hp calculators

HP 33S House payment qualification

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The Time Value of Money on the HP 33S

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House payment qualification

The payment required to pay off a house over time involves the solution of an ordinary annuity with the value of the payment as the unknown variable. When applying for a house loan, the lender takes the applicant's overall debt burden into account. A general guideline applied is that the total debt-to-income ratio should be below 34% and that the house payment plus taxes and insurance should be below 27% of total income. This will determine the maximum house payment for which an applicant may qualify as well as the corresponding maximum loan amount.

The Time Value of Money on the HP 33S

To solve time value of money problems on the HP 33S, the formula below is entered into the flexible equation solver built into the calculator. This equation expresses the standard relationship between the variables in the time value of money formula. The formula uses these variables: N is the number of compounding periods; I is the *periodic* interest rate as a percentage (for example, if the *annual* interest rate is 15% and there are 12 payments per year, the *periodic* interest rate, i, is 15÷12=1.25%); B is the initial balance of loan or savings account; P is the periodic payment; F is the future value of a savings account or balance of a loan.

Equation: P x 100 x (1 - (1 + I ÷ 100)^ -N) ÷ I + F x (1 + I ÷ 100) ^ -N + B

To enter this equation into the calculator, press the following keys on the HP 33S:

⬛ EQN RCL P × 1 0 0 × ⬛ ((1 − ⬛ ((1 + RCL I ÷ 1 0 0 ⬛) y^x − RCL N ⬛)) ÷ RCL I + RCL F × ⬛ ((1 + RCL I ÷ 1 0 0 ⬛) y^x − RCL N + RCL B ENTER

To verify proper entry of the equation, press

⬛ SHOW

and hold down the SHOW key. This will display the equation's checksum and length. The values displayed should be a checksum of 382E and a length of 41.

To solve for the different variables within this equation, the SOLVE button is used. This key is found on the top of the calculator to the left of the cursor keys. An arrow points to its location in Figure 1 below.

HP 33S displays a menu of possible values. Items on this menu are viewed by pressing the ⬅ or ➡ parts of the cursor key at the top of the HP 33S, as shown in Figure 1 below.
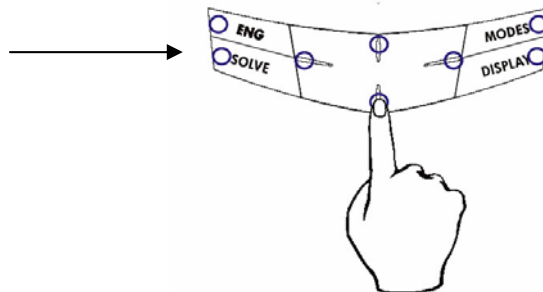

Figure 1

Notes for using the SOLVE function with this equation:

1)   If your first calculation using this formula is to solve for the interest rate I, press ☐1☐ STO ☐I☐ before beginning.
2)   Press 🔁 EQN. If the time value of money equation is not at the top of the list, press ☐↑☐ or ☐↓☐ to scroll through the list until the equation is displayed.
3)   Determine the variable for which you wish to solve and press:
     a)   SOLVE ☐N☐ to calculate the number of compounding periods.
     b)   SOLVE ☐I☐ to calculate the periodic interest rate. Note: this will need to be multiplied by the number of compounding periods per year to get the annual rate. If the compounding is monthly, multiply by 12.
     c)   SOLVE ☐B☐ to calculate the initial balance (or Present Value) of a loan or savings account.
     d)   SOLVE ☐P☐ to calculate the periodic payment.
     e)   SOLVE ☐F☐ to calculate the future value of a loan or savings account.
4)   When prompted, enter a value for each of the variables in the equation as you are prompted and press R/S. The solver will display the variables' existing value. If this is to be kept, do not enter any value but press R/S to continue. If the value is to be changed, enter the changed value and press R/S. If a variable had a value in a previous calculation but is not involved in this calculation (as might happen to the variable P (payment) when solving a compound interest problem right after solving an annuity problem), enter a zero for the value and press R/S.
5)   After you press R/S for the last time, the value of the unknown variable will be calculated and displayed.
6)   To do another calculation with the same or changed values, go back to step 2 above.

The SOLVE feature will work effectively without any initial guesses being supplied for the unknown variable with the exception noted above about the variable I in this equation. This equation follows the standard convention that money in is considered positive and money out is negative.

The practice problems below illustrate using this equation to solve a variety of sinking fund problems.

Practice solving house payment qualification problems

Example 1:   Richard wants to buy a house that costs $170,000 using a 30 year loan at 6% compounded monthly. His annual income is $55,000. His existing monthly debt includes a car payment of $295 per month and a minimum payment on his credit card of $25 per month. Property taxes are estimated at $1,300 per year and the annual insurance premium is estimated at $450 per year. Can Richard qualify for this house loan if the lender applies the 27%/34% guidelines?

Solution: First, enter the time value of money equation into the HP 33S solver as described earlier in this document.

Richard's monthly income is $55,000 divided by 12, or $4,583.33. The maximum house payment (including taxes and insurance) Richard can qualify for is 27% of his monthly income, or $1,237.50.

