

Excerpt from
***Introduction to Real Estate Finance and Investment:
Sample Problems, Student Edition, by Frank Gallinelli***

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Chapter 2: Compound Interest

Compound interest differs from simple interest in one key respect: With compound interest you apply the interest rate not only to the original principal but also to the accumulated interest.

You can use the first formula below to calculate the Future Value, i.e., the original principal plus accumulated interest. You can also calculate the Future Value longhand, by stepping through one period at a time. Use the second formula to figure the total interest that accrues over time.

$$\text{Future Value} = \text{Principal} \times (1 + \text{Periodic Rate})^{\text{Number of Periods}}$$

$$\text{Total Interest} = \text{Future Value} - \text{Original Principal}$$

Problem 2-1:

You take \$6,250 to the bank and deposit it in an account that pays 2% interest compounded annually. Use the longhand method to calculate what your account balance should be at the end of three years.

Problem 2-2:

A second bank also pays 2% per year, but they compound it quarterly. You pull your money out of the first bank at the end of the third year there, and put the full proceeds into the second bank. Use the first formula above to calculate how much you will have after your money has been in the old bank for three years and the new bank for three more years.

Problem 2-3:

How much interest did you earn after three years in the first bank?

Problem 2-4:

If you had put \$6,250 in each bank for one year, how much more interest would you have earned in the second bank because of its more frequent compounding?

Answer 2-1:

You start with \$6,250 and earn 2% (\$125.00) in the first year. At the beginning of the second year you have \$6,375 in your account, which earns 2% (\$127.50). At the beginning of the third year you have \$6,502.50, which earns 2% (\$130.05), so your account balance at the end of that year should be \$6,632.55.

Year	Starting Balance	Interest	Ending Balance
1	6,250.00	125.00	6,375.00
2	6,375.00	127.50	6,502.50
3	6,502.50	130.05	6,632.55

Answer 2-2:

You'll be taking your money out of the bank above at the end of the third year, so your starting principal with the new bank is \$6,632.55. A 2% annual interest rate compounded quarterly means 0.5% applied each quarter, so 0.5% is the periodic rate for each of 12 periods.

Apply the formula, $\text{Principal} \times (1 + \text{Periodic Rate})^{\text{Number of Periods}}$

$$\text{Future Value} = 6,632.55 \times (1 + 0.005)^{12}$$

$$\text{Future Value} = 6,632.55 \times (1.005 \times 1.005 \times 1.005 \times 1.005 \times 1.005 \times 1.005 \times 1.005 \times 1.005 \times 1.005 \times 1.005 \times 1.005 \times 1.005)$$

$$\text{Future Value} = 6,632.55 \times 1.06167781$$

$$\text{Future Value} = 7,041.63$$

Answer 2-3:

To determine the interest earned, subtract what you started with from what you ended up with. Apply the formula, $\text{Total Interest} = \text{Future Value} - \text{Original Principal}$

$$\text{Total interest, by End of Year 3} = 6,632.55 - 6,250 = 382.55$$

Answer 2-4:

You already know that \$6,250 invested in Bank #1 would earn \$125 in one year.

For Bank #2, apply the formula, $\text{Principal} \times (1 + \text{Periodic Rate})^{\text{Number of Periods}}$

$$\text{Future Value} = 6,250.00 \times (1 + 0.005)^4$$

$$\text{Future Value} = 6,250.00 \times 1.005 \times 1.005 \times 1.005 \times 1.005$$

$$\text{Future Value} = 6,250.00 \times 1.0201505$$

$$\text{Future Value} = 6,375.94$$

Then apply the formula, Total Interest = Future Value - Original Principal

$$\text{Total Interest} = 6,375.94 - 6,250.00 = 125.94$$

You would have earned \$125.00 with Bank #1's annual compounding, but \$125.94 with Bank #2's quarterly compounding, a difference of \$0.94