GLOBAL EDITION

Foundations of Finance

The Logic and Practice of Financial Management

TENTH EDITION

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Prepare, Apply, Confirm and Develop Employability Skills with MyLab Finance

MyLab™ Finance is an online homework, tutorial, and assessment program constructed to work with this text to engage students and improve results. It was designed to help students develop and assess the skills and applicable knowledge that they will need to succeed in their courses and their future careers.

85%

of students said MyLab Finance helped them earn higher grades on homework, exams, or the course

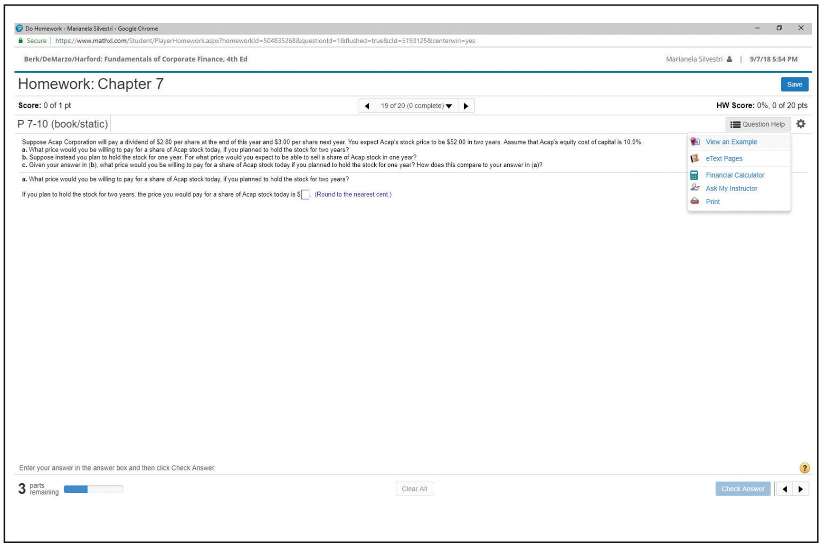
*Source: 2017 Student Survey, n 4703

See what more than 30,000 students had to say about MyLab Finance:

"MyLab Finance's primary benefit was that it helped me to learn how to solve problems and not just memorize information."

— Student,
Southern New Hampshire University

Question Help consists of homework and practice questions to give students unlimited opportunities to master concepts. **Learning aids** walk students through the problem—giving them assistance when they need it most.



Pearson

You'll notice that PV is input with a negative sign. In effect, the financial calculator is programmed to assume that the $9,330 is a cash outflow, whereas the $20,000 is money that you receive. If you don't give one of these values a negative sign, you can't solve the problem.

Using an Excel Spreadsheet With Excel, solving for *n* is straightforward. You simply use the = NPER function and input values for rate, pmt, pv, and fv.

	A	B
1	interest rate (rate) =	10.00%
2	payment (pmt) =	0
3	present value (pv) =	($9,330)
4	future value (fv) =	$20,000
5		
6	number of periods (nper) =	8
7		
8	Excel formula =nper(rate,pmt,pv,fv)	
9	Entered in cell b6: =nper(b1,b2,b3,b4)	

Solving for the Rate of Interest You have just inherited $34,946 and want to use it to fund your retirement in 30 years. If you have estimated that you will need $800,000 to fund your retirement, what rate of interest would you have to earn on your $34,946 investment? Let's take a look at solving this using a financial calculator and an Excel spreadsheet to calculate the interest rate.

Using a Financial Calculator With a financial calculator, all you do is substitute in the values for N, PV, and FV, and solve for I/Y:

Enter	**30**		**−34,946**	**0**	**800,000**
	N	I/Y	PV	PMT	FV
Solve for		**11**			

Using an Excel Spreadsheet With Excel, the problem is also very easy. You simply use the = RATE function and input values for nper, pmt, pv, and fv.

