Compound Interest Applications

TF YOU WERE REVIEWING two banks and their products and one offered simple interest on savings accounts and the other offered compounded interest on savings accounts, which would you prefer? The difference may not make you rich, but it could definitely pay for a lot of new applications for your iPhone.



Objective:



Define interest, and explain how it works.

Key Terms:



compound interest interest interest rate principal simple interest time

Compound Interest

Interest on your savings account is good, but compounded interest is even better. On the contrary, compounded interest on a purchase can clobber you if you do not complete the math before you make a large purchase. Simple interest on a purchase is a little easier to accept.

INTEREST

There are several advantages of storing money in a bank or similar financial institutions. One of the biggest advantages is that the bank pays you for keeping money there. **Interest** is the money a person receives because his or her money is in a financial institution. **Principal** is the initial amount of money deposited into a bank account that earns interest. An **interest rate** is the percentage at which the principal earns money.



Amount of Interest Earned

Three variables are taken into account when determining the amount of interest earned.

- Principal, denoted by the letter "P," is the amount of money deposited into an account that earns interest. If John walks into a bank and opens a savings account with \$1,000, then the \$1,000 he deposited is the principal amount.
- Rate, denoted by the letter "r," is the annual percentage the bank pays on the principal. It is expressed as a decimal, a fraction, or a percent. An example of rate is 6 percent.
- **Time** is the duration in which the deposit remains in the account; it is denoted by the letter "t." Time is expressed in years or as a fraction of a year.

TWO TYPES OF INTEREST

There are two types of interest: simple and compound. Both are vital to daily life—personally and professionally.



FIGURE 1. The more money you store in a bank, the more interest you will earn—as long as the money is in an interest-bearing account.

Simple Interest

Simple interest is an amount calculated by multiplying principal by rate by time (I = Prt). Principal is the amount of money placed into the account, so any previous interest earned is not considered principal.

Example:

John deposits \$1,000 into an account that earns 4 percent interest annually. How much interest will he earn if he leaves his money in the bank for two years?

Calculation:

- ◆ Year 1: Prt = \$1,000(0.04) = \$40
- Year 2: Prt = \$1,000(0.04) = \$40
- Total = \$80 after two years



Compound Interest

Compound interest is an amount calculated by multiplying principal by rate by time (I = Prt). The interest earned on this deposit is combined with the previous principal amount. In addition, the new balance is drawing interest. Therefore, interest is calculated on principal and on any earned interest. Compound interest accounts generate more interest than simple interest accounts.

Example:

John deposits \$1,000 into an account that earns 4 percent interest annually. How much interest will he earn if he leaves his money in the bank for two years?

Calculation:

- ◆ Year 1: Prt = \$1,000(0.04) = \$40
- ◆ Year 2: Prt = \$1,040(0.04) = \$41.60
- Total = \$81.60 after two years

It is important to know when principal is compounded. It can be compounded daily, monthly, quarterly, or yearly. If interest is calculated quarterly, it is calculated four times (t = $\frac{1}{4}$). If it is calculated monthly, it is calculated 12 times (t = $\frac{1}{12}$). If it is calculated daily, it is calculated 365 times (t = $\frac{1}{365}$). It is difficult to calculate compound interest daily without using a tool (e.g., a table or a software program). Microsoft Excel can be used to calculate compound interest with the appropriate formula. Compound interest calculators can also be found online.

CALCULATING COMPOUND INTEREST

The formula for calculating compound interest is I = Prt. Remember, interest earned is included each time interest is compounded.

Example One

Suppose Ann deposits \$1,000. The bank is paying interest at a rate of 5 percent, and it is compounded quarterly. What will Ann's balance be at the end of one year? Start with the formula $I = Prt = (\$1,000)(0.05)(\frac{1}{4}) = \12.50 . Ann will make \$12.50 at the end of the first quarter. The interest is being calculated quarterly, so the formula will be repeated four times.

Each time the formula is repeated, the interest will be added to the previous principal amount. Going into the second quarter, Ann's principal is no longer \$1,000. Her principal is now \$1,012.50 (\$1,000 + \$12.50). The calculation for the second quarter is I = Prt = (\$1,012.50)(0.05)($^{1}/_{4}$) = \$12.66. The interest is again added to the previous principal for a total of \$1,025.16. The third quarter is calculated I = Prt = (\$1,025.16)(0.05)($^{1}/_{4}$) = \$12.81. The





DIGGING DEEPER...

UNCOVERING ADDITIONAL FACTS: Using an Online Compound Interest Calculator

Solve the first two questions below by using a regular calculator, paper, and pencil. For the third question, visit the following Web site:

http://www.moneychimp.com/calculator/compound_interest_calculator.htm (or use another online compound interest calculator)

Use the online compound interest calculator to solve the final question. Also, use the online calculator to check your work for all of the questions.

- 1. Johnny deposits \$2,000. At 3.5 percent interest compounded semiannually, what will his balance be at the end of two years?
- 2. Sarah deposits \$1,500. At 3.5 percent interest compounded quarterly, what will her balance be at the end of two years?
- 3. Morgan deposits \$4,000. At 1 percent interest compounded daily, what will her balance be at the end of one year? How much interest did she earn?

new principal amount is \$1,037.97. The fourth and final quarter is calculated I = Prt = $(\$1,037.97)(0.05)(\frac{1}{4}) = \12.97 . Add Ann's interest to the previous balance for a total of \$1,050.94 at the end of one year.

Example Two

Online compound interest calculators can be used to determine compound interest. Use a search engine (e.g., http://www.google.com) and type "compound interest calculator" into the search box. Several sites will appear that can be used to calculate compound interest. A tool

such as this is useful for calculating compound interest when it is compounded daily. Once a compound interest calculator has been located, simply fill in the variables needed to determine the compound interest.

Summary:



Interest is the money a person receives because his or her money is in a financial institution. Principal is the initial



FIGURE 2. Free online calculators can help you determine compound interest.



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amount of money deposited into a bank account that earns interest. An interest rate is the percentage at which the principal earns money. There are two types of interest: simple and compound. Both are part of our daily lives.

Simple interest is calculated by multiplying principal by rate by time (I = Prt). Principal is the amount of money placed into the account, so any previous interest earned is not considered principal. Compound interest is calculated by multiplying principal by rate by time (I = Prt). The interest earned on this deposit is now combined with the previous principal amount. In addition, the new balance is drawing interest. Therefore, interest is calculated on principal and on any earned interest. Compound interest accounts generate more interest than simple interest accounts.

Checking Your Knowledge:



- 1. Define simple interest.
- 2. Define compound interest.
- 3. Write the formula for calculating simple interest.
- 4. John deposits \$500. He earns 2 percent interest that is compounded quarterly. What is his balance at the end of two years?
- 5. Bella deposits \$1,000. At 1 percent interest compounded daily, what will her balance be at the end of one year? How much interest did she earn?

Expanding Your Knowledge:



Ask your friends if they have purchased anything on a credit card that cost more than \$100. What was the item, and how much was it? Ask how long it took to pay off the item and the actual amount paid for the item with interest. If it took many months to pay off the item, the actual price paid was probably considerably higher than what the individual thought he or she paid. Perhaps paying with cash would be a better bargain.

Web Links:



The Compounding Interest Calculator

http://www.u.arizona.edu/~avr/finances/scalculator.htm

Compound / Simple Interest Calculator

http://www.pine-grove.com/online-calculators/interest-calculator.htm

Compound Interest Calculator

http://math.about.com/library/blcompoundinterest.htm

Compound Interest—Future Value

http://www.moneychimp.com/articles/finworks/fmfutval.htm

