Topics this Chapter

Simple Interest

▼ Simple Interest Formula

The simple interest formula is

$$I = Prt$$

Compound Interest

▼ Compound Amount Formula

The compound amount formula is

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

Present Value

▼ Present Value Formula

The present value formula is

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

Credit Cards

▼ Average Daily Balance

$$\text{Average daily balance} = \frac{\text{sum of the total amounts owed each day of the month}}{\text{number of days in the billing period}}$$

Consumer Loans: Calculating Monthly Payments

Payment Formula for an APR Loan

The payment for a loan based on APR is given by

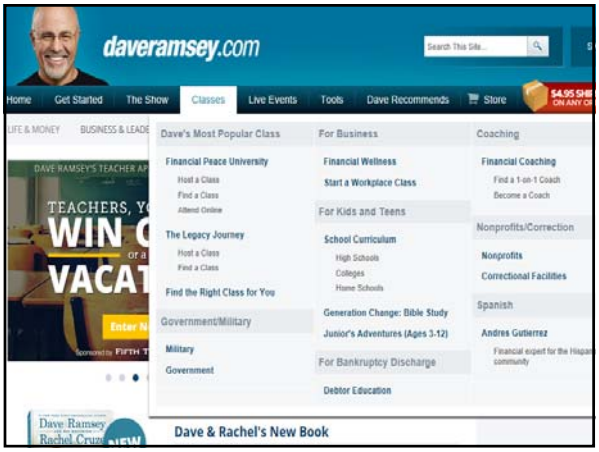
$$PMT = A\left(\frac{\frac{r}{n}}{1-\left(1+\frac{r}{n}\right)^{-nt}}\right)$$

Mortgages & Ongoing Expenses

Mortgage Payment Formula

The mortgage payment for a mortgage is given by

$$PMT = A\left(\frac{\frac{r}{n}}{1-\left(1+\frac{r}{n}\right)^{-nt}}\right)$$



Getting out of debt will not happen overnight; it takes time.

Dave Ramsey's Financial Peace University

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step 1: $1,000 In An Emergency Fund

step 2: Pay Off All Debt With The Debt Snowball

step 3: 3 To 6 Months Expenses In Savings

step 4: Invest 15% Of Income Into Roth IRAs And Pre-Tax Retirement Plans

step 5: College Funding

step 6: Pay Off Your Home Early

step 7: Build Wealth And Give!

Simple Interest: $I = Prt$

- I = Interest earned.
- P =
- r =
- t =

Principal:	500	800	2000	5000
Annual % Rate:	6.00	8.00	12.00	15.00
# of Years:	1	10	25	50
Simple Interest:	30	640	6000	37500
Total:	530	1440	8000	42500

Calculate simple interest due on a 3-month loan of $2000 if the interest rate is 6.5%.

$P = 2000$

$r = 6.5\% = 0.065$

$$t = \frac{3 \text{ months}}{1 \text{ year}} = \frac{3 \text{ months}}{12 \text{ months}} = \frac{3}{12}$$

$$I = Prt$$

$$I = 2000(0.065)\left(\frac{3}{12}\right) = 32.5$$

Simple interest due is $32.50.

Simple Interest *t*

Exact method: $t = \dfrac{\text{number of days}}{365}$

Ordinary method: $t = \dfrac{\text{number of days}}{360}$

Average 30 days/month • 12 months = 360

The ordinary method is used by most businesses. Therefore, unless otherwise stated, the ordinary method will be used.

Calculate the simple interest due on a 45-day loan of $3500 if the annual interest rate is 8%.

$$I = Prt$$

$$P = 3500,\ r = 8\% = 0.08,\ t = \frac{\text{number of days}}{360} = \frac{45}{360}.$$

$$I = 3500(0.08)\left(\frac{45}{360}\right) = 35$$

The simple interest due is $35.

