

Mortgage payments and the TVM Solver

Suppose you obtain a 30 year mortgage for \$390,000 at 3.7%, compounded monthly. One obvious question is the amount of the the monthly payments. This is done on the TI-83 with the TVM Solver.

N=	360
I%=	3.7
PV=	390000
PMT=	<i>anything at all</i>
FV=	0
P/Y=	12

ALPHA-SOLVE
→

N=	360
I%=	3.7
PV=	390000
PMT=	• -1795.10382
FV=	0
P/Y=	12

The cursor must be on the PMT-line when Alpha-Solve is executed. The initial entry on the PMT-line is irrelevant; it can be “anything at all”. The last two lines on the TVM display are not shown because in all the problems we consider, C/Y (the number of times per year the interest is compounded) is always the same as P/Y (the number of times per year that payment is made), and payments are always made at the end of the payment period. This computation shows that if payments of \$1,795.10382 are made each month, the amount still owed after 30 years will be exactly \$0.

There is one subtle problem in determining the mortgage payments. You can not make a payment in thousandths of a penny, which is what paying \$1,795.10382 would require. Banks solve this problem by rounding the payment up (to \$1,795.11 in this case) and making up for the slight monthly overpayment (for 29 years and 11 months) by reducing the final mortgage payment appropriately. What is appropriate? This requires another TVM calculation. We compute FV using the actual mortgage payment.

N=	360
I%=	3.7
PV=	390000
PMT=	-1795.11
FV=	<i>anything at all</i>
P/Y=	12

ALPHA-SOLVE
→

N=	360
I%=	3.7
PV=	390000
PMT=	-1795.11
FV=	• 4.1853535
P/Y=	12

We conclude that after 30 years, the bank would owe \$4.19 to the payer of the mortgage, assuming that payments of \$1795.11 are made every month for 30 years. Instead, the final mortgage payment is reduced by \$4.19 (to \$1790.92).

The total amount paid to the bank over the 30 years is therefore

$$359 \times \$1,795.11 + \$1,790.92 = \$646,235.41$$

Of this, \$390,000 went to pay off the money borrowed and

$$\$646,235.41 - \$390,000 = \$256,235.41$$

was payed in interest charges.

The TVM Solver can also be used to answer other questions about the mortgage. Suppose, for example, you want to know what part of your mortgage payment goes to pay off the interest charges. This will vary over the life of the mortgage. Initially, most of the mortgage payment goes to pay interest charges because you owe so much money. At the end, very little of the mortgage payment goes to pay interest charges because you owe relatively little money at that point.

Suppose for example, you want to know how much the interest charges are halfway through the life of the mortgage. Specifically, suppose we want to know how much of the 180th payment goes to pay interest. We need to know how much we owed the bank during the previous month, because that is the debt that we are paying interest on. So we need to know the balance due after the 179th payment. Using the TVM Solver:

N=	179
I%=	3.7
PV=	390000
PMT=	-1795.11
FV=	<i>anything at all</i>
P/Y=	12

ALPHA-SOLVE
 →

N=	360
I%=	3.7
PV=	390000
PMT=	-1795.11
FV=	• -248714.5385
P/Y=	12

The interest payment is obtained by multiplying FV by $.037/12$ (1/12 of 3.7% of FV). This is carried out by evaluating $\text{tvm_FV} * .037/12$ on your main screen. You get tvm_FV on your main screen via the Finance Menu. The result is -766.8698272 .

A complete table of mortgage payments (all 360 of them), broken down into interest payment and payment on the balance, is given in:

<http://www.math.neu.edu/~frampton/u130/things/mortgage.html>

Click on the URL to retrieve the file. This is the printout of an Excel worksheet, with the formatting set so that numbers are displayed rounded to 2 decimal places. The rounding is only in the display; Excel does all the computations much much more accurately.