by 2 to the power t then plus your par value of the bond like that i by 2 to the power 2 n. This is the way generally the bond valuation is done.

So, what exactly this term means and this term means? The first term is basically nothing but it is the present value, present value, of, of, the cash flow, cash flow for the, present value of the cash flow for the years, for the number of years number of years or for the term to maturity at the rate of interest, at the certain rate of interest.

So, if you see this, then it is basically in this case, if you talk the term to maturity is 10 percent, sorry, the term to maturity is 20 years, then here your number of period will be 2 n; that means, the, if you divide in the 6 months, then 2 n will be 4. Then your, if you divide it at the rate of interest, then your I by 2 will be the 5 percent. So, this is basically

the present value of the cash flow what you are receiving regularly for the reasonable numbers of years, when the, up to the time when the bond will be matured or the term to maturity at the rate of interest.

Then the second term, this term what basically it defines? It is basically defines, what basically the second term defines that P p by 1 plus i by 2 to the power 2 n. So, that basically defines the present value of, present value of the par value to be received, to be received, in the, this 40 period whatever we have taken in the whole period, whole period, at the certain level of interest. So, in this case, this interest payment is 5 percent.

So, if you want to calculate this example whatever we are taken, then it will be your P m. The value of the bond will be t is equal to 1 to 40, because we have divided into 2 n because the number of years will be 20, then it will be 80 by 2, because here, unvalid coupon payment is 8 percent. So, that is why these are the rate of 8 percent for 1,000 the coupon will be 80 rupees.

So, divided by 2, then you have taken 1 plus 0 point on which is the interest rate; that means, 10 percent by 2 to the power t plus 1000 which is the par value of the bond by 0.1 by 2 to the power 40. So, here, if you want to convert this one and this one, then what is this? This is the, this term basically, the first term is basically defined as the present value of annuity of R s 40; 40 means what you are getting in every 6 months, in every 6 months for 40 periods; 40 periods means 46 months at the rate of 5 percent.

So, what this term means? This is the present value of interest payment, present value of the, sorry, the present value of 1,000 to be received in 40 periods at 5 percent. So, this is the way this two term is defined. So, if you want to calculate this present value of interest payments, then the present value of interest payment is basically nothing but is the present value of annuity at the rate of 5 percent for these 40 periods of time.

So, let that that is why the present value that will be 40 into 17.1591, it will be 686.36. So, here, the present value, the present value of the principle or in the par value will be present value of the, is equal to this 1,000 multiplied by 0.420. This figure, the present value of annuity and this is the present value of this, you can calculate from the tables is equal to142.

So, the value of the bond, the market value of a bond will be 686.36 plus 142 that will give you 828.36. So, this is basically the market value of the bond in this particular point of time.

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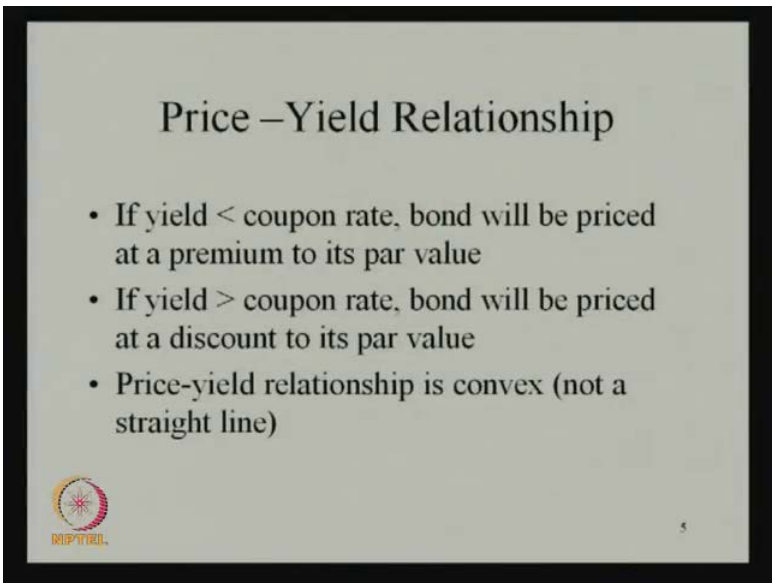

So, this is the way generally we can calculate this value of bond, the market value of the bond at a particular time period. So, like that, if you see that there is a relationship between this price and this yield or the return what we are going to get from this particular bond investment. So, if you want to establish a price yield relationship, a price yield relationship basically in this way, let if you draw like this, let this is your yield and this is your price, then your price yield relationship basically go like this. So, we call it price yield curve; the price yield curves basically go like this.

