Management of Fixed Income Securities
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Lecture - 53
Mortgage Backed Securities - III

Welcome back, so in the previous class we have discussed about the role of the prepayment and the default risk and how the PSA models are able to help us to measure this projected prepayment cash flow or the default risk cash flow, what can be always possible while calculating the cash flow from the different type of mortgages.

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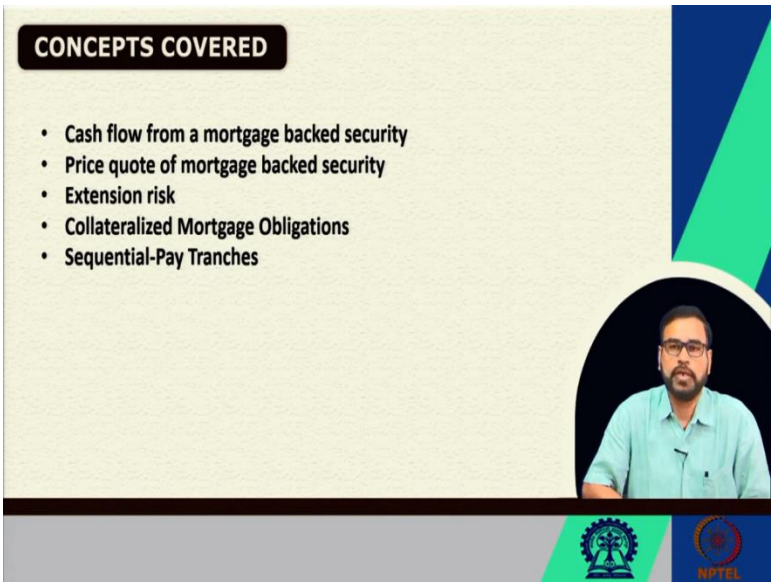

In today's discussion we will discuss about the cash flow from a mortgage-backed security because in the previous class we discussed about the cash flow from the mortgages particularly the residential mortgages. And today we will discuss about because the mortgage-backed securities are established can be constructed on the basis of the mortgage-backed loans and how the cash flow from that particular mortgage back securities can be estimated.

How the price of the mortgage-backed securities are quoted in the market. And there is a concept of extension risk which is related to those mortgage-backed securities that will discuss, then we will discuss about the CMO the collateralized mortgage obligations what exactly it means. Then

we can in start the discussion on the sequential pay tranches that will go ahead we will discuss also in the forthcoming sessions in detail but we can introduce that concept in today's class.

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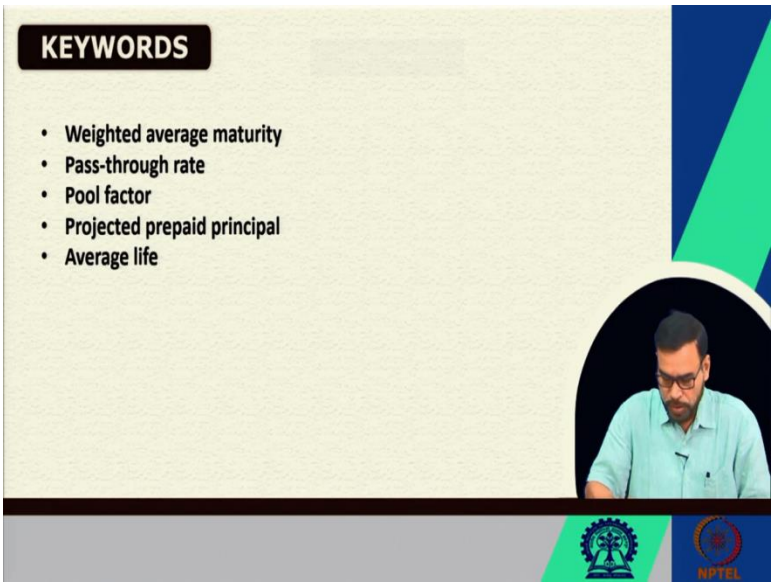

So, you will come across certain keywords like weighted average maturity, pass through rate, pool factor, projected principal or prepared principal, average life all kinds of things we will basically come across while discussing about these particular issues in today's session.

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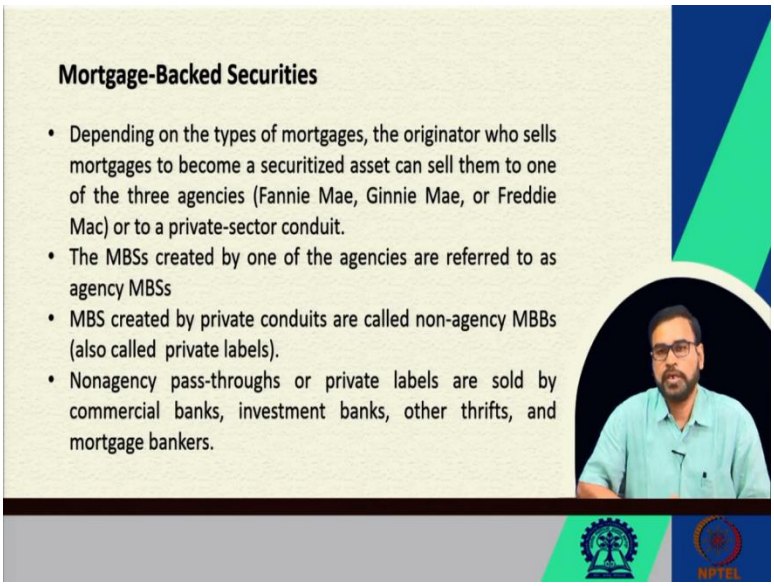

So, let us see that what basically the mortgage-backed securities and already I told you in the beginning we are discussing about the agency based the residential mortgages. So, depending upon the types of the mortgages the originator who sells the mortgage to become a securitized

asset. And the originator is the bank who takes the loan and they generally sells those particular loans(here the mortgages mean these are the loans) to particular agency.

