Interpreting Complicated Expressions—Bank Statements and Savings Accounts

Warm-Up

The bank sent Sarah a new credit card with an interest rate of 15%. Sarah decides to purchase a new pair of boots with her credit card. The boots cost $156. How much interest will Sarah pay for the pair of boots?

1. What is the problem asking us to calculate?
2. What is the percent represented as a decimal?
3. What is the interest payment on the boots?

1. What is the problem asking us to calculate?
   - In this problem, we are asked to calculate the interest on a credit card purchase.
   - The purchase is $156.
   - To calculate the interest payment, we need to calculate 15% of that price.

2. What is the percent represented as a decimal?
   - To convert a percent to a decimal, we need to divide the percent by 100, because each percent is out of 100.
   - We could also move the decimal place two places to the left.
   - 15% = 0.15

3. What is the interest payment on the boots?
   - We need to multiply that percent as a decimal by the dollar amount $156.

     $156(0.15) = $23.40
   - The interest Sarah will pay for the boots is $23.40.

Instruction

Introduction

Algebraic expressions can be used to describe financial situations. Using an algebraic expression can make it easier to analyze financial offers. This, in turn, allows you to make better-informed financial decisions.

One important decision people make is choosing a bank to store their money, and choosing what kind of accounts to use.

Key Concepts

- The most common type of bank account is a **checking account**. A checking account is like a wallet from which cash is accessed via debit card, ATM, or personal check.
- A **debit card** is a card issued by the bank that allows you to access your account funds for purchases. Unlike credit cards, debit cards are linked directly to your own funds. Credit cards go through a third party, the credit card company.

Key Concepts, *continued*

- An **ATM (automated teller machine)** is a device that allows people to access funds in their accounts without having to go into the bank. Most ATMs allow you to check balances, transfer money between accounts, and withdraw cash.
- Most checking accounts allow ATM access using a debit card, but some still have specialized ATM cards.

Key Concepts, *continued*

- A **personal check** is a voucher that tells the account holder's bank to make a payment of a designated amount to a designated payee from the linked account. Personal checks typically come in sets called checkbooks. Not all businesses accept personal checks.

Key Concepts, *continued*

- Checking accounts usually do not accrue interest. Some things to take into consideration when choosing a checking account include:
  - **Minimum balance** requirement: Some accounts require a minimum balance, or the bank charges a fee.
  - **Direct deposit**: This allows payments to be made directly from one account to another without the need of a check or other intermediate step; most employers prefer to pay their employees via direct deposit.

Key Concepts, *continued*

- **Online banking**: This allows customers to access most banking options via the Internet, at any time. Some features may still require in-person contact; many online banking apps do not allow remote check deposit, for example.
- **Overdraft** protection/fees: Overdraft is when the account balance goes negative; most banks charge sizeable fees when this occurs.

Key Concepts, *continued*

- **Bounced check fees**: If the funds in a checking count are insufficient to cover a written check, the payee will be unable to deposit or cash the check; most banks charge a fee when a check you write bounces.
- **Maintenance fee**: Some accounts may charge an amount to keep the account open; these fees sometimes have conditions under which they may be applied.

Key Concepts, *continued*

- The second most common type of bank account is a savings account. A **savings account** is similar to a checking account, except it accrues interest and there may be a cap on the number of withdrawals you can make in a month. Most people do not make withdrawals directly from their savings accounts, but rather move funds to their checking accounts first.
- Some things to take into consideration when choosing a savings account include the interest rate, minimum balance requirements, direct deposit availability, online banking access, and maintenance fees.

Key Concepts, *continued*

- Because savings accounts accrue interest, you can find the balance of an account using the compound interest formula, $A = P\left(1 + \frac{r}{n}\right)^{nt}$, so long as no additional withdrawals or deposits are made to the account. Recall that P is the principal, r is the annual interest rate, n is the number of times interest is compounded in a year, and t is years.

Key Concepts, *continued*

- Some other kinds of bank accounts include money markets, certificates of deposit (CDs), and retirement accounts. This lesson will not focus on these types of accounts.
- Once you have a bank account, your bank will send you monthly statements. A **bank statement** summarizes activity in your account for a period of time, usually a month.

