Section 2.1 Change, Percentage Change, and Average Rate of Change

**Change:** The change in the quantity is found by subtracting the first value from the second.
Change = $n - m$

**Percentage Change:** The change divided by the first number multiplied by 100.
Percentage Change = $\frac{n - m}{m} \times 100\%$

**Average Rate of Change:** The change divided by the length of the interval.
Average rate of Change = $\frac{n - m}{b - a}$

*Example 1*

The population of a town is represented by $P(t) = 11(1.04^t)$, where $P$ is the population in thousands and $t$ is years after 1990. Find the change, percentage change, and average rate of change between 1992 and 1995.

NOTE: The average rate of change can be represented on a graph by drawing a **secant line** between the two points and thinking of the average rate of change as the slope.
Example 2

The following table shows the amount of money a bank will lend on the basis of a monthly payment of $600 per month with a 30 year term.

<table>
<thead>
<tr>
<th>Monthly APR</th>
<th>6</th>
<th>8</th>
<th>10</th>
<th>12</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loan amount (thousands)</td>
<td>100</td>
<td>81.7</td>
<td>68.3</td>
<td>58.3</td>
<td>50.6</td>
</tr>
</tbody>
</table>

Determine the change, percentage change, and average rate of change in the loan amount when the interest rate increases from 8 to 12 percent.

Compound Interest Formula

The amount accumulated in an account after \( t \) years when \( P \) dollars are invested at an annual interest rate of \( r \) compounded \( n \) times a year is

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

The Annual Percentage Rate (APR) is the percentage given by \( r \). This is also called the nominal rate.

The Annual Percentage Yield (APY) is the percentage change of the amount accumulated over one year. This is also called the effective rate. This is found by taking \((b - 1) \times 100\%\)

Example 3

An investment has interest compounded quarterly with an APR of 6.5%. What is the APY for this investment?

If 10,000 dollars is invested initially, what will be the value of the investment after 2 years?
Continuously Compounded Interest
The amount accumulated in an account after $t$ years when $P$ dollars are invested at a APR of $r$ compounded continuously is:

$$A = Pe^{rt}$$

Example 4
An investment has interest compounded continuously at an APR of 9.2%. If 500 dollars is initially invested, what is the value of the investment after 10 years?

What is the APY of this account?