And what is the decision? Let it is 2 years, 4 years, 6 years, 8 years, 10 years like that. Then, let this is the values 200, 400, 600, 800, 1,000 like this. Then the price yield relationship basically goes like this and it is basically not a straight line, the price yield curve is not a straight line, it is convex to the origin. If the rate of interest goes down, the value of the bond, rate of interest, if the rate of interest goes down, the value of the bond goes up. Therefore, there is an inverse relationship between bond price and interest rate.

So, in this case, if you see that what is the decision always we take, if the yield whatever we have in particular time is less than the coupon rate whatever we have taken. Let the 8 percent in our previous example, then the bond will be priced at a premium, bond will be priced at a premium to its par value.

If yield is more than the coupon rate, then the bond will be priced at a discount to its par value, and if price yield relationship is basically convex, it is not a straight line. So, the decision maker or the participants who participate in the bond market what basically they do? They always look for where whether the interest rate or the particular yield of the bond is higher or the coupon what we are getting from this is higher. So, by making the comparison or by making this relationship between or making this figures or by establishing or by knowing this value of the coupon and as well as the yield, they generally take the decision what to be done in this particular bond. So, whether it should be priced at a par premium to its par value or it should be priced at a discount to its par value. That basically decided on the basis of the yield and the coupon rate.

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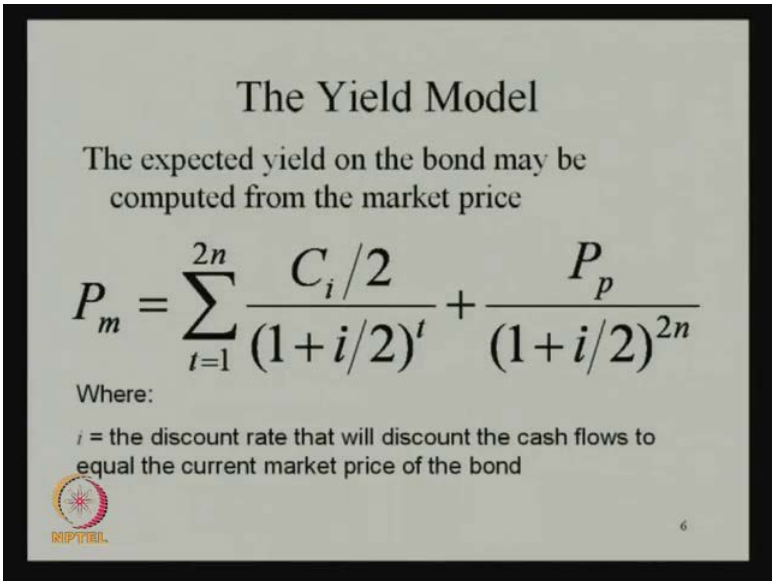

So, what basically the, there are various models which calculate this yield. What basically the yield defines that the expected yield on the bond may be computed from the market price; that means, if the market price will be given and the coupon will be given

and the par value of the bond is given, then we can calculate the yield of this particular bond. So, how it will be calculated? The expected yield in the bond may be computed from the market price.

So, go by your, go by your previous formula what we have derived to calculate this market value of the bond. So, in this case, if you see that you can easily measure where the i is equal to the discount rate that will discount the cash flows to recall the current market price of the bond. Then in this case, you can calculate what should be the yield of this particular bond.

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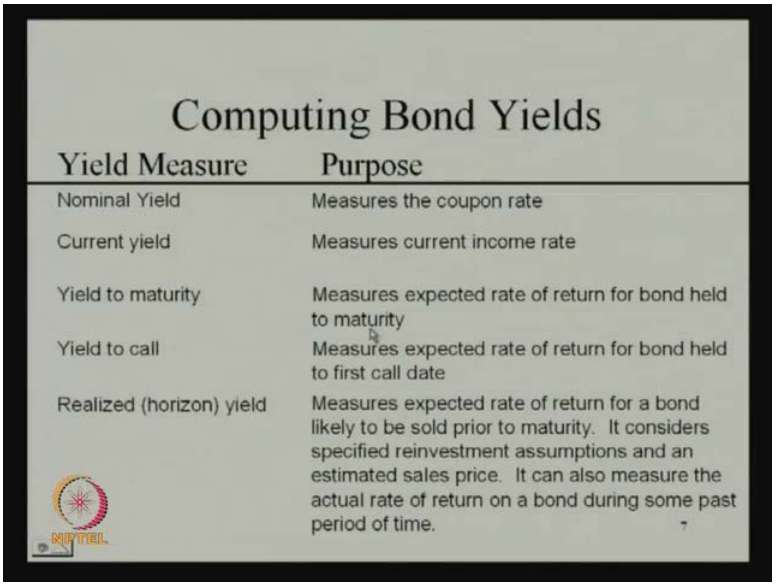

So, this is the general way through which the bond yield is calculated. So, there are various type of yields and how generally the yields are calculated or the yields are measured and how the different yields are used for different purposes or the different reasons. So, if you talk about the different type of the yield, we have a nominal yield; we have a current yield; we have a yield to maturity; we have a yield to call and we have a realized yields.