And that agency can make that particular pool of the assets into a securitized asset. And then what will happen that particular securitized asset can be invested in the market in the beginning we have discussed that which is the process of the securitization. So, here the originator what they will do? They will basically sell these mortgages to create or maybe to construct one securitized asset to one of these three agencies.

Because we are talking about the agency based securities like your all these agencies are funded by the government or maybe on behalf of the government they work on like your Fannie Mae, Ginnie Mae and Freddie Mae and all kind of agencies which are popularly based in US or to a private sector conduit. So, they can sell that particular thing to either of these particular agencies. So, if this mortgage back securities created by one of these agencies like these three agencies what we are talking about.

These are called the agency mortgage-backed securities but if they are created by the private conduits then we call them the non-agency mortgage-backed securities or we can also call them the private labels. So, the non-agency pass-through or the private labels are sold by the commercial banks, investment banks and some of the mortgage bankers. There are different private agencies who basically always act in this particular regard.

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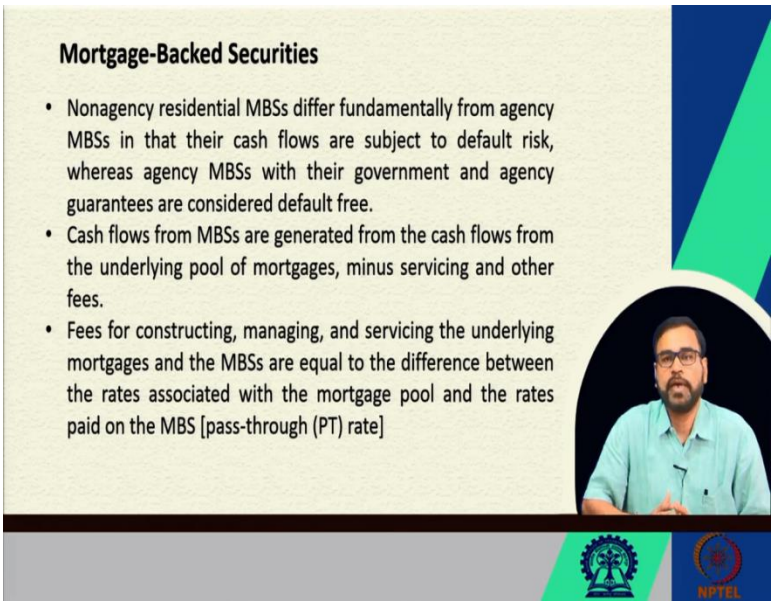

So, now what basically we see? The non-agency residential mortgage-backed securities fundamentally different from the agency mortgage back securities in terms of their cash flow. Why? Because the non-agency residential mortgage-backed securities are subject to default risk but if these particular securities are sold by these three governmentsagencies, then the default risk is free there is no default risk.

So, only in terms of default risk you will find a difference between these two types of securities. This agency based residential mortgage-backed securities and the non-agency residential mortgage-backed securities. So, already you know that the cash flow from these mortgage-backed securities are generated from the cash flow from the underlying pool of the mortgages. It is a kind of derived instrument.

And here the cash flow means it is the mortgage back securities cash flow whatever basically can be generated that basically is the cash flow from the mortgages minus the servicing in the other fees to provide that particular security. So, for constructing, managing and servicing the underlying mortgages and the mortgage-backed securities are equal to the difference between the rates which are associated with the mortgage pool.

And the rates which are paid on this particular mortgage back security; what we call it the pass-through rate or PT rate. So, the PT rates are basically the rate or the cost which is generated out of the mortgage-backed securities and we have the WAC which is basically generated out of the mortgages or the loans. So, now these things basically will be considered while calculating the cash flow from the mortgage-backed securities.

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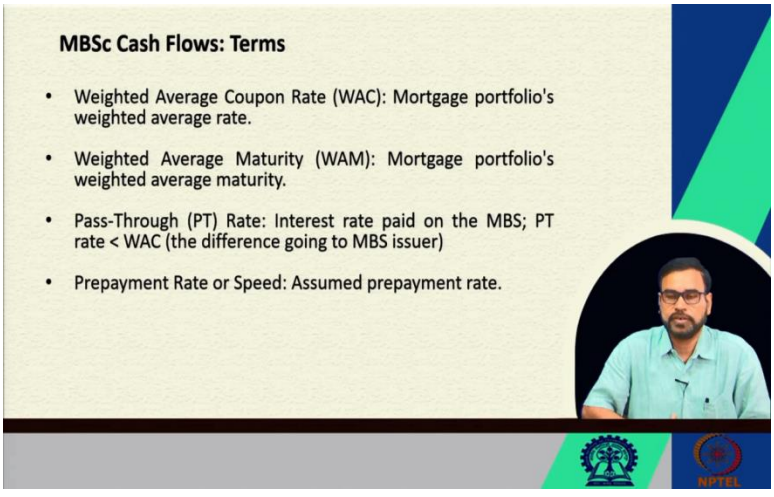

Let us see how this works but before that these are the different terms you have to keep in the mind, one is weighted average coupon rate also we have discussed in the previous class that is basically called the is nothing but the mortgage portfolios weighted average rate. Then weighted average maturity that is mortgage portfolio weighted average maturity. Then we have the pass-through rate which is interest paid on this mortgage back security.

And your PT rate is always they less than the WAC and the difference generally always goes to the MBS issuer (mortgage back security issuer). And another concept will also use it that is called the prepayment rate or the speed we are basically already discussed about that how this prepayment rate or the speed is also affecting the cash flow from that particular asset. So, we have assumed a prepayment rate.

