LESSON 4

Chapter 5: Mortgage Loan Analysis

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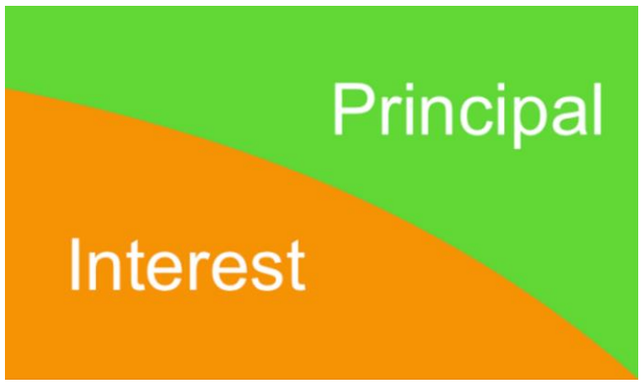
Real Estate Division

Outline

- Constant payment loans
- Mortgage loan calculations
  - PV
  - PMT
  - I/YR (and P/YR)
  - N
- Outstanding balances
- Principal/interest split
- Final payments

Constant Payment Mortgage Loans

- PMT = Principal (P) + Interest (I)
- Total payments are equal throughout the life of the loan
- Total PMT is the same, but proportions of P + I change over time
- With increasing amounts to principal and decreasing amount to interest



Mortgage Loan Terminology

- Amortization Period – amount of time to repay mortgage loan; used to calculate the size of the required payment
- Term – represents the duration of the mtg contract
- Fully Amortized – length of term = length of amortization period
- Partially Amortized – term is shorter than the amortization period
- Outstanding Balance (OSB) – remaining amount of principal owing on a loan at ANY point in time

Financial Keys

N Number of compounding or payment periods

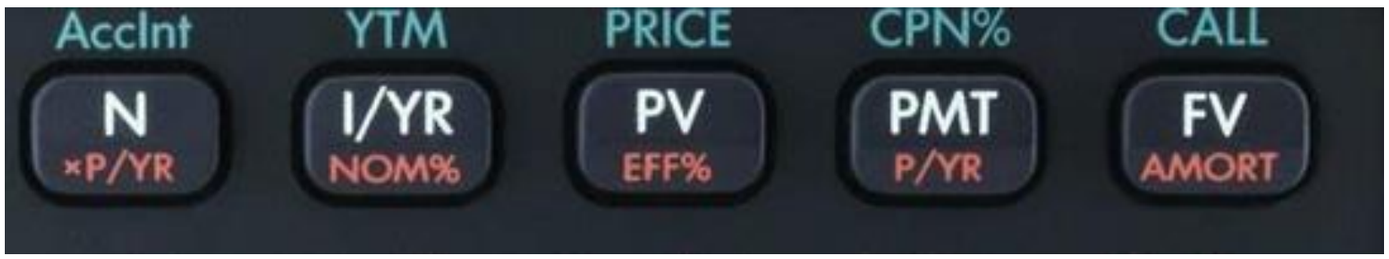
I/YR Nominal interest rate per year (j_m)

P/YR Periods per year (m)

PV Present value (today)

PMT Payment per period

FV Future value at some future time N



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Example 1: PV (Loan Amount)

- Dave would like to purchase a condo, but would like to limit his mortgage payments to $500 per week. If mortgage rates are 5.5% per annum, compounded semi-annually, and the lender will permit weekly payments over a 20-year amortization period, what is Dave's maximum allowable loan?
- PV = \$500 × a[[1,040, j_2 = 5.5%]]
- N = 20 × 52 = 1,040
- j_{52} = ?
- PV = ?

Example 1: PV (Loan Amount)

Press	Display
5.5 NOM%	5.5
2 P/YR	2
EFF%	5.575625
52 P/YR	52
NOM%	5.428565
500 +/− PMT	−500
20 × 52 = N	1,040
0 FV	0
PV	317,134.306307

Example 2: Payment

- A mortgage loan for $350,000 is to be repaid by equal monthly payments over a 20-year amortization period. The interest rate is 6.25% per annum, compounded semi-annually. Calculate the size of the required monthly payment.

- $350,000 = PMT × a[[240, j_2 = 6.25%]]
- j_{12} = ?
- PMT = ?

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Example 2: Payment

Press	Display
6.25 NOM%	6.25
2 P/YR	2
EFF%	6.347656
12 P/YR	12
NOM%	6.17014
350000 PV	350,000
240 N	240
0 FV	0
PMT	−2,541.983858

PMT = $2,541.98

Example 3: Interest Rate

- A $75,000 mortgage loan is repaid over a 25-year amortization period with payments of $550 per month

- Solve for the interest rate, expressed as j_1 and j_2
- $\$75{,}000 = \$550 \times a[[300, j_1 \text{ and } j_2 = ?]]$
- $j_{12} = ?$
- $j_1 = ?;\ j_2 = ?$

Example 3: Interest Rate

Press	Display
12 P/YR	12
75000 PV	75,000
300 N	300
550 +/− PMT	−550
0 FV	0
I/YR	7.412874 (j_{12})
EFF%	7.669991 (j_1)
2 P/YR	2
NOM%	7.528302 (j_2)

Example 4: Amortization

- A $195,000 loan is repaid with quarterly payments of $5,000
- Interest rate is $j_2 = 6.5\%$
- Solve for the amortization period (in quarters and years)

