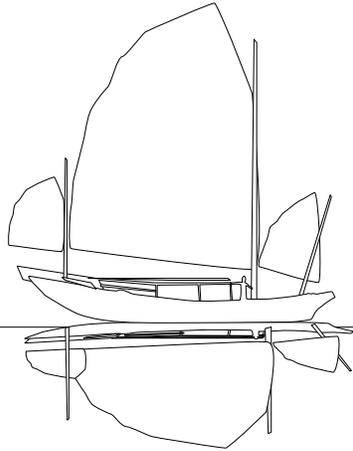


The Mortgage Market



Concepts and Buzzwords

- The Mortgage Market
 - The Basic Fixed Rate Mortgage
 - Prepayments
- mortgagor, mortgagee, PTI and LTV ratios, fixed-rate, GPM, ARM, balloon, GNMA, FNMA, FHLMC, Private label, WAC, WAM, amortization schedule, SMM, CPR, FHA, PSA*

Readings

- Tuckman, chapter 21.

Mortgage

- A mortgage is a loan secured by the collateral of some specified real estate property, which obliges the borrower (the mortgagor) to make a predetermined series of payments.
- The mortgage gives the lender (mortgagee) the **right of foreclosure** on the loan if the mortgagor defaults.

Types of Mortgages

- Fixed-rate mortgage (FRM)
 - mortgage features level monthly payments (paying interest and repaying principal) over its maturity (fully amortized)
- Adjustable-rate mortgage (ARM)
 - mortgage features predetermined adjustments of the interest rate at regular intervals, based on the movement of some benchmark rate (periodic and lifetime caps are common)
- Balloon mortgage
 - like a FRM until the balloon date, when all remaining principal comes due (the borrower either repays principal or refinances loan).
- Graduated payment mortgage (GPM)
 - like a FRM with fixed interest rate and maturity, but monthly mortgage payments increase over loan's life.

Mortgage Origination and Service

- **Mortgage origination** (originator=original lender)
 - **Typical lenders:** commercial banks, thrifts, mortgage bankers
 - **Revenue sources:** origination fee (points) and secondary marketing profits
 - **Typical requirements:** low payment-to-income (PTI) and low loan-to-value (LTV) ratios
- **Mortgage service**
 - Collecting and forwarding monthly payments, record keeping
 - **Revenues:** servicing fees (approx. 50bp), float earned on monthly payments
- **Mortgage insurance** (insures against default by the borrower)
 - **Providers:** government agencies (FHA, the Federal Housing Association; VA, Veterans Affairs) and private mortgage insurers (e.g., Mortgage Guaranty Insurance Co.)

Mortgage-Backed Securities

- Issuers buy mortgages from original lenders, form pools, and sell mortgage-backed securities--shares or certificates of participation in the pools--to investors.
- Pools are characterized by their weighted average coupon rate and maturity (WAC and WAM)
- Each month, the total of all principal and interest payments made by the mortgages in the pool, less a servicing spread, goes to the security holders.

Securitization: Background

- Before 1970, mortgage loans were held by originators, such as banks and thrifts.
- During the 1970s, a market emerged in which originators sold the loans to agencies which pooled them and created marketable mortgage-backed securities. The first pass-through was issued in 1970. A pass-through pays pro-rated share of the pool cash flows.
- Since the 1980s, the cash flows from mortgage pools have been packaged in more exotic ways: **CMOs, IOs, POs, PAC Bonds** (Planned Amortization Class, largely eliminates prepayment risk), Support classes
- The first European mortgage-backed securities were issued in the U.K. in 1987. These tend to be variable rate securities with lower and more stable prepayment rates than in the U.S.
- Issuance of mortgage backed securities has spread since the 1990s to Australia, Japan, southeast Asia, Latin America and Canada.

Securitization: Issuing Agencies

- Mortgage bankers buy mortgages from home buyers and sell them to mortgage-backed security issuers.
- The main issuers are federal agencies:
 - GNMA (Government National Mortgage Association, *Ginnie Mae*)
 - FHLMC (Federal Home Loan Mortgage Corporation, *Freddie Mac*)
 - FNMA (Federal National Mortgage Association, *Fannie Mae*)
 - No “default risk”—mortgages are insured so defaults show up as prepayment in the pool
- There is also a growing market for *private labels* (non-agency issuers)
 - Loans need not conform to agency requirements
 - Some loans may be uninsured.

Basic Fixed Rate Mortgage

- With a basic fixed rate mortgage, the borrower is scheduled to make **level monthly payments** consisting of
 - **interest** on the amount of the loan outstanding, at the pre-determined fixed mortgage rate, and
 - **principal** payments which reduce the outstanding loan balance.
- The size of the monthly payment is set so that the original loan is paid off after a prespecified amount of time, typically 30 years.

Monthly Payment for 30-Year Fixed Rate Mortgage

The fixed monthly payment is set to make the present value of the 30-year stream, discounted at the **mortgage rate**, equal to the principal amount of the loan.

By convention, the quoted mortgage rate is *annualized with monthly compounding*.

