9. Time Value of Money 1: Understanding the Language of Finance

Introduction

The language of finance has unique terms and concepts that are based on mathematics. It is critical that you understand this language, because it can help you develop, analyze, and monitor your personal financial goals and objectives so you can get your personal financial house in order.

Objectives

When you have completed this chapter, you should be able to do the following:

A. Understand the term *investment.*
B. Understand the importance of compound interest and time.
C. Understand basic financial terminology (the language of finance).
D. Solve problems related to present value (PV) and future value (FV).

I strongly recommend that you borrow or purchase a financial calculator to help you complete this chapter. Although you can do many of the calculations discussed in this chapter on a standard calculator, the calculations are much easier to do on a financial calculator. Calculators like the Texas Instruments (TI) Business Analyst II, TI 35 Solar, or Hewlett-Packard 10BII can be purchased for under $35. The functions you will need for calculations are also available in many spreadsheet programs, such as Microsoft Excel. If you have a computer with Excel, you can use our Excel Financial Calculator (LT12), which is a spreadsheet-based financial calculator available on the website. We also have a Financial Calculator Tutorial (LT3A) which shares how to use 9 different financial calculators.

Understand the Term Investment

An investment is a current commitment of money or other resources with the expectation of reaping future benefits.

For the most part, we will be working with financial investments in this course—stocks (or equities), bonds, mutual funds, cash, treasury bills and notes, options, futures, and so on. However, we will make reference to other important investments such as education and relationships. It is important that we have a broader view of what an investment is so that we recognize those investments that are of most worth—those that bring true joy in this life and in the life to come. You should have priorities when it comes to investments, and the most important investments you will make involve your family, your religion, and your relationship with God. The Book of Mormon prophet Jacob wisely counseled, "Wherefore, do not spend

money for that which is of no worth, nor your labor for that which cannot satisfy."[1]

Understand the Importance of Compound Interest and Time

Interest is similar to rent. Just as tenants pay rent to landlords in exchange for the use of an apartment or house, people will pay you interest in exchange for the use of your money. You can either invest your money yourself or you can lend it to others who will then invest your money and pay you an agreed upon rate.

With simple interest, you only earn interest on your original principal. However, with compound interest, interest is calculated not only on the initial principal but also on the accumulated interest earned in prior periods. The magic of compound interest is that you earn interest on money earned in previous periods, hence the importance of time. Time is the only tool that everyone has an equal amount of each day. However, you must have the discipline and foresight to use time to your advantage by investing early and not stopping for "diversions" in your spending and your goals.

The key investing principle states that a dollar in hand is worth more than a dollar received in the future. This principle is true because you can invest that dollar today and begin earning interest on it. The sooner your money can earn interest, the faster your interest can earn interest, and the more money you will have.

Understand Basic Financial Terminology (i.e., the Language of Finance)

For you to understand the language of finance, you must understand thirteen key terms:

Amortized loan: A loan paid off in equal installments composed of both principal and interest. It may also be called an installment loan.

Annuity: A series of equal payments; these payments are made at the end of a specific time period for a specified number of time periods (generally months or years).

Compound annuity: An investment that involves depositing the same amount of money at the end of each period for a certain number of years.

Compounding (annually, quarterly, daily, etc.): The number of periods during the year where interest is calculated. Compound interest is where interest is paid on previously earned interest as well as on the principal. The shorter the compounding period, the higher the effective annual rate of interest.

Effective interest rate: The actual rate (as opposed to the stated or nominal rate) that is received after the effects of compounding are taken into account.

Future value (FV): The value of an investment at some point in the future.

Interest or discount rate: The stated rate you will receive for investing at a specified compounding period for a specified period of time.

Nominal return: The return on your investment before the impact of inflation and taxes is taken into account.

Present value (PV): The current value (today's value) of a future sum of money.

Principal: The money you have available to invest or save, or the stated amount on a bond or deposit instrument.

Real return: The rate of return on an investment after the impact of inflation is accounted for. The formula for approximating the real return is the nominal return minus inflation. The exact formula for the real return is= [(1+ nominal return) / (1 + inflation)] – 1.

Tax-adjusted (or after-tax) return: The return on your investment after the impact of federal and state taxes has been taken into account.

Compounding

How will different compounding periods impact your investment and investment returns?

