

7.3 Reducing balance loans II

Number of repayments

A situation can arise in reducing balance loans when a borrower knows how much money needs to be borrowed as well as the amount of money that can be repaid each month. A person then would want to know how long the loan needs to be, that is, to determine the number of repayments, n , required.

Worked Example 5

A reducing balance loan of \$60 000 is to be repaid with monthly instalments of \$483.36 at an interest rate of 7.5% p.a. (debited monthly).

Find:

a) the number of monthly repayments (and, hence, the term of the loan in more meaningful units) needed to repay the loan in full so $FV = 0$

Using the Financial Solver

Enter the following:

n (N:) = unknown

r (I(%):) = 7.5

P (PV:) = 60000

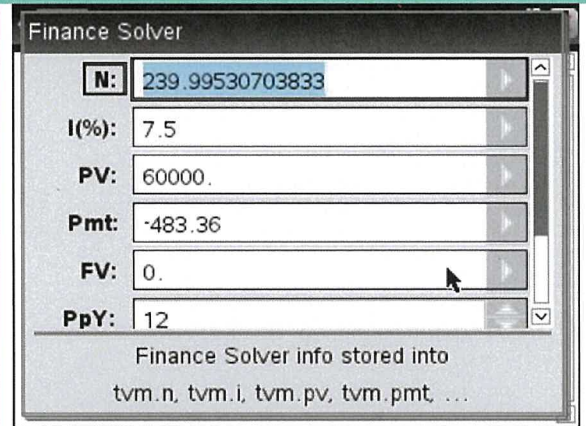
Pmt: = -483.36

FV: = 0

PpY: = 12

CpY: = 12

Place the cursor on N, Press ENTER to solve.



Interpret the results:

$n = 240$ months is $240/12 = 20$ years

Hence, the term of the loan needs to be 20 years

b) the total interest charged

$$\text{Total Interest} = \text{Total repayments} - \text{Principal repaid.}$$

Note: Remember to write the answer to 2 decimal places. \$ Dollars.cents

$$= \text{repayment (Pmt)} \times n - PV$$

$$= 483.36 \times 240 - 60000$$

$$= 56006.40$$

Total interest charged on the loan is \$56,006.40

Sometimes we may want to find the time for only part of the loan term. The procedure that is followed is the same as Worked example 5; however, V_n is zero only if we are calculating the time to repay the loan in full. Otherwise we should consider the amount still owing at that time. The next example shows this.

Worked Example 6

Some time ago, Petra borrowed \$14 000 to buy a car. Interest on this reducing balance loan has been charged at 9.2% p.a. (adjusted monthly) and she has been paying \$446.50 each month to service the loan. Currently she still owes \$9753.92. How long ago did Petra borrow the money?

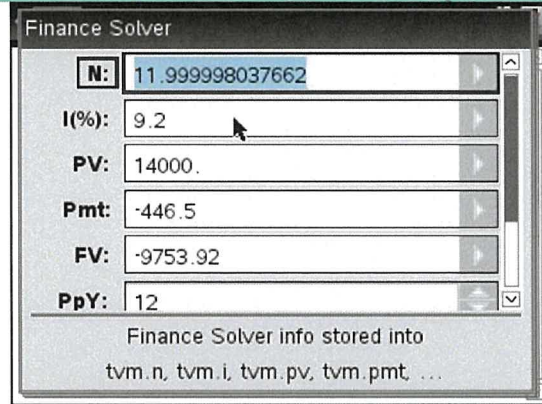
CpY *PV = +14000* *Use Finance Solver* *Pmt* *PpY*

Using the Financial Solver

Enter the following:

n (N:) = unknown
 r (I%): = 9.2
 P (PV:): = 14000
 Pmt^* : = -446.50
 FV^* : = -9753.92
 PpY : = 12
 CpY : = 12

Place the cursor on N, Press ENTER to solve.



*Note: in this case both the payment and the Final Value are negative (-) because they are monies you owe.

Answer the question:

Petra has had the loan for the past 12 months

In the situations covered so far, we have considered calculating only the time from the start of the loan to a later date (including repayment in full). It does not matter what period of the loan is considered; we can still use the Financial Solver. In using CAS, we can define V_n as the amount owing at the end of the time period and V_0 as the amount owing as the start of the time period.

