



Chapter 15

Basic Mortgage Calculations

Five Vital Features of a Mortgage

1. Payment
2. Balance (at any point in time)
3. Lender's yield (internal rate of return), (*IRR*)
4. Borrower's effective borrowing cost (*EBC*)
5. Present value of the debt
 1. (we do not study this in FIN3433)

Interest Due

- ▶ Interest Due is the mirror image of interest earned
- ▶ In Principles of Finance you learned that interest earned is:
 - ▶ Interest rate * Amount Deposited
- ▶ Interest due is:
 - ▶ Interest rate * Amount Borrowed

Periodic Interest Rate

- ▶ The periodic interest rate is the Note Rate divided by the periods per year
- ▶ For mortgages, the period is usually one month (12 periods per year)
- ▶ The monthly interest rate charged can then be computed as:
 - ▶ **Rate%/1200**

Interest Due Example

- ▶ You borrowed \$250,000 last month at 6 3/8%. How much interest is due now?
- ▶ $250,000 * 6.375 / 1200 = 1328.13$
- ▶ If you make a payment more than 1328.13, you will be "amortizing" your loan
- ▶ If you make a payment less than 1,328.13 you will have negative amortization, or more pleasantly called, positive accrual

Application of payments to loan balances

- ▶ Your loan contract will specify the use of payments on your loan. Typically money will first be used to make up any arrears in payments or any penalties you have incurred
- ▶ If you are paying according to schedule, your payment will first be applied to interest due.
- ▶ Any amount of your payment that exceeds the interest due will be used to amortize (pay down) the principal

Amortization Example

- ▶ For the previous Interest Due example, say you made of payment of \$1500.
- ▶ First the 1328.13 interest would be subtracted from your payment and the remaining amount ($1500 - 1328.13 = 171.88$) would be used to pay down the principal. Your new principal amount would be
- ▶ $250,000.00 - 171.88 = 249,828.12$

Loan Amortization

- ▶ If your loan payment and interest rate are constant, your calculator can do the amortization calculations for you.
- ▶ If your loan payment changes every month, and if the interest rate changes every month, you will need to do a month by month amortization of the loan which allows for these changes.

Calculator hints

- ▶ Clear the calculator before new problems (Use the **■** **CALL**)
- ▶ Make sure:
 - ▶ The desired number of decimal places are displayed
 - ▶ Set using **■** **DISP** followed by entering a digit
 - ▶ You have the correct payments (periods) per year
 - ▶ Set by typing a number then press **■** **P/YR**
 - ▶ Check by holding down **■** **CALL**

Calculator hints (continued)

- BEGIN indicator is not displayed, unless you are told this problem has beginning of period cash flows
- ▶ Set using **■** **BEG/END**
- If you have a comma where you should have a decimal point (European notation) then toggle to decimal by:
- ▶ Toggle using **■** **./,**

My notation when using calculator

- What will your loan payment (P&I) be for a \$270,000 loan at 6% amortized over a 15 year period
- ▶ $P/YR = 12$ (indicate the periods per year)
 - ▶ $PMT(N=180, I/YR=6, PV=-270,000) = 2278.41$
 - ▶ Order of inputs does not matter
 - ▶ Negative sign for PV indicates a cash outflow
 - ▶ N = number of periods
 - ▶ I/YR = stated annual interest rate
 - ▶ The last button one pushes is what you want to solve for: in this case PMT.

Amortization function on Calculator

- ▶ One sets up the Amortization table in the calculator by entering the starting period and pressing the INPUT key, and then entering the ending period and pressing the **■** **AMORT** key.
- ▶ Press the = key to cycle through the principal paid, the interest paid, and the ending balance.