	A	B
1	number of periods (nper) =	30
2	payment (pmt) =	0
3	present value (pv) =	($34,946)
4	future value (fv) =	$800,000
5		
6	interest rate (rate) =	11.00%
7		
8	Excel formula =rate(nper,pmt,pv,fv)	
9	Entered in cell b6: =rate(b1,b2,b3,b4)	

Applying Compounding to Things Other Than Money

While this chapter focuses on moving money through time at a given interest rate, the concept of compounding applies to almost anything that grows. For example, let's assume you're interested in knowing how big the market for 3-D printers will be in 5 years, and assume the demand for them is expected to grow at a rate of 25 percent per year over the next 5 years. We can calculate the future value of the market for printers using the same formula we used to calculate future value for a sum of money. If the market is currently 25,000 printers per year, then 25,000 would be the present value, n would be 5, r would be 25 percent, and substituting into equation (5-1) you would be solving for FV,

$$\text{Future value} = \text{present value} \times (1 + r)^n \tag{5-1}$$
$$= 25{,}000(1 + 0.20)^5 = 76{,}293$$

In effect, you can view the interest rate, r, as a compound growth rate and solve for the number of periods it would take for something to grow to a certain level—what something will grow to in the future. Or you could solve for r; that is, solve for the rate that something would have to grow at in order to reach a target level.

Present Value

present value the value in today's dollars of a future payment discounted back to present at the required rate of return.

Up to this point we have been moving money forward in time; that is, we know how much we have to begin with and are trying to determine how much that sum will grow in a certain number of years when compounded at a specific rate. We are now going to look at the reverse question: What is the value in today's dollars of a sum of money to be received in the future? The answer to this question will help us determine the desirability of investment projects in Chapters 10 and 11. In this case we are moving future money back to the present. We will determine the **present value** of a lump sum, which in simple terms is the *current value of a future payment*. In fact, we will be doing nothing other than inverse compounding. The differences in these techniques come about merely from the investor's point of view. In compounding, we talked about the compound interest rate and the initial investment; in determining the present value, we will talk about the discount rate and present value of future cash flows. Determining the appropriate discount rate is the subject of Chapter 9 and can be defined as the rate of return available on an investment of equal risk to what is being discounted. Other than that, the technique and the terminology remain the same, and the mathematics are simply reversed. In equation (5-1) we were attempting to determine the future value of an initial investment. We now want to determine the initial investment or present value. By dividing both sides of equation (5-1) by $(1 + r)^n$, we get

$$\text{Present value} = \text{future value at the end of year } n \times \left[\frac{1}{(1 + r)^n}\right]$$

or

$$PV = FV_n\left[\frac{1}{(1 + r)^n}\right] \tag{5-2}$$

present value factor the value of $\frac{1}{(1 + r)^n}$ used as a multiplier to calculate an amount's present value.

The term in the brackets in equation (5-2) is referred to as the **present value factor**. Thus, to find the present value of a future dollar amount, all you need to do is multiply that future dollar amount times the appropriate present value factor:

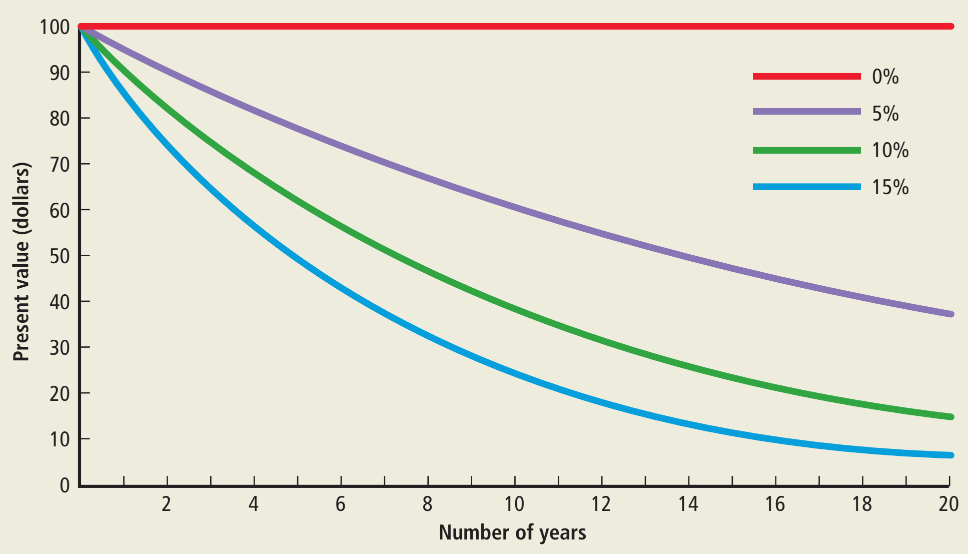
$$\text{Present value} = \text{future value (present value factor)}$$