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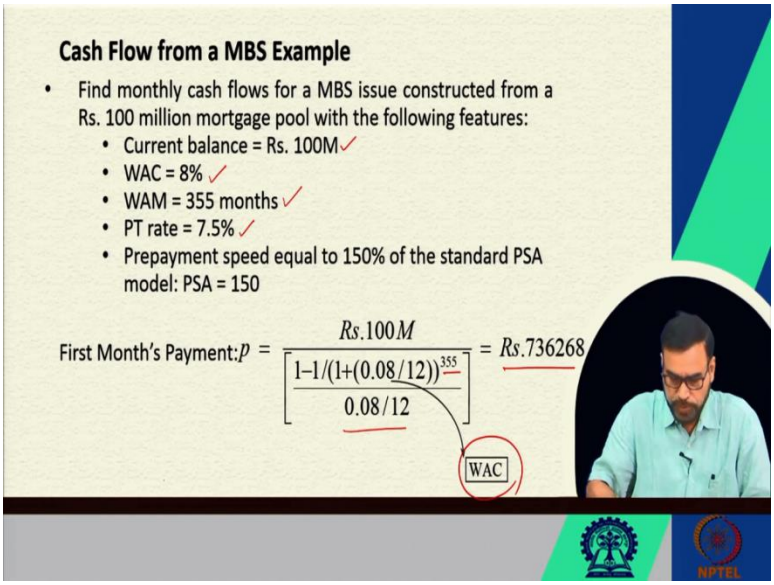

So, now we will see that how the cash flow from the mortgage-backed securities can be estimated. So, if you see that here let you take the example. Find the monthly cash flow for a mortgage back security issue constructed from a let 100 million mortgage pool with the following features, the current balance is 100 million, WAC 8%, let WAM = 355 months, PT rate is 7.5% and we have here the prepayment speed is equal to the 150% of the standard PSA model.

And that means here we have taken your PSA = 150. The standard model is PSA 100 and here we have for example we have taken 150, so then what will be the first month payment p?

$$P=\frac{Rs100M}{\left[\frac{1-1/(1+\left(\frac{0.08}{12}\right))^{355}}{0.08/12}\right]} = \text{Rs } 736268$$

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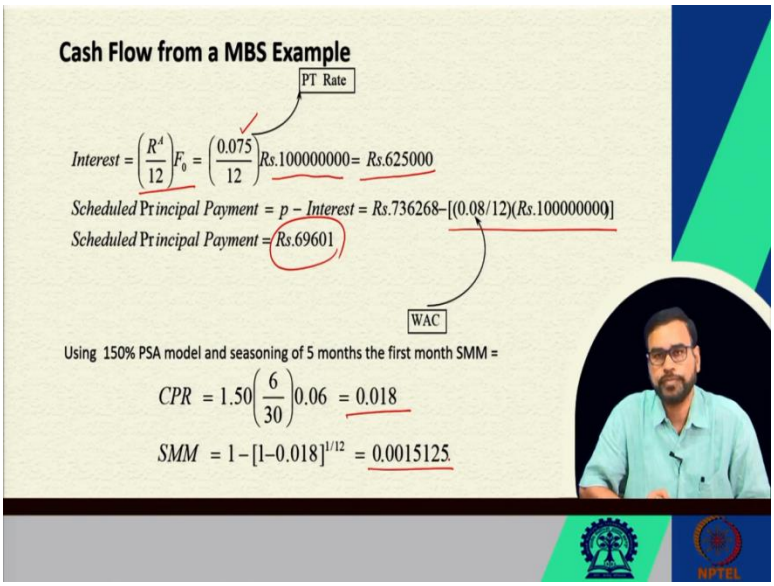

Then what we can see then what will be the interest payment.

Interest = $\left(\frac{R^A}{12}\right) F_0$

Interest = $\left(\frac{0.075}{12}\right)$ 100000000 = Rs625000

Scheduled principal payment= p- interest

Scheduled principal payment= Rs 736268-[(0.08/12) (Rs100000000)]

Scheduled principal payment= Rs69601

So, now if you want to calculate this 150% PSA model ;

CPR= $1.50\left(\frac{6}{30}\right)$ $0.06 = 0.018$

SMM= 1-$[1 - 0.018]^{1/12}$ = 0.0015125

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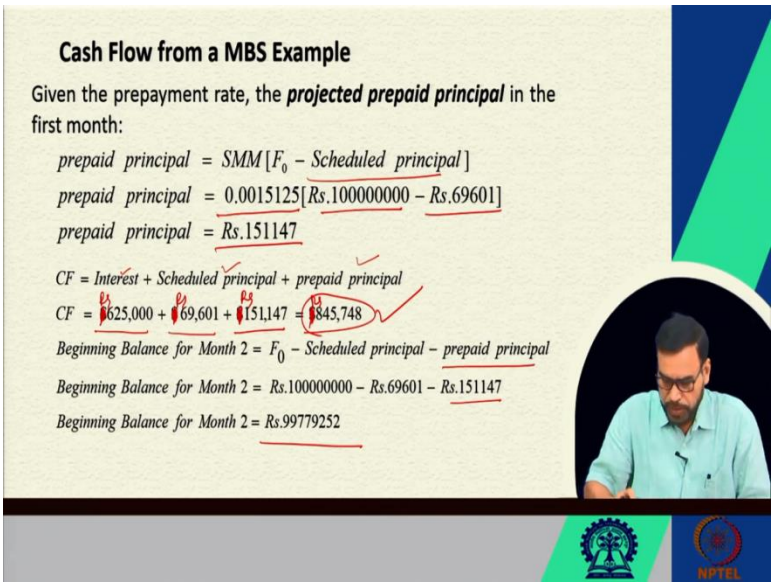

So, if you got your SMM then what basically you can do you can calculate your cash flow accordingly. So, for example if you are trying to calculate the projected prepaid principal that will be your

Prepaid principal= SMM[F_0 – scheduled principal]

Prepaid principal= 0.0015125[100000000-69601]

Prepaid principal= Rs 151147

Cash flow= interest+ scheduled principal+ prepaid principal

CF= Rs 625000+ Rs69061+ Rs 151147= Rs845748

Beginning balance for month 2= F_0- scheduled principal- prepaid principal

Beginning balance for month 2= Rs 10000000-Rs 69601- Rs151147= Rs 99779252

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So, that will be your beginning balance for the month 2. So, here we have incorporated the projected prepaid principal by calculating or by considering the 150 PSA model. So, that basically you can keep in the mind.