Using the annuity formula from the yield lecture, we can get a closed form expression for the monthly payment.

$$\text{prin} = \sum_{n=1}^{360} \frac{\text{pmt}}{(1 + r_m / 12)^n} = \frac{\text{pmt}}{r_m / 12} (1 - (1 + r_m / 12)^{-360})$$

$$\Rightarrow \text{pmt} = \frac{\text{prin} \times r_m}{12(1 - (1 + r_m / 12)^{-360})}$$

Example

Suppose the original principal balance is \$100,000 and the mortgage rate is 7.25%.

$$\text{pmt} = \frac{100,000 \times 0.0725}{12(1 - (1 + 0.0725 / 12)^{-360})} = 682.18$$

Amortization Schedule for 30-Year 7.25% mortgage

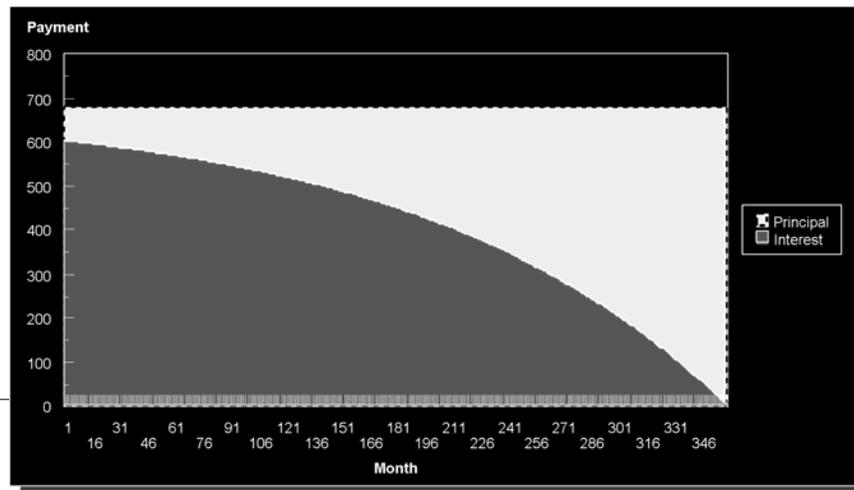
Month	Beginning Principal Balance	Monthly Payment	Monthly Interest	Scheduled Principal Repayment	Ending Principal Balance
1	100,000.00	682.18	604.17	78.01	99,922
2	99,921.99	682.18	603.70	78.48	99,844
3	99,843.51	682.18	603.22	78.96	99,765
4	99,764.55	682.18	602.74	79.43	99,685
360	678.08	682.18	4.10	678.08	0

Note that on any month:

PV(remaining stream of payments,
discounted at the fixed mortgage rate)

= remaining principal balance.

Principal and Interest Components of Monthly Payments



Mortgagor's Prepayment Option

- The mortgagor has the **option** to payoff the mortgage at any time, without penalty, by paying the remaining principal balance.
- The mortgage can be paid off in whole or in part.
- Any payment of principal in excess of the scheduled payment is called *prepayment*.

Mortgagor's Prepayment Option

- Think of paying off the mortgage (in whole) as **buying back the remaining stream of monthly payments.**
- Then the prepayment option is an American call option where
 - the underlying asset is the remaining stream of monthly payments
 - the strike price is the remaining principal balance.
- **Thus, the underlying asset is "wasting away" and the strike price declines over time according to the pre-determined amortization schedule.**

Non-Market Prepayment Risk

- Typically, we assume that American option holders exercise their options according to a value-maximizing strategy.
- That is not necessarily the case with mortgage holders:
 - To some extent, mortgagors do prepay for market reasons-- interest rate declines trigger prepayments.
 - However, mortgagors deviate from the option value-maximizing prepayment policy for reasons unrelated to interest rate changes:
 - **Prepay too early--** if the collateralizing property is **sold or destroyed**, or if the borrower defaults.
 - **Prepay too late or never--** refinancing may not be possible if transaction costs are high, or if the property has lost value.

Measures of Prepayment

- The amount of prepayment in a pool in a given period is described by a *prepayment rate*:
 - The Single Monthly Mortality rate (SMM) is the proportion of pool that terminates during a month:
 - total prepayments divided by (principal balance at beginning of month minus scheduled principal payments)
- The Conditional Prepayment Rate (CPR) is the annualized (X12) SMM.

Deterministic Prepayment Scenarios Used as Benchmarks

- The actual pattern of prepayments a given pool will experience is random.
- Nevertheless, practitioners have used **fixed prepayment schedules** as benchmarks against which to compare the actual prepayments in a given pool.
 - **12-year life**--no prepayments until year 12, then lump prepayment
 - **FHA Experience**--schedule of prepayments based on data
 - **Public Securities Association (PSA)** convention for 30 year mortgages--0.2% CPR in month 1, 0.4% CPR in month 2,..., 6% CPR in month 30, and then 6% CPR in months 31-360

Example: 2-Year, 5.5% Semi-Annual Mortgage

For consistency with other lectures, we consider a semi-annual paying with a semi-annually compounded mortgage rate.

Amortization Schedule

Date	Beginning Balance	Scheduled Payment	Interest	Principal	Ending Balance
0.50	100.00	26.74	2.75	23.99	76.01
1.00	76.01	26.74	2.09	24.65	51.36
1.50	51.36	26.74	1.41	25.33	26.03
2.00	26.03	26.74	0.72	26.03	0.00

If there are no prepayments, the cash flows of the mortgage will follow the amortization schedule.

Cash Flows to Mortgage Assuming 50% Prepayment at Time 0.5 and 25% Prepayment at Time 1.5

Think of the mortgage below as a pool of mortgages. Assume 50% prepayment means half the mortgages prepay in full, not that all mortgages prepay half of their remaining balance.

Date	Beginning Balance	Scheduled Payment	Interest	Principal	Prepayment	Ending Balance
0.50	100.00	26.74	2.75	23.99	38.00	38.00
1.00	38.00	13.37	1.05	12.33	0.00	25.68
1.50	25.68	13.37	0.71	12.66	3.25	9.76
2.00	9.76	10.03	0.27	9.76	0.00	0.00

Sample calculations:

Time 0.5 PPMT: $38.00 = 0.50 \times (100 - 23.99)$.

Time 1 SCH PMT: $13.37 = 26.74 \times \text{fraction of pool remaining}$
 $= 26.74 \times 0.50$