Simple Interest

Interest does NOT make Interest

Minimal Algebra Required

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The initial amount of money we loan or borrow is called the **principle (present value)**: P

If we *loan money*, we expect to get compensated with **interest** I.

If we *borrow money*, we are expected to pay **interest**: I.

In **simple interest**, the period t in which we loan or borrow money is usually measured in years or portions of years:

$$\mathbf{t}\left[\#\text{years};\frac{\#\text{days}}{360\,\text{days/year}};\frac{\#\text{months}}{12\,\text{months/year}};\ldots\right]$$

The **interest rate** r we pay or receive is usually given in % per year (%/year) but must be converted to decimal form using the fact that $\% = \frac{1}{100} = 0.01$:

$$\mathbf{r}\,\%\,\text{per year} = \frac{\mathbf{r}\,\%}{\text{year}} = \frac{\mathbf{r}}{100\,\text{year}}$$

The **interest** I is given by

$$\mathbf{I} = \mathbf{P} * \mathbf{r} * \mathbf{t} = \mathbf{P}\,\mathbf{r}\,\mathbf{t}\left[\text{or } \mathbf{P} = \frac{\mathbf{I}}{\mathbf{r}\,\mathbf{t}};\ldots\right]$$

Note: $\$ = \$\left[\frac{\mathbf{r}}{100\,\text{year}}\right][\#\text{years}];\ldots$ Observe how the years "cancel out" on the right-hand side to result in $ like on the left-hand side.

The amount A that the transaction is worth (**future value**) when the transaction is complete is

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$$\mathbf{A} = \mathbf{P} + \mathbf{I} = \mathbf{P} + \mathbf{P}\,\mathbf{r}\,\mathbf{t} = \mathbf{P}(1 + \mathbf{r}\,\mathbf{t})$$

What we have is an equation with 4 variables and thus we must be given 3 of them in order to solve for the one not given (unknown).

Example 01: Joe M borrows \$2000 for 8 months at a rate of 4% (annual rate unless otherwise specified). How much interest will he owe? What is the total amount that he must pay at the end of the period?

Solution:

The interest owed is $\mathbf{I} = \mathbf{P}\,\mathbf{r}\,\mathbf{t} = \$2000\left(\frac{4}{100\,\text{year}}\right)\left(\frac{8\,\text{months}}{12\,\text{months}}\,\text{year}\right) = \$53.33$. The payback amount is $\mathbf{A} = \mathbf{P} + \mathbf{I} = \$2000 + \$53.33 = \$2053.33$

Example 02: Grandma LC opens a \$500 college fund for grandson Thomas when he is born. If she gets a 4.2% rate of return guaranteed for 18 years, how much will the fund be worth then?

Solution:

The interest made is $\mathbf{I} = \mathbf{P}\,\mathbf{r}\,\mathbf{t} = \$500\left(\frac{4.2}{100\,\text{year}}\right)(18\,\text{years}) = \$378.00$ and the fund is worth $\mathbf{A} = \mathbf{P} + \mathbf{I} = \$500 + \$378 = \$878.00$

Example 03: How much do you need to invest at 5% for 7 years if you want it to be worth \$5000 at that time?

Solution:

We have

$$\mathbf{A} = \mathbf{P}(1 + \mathbf{r}\,\mathbf{t}) \Rightarrow$$

$$\mathbf{P} = \frac{\mathbf{A}}{1 + \mathbf{r}\,\mathbf{t}} = \frac{\$5000}{1 + \left(\frac{5}{100\,\text{year}}\right)(7\,\text{years})}$$

$$= \$3704.00$$

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Example 04: Public debt is financed by Uncle Sam (US government) with Treasury Bills/Notes (T-bills/notes). Assuming you can purchase a 6 month (180 day) $1000 bill for $986, what interest rate are you being paid?

Solution:

We have

$$\mathbf{A} = \mathbf{P}(1 + \mathbf{r}\,\mathbf{t}) \Rightarrow$$

$$1 + \mathbf{r}\,\mathbf{t} = \frac{\mathbf{A}}{\mathbf{P}} \Rightarrow \mathbf{r}\,\mathbf{t} = \frac{\mathbf{A}}{\mathbf{P}} - 1 \Rightarrow$$

$$\mathbf{r} = \frac{\frac{\mathbf{A}}{\mathbf{P}} - 1}{\mathbf{t}} = \frac{\frac{\$1000}{\$986} - 1}{\left(\frac{6\,\text{months}}{12\,\text{months}}\right)\text{year}} = 0.02840 = 2.84\%$$

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