Compounding periods refer to the frequency with which interest is applied to your investment. Interest may be compounded daily, weekly, monthly, semiannually, or annually. A key relationship exists between time and interest rate. The shorter the compounding period, the higher the effective annual interest rate (the actual rate you are earning on your investment after taking the effect of compounding into account). For example, if interest is compounded daily, the investment will grow faster than if the interest is compounded monthly or annually.

The formula for calculating the effective interest rate (EIR) is as follows:

$$EIR = [(1 + (\text{nominal return or APR} / \text{periods}))]^{\text{periods}} - 1$$

Problem 1: Impact of Compounding

Let's illustrate the effect of compounding and the effective interest rate. The following are examples of four investments with four different nominal returns. Which of these investments would you rather own?

Investment A earns 12.0 percent annually.
Investment B earns 11.9 percent semiannually.
Investment C earns 11.8 percent quarterly.
Investment D earns 11.7 percent daily.

To figure out which investment is best for you, you must determine the effective interest rate of each investment.

For Investment A, the effective rate would be $(1 + .12 / 1)^1 - 1$, or 12.00 percent.
For Investment B, the effective rate would be $(1 + .119 / 2)^2 - 1$, or 12.25 percent.
For Investment C, the effective rate would be $(1 + .118 / 4)^4 - 1$, or 12.33 percent.
For Investment D, the effective rate would be $(1 + .117 / 365)^{365} - 1$, or 12.41 percent.

Even though Investment D has the lowest nominal return, because of compounding, it has the highest effective interest rate. Investment D would be the best vehicle, assuming you were lending money at this rate. Compounding makes an important difference!

Solve Problems Related to Present Value (PV) and Future Value (FV)

Present Value (PV)

Let's suppose you want to determine the current value of the ultimate earnings on an investment. This question could be restated in the following manner: What is the present value of my investment that will mature in N years at I percent interest (or discount rate)?

To solve this problem, you will need to know the future value of your investment, how many years are required for the investment to reach maturity, and what interest or discount rate your investment has. The result of the equation will be a dollar amount that is smaller than the future amount of principal and interest you will have earned; it is the amount the investment is worth at the present time.

The present value (PV) equation is as follows:

$$PV = FV / (1 + I)^N$$

The key inputs in the PV equation are as follows:

- FV = the future value of the investment at the end of N years
- N = the number of years in the future
- I = the interest rate, or the annual interest rate or discount rate
- PV = the present value, in today's dollars, of a sum of money you have invested or plan to invest

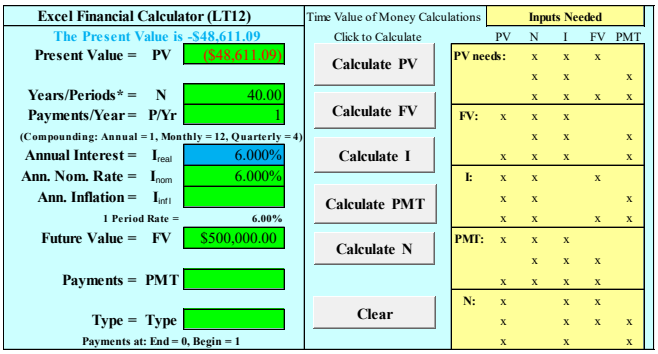
After you find these inputs, you can solve for the present value (PV).

Problem 2: Determining Present Value

Let's suppose your rich uncle promises to give you $500,000 in 40 years. Assuming a six percent interest rate, what is the present value of the amount your uncle is promising to give you in 40 years?

To solve this problem, use the equation given above, which would appear as follows: PV = 500,000 / $(1 + .06)^{40}$, or $48,611. You can also use a financial calculator. Set your calculator to end mode, meaning payments are at the end of each period, and clear the memory registers to make sure you have no old data in the calculator memories. Set $500,000 as your future value (FV), 40 as your number of years (N), and 6 as your interest rate (I); then solve for the present value (PV). You should get the same result as you did when you used the PV equation.

Using our Excel Financial Calculator (LT12), it is:



Future Value (FV)

Let's suppose you want to determine what an investment will be worth at some point in the future, i.e., what will the value of my investment be in N years if my interest rate is I percent?

You will need to know how many years it will be until you have the investment, the interest rate, and the amount of the investment (the present value of the investment).

The result of the equation will be a dollar amount that is larger than the original investment, since your money will earn interest and will then earn interest on that interest. For an approximation, remember the rule of 72, which states that an investment will double approximately each time you multiply the number of years of investment by the interest rate (in percentage terms) and get a number that is greater than 72. For example, if your investment is earning 8 percent interest, it will take nine years for it to double (72 divided by 8 = 9).

