

2.1 – Analyzing Loans

Loan – When a bank (or other business) lend money to a customer

Interest – The amount of money paid on a loan

Collateral – An asset that is held as security against the repayment of a loan

Amortization Table – A table that lists regular payments of a loan and shows how much of each payment goes toward the interest charged and the principal borrowed.

Mortgage – A loan (usually for the purchase of real estate) where the purchased real estate is used as collateral

Example 1: Trina's employer loaned her \$10 000 at a fixed interest rate of 6%, compounded annually, to pay for college tuition and textbooks. The loan is to be repaid in a single payment on the maturity date, which is at the end of 5 years.

$$FV = P(1+i)^n$$

- a) How much will Trina need to pay her employer on the maturity date?

$$P = 10000$$

$$i = \frac{0.06}{1} = 0.06$$

$$n = 1 \times 5 = 5$$

$$FV = 10000(1+0.06)^5$$

$$FV = 10000(1.06)^5$$

$$FV = \$13382.26$$

She will need to pay \$13382.26 to her employer

- b) What is the accumulated interest on the loan?

$$\begin{array}{r} 13382.26 \\ - 10000.00 \\ \hline 3382.26 \end{array}$$

she is paying \$3382.26 in interest

- c) Suppose the interest was compounded monthly instead. How much interest would she have to pay?

$$P = 10000$$

$$i = \frac{0.06}{12} = 0.005$$

$$n = 12 \times 5 = 60$$

$$FV = 10000(1.005)^{60}$$

$$FV = 13488.50$$

$$\begin{aligned} \text{Interest} &= 13488.50 - 10000 \\ &= \$3488.50 \end{aligned}$$

She would have to pay \$3488.50 in Interest (\$14,978.50 total)

Example 2: Annette wants a home improvement loan to renovate her kitchen. Her bank will charge her 3.6%, compounded quarterly. She already has a 10-year GIC that will mature in 5 years. When her GIC reaches maturity, Annette wants to use the money to repay the home improvement loan with one payment. She wants the amount of the payment to be no more than \$20 000.

a) How much can she borrow?

$$FV = 20000$$

$$i = \frac{0.036}{4} = 0.009$$

$$n = 4 \times 5 = 20$$

$$P = ?$$

$$FV = P(1+i)^n$$

$$\frac{20000}{1.009^{20}} = \frac{P(1.009)^{20}}{1.009^{20}}$$

$$P = \$16718.86$$

Annette can borrow
\$16718.86

b) How much interest will she pay?

$$\text{Interest} = \text{Final Payment} - \text{Initial Loan}$$

$$I = 20000 - 16718.86$$

$$I = \$3281.14$$

She will be
paying \$3281.14

However, most often Loans are paid in installments, not one large payment at the end.....

Example 3: Lars borrowed \$12 000 from a bank at 5%, compounded monthly, to buy a new boat. The bank will use the boat as collateral for the loan. Lars negotiated regular loan payments of \$350 at the end of each month until the loan is paid off. Lars set up an amortization table to follow the progress of his loan.

a) Complete Lars's amortization table for the first year...What is the Balance still owing at the end of the first year?

Payment Period (Month)	Payment (\$)	Interest Paid (\$) = $Balance \times i$	Principal Paid (\$) = $Payment - Interest$	Balance (\$)
0				12 000.00
1	350	50.00	300.00	11 700.00
2	350	48.75	301.25	11 398.75
3	350	$11398.75 \times (\frac{0.05}{12}) = \47.49	$350 - 47.49 = 302.51$	11 096.24
4	350	$11096.24 \times (\frac{0.05}{12}) = 46.23$	$350 - 46.23 = 303.77$	10792.47

⋮ This will take a long time!

To skip to the end of the year (too long to do it payment by payment) we can use the TVM Solver on our calculators. Just remember that negative amounts are when you pay out money, and positive amounts are when you receive money.

So for our question.....

$N = 12$ (we want balance after 1 year)

$I = 5$

$PV = 12000$ (this is Lars's loan)

$PMT = -350$ (Negative means payment)

$FV = ?$

$P/Y = 12$

$C/Y = 12$

$PMT: \text{END} \text{ BEGIN}$

$FV = -8316.34$

Negative amount implies it needs to be paid.

Lars still owes \$8316.34 after 1 year

b) How much has Lars paid on the Principal of the loan after 1 year?

Loan - still owing $12000 - 8316.34 = \$3683.66$

Lars has only paid off \$3683.66 of loan

c) What is the total of Lars's payments after 1 year?

$12 \times 350 = \$4200$ Lars has paid \$4200

d) How much interest has Lars paid after 1 year?

$4200 - 3683.66 = 516.34$

\$516.34 has been interest

e) How many months will it take to pay off the loan?

$N = ?$

$I = 5$

$PV = 12000$

$PMT = -350$

$FV = 0$ (None left to pay off)

$P/Y = 12$

$C/Y = 12$

$N = 37.073$

It will take 38 months to pay off

Example 4: Jose is negotiating with his bank for a mortgage on a house. He has been told that he needs to make a 10% down payment on the purchase price of \$225 000. Then the bank will offer a mortgage loan for the balance at 3.75%, compounded semi-annually, with a term of 20 years and with monthly payments.

a) How much will each payment be?

Find downpayment:

$$0.10 \times 225000 = \$22500$$

Amount of Mortgage :

$$\frac{225000}{22500} = 10$$

Jose needs a mortgage for \$202500 (PV)

$$N = 20 \times 12 = 240$$

$$I = 3.75$$

$$PV = 202500$$

$$PMT = ?$$

$$PMT = -1197.55$$

$$FV = 0$$

$$P/Y = 12$$

$$C/Y = 2$$

$$PMT: \text{END} \text{ BEGIN}$$

Each payment will be \$1197.55

b) How much will he pay altogether over 20 years?

$$240 \times 1197.55 = 287412$$

Jose will pay a total of \$287412

c) How much interest will Jose end up paying by the time he has paid off the loan in 20 years?

$$\begin{array}{r} 287412 \\ - 202500 \\ \hline 84912 \end{array}$$

He will pay \$84912 in interest

Interest is only paid on the original mortgage amount. (Not the total price of the house)