

Savings model: Only putting \$ in, not taking any out

2.1: Arithmetic growth and simple interest

- Why do banks pay interest?

Basically, interest is a rental fee that the bank pays you for letting them hang on to your money.

When you deposit money in a savings account or a CD, it doesn't just sit there. Banks use the combined savings of their customers to do things like give people loans and mortgages. Banks will pay you interest on this money because they're basically borrowing it for other stuff while you leave it there.

You get a very small % of interest on some accounts because you can draw it out at any time. Therefore, they can't use it on high return investments for a longer period.

Suppose you deposit \$1000 in an account that pays an interest rate of 10% annually (yearly) (unrealistic)

Interest: money charged on a loan

- Letting the money sit (do not make any other deposits or withdrawals)

Principal: initial balance of the account

Simple interest: interest is only paid on the original balance (principal), no matter how much interest has accumulated

*not normally what you're accustomed to

Usually occurs:

- Private loans between individuals, because it's easy to calculate
- Commercial loans for less than one year
- Financing of corporations and the government through bonds

Bond: a loan with repayment at the end of a fixed term and simple interest in the mean time, paid usually annually (year) or semiannually (half a year)

- So with our example, at the end of year 1 you'd now have \$1100 dollars in the bank because you received \$100 in interest
- At the end of year 2, you'd have \$1200 dollars in the bank, again only receiving \$100 dollars for interest

Simple Interest Formula:

For a principal P and an annual rate of interest r , the interest earned in t years is:

- $I = Prt$

The total amount A accumulated in the account is:

- $A = P + I = P + Prt = P(1 + rt)$, $A = P(1 + rt)$

Suppose you have exhausted the amount that you can borrow under federal loan programs and need a private direct student loan for \$10,000.

National City Corporation offers an interest-only repayment option at a annual rate of 5.7%, under which you make monthly interest payments while you are in school and pay on the principal only after graduation.

How much monthly interest would you pay for such a \$10,000 loan?

$P = \$10,000$, the annual interest rate is $r = 5.7\%$, the number of years (since we are looking for how much you pay in one month) is $t = 1/12$

$$I = Prt = (10,000)(.057)(1/12) = \$47.50.$$

Growth of simple interest: is called arithmetic growth, or linear growth.

Arithmetic growth: is growth by a constant amount each year

21.2 Geometric Growth and Compound Interest (The more familiar interest)

Same situation as last time:

Suppose you deposit \$1000 in an account that pays an interest rate of 10% annually (yearly) (unrealistic)

Now, at the end of the second year, you would earn interest on the **new** balance in the account of \$1100. So at the end of the second year, 10% of \$1100, or \$110, would be added to the account.

Thus during the second year you would earn interest on both the principal of \$1000 and on the interest of \$100 that was earned during the first year. (the account is growing at a greater amount during the second year)

At the beginning of the third year the account contains \$1210, so at the end of the third year you receive \$121 in interest.

Thus, not only is the account balance increasing each year, but the amount added also increases each year.

Compound interest: is interest is paid on both the original principal and accumulated interest.

- Usually savings institutions compound interest and credit it to accounts more over than once a year—for example, quarterly (four times per year)

With an interest rate of 10% per year and quarterly compounding, you get one-fourth of the rate, or 2.5% paid in interest each quarter year (every 3 months)

The “quarter” (three months) is the **compounding period** (the time elapsing before interest is paid)

So again, consider a principal of \$1000.

- At the end of the first quarter, you have the original balance plus \$25 interest so the balance at the beginning of the second quarter is \$1025
- During the 2nd quarter, you receive interest equal to 2.5% of \$1025, or \$25.
- Balance at the end of the first year is \$1103.82
- Even though the account was advertised as paying 10% interest, the interest for the year is \$103.82, which is 10.382% of the principal of \$1000.

Imagine if the interest is compounded monthly (12 times per year) or daily (365 or 366 times per year)

Take a look at Table 21.2

Terminology for Interest Rates:

We have seen that an account at a particular annual rate of interest can produce different amounts of interest, depending on how the compounding is done.

To help prevent confusion on the part of the consumers, the Truth in Savings Act establishes

A nominal rate: is any stated rate of interest for a specific length of time, such as 3% annual interest rate on a savings account or a 1.5% monthly rate on a credit card balance. By itself, a nominal rate *does not indicate or take into account whether or how often interest is compounded*

Effective Rate and APY

The **effective rate**: is the rate of simple interest that would realize exactly as much interest over the same length of time. For a year, the effective rate is called the: **annual percentage yield (APY)**

i = nominal rate for a specified *compounding period*—a day, a month, or a year—*within which no compounding is done*.

Because no compounding is done for shorter intervals than this period, the effective rate and the nominal rate are the same for the compounding period.