What basically this nominal yield means coupon is basically also yield which measures the nominal yield or basically, always whatever return, immediate return, regular return the what we are getting from this particular bond that basically measured as the coupon rate. So, that is why whenever we talk about the coupon, coupon is nothing but it is

represented as or it can be defined as the current yield of a particular bond. Then, sorry, the nominal yield of a particular bond.

But whenever we talk about the current yield, it basically measures the current income rate; that means, what is the return you can give it in that particular time, so that basically talks about the current yield, but whenever we talk about the yield to maturity, it basically measures the expected rate of return, the yield to maturity basically measures the expected rate of return for bond yield to maturity; that means, if somebody wanted to invest in a bond or somebody has got a bond, what basically this yield to maturity means that if the bond will be let in the beginning that bond as issued for a 20 years or the term to maturity will be 20 years, then if the bond will be held by this investor for the 20 years or he will keep this particular investment and continues up to 20 years, then what will happen that whatever yield in the end of the day, we can calculate from this bond; that basically is defined as the yield to maturity.

So, in this context, what we can say if the bond will be kept with the investor. This particular investment will be throughout carried out by the investor on the basis of the yield to maturity, on the basis of the term to maturity. Then, we can say this particular yield is defined as the yield to maturity. Then yield to call is basically measures the expected rate of return for bond held to first call rate.

If you go back to your previous class, we discussed about the, there are certain features about the bond, there are certain features which is defined as the callable bonds; that means, the bond is sure can go for redemption of this particular bond after a particular time; that means, he can go for a call from the particular people or particular investor who was helding, who is helding this particular bond in a particular time.

But in the beginning, what we have mentioned there that there is a reasonable period of time will be mentioned from the beginning in the starting period that when the first call can be made or when this bond is sure can go for calling this particular bond. So, here, what do we mean by the yield to call? At the time of calling this particular bond for the redemption or for any other reason if whatever yield this particular bond will give that yield basically defined as the yield to maturity, sorry, the yield to call.

Then, we have the realized yield or the horizon yield. What do we mean by this horizon yield? It basically measures the expected rate of return for a bond likely to be sold prior to maturity. It considers specified reinvestment assumption and an estimated sales price. It can also measure the actual rate of return on a bond during some past period of time. Basically you have issued a bond for 20 years, but you could not keep this particular bond for 20 years, in between it had been redeemed.

So, if it has been resumed by bond investor within this particular period may be 10 years or 15 years, then what will happen that within this time horizon or on the basis of the investment horizon for that particular bond is sure. Whatever return, we can get from these. In that particular period of time, that is defined as the horizon yield or that is the investment horizon period for that particular bond holder up to what time he has kept the bond for the investment. So, these are the different ways through which it is calculated.

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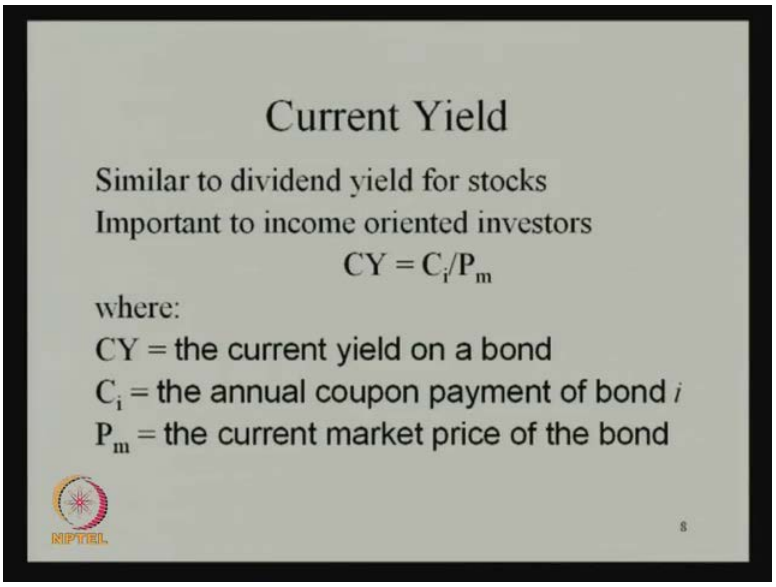

So, if you talk about the current yield, current yield is nothing but it is basically defined as in this way that it is similar to the dividend yield, it is similar to the dividend yield for the stocks already, already, we mentioned that the different yields basically used by the different investor on the basis of their objective or on the basis of their purpose for which they are trying to make the investment on this particular bond.

