

3.2: Simple Interest

Learning Objectives

- Calculate simple interest
- Find the annual percentage rate of an account

Discussing interest starts with the **principal**, or amount your account starts with. This could be a starting investment, or the starting amount of a loan. Interest, in its most simple form, is calculated as a percent of the principal. For example, if you borrowed \$100 from a friend and agree to repay it with 5% interest, then the amount of interest you would pay would just be 5% of 100: $\$100(0.05) = \5 . The total amount you would repay would be \$105, the original principal plus the interest.

Simple One-time Interest

$$I = Pr$$

$$A = P + I = P + Pr = P(1 + r)$$

where

- I is the interest
- A is the accumulated amount: principal plus interest
- P is the principal (starting amount)
- r is the interest rate (in decimal form. Example: $5\% = 0.05$)

✓ Example 3.2.1

A friend asks to borrow \$300 and agrees to repay it in 30 days with 3% interest. How much interest will you earn?

Solution

$P = \$300$ the principal

$r = 0.03$ 3% rate

$I = \$300(0.03) = \9 . You will earn \$9 interest.

One-time simple interest is only common for extremely short-term loans. For longer term loans, it is common for interest to be paid on a daily, monthly, quarterly, or annual basis. In that case, interest would be earned regularly. For example, bonds are essentially a loan made to the bond issuer (a company or government) by you, the bond holder. In return for the loan, the issuer agrees to pay interest, often annually. Bonds have a maturity date, at which time the issuer pays back the original bond value.

✓ Example 3.2.2

Suppose your city is building a new park, and issues bonds to raise the money to build it. You obtain a \$1000 bond that pays 5% interest annually that matures in 5 years. How much interest will you earn?

Solution

Each year, you would earn 5% interest: $\$1000(0.05) = \50 in interest. So over the course of five years, you would earn a total of \$250 in interest. When the bond matures, you would receive back the \$1000 you originally paid, leaving you with a total of \$1250.

We can generalize this idea of simple interest over time.

Simple Interest over Time

$$I = Prt$$

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

where

- I is the interest
- A is the accumulated amount: principal plus interest (also known as the future value)
- P is the principal (starting amount)
- r is the interest rate in decimal form
- t is time

The units of measurement (years, months, etc.) for the time should match the time period for the interest rate.

✓ Example 3.2.3

Treasury Notes (T-notes) are bonds issued by the federal government to cover its expenses. Suppose you obtain a \$1000 T-note with a 4% annual rate, paid semi-annually, with a maturity in 4 years. How much interest will you earn?

Solution

Since interest is being paid semi-annually (twice a year), the 4% interest will be divided into two 2% payments.

$P = \$1000$ the principal

$r = 0.02$ 2% rate per half-year

$t = 8$ 4 years = 8 half-years

$I = \$1000(0.02)(8) = \160 . You will earn \$160 interest total over the four years.

📌 APR – Annual Percentage Rate

Interest rates are usually given as an **annual percentage rate (APR)** – the total interest that will be paid in the year. If the interest is paid in smaller time increments, the APR will be divided up.

For example, a 6% APR paid monthly would be divided into twelve 0.5% payments.

A 4% annual rate paid quarterly would be divided into four 1% payments.

✎ Try it 3.2.1

A loan company charges \$30 interest for a one month loan of \$500. Find the annual interest rate they are charging.

Answer

We want to find the interest rate. Solving $I = Pr$ for r , we get $r = \frac{I}{P}$.

$I = \$30$ interest

$P = \$500$ principal

$$r = \frac{I}{P} = \frac{30}{500} = 0.06 = 6\% \text{ for one month}$$

$$(0.06)(12) = 0.72 = 72\% \text{ for one year}$$

They are charging an annual interest rate of 72%.

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