Future Value or Maturity Value Formula for Simple Interest

The future or maturity value formula for simple interest is

$$A = P + I$$

where A is the amount after the interest, I, has been added to the principal, P.

- So when you borrow money, the total amount to be repaid to the lender is the sum of the principal and interest.
- **Maturity Value:** For Loans
  A is the total amount to be repaid to the lender
- **Future Value:** For Investments
  A is the total amount on deposit after the interest earned has been added to the principal.

Calculate the maturity value of a simple interest, 8-month loan of $8000 if the interest rate is 9.75%.

$$I = Prt$$

Step 1: Find the interest.

$$P = 8000,\ r = 9.75\% = 0.0975,\ t = \frac{8}{12}$$

$$I = 8000(0.0975)\left(\frac{8}{12}\right) = 520$$

•**Step 2:** Find the maturity value. $A = P + I$

P = 8000 and *I* = 520 into the formula.

$$A = 8000 + 520 = 8520$$

The maturity value of the loan is $8520.

The maturity value of a 3-month loan of $4000 is $4085. **What is the simple interest rate?**

•First find the amount of interest paid.

$$A = P + I$$

$$I = A - P = 4085 - 4000 = 85$$

•Find simple interest rate by solving $I = Prt$ for *r*

$$I = Prt$$

$$85 = 4000(r)\left(\frac{3}{12}\right)$$

$$85 = 1000r$$

$$0.085 = r$$

$$r = 8.5\%$$

Write the decimal as a percent.

The simple interest rate on the loan is 8.5%.

Compound Interest: $A = P\left(1 + \frac{r}{n}\right)^{nt}$

- A = Amount of money accumulated, including interest.
- P =
- r =
- t =
- n =

Principal:	500	800	2000	5000
Annual % Rate:	6.00	8.00	12.00	15.00
# of Years:	1	10	25	50
Compounded (Times/Year):	1	1	1	1
Total:	530.00	1,727.14	34,000.13	5,418,287.21
Compounded (Times/Year):	12	12	12	12
Compound Interest:	530.84	1,775.71	39,576.93	8,629,569.61

Calculate the compound amount when $10,000 is deposited in an account earning 8% interest, compounded semiannually, for 4 years.

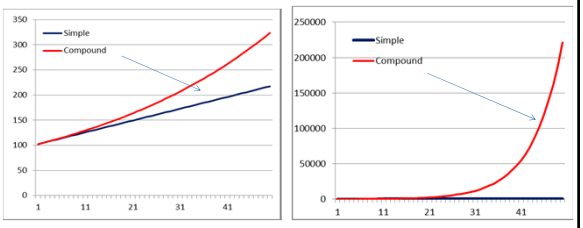
- P = 10,000, r = 8% = 0.08, n = 2, t = 4

$$A = P\left(1 + \frac{r}{n}\right)^{nt} = 10{,}000\left(1 + \frac{0.08}{2}\right)^{2\cdot 4}$$

$$A = 10{,}000(1 + 0.04)^8 = 10{,}000(1.04)^8$$

$$A \approx 10{,}000(1.368569) \approx 13{,}685.69$$

The compound amount after 4 years is approximately $13,685.69.



Present value is used to determine how much money must be invested today in order for an investment to have a specific value at a future date.

Present Value Formula

The present value formula is

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

where P is the original principal invested, A is the compound amount, r is the annual interest rate, n is the number of compounding periods per year, and t is the number of years.

How much money should be invested in an account that earns 8% interest, compounded quarterly, in order to have $30,000 in 5 years?

- A = 30,000, r = 8% = 0.08, n = 4, t = 5

$$P = \frac{A}{\left(1 + \frac{r}{n}\right)^{nt}} = \frac{30{,}000}{\left(1 + \frac{0.08}{4}\right)^{4\cdot 5}} = \frac{30{,}000}{1.02^{20}}$$

$$P \approx \frac{30{,}000}{1.485947396} \approx 20{,}189.14$$

$20,189.14 should be invested in the account in order to have $30,000 in 5 years.

