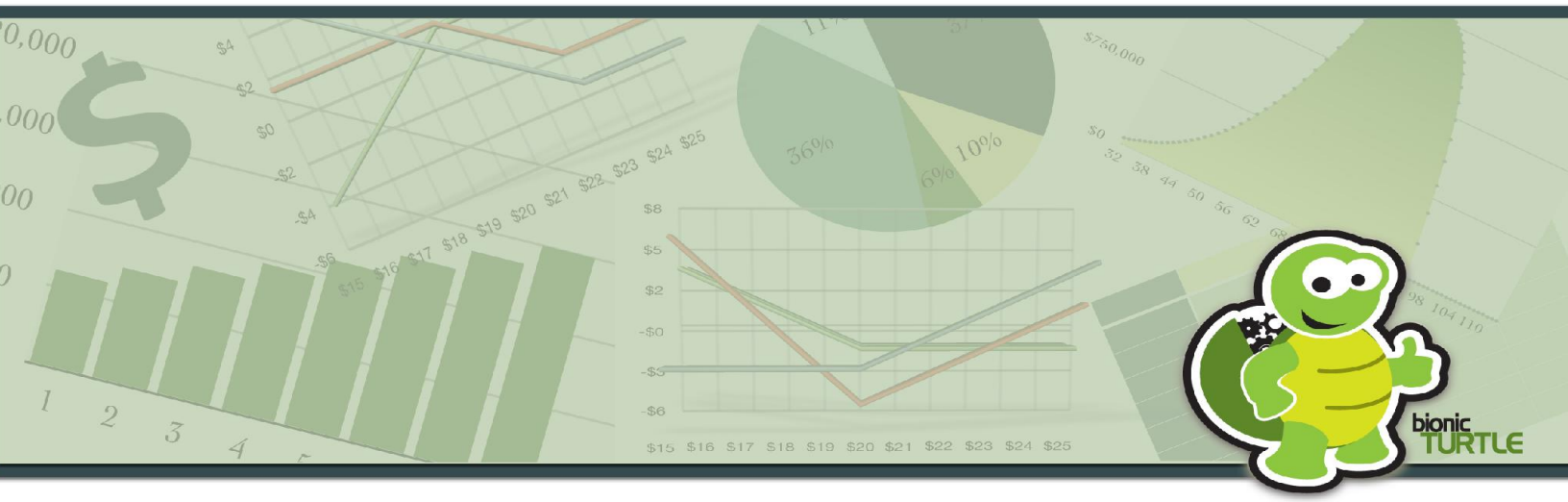

P1.T3. Financial Markets & Products

Chapter 18. Mortgages and Mortgage-Backed Securities

Bionic Turtle FRM Study Notes

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Chapter 18. Mortgages and Mortgage-Backed Securities

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Describe the various types of residential mortgage products.

Calculate a fixed rate mortgage payment, and its principal and interest components.

Describe the mortgage prepayment option and the factors that influence prepayments.

Summarize the securitization process of mortgage backed securities (MBS), particularly formation of mortgage pools including specific pools and TBAs.

Calculate weighted average coupon, weighted average maturity, single monthly mortality rate (SMM), and conditional prepayment rate (CPR) for a mortgage pool.

Describe the process of trading of pass-through agency MBS.

Explain the mechanics of different types of agency MBS products, including collateralized mortgage obligations (CMOs), interest-only securities (IOs), and principal-only securities (POs).

Describe a dollar roll transaction and how to value a dollar roll.