Amortization Example

- ▶ For the previous example, how much interest will be paid in the second year?
- ▶ First solve for the monthly payment
 - ▶ $PMT(PV=-270,000, I/Yr = 6, N=180) = 2278.41$
- ▶ Then:
 - ▶ I3 INPUT
 - ▶ 24 ■ AMORT
- ▶ Press the = sign twice to get the interest paid during the second year of **15,182.12**

Finding the Balance at Any Date

- ▶ The balance at any point in the life of a level payment loan is the present value of the remaining contract payments, discounted at the contract interest rate.
- ▶ An alternate way to compute the balance at any point in time is to use the amortization function on your calculator. Start by computing the payment on the loan and then you can easily use the AMORT function to compute the balance at any time

Example 1. Fixed Rate Mortgage (FRM)

- ▶ You have applied for a \$200,000, 30 yr, FRM, at 4.75%, with three points in lender fees.
- ▶ What is your payment?
- ▶ How much do you pay in principal in the 14th month?
- ▶ How much do you pay in interest in the 14th month?
What is your loan balance after your 14th payment?
- ▶ How much do you pay in principal in the 4th year?
- ▶ How much do you pay in interest in the 4th year?
- ▶ What is your balance after 4 years?
- ▶ How about some PollEverywhere practice on this?

Lender's Yield

- ▶ Recall there were 3 points on this loan. This increases the lenders yield above the note rate.
- ▶ The lender's cash flows could be seen as an initial up front payment, in addition to your monthly payments
- ▶ Because the payment of points is at time period zero, from the lenders point of view it provides you with less than the note amount
- ▶ Assuming you keep the loan 360 months, what is the lender's yield (as an APR)?

Cost to Borrower

- ▶ In addition to paying the lender points there are other fees associated with obtaining a mortgage loan.
- ▶ What is the cost to the borrower if these 3rd party charges are \$1250 and you keep the loan for 30 years?

Special Case of Cost to Borrower – The FTLAPR

- ▶ Federal Truth in Lending Act requires disclosure of annual percentage rate (APR) on virtually all home mortgage loans
- ▶ FTLAPR: Yield to maturity, after adjusting for:
 - ▶ All loan finance charges
 - ▶ All compensation to (mortgage) originating brokers
 - ▶ All other charges controlled by lender
 - ▶ Premiums for any required mortgage insurance
- ▶ When no mortgage insurance is required, the FTLAPR is essentially the Yield to Lender; if you keep your loan for its entire term
 - ▶ How likely are you to keep a loan for 30-years?

Federal Truth in Lending APR

- ▶ This is the yield to lender (if you are not required to pay mortgage insurance) if you keep your loan the entire term
- ▶ It needs to be accurate to 1/8%, so the result is often rounded to the nearest 1/8%
- ▶ When you have mortgage insurance, it must be included in the FTLAPR and is a complicated computation if trying to accomplish “by hand”

Lender’s Yield, EBC – Early Payoff

- ▶ Recall there were 3 points on this loan, and 1250 in third party costs. This increases the lenders yield above the note rate, and the EBC will be higher than the Lenders Yield.
- ▶ Assuming you keep the loan 48 months, what is the lender’s yield (as an APR)?
- ▶ Assuming you keep the loan 48 months, what is the EBC (as an APR)?

So when we do mortgage computations how do we know whether to use the note amount or the net loan proceeds as the PV?

- ▶ In finance we are all about the cash flows.
- ▶ We use the note amount to calculate:
 - ▶ The loan payment
 - ▶ Separating the loan payments into principal and interest
 - ▶ Finding the balance at any point in time
- ▶ With the information computed above, we can now track Cash Flows. The note amount minus points or other fees charged by the lender is the period zero cash flow to the lender. We use this to compute the yield to lender as an I/YR
- ▶ For most mortgages the borrower will have to pay fees to other service providers (e.g. title insurance fee) to obtain the mortgage. This money is not paid to the lender so is not part of the yield to lender. It is a cost to the borrower so it reduces the time period cash flow to the borrower and is included in the EBC

Yet another example: Thirty year \$150000 mortgage at 5.25% with 2.5 points that you payoff in 5 years. What is the yield to Lender?

