Compound Interest Formula
Interest that is applied to the balance of an account at the end of a compounding period.

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

- \( A = \text{amount} \): the amount in the account after interest is added
- \( P = \text{principal} \): the amount in the account before interest is added
- \( r = \text{interest rate} \): the interest rate also known as APR in decimal form
- \( t = \text{time} \): the number of years
- \( n = \text{number of compoundings per year} \): number of times the interest is compounded
  - annually : \( n=1 \)
  - semiannually : \( n=2 \)
  - quarterly : \( n=4 \)
  - monthly : \( n=12 \)
  - weekly : \( n=52 \)
  - daily : \( n=365 \)

1. In the standard notation given above, what should \( n \) be if the interest is compounded every minute.

2. If I deposit \$800 in a savings account at 6% interest compounded annually, and if I make no withdrawals or deposits for 4 years, how much will I have in my account at the end of 4 years?

3. Laura deposit \$2000 in a CD account at 3% interest compounded monthly, after 2 years, she withdraws all the money from that bank and deposits in another CD account at another bank which pays 3.5% compounded annually. How much will she have in her account 3 years after she had invested in the new bank? If she did not change the banks, how much would she have had in 5 after depositing \$2000 in the first bank?

4. How much should I save today in a CD account, which pays 3% compounded monthly, if I am to have \$3000 in 5 years?

5. Michael’s parents has deposited \$2500 in an account which pays 2.25% interest compounded daily. If no money is deposited to or withdrawn from that account, how old will Michael be when that account has a balance of \$5000 ?

6. If you deposit \$1000 in a CD at The First United Trust Bank of Far Far Away Land, which is run by Princess Fiona and Shrek, you are guaranteed to get \$1500 after 5 years. All you know is they compound the interest semiannually. How much is their interest rate?
Continuously Compound Interest Formula
Interest that is applied to the balance of an account continuously

\[ A = Pe^{rt} \]

- **A** = *amount*: the amount in the account after interest is added
- **P** = *principal*: the amount in the account before interest is added
- **r** = *interest rate*: the interest rate in decimal form
- **e** = *natural base*: 2.71828...
- **t** = *time*: the number of years

Exponential Growth and Decay Formula
A model of growth or decay that has the form

\[ N(t) = N_0e^{kt} \]

- **N(t)** = function notation for the size of a population at a given time
- **N_0** = the initial population
- **e** = *natural base*: 2.71828...
- **t** = *time*: use the given units
- **k** = *growth or decay constant*:
  - If \( k > 0 \) growth
  - If \( k < 0 \) decay

1. Suppose you invest $1000 at 4% for 5 years. Calculate (and tabulate) how much you will have as balance under different compounding plans.

<table>
<thead>
<tr>
<th>Plan</th>
<th>A</th>
<th>r</th>
<th>t</th>
<th>n</th>
<th>P</th>
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<tr>
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<td>0.04</td>
<td>5</td>
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</table>

2. *Growth of bacteria can be modeled as an exponential growth.* At the start of an experiment there are 3500 bacteria present. Two hours later, the population is 5200.

- (a) Determine the growth constant.
- (b) Determine the population five hours after the experiment began.
- (c) When will the population reach 10000?

3. *Radioactive decay can be modeled as an exponential decay.* The half-life (i.e. if you start with some amount, the time it takes to decay down to one half of the starting amount) of Iodine-131 is 8 days.

- (a) Determine the decay constant.
- (b) If you start with a sample of 5 grams of Iodine-131, how much of it will remain after 6 days?
- (c) How long will it take until only 1 gram of Iodine-131 is left?