Utilizing Microsoft Excel for Loan Calculations

By Palani Murugappan

The housing loan (long term loan)

As we move up the corporate ladder, many are tempted to upgrade their current possession such as house and car. Studies have shown that bulk of a person's salary goes towards the payment and maintenance of a house and car. When one takes a housing loan, this is considered as a long term loan. Generally, a long term loan is considered as a loan that takes 10 or more years to settle. The monthly repayment calculation is based on a technique called "*reducing balance*". How does this work? Performing this calculation is not as straight forward. Let us look at the data given below.

	A	B	C
1	House value	$ 500,000	
2	Deposit paid (10%)	$ 50,000	
3	Loan taken	$ 450,000	
4	Repayment period	30	years
5	Interest rate	6%	p.a.
6			
7	Monthly payment		

Assume one has taken a loan of $450,000 after paying a 10% deposit for a house valued at $500,000. Total repayment period is 30 years with a fixed interest of 6% per annum. How would one calculate the monthly repayment?

B7 f_x =ROUND(PMT(B5/12, B4*12, -B3), -1)

	A	B	C	D
1	House value	$ 500,000		
2	Deposit paid (10%)	$ 50,000		
3	Loan taken	$ 450,000		
4	Repayment period	30	years	
5	Interest rate	6%	p.a.	
6				
7	Monthly payment	$2,700		

In cell B7 above, we had used the Excel built-in finance function called PMT (an abbreviation for "payment") where it is used to calculate long term loan calculations. Applying the PMT function gives us a result of $2700 after rounding the value to the nearest 10 (actual calculated value to the nearest dollar is $2698). This is the amount the borrower will be paying for the next 30 years (assuming payment is made on time!).

How does the reducing balance technique work? Now, if the borrower has just settled the first month repayment of $2700, the amount owing to the bank is not $450,000 less $2700. Rather, the bank will deduct a high interest of $2250 from the first month's repayment and the balance of $450 is offset from the principal amount borrowed of $450,000. In other words, the amount owing after making the first month's repayment is now $449,550. This is reflected in the illustration below.

Term	Principal
0	$450,000
1	$449,550

In the above illustration, the current outstanding amount to the bank now is $449,550. Interest is now charged on this outstanding figure, not the principal amount borrowed of $450,000.

As the borrower keeps repaying the monthly repayments, interest is first deducted from the repayment and the balance is offset against the previous month's principal amount outstanding. This technique is known as the reducing balance.

Let us analyze the amounts in further detail. How did we arrive at a figure of $2250 as the interest charged and $450 as the amount deducted from the principal amount outstanding?

This is where Excel can be used to work out how much goes towards the interest and principal portion of a loan amount. The function used to calculate the interest part for a specific month from the monthly repayment is IPMT (interest part of a payment). To calculate the principal part that is deducted for a specific month from the monthly repayment, the function PPMT (principal part of a payment) is used. Let us analyze how both these functions work.

	A	B	C
1	House value	$ 500,000	
2	Deposit paid (10%)	$ 50,000	
3	Loan taken	$ 450,000	
4	Repayment period	30	years
5	Interest rate	6%	p.a.
6			
7	Monthly payment	$2,700	
8			
9	Interest for 1st month	$ 2,250	83%
10	Principal for 1st month	$ 450	17%

The IPMT function evaluates and gives you a value of $2250 in cell B9, while the PPMT function evaluates and gives you a value of $450 (both have been rounded to the nearest 10). In other words, for the first month's repayment, 83% of what the borrower pays goes towards interest alone! Only 17% gets offset from the principal amount. That is why we hear many complaining that they have been paying for many years and the principal amount does not seem to be decreasing as quick as they expect it to!

The whole scenario can be represented as below in what is known as a loan amortization table. The illustration below shows how much the borrower owes the bank as he/she keeps up with the monthly repayments (observe that the figures below are NOT rounded to the nearest 10 as in the previous examples).

Month	Interest	Principal	Outstanding
0			$ 450,000
1	$ 2,250	$ 448	$ 449,552
2	$ 2,248	$ 450	$ 449,102
3	$ 2,246	$ 452	$ 448,649
4	$ 2,243	$ 455	$ 448,195
5	$ 2,241	$ 457	$ 447,738
6	$ 2,239	$ 459	$ 447,278
7	$ 2,236	$ 462	$ 446,817
8	$ 2,234	$ 464	$ 446,353
9	$ 2,232	$ 466	$ 445,887
10	$ 2,229	$ 469	$ 445,418
11	$ 2,227	$ 471	$ 444,947
12	$ 2,225	$ 473	$ 444,474

After a year of paying the monthly repayments of $2698 (total of $32,376), the amount that gets offset for the first year from the outstanding principal amount is only $5526 (i.e. $450,000 minus $444,474).

As can be seen, the interest charged by the bank keeps reducing a little every month while the principal amount that gets deducted from the outstanding principal amount gets a little higher from month to month.

How do we know if the above calculations are correct? When you create a loan amortization table for the entire 360 months, the final outstanding principal amount due should be 0 as in the illustration below for the 360th month (the final settlement payment).