So, in this context, if you observe this current yield, why this current yield is important and why this current yield is required for the investor? For what kind of investors the current yield is important, that basically the matter of concern for the investors or for the people who really wanted to make the investment in the bond market.

So, in this case, if you observe one thing what basically this is, this talks about, it talks about that it is important that or the current yield basically important for the people to who are income oriented; that means, immediate gain or they want to maximize their income in the current period or day to day business or day to day investment process. So, that particular yield they are bothered about how much current yield I am getting on the basis of my coupon payment.

So, that is why the current yield is nothing but, the current yield is nothing but in a particular period, how much coupon you got either annually or semiannually, and in this particular period, what is the market price of the bond, market price of the bond? So, the coupon whatever you have received from there divided by this market price of the bond in that particular time that will give you the current yield. So, this is basically the current market price. So, the coupon divided by the current market price of the bond that will give you the current yield and the income oriented investors are always concerned about this.

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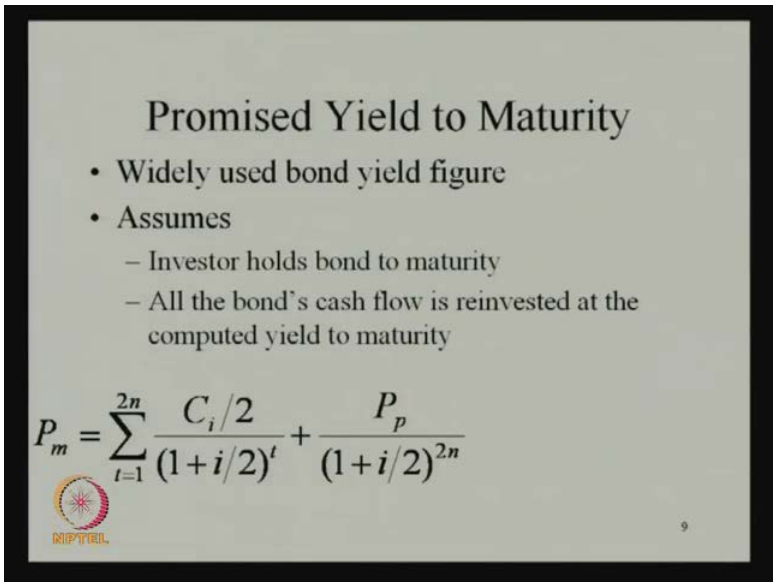

Then, we have the Promised Yield to Maturity. What do we mean by the promised yield to maturity? Why we call it promised yield to maturity? You see that the promised yield to maturity is a concept which is widely use the bond yield figure. Basically always we, whenever we the yield concept comes to our mind, basically the yield means in general literature, this is always we defined that is the promised yield.

So, what do we mean by, why we call it the promised yield? It is called because it assumes that a investor holds bond to maturity; that means, the investor holds the bond to maturity; to the end period of time, the investor holds the bond, and another thing is all the bonds cash flow is reinvested at the computed yield to maturity; that means, this concept is very important what we define that this concept is basically nothing but it is interest on interest.

What basically the interest on interest means that whenever we get the coupon, coupon is a regular cash flow what we are receiving from the bond and the coupon whatever we are receiving in the regular interval on the basis of the period, time period. These coupons are reinvested, reinvested, in the market at the computed yield to maturity; that means, at that particular time, whatever yield will be available. So, whatever interest rate will be available to the investor, what they basically do? They basically reinvest this particular payment, coupon payment whatever they have received this from that particular point.

So, if you assume this to that one thing is this investor keeps the promise that he will hold the bond up to the maturity or the term to maturity number 1. Number 2: whatever coupon he will be receiving, whatever money he will be receiving at a regular cash flow basis, that will be reinvested in the market, in the, at that, at certain level of interest rate prevailed in that particular time which is basically nothing but the computed yield to maturity. So, therefore, we call it the promised yield to maturity.

So, let if you talk about the different concepts where related to this, then what basically this i represents that let the, if you want to solve this equation, just solve for i that will equate to the current price to all cash flows from the bond to maturity similar to your internal rate of return whenever we calculate in our case in the financial management case.

So, in this case, what we can see that in the trial error basis, for example, you say that there is a in the same example you take, the coupon will be given to you, let 8 percent, then you have a term to maturity. Let your term to maturity will be 20 years, then you have par value of the bond par value of the bond is 1,000 and, and, and, we have to calculate the i form here.