- $\$195{,}000 = \$5{,}000 \times a[[N, j_2 = 6.5\%]]$
- $j_4 = ?$
- $N = ?$

Example 4: Amortization

Press	Display
6.5 ⏬ NOM%	6.5
2 ⏬ P/YR	2
⏬ EFF%	6.605625
4 ⏬ P/YR	4
⏬ NOM%	6.448029
195000 PV	195,000
5000 +/− PMT	5,000
0 FV	0
N	61.951484 [quarters]
÷ 4 =	15.487871 [years]

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Outstanding Balances (OSBs)

- Definition: how much is owing on a loan at a particular point in time
- Partially amortized loans have OSBs
- Calculated at the end of the term or at any point during the term
- $OSB_n = PV(1 + i)^n – PMT \times s[[n, j_m]]$

Outstanding Balances (OSBs)

PROCESS:

1. **Interest Rate:** get interest rate in proper form
2. **Payment:** calculate the payment
3. **OSB:** using the exact payment, calculate the OSB

OSBs: INPUT and AMORT Keys

Z INPUT AMORT

= Principal paid in payment Z

= Interest paid in payment Z

= Outstanding balance after Z payments made

OR

Y INPUT Z AMORT

= Principal paid in payments Y through Z

= Interest paid in payments Y through Z

= Outstanding balance after Z payments made

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Example 5: OSB, Principal, Interest

- Loan Amount: $495,000
- Interest Rate: $j_2 = 2.75\%$
- Amortization Period: 30 years
- Term: 5 years
- Monthly Payments, rounded up to next higher dollar

(a) What is the OSB at the end of the term? What is the principal/interest split for the 60^{th} payment?

(b) How much interest and principal will be paid over the 5-year term?

(c) How much interest and principal is paid in the first year? The fifth year?

Example 5(a)

Press	Display
2.75 NOM%	2.75
2 P/YR	2
EFF%	2.768906
12 P/YR	12
NOM%	2.734376
495000 PV	495,000
30 x 12 = N	360
0 FV	0
PMT	−2,016.699662
2017 +/− PMT	− 2,017

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Example 5(a): OSB, Principal, Interest

(a) What is the OSB end of term? What is the P/I split for month 60?

The calculator steps continue as follows:

Press	Display
60 INPUT ⏬ AMORT	PER 60-60
=	−1,016.848193 (P month 60)
=	−1,000.151807 (I month 60)
=	437,906.771451 (OSB 60)
60 N FV	−437,906.771454 (OSB 60)

- Total Payment = $1,016.85 + $1,000.15 = $2,017

Example 5(b): Principal and Interest Term

(b) How much interest and principal will be paid over the 5-year term?

The calculator steps continue as follows:

Press	Display
1 INPUT 60 ↓ AMORT	PER 1-60
=	−57,093.23 (P term)
=	−63,926.77 (I term)

Example 5(c): Principal and Interest Year 1 and 5

(c) How much interest and principal is paid in the first year? Fifth year?

The calculator steps continue as follows:

Press	Display
1 INPUT 12 ↓ AMORT	PER 1-12
=	−10,803.57 (P Year 1)
=	−13,400.43 (I Year 1)
49 INPUT 60 ↓ AMORT	PER 49-60
=	−12,050.75 (P Year 5)
=	−12,153.25 (I Year 5)

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Final Payments

- Applies to fully amortized loans
- As all payments are rounded, we must adjust the final payment to reflect the true debt
- Can have smaller final payment and/or a smaller number of final payments
- Two methods to solve: overpayment and mini-loan

Example 6: Final Payments

- $25,000 loan at $j_{12} = 4\%$ repaid over 25 years with monthly payments, rounded up to next $10
- $25,000 = PMT × a[[300, $j_{12} = 4\%$]]
- PMT = $131.95921 = $140.00
- N= 271.78886 months

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Example 6: Final Payments

Press	Display
4 I/YR	4
12 P/YR	12
25000 PV	25,000
300 N	300
0 FV	0
PMT	−131.95921
140 +/− PMT	−140
N	271.78886

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Example 6: Overpayment

- Find OSB just AFTER loan goes to zero
- OSB will be negative. WHY??
- To obtain true final payment, take the difference between the negative OSB and the regular payment
- $OSB_{272} = -\$29.52$
- $PMT - OSB_{272} = \$140.00 - \$29.52 = \$110.48$

Example 6: Overpayment

The calculator steps continue as follows:

Press	Display
272 N FV	29.520871
+/− + 140	140
=	110.479129

Alternatively,

Press	Display
272 N	272
272 INPUT ↓ AMORT	
= = =	−29.520872
+ 140 =	110.479128

271 PMTS of $140 + a final payment of $110.48

Example 6: Mini-Loan

- Find OSB just BEFORE loan goes to zero
- Take OSB forward one period to find final pmt → $OSB_{271}(1+i)^1$
- $110.112089(1+i) = $110.48

Example 6: Mini-Loan

The calculator steps continue as follows:

Press	Display
271 N FV	−110.112089
+/− PV	110.112089
1 N	1
0 PMT	0
FV	−110.479129

271 PMTS of $140 + a final payment of $110.48

Further Reading

- Review this Lesson's Recommended Readings on the Online Readings page

Questions?

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- Administrative Issues:

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- Technical Issues with videos or website:

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