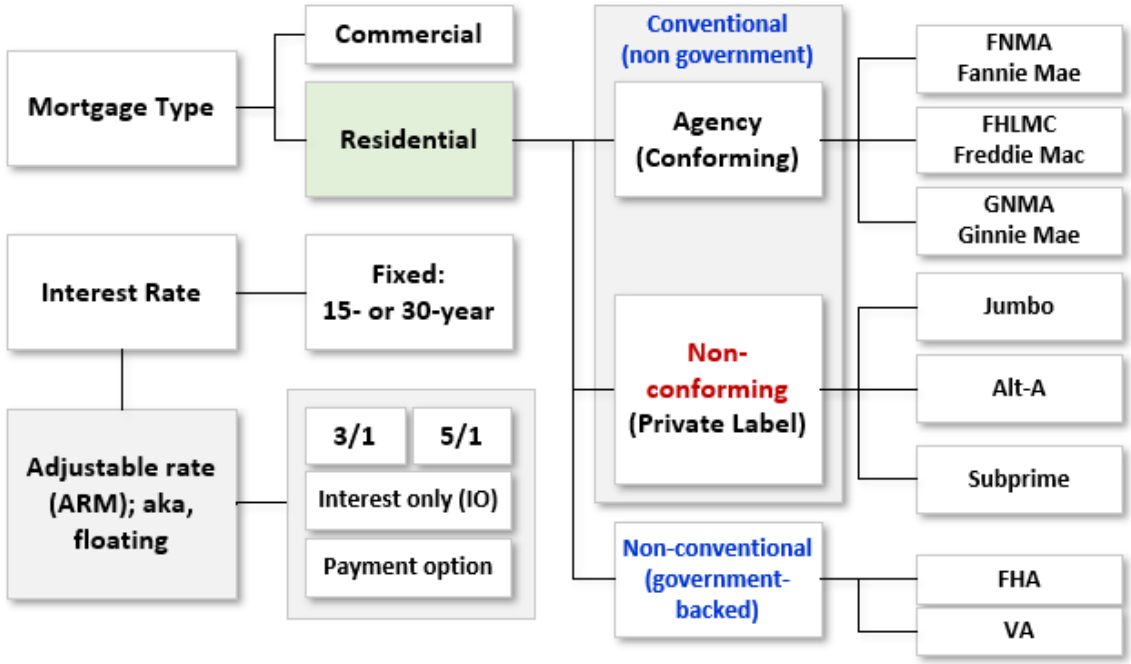
Explain prepayment modeling and its four components: refinancing, turnover, defaults, and curtailments.

Describe the steps in valuing an MBS using Monte Carlo Simulation.

Define Option Adjust Spread (OAS), and explain its challenges and its uses.

Describe the various types of residential mortgage products.

Lenders offer many types of mortgage loan products. Below is a simplified, non-exhaustive typology. Notice there is a difference between *conventional* and *conforming* loans.



Types of Residential Mortgages

The typical (~ 70 to 80%) residential mortgage loan has a maturity of 30 years but is paid off earlier. The 15-year fixed-rate mortgage accounts for about 10.0% and is popular as a refinance product[1]. Adjustable-rate mortgages (ARMs) surged in popularity (up to 40%) prior to the global financial crisis (GFC) but currently account for less than 5.0% of loans.

Conventional loans are either agency (aka, conforming) or non-conforming.

- ***Agency* or *conforming*** loans meet the eligibility standards of Federal National Mortgage Association (FNMA; aka, Fannie Mae), Federal Home Loan Mortgage Corporation (FHLMC; aka, Freddie Mac), or Government National Mortgage Association (GNMA; aka, Ginnie Mae). Fannie Mae and Freddie Mac are housing-related government-sponsored enterprises (GSEs); as opposed to education GSE (Sallie Mae) of farming GSE. Most lenders—after they *originate* the loan—sell or securitize the loan; they can sell conforming loans to Fannie Mae or Freddie Mac.

  Although the loan size limit is the most well-known criteria, conforming loans must meet several standards:

  - Loan limits. In 2020, the maximum ("baseline") loan amount in the (contiguous) United States was $510,400, For high-cost areas, the maximum can be up to 150% of this baseline, or up to $765,600. See FHFA[2]
  - Loan-to-value (LTV) ratio; e.g., at least 80.0%
  - Debt-to-income ratio
  - Credit score; and documentation requirements

- ***Non-agency* or *Non-Conforming Loans*** do not meet all of the conforming loan criteria; i.e., if a loan does not meet all criteria, it is non-conforming. Because they do not "conform" with the standards, they are not necessarily eligible to be purchased by the housing GSEs. Instead, they are funded by an ample pool of private lenders (including *hard money* lenders) and sold into the private-label securitization market.

  Non-conforming loans might simply exceed the limit (aka, Jumbo); or the borrower may not meet the credit quality standards of the conforming loan (and would traditionally be considered higher risk). Interest rates will be higher than conforming products, although Jumbos have sometimes been lower. Types include:

  1. **Jumbos:** These are above conforming loan size limit; often, this is the only variation from conforming loan.
  2. **Alt-A:** These are almost conforming but failed to meet one requirement. Consequently, the interest rate is higher than the prime lending rate but lower than the subprime lending rate
  3. **Subprime:** These fail to qualify against multiple criteria such that borrowers represent significantly greater credit risk (aka, poor creditworthiness). Subprime loans are disproportionally adjustable-rate mortgages (ARMs) and the interest rates, after the teaser, are higher.

