hp calculators

HP 20b Simple and Compound Interest

The time value of money application

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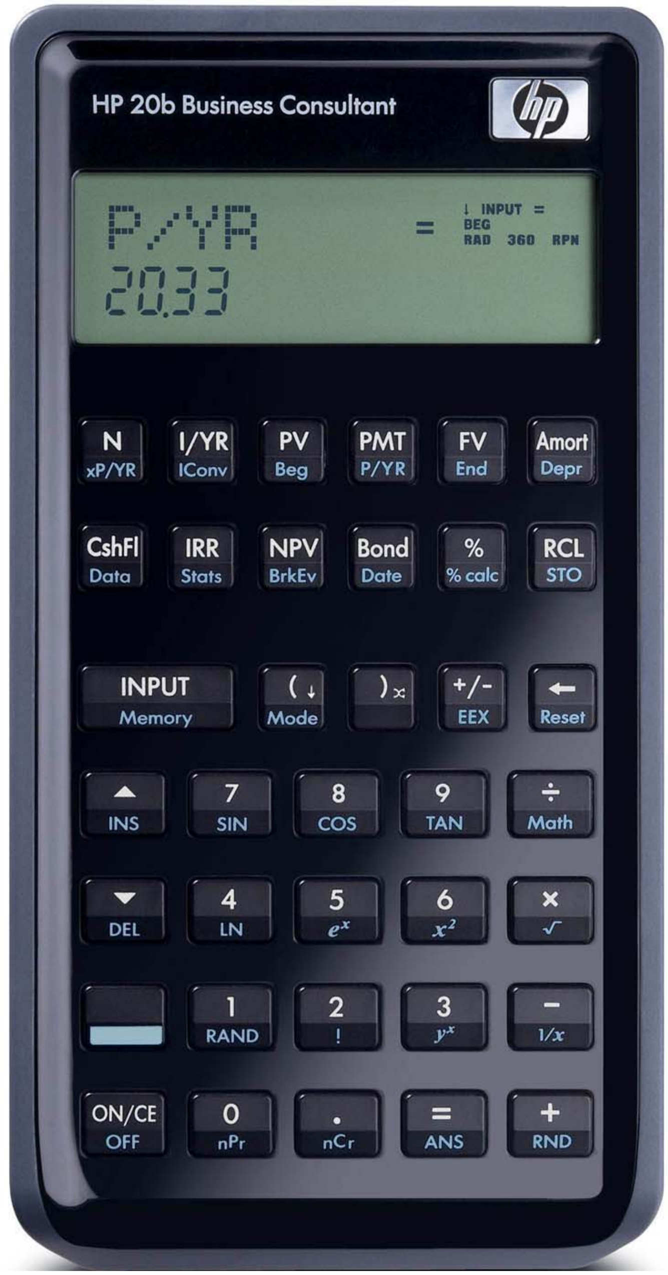
Practice solving simple and
compound interest problems



The time value of money application

The time value of money application built into the HP 20b is used to solve compound interest problems and annuities that involve regular, uniform payments. Compound interest problems require the input of 3 of these 4 values: N I/YR PV FV. Annuity problems require the input of 4 of these 5 values: N I/YR PV PMT FV. Once these values have been entered in any order, the unknown value can be computed by pressing the key for the unknown value.

The time value of money application operates on the convention that money invested is considered positive and money withdrawn is considered negative. In a compound interest problem, for example, if a positive value is input for the PV, then a computed FV will be displayed as a negative number. If a negative value is entered for the PV, then the FV will be positive. An analysis of the monetary situation should indicate which values are being invested and which values are being withdrawn. This will determine which are entered as positive values and which are entered as negative values.

Interest rates are always entered as the number is written in front of the percent sign, i.e., 5% is entered as a 5 rather than as 0.05. The stated annual nominal interest rate is always entered into I/YR, as shown in the examples.

Simple and compound interest

Simple interest is generally used for short duration deposit or loan arrangements. It is often used for accounts holding cash balances that change each day. Many car loans are arranged using simple interest. Interest is computed for the entire time period under consideration only at the end of the period. On a car loan, the interest would be computed from the last date a payment was made until the next date a payment is made. The basic relationship is given by the formula shown in figure 1 below.

$$I = PRT$$

Figure 1

In this formula, I is the interest, P is the principal, R is the simple interest rate and T is the time expressed in years or portions of a year. If the time is measured in months, then T would be the fraction of the number of months under consideration divided by 12. If the time is measured in days, T will be a fraction of the number of days under consideration divided by 365 if using exact interest or divided by 360 if using ordinary interest. For example, simple interest for 80 days using ordinary interest would have a T fraction of 80/360.

The ending amount is therefore equal to the principal plus the interest. This is illustrated by the formula in figure 2 below.

$$FV = P + I$$

Figure 2

In this formula, FV is the future or ending value, I is the interest and P is the principal.

