Adjustable rate mortgages

Real-Estate Investments - Tutorial 4

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Adjustable rate mortgages (ARM)

Recall, mortgage pricing follows : $i = r + f + p$

- Real rate of interest (r).
- Inflation (f)
- Risk premium (p)

Adjustable rate mortgages (ARM)

$$i = r + f + p$$

- f is adjustable: **Price level adjusted mortgage (PLAM)**
- Problems:
  - Payment is computed again every period given changes in CPI.
  - CPI may not be appropriate to determine mortgage pricing.
  - Borrower's income might not follow the rate inflation.
  - Past changes in CPI affect future mortgage interest rate.

Adjustable rate mortgages (ARM)

$i = r + f + p$

- r, f, p are adjustable: rate is linked to **index interest rate**.
  - Let market expectations of r, p, f determine i.
  - Mortgage interest rates reflects future expectations and not past outcomes.

Important observations:

- Compared with FRM, lender faces less risk and borrower bears more risk.
- Risk depends on the adjustment intervals.

Adjustable rate mortgages (ARM)

$i = r + f + p$

- **Hybrid ARM**
  - ARM rates adjust in relatively long intervals (i.e, every few years).
  - Interest rate risk is better divided between borrower and lender (compared with other ARM).
- Risk to lender:

FRM $>$ *ARM (Hybrid - capped interest rates)* $>$ *FRM (Hybrid - capped payments)* $>$ *ARM (no limit)*

(Lower risk = lower demanded premium)

ARM main characteristics and terms

- **Index**: The index to which the interest rate is linked.
- **Margin**: A premium in addition to the index chosen.
- **Cap/Floor**: Limitations on the changes in payments or interest rates.
  - Due to caps, payments may be lower than the interest on the outstanding loan $\rightarrow$ negative amortization.
- **Reset**: The point in time when mortgage payments will be adjusted.
- **Discount points**: Points or fees added to increase the lender's yield (also in FRM).

Exercises (from the book)

Problem 2 (P.146)

A basic ARM is made for $200,000 at an initial interest rate of 6 percent for 30 years with an annual reset date. The borrower believes that the interest rate at the beginning of year 2 will increase to 7 percent.

1. Assuming that a fully amortizing loan is made, what will monthly payments be during year 1?
2. Based on (1) what will the loan balance be at the end of year 1?
3. Given that the interest rate is expected to be 7 percent at the beginning of year 2, what will monthly payments be during year 2?
4. What will be the loan balance at the end of year 2?
5. What would be the monthly payments in year 1 if they are to be interest only?
6. Assuming terms in (5), what would monthly interest only payments be in year 2?

Problem 2 answer

```
See Excel

# 1
=PMT(0.06/12, 30*12, 200000, 0) = -1,199.1

# 2
=FV(0.06/12, 12, -1199.1, 200000) = -197,543

# 3
=PMT(0.07/12, 29*12, 197543, 0) = -1,327.7
```

Problem 2 answer (continued)

```
# 4
=FV(0.07/12, 12, -1327.7, 197543) = -195,370

# 5
=PMT(0.06/12, 30*12, 200000, -200000) = -1,000

# 6
=PMT(0.07/12, 29*12, 200000, -200000) = -1,167
```

Problem 3 (P.147)

A 3/1 ARM (reset after 3 years) is made for \$150,000 at 7% with a 30-year maturity.

1. Assuming that fixed payments are to be made monthly for three years and that the loan is fully amortizing, what will be the monthly payments? What will be the loan balance after three years?
2. What would new payments be beginning in year 4 if the interest rate fell to 6% and the loan continued to be fully amortizing?
3. In (1) what would monthly payments be during year 1 if they were interest only? What would payments be beginning in year 4 if interest rates fell to 6% and the loan became fully amortizing?

Problem 3 answer

```
See Excel

# 1
=PMT(0.07/12, 30*12, 150000, 0) = -997.9537
=FV(0.07/12, 12*3, -997.9537, 150000) = -145,090.4

# 2
=PMT(0.06/12, 27*12, 145090.4, 0) = -905.34

# 3
=PMT(0.07/12, 30*12, 150000, -150000) = -875
=FV(0.07/12, 12*3, -875, 150000) = -150,000
=PMT(0.06/12, 27*12, 150000, 0) = -935.978
```

Problem 5 (P.147)

An interest only ARM is made for $200,000 for 30 years. The start rate is 5% and the borrower will make monthly interest only payments for 3 years. Payments thereafter must be sufficient to fully amortize the loan at maturity.

1. If the borrower makes interest only payments for 3 years, what will payments be?
2. Assume that at the end of year 3, the reset rate is 6%. The borrower must now make payments so as to fully amortize the loan. What will payments be?

Problem 5 answer

```
# 1
=PMT(0.05/12, 30*12, 200000, -200000) = -833.3333

# 2
=PMT(0.06/12, 27*12, 200000, 0) = -1,247.971
```

Problem 6 (P.147)

A borrower has been analyzing different ARM alternatives for the purchase of a property. The borrower anticipates owning the property for five years. The lender first offers a \$150,000, 30-year fully amortizing ARM with the following terms:

- Initial interest rate = 6%
- Payments = Reset each year
- Margin = 2%
- Negative amortization = Not allowed
- Discount points = 2%

Based on estimated forward rates, the index to which the ARM is tied is forecasted as follows:

- Beginning of year 2 = 7%
- Beginning of year 3 = 8.5%
- Beginning of year 4 = 9.5%
- Beginning of year 5 = 11%

Compute the payments, loan balances, and yield for the unrestricted ARM for the five-year period.