Month	Interest	Principal	Outstanding
0			$ 450,000
1	$ 2,250	$ 448	$ 449,552
2	$ 2,248	$ 450	$ 449,102
3	$ 2,246	$ 452	$ 448,649
4	$ 2,243	$ 455	$ 448,195
5	$ 2,241	$ 457	$ 447,738
6	$ 2,239	$ 459	$ 447,278
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11	$ 2,227	$ 471	$ 444,947
12	$ 2,225	$ 473	$ 444,474
358	$ 40	$ 2,658	$ 5,356
359	$ 27	$ 2,671	$ 2,685
360	$ 13	$ 2,685	$ 0

Observe that even in the final repayment month of 360, the borrower is still paying an interest of $13!

The above holds true assuming the borrower pays the monthly repayment on a timely basis i.e. in other words, repayment is paid before or on the due date. Otherwise, the banks will impose interest charges for late payment on top of the monthly interest due.

How can you settle the loan sooner than the 360 months? This is where one can utilize a built-in feature of Excel called Goal Seek, a classic what-if analysis feature. The Goal Seek feature only works on a cell that contains a formula or a function. If the user had keyed-in a value and selected that cell to perform Goal Seek, it will cease to work. Here it goes.

Select the cell that contains the formula of PMT that was used to work out the monthly repayment. In our case, it is cell B7. Invoke the Goal Seek feature (found within the Data tab and within the What-If Analysis command).
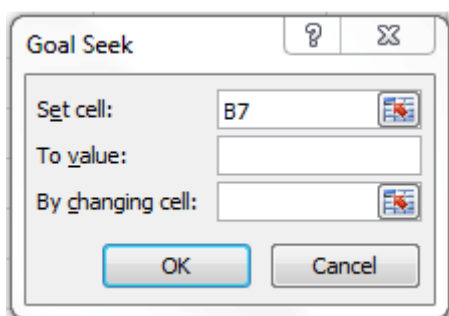
In the To value text box, type in the value $2970 (assuming the borrower has the funds to pay an extra 10% on top of the monthly repayment i.e. $2700 + $270).

Click to select the cell B4 in the By changing cell text box. Any borrower who decides to pay more will obviously be decreasing the total repayment period. This is why you click on cell B4, which is the total repayment period of the loan.

Goal Seek		
Set cell:	B7	
To value:	2970	
By changing cell:	B4	
	OK	Cancel
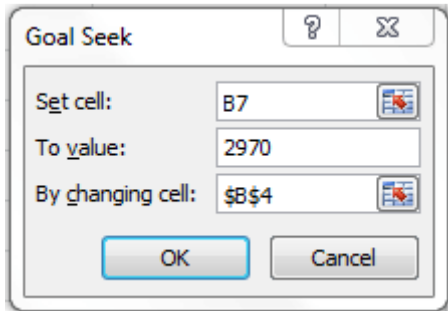
Upon clicking the OK button, Excel calculates and determines that the borrower is able to settle the loan in approximately 24 years (valued displayed in cell B4). Thus, a small increment of 10% in the monthly repayment can actually reduce the total repayment period in a significant way.

Note that Goal Seek works best if the borrower commences the extra payment from the initial stage of the repayment, not towards the end of the repayment term. For example, if the borrower is able to pay an extra of 10% from the first instalment, the above holds well. However, if the borrower decides to make an extra payment of 10% at the 20 year and above, the savings in terms of number of years will be small.

The car loan (short term loan)

The short term loan on the other hand works quite differently as compared to the long term loan. Generally, in the short term loan calculations, interest is calculated for the entire duration and added to the principal amount. This total amount is then divided by the number of years or months or repayments. Let us look as a typical car loan calculation as illustrated below.

	B7		f_x	=((B3*B4*B5)+B3)/(B4*12)	
	A		B	C	
1	Car value		$ 80,000		
2	Deposit paid (10%)		$ 8,000		
3	Loan taken		$ 72,000		
4	Repayment period		9	years	
5	Interest rate		3%	p.a.	
6					
7	Monthly payment		$ 847		

The calculation of a car loan does not require the use of any built-in function of Excel. In the above scenario, the borrower has taken a loan of $72,000 based on a fixed interest of 3% for a total period of 9 years. The borrower's monthly repayment is $847 based on the formula displayed in the formula bar above.

As a comparison, should the bank calculate the repayment based on long term loan calculation, the amount due is $762 per month, as compared to $847 (a difference of $85 per month). The difference may not be significant on a monthly basis. However, for a term of 9 years, this adds up to $9194 (i.e. $85*12*9).

What does this tell the borrower? It is clear that more interest is paid for short term loan as the calculations are different significantly. To recap, for long term loans, interest outstanding is calculated after the monthly payment is made. For short term loans, interest is calculated for the entire loan period and divided equally by the total number of repayments, thus working out to be higher.

The examples illustrated above are a snapshot of what the author covers in some of his 2-days training sessions. Having been a corporate trainer for the last 14 years, Palani specializes in training participants how best to perform data analysis from company's raw data and concluding from the information gathered by harnessing Excel's built-in functions and features. A HRDF certified trainer and author of 51 books to-date on various software applications, Palani is passionate on what Excel can do, and how best to present data in different formats. More information is covered in his website www.avimursolutions.com. He can be reached at palani@avimursolutions.com