Compound interest periodically computes the interest accrued or earned and adds it to the value of the account or to the amount owed on a loan. The period for which is compounding occurs can vary from daily to annually. For the same amount of time, a compound interest deposit will grow to be much larger than the same size deposit in a simple interest account. This is because interest earned will be computed each period and added to the balance of the account. During the next period, the interest earned the previous period will then earn interest. It is this interest-earning-interest that gives compound interest the remarkable ability to turn a small deposit into a very large deposit over time. The basic relationship is given by the formula shown in figure 3 below.

$$FV = PV \times (1 + i)^N$$

Figure 3

In this formula, FV stands for the future value, PV is the present value, i is the interest rate per period, and N is the total number of periods. The interest rate per period is computed by taking the nominal annual rate and dividing by the number of periods per year.

Compound interest problems can be directly solved using the time value of money application. The nominal annual interest rate is entered and the HP 20b automatically uses the value for the number of periods per year to compute the interest rate per period. Simple interest problems are solved as basic arithmetic problems.

Practice solving time value of money problems

Example 1: If you deposit $175 today, how much is it worth in 10 years, if interest is compounded at a 4% annual rate?

Solution: [ON/CE] [ON/CE] [ ] [Reset] [INPUT] [1] [ ] [P/YR]
[1] [0] [N]
[4] [I/YR]
[1] [7] [5] [PV]
[FV]

Answer: $-259.04. Note that the solution is displayed as a negative value. The problem is set up with the $175 as a deposit. The value at the end of the 10-year period would be a withdrawal and is therefore shown as a negative value.

Example 2: If you owe $500 today, how much do you owe in 3 months, if the debt accumulates interest at 5% simple interest?

Solution: In algebraic or chain mode, press: [ON/CE] [ON/CE]
[5] [0] [0] [×] [0] [•] [0] [5] [×] [3] [÷] [1] [2] [=]
[+] [5] [0] [0] [=]

In RPN mode, press: [5] [0] [0] [INPUT] [0] [•] [0] [5] [×] [3] [×] [1] [2] [÷]
[5] [0] [0] [+]

Answer: $506.25.

Example 3: If you deposit $1,234 today, how much do you have in the account in 87 days, if the deposit earns interest at 4% simple interest, using ordinary interest?

Solution: Since the deposit will earn interest using ordinary interest, the T fraction will have 360 as the denominator.

In algebraic or chain mode, press: [ON/CE] [ON/CE] [1] [2] [3] [4] [×] [0] [•] [0] [4] [×] [8] [7]
[÷] [3] [6] [0] [=] [+] [1] [2] [3] [4] [=]

In RPN mode, press: [1] [2] [3] [4] [INPUT] [0] [•] [0] [4] [×] [8] [7] [×]
[3] [6] [0] [÷] [1] [2] [3] [4] [+]

Answer: $1,245.93.

<u>Example 4:</u> If you want $1,000,000 when you retire in 40 years, how much must you deposit today into an account earning interest at 7%, compounded monthly?

<u>Solution:</u>
[ON/CE] [ON/CE] [ ] [Reset] [INPUT] [1] [2] [ ] [P/YR]
[4] [8] [0] [N]
[7] [I/YR]
[1] [0] [0] [0] [0] [0] [0] [+/-] [FV]
[PV]

<u>Answer:</u> $61,306.77. The $1,000,000 amount is entered as a negative number since it will be a withdrawal from the account in 40 years.

<u>Example 5:</u> What interest rate, compounded semiannually will cause an initial deposit of $400 to grow to become $600 in 5 years?

<u>Solution:</u>
[ON/CE] [ON/CE] [ ] [Reset] [INPUT] [2] [ ] [P/YR]
[1] [0] [N]
[4] [0] [0] [PV]
[6] [0] [0] [+/-] [FV]
[I/YR]

<u>Answer:</u> 8.28%, compounded semiannually.

<u>Example 6:</u> How long would it take before an initial deposit of $2,345 would grow to become $3,456, if the account earns interest at 5%, compounded monthly?

<u>Solution:</u>
[ON/CE] [ON/CE] [ ] [Reset] [INPUT] [1] [2] [ ] [P/YR]
[5] [I/YR]
[2] [3] [4] [5] [PV]
[3] [4] [5] [6] [+/-] [FV]
[N]

<u>Answer:</u> 93.27 months or approximately 7.8 years. In actuality, the balance in the account would not exceed $3,456 until month 94.

<u>Example 7:</u> If you earn $26.25 interest in two months on a deposit into an account paying 3.5% simple interest, what was the size of the original deposit?

<u>Solution:</u> Rearrange I = PRT so that P is isolated: P = I / R / T. Note that since T will equal 2/12 in this example, it should be enclosed in parentheses as shown below in the algebraic and chain mode keystrokes.

In algebraic or chain mode, press: [ON/CE] [ON/CE] [2] [6] [•] [2] [5] [÷] [0] [•] [0] [3] [5] [÷]
[(] [2] [÷] [1] [2] [)] [=]

In RPN mode, press: [2] [6] [•] [2] [5] [INPUT] [0] [•] [0] [3] [5] [÷]
[2] [INPUT] [1] [2] [÷] [÷]

<u>Answer:</u> $4,500.