Common Errors/Misconceptions

- students sometimes forget to change the percent to a decimal
- students sometimes forget to convert months to years when calculating compound interest
- students sometimes substitute the wrong information into the compound interest formula

Guided Practice

Example 1

The following tables represent Jessica's bank statement. On February 28th, Jessica has $2,000 in her bank account before the deposit is made. How much money should Jessica have in her bank account if all of the following transactions have gone through?

Check #	Date Paid	Payable to	Amount
130	3/1	Big Lake Apartments	$800
131	3/1	Big O Auto Sales	$220
132	3/3	So Flo Car Insurance	$150

Guided Practice: Example 1, *continued*

Deposits	
Date	**Amount**
2/28	$2,550

ATM withdrawals		
Date	**Location**	**Amount**
3/10	Okeechobee FL	$40
3/15	West Palm Beach FL	$100

Guided Practice: Example 1, *continued*

2. Find the total value of all withdrawals.

Withdrawals consist of checks and ATM withdrawals.

Add the check amounts together:

800 + 220 + 150 = $1,170

Add the ATM withdrawal amounts together.

40 + 100 = $140

The total value of all withdrawals is 1,170 + 140 = $1,310.

Guided Practice: Example 1, *continued*

1. Find the total value of all deposits.

The balance on February 28 is $2,000. On the same day, she makes a deposit of $2,550. This gives a total of 2000 + 2550 = 4550.

The total value of all deposits is $4,550.

Guided Practice: Example 1, *continued*

3. Subtract the withdrawals from the deposits.

The total value of the deposits was $4,550. The total value of the withdrawals was $1,310. The difference is 4550 – 1310 = 3240.

Jessica should have $3,240 if all the transactions have gone through.

Guided Practice

Example 2

You take on a summer job to save money for a new car. You will need to choose a savings account to make the most of your money and earn interest. You are going to make an initial deposit of $1,000. You will leave the funds in the bank account for a year. You have two banking options:

- **Bank 1:** Offers 5% interest accruing annually
- **Bank 2:** Offers 3.5% interest accruing monthly

Which account would you select? Why would you select this bank account over the other option?

Guided Practice: Example 2, *continued*

1. Find an expression for the growth of the deposit in Bank 1.

The formula for calculating the value of a deposit that accrues compound interest is $A = P\left(1 + \frac{r}{n}\right)^{nt}$, where P is the principal, r is the interest rate, t is years, and n is the number of times the interest is compounded per year. The principal amount is \$1,000, and the annual interest rate is 5%. The interest is compounded yearly. This gives the formula $A = 1000(1 + 0.05)^t$.

Guided Practice: Example 2, *continued*

2. Find the value of the deposit after 1 year if you choose Bank 1.

Evaluate the expression for $t = 1$.

$A = 1000(1 + 0.05)^t$	Original expression
$A = 1000(1 + 0.05)^1$	Substitute 1 for t.
$A = 1000(1.05)$	Simplify.
$A = 1050$	Simplify.

If you invest in Bank 1, you would have $1,050 at the end of 1 year.

Guided Practice: Example 2, *continued*

3. Find an expression for the growth of the deposit in Bank 2.

The formula for calculating the value of a deposit that accrues compound interest is $A = P\left(1 + \frac{r}{n}\right)^{nt}$, where P is the principal, r is the interest rate, t is years, and n is the number of times the interest is compounded per year.

Guided Practice: Example 2, *continued*

The principal amount is $1,000, and the annual interest rate is 3.5%. The interest is compounded monthly. This gives the formula $A = 1000\left(1 + \frac{0.035}{12}\right)^{12t}$.

Guided Practice: Example 2, *continued*

4. Find the value of the deposit after 1 year if you choose Bank 2.

Evaluate the expression for $t = 1$.

$$A = 1000\left(1 + \frac{0.035}{12}\right)^{12t}$$ Original expression

$$A = 1000\left(1 + \frac{0.035}{12}\right)^{12(1)}$$ Substitute 1 for t.

Guided Practice: Example 2, *continued*

$$A = 1000\left(1 + \frac{0.035}{12}\right)^{12}$$ Simplify.

$$A \approx 1000(1 + 0.0029167)^{12}$$

$$A \approx 1000(1.0029167)^{12}$$

$$A \approx 1000(1.035567)$$

$$A \approx 1035.57$$ Simplify.

If you invest in Bank 1, you would have $1,035.57 at the end of 1 year.

Guided Practice: Example 2, *continued*

5. Determine the best option.

The best option for this scenario is Bank 1. The higher interest rate gets you a higher return on your investment.

