Key

## *8.3: Compound Interest*

- I can calculate compound interest (with the formula and with a graphing calculator)
- I understand "e" and can calculate interest that is compounded continuously

**Vocabulary**

**Simple Interest** – The amount of money you earn on an investment (not added back into your investment)

**Compound Interest** – The interest is added back into your investment and that larger amount earns interest (The interest earns interest and grows faster).

**Compounding** – how often the interest is added back into the original investment

**Compound Interest Formula**

$$A = P\left(1+\frac{r}{n}\right)^{(nt)}$$

A = Ending *Amount* P = *Principal (starting amount)* r = *rate (in decimal form)*
n = *number of times interest is compounded per year* t = *time (in years)*

Fill in the table for the value of n

| Annually | Semiannually | Trimesters | Quarterly | Monthly | Daily |
|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 12 | 365 |

EX 1: You decide to invest $1250 in a savings account that earns .75% interest.

a. How much money will you have in 3 years if the interest is compounded quarterly? ↳ n = 4

$A = 1250\left(1+\frac{.0075}{4}\right)^{4\cdot 3}$

$A = \$1278.42$

b. How much money will you have in 3 years if the interest is compounded daily?

$A = 1250\left(1+\frac{.0075}{365}\right)^{365\cdot 3} = \$1278.44$

**Quick Check**

How much money will you have in 7 years if you invest $5000 in an account earning 6.5% interest compounded monthly?

$A = 5000\left(1+\frac{.065}{12}\right)^{12\cdot 7} = \$7871.20$

**Ex 2:** You invest \$1 for 1 year in an account earning 100% interest. Use the table below and calculate how much you will have if the interest is compounded the given number of times (n) per year.
Round to 5 decimal places.

| $n$ | 10 | 100 | 1000 | 10,000 | 100,000 | 1,000,000 |
|---|---|---|---|---|---|---|
| $1\cdot\left(1+\frac{1}{n}\right)^n$ | $1\cdot\left(1+\frac{1}{10}\right)^{10}=$ 2.59374 | $1\left(1+\frac{1}{100}\right)^{100}$ 2.70481 | $1\left(1+\frac{1}{1000}\right)^{1000}$ 2.71692 | $\left(1+\frac{1}{10000}\right)^{10{,}000}$ 2.71814 | $(1.00001)^{10^5}$ 2.71827 | $(1.000001)^{10^6}$ 2.71828 |

The more often the interest is compounded, the amount approaches ≈2.72 which is the number $e$.

$e$ Is named after Leonard Euler and is used in situations where interest is compounded continuously

**Continuously Compounded Interest:** $A = P \cdot e^{rt}$

* e is a constant
* e is irrational

A = Ending amount P = Principal e = 2.72 r = rate (as a decimal) t = time (in yrs)

**Ex 3a:** You invest \$850 into an account earning 3.5% interest compounded continuously. How much money will you have in 18 months?

$A = 850 \cdot e^{(.035)(1.5)} = \$895.82$

**Ex 3b:** How long will it take to earn \$1250? (Use your graphing calculator).

$y_1 = 850 \cdot e^{.035x}$
$y_2 = 1250$

$x \approx 11$ years

**Do and Discuss**

You are going to invest \$500. Which investment option will result in more money for you? How much more?

A: 5 years at 2.5% compounded *continuously*

$A = 500 \cdot e^{(.025)(5)} = \$566.57$

B: 4 years at 3% compounded *quarterly*. (Careful, what formula do you need?)

$A = 500\left(1+\frac{.03}{4}\right)^{4\cdot4} = \$563.50$

* 5 year investment \$3.07 more