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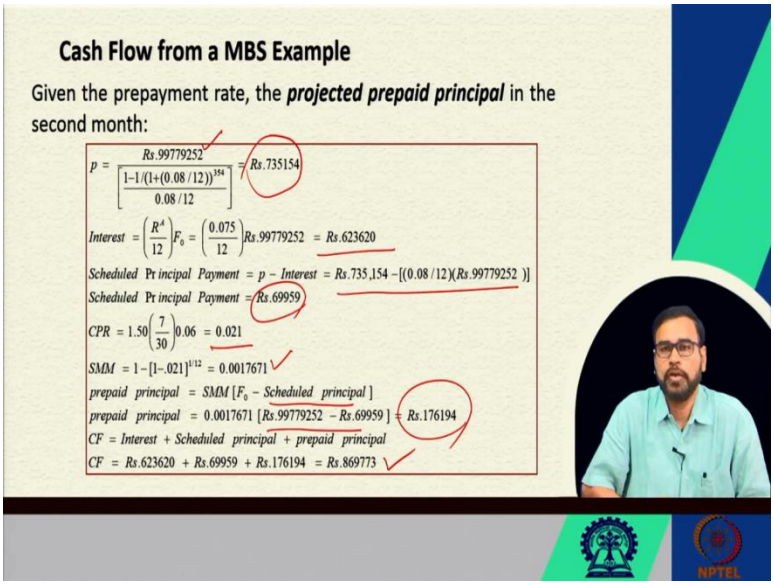

$$P = \frac{Rs99779252}{\left[\frac{1-1/(1+(\frac{0.08}{12}))^{354}}{0.08/12}\right]} = \text{Rs } 735154$$

Interest = $\left(\frac{R^A}{12}\right) F_0$

Interest = $\left(\frac{0.075}{12}\right)$ 99779252 = Rs623620

Scheduled principal payment= p- interest

Scheduled principal payment= Rs 735154-[(0.08/12) (Rs99779252)]

Scheduled principal payment= Rs69959

CPR= $1.50\left(\frac{7}{30}\right) 0.06 = 0.021$

SMM= 1-$[1 - 0.021]^{1/12}$ = 0.0017671

Prepaid principal= SMM[F_0 – scheduled principal]

Prepaid principal= 0.0017671[99779252-69959]

Prepaid principal= Rs 176194

Cash flow= interest+ scheduled principal+ prepaid principal

CF= Rs 623620+ Rs69959+ Rs 176194= Rs869773

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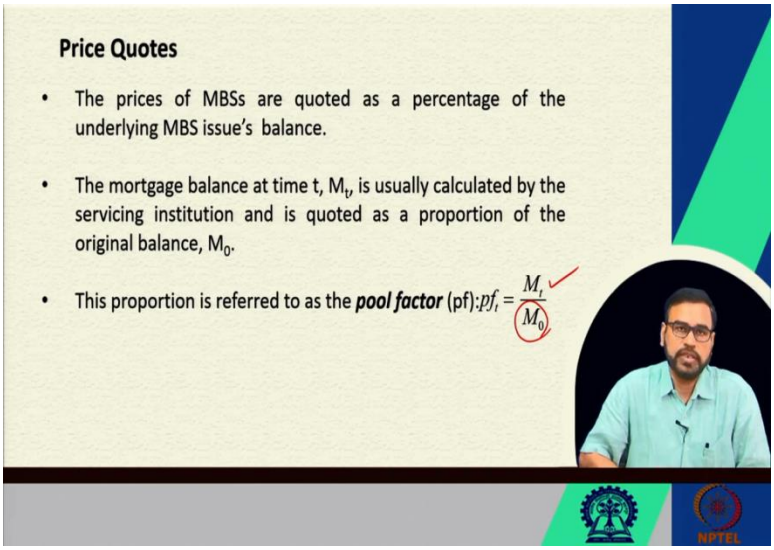

Then the next question is that how the price of the mortgage back securities are quoted in the market? So, if you look at the market the price of the mortgage-backed securities are quoted as a percentage of the underlying mortgage back security issues balance. That means if the mortgage balance at time t is empty it is usually calculated by the servicing institution and it is quoted as a proportion of the original balance that is M_0.

And this proportion is generally considered as the pool factor. So, the pool factor basically is called M_t by M_0 the proportion of the original balance that $M_t$by M_0, $M_0$is basically your original balance in the beginning. So, this is the balance or the time t that is basically will give you the price quote for the mortgage back security.

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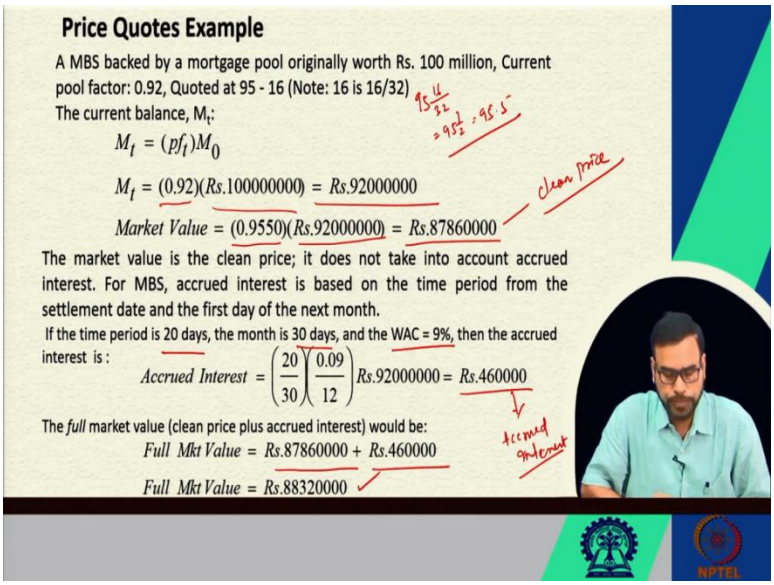

Then we will see that how generally it is really considered? Let there is a mortgage-backed security which is by a mortgage pool which is originally worth of 100 million. Let you assume that the current pool factor is 0.92 and let it is quoted as 95-16 that means already you know that that means it is 16 means it is 16 by 32. So, the current balance will be your M_t let M_t is equal to your pool factor t into M_0.