where

$$\text{Present value factor} = \left[\frac{1}{(1 + r)^n}\right]$$

Because the mathematical procedure for determining the present value is exactly the inverse of determining the future value, we also find that the relationships among n, r, and present value are just the opposite of those we observed in future value. The present value of a future sum of money is inversely related to both the number of years until the payment will be received and the discount rate. This relationship is shown in Figure 5-3. Although the present value equation [equation (5-2)] is used extensively to evaluate new investment proposals, it should be stressed that the equation is actually the same as the future value or compounding equation [equation (5-1)], only it solves for present value instead of future value.

FIGURE 5-3 The Present Value of $100 to Be Received at a Future Date and Discounted Back to the Present at 0, 5, 10, and 15 Percent



EXAMPLE 5.4

Calculating the Discounted Value to Be Received in 10 Years

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What is the present value of $500 to be received 10 years from today if our discount rate is 6 percent?

STEP 1: Formulate a Solution Strategy

The present value to be received can be calculated using equation (5-2) as follows:

$$\text{Present value} = FV_n\left[\frac{1}{(1+r)^n}\right] \tag{5-2}$$

STEP 2: Crunch the Numbers

Substituting $FV = \$500$, $n = 10$, and $r = 6$ percent into equation (5-2), we find:

$$\begin{aligned}\text{Present value} &= \$500\left[\frac{1}{(1+0.06)^{10}}\right]\\ &= \$500(0.5584)\\ &= \$279.20\end{aligned}$$

STEP 3: Analyze Your Results

Thus, the present value of the $500 to be received in 10 years is $279.20.

CALCULATOR SOLUTION

Data Input	Function Key
10	N
6	I/Y
−500	FV
0	PMT
Function Key	**Answer**
CPT	
PV	279.20

EXAMPLE 5.5

Calculating the Present Value of a Savings Bond

MyLab Finance Video

You're on vacation in a rather remote part of Florida and see an advertisement stating that if you take a sales tour of some condominiums "you will be given $100 just for taking the tour." However, the $100 that you get is in the form of a savings bond that will not pay you the $100 for 10 years. What is the present value of $100 to be received 10 years from today if your discount rate is 6 percent?

CALCULATOR SOLUTION

Data Input	Function Key
10	N
6	I/Y
−100	FV
0	PMT

Function Key	Answer
CPT	
PV	55.84

STEP 1: Formulate a Solution Strategy

The present value of your savings bond can be computed using equation (5-2) as follows:

$$\text{Present value} = FV_n\left[\frac{1}{(1+r)^n}\right] \tag{5-2}$$

STEP 2: Crunch the Numbers

Substituting $FV = \$100$, $n = 10$, and $r = 6$ percent into equation (5-2), we compute the present value as follows:

$$\text{Present value} = \$100\left[\frac{1}{(1+0.06)^{10}}\right]$$
$$= \$100(0.5584)$$
$$= \$55.84$$

STEP 3: Analyze Your Results

Thus, the value in today's dollars of that \$100 savings bond is only \$55.84.