In RPN mode, press: ☐5☐☐5☐☐0☐☐0☐☐0☐ ENTER ☐1☐☐2☐÷☐0☐·☐2☐☐7☐×

In algebraic mode, press: ☐5☐☐5☐☐0☐☐0☐☐0☐÷☐1☐☐2☐×☐0☐·☐2☐☐7☐ ENTER

Then, find the monthly payment needed to buy the house by pressing 🔁 EQN and press ☐↑☐ or ☐↓☐ to scroll through the equation list until the time value of money equation is displayed. Then press:

SOLVE ☐P☐

The HP 33S SOLVER displays the first variable encountered in the equation as it begins its solution. The value of 0.0000 is displayed below if this is the first time the time value of money equation has been solved on the HP 33S calculator. If any previous equations have used a variable used in the time value of money equation, they may already have been assigned a value that would be displayed on your HP 33S display. Follow the keystrokes shown below and the solution should be found as described.

Figure 2

In RPN mode, press: 6 ENTER 1 2 ÷ R/S
In algebraic mode, press: 6 ÷ 1 2 ENTER R/S

Figure 3

In RPN mode, press: 3 0 ENTER 1 2 × R/S
In algebraic mode, press: 3 0 × 1 2 ENTER R/S

Figure 4

In either RPN or algebraic mode, press: 0 R/S

Figure 5

In either RPN or algebraic mode, press: 1 7 0 0 0 0 R/S

Figure 6

The house payment is $1,019.24 a month. With taxes and insurance, this increases to $1,165.07.

In RPN mode, press: 1 3 0 0 ENTER 4 5 0 + 1 2 ÷ −

In algebraic mode, press: − ⟳ (⟳ (1 3 0 0 + 4 5 0 ⟳)
÷ 1 2 ⟳) ENTER

The $1,165.07 is the total monthly house payment plus taxes and insurance. This is lower than the 27% limit earlier computed of $1,237.50, so Richard meets the 27% guideline.

Richard's total monthly debt is to be less than 34% of his monthly income. The maximum monthly debt Richard can have is 34% of his monthly income, or $1,558.33

In RPN mode, press: 5 5 0 0 0 ENTER 1 2 ÷ 0 · 3 4 ×

In algebraic mode, press: 5 5 0 0 0 ÷ 1 2 × 0 · 3 4 ENTER

Richard's total debt would be the $1,165.07 house payment, the $295 car payment and the $25 per month credit card payment. This is a total of $1,485.07, which is less than the maximum monthly debt limit set by the 34% guideline.

In RPN mode, press: 1 1 6 5 · 0 7 ENTER 2 9 5 + 2 5 +

In algebraic mode, press: 1 1 6 5 · 0 7 + 2 9 5 + 2 5 ENTER

Answer: Richard can qualify for this house loan because he meets the 27%/34% guidelines.

Example 2: Caroline wants to buy a house that costs $208,000 using a 15-year loan at 5% compounded monthly. Her annual income is $75,000. Her existing monthly debt includes a car payment of $365 per month and minimum payments on her credit card of $96.50 per month. Property taxes are estimated at $1,900 per year and the annual insurance premium is estimated at $1,150 per year. Can Caroline qualify for this house loan if the lender applies the 27%/34% guidelines?

Solution: First, enter the time value of money equation into the HP 33S solver as described earlier in this document.

Caroline's monthly income is $75,000 divided by 12, or $6,250. The maximum house payment (including taxes and insurance) Caroline can qualify for is 27% of her monthly income, or $1,687.50.

In RPN mode, press: 7 5 0 0 0 ENTER 1 2 ÷ 0 · 2 7 ×

In algebraic mode, press: 7 5 0 0 0 ÷ 1 2 × 0 · 2 7 ENTER

Then, find the monthly payment needed to buy the house by pressing ▤ EQN and press ↑ or ↓ to scroll through the equation list until the time value of money equation is displayed. Then press:

SOLVE P

The HP 33S SOLVER displays the first variable encountered in the equation as it begins its solution. The value of 0.0000 is displayed below if this is the first time the time value of money equation has been solved on the HP 33S calculator. If any previous equations have used a variable used in the time value of money equation, they may already have been assigned a value that would be displayed on your HP 33S display. Follow the keystrokes shown below and the solution should be found as described.

In RPN mode, press: 5 ENTER 1 2 ÷ R/S   (Enters I)
                       1 5 ENTER 1 2 × R/S   (Enters N)
                       0 R/S   (Enters F)
                       2 0 8 0 0 0 +/− R/S   (Enters B)

In algebraic mode, press: 5 ÷ 1 2 ENTER R/S   (Enters I)
                           1 5 × 1 2 ENTER R/S   (Enters N)
                           0 R/S   (Enters F)
                           2 0 8 0 0 0 +/− R/S   (Enters B)

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        RPN
P =
-1,644.8507
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                                             Figure 7

The house payment is $1,644.85 a month. With taxes and insurance, this increases to $1,899.02.

In RPN mode, press: 1 9 0 0 ENTER 1 1 5 0 + 1 2 ÷ −

In algebraic mode, press: − ↱ (↱ (1 9 0 0 + 1 1 5 0 ↱)
                                 ÷ 1 2 ↱) ENTER

The $1,899.02 is the total monthly house payment plus taxes and insurance. This is larger than the 27% guideline amount of $1,687.50 previously computed.

Answer: Caroline cannot qualify for this house loan because she does not meet the 27% guideline. Perhaps she should consider a 30 year loan.