Guided Practice

Example 3

Stan is trying to choose the best savings account for his business. Stan has $10,000 that he needs to invest for the next two years in a savings account for emergency situations. Stan has three options to choose from:

- **Bank 1:** Offers 2.5% interest accruing quarterly
- **Bank 2:** Offers 3% interest accruing semi-annually
- **Bank 3:** Offers 2% interest accruing monthly

Which is the best option for Stan if he wants to make the most of his funds? If you were a bank, which of the three offers would be best for you? Why would you want to offer this interest rate? Justify your answer.

Guided Practice: Example 3, *continued*

1. **Find an expression for the growth of the deposit in Bank 1.**

   The formula for calculating the value of a deposit that accrues compound interest is $A = P\left(1 + \frac{r}{n}\right)^{nt}$, where P is the principal, r is the interest rate, t is years, and n is the number of times the interest is compounded per year.

Guided Practice: Example 3, *continued*

The principal amount is $10,000, and the annual interest rate is 2.5%. The interest is compounded quarterly. This gives the formula $A = 10,000\left(1+\frac{0.025}{4}\right)^{4t}$.

Guided Practice: Example 3, *continued*

2. Find the value of the deposit after 2 years if Stan chooses Bank 1.

Evaluate the expression for $t = 2$.

$$A = 10,000\left(1+\frac{0.025}{4}\right)^{4t}$$ Original expression

$$A = 10,000\left(1+\frac{0.025}{4}\right)^{4(2)}$$ Substitute 2 for t.

Guided Practice: Example 3, *continued*

$$A = 10,000\left(1 + \frac{0.025}{4}\right)^{8}$$ Simplify.

$A = 10,000(1 + 0.00625)^{8}$

$A = 10,000(1.00625)^{8}$

$A \approx 10,000(1.051108)$ Simplify.

$A \approx 10,511.08$ Simplify.

If Stan chooses Bank 1, he will have $10,511.08 at the end of 2 years.

Guided Practice: Example 3, *continued*

3. Find an expression for the growth of the deposit in Bank 2.

The formula for calculating the value of a deposit that accrues compound interest is $A = P\left(1 + \frac{r}{n}\right)^{nt}$, where P is the principal, r is the interest rate, t is years, and n is the number of times the interest is compounded per year.

Guided Practice: Example 3, *continued*

The principal amount is \$10,000, and the annual interest rate is 3%. The interest is compounded semi-annually. This gives the formula $A = 10,000\left(1+\frac{0.03}{2}\right)^{2t}$.

Guided Practice: Example 3, *continued*

4. Find the value of the deposit after 2 years if Stan chooses Bank 2.

Evaluate the expression for $t = 2$.

$$A = 10,000\left(1+\frac{0.03}{2}\right)^{2t}$$ Original expression

$$A = 10,000\left(1+\frac{0.03}{2}\right)^{2(2)}$$ Substitute 2 for t.

Guided Practice: Example 3, *continued*

$$A = 10,000\left(1 + \frac{0.03}{2}\right)^4$$ Simplify.

$A = 10,000(1 + 0.015)^4$

$A = 10,000(1.015)^4$

$A \approx 10,000(1.06136)$

$A \approx 10,613.63$ Simplify.

If Stan chooses Bank 2, he will have $10,613.63 at the end of 2 years.

Guided Practice: Example 3, *continued*

5. Find an expression for the growth of the deposit in Bank 3.

The formula for calculating the value of a deposit that accrues compound interest is $A = P\left(1 + \frac{r}{n}\right)^{nt}$, where P is the principal, r is the interest rate, t is years, and n is the number of times the interest is compounded per year.

Guided Practice: Example 3, *continued*

The principal amount is \$10,000, and the annual interest rate is 2%. The interest is compounded monthly. This gives the formula $A = 10,000\left(1+\frac{0.02}{12}\right)^{12t}$.

Guided Practice: Example 3, *continued*

6. Find the value of the deposit after 2 years if Stan chooses Bank 3.

Evaluate the expression for $t = 2$.

$$A = 10,000\left(1+\frac{0.02}{12}\right)^{12t}$$ Original expression

$$A = 10,000\left(1+\frac{0.02}{12}\right)^{12(2)}$$ Substitute 2 for t.

