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 1,328.13, 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 a 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 \( \text{\textbf{C ALL}} \))
- Make sure:
  - The desired number of decimal places are displayed
  - The calculator uses \( \text{\textbf{DISP}} \) followed by entering a digit
  - You have the correct payments (periods) per year
    - Set by typing a number then press \( \text{\textbf{P/YR}} \)
    - Check by holding down \( \text{\textbf{C ALL}} \)

Calculator hints (continued)

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

Usage when using Calculator

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

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 \( \text{\textbf{AMORT}} \) key.
- Press the \( \text{\textbf{=}} \) 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
  \[ \text{PMT} \left( PV = -270,000, i/Y = 6, N = 180 \right) = 2278.41 \]
- Then:
  - Input: 13
  - AMORT
  - Press the = sign twice to get the interest paid during the second year of 15,182.12

Payment for $100,000, 30 year, 12% loan
- Annual Payment
  
<table>
<thead>
<tr>
<th>Annual Payment</th>
<th>P/YR = 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>12</td>
</tr>
<tr>
<td>12,414.37</td>
<td></td>
</tr>
</tbody>
</table>

- Monthly Payment
  
<table>
<thead>
<tr>
<th>Monthly Payment</th>
<th>P/YR = 12</th>
</tr>
</thead>
<tbody>
<tr>
<td>360</td>
<td>12</td>
</tr>
<tr>
<td>1,028.61</td>
<td></td>
</tr>
</tbody>
</table>

What Are a Series of Loan Payments Worth?
- The value is the PV of the series of payments
- What would the value of these payments be to a lender who can make 6% on other loans?
  - 360 level payments
  - $1,000 each
  
  \[ \text{PV} \left( P/Y = 12, N = 360, \text{Pmt} = 1,000 \right) = 166,791.61 \]

Payment on a Loan
- What would be the payment on the following loan? $166,791.61
  - Level payment
  - 360 months
  - 6% per year
  
  \[ \text{PV} \left( P/Y = 12, N = 360, \text{Pmt} = 166,791.61 \right) = 1,000 \]

Another Example of Finding a Payment
- Loan amount: $100,000
- Term: 15 years (monthly)
- Interest rate: 6%
- Find the payment for 180 months on a loan that has a present value of $100,000
  
  \[ \text{P/Y} = 12 \]
  \[ P = 100,000 \]
  \[ N = 180 \]
  
  \[ \text{PMT} \left( P/Y = 12, N = 180, \text{PV} = 100,000 \right) = 843.86 \]

Finding the Balance at Any Date
- Consider these questions about the previous loan:
  - What is the payment?
  - How much of this is reduction of principal?
  - What balance therefore remains?
  - How many payments now remain?
  - What is the present value of these payment?
  - It’s the PV of all FUTURE payments: $99,656.14
  
  \[ \text{PV} \left( P/Y = 12, N = 179, \text{Pmt} = 843.86 \right) = 99,656.14 \]
Finding the Balance at Any Date: One More Time

What is the balance after two payments?
- Principal = $843.86 – Interest
  \[\text{Interest} = 0.05 \times 99,656.14\]
  \[\text{reduction} = 843.86 – 498.28\]
  \[= 345.58\]
- Balance after 2 payments = $99,656.14 – 345.58 = $99,310.56
- Confirm this computation on financial calculator

Finding the Balance at Any Date: Conclusion

- 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.

Lender’s Yield

- Consider the following mortgage assumption:
  - Term: 360 months
  - Required yield: 7%
  - Monthly payment: $1,000
- What is the initial loan balance?

Lender’s Yield (continued)

- This shows the lender earns 7% if it lends you $150,307.57 and you make payments of $1000 per month for 360 months.

Lender’s Yield (continued)

- What interest rate will result from monthly payment of $1,000 if you only receive $145,000?

Lender’s Yield (continued)

- Implicit yield is 7.36%; that is, the lender’s yield, when charging 3.53 points, is 7.36%
- This computation assumes you keep your mortgage for 360 months — lenders yield will be higher if you prepay

- Lender’s yield:
  - implicit interest rate received on a loan
  - also the lender’s expected IRR on loan
  - Is based on
  - actual cash loaned out
  - actual cash payments received
  - Based on holding the full 360 months in this example
Effective Borrowing Cost (EBC)

- The cost to a borrower exceeds the yield to the lender
- Third-party expenses: Borrower expenses not paid to lender:
  - Mortgage insurance premium
  - Taxes on the loan
  - Lender’s title insurance
  - Appraisal
  - Survey
- Effect:
  - Borrower receives less than lender’s actual disbursement
  - EBC > lender’s yield/IRR

Effective Borrowing Cost (continued)

- Example: Same loan, but with additional borrower expenses
  - Points to lender: $5,307.57
  - Borrower’s 3rd party loan expenses: $2,692.43
  - Total deducted from loan disbursement: $8,000 ($5,307.57 + $2,692.43)
  - Total net loan proceeds received by borrower: $142,307.57

Special Case of EBC: APR

- Federal Truth in Lending Act requires disclosure of annual percentage rate (APR) on virtually all home mortgage loans
- APR: Yield to maturity, after adjusting for:
  - All loan finance charges
  - All compensation to originating brokers
  - All other charges controlled by lender
  - Premiums for any required insurance
- What inadequacy might you see in the APR as a measure of true borrowing cost?

Effect of Prepayment on Lender’s Yield & Borrower’s EBC?