Problem 6 answer

```
See excel.
```

Problem 10 (P.147)

A floating rate mortgage loan is made for $100,000 for a 30-year period at an initial rate of 12% interest. However, the borrower and lender have negotiated a monthly payment of $800.

1. What will be the loan balance at the end of year 1?
2. What if the interest rate increases to 13% at the end of year 1? How much interest will be accrued as negative amortization in year 1 if the payment remains at $800? Year 5?

Problem 10 answer

```
# 1
=FV(0.12/12, 12*1, -800, 100000) = -102,536.5 (#year 1)

#2
=FV(0.13/12, 12*1, -800, 102536.5) = -106,496.7 (# year 2)
=FV(0.13/12, 12*5, -800, 102536.5) = -128,611.9 (# year 6)
```

Problem 1 (P.177)

A borrower can obtain an 80% loan with an 8% interest rate and monthly payments. The loan is to be fully amortized over 25 years. Alternatively, he could obtain a 90% loan at an 8.5% rate with the same loan term. The borrower plans to own the property for the entire loan term.

1. What is the incremental cost of borrowing the additional funds? (Hint: The dollar amount of the loan doesn't affect the answer.)
2. How would your answer change if two points were charged on the 90% loan?
3. Would your answer to (2) change if the borrower planned to own the property for only five years?

Problem 1 answer

```
# 1. (assume loan balance = 1,000)
p1 = PMT(0.08/12, 12*25, -800, 0) = 6.17 monthly
p2 = PMT(0.085/12, 12*25, -900) = 7.25 monthly

Difference in PV: PV1-PV2 = 100
Difference in payment: p1-p2 = -1.07

Solve : =12*RATE(25*12, -1.07, 100, 0) = 12.26\%

# 2 Points:
p1 = PMT(0.08/12, 12*25, -800, 0) = 6.17 monthly
p2 = PMT(0.085/12, 12*25, -900) = 7.25 monthly

Difference in PV: PV1-PV2 = 100 - 0.02*900
    = 82
Difference in payment: p1-p2 = -1.07

Solve : =12*RATE(25*12, -1.07, 82, 0) = 15.35\%
```

Problem 1 answer (continued)

3. Early repayment, loan balance after five years:

```
p1 = PMT(0.08/12, 12*25, -800) = 6.17 monthly
p2 = PMT(0.085/12, 12*25, -900) = 7.25 monthly

FV1 = FV(0.08/12, 12*5, -6.17, 800) = 738.19
FV2 = FV(0.085/12, 12*5, -7.25, 900) = 835.08

Difference in PV: PV1-PV2 = 100
Difference in payment: p1-p2 = -1.07
Difference in 5Y FV: FV1-FV2 = -96.89

Solve : =12*RATE(5*12, -1.07, 100, -96.89) = 12.42\%
```

Problem 3 (P.177)

An investor obtained a fully amortizing mortgage 5 years ago for \$95,000 at 11% for 30 years. Mortgage rates have dropped, so that a fully amortizing 25-year loan can be obtained at 10%. There is no prepayment penalty on the mortgage balance of the original loan, but three points will be charged on the new loan and other closing costs will be \$2,000. All payments are monthly.

1. Should the borrower refinance if he plans to own the property for the remaining loan term? Assume that the investor borrows only an amount equal to the outstanding balance of the loan.
2. Would your answer to (1) change if he planned to own the property for only 5 more years?

Problem 3 answer

```
# 1
=PMT(0.11/12, 30*12, 95000, 0) = -904.71
=FV(0.11/12, 5*12, -904.71, 95000) = -92,306.19
=PMT(0.10/12, 25*12, 92306.19, 0) =  -838.79
=12*IRR(92306.19 - 92306.19*0.03 - 2000, -838.79, ...,
    (25*12 payments) ...,-838.79, 0) = 10.69%

# 2
=FV(0.11/12, 10*12, -904.71, 95000) = -87,648.83
=PMT(0.10/12, 20*12, 87648.83, 0) = -796.47
=FV(0.10/12, 5*12, -796.47, 87648.83) = -82,533.10
=12*IRR(87648.83 - 87648.83*0.03 - 2000, -796.47, ...,
    (5*12 payments) ...,-796.47, -82,533.10) = 11.29%
```

Problem 4 (P.177)

Secondary Mortgage Purchasing Company (SMPC) wants to buy your mortgage from the local savings and loan. The original balance of your mortgage was $140,000 and was obtained 5 years ago with monthly payments at 10% interest. The loan was to be fully amortized over 30 years.

1. What should SMPC pay if it wants an 11% return?
2. How would your answer to (1) change if SMPC expected the loan to be repaid after five years?

Problem 4 answer

```
# 1
=PMT(0.10/12, 30*12, 140000, 0) = -1228.60

=FV(0.10/12, 5*12, -1228.60, 140000) = -135,204.05
# Loan balance after 5 years

=PV(0.11/12, 25*12, -1228.60, 0) = 125,352.9
# PV of loan, given 11%, same payments and remaining 25y.

135,204.05 - 125,352.9 = 9,851.15

# 2
# Repayment after 5y

=FV(0.11/12, 5*12, -1228.60, 125352.9) = -119,028.69
# Loan balance

=PV(0.11/12, 5*12, -1228.60, -119028.69) = 125,352.9
# PV of loan is same (given same payment and i)
```