

Mini Lesson: Compound Interest

Revised August 2016

Requires Simple Interest Project as Prerequisite

As mentioned in the previous project, **interest** is the payment you make for using someone else's money or the payment you receive for lending money. **Simple interest** is equal to a percentage of the amount of money borrowed or loaned.

To compute (simple) interest, you need to know the following:

Principal = the amount of money borrowed or loaned

Rate = the percentage charged to borrow or loan; normally expressed on an annual basis

Time = the period of time the money is borrowed or loaned

Simple interest can be calculated with the following formula:

Interest = Principal * Rate * Time, abbreviated as $I = P * R * T$

As you have previously learned, the principal plus the interest (called the Maturity Value or Value of the Investment) is calculated using the formula below:

Maturity Value = $P * (1 + (R * T))$

Compound interest is a different case; it is where money builds on itself, that is, it is calculated on the principal and the interest earned in prior periods.

Computing compound interest is more complicated than computing simple interest because interest will be computed on a **new amount each period**. The compound amount (or new principal) is the sum of the original principal and its compound interest for that period. The interest period is the time (daily, monthly, quarterly, semiannually or annually) for which interest has been computed. The interest rate is normally quoted on an annual basis (APR) so if interest is computed for a different time period, you must convert the annual interest rate. For example, an 8% APR compounded monthly results in 12 interest payments per year with interest each month equal to $1/12^{\text{th}}$ of 8%, or about 0.67% per month.

To compute compound interest, you will need to know the following:

- The amount of money on deposit (the balance)
- The interest rate applied (sometimes called the *stated* rate of interest)
- The frequency of compounding (annually, semiannually, quarterly, monthly, daily)

Compound interest can be calculated with the same formula as used for simple interest:

Interest = Principal * Rate * Time, abbreviated as $I = P * R * T$

However, the formula to calculate Maturity Value when compound interest is applied changes. It is calculated using the formula below, where N = number of time periods.

Maturity Value = $P * (1 + R)^N$

Click on the tab with the worksheet titled Activity 1 to begin.

Activity 1: Compute Compound Interest and Compound Value – Compounded Annually (using a constant in the formula)

Suppose Henry makes an investment of \$1000 with an annual interest rate (APR) of 3.5% that is compounded annually for 5 years. What will the value of Henry’s investment be by the end of these 5 interest periods?

Directions:

- a. Copy the worksheet titled “Activity 1” into a new worksheet and title it "Activity 1 Solution."
- b. Readjust the width of each column to allow for the contents in each cell to become visible.
- c. Enter periods 1-5 in Cells B8:B12.
- d. Type in the amount of the investment (Original Principal) into cell D4.
- e. Set cell C8 equal to the contents of cell D4.
- f. Enter formula into cell D8 to compute the Interest for the Period. Create the formula using a constant value for the Interest Rate and a relative cell reference to the Compound Amount.
- g. Use the Fill Handle to copy the formula from cell D8 to cells D9:D12.
- h. Enter a formula into cell E8 that will result in the New Compound Amount. New Compound Amount = Compound Amount + Interest for the Period.
- i. Use the Fill Handle to copy the formula from cell E8 to cells E9:E12.
- j. Set cell C9 equal to cell E8.
- k. Use the Fill Handle to copy the formula from cell D9 to cells D10:D12.
- l. Format cells F8:F12 to TEXT.
- m. Select cell F8 and write the algebraic expression (number formula) that will compute the New Compound Amount (value of the investment). Make sure you are entering numbers for this formula. Repeat for cells F9:F12. Refer to Compound Interest formula in the Mini Lesson and use “^” to indicate exponent.
- n. Using the same formula as the algebraic expression from the previous step, enter those numbers for cells G8:G12 that will compute the Value of Investment after interest has been earned for this period. Use constant values – not relative cell references in the formulas. Hint: the values of G8:G12 should be identical to the values of E8:E12.
- o. Format cells C8:C12, D4, D8:D12, E8:E12, and G8:G12 to Currency with 2 decimal places, comma separator, and \$ symbol.
- p. Format shading of the column headings in cell areas B7:G7 to Light Purple.
- q. Change cells B7:G7 to Bold Font.
- r. Format the table with All Borders and use Thick Borders to surround the outside of the table and column headings.
- s. Center align cells B8:B12.
- t. Save file as Compound Interest Part I XX, where XX are your initials.
- u. Click on the tab for the worksheet titled Activity 2 to continue.

Activity 2: Compute Compound Interest – Compounded Annually (using an absolute cell reference in the formula)

Now suppose Hillary makes an investment of \$1000 at a bank that offers an APR of 5.25% compounded annually for 10 periods. What will the value of Hillary’s investment be at the end of these 10 investment periods?