Again, we have only one present value–future value equation; that is, equations (5-1) and (5-2) are different formats of the same equation. We have introduced them as separate equations to simplify our calculations; in one case we are determining the value in future dollars, and in the other case, the value in today's dollars. In either case, the reason is the same: to compare values on alternative investments and to recognize that the value of a dollar received today is not the same as that of a dollar received at some future date. In other words, we must measure the dollar values in dollars of the same time period. For example, if we looked at three projects—one that promised \$1,000 in 1 year, one that promised \$1,500 in 5 years, and one that promised \$2,500 in 10 years—the concept of present

FINANCE AT WORK

Forgetting Principle 4: Market Prices Are Generally Right

In 2007, several U.S. real estate markets entered a housing bubble. To look more closely at the underlying factors that led to this recent bubble (and burst), let's take a step back for a moment.

Beginning in the mid-1990s, the federal government made moves to relax conventional lending standards. In one such move, the government required the Federal National Mortgage Association, commonly known as Fannie Mae, and the Federal Home Loan Mortgage Corporation, known as Freddie Mac, to increase their holdings of loans to low- and moderate-income borrowers. Then in 1999, the U.S. Department of Housing and Urban Development (HUD) regulations required Fannie Mae and Freddie Mac to accept more loans with little or no down payment. As a result, the government had opened the door to very risky loans that would not have been made without this government action.

After the 2001 terrorist attack on the World Trade Center, the government made another move that acted against what we know about competitive markets. The Fed lowered short-term interest rates to ensure that the economy did not seize up. These low, short-term interest rates made adjustable rate loans with low down payments highly attractive to homebuyers. As a result of the low interest rates, when individuals took out variable rate mortgages, they often qualified for bigger mortgages than they could have afforded during a normal interest rate period. But in 2005 and 2006, to control inflation, the Fed returned these short-term interest rates to higher levels and the adjustable rates reset, causing the monthly payments on these loans to increase. Housing prices began to fall and defaults soared.

These actions prevented supply and demand from acting naturally. As a result, housing prices were unnaturally inflated and the listed value of the mortgages, when packaged as securities, was a poor indicator of their actual worth. When homeowners defaulted on their loans in spades, investors were left holding the bad mortgages. These defaulted mortgages also led to a lot more houses on the market that the banks couldn't sell, which led to the market drying up, as it then became very difficult for anyone to get a *new* loan.

We now know that these events put into motion the housing bubble that contributed to our recent economic downturn. Competitive markets operate with natural forces of supply and demand, and while they tend to eliminate huge returns, competitive markets can also help to prevent the occurrence of short-lived false values—such as the temporarily low monthly interest payments for new homebuyers—that lead to an eventual crash. If we take one lesson away from this scenario, it should be this: Don't mess with efficient markets. If the markets move interest rates to higher levels, it's for a reason.

value would allow us to bring their flows back to the present and make those projects comparable. Moreover, because all present values are comparable (they are all measured in dollars of the same time period), we can add and subtract the present value of inflows and outflows to determine the present value of an investment. Let's now look at an example of an investment that has two cash flows in different time periods and determine the present value of this investment.

EXAMPLE 5.6

Calculating the Present Value of an Investment

What is the present value of an investment that yields $1,000 to be received in 7 years and $1,000 to be received in 10 years if the discount rate is 6 percent?

STEP 1: Formulate a Solution Strategy

The present value of our investment can be computed using equation (5-2) for each yield, then adding these values together as follows:

$$\text{Present value} = FV_n\left[\frac{1}{(1+r)^n}\right] + FV_n\left[\frac{1}{(1+r)^n}\right] \quad (5\text{-}2)$$

STEP 2: Crunch the Numbers

Substituting into equation (5-2), we compute the present value as follows:

$$\text{Present value} = \$1{,}000\left[\frac{1}{(1+0.06)^7}\right] + \$1{,}000\left[\frac{1}{(1+0.06)^{10}}\right]$$

$$= \$665.06 + \$558.39 = \$1{,}223.45$$

STEP 3: Analyze Your Results

Again, present values are comparable because they are measured in the same time period's dollars.

