A Brief Introduction to Mortgage Calculations

FIN 4723

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

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

Another month of amortization

- Lets assume you have a variable interest rate loan, and the rate changes to 8% and you make the minimum payment you are allowed, that is $1000. How much will you owe in interest and what will your balance be at the end of the month?
- Interest due = $249,828.12 * 8/1200 = $1,665.52
- Because your payment was less than $1,665.52, your payment is too small to cover the interest; thus, you will have accrued interest payable in the future.
- New Balance = Previous Balance + Interest Due – PMT = 249,828.12 + 1665.52 – 1000 = 250,493.64

Bullet Loan (Interest Only)

- Are sometimes used in commercial lending
- Balloon amount of balance due at end of loan period
- Example. What is the payment pattern on a 5 year bullet loan of $5,000,000 at 6 3/8%?
- 5,000,000 * 6.375/1200 = $26,562.50 monthly payment for 59 months
- Final payment of 5,026,562.50 at month 60
- Note: This is like the payment pattern for a bond

Loan Amortization

- If your loan payment and interest rate are constant, most financial calculators 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, as previously illustrated, which allows for these changes.

Calculator hints

- Clear the calculator before new problems
  - (Use the ▮ C ALL)
- 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 ▮ C ALL

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 ▮ ./,

FRM (Fixed Rate Mortgage)

- Financial calculators can easily compute the payments and other features of fixed rate mortgages.
- A more complete description is a **fixed rate, constant payment fully amortizing mortgage**
- Use the TVM (time value of money keys)

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(PV=-270,000, I/Yr = 6, N=180) = 2,278.41
- Order of inputs does not matter
- Negative sign for PV indicates a cash outflow
- N = number of periods (typically months for mortgages)
- 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.
- The amortization function assumes you make the payments specified.
- The amortization table will work for any Payment, Interest Rate, and PV you input into the calculator.

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:
  - 13 INPUT
  - 24 AMORT
- Press the = sign twice to get the interest pay during the second year of 15,182.12

Balloon Loans

- Balloon loans are those which are due before they fully amortize. For example, one could have a loan that amortized over 25 years but is due after 5 years. At this point, the balance must be repaid in full, usually by either selling the property or taking out a new loan.
- Balloon loans are the norm in CRE, although some long term fully amortization loans are available for apartment buildings though backing by Fannie Mae, Freddie Mac, or FHA.

Balloon loan example

- You have a 5 year term on a 25 year amortization period for a 6 7/8% mortgage for $4,000,000.00 What will your payments be? (P/YR = 12)
- PMT(PV=-4000000, N=300, I/YR=6.875) = 27953.01
- You can use the amortization function to get the ending loan balance, or use the fact the on an FRM, the balance at any point in time is the PV of the remaining payments: hence:
- PV(PMT=27953.01,N=240,I/YR=6.875) = 3,640,598.01
- You will have monthly payments of $27953.01 per month for 60 months, with an additional 3,640,598.01 due on month 60

Yield to Lender

- A lender typically charges "points" and other fees to the borrower
- One point is one percent of the loan amount
- In addition, a borrower has to pay 3rd party charges to title companies, the county and others
- Assume that for the 5 year balloon loan the borrower had to pay the lender 2 points and had to pay 3rd parties a sum of $25,000. What is the yield of this loan to the lender, expressed as an IRR/YR (APR). In this case, the payments are as stated earlier, but the amount the lender disburses is reduced by 2%, which is $80,000 to cover points
- I/YR(PV=-3920000, PMT=27953.01, FV= 3,640,598.01, N=60) = 7.37%, which is higher than the note rate of 6.875%

Cost of the Mortgage to the Borrower

- A lender typically charges "points" and other fees to the borrower
- One point is one percent of the loan amount
- In addition, a borrower has to pay 3rd party charges to title companies, the county and others
- Assume that for the 5 year bullet loan the borrower had to pay the lender 2 points and had to pay 3rd parties a sum of $25,000. What is the cost of this loan to the borrower, expressed as an IRR/YR (APR). In this case, the payments are as stated earlier, but the amount the borrower receives is reduced by $105,000 to cover points and fees
- I/YR(PV=-3895000, PMT=27953.01, FV= 3,640,598.01, N=60) = 7.532%, which is higher than the note rate of 6.875%

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"As an alternative to the traditional 30-year mortgage, we also offer an interest-only mortgage, balloon mortgage, reverse mortgage, upside down mortgage, inside out mortgage, loop-de-loop mortgage, and the spinning double axel mortgage with a triple lutz."

Adjustable Rate Mortgages (ARM's)

- Many loans have an adjustable interest rate that resets according to the agreement based on some index rate plus a margin or spread.
- The beginning payment is the same as for a FRM until the rate adjusts, if the mortgage is set up to be fully amortizing.
- Each time the rate changes, the payment must be recomputed using the current loan balance, new interest rate, and the remaining amortization term.
- Some loans have interest rates that change every month, and some that are fixed for some longer period and then allowed to vary.

Creative Financing

- Many other types of mortgages exist including Graduated Payment Mortgages, Shared Appreciation Mortgages, Price Level Adjusted Mortgages, and even Reverse Mortgages
- Mortgages are not the focus of this course so we will typically assume either an FRM or a Bullet mortgage.