Inflation - increases in costs of goods & services.

- Example: Your annual salary today = $35,000.
- In 20 years, what salary will have the same purchasing power with a 6% inflation rate?

P = 35,000, r = 6% = 0.06, t = 20. $A = P\left(1 + \frac{r}{n}\right)^{nt}$

The inflation rate is an annual rate, so n = 1.

$$A = 35{,}000\left(1 + \frac{0.06}{1}\right)^{1\cdot 20} = 35{,}000(1.06)^{20} \approx 35{,}000(3.20713547)$$

$$A \approx 112{,}249.74$$

You need to earn an annual salary of approximately $112,249.74 in order to have the same purchasing power.

Inflation

•The present value formula can be used to determine the effect of inflation on the future purchasing power of a given amount of money.

•Substitute the inflation rate for the interest rate in the present value formula. The compounding period is 1 year. Again we will assume a constant rate of inflation.

Calculate the Effect of Inflation on Future Purchasing Power

Suppose you purchase an insurance policy in 2015 that will provide you with $250,000 when you retire in 2050. Assuming an annual inflation rate of 8%, what will be the purchasing power of the $250,000 in 2050?

Use the present value formula.

A = 250,000, r = 8% = 0.08, t = 35, annual rate, so n = 1.

$$P = \frac{A}{\left(1+\frac{r}{n}\right)^{nt}} = \frac{250{,}000}{\left(1+\frac{0.08}{1}\right)^{1\cdot 35}} = \frac{250{,}000}{(1+0.08)^{35}} \approx \frac{250{,}000}{14.785344}$$

$$P \approx 16{,}908.64$$

Assuming an annual inflation rate of 8%, the purchasing power of $250,000 will be about $16,908.64 in 2050.

Effective Interest Rate

•When interest is compounded, the annual rate of interest is called the **nominal rate.**

•The **effective rate** is the simple interest rate that would yield the same amount of interest after 1 year.

•When a bank advertises a "7% annual interest rate compounded daily and yielding 7.25%," the nominal interest rate is 7% and the effective rate is 7.25%.

Calculate the Effective Interest Rate

A credit union offers a certificate of deposit at an annual interest rate of 3%, compounded monthly. Find the effective rate. Round to the nearest hundredth of a percent.

Use the compound amount formula to find the future value of $100 after 1 year.

P = 100, r = 3% = 0.03, n = 12, t = 1

$$A = P\left(1+\frac{r}{n}\right)^{nt} = 100\left(1+\frac{0.03}{12}\right)^{12\cdot 1} \approx 103.04$$

$$I = A - P = 103.04 - 100 = 3.04$$

The effective interest rate is 3.04%.

Effective Interest Rate

To compare two investments or loan agreements, we could calculate the effective annual rate of each. However, a shorter method involves comparing the compound amounts of each. Because the value of

$$\left(1+\frac{r}{n}\right)^{nt}$$

is the compound amount of $1, we can compare the value of

$$\left(1+\frac{r}{n}\right)^{nt}$$

for each alternative.

Compare Annual Yields

One bank advertises an interest rate of 5.5%, compounded quarterly, on a certificate of deposit. Another bank advertises an interest rate of 5.25%, compounded monthly. Which investment has the higher annual yield?

Calculate $\left(1+\frac{r}{n}\right)^{nt}$ for each investment.

$$\left(1+\frac{r}{n}\right)^{nt} = \left(1+\frac{0.055}{4}\right)^{4\cdot 1} \approx 1.0561448 \qquad \left(1+\frac{r}{n}\right)^{nt} = \left(1+\frac{0.0525}{12}\right)^{12\cdot 1} \approx 1.0537819$$

An investment of 5.5% compounded quarterly has a higher annual yield than an investment that earns 5.25% compounded monthly.