hp calculators

HP 9s Solving Compound Interest Problems

Compound Interest

Practice Solving Compound Interest Problems

Compound interest

Interest is a charge for the use of money. There are two types of interest calculations: simple and compound. With the former, only the original amount of money (i.e. the principal) earns interest for the entire life of the transaction:

$$\text{interest} = \text{principal} \times \text{interest rate} \times \text{time}$$

For example, suppose you put \$1,000 in the bank at 6% simple interest for 3 years. You would earn \$1,000 × 6% × 3 = \$180. In essence, you receive \$60 in interest at the end of each year. By *adding the interest* to the principal each year you could earn more money: suppose at the end of the first year, you withdraw the \$1,060, go to another bank, and deposit a balance of \$1,060. The second year you will earn \$1,060 × 6% × 1 = \$63.60. You do the same thing again and, at the end of the third year, earn \$1,123.60 × 6% × 1 = \$67.42. So instead of \$180, you receive \$191.02. This is the way *compound* interest works: each time the interest is paid, it is added to the balance. Calculations involving compound interest use the following formula:

$$\boxed{F = P(1+i)^n}$$

where *F* is the future value, *P* is the principal, *i* is the interest rate and *n* is the number of compounding periods. Compound interest is usually "compounded" (i.e. paid) annually, but it may also be monthly, quarterly or semiannually.

Even though the HP 9s is a scientific calculator, it can solve a wide variety of compound interest problems. Several examples are shown below.

Practice solving compound interest problems

Example 1: Calculate the future value of \$3,000 invested at 7% for 5 years.

Solution: The future value is given by the compound interest formula: $F = 3000 \cdot (1 + 7\%)^5$. Press:

3 EXP 3 x (1 + 7 2ndF %) x^y 5 ENTER

Answer: \$4,207.66, rounded to the nearest cent.

Example 2: Find the principal which yields \$25,000 when invested at 3% annually for 20 years.

Solution: The principal is $P = \dfrac{F}{(1+i)^n} = \dfrac{25000}{(1+3\%)^{20}}$, which can be calculated as follows:

2 5 EXP 3 ÷ (1 + 3 2ndF %) x^y 2 0 ENTER

Answer: The principal that must be invested is \$13,841.89.

Example 3: How many time periods are needed to increase \$10,000 at 8.5% annual interest to \$15,000?

Solution: The unknown value is now n, which is given by: $n = \ln\left(\frac{F}{P}\right) / \ln(1+i)$. In this example:

$n = \frac{\ln(15000/10000)}{\ln(1+8.5\%)}$. The keystroke sequence is then:

[1] [5] [EXP] [3] [÷] [EXP] [4] [ENTER] [ln] [÷] [(] [1] [+] [8] [•] [5] [2ndF] [%] [)] [ln] [ENTER]

Answer: n = 4.97, so the number of time periods is five.

Example 4: Find the annual interest rate that produces $100,000 from $20,000 in 15 years.

Solution: The formula is now: $i = \left(\frac{F}{P}\right)^{\frac{1}{n}} - 1$, where F = 100000, P = 20000 and n = 15:

[EXP] [5] [÷] [2] [EXP] [4] [ENTER] [x^y] [1] [5] [2ndF] [x^{-1}] [−] [1] [ENTER]

Answer: i = 0.1133 or 11.33%.

Example 5: Calculate the effective interest rate compounded quarterly of a 13% annual rate.

Solution: Given the nominal annual rate *i*, the effective interest rate *E* is calculated as follows:

$$E = \left(1 + \frac{i}{n}\right)^n - 1$$

where n is the number of compounding periods, i.e. n = 4 in this example. Press:

[1] [+] [1] [3] [2ndF] [%] [÷] [4] [ENTER] [x^y] [4] [−] [1] [ENTER]

Answer: E = 0.1365 or 13.65%.

Example 6: Calculate the effective interest rate of a 10% annual rate compounded *continuously*.

Solution: When compounding is continuous, the effective rate is given by:

$$E = e^i - 1$$

Therefore, the keystroke sequence is as follows:

[1] [0] [2ndF] [%] [2ndF] [e^x] [−] [1] [ENTER]

Answer: E = 0.1052 or 10.52%.