Worked Example 7

A loan of \$11 000 is being repaid by monthly instalments of \$362.74 with interest being charged at 11.5% p.a. (debited monthly). Currently, the amount owing is \$7744.05. How much longer will it take to:

CpY = 12 *PpY = 12* *pmt = -362.74* *PV = +7744.05*

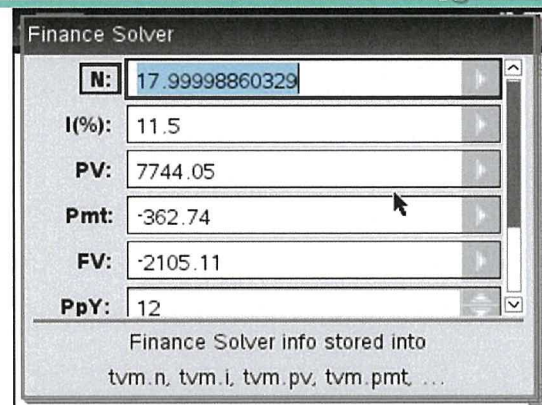
a) reduce the amount outstanding to \$2105.11

Using the Financial Solver

Enter the following:

n (N:) = unknown
 r (I%): = 11.5
 P^* (PV:): = 7744.05
 Pmt : = -362.74
 FV : = -2105.11
 PpY : = 12
 CpY : = 12

Place the cursor on N, Press ENTER to solve.



*Note: In this case the Principal Value is 7744.05 as this is the current amount.

Note: N is in months because PpY is in months.

Answer the question:

It will take another years or months to reduce the amount owed to \$2105.11

Above, the time is 18 months which we know is 1 1/2 years. If the value for n was 32. Then we would divide by 12, giving 32/12=2.667. In this case we would have 2 years and 0.667x12months=8 months. So, the answer would be 2 years and 8 months.

b) repay the loan in full?

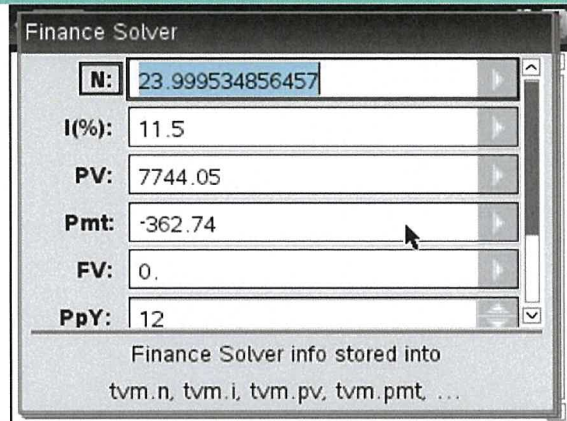
Now we want $FV = 0$

Using the Financial Solver

Enter the following:

n (N:) = unknown
 r (I(%)) = 11.5
 P (PV:) = 7744.05
 Pmt : = -362.74
 FV : = 0
 PpY : = 12
 CpY : = 12

Place the cursor on N, Press ENTER to solve.



Answer the question:

It will take a further 24 mths or 2 years to repay the loan in full.

Effects of changing the repayments

As most loans are taken over a long time, such as mortgages, the financial situation of the borrower is likely to change e.g. they may get a pay increase and decide to increase their repayments or they may have financial difficulties and seek to decrease their repayments.

In this section we will look at the effects of changing repayments on the term of the loan and the total interest paid.

Worked Example 8

A reducing balance loan of \$16 000 has a term of 5 years. It is to be repaid by monthly instalments at a rate of 8.4% p.a. (debited monthly).

a) Find the repayment value.

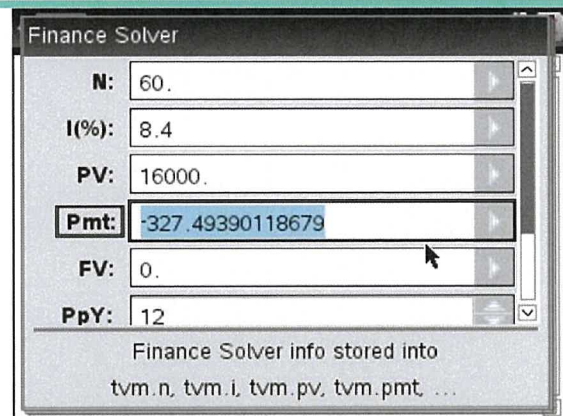
Calculate the value of n : $n = 5 \times 12 = 60$

Using the Financial Solver

Enter the following:

n (N:) = 60
 r (I(%)) = 8.4
 P (PV:) = 16000
 Pmt : = ?
 FV : = 0
 PpY : = 12
 CpY : = 12

Place the cursor on Pmt, Press ENTER to solve.



Answer the question:

To pay off \$16,000 in 5 years at 8.4%, need to pay \$327.49 per month.