The future value (FV) equation is as follows:

$$FV_N = PV * (1 + I)^N$$

The key inputs in the FV equation are as follows:

FV = future value of the investment at the end of N periods (years)
N = number of years in the future
I = interest rate, or the annual interest (or discount) rate
PV = present value, in today's dollars, of a sum of money you have already invested or plan to invest

Problem 3: Determining Future Value

Let's look at two similar problems:

A. Calculate the future value (in 15 years) of $5,000 that is earning 8 percent; assume an

annual compounding period.

B. Calculate the future value (in 15 years) of $5,000 that is earning 8 percent; assume simple interest (the interest earned does not earn interest).

C. How much did interest on interest earn in the first problem?

A. To solve this problem, we must consider compound interest. On your calculator, clear your registers and your memory. Set –$5,000 as the present value (PV), 8 percent as the interest rate (I), and 15 as the number of years in the future (N); then solve for the future value (FV), which is $15,861. With a standard calculator, the result is $5,000 * (1 +.08)^15^, or the same sum of $15,861.

B. To solve for simple interest, which does not accrue interest on interest, it is easiest to use a standard calculator. First, calculate your annual interest, which is $5,000 times 8 percent (5,000 * .10), or $400. Multiply $400 by 15 years; the result should be $6,000. Then add the amount of the original investment of $5,000 to get $11,000.

C. The difference between $15,861 and $11,000 is $4,861, which is the amount of interest that your interest has earned. This concept is the key to financial success—earn interest on your interest.

Summary

In this chapter, we have become familiar with the language of finance. The language of finance comprises many different concepts and terms, and understanding these concepts and terms is can help you to develop, analyze, and monitor your personal and financial goals successfully.

An *investment* is the current commitment of money or other resources with the expectation of reaping future benefits. We make investments in many areas of our lives; key investments can involve education and skills, knowledge and friendships, food storage and emergency funds, and finances.

Compounding is an important principle to understand. Compounding periods are the frequency with which interest is applied to your investment. Interest may be compounded daily, weekly, monthly, semiannually, or annually. The sooner your money can earn interest, the faster your interest can earn interest, and the more money you will have.

Present value (PV) is another key term. The present value of an investment refers to the current value of a future sum of money. You must remember, however, that money you will earn in the future is less valuable to you than money you have right now; you cannot use future money to earn interest today. You can only earn interest on money you have in hand.

Future value (FV) is the value an investment will have at some point in the future. The result of a future value equation will be a dollar amount that is larger than the original investment

(assuming a positive rate of interest or return) because your money will earn interest and earn interest on that interest.

Assignments

Financial Plan Assignments

There are no financial plan assignments for this section, although understanding the language of finance is critical to all other sections. As you read through this chapter, think about the purpose of each financial concept. Use either a calculator, your own spreadsheets, or the Excel Financial Calculator (LT12) to make sure you understand how to solve problems of present value and future value.

Learning Tools

The following Learning Tools may also be helpful as you prepare your Personal Financial Plan:

Financial Calculator Tutorial (LT03)

This document is a financial calculator tutorial about most of the major financial calculators. It also includes the financial formulas if you would prefer to program your own calculator.

Excel Financial Calculator (LT12)

This Excel spreadsheet is a simple financial calculator for those who prefer to use spreadsheets. This tool can perform most of the functions of a financial calculator, including present value, future value, payments, interest rates, and number of periods.

Review Materials

Terminology Review

Amortized Loan. A loan paid off in equal installments composed of both principal and interest. It may also be called an installment loan.

Annuity. A series of equal payments; these payments are made at the end of a specific time period for a specified number of time periods (generally months or years).

Compounding (annually, quarterly, daily, etc.): The number of periods during the year where interest is calculated. Compound interest is where interest is paid on previously earned interest as well as on the principal. The shorter the compounding period, the higher the effective annual rate of interest.

Compound Annuity. An investment that involves depositing the same amount of money at the end of each year for a certain number of years.