Let in that particular time, the market value of the bond is 900. So, what we do? We basically equate this 900 with this equation; this is your t is equal to1 to 40. Then, this is your 40 because coupon will be 80 by 2. Let we are talking about the semiannual interest coupon is paid semiannually. This is your annual interest payments. Then this will be 40 by your 1 plus 5 by 2 to the power t then plus if this is your 1,000 divided by 1 plus i by 2 to the power 40.

So, in this case, if you want to calculate this i in trial and error basis, then what you can find that this can be calculated in this way, and how which I basically in this 40 years period, if all those cash flows of the 40 rupees will be discounted at that particular rate and this 1000 also will be discounted at that particular rate. That basically will give you the value of then 900.

So, if you see these things calculate, then we can find. In this case, if your i is basically 9.9 percent, then this will equate you this 900. So, in this case, example, if you say that, then let it is t is equal to 1 to 40 by 1, let 1 plus I by 2 to the power talking about, then

you take, let we take this present value of that particular annuity that some kind of i should be solved from here. Let your i will be 4.5, i by 2 will be 4.5 percent.

Then, if your i will be 4.5, i will be your 4.5, i by 2 will be 4.5 percent, then it will be basically 1.0454 to the power; that means, let this is 40 t is equal to 1 to 40 1 to the 40 by to the power t. Then these will be1, 000 by 1.0454 to the power 40; then this will be close to 900 rupees. That is why may be this market the promised yield to maturity in that particular time will be 0 4 5 4; that means, 4.54 multiplied by 2 that will be 9 point something, 9.8 percent. So, that basically will give you this promised yield to maturity in that particular time period.

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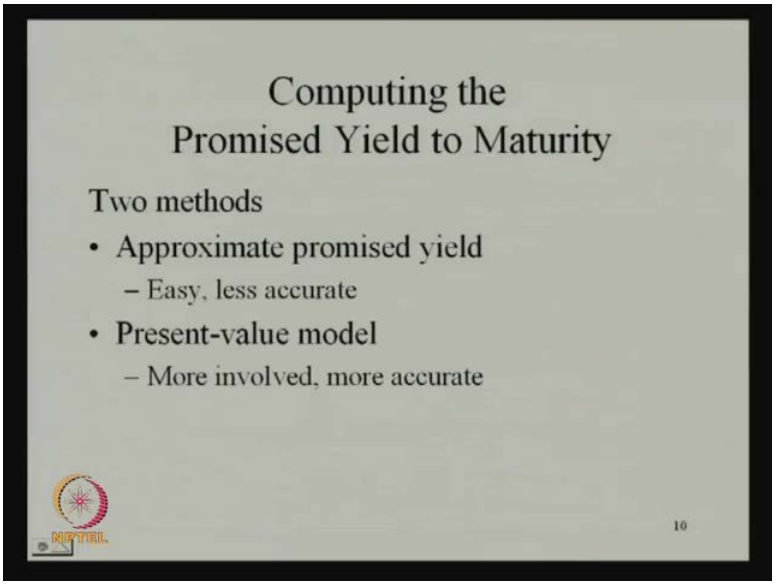

So, then, how generally we calculate this there are two methods what we use I have just shown this randomly used methods through which the trial error basis we calculate, which one will equate this market value of the bond with certain rate of interest, but if

you want to see, we have two methods - one is your approximate promised yield method which is what we have used now, what we always most of the time used that is easy and less accurate. Although it is easy to calculate what sometimes we can say, then accuracy level of this method will be little bit less.

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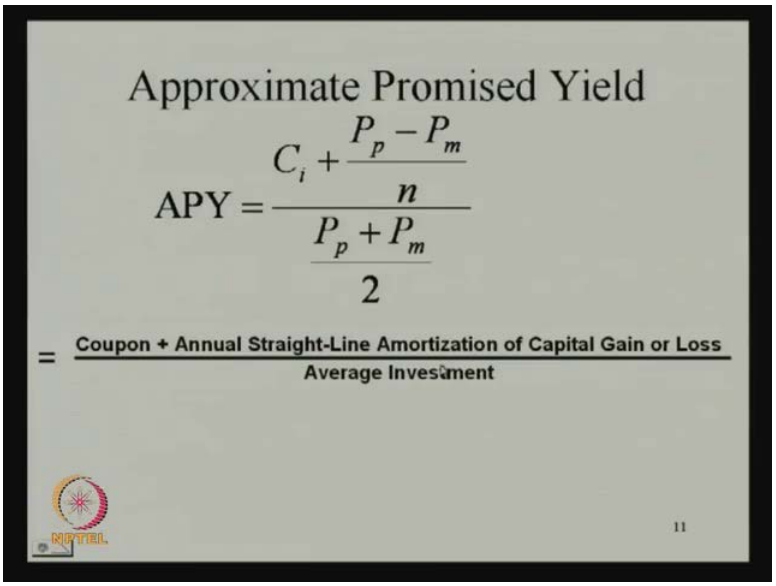

Then, we have also the present value model which is more involved and the more accurate. What this present value? The approximate yield methods basically talks about. The approximate method basically approximate promised yield. This is your coupon; this is your approximate promised yield. So, what it talks about? How it is measured? This is basically what it talks about the coupon plus your par value of the bond minus the market value of the bond in that particular time divided by your number of periods by the market price value of the par value of the bond plus the market value of the bond by the 2.

