Algebra 1R – Mr. Bo
Unit 5 – Day 1 Notes

Name:_____
Date:_____

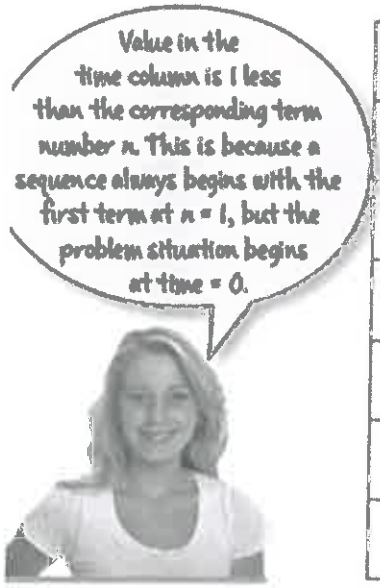
# Comparing Linear & Exponential Functions

## PROBLEM 1 Let's Build a Formula for Simple Interest

**Simple Interest:** Interest that is calculated using the original (principle) balance each term.

**Annual Percentage Rate (APR):** The interest rate used to calculate interest once per year. It is always written as a decimal when used in a calculation.

1. Suppose that Nico deposits $1000 into an account that earns 5% simple interest each year. Complete the table to show Nico's account balance after each year. Show your work. The first three rows have been completed for you.




| Term Number ($n$) | Time (years) | Interest Earned (dollars) | Account Balance (dollars) | |
|---|---|---|---|---|
| 1 | 0 | 0 | 1000 | |
| 2 | 1 | 1000(0.05) = 50 | 1000 + 1000(0.05) = 1050 | +50 |
| 3 | 2 | 1000(0.05) = 50 | 1050 + 1000(0.05) = 1100 | +50 |
| 4 | 3 | 1000(.05) = 50 | 1100 + 50 = 1150 | +50 |
| 5 | 4 | 1000(.05) = 50 | 1150 + 50 = 1200 | +50 |
| 6 | 5 | 1000(.05) = 50 | 1200 + 50 = 1250 | +50 |

2. Does the account balance form an Arithmetic or Geometric sequence? How do you know? Find the common difference or ratio.

Arithmetic. the balance goes up at a constant rate of $50 per year.

$d = 50$

## Writing and Solving Simple Interest Equations

**In a simple interest account, the interest you earn at the end of each year is a percent of the original principal. The pattern of the account balance year after year creates a arithmetic sequence because the same amount is added to each term to create the next term in the sequence. The sequence can be written as a function in terms of time: $P(t) = P_0 + (P_0 \cdot r)t$, where $t$ is time, $P(t)$ is the total balance after $t$ years, $P_0$ is the original principal, and $r$ is the interest rate written as a decimal.**

1. An account earns 3% simple interest on a deposit of $500.

$P_0 = 500$
$r = .03$

a. Write a function to represent this simple interest situation.

$P(t) = 500 + 500(.03)t$
$P(t) = 500 + 15t$

b. How much money is in the account after 8 years? Show how you got your answer.

$P(8) = 500 + 15(8)$
$= \$620.00$

c. How many years it will take for the account to have $725 in it? Show how you got your answer.

$P(t) = 500 + 15t$
$725 = 500 + 15t$
$-500 \quad -500$
$225 = 15t$

output

$t = 15$ years

2. Perry deposits $175 into a simple interest account. The interest rate for the account is 4.25%.

a. Complete the table for the simple interest.

$P_0 = 175$
$r = 0.0425$

$P_0 \cdot r = 175(.0425)$
$= 7.44$

| | Time | Simple Interest Balance |
|---|---|---|
| Units | years | dollars |
| Expression | $t$ | $175 + 7.44t$ |
| | 0 | 175 |
| | 1 | 182.44 |
| | 2 | 189.88 |
| | 3 | 197.32 |
| | 10 | 249.40 |

b. How much money will Perry have in her account after 18 years?

$P(t) = 175 + 7.44(18) = \$308.92$

## PROBLEM 2 Now Let's Build a Formula for Compound Interest

**Compound Interest:** Interest that is calculated using the balance of the previous term.

1. Suppose that Raul deposits $1000 into an account that earns 5% compound interest each year. Complete the table to show Raul's account balance after each year. Show your work. The first three rows have been completed for you.

| Term Number ($n$) | Time (years) | Interest Earned (dollars) | Account Balance (dollars) |
|---|---|---|---|
| 1 | 0 | 0 | 1000 |
| 2 | 1 | 1000(0.05) = $50 | 1000 + 1000(0.05) = 1050 |
| 3 | 2 | 1050(0.05) = 52.5 | 1050 + 1050(0.05) = 1102.5 |
| 4 | 3 | 1102.5(.05) = 55.125 | 1102.5 + 55.125 = 1157.625 |
| 5 | 4 | 1157.625(.05) = 57.88125 | 1157.625 + 57.88125 = 1215.50625 |
| 6 | 5 | 1215.50625(.05) = 60.7753125 | 1215.50625 + 60.7753125 = 1276.281563 |

2. Is the account balance an Arithmetic or Geometric sequence? How do you know? Find the common difference or ratio.

Geometric. there is a common ratio between consecutive terms.

$\frac{1050}{1000} = 1.05$

$\frac{1102.5}{1050} = 1.05$

$\frac{1157.625}{1102.5} = 1.05$

$r = 1.05$

## Writing and Solving Compound Interest Equations

In a compound interest account, the interest you earn at the end of each year is a percent of the account balance at the beginning of the year. The pattern of the account balance year after year creates a geometric sequence because the same amount is multiplied by each term in the sequence to produce the next. The sequence can be written as a function in terms of time: $P(t) = P_0 \cdot (1 + r)^t$, where $t$ is time, $P(t)$ is the total balance after $t$ years, $P_0$ is the initial deposit amount, and $r$ is the interest rate each year, written as a decimal.

1. An account earns 3% compound interest on a deposit of \$500. $P_0 = 500$, $r = .03$

a. Write a function to represent this ~~simple~~ compound interest situation.

$P(t) = 500(1+.03)^t$

$P(t) = 500(1.03)^t$

b. How much money is in the account after 8 years? Show how you got your answer.

$P(8) = 500(1.03)^8$

$= \$633.39$

c. How many years it will take for the account to have \$725 in it? Show how you got your answer.

$P(t) = 500(1.03)^t$

$\frac{725}{500} = \frac{500(1.03)^t}{500}$

$1.45 = (1.03)^t$ ← "guess + check"

$12 < t < 13$

$t \approx 12.5$ years.

2. Suppose that your family deposited \$10,000 in an interest bearing account for your college fund that earns 4% simple interest each year and a friend's family deposited \$10,000 in an interest bearing account for their child's college fund that earns 4% compound interest each year.

Use the simple and compound interest formulas to complete the table and round the values in the table to the nearest cent.

$P_0 = 10{,}000$

$r = .04$

$P_0 \cdot r = 400$

$1 + r = 1.04$

| | Time | Simple Interest Balance | Compound Interest Balance |
|---|---|---|---|
| Units | years | dollars | dollars |
| Expression | $t$ | $10000 + 400t$ | $10000(1.04)^t$ |
| | 0 | 10,000 | 10,000 |
| | 1 | 10,400 | 10,400 |
| | 2 | 10,800 | 10,816 |
| | 3 | 11,200 | 11,248.64 |
| | 10 | 14,000 | 14,802.44 |

How much money will you and your friend have in the college funds when you each turn 18 years old?

$10{,}000 + 400(18)$

$= \$17{,}200$

$10{,}000(1.04)^{18}$

$= \$20{,}258.17$