- Suppose example loan will be prepaid at end of 7 years (84 months)
- Loan balance at end of 7 years?
  - Note Amount: $150,307.57
  - Payment: $1,000
  - Interest rate: 7%
  - Term: 360 mos.
- # of months remaining after 7 yrs: 84 - 7 = 77
- Or: Use the AMORT function

Summary of Effect of Prepayment on Lender’s Yield & EBC

Lender’s Yield

84  -145,000 1,000 137,001.46
7.69%

Effective Borrowing Cost

84  -142,307.57 1,000 137,001.46
8.03%
Interaction of EBC, Points, & Holding Period

<table>
<thead>
<tr>
<th>Discount Points</th>
<th>2 Yrs.</th>
<th>4 Yrs.</th>
<th>6 Yrs.</th>
<th>8 Yrs.</th>
<th>10 Yrs.</th>
<th>30 Yrs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>6.81%</td>
<td>6.44%</td>
<td>6.31%</td>
<td>6.25%</td>
<td>6.22%</td>
<td>6.14%</td>
</tr>
<tr>
<td>0.50</td>
<td>7.09%</td>
<td>6.72%</td>
<td>6.58%</td>
<td>6.52%</td>
<td>6.49%</td>
<td>6.41%</td>
</tr>
<tr>
<td>1.00</td>
<td>7.36%</td>
<td>7.03%</td>
<td>6.89%</td>
<td>6.84%</td>
<td>6.81%</td>
<td>6.74%</td>
</tr>
<tr>
<td>1.50</td>
<td>7.64%</td>
<td>7.38%</td>
<td>7.05%</td>
<td>6.99%</td>
<td>6.96%</td>
<td>6.90%</td>
</tr>
<tr>
<td>2.00</td>
<td>7.92%</td>
<td>7.66%</td>
<td>6.91%</td>
<td>6.85%</td>
<td>6.82%</td>
<td>6.76%</td>
</tr>
<tr>
<td>2.50</td>
<td>8.20%</td>
<td>7.94%</td>
<td>7.22%</td>
<td>7.16%</td>
<td>7.13%</td>
<td>7.07%</td>
</tr>
</tbody>
</table>

30-Year Loans vs. 15-Year Loans

Note: Can you compute the interest rate on the loan using the data shown?

<table>
<thead>
<tr>
<th>30-Year</th>
<th>15-Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly payment</td>
<td>$1,498.88</td>
</tr>
<tr>
<td>Total payments (loan amount x monthly payment)</td>
<td>$52,999.25</td>
</tr>
<tr>
<td>Minus: Principal amortization</td>
<td>250,000</td>
</tr>
<tr>
<td>Equals: Total interest</td>
<td>$289,999.25</td>
</tr>
</tbody>
</table>

P/YR = 12
I/YR(PV=-250,000, N=360, PMT=1,498.88) = 6.00
I/YR(PV=-250,000, N=360, PMT=2,109.64) = 6.00

Question: Which is the better loan for a borrower?

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

30-Year vs. 15-Year Mortgage with Borrower Constrained

- What indicates borrower is constrained?
  - Borrowing the maximum loan?
  - Large credit card balances?
- What is constrained borrower’s opportunity cost, or discount rate?
  - May be as high as credit card interest rate

Implications for 30-Year & 15-Year Loans

- What is present value of the 30-year loan of $90,000 at 9% interest rate?
- What is present value of the 15-year loan of $90,000 at 9% interest rate?
- Conclusion: borrower is indifferent between the loans, assuming:
  - Both loans are at a market interest rate
  - Borrower is unconstrained in borrowing (i.e., can afford the higher payment with a 15-year loan)

30-Year vs. 15-Year Mortgage with Borrower Constrained

- Suppose household has large credit card balances at a 15% interest rate
- Assume this rate indicates the opportunity cost, or discount rate
- Which of these home loans would the household prefer?
  - 30-year at 9%
  - 15-year at 8.5%
  - Because a 15-year loan is less risky, it will have lower interest rate
Alternative Amortization Schedules

- Interest-only mortgage
  - Seldom with home loans (at least until recently)
  - Often with income property loans
- Partially amortized mortgage
  - Maturity is less than amortization period
  - Results in “balloon” payment
- Early payment mortgage

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

<table>
<thead>
<tr>
<th>Loan Assumptions</th>
<th>Caps: None</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial amount: $100,000</td>
<td></td>
</tr>
<tr>
<td>Term: 30 years (360 months)</td>
<td></td>
</tr>
<tr>
<td>Margin: 2.75% (25 basis points)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Beginning of Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Index</td>
<td>3.25%</td>
<td>3.25%</td>
<td>3.50%</td>
</tr>
<tr>
<td>Interest rate</td>
<td>4.5%</td>
<td>(3.25 + 2.75)</td>
<td>(3.50 + 2.75)</td>
</tr>
<tr>
<td>Loan balance</td>
<td>$100,000</td>
<td>$98,386.77</td>
<td>$97,088.11</td>
</tr>
<tr>
<td>Months remaining</td>
<td>360</td>
<td>336</td>
<td>36</td>
</tr>
<tr>
<td>Monthly payment</td>
<td>$396.89</td>
<td>$397.21</td>
<td>$402.61</td>
</tr>
</tbody>
</table>

Adjustable Rate Mortgages: Recent Variations

- 3 year/1 year ARM
  - Interest rate fixed for 3 years
  - Adjusts annually thereafter
- 5/1 ARM
- 7/1 ARM
- 10/1 ARM
- Many more variations have been available in the past

End of Chapter 15