That means what? It talks about, it talks about coupon means it is your coupon what the regular flow you are getting plus this is this part basically, this part, it is nothing but it talks about the, the, annual straight line the amortization of capital gain or loss, gain or loss on the basis of the market interest rate. What you are getting the capital gain because the total return is basically, then regular cash flow and as well as the capital gain if you

want to stay in the market with certain number of period of time, then you must be receiving some capital gain for that.

So, this is your coupon; this is your capital gain divided by the average level of investment. The average investment is nothing but the par value of the bond for which you have paid already, then the market value of the bond and you are averaging it by taking by dividing the 2 there.

So, therefore, what we can say that the average or the approximate promised yield basically coupon plus the capital gain or loss, capital gain or loss which is basically annual by the average investment. This is the way generally sometimes we calculate the promised yield to maturity. It is approximately calculate because it is not that always we have averaging out between these two. That is why we call it the approximate know that is the easiest method easy but less accurate, it is easy but less accurate in terms of the example.

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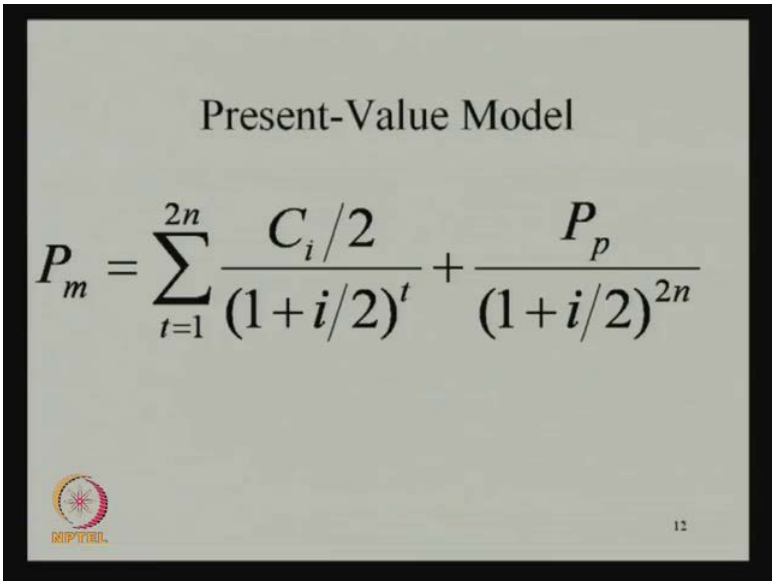

Another way we have the present value model where we have to find out this different i's; we have to find out these i's to find out this yield and we have to exactly find out the value of the i which can equate this particular value of the, market value of the bond with this particular right hand side of the equation and it is little bit more complex.

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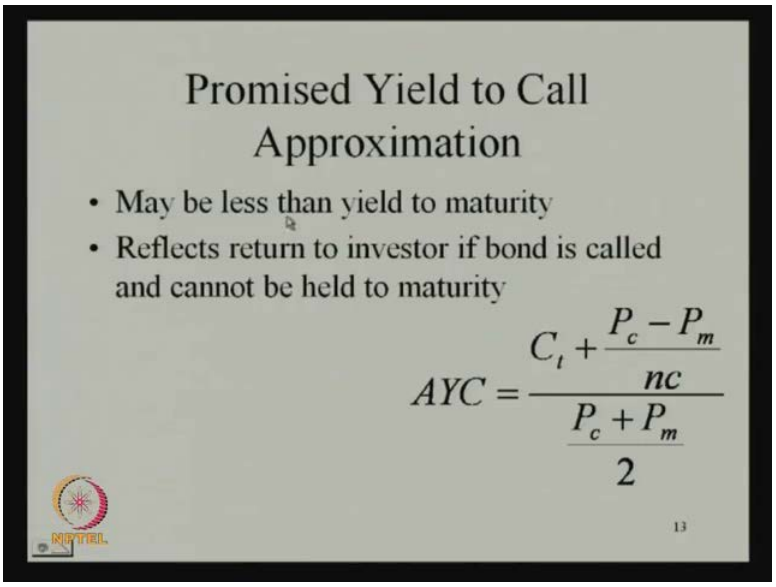

So, therefore, if you talk about all, then it may be less than yield to maturity. It reflects return to investor if the bond is called, because if you already remember that the call option you have that any time the, the, bond is sure can go for a call option for this particular bond, then what we can observe there that we call it the particular yield what we are receiving from this call option case. So, that is why we call it, sometimes it will be less than the yield to maturity, because the bond is not held up to the term to maturity for which period the particular bond has been issued. Then it reflects the return to investor if the bond is called and cannot be held to maturity.