$M_t = (pf_t)M_0$

$M_t = (0.92)\ (Rs100000000) = Rs92000000$

Market value= (0.9550) (Rs92000000)= Rs87860000

Accrued interest= $\left(\frac{20}{30}\right)\left(\frac{0.09}{12}\right) Rs92000000$= Rs460000

Full Mkt value= Rs87860000+Rs460000

Full Mkt value= Rs88320000

Your pool factor here we have taken that is 0.92 then 0.92 into 100 million that will give you this much the 92 million. So, then what will be the market value then? The market value basically will be your what we can say that this 16 by 32 means it is 95, 16 by 32 that means 95, 1 by 2 that means 95.5. So, then what is the market value of that particular mortgage back security that is your 0.955 into your 92 million that will give you 87.86 million.

So, the market value whatever you are calculating in this case that is the clean price it does not take into account the accrued interest. Already we have discussed that you have a concept of the clean price and you have the concept of the dirty price. So, in this case the total price basically generally consisting of both your clean price plus your accrued interest. But here the market value whatever you have calculated that is 87.86 million that is basically your clean price.

So, now for MBS the accrued interest is based on the time period from the settlement date and the first day of the next month. So, let if the time period is 20 days we have considered and the month is 30 days and let WAC is 9% we have assumed. Then what is the accrued interest? The accrued interest will be 20 by 30 into 0.09 by 12 into your 92 million that will give you this your 460000 that is the accrued interest.

So, now the market value whatever you have calculated this one is the clean price. So, now you got your this one is your accurate interest. So, now what basically you can do? The full market value if you want to calculate that is your clean price plus the accrued interest that will be your 87.86 million plus your 460,000. Then you will find the full market value. So, that is the way the full market value of these particular mortgage back security can be calculated.

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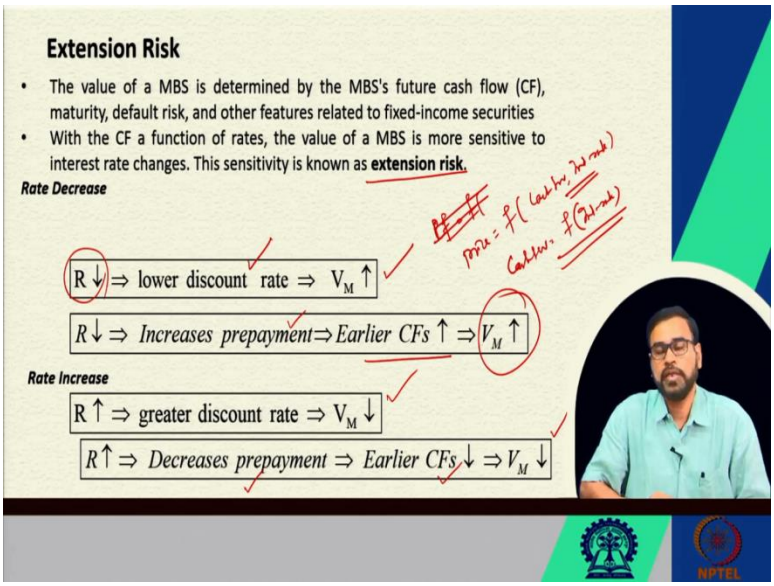

Now we will see that the concept of the extension risk. The value of this mortgage back security is generally determined by this mortgage-backed securities future cash flow. Maturity, default risk and the other features which are related to this particular fixed income security. If you

assume that the cash flow is a function of the interest rate. Obviously, the cash flow is a function of interest rate.

What basically we can say that you can consider the price is basically function of a cash flow and interest rate or discount rate. Again, there is a possibility that the cash flow is also a function of interest rate; interest rate also can determine in the cash flow. So, in that case if you assume that cash flow is a function of the interest rate then the value of the mortgage-backed security is more sensitive to the interest rate changes.

And this sensitivity is known as the extension this sensitivity is known as the extension risk. For example, let the interest rate has declined, if the interest rate will decline then discount rate will decline that means the lower discount rate. If lower discount rate will be there then the value will increase. But if the interest rate will decline it will increase the prepayment yes or no, the increases the prepayment.

So, then your earlier cash flows will increase if it will increase then also value will increase if the rate is increasing then again greater discount rate value will decline. If rate will increase it will decline the prepayment, then earlier cash flow will go down then again value will further go down. So, here we are assuming that if there is a change in interest rate then the probability of the prepayment will change.

If the probability of the prepayment will change; that will have also the impact on the value of that particular asset. So, discount rate will change the value of the asset and due to the change in discount rate then probability of prepayment will change. If the probability of prepayment will change then automatically that will also have the impact on the value of the cash flow that is basically nothing but the extension risk.

Because the interest rate is also affecting the cash flow and if the interest rate is affecting the cash flow, then obviously the value of the assets also is going to be affected by that.