Directions:

- a. Copy the worksheet titled “Activity 2” into a new worksheet and title it "Activity 2 Solution.”
- b. Readjust the width of each column to allow for the contents in each cell to become visible.
- c. Type the given interest rate into Cell D5. Format the cell to Currency with 2 decimal places and the % symbol.
- d. Type in 1 in cell B8 and 2 in cell B9, then use the Auto Fill feature to enter the rest of the interest periods to cells B10:B17.
- e. Type the original investment amount (the principal) into cell D4.
- f. Set cell C8 equal to the contents of cell D4.
- g. Enter formula to calculate Interest for the Period in cells D8:D17 using a relative cell reference to the Compound Amount and an absolute cell reference to the Annual Interest Rate in cell D5.
- h. Use the Fill Handle to copy the formula from cell D8 to cells D9:D17.
- i. Enter a formula in cell E8 to calculate the New Compound Amount using relative cell references to the Compound Amount and the Interest for the Period.
- j. Use the Fill Handle to copy the formula from cell E8 to cells E9:E17.
- k. Set cell C9 equal to the value of cell E8.
- l. Use the Fill Handle to copy the formula from cell C9 to cells C10:C17.
- m. Format cells F8:F17 to TEXT.
- n. Select cell F8 and write the algebraic expression (number formula) that will compute the New Compound Amount (value of the investment). Make sure you are entering numbers for this formula. Repeat for cells F9:F17.
- o. Enter a formula in cell G8 that will compute the Value of Investment after interest has been earned for this period. Use an absolute cell reference for both the compound amount and the interest rate and use a relative cell reference to refer to the interest period. Hint: the values of G8:G17 should be identical to the values of E8:E17.
- p. Use the Fill Handle to copy the formula from cell G8 to cells G9:G17.
- q. Format cells C8:C17, D8:D17, E8:E17, and G8:G17 to Currency with 2 decimal places, comma separator, and \$ symbol.
- r. Format the shading of cell areas B7:G7 to Light Purple.
- s. Change cells B7-G7 to Bold Font.
- t. Format the table with All Borders and use Thick Borders to surround the outside of the table and column headings.
- u. Center align cells B8:B17.
- v. Save file.
- w. Click on the tab for the worksheet titled Activity 2 to continue.

Activity 3: Compute Compound Interest with Different Compounding Frequency

While Hillary was shopping for various investment opportunities, she found 2 banks that offered the same interest rate, but different compounding frequencies. Friendly Bank is offering 5.25% APR, compounded semi-annually and Happy Bank is offering 5.25% APR, compounded quarterly. Hillary is curious to see what difference, if any, the compounding frequency will have on the value of her investment. Calculate the value of a \$1000 earning 5.25% APR invested for 10 years under different compounding frequencies. After you have determined the value of the investment for both banks after 10 years, decide which bank Hilary should invest in to reap the highest earnings.

Directions:

- a. Copy the worksheet titled “Activity 3” into a new worksheet and title it "Activity 3 Solution.”
- b. Readjust the width of each column to allow for the contents in each cell to become visible.
- c. Enter a formula into cell F5 to compute the period (semi-annual) interest rate. Period Interest Rate = APR/# of times compounded in a year. Use a relative cell reference to link the APR (located in cell D5) for your formula. Format the cell to Percentage with 3 decimal places and the % symbol.
- d. Type in 1 in cell B8 and 2 in cell B9, then use the Auto Fill feature that will allow the rest of the interest periods to appear in cells B10:B27.
- e. Type the original principal amount in cell D4.
- f. Set cell C8 equal to cell D4.
- g. Enter formula to calculate Interest for the Period in cells D8:D27 using a relative cell reference to the Compound Amount and an absolute cell reference to the Period Interest Rate, (which was calculated earlier in cell F5).
- h. Copy the formula from cell D8 to cells D9:D27.
- i. Enter a formula in cell E8 to calculate the New Compound Amount.
- j. Copy the formula from cell E8 to cells E9:E27.
- k. Set cell C9 equal to the contents of E8.
- l. Use the Fill Handle to copy the contents of cell C9 to cells C10:C27.
- m. Format cells F8:F27 to TEXT.
- n. Select cell F8 and write the algebraic expression (number formula) that will compute the New Compound Amount (value of the investment). Make sure you are entering numbers for this formula. Instead of manually typing each algebraic expression, Drag and Drop the contents of cell F8 to cells F9:F27.
- o. Enter a formula in cell G8 that will compute the Value of Investment after interest has been earned for this period. Use an absolute cell reference for both the Compound Amount and the Interest Rate and use a relative cell reference to refer to the Interest Period. Hint: the result of the formula should be equal to the value in cell E8
- p. Use the Fill Handle to copy the formula from from cell G8 to cells G9:G27.
- q. Format cells C8:C27, D4, D8:D27, E8:E27, and G8:G27 to Currency with 2 decimal places, comma separator, and \$ symbol.
- r. Format the shading of cell areas B7:G7 to Light Purple.
- s. Change cells B7:G7 to Bold Font.

- t. Format the table with All Borders and use Thick Borders to surround the outside of the table and column headings.
- u. Center align cells B8:B27.
- v. Repeat the same steps for the second table. Now there are 40 periods (10 years x compounding frequency).
- w. Change cells B27 and B74 to Bold Font.
- x. Insert a Comment in either cell B27 or B74 to indicate the bank that Hillary should invest in.
- y. Save file.