So, in this case, how it is calculated? We call it the approximate yield to call. How it is calculated? The same way or the time of call option what was the coupon, then your the time what is the par value of this particular bond, then your p m for this bond also and divided by your n c whole divided by the p c plus p m by 2. What this p c p m and n c reflects? This is a y c basically approximate yield to call in short we call it a y c.

Then your p c basically the call price of the bond; the p c basically the call price of the bond; then p m is the market price of the bond in that particular time; then c t is basically the annual coupon payment whatever we are receiving from here; then this n c basically the number of years it is important, the number of years to first call date, because we are calculating this particular promised approximate yield call. So, that is why we have to measure the yield when the first call has been made by the bond issuer.

So, therefore, what we can see that if the first call has been made by the issuer after five years or six years, then what should be this yield for, for, that particular bond in that particular time. So, therefore, what we call it, it is called the promised yield to called and it is measured as the approximation and also it can be measured through the present value model.

How this present value model is used in this case. In the same way, whatever way we have used that the market value of the bond is given length. You see, this will be 2 n c and number of years because the coupon you are talking about semiannually, then your 1 plus by t p c by, there is a mistake, here may be 1 plus i by 2 n c, where this is i by 2; this is i by 2. This will be, can be calculated in this case, because if you make it semiannual, then it should be, if it is 2 n c, then it should be 2 n c and this will be on the basis of that it will be divided by the 2.

Then another yield whatever we have used that is your realized yield approximation. What does it mean? The realized yield approximation is nothing but your coupon. Then again your p f minus p it can, it is basically your realized yield approximation. What it basically means this will be your coupon plus again this capital gain whatever we have that is your p f minus p by your holding period whole divided by the p f plus p by the holding period the average of this.

So, that is why it is your a r y means it is the approximation realized yield; c represents the annual coupon payment; p f represents the estimated. p f basically the estimated future selling price of the bond and this is your, p is equal to your par value of the bond, then s p is a number of years the holding period of the bond, the holding period of the bond. This is the way this thing is calculated.

So, like that if you calculate also using the present value method, the present value method basically talks about in the same way how this present value method is used. The present value method is basically p m. If t is equal to 1 to 2 h p, then your c t by 2 is equal to 1 plus i by 2 to the power t plus p f i 1 plus i to the power 2 b 2 h p.

So, this is your present value of the cash flow; then this is your present value of the par value whatever we are calculating and that will, if you equate this market value, then the i can be measured and this i basically is talking about the realized yield. So, therefore,

what we can see here? One observation what we can make that if you have this future selling price of the bond, this future price of the bond basically is nothing but with a certain level of the yield, what should be the value of the bond in the next period.

Then from there, if you can calculate the real price or the actual par value of this particular bond, then that is the capital gain. This is the capital gain what we are going to derive from here, then only that capital gain plus the yield, nominal yield what you are getting from this point in terms of the coupon that basically gives you the total yield of the realized yield for that particular case.

So, in this context, what this bond investor always feels that the expectation level of the bond investor varies on the basis of the market interest rate; that means, if the interest rate varies, then the price of the bond goes down and goes up on the basis of the change in interest rate or direction of the change of the interest rate. If the, already I told you that interest has an inverse relationship with a bond pricing, and if you can anticipate this interest rate, then the future price of the bond can be calculated in approximation. Then if the future price of the bond can be calculated, then it will be easy for the investor to find out the yield how much he is going to get from this investment.

So, what we are talking about here that exactly this interest rate what we are getting from this market. This is not the yield, it is basically the yield what you are deriving from the bond including this coupon what you are getting. So, this yield which is basically measured on the basis of both nominal yield and as well as the yield to maturity what we are deriving from here, it may not be the yield to maturity, it may be this realized yield to maturity.

Because the time horizon for the bond investor may be different from time to time and as well as also what we have observed that sometimes we have seen that the yield on the bonds or the yield characteristics of the bond basically varies on the basis of the term to maturity.