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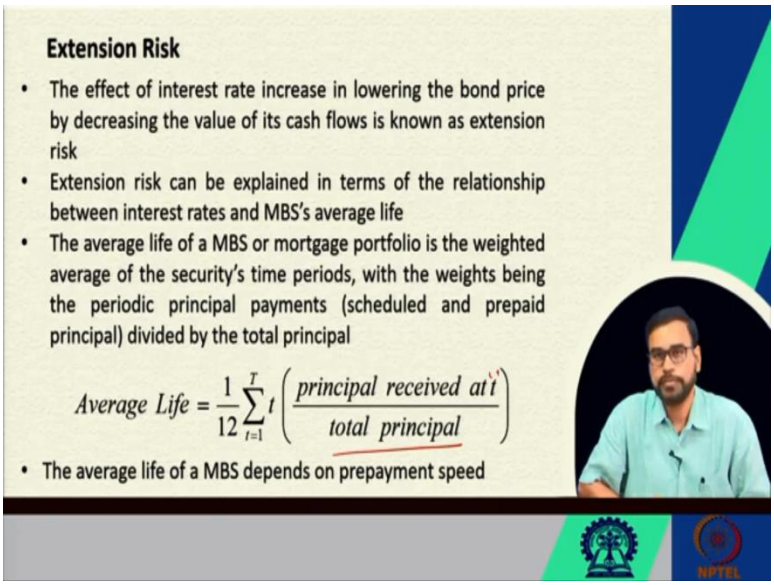

Now the effect of interested increase in lowering the bond price by decreasing the value of the cash flow is basically known as the extension risk that already we have discussed. So, the extension risk also can be explained in terms of the relationship between interest rates and the mortgage-backed securities average life. So, there is another concept here called average life. The average life of a mortgage back security is nothing but is the weighted average of securities time period.

And the weights are basically always given on the basis of the periodic principal payments. It is the scheduled and the prepaid principal divided by the total principal. So, the average life of a mortgage-backed security is nothing but 1 by 12 summation t = 1 to t, t into principal received at the time t divided by the total principal. So, the average life of the mortgage-backed security generally depends on the prepayment speed.

Because accordingly your prepaid principal amount is also going to be affected or are going to be changed.

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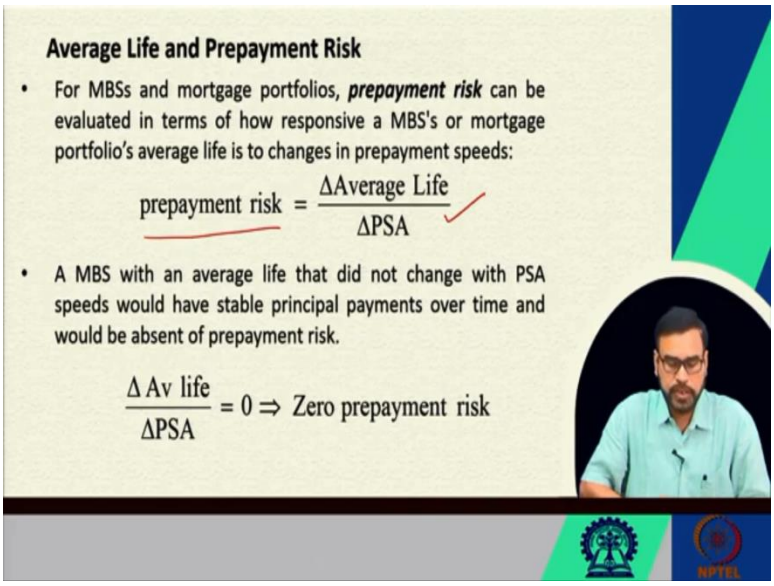

So, now if you see in this case for the mortgage-backed securities the mortgage portfolios and the mortgage portfolios. The prepayment risk can be evaluated in terms of how responsive a mortgage back securities mortgage portfolios average life is to changes in the prepayment speed. So, the prepayment risk is nothing but your change in the average life divide by your change in the PSA.

Your delta of the average life divided by delta of the PSA that basically also give you the repayment risk. So, a mortgage-backed security with an average life that did not change with PSA speed should have stable principal payments over time and will be absent of the prepayment risk. So, the delta average life divided by delta PSA if it is equal to 0 then that will imply that this particular kind of asset has no prepayment risk.

So, that is why the prepayment risk can average life also the as a relationship and if you know this particular change in the average life then you can always estimate that how much the prepayment risk is involved with respect to that.

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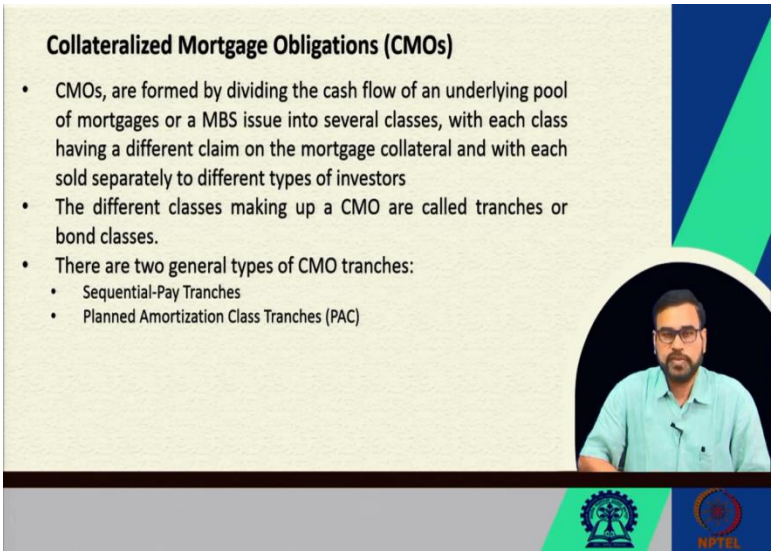

So, then we have a concept of the collateralized mortgage obligations. These particular assets or CMOs generally are formed by dividing the cash flow of an underlying full of mortgages or the mortgage back securities issue into several classes and each class having a different claim on the mortgage collateral. And each basically sold separately to different type of the investors. And the different classes making of this collateralized mortgage obligations are called the tranches or the bond classes.