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[1] Urban Institute's Housing Finance at a Glance (April 2020): https://www.urban.org/research/publication/housing-finance-glance-monthly-chartbook-april-2020/view/full_report

[2] Specifics available at the Federal Housing Finance Agency (FHFA) https://www.fhfa.gov/DataTools/Downloads/Pages/Conforming-Loan-Limits.aspx

Calculate a fixed rate mortgage payment, and its principal and interest components.

A fixed-rate mortgage has a constant interest rate over the life of the loan. Further, the payments are level and the principal balance *amortizes* such that the final principal balance is zero. Unlike a bond, the borrower does not repay a balloon-type amount at the end: the principal decreases over time and the final installment expires the principal. The original loan amount, B(0), must equal the present value of the stream of monthly payments, discounted at the constant mortgage rate (which is expressed in per annum terms with monthly compound frequency):

$$B(0) = Monthly\ Payment\ (X) \times \sum_{n=1}^{12T} \frac{1}{\left(1 + \frac{y}{12}\right)^n}$$

where, $B\ (0)$ is the original loan amount, y is the annual rate of interest, and T denotes the tenure of the loan in years.

For example: Calculate fixed-rate mortgage payment with the following parameters:

- Original loan (principal) amount, $B\ (0)$ = $100,000
- Mortgage interest rate, y = 5.0% per annum with monthly compounding
- Loan maturity, T = 30 Years

On the next page, we show the *amortization schedule*. The monthly payment is $536.82 which implies the following:

$$\$100{,}000 = \ \$\mathbf{536.82} \times \sum_{n=1}^{360} \frac{1}{\left(1 + \frac{0.050}{12}\right)^n}$$

The fixed monthly payment of $536.82 includes two components: interest and principal.

- The *interest component* equals the periodic mortgage rate, y/12, multiplied by the outstanding principal amount at the beginning of that period. If B(n) is the outstanding principal amount (i.e., original principal less principal repaid) after the payment on date (n), the interest component of the payment on date (n+1) is $\mathrm{B(n)} \times \frac{\mathrm{y}}{12}$.
- The *principal component* is the remainder of the monthly payment after subtracting the interest component. Therefore, it is given by $X - B(n) \times \frac{y}{12}$

In this example where the original balance is $100,000:

- At the **first month's** end, the mortgage interest of 5.0% per annum on the original balance amounts to $100,000 × 0.050/12 or $416.67. The remainder of the total monthly payment, $536.82 − $416.67 = $120.15 is the (scheduled) re-payment of principal. This principal payment reduces the outstanding balance from the original $100,000 to $100,000 − $120.15 = $99,879.85 at the end of the first month.
- At the **second month's** end, the interest is (5.0%/12) × $99,879.85 = $416.17.
- At the **third month's** end, the interest is (5.0%/12) × $99,759.19 = $415.66.

Continuing in this way produces an ***amortization table***, as shown below:

Original balance:	**$100,000**	
Term (years):	**30.0**	360 months
Rate:	**5.0%**	0.42% per month

Payment factor: **0.0053682**

=0.42%*(1+0.42%)^360/[(1+0.42%)^360-1]

	Payment			Ending
Month	Interest	Principal	Total	Balance
0				$100,000.00
1	$416.67	$120.15	$536.82	$99,879.85
2	$416.17	$120.66	$536.82	$99,759.19
3	$415.66	$121.16	$536.82	$99,638.03
4	$415.16	$121.66	$536.82	$99,516.37
5	$414.65	$122.17	$536.82	$99,394.20
6	$414.14	$122.68	$536.82	$99,271.52
7	$413.63	$123.19	$536.82	$99,148.33
8	$413.12	$123.70	$536.82	$99,024.62
9	$412.60	$124.22	$536.82	$98,900.41
10	$412.09	$124.74	$536.82	$98,775.67
11	$411.57	$125.26	$536.82	$98,650.41
12	$411.04	$125.78	$536.82	$98,524.63
13	$410.52	$126.30	$536.82	$98,398.33
...	...	...	...	...
357	$8.85	$527.97	$536.82	$1,597.14
358	$6.65	$530.17	$536.82	$1,066.97
359	$4.45	$532.38	$536.82	$534.59
360	$2.23	$534.59	$536.82	$0.00

Using the calculator to retrieve the mortgage payment

Using the time value of money keys, we can solve for the PMT. In this case,

N = 360,
I/Y = 5 ÷ 12 = 0.4167
PV = -100,000
FV = 0, and then
[CPT] [PMT] returns 536.82

Notice that we need to specify that future value (FV) equal zero because the principal amortizes.