So, if you have a relationship between yield with term to maturity, what we call it yield curve, and according to the theory, the term to maturity and yield should have whenever the term to maturity will be more then the yield will be more and what is the logic or is there any possibility that, that, yield and term to maturity may not fond together, that is a

matter of question whenever or that is a very important question always comes to mind of the investor while taking the decision process, in the decision making process of the investor in the financial market.

Here, what we are trying to say that whenever we use this different concepts of the yield, the question always arises that whether the yield to maturity and the concept of the different issues related to the yield to maturity are really helpful for the investor while they are, they take the decision in the financial market.

So, in this context, what we are trying to say or what I am trying to infer that this yield concept is quite important because which talks about the return what we are deriving from this bond, and obviously, the different types of the yields will be important for the bond investor because the different bonds of the different characteristics.

So, on the basis of their nature, on the basis of their objective, on the basis of their decision in the market, this investment return varies from time to time. So, here, what I am trying to say that before the bond investor takes part in the bond market for the investment, always he should consider that what kind of direction of the interest rate today is and how the expected interest rate it is going to change in the future. Then, as well as they should also discuss that how t his particular interest rate is going to behave in a particular market which directly affect the pricing of the bond and ultimately the yield. So, therefore, we should think about this.

Then another factor also we have always not only, but basically it is more involved in the context of USA that we talk about these sometimes they do the adjustment for the tax, because tax is also another issue which plays the significant role. How they calculate this that the yield adjustment for the tax exempt bonds, which is basically nothing but the annually return what you get from this particular bond divided by the 1 minus tax rate.

That means if the particular bond is tax exempted, there are certain characteristics of different bonds. We have certain bonds investments are tax exempted the certain investments and bonds are tax exempted. So, if you want to calculate this particular or you want to adjust this particular return from these, the return will be little bit higher.

Therefore, this particular thing also should be adjusted whenever we do the bond investment in the market. So, that things also should be looked upon. So, here, in this context, what we can see that, what we have observed that on the basis of change in interest rate, the price of the bond varies. If the price of the bond varies, we can conclude or we can say that the bond price is very much volatile on the basis of the change in interest rates.

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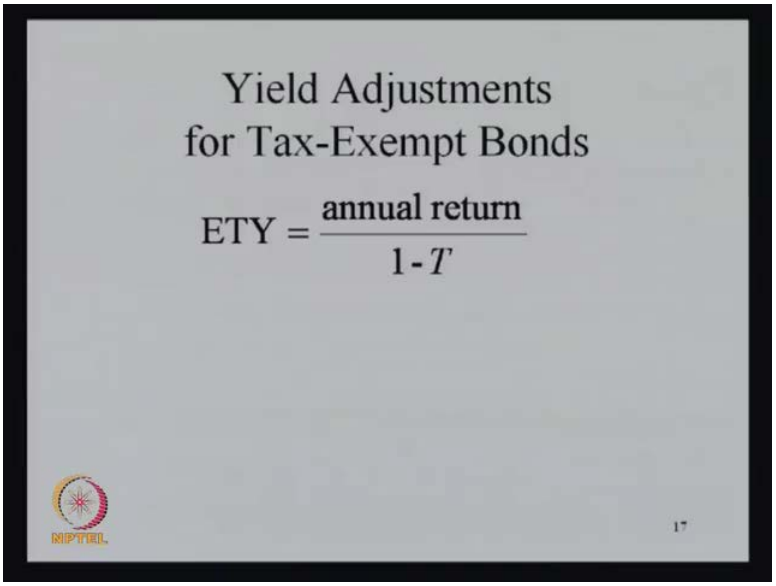

So, if you talk about the bond is volatile or whenever the volatility comes to our mind, definitely we always see that there is some risk involved in the bond investment and that risk basically comes from the investment change return, sorry, interest rate changes in the market. So, because interest rate changes basically decides the price of the bond and accordingly the investment on the bond will be more risky.

Therefore, what we can say that there is some kind of volatility in the bond prices, and how this volatility is measured for the bond and as well as how this volatility can be used for the investment purpose, and whenever we use those kind of concepts, then before that, we should know how this interest rate is determined in the market because interest, if interest rate is very important from the bond pricing, we should also know that how this interest rate is determined or is it possible to predict the interest rate in the future and how this interest rate can be determined or how the expected direction of the change of

the interest rate can be determined. So, those concepts, those things will be extensively discussed in the coming sessions.

So, coming sessions we will be talking about the how this interest rate is determined. Particularly how the different bonds of the different interest rates, and how the natural normal interest rates in the market is determined, which are the different logics theoretical aspects involved in that. Then, we will come to this bond price volatility and as well as how the measurement of the volatility is done and how it will be helpful for the bond investment. Thank you.