Compound Interest. Compound interest is where interest is calculated not only on the initial principal but also on the accumulated interest earned in prior periods. The magic of

compound interest is that you earn interest on money earned in previous periods.
Effective Interest Rate. The actual rate (as opposed to the stated or nominal rate) that is received after the effects of compounding are taken into account.
Effective Interest Rate. The actual rate (as opposed to the stated or nominal rate) that is received after the effects of compounding are taken into account.
Financial Investments. These are equity or debt investments including stocks (or equities), bonds, mutual funds, cash, treasury bills and notes, options, futures, and so on.
Future Value (FV). The value of an investment at some point in the future.
Inflation. An increase in the volume of available money in relation to the volume of available goods and services; inflation results in a continual rise in the price of various goods and services. In other words, because of increased inflation, your money can buy fewer goods and services today than it could have bought in the past.
Interest or Discount Rate. The stated rate you will receive for investing at a specified compounding period for a specified period of time.
Investment. The current commitment of money or other resources with the expectation of reaping future benefits.
Minimum Payment. The minimum amount of payment required by credit card companies each month. The credit card companies purposefully keep these as low as possible, in order to maximize the amount that they earn in interest.
Nominal Return. The return on your investment before the impact of inflation and taxes is taken into account.
Present Value (PV). The current value (today's value) of a future sum of money.
Principal. The money you have available to invest or save, or the stated amount on a bond or deposit instrument.
Real Return. The rate of return on an investment after the impact of inflation is accounted for. The formula for approximating the real return is the nominal return minus inflation. The exact formula for the real return is= [(1+ nominal return) / (1 + inflation)] – 1.
Simple Interest. Interest is paid only on your original principal.
Tax-adjusted (or after-tax) return. The return on your investment after the impact of federal and state taxes has been taken into account.

Review Questions

1. What is compound interest?

2. What are the four variables of the present value equation?
3. What are the 13 financial terms mentioned in the chapter? What do they mean?
4. What is the relationship between the compounding period and the effective interest rate?

Case Studies

Case Study 1

Data

Brian has a goal to have $500,000 saved by the time he turns 65, which is 40 years from now.

Calculation

Assuming he can make 6 percent on his money, what is the value of that money now (this indicates present value)? The math formula is as follows:

$PV = FV/ (1 + I)^N$

Case Study 1 Answer

The formula is $PV = FV/ (1 + I)^N$, or $PV = 500,000 / (1.06)^{40}$, or $48,611.10. This formula shows you how this equation would be calculated on a standard calculator. Using a financial calculator, you would clear the memories and then enter the following information:

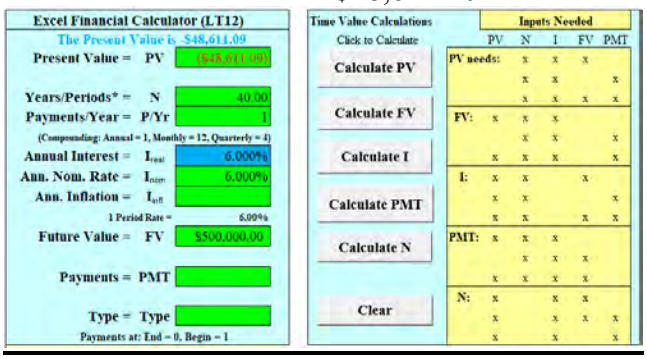
$500,000 = FV

6% = I, which is the interest rate (the annual interest, or discount, rate)

40 = N, or the number of years

You would then solve for PV:

PV = the present value, in today's dollars, of a sum of money you have invested or plan to invest. If you use a financial calculator for this equation, the present value should come out as $48,611.10.



Case Study 2

Data

Ron has $2,500 saved.

Calculation

If his investment earns 8 percent per year for 20 years, how much will his investment be worth in 20 years (the investment's future value)? The formula is as follows:

$FV = PV (1 + I)^N$

Case Study 2 Answer

The equation would be $FV = \$2,500 * (1 +.08)^{20}$ or $11,652.39

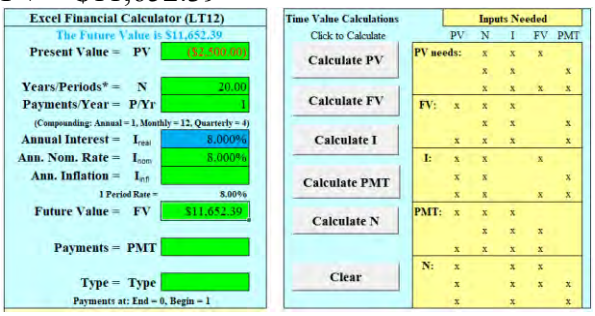
If you were using a financial calculator, you would clear the memories and then enter the following:

$2,500 = PV

8% = I, which is the interest rate (the annual interest, or discount, rate)
40 = N, or the number of years

You would then solve for FV:

FV = $11,652.39



[1] 2 Nephi 9:51