10.6. Advanced Algebra
Compound Interest

DATE: 12/16

Target 4B. Model and evaluate application involving exponential growth or decay.

Objective: Calculate final account balances using formulas for compound and continuous interest.

Compound Interest Formula	
$A = P\left(1 + \frac{r}{n}\right)^{nt}$	A = Final Amount P = Principle (starting balance) r = Interest Rate (as a decimal) n = number of compounds per year t = time (in years)

Common Compounds:

- Annually: 1 per year
- Semi-annually: 2 per year
- Quarterly: 4 per year
- Monthly: 12 per year
- Weekly: 52 per year
- Daily: 365 per year

Examples:

1. If you take a car loan for $25000 with an interest rate of 6.5% compounded quarterly, no payments required for the first five years, what will your balance be at the end of those five years?

$A = ?$ $P = 25{,}000$ $r = 0.065$ $n = 4$ $t = 5$

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

$$= 25{,}000\left(1 + \frac{0.065}{4}\right)^{4 \cdot 5}$$

$$\approx \$34{,}510.49$$

I will use Nspire to calculate all values

? 0.065 52

2. What principle will amount to $3000 if invested at 6.5% compounded weekly for 4 years?

$A = 3{,}000$ $P = ?$ $r = 0.065$ $n = 52$ $t = 4$

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

$$3000 = P\left(1 + \frac{0.065}{52}\right)^{52 \cdot 4}$$

$$\frac{3000}{1.2967} = P \cdot \frac{1.2967}{1.2967} \approx$$

$$P = \frac{3000}{1.2967} = \$2313.57$$

0.03

3. If $4000 is invested in an account paying 3% interest compounded monthly, what is the balance after 7 years? 12

$A = ?$ $P = 4{,}000$ $r = 0.03$ $n = 12$ $t = 7$

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

$$= 4{,}000\left(1 + \frac{0.03}{12}\right)^{12 \cdot 7} \approx \$4933.42$$

4. If $4000 is invested in an account paying 3% (0.03) interest compounded daily (365), what is the balance after 7 years?

$A = ?$ $P = 4000$ $r = 0.03$ $n = 365$ $t = 7$

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

$$= 4000\left(1 + \frac{0.03}{365}\right)^{365 \cdot 7}$$

$$\approx \$4934.67$$

Interest Compounded Continuously

Interest Compounded Continuously	
$A = Pe^{rt}$	A = Final Amount P = Principle (starting balance) e = 2.71828183... r = Interest Rate (as a decimal) t = time (in years)

5. If $4000 is invested in an account paying 3% compounded continuously, what is the balance after 7 years?

$A = ?$ $P = 4000$ $r = 0.03$ $t = 7$

Use formula when interest is compounded continuously → $A = Pe^{rt} = 4000e^{0.03 \cdot 7} \approx \$4934.71$

6. If you invest $6.16 in an account paying 12% interest compounded continuously for 100

6. If you invest \$6.16 in an account paying 12% interest compounded continuously for 100 years, and that is all you have to leave your children as an inheritance, what will the final balance be that they receive?—Before you do the math, how would you feel about that being your inheritance?

$A = ?$ $P = \$6.16$ $r = 0.12$ $t = 100$

$A = 6.16e^{0.12 \cdot 100} \approx \$1,002,569.52$ ← WOW

Time and interest, baby!
(compounded)