Investment Extension for Tim & Tom Name Key 2015-16

Algebra 2

Compounding Interest when Making Deposits:

$$A = P\left[\frac{(1+r)^t - 1}{r}\right](1+r)$$

P=the value at the end, r=interest rate as a decimal, t=number of periods, P=deposit amount

Compounding Interest when **NOT** Making Deposits:

$$A = P(1+r)^t$$

S=value at the end, i=interest rate as a decimal, n=number of periods, P=principal invested

Use the following scenario to answer question #1-4:

Suppose you deposit money into a savings program that earns 7% annually.

1. If you deposit $500 every year for 15 years, how much money will you have after 15 years?

$A = 500\left[\frac{(1+0.07)^{15}-1}{0.07}\right](1+0.07) = \$13,444.03$

2. Suppose you leave the money in the account for another 15 years after you stop making deposits. How much money would you have after the 30 total years of investing?

$A = 13,444.03(1+0.07)^{15} = \$37,092.50$

3. How much longer would you have to keep the money in the account to have over $50,000 in the account?

$50,000 = 37,092.50(1.07)^x$

4-5 more years

4. Suppose you continued to deposit $500 every year for 30 years. How much more money would you have if you made deposits the entire time than if you stopped after 15 years and let the money ride?

$A = 500\left[\frac{(1.07)^{30}-1}{0.07}\right](1.07)$ ← answer to #2

$= \$50,536.52$

How much more $= 50,536.52 - 37,092.50$

$= \$13,444.02$

Use this scenario for question #5-9: Suppose you and your friend both start working at the same time. You are both age 22 when you start working. You smartly use what you learned from the Tim and Tom Activity and invest immediately. You invest $4000 per year for the first five years and then decide to let your money ride for the last 25 years of your career. Unfortunately, your friend never heard the story of Tim and Tom. Consequently, they fail to understand the importance of investing early in life. Your friend waits fifteen years before investing. After the fifteenth year of work your friend decides to begin to invest $5000 per year for the last 15 years of their career. Suppose you both invest at 10% annually.

5. Complete the table to represent the investment scenario.

Year	Age	Your Deposits	Your Balance	Friend's Deposits	Friend's Balance
1	22	4,000	4,400	0	0
2		4,000	9,240	0	0
3		↓	14,564	↓	↓
4		↓	20,420.40	↓	↓
5		4,000	26,862.44	↓	↓
6		0	29,548.68	↓	↓
7		0	32,503.55	↓	↓
8		↓	35,753.91	↓	↓
9		↓	39,329.30	↓	↓
10		↓	43,262.23	↓	↓
11		↓	.	↓	↓
12		↓	.	↓	↓
13		↓	.	↓	↓
14		↓	↓	↓	↓
15		↓	↓	0	0
16		↓	↓	5,000	5,500
17		↓	↓	5,000	11,550
18		↓	↓	↓	18,205
19		↓	↓	↓	25,505.50
20		↓	↓	↓	33,578.05
21		↓	↓	↓	.
22		↓	↓	↓	.
23		↓	↓	↓	.
24		↓	↓	↓	↓
25		↓	↓	↓	↓
26		↓	↓	↓	↓
27		↓	↓	↓	↓
28		↓	↓	↓	↓
29	↓	↓	↓	↓	↓
30	51	0	$291,046.64	5,000	$174,748.65

6. How much total money did you deposit?

5 · 4,000

= $20,000

$A = 4000\left[\frac{(1.1)^5-1}{0.1}\right](1.1)$

= $26,862.44

$A = 26{,}862.44(1.1)^{25}$

= $291,046.64

$A = 5{,}000\left[\frac{(1.1)^{15}-1}{0.1}\right](1.1)$

= $174,748.65

7. How much total money did your friend deposit?

$15 \cdot 5{,}000$

$= \$75{,}000$

8. Who will have more money at retirement? Why?

You will have $116,297.99 more. You invested earlier and capitalized on the most important factor in investing (time).

9. What if you only invested for 1 year and then let your money ride for 29 years? Would you have more money than your friend at retirement? Explain.

$A = 4{,}000(1.1)^{30}$

$= \$69{,}797.61$

* your friend would have more $ ($174,748.65).

For question #10-12: What plan would be better? After, determine the amount of money deposited for each plan. Also, what does each problem teach you about investing?

10. Over a period of 30 years:

a.) Depositing $2,000 for twelve years and letting it ride out in an account that gains 8% annually.

b.) Depositing $2,000 for ten years and letting it ride out in an account that gains 10% annually.

a) $A = 2{,}000\left[\frac{(1.08)^{12}-1}{0.08}\right](1.08)$

$= 40{,}990.59$

$A = 40{,}990.59(1.08)^{18}$

$= \$163{,}799.17$

b) $A = 2{,}000\left[\frac{(1.1)^{10}-1}{0.10}\right](1.1)$

$= \$35{,}062.33$

$A = 35{,}062.33(1.1)^{20}$

$= \$235{,}881.82$

Which plan is better? b.

Amount of money deposited into plan a.) $2{,}000 \cdot 12 = \$24{,}000$

Amount of money deposited into plan b.) $2{,}000 \cdot 10 = \$20{,}000$

What does this teach you about investing?

Invest wisely to maximize your return %.

11. Over a period of 40 years:

a.) Depositing $10,000 for the first thirty years and letting it ride in an account that gains 9% annually.

b.) Depositing $8,000 for all forty years in an account that gains 9% annually.

a) $A = 10{,}000\left[\frac{(1.09)^{30}-1}{0.09}\right](1.09)$

$= 1{,}485{,}752.17$

$A = 1{,}485{,}752.17(1.09)^{10}$

$= 3{,}517{,}315.72$

b) $A = 8{,}000\left[\frac{(1.09)^{40}-1}{0.09}\right](1.09)$

$= \$2{,}946{,}334.92$

Which plan is better? a.

Amount of money deposited into plan a.) $10{,}000 \cdot 30 = \$300{,}000$

Amount of money deposited into plan b.) $8{,}000 \cdot 40 = \$320{,}000$

What does this teach you about investing?

Front load your investment.

12. Over a period of 50 years:

a.) Depositing $100 for all 50 years in an account that gains 10% annually.

b.) Depositing $1,000 for the last ten years at 10% annually.

a.) $A = 100\left[\frac{(1.1)^{50}-1}{0.10}\right](1.1)$

$= \$128{,}029.94$

b.) $A = 1{,}000\left[\frac{(1.1)^{10}-1}{0.10}\right](1.1)$

$= \$17{,}531.17$

Which plan is better? a.

Amount of money deposited into plan a.) $100 \cdot 50 = \$5{,}000$

Amount of money deposited into plan b.) $1{,}000 \cdot 10 = \$10{,}000$

What does this teach you about investing?

Invest early!