- ▶ Use the note amount of \$150,000 to find the loan payment and balance
 - ▶ $PMT(N=360, I/YR=5.25, PV=-150000) = 536.82$
 - ▶ Payoff: 60 INPUT 60 AMORT = = = 93,630.06
- ▶ To compute the yield to lender we use the lender’s cash flows, so the PV will be the time period zero cash flow of the lender, which is the Note Amount minus the points.
 - ▶ $I/YR(N=48, PV=-146125, PMT=536.82, FV=93630.06) = 5.87$
- ▶ For EBC problems the PV is further reduced by the “third party” costs

Bullet Loan

- ▶ You are purchasing an apartment building for 10,000,000 and have been approved for a 5-year bullet loan at 4.125% in the amount of 7,000,000?
- ▶ What is your monthly payment?
- ▶ How much will you repay at the end of 5 years?

Partially Amortizing Loan

- ▶ You purchased a small shopping center for \$5,000,000 and have obtained a 4.625% loan that amortizes over a 25-year period, with a balloon payment due on after 6 years. The loan amount is 3,000,000
- ▶ What is your monthly payment?
- ▶ What is amount of your balloon payment?

Loan Payoff Mid Month

- ▶ On March 1, 2012 you took out a loan for 180,000 that was a 30 year FRM, with an interest rate of 5.25%. What would your loan payoff be on June 21, 2018.?

Interaction of EBC, Points, & Holding Period

Discount Points	Number of Years Loan Is Outstanding					
	2 Yrs.	4 Yrs.	6 Yrs.	8 Yrs.	10 Yrs.	30 Yrs.
0.00	6.81%	6.44%	6.31%	6.25%	6.22%	6.14%
0.50	7.09	6.58	6.42	6.34	6.29	6.19
1.00	7.36	6.73	6.52	6.42	6.36	6.24
1.50	7.64	6.88	6.63	6.51	6.44	6.29
2.00	7.92	7.03	6.74	6.59	6.51	6.34
2.50	8.20	7.18	6.85	6.68	6.58	6.39

30-year \$200,000 fixed-payment mortgage with contract rate of 6.0 percent and other up-front financing costs of \$3,000.

Based on 30-year, \$200,000, fixed payment mortgage with contract interest rate of 6.0% and other up-front financing costs of \$3,000

Implications?

- ▶ Borrowers who expect to move relatively soon should choose to pay few or no discount points & a slightly higher interest rate
- ▶ Borrowers who expect to keep the loan outstanding for a long period should consider paying discount points to **buy down** the interest rate

Adjustable Rate Mortgages w/o Caps: Ex 15-3

Loan Assumptions		Caps: None		
Initial amount: \$100,000				
Term: 30 years (360 months)				
Margin: 2.75% (275 basis points)				
	Beginning of Year			
	1	2	3	
Index	3.25%	3.25%	3.50%	
Teaser rate	4.50%			
Interest rate	4.5%	(3.25 + 2.75) 6.00%*	(3.50 + 2.75) 6.25%*	
Loan balance	\$100,000	\$98,386.77	\$97,088.11	
Months remaining	360	348	336	
Monthly payment	\$506.69	\$597.21	\$612.61	

Interest rate equals (index + margin) after year 1.

Adjustable Rate Mortgages with Caps: Ex. 5-5

Loan Assumptions		Caps		
Initial amount: \$100,000		Periodic (annual): 1.00%		
Term: 30 years (360 months)		Overall: 5.00%		
Margin: 2.75% (275 basis points)				
	Beginning of Year			
	1	2	3	
Index	3.25%	3.25%	3.50%	
Teaser rate	4.50%			
Interest rate	4.50%	Lesser of: (3.25 + 2.75) or (4.50 + 1.00) 5.50%*	Lesser of: (3.50 + 2.75) or (5.50 + 1.00) 6.25%*	
Loan balance	\$100,000	\$98,386.77	\$97,976.54	
Months remaining	360	348	336	
Monthly payment	\$506.69	\$566.26	\$611.85	

Overall maximum interest rate: 9.50% (4.50 + 5.00)
 *Assumes the periodic cap applies to the "teaser" rate.