And there are two general types of the collateralized mortgage obligation tranches, one basically called the sequential pay tranches and another one is called the planned amortization class tranches in short, we call it the PAC. One by one we will see and there are some special tranches also that will also see that what are those characteristics of that.

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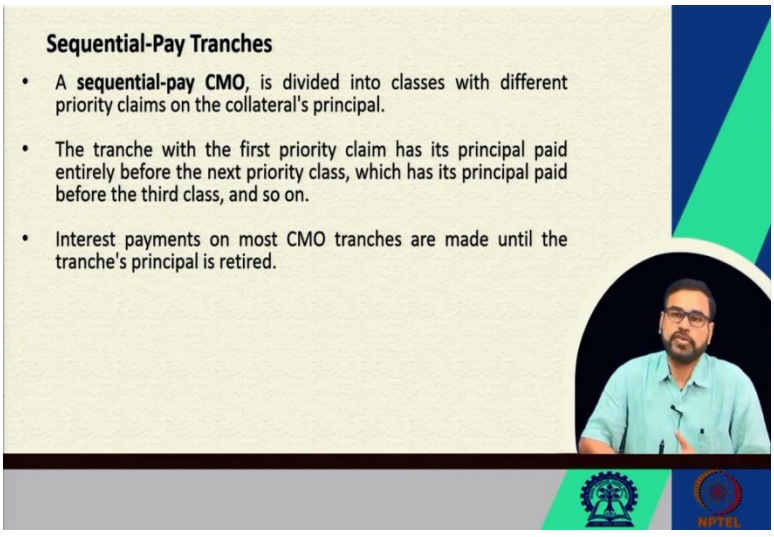

Whenever you go for the sequential pay tranches here basically what exactly happens a sequential CMO is divided into classes with different priority claims on the collateral's principal. That means the particular assets are classified on the basis of certain kind of characteristics. The tranches with the first priority claim has its principal paid entirely before the next priority class which has its principal paid before the third class and so on.

The interest payments on most CMO tranches are made until the tranches principal is retired. Principal basically will not be changed for that particular class unless the previous tranches principal is not paid but the interest basically will be paid against that.

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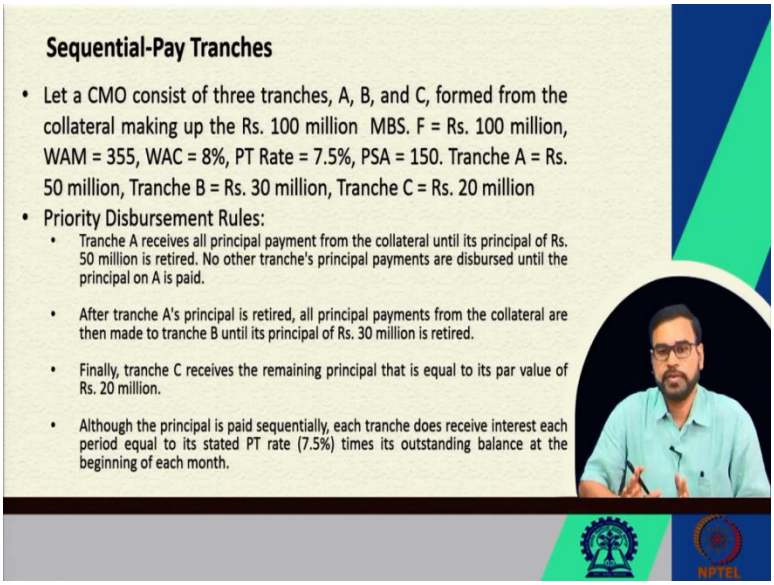

So, if you assume let there is a CMO consists of three tranches A, B, C formed from the collateral which value is totalled 100 million that means F = 100 million let WAM = 355 that already we have considered WAC = 8%, this pass-through rate is 7.5%, then the PSA we have considered 150, let the tranche A is 50 million, tranche B is 30 million and tranche C basically 20 million. Then what is the priority disbursement rule in this case as for the sequential pay tranches?

The tranche A receives principal payment from the collateral until its principal of 50 million is retired. No other tranche principal payments are disbursed until the principal on A is paid. After tranches A principal is retired all principal payments from the collateral are then made to

tranches B until its principal of 30 million is retired. Then finally the tranches C receives the remaining principal that is equal to its far value of the 20 million.

So, although the principals are paid sequentially each tranche does receive interest in each period equal to their stated pass through rate that is 7.5% times the outstanding balance at the beginning of the each month that we have seen, this is the way basically the sequential way tranches are created.

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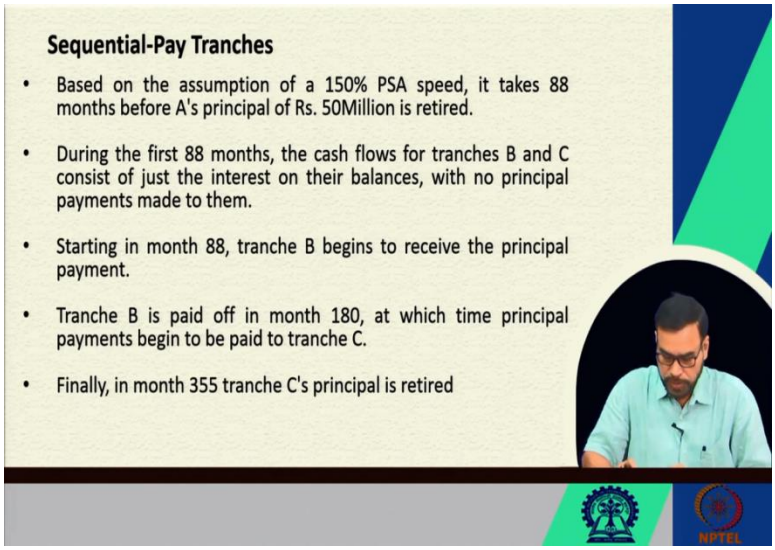

So, based on the assumption of the 150% PSA speed if you know it is a very big calculation, we have not shown all the detailed calculation. But it will take 88 months before A's principal of 50 million is retired. Then during the first 88 months, the cash flows for tranches B and C consist of just the interest on their balances and with no principal payments basically made to them. Starting in month 88 tranches B begins to receive the principal payments.