Guided Practice: Example 3, *continued*

$$A = 10,000\left(1 + \frac{0.02}{12}\right)^{24}$$ Simplify.

$$A = 10,000(1 + 0.00166667)^{24}$$

$$A = 10,000(1.00166667)^{24}$$

$$A \approx 10,000(1.040776)$$

$$A \approx 10,407.76$$ Simplify.

If Stan chooses Bank 3, he will have $10,407.76 at the end of 2 years.

Guided Practice: Example 3, *continued*

7. Determine the best option for Stan.

Recall that at the end of 2 years Stan would have the following balances at each bank:

- Bank 1: $10,511.08
- Bank 2: $10,613.63
- Bank 3: $10,407.76

The best option for Stan is Bank 2.

Guided Practice: Example 3, *continued*

8. Determine which interest rate option would most benefit a bank.

The bank is the one paying the interest, so the best option for a bank is the option that pays out the least interest to Stan. In this case, this is the offer from Bank 3.

Guided Practice

Example 4

Consider the following two bank account options.

- **Option 1:** Account accruing 0.3% APR, compounded monthly; $10 annual account maintenance fee
- **Option 2:** Account accruing no interest; no maintenance fee

Olivia intends to deposit $3,000 into a bank account. Suppose she makes no additional deposits or withdrawals. Which account would you recommend, and why? Would this recommendation change if Olivia deposited $5,000 instead?

Guided Practice: Example 4, *continued*

1. **Find an expression for the value of the deposit in Option 1.**

   The formula for calculating the value of a deposit that accrues compound interest is $A = P\left(1 + \frac{r}{n}\right)^{nt}$, where P is the principal, r is the interest rate, t is years, and n is the number of times the interest is compounded per year.

Guided Practice: Example 4, *continued*

In this case, $P = 3000$, $r = 0.003$, and $n = 12$. This gives the formula $A = 3000\left(1 + \frac{0.003}{12}\right)^{12t}$.

From this amount, the maintenance fee must be subtracted. Option 1 charges a $10 annual account maintenance fee. Subtract 10 from the expression.

This gives the formula $A = 3000\left(1 + \frac{0.003}{12}\right)^{12t} - 10$.

Guided Practice: Example 4, *continued*

2. Find the value of the deposit after 1 year under Option 1.

Evaluate the expression for $t = 1$.

$$A = 3000\left(1 + \frac{0.003}{12}\right)^{12t} \quad 10 \quad \text{Original expression}$$

$$A = 3000\left(1 + \frac{0.003}{12}\right)^{12(1)} \quad 10 \quad \text{Substitute 1 for } t.$$

Guided Practice: Example 4, *continued*

$$A = 3000\left(1+\frac{0.003}{12}\right)^{12(1)} \quad 10 \quad \text{Simplify.}$$

$$A = 3000(1 + 0.00025)^{12} - 10$$

$$A = 3000(1.00025)^{12} - 10$$

$$A \approx 3000(1.003004) - 10$$

$$A \approx 3009.01 - 10$$

$$A \approx 2999.01$$

If Olivia chooses Option 1, she should have $2,999.01 after 1 year.

Guided Practice: Example 4, *continued*

3. Find the value of the deposit after 1 year under Option 2.

Under Option 2, no interest accrues. Option 2 also charges no maintenance fees. So the account balance will stay at $3,000.

Guided Practice: Example 4, *continued*

4. Determine which option is better for the $3,000 deposit.

In Option 1, Olivia would lose money, whereas in Option 2 Olivia would not lose money. Option 2 is better for the $3,000 deposit.

Guided Practice: Example 4, *continued*

5. Determine which option is better for a $5,000 deposit.

Recall that for Option 1, the formula for the $3,000 deposit was $A = 3000\left(1+\frac{0.003}{12}\right)^{12t}$ 10. If the deposit is $5,000 instead, the formula will be

$$A = 5000\left(1+\frac{0.003}{12}\right)^{12t}$$ 10.

Guided Practice: Example 4, *continued*

Evaluating this at $t = 1$ gives $A \approx 5000(1.003004) - 10 = 5015.02 - 10 = \$5{,}005.02$. So, Olivia would make $5.02 under Option 1 with a $5,000 deposit. Meanwhile, under Option 2 the value of the $5,000 would stay at $5,000.

If the initial deposit is $5,000 instead of $3,000, Option 1 is better. In general, an account that accrues interest is better than one that does not so long as the interest amount is sufficient to cover any account fees. This generally requires larger deposits to accomplish.