

$P$

$t$

$r$

- Simple Interest** Suppose Liz borrows \$1000 and agrees to pay it back in 3 years with 5% simple interest added each year.

- How much **interest** will she pay? In addition to your answer, write down your computation, including the decimal values you would plug into a calculator.

Recall  $I = (Pr)t = (1000)(0.05)(3) = \$150$

↑  
\$ added in 1 year

↑  
5% as decimal

computation → answer

- How much will she owe **in total** at the end of three years? Write down the computation and the answer.

Recall  $A = P + I = 1000 + 150 = \$1150$

↑  
computation

↑  
answer

- Annual Interest Rate (APR)** Annual interest rates are pro-rated by time.

- Definition: An APR of  $r\%$  paid  $n$  times year means

$n$  times each year  $\frac{r\%}{n}$  is added.

- So an APR of 5% paid quarterly means

quarterly means 4x per year.  $\frac{5\%}{4} = \frac{0.05}{4} = 0.0125$

So 4 times each year 1.25% interest is added.

- Determine  $n$  for each word below.

word:	annually	semi-annually	quarterly	monthly	weekly	daily
$n$ times per year	1	2	4	12	52	365

rough approximations

**Compound Interest**

- What is **compound** interest and how is it different from **Simple** Interest?

Compound interest is a percent of  $P + I$ , where  $I$  is whatever interest has accumulated over time.

Simple interest is a percent of  $P$  only

5. Suppose \$1000 will be invested in an account that accrues **compound** interest at an APR of 3% compounded monthly. We will set up a spreadsheet to model this account assuming no other deposits or withdrawals.

- (a) Open a new spreadsheet and type column headers in cells A1, B1, C1, D1, E1, F1. (See below.)
- (b) In row 2, type the variables for reference. (hint: A2 is  $r$ .)
- (c) In row 3, enter the **start** values for this specific problem. Assume time  $t$  is in years.
- (d) In rows 4 and 5, enter the values/formulas and the end of 1 month and 2 months.
- (e) Use the pull down feature to determine the values in the account at the end of 2 years.

Note to Instructors:  
Explaining this part - especially why F3 not C3 is the most important part.

	A	B	C	D	E	F
1	Interest Rate	Times per Year	Principal	Time Elapsed	Interest	Total
2	$r$	$n$	$P$	$t$	$I$	$A$
3	$= 0.03$	$= 12$	$= 1000$	$= 0$	$= 0$	$= 1000$
4	$= 0.03$	$= 12$	$= 1000$	$= D3 + \frac{1}{B4}$	$=$	$= F3 + E4$
5	$= 0.03$	$= 12$	$= 1000$	$= D4 + \frac{1}{B5}$	$=$	$= F4 + E5$

start →

$$= (F3) * (A^4 / B4)$$

$$\rightarrow = (F4) (A^5 / B5)$$

6. Write out the month-by-month computations and look for a pattern.

1 month:  $A = P + P(\frac{r}{n}) = P(1 + \frac{r}{n})$

2 months:  $A = P(1 + \frac{r}{n}) + P(1 + \frac{r}{n})(\frac{r}{n}) = P(1 + \frac{r}{n})(1 + \frac{r}{n}) = P(1 + \frac{r}{n})^2$

3 months:  $A = P(1 + \frac{r}{n})^2 + P(1 + \frac{r}{n})^2(\frac{r}{n}) = P(1 + \frac{r}{n})^2(1 + \frac{r}{n}) = P(1 + \frac{r}{n})^3$

K months:  $A = P(1 + \frac{r}{n})^k$

Wait! time  $t$  is in YEARS!

$A = P(1 + \frac{r}{n})^{tn}$

7. With a principal of  $P$  dollars earning  $r\%$  interest compounded  $n$  times per year for  $t$  years will result in a total of  $A$  dollars where

$$A = P(1 + \frac{r}{n})^{tn}$$

interest rate	times per year	principal	time elapsed	interest	total	COLOR CODING KEY			
r	n	P	t (years)	I	A		These values do not change over time.		
							These values will change each month		
3.00%	12	\$1,000.00	0	0	\$1,000.00				
3.00%	12	\$1,000.00	0.0833333333	\$2.50	\$1,002.50				
3.00%	12	\$1,000.00	0.1666666667	\$2.51	\$1,005.01	"=D3+1/B3"	"=F3*(A4/B4)"	"=F3+E4"	cell CONTENTS
3.00%	12	\$1,000.00	0.25	\$2.51	\$1,007.52				
3.00%	12	\$1,000.00	0.3333333333	\$2.52	\$1,010.04				
3.00%	12	\$1,000.00	0.4166666667	\$2.53	\$1,012.56				
3.00%	12	\$1,000.00	0.5	\$2.53	\$1,015.09				
3.00%	12	\$1,000.00	0.5833333333	\$2.54	\$1,017.63				
3.00%	12	\$1,000.00	0.6666666667	\$2.54	\$1,020.18				
3.00%	12	\$1,000.00	0.75	\$2.55	\$1,022.73				
3.00%	12	\$1,000.00	0.8333333333	\$2.56	\$1,025.28				
3.00%	12	\$1,000.00	0.9166666667	\$2.56	\$1,027.85				
3.00%	12	\$1,000.00	1	\$2.57	\$1,030.42				
3.00%	12	\$1,000.00	1.0833333333	\$2.58	\$1,032.99				
3.00%	12	\$1,000.00	1.1666666667	\$2.58	\$1,035.57				
3.00%	12	\$1,000.00	1.25	\$2.59	\$1,038.16				
3.00%	12	\$1,000.00	1.3333333333	\$2.60	\$1,040.76				
3.00%	12	\$1,000.00	1.4166666667	\$2.60	\$1,043.36				
3.00%	12	\$1,000.00	1.5	\$2.61	\$1,045.97				
3.00%	12	\$1,000.00	1.5833333333	\$2.61	\$1,048.58				
3.00%	12	\$1,000.00	1.6666666667	\$2.62	\$1,051.21				
3.00%	12	\$1,000.00	1.75	\$2.63	\$1,053.83				
3.00%	12	\$1,000.00	1.8333333333	\$2.63	\$1,056.47				
3.00%	12	\$1,000.00	1.9166666667	\$2.64	\$1,059.11				
3.00%	12	\$1,000.00	2	\$2.65	\$1,061.76				