Then tranches B is paid off in month 180, at which the time principal payments begin to be paid to tranches C. Finally in month 355 tranches C principal is retired because total maturity period we have considered 355.

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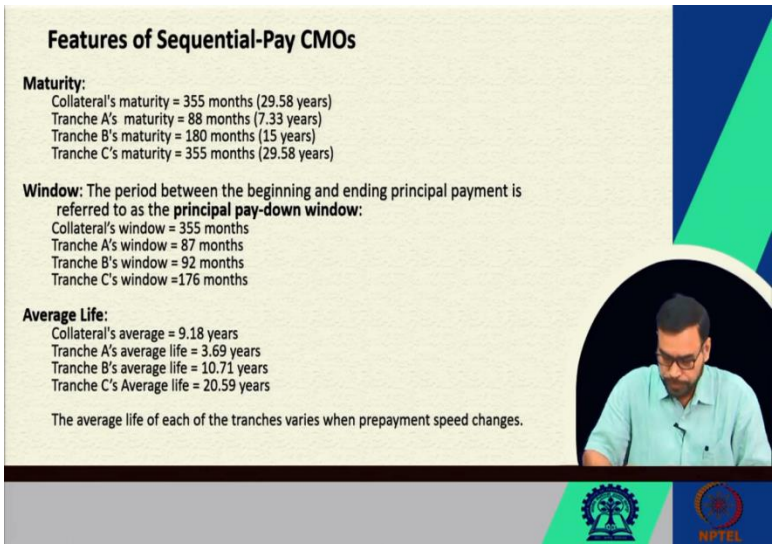

On the basis of this data whenever we have calculated this the collateral's maturity is 355 months total maturity that is 29.58 tranches A's maturity, we have seen here 88 months 7.33 years, tranches B's maturity is 180 months that means 15 years, tranches C maturity is 355 months that means 29.58 years. So, there is a window the period between the beginning and ending principal payment is referred to as principal pay down window.

The collaterals window is 355 tranches A window is 87 months, tranches B's window is basically your 180 - 88 that is 92 months, then transit siege window is 176 months. So, the average life of the total collateral is 9.18 years, tranches A is average life is 3.69, tranches B average life is 10.71 and tranches C average life is 20.59 years because how to calculate the average life that already we have discussed.

So, the average life of each tranche can vary if you change your prepayment speed. We have considered here it is 150 PSA model, if you go for 100 PSA model or if you go for 300 PSA model then accordingly the average life of A's tranches will basically change. So, this is basically your features of the sequential CMO's on the basis of the example whatever we have considered.

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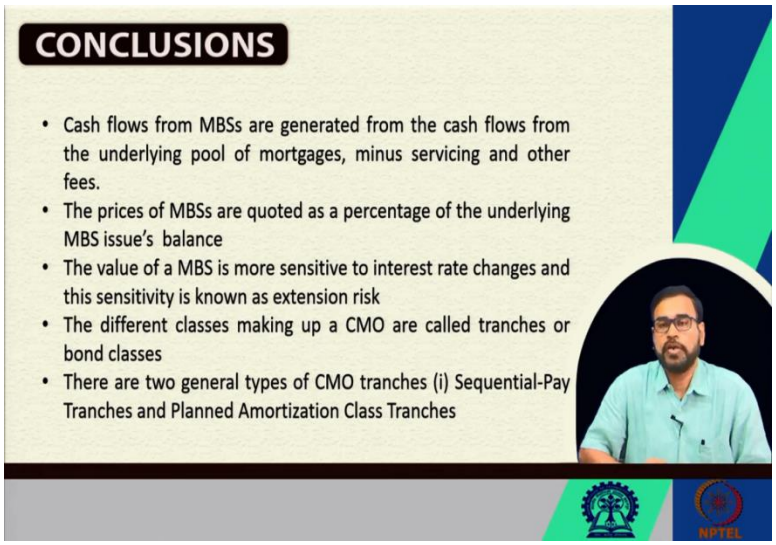

So, then what we have discussed? The cash flows from mortgage-backed securities are generated from the cash flow from the underlying pool of mortgages, minus the servicing and the other fees. And the price of the mortgage back securities are always quoted as a percentage of the underlying mortgage backs issued balance. The value of mortgage-backed securities is more sensitive to interest rate changes.

And this sensitivity is known as extension risk. The different class making of CMO's are called the tranches or the bond classes. And there are two general types of CMO tranches that is the sequence-pay tranches and the planned amortization class tranches.

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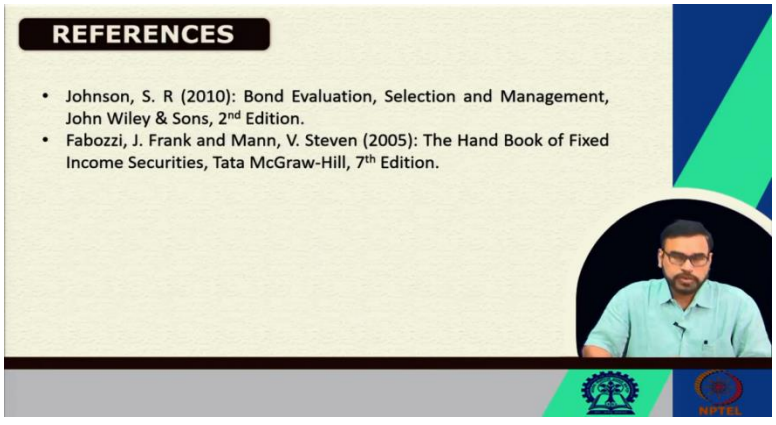

So, these are the references. Thank you.