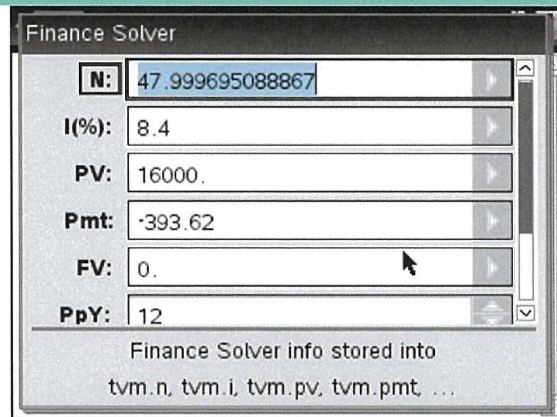
b) What will be the term of the loan if the repayment is increased to \$393.62?

Using the Financial Solver

Enter the following:

$$\begin{aligned} n (N): &= \underline{\hspace{2cm}} \\ r (I\%): &= \underline{8.4} \\ P (PV): &= \underline{16000} \\ \text{Pmt}: &= \underline{-393.62} \\ \text{FV}: &= \underline{0} \\ \text{PpY}: &= \underline{12} \\ \text{CpY}: &= \underline{12} \end{aligned}$$

Place the cursor on N, Press ENTER to solve.



Answer the question:

The new term (length) of the loan would be 4 years or 48 months.

c) Calculate the total interest paid for repayments of \$393.62

$$n = \underline{48} \quad d = \underline{\$393.62}$$

$$\begin{aligned} \text{Interest paid} &= \text{total repayments} - \text{principal repaid.} \\ &= \underline{393.62} \times \underline{48} - 16000 \\ &= \underline{\$2893.76} \end{aligned}$$

d) By how much does the interest figure in c differ from that paid for the original offer?

$$\begin{aligned} \text{Originally: Interest paid} &= \text{total repayments} - \text{Principal repaid.} \\ &= \underline{60} \times \underline{327.49} - \underline{16000} \\ &= \underline{\$3649.40} \end{aligned}$$

$$\begin{aligned} \text{so the difference in Interest} &= \text{original} - \text{part(c)} \\ &= \underline{\$3649.40} - \underline{\$2893.76} \\ &= \underline{\$755.64} \end{aligned}$$

If the repayments are increased from \$327.49 to \$393.62 per month, then \$755.64 is saved in interest payments.

Increasing the repayment amount

If a borrower increases the amount of each repayment and all the other variables remain the same, the term of the loan is reduced. Conversely if a decrease in the repayments occurs the term of the loan is increased.

Worked Example 9

Brad borrowed \$22 000 to start a business and agreed to repay the loan over 10 years with quarterly instalments of \$783.22 and interest debited at 7.4% p.a. However, after 6 years of the loan Brad decided to increase the repayment value to \$879.59. Find:

a) the actual term of the loan

Calculate the value of n: $n = 6 \times 4 = 24$

Note: There are 2 parts to the loan. We must do them separately and then join.

Using the Financial Solver*

Enter the following:

$n(N:) = 24$
 $r(I%) = 7.4$
 $P(PV:) = 22000$
 $Pmt = -783.22$ ←
 $FV = ?$
 $PpY = 4$
 $CpY = 4$

Place the cursor on FV, Press ENTER to solve.

Now we need to find the n value to repay the loan in full, in other words reduce \$10761.83 to \$0.

Enter the following:

$n(N:) =$
 $r(I%) = 7.4$
 $P(PV:) = 10761.83$
 $Pmt = -879.59$ ←
 $FV = 0$
 $PpY = 4$
 $CpY = 4$

Place the cursor on N, Press ENTER to solve.

b) the total interest paid

The total Interest Paid = Total repayments - Principal (for both parts) (both parts) (overall).

$$\Rightarrow \text{Interest} = (\text{Part 1 repayments} + \text{Part 2 repayments}) - \text{Principal}$$

$$= (24 \times 783.22) + (14 \times 879.59) - 22000$$

$$= \$9111.54$$

c) the interest saving achieved by increasing the repayment value.

In other words, what would the original interest have been if he didn't increase his repayment and the term was 10 years. AND How is this different to (b).

$$\text{Interest} = \$738.22 \times 40 - 22,000 = \$9328.80$$

$$\text{Interest difference} = \$9328.80 - \$9111.54 \text{ (part b)}$$

$$= \$217.26$$

Brad, will save \$ 217.26 in interest by increasing repayments to \$879.59 per quarter.