Day 6

Loan Amortization and EMI Breakdown

EMI Formula

EMI = (P * r * (1+r)^n) / ((1+r)^n - 1)

Where:

- P = Principal loan amount
- r = Periodic interest rate (decimal)
- n = Number of periods

Step-by-Step Calculation Example:

- P = 1000, r = 0.10, n = 3
- $(1+r)^n = (1.10)^3 = 1.331$
- Numerator = 1000 * 0.10 * 1.331 = 133.1
- Denominator = 1.331 - 1 = 0.331
- EMI = 133.1 / 0.331 ≈ 402

2. Amortization Table

Period	Opening Balance	Interest	Principal	Closing Balance
1	1000	100	302	698
2	698	70	332	366
3	366	37	365	0

Calculation Logic:

- Interest = Opening Balance * r
- Principal = EMI - Interest
- Closing Balance = Opening Balance - Principal

Key Insights

- EMI remains fixed because the formula balances interest and principal payments over the loan term.
- Interest declines each period as principal reduces; principal repayment increases.
- Reverse-engineering formulas strengthens intuition for financial modeling.

$PV = 10,000$

$FV_1 = PV \times (1+r)$

$r = 5\%$ $FV = 7$ $10,000 \times 1.05 = 10,500$

Why we multiply $\rightarrow$ interest is a proportion of principal

$FV_2 = FV_1 \times (1+r) = PV \times (1+r) \times (1+r) = PV \times (1+r)^2$

Compounding = Repeated multiplication

4) $FV_n = PV \times (1+r)^n \rightarrow (1+r)^n = 1 + nr + \frac{n(n-1)}{2}r^2 + \cdots$

5) Semi Annual = $FV = PV \cdot \left(1+\frac{r}{2}\right)^{2n}$

Quarterly $\cdot$ $FV = PV \cdot \left(1+\frac{r}{4}\right)^{4n}$

Monthly $FV = PV \cdot \left(1+\frac{r}{12}\right)^{12n}$

It's like a Snow-ball effect

$FV = PV(1+r)^n$

$FV = \frac{PV}{(1+r)} + \frac{PV}{(1+r)^2} + \frac{PV}{(1+r)^3} + \cdots \frac{PV}{(1+r)^n}$

$FV = PV\left(\frac{1}{(1+r)} + \frac{1}{(1+r)^2} + \frac{1}{(1+r)^{3-1}} \cdots \frac{1}{(1+r)^n}\right)$

FV = PV(1+r)^n

20k
15k
10,000
5,000
1 2 3 4 5
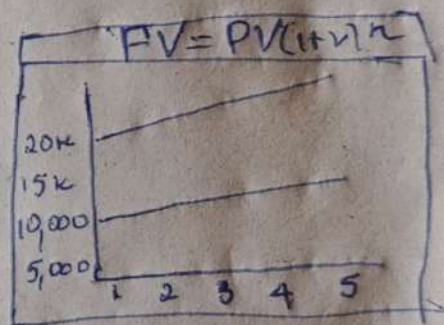
year-1 = $10,000 \times (1.05) = 10,500$

year-2 = $10,500 \times (1.05)^2 = 11,025$

year-3 = $11,025 \times (1.05)^3 = 11,576$

year-4 = $11,576 \times (1.05)^4 = 12155$

years = $12,155 \times (1.05)^5 = 12762$

₹10,000 To ₹12,762

Amortization Table

Period	opening Balance		Interest	Principal	CL
1	1000	100	100	302	698
2	698		69.8	332	336
3	366		36.6	365	0

$$EMI = 402 \cdot 2$$

Period $1:-$)

Opening Balance = 1000

Interest = opening $\times r$ = 1000 $\times$ 0.10 = 100

Principal = EMI - Interest => 402 - 100 = 302

Closing Balance = opening - Principal paid

= 1000 - 302 = 698