Video 7 - Amortization of Loans: Interest and Fixed Principal

The following is a supplementary transcript for tutorial videos from

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Hi everyone. Welcome back! Today, we will be talking about loans. This video will help us to: 1. understand the components of a loan, 2. determine the different types of loans available to borrowers, and 3. amortize a loan over its lifetime. Have you ever borrowed money from a friend? I have, and I usually pay them back in about a week or so. Have you ever borrowed money from a friend for a few years? Probably not. However, companies will often take out long-term debt, such as bonds or bank loans, in order to fund their operations. This type of borrowing is much more complex, as we must factor in the time value of money. Also, the amount we pay in cash and interest may not truly reflect the cost of borrowing, and that's what we'll be talking about today.

Video at 00:52

Let's start by looking at the components of a loan. First, we have the principal amount, which is the total amount of money that is lent. Next is the interest rate, which is specified in the loan agreement, and is used to calculate the cash payments the borrower must make to the lender, in exchange for using the borrowed money for that period. The next component of a loan is the payment, which are the periodic payments that the borrower will pay to the lender. Lastly, there's the loan period, or the length of time that the loan is outstanding.

Video at 01:22

In the same way that we need to calculate the present value of investments, we also need to calculate the present value of a loan, in order to figure out what the value of our loan obligation is today. We do this by discounting the future cash flows to today's dollars. As we will soon see, these outflows include both the cash payments we make during the loan, and the large cash outflow we make to repay the loan at the end.

Video at 01:46

There are three types of loans that can be made. The first is the peer discount loan. This loan requires that the principal amount must be paid at the end of the term in one payment, which is sometimes referred to as a lump sum, a bullet payment, or a balloon payment. To find the

present value of a peer discount loan, we simply discount the future value principal back to today by using the appropriate discount rate.

Video at 02:09
For example, let's say you agreed to pay back a loan of $10,000 two years from now. If the annual interest rate is 4%, what is that $10,000 worth today? Using our present value formula, we can plug in the principal amount of $10,000, the annual rate of 4%, and the period of 2 years. Pause the video here to calculate the present value of the loan yourself. With the formula, we calculate the following: The present value is equal to $10,000 / (1.04)^2. Thus, our loan has a present value of $9,246.

Video at 02:51
The second type of loan is an interest-only loan. Unlike the peer discount loan, this type of loan is one where the borrower pays the interest every period. At the end of the last period, the borrower pays the last interest payment and repays the principal amount.

Video at 03:06
For example, a phone store offers you the chance to pay off your brand-new phone over the course of 6 months. The phone costs $1,400 with an 18% annual interest rate, as per the contract. At the end of the 6 months, we will pay the phone balance of $1,400. We will need to calculate the present value of the interest payments separately and then discount this lump sum of the $1,400 at the end of the 6 months. Pause the video here and give this question a try. When you're ready, resume the video to see how we found the solution.

Video at 03:41
First, let's calculate the interest payments using the monthly interest rate. We know the annual interest rate is 18%, and so the monthly rate is 1.5%, or 18% divided by 12 months. $1,400 x 1.5% = $21/month for 6 months. Since it's the same payment each period, this is an annuity and we can use the present value of an annuity formula. We use the present value of an annuity formula to calculate the present value of the interest rate to be $119.64.

$$\text{PVA} = A\left[\frac{1-(1+r)^{-n}}{r}\right] = 21\left[\frac{1-(1.015)^{-6}}{0.015}\right] = \$119.64$$

Video at 04:15

The third type of loan is an amortized loan. With this loan, the borrower pays off a portion of the principal amount and a portion of the interest payment each period. Therefore, unlike the two previous types of loans, an amortized loan helps you pay down the principal throughout the lifetime of the loan. By the end of the loan term, the borrower will have paid all of the principal amounts and interest payments.

Video at 04:37

There are two types of amortized loans that we will be discussing: fixed principal and fixed payment amortized loans. In this video, we will focus on fixed principal amortized loans, which are common in business loans, and look at fixed payment amortized loans in the next video, which is commonly found in mortgage payments. With a fixed principal loan, the borrower pays a fixed periodic payment towards the principal balance, and an interest payment. The amount paid in interest is dynamic and calculated based on the principal remaining. Recall that the amount of interest payment is calculated by multiplying the interest rate by the principal, which is the beginning balance of the loan. Combining these two components, the fixed principal payment and interest payment, will make up the total periodic payment on the loan.

Video at 05:22

Let's take a business loan of $20,000 to be repaid in 4 years. The annual interest rate is 10%, compounded annually. In the loan agreement, the borrower agrees to pay $5,000 per year as a fixed principal payment. We will use an amortization schedule for this loan to see which portions of the payments are going towards paying off the principal in which are interest-related. With a fixed principal loan, the interest payment is the beginning balance multiplied by the interest rate. Since the principal payment is fixed at $5,000, the total annual payment is the sum of the fixed principal and interest, which gets smaller as the beginning balance gets paid down. As we already learned that the interest payment decreases when the remaining principal or the beginning balance amount decreases, we can say the same for the interest payment as it decreases over the lifetime of the loan.

Video at 06:13

Here is the full amortization schedule.

Period	Beginning balance of loan	Interest	Fixed Principal Payment	Total Payment	Ending balance of loan
1	$20,000	$2,000	$5,000	$7,000	$15,000
2	$15,000	$1,500	$5,000	$6,500	$10,000
3	$10,000	$1,000	$5,000	$6,000	$5,000
4	$5,000	$500	$5,000	$5,500	$0

We can see the principal payment stays the same and the interest payment changes each period, as the beginning balance of the loan decreases. Let's learn how to fill in the amortization schedule ourselves. In the first column, the beginning balance of the loan is set to the starting principal of $20,000. The next column is the interest payment. We know that interest equals the interest rate multiplied by the beginning balance of the loan. The first year interest payment is 10% x $20,000 = $2,000. We add this to the principal portion for the period, which is $5,000, and together the total annual payment is $7,000. The ending balance of the loan is the beginning balance minus the principal portion. Thus, in the last column we calculate $20,000 - $5,000 to get $15,000 as our ending balance.

Video at 07:09

I'll remind you that the ending balance of one period is the beginning balance of the next period. So in the second row of our amortization schedule, the beginning balance of the loan is $15,000. Pause the video and repeat the steps we just talked about to see if you can calculate the values in the second row of the amortization schedule, and resume the video when you're ready to see how we did it. The second month interest payment is 10% x $15,000 = $1,500. The principal portion for the period is still $5,000 and together, the sum of the total monthly payment is $6,500. In the last column, we calculate $15,000 - $5,000 = $10,000 as the ending balance of the loan. You can see that this process will repeat itself every year until we reach the end of the loan, when there will be $0 left for what we owe.

Video at 08:04

Great! Our amortization schedule is done. In the last cell of the schedule, we should see a value of $0. As we read the schedule across, we can see how the payment slowly chip away at both the interest in the principal amount so that by the end of the 4 years, we have paid off all the payments on this loan.

Video at 08:23

To summarize, we pay the same $5,000 plus the changing annual interest payment each year for 4 years, and over the 4 years, we will be paying off the entire $20,000 loan, as well as the interest owed. However, over time, we will be paying less and less interest as we pay off more and more of the principal owed.

Video at 08:44

Let's recap what we learned through this lesson. We learned the importance of the time value of money when determining the present value of our loan that we must pay off in the future. We also learned about the different types of loans that are available to borrowers. And finally, we talked about amortizing loans and created our own amortization schedule to determine the portion of our monthly payment that goes towards our interest and the portion that pays down the principal.

Thanks for watching and we'll see you next time!