Simple Interest

Interest = principal $\times$ rate $\times$ time

\[ i = prt \]

Compound Interest Formula

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

where \( A \) (Future Value) is the amount after time \( t \), \( p \) is the principal (Present Value), \( r \) is the annual rate of interest, and \( n \) is the number of compounding periods per year.

\[
\text{Present Value} = \frac{\text{Future Value}}{(1 + \frac{r}{n})^{nt}}
\]

Effective Annual Yield (Annual Percentage Yield – APY) – the equivalent simple interest rate that gives the same amount of interest as a compound rate over the same period of time.

For compounding period \( n \) (note \( n \) is often daily and 360 is used by banks)

\[ APY = \left( 1 + \frac{r}{n} \right)^n - 1 \]

Annuity

\[
S = \frac{R \left[ \left( 1 + \frac{r}{n} \right)^{nt} - 1 \right]}{\frac{r}{n}}
\]

where \( S \) is the value (future value) of the annuity after \( t \) years and \( R \) is the amount invested each period.
Fixed Installment Loans

**Amount financed** = Cash price – Down payment

**Total installment price** = Total of all monthly payments + Down payment

**Finance charge** = Total installment price – Cash price

**Annual Percentage Rate** – applies to interest owed per year on loans. (vs. Effective Annual Yield which is annual interest earned on an investment.)

<table>
<thead>
<tr>
<th>Numbers of payments</th>
<th>Finance Charge per $100 of amount finance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4.00%</td>
</tr>
<tr>
<td>6</td>
<td>1.17</td>
</tr>
<tr>
<td>12</td>
<td>2.18</td>
</tr>
<tr>
<td>18</td>
<td>3.2</td>
</tr>
<tr>
<td>24</td>
<td>4.22</td>
</tr>
<tr>
<td>36</td>
<td>6.29</td>
</tr>
<tr>
<td>60</td>
<td>10.5</td>
</tr>
</tbody>
</table>

**Using Table to Find APR**

1) Compute finance charge per $100 financed

\[
\text{Finance charge per$100} = \frac{\text{Finance charge}}{\text{Amount financed}} \times $100
\]

2) Find the value closest to the finance charge per $100 you calculated in step 1)

3) Look at the associated APR at the top of the column.

**Example:** A truck priced at $12,500 is financed after a $1000 dollar down payment is made. A monthly payment of $229 over 5 years is established. What is the APR for this loan?

**Solution:**

Cash price = $12,500,  
Down payment = $1000,  
Total monthly payment = $5(12) \times $229 = $13,740

Amount financed = $12,500 - $1000 = $11,500

Total installment price = $13,740 + $1000

Finance charge = $14740 - $12,500 = $2240

1) Finance charge per $100 financed

\[
\frac{2240}{11,500} \times 100 = 19.48
\]

2) For 5(12) = 60 monthly payments, 18.81 is the closest value in the table.

3) Therefore, the APR is about 7.0%
**Unearned Interest** – The interest saved by paying off the loan early.

### Actuarial Method

\[ u = \frac{kRV}{100+V} \]

- **u** – unearned interest
- **k** – remaining number of scheduled payments (excluding current payment)
- **R** – regular monthly payment
- **V** – finance charge per $100 (from the APR table) for a loan with the same APR and **k** monthly payments

### Rule of 78

\[ u = \frac{k(k+1)}{n(n+1)} \times F \]

- **n** – original number of payments
- **F** – original finance charge

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**Monthly Mortgage Payments**

\[ PMT = PV \left( \frac{\frac{r}{n}}{1 - \left(\frac{1 + \frac{r}{n}}{n}\right)^{-nt}} \right) \]

where **PV** is the present value, **r** the annual rate, **n** the number of payments per year, **t** the number of years for the mortgage, and **PMT** the amount of the payment.