With a financial calculator, this becomes a three-step solution, as shown in the margin. First, you'll solve for the present value of the $1,000 received at the end of 7 years; then you'll solve for the present value of the $1,000 received at the end of 10 years; and finally, you'll add the two present values together. Remember, once you've found the present values of those future cash flows, you can add them together because they're measured in the same period's dollars.

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STEP 1

CALCULATOR SOLUTION

Data Input	Function Key
7	N
6	I/Y
−1,000	FV
0	PMT

Function Key	Answer
CPT	
PV	665.06

STEP 2

CALCULATOR SOLUTION

Data Input	Function Key
10	N
6	I/Y
−1,000	FV
0	PMT

Function Key	Answer
CPT	
PV	558.39

STEP 3

Add the two present values that you just calculated together:

$ 665.06
558.39
$1,223.45

CAN YOU DO IT?

Solving for the Present Value With Two Flows in Different Years

What is the present value of an investment that yields $500 to be received in 5 years and $1,000 to be received in 10 years if the discount rate is 4 percent?

(The solution can be found on page 187.)

Concept Check

1. Principle 2 states that "money has a time value." Explain this statement.
2. How does compound interest differ from simple interest?
3. Explain the formula $FV_n = PV(1+r)^n$.
4. Why is the present value of a future sum always less than that sum's future value?

LO2 Understand annuities.

annuity a series of equal dollar payments made for a specified number of years.

ordinary annuity an annuity in which the cash flows occur at the end of each period.

Annuities

An **annuity** is *a series of equal dollar payments for a specified number of years*. When we talk about annuities, we are referring to **ordinary annuities** unless otherwise noted. With an ordinary annuity *the payments occur at the end of each period*. Because annuities occur frequently in finance—for example, as bond interest payments—we treat them specially. Although compounding and determining the present value of an annuity can be dealt with using the methods we have just described, these processes can be time consuming, especially for larger annuities. Thus, we have modified the single cash flow formulas to deal directly with annuities.

Compound Annuities

compound annuity depositing an equal sum of money at the end of each year for a certain number of years and allowing it to grow.

A **compound annuity** involves *depositing or investing an equal sum of money at the end of each year for a certain number of years and allowing it to grow*. Perhaps we are saving money for education, a new car, or a vacation home. In any case, we want to know how much our savings will have grown at some point in the future.

Actually, we can find the answer by using equation (5-1), our compounding equation, and compounding each of the individual deposits to its future value. For example, if to provide for a college education we are going to deposit $500 at the end of each year for the next 5 years in a bank where it will earn 6 percent interest, how much will we have at the end of 5 years? Compounding each of these values using equation (5-1), we find that we will have $2,818.50 at the end of 5 years.

$$\begin{aligned} FV_5 &= \$500(1 + 0.6)^4 + \$500(1 + 0.6)^3 + \$500(1 + 0.6)^2 + \$500(1 + 0.6) + \$500 \\ &= \$500(1.262) + \$500(1.191) + \$500(1.124) + \$500(1.060) + \$500 \\ &= \$631.00 + \$595.50 + \$562.00 + \$530.00 + \$500.00 \\ &= \$2,818.50 \end{aligned}$$

By examining the mathematics involved and the graph of the movement of money through time in Table 5-1, we can see that all we are really doing is adding up the future values of different cash flows that initially occurred in different time periods. Fortunately, there is also an equation that helps us calculate the future value of an annuity:

$$\text{Future value of an annuity} = PMT\left[\frac{\text{future value factor} - 1}{r}\right]$$

$$= PMT\left[\frac{(1 + r)^n - 1}{r}\right] \tag{5-3}$$

TABLE 5-1 Growth of a 5-Year, $500 Annuity Compounded at 6 Percent

r = 6%

YEAR	0	1	2	3	4	5
Dollar deposits at end of year		500	500	500	500	500
						$ 500.00
						530.00
						562.00
						595.50
						631.00
Future value of the annuity						$2,818.50