



# 2-4 Explore Compound Interest

Advanced Financial Algebra

# What is Compound Interest?

- Principal (the amount of \$ you deposit) increases each time interest is added to the account.
- Compound interest is when you earn interest on your principal AND on the interest that you already earned.
- There are different ways to compound interest:
  - Annually (once each year)
  - Semiannually (twice per year)
  - Quarterly (four times per year)
  - Monthly (12 times per year)
  - Daily (365 times per year)
  - Etc.

# General Example Two Ways

- If you deposit \$5,000 at 2% annual interest for the 3 years, how much money will you have at the end?
- SOLUTION:
- Year 1:  $\$5000 (.02) = \$100$  interest for year 1
- $\$5000 + \$100$  interest = \$5,100 at the end of year 1
- Year 2:  $\$5,100 (.02) = \$102$  interest for year 2 (earned interest on \$5000 and on interest)
- $\$5100 + \$102$  interest = \$5,202 at end of year 2
- Year 3:  $\$5,202 (.02) = \$104.04$  interest for year 3
- $\$5202 + \$104.04$  interest = **\$5,306.04 at end of year 3**

# General Example short way 😊

- If you had to figure that out for more than a few years, it would be too much work.
- Instead, we can use the formula we learned in the last chapter  $A = P (1 + r)^t$
- Using that formula, we get the same answer.  $A(3) = \$5,000 (1 + .02)^3 = \$5,306.04$

# Example 1 – annual compounding

○ How much interest would \$1,000 earn in 1 year at an annual rate of 2%, compounded annually? What would be the new balance?

○ SOLUTION:

○ Formula  $A = P (1 + r)^n$

○ Substitution  $A = \$1,000 (1 + .02)^1 = \underline{\underline{\$1,020.00}}$

# Example 3 – quarterly compounding

- How much interest does \$1,000 earn in 3 months at an interest rate of 2%, compounded quarterly? What is the balance after 3 months?
- SOLUTION:
- Quarterly is  $\frac{1}{4}$  of a year, so you get  $\frac{1}{4}$  of 2% interest       $2\%/4 = .5\%$  per quarter
- Change that percent to a decimal       $.5\% = .005$
- Use formula       $A = P (1 + ) = \$1,000 (1 + .005)^1$
- Balance after three months (one quarter) = **\$1,005.00**

# Example 4 – daily compounding

- How much interest does \$1,000 earn in one day at an interest rate of 2%, compounded daily? What is the balance after a day? What is the balance after one year?

- SOLUTION FOR ONE DAY:

- Daily is  $1/365$  of a year, so you get  $1/365$  of 2% interest  $2\%/365 = .00548\%$  per day

- Change that percent to a decimal  $.00548\% = .0000548$

- Use formula

$$A = P (1 + ) = \$1,000 (1 + .0000548)^1$$

- Balance after one day= **\$1,000.05**

# Example 4 SOLUTION continued

- SOLUTION FOR ONE YEAR:

- Daily is  $1/365$  of a year, so you get  $1/365$  of 2% interest       $2\%/365 = .00548\%$  per day

- Change that percent to a decimal       $.00548\% = .0000548$

- Use formula ( $t = 365$  since there are 365 days in one year)

$$A = P (1 + ) = \$1,000 (1 + .0000548)^{365}$$

- Balance after one year= **\$1,020.20**



# Example 5 – account balance

- Jennifer has a bank account that compounds interest daily at a rate of 1.2%. On July 11, the principal is \$1,234.98. She withdraws \$200 for a car repair. She deposits a \$34 check from her health insurance company. On July 12, her \$345.77 paycheck is directly deposited to her account. What is her balance at the end of the day on July 12?

- SOLUTION:

○ Balance	\$1,234.98	
○ Withdrawal for car repair	-\$200.00	
○ Deposit from insurance company	+\$34.00	
○ Deposit Paycheck	<u>+345.77</u>	
○ Balance before interest is added	\$1,414.75	
○ Calculate interest and get new balance	$1,414.75(1 + .000033)^1 =$	<u><b>\$1,414.80</b></u>

- WORK:  $1.2\% / 365 \text{ days in a year} = .0033\% = .000033$  as a decimal for one day from 7/11 to 7/12

# Assignment: pg 93 # 2, 5, 7, 10, 12, 13

○ #2

Jerome deposits \$3,700 in a certificate of deposit that pays 1.8% interest, compounded annually. How much interest does Jerome earn in one year?

○ #5 Kevin has  $x$  dollars in an account that pays 2.2% interest, compounded quarterly. Express his balance after one quarter in an algebraic formula.

# Assignment: pg 93 # 2, 5, 7, 10, 12, 13 continued

○ #7

Liam deposits \$3,500 in a saving account that pays 0.8% interest, compounded quarterly. In a-i, round to the nearest cent.

Find the first quarter's interest.

Find the first quarter's ending balance.

Find the second quarter's interest.

Find the second quarter's ending balance.

Find the third quarter's interest.

Find the third quarter's ending balance.

Find the fourth quarter's interest.

What is the balance at the end of one year?

How much interest does the account earn in the first year?

# Assignment: pg 93 # 2, 5, 7, 10, 12, 13 continued

## ○ #10

Jacob opens a savings account in a non-leap year on August 10 with a \$4,550 deposit. The account pays 1.1% interest, compounded daily. On August 11 he deposits \$300, and on August 12 he withdraws \$900. Find the missing amounts in the table. Round to the nearest cent.

Date	Aug. 10	Aug. 11	Aug. 12
Opening balance	a.	f.	k.
Deposit	b.	g.	-----
Withdrawal	-----	-----	l.
Principal used to compute interest	c.	h.	m.
Day's interest rounded to nearest cent	d.	i.	n.
Ending balance	e.	j.	p.

# Assignment: pg 93 # 2, 5, 7, 10, 12, 13 continued

## ○ #12

On May 29, Rocky had an opening balance of  $x$  dollars in an account that pays 1.3% interest, compounded daily. He deposits  $y$  dollars. Express his ending balance on May 30 algebraically.

## #13

Linda has  $d$  dollars in an account that pays 1.4% interest, compounded weekly. She withdraws  $w$  dollars. Express her first week's interest algebraically.