

## Formulas of Mathematics of Finance

Simple Interest	$\text{S.I.} = \frac{P * r * t}{100} \text{ or } P * i * t \text{ or } P * R * T$ <p style="text-align: center;">Where, P = principal value,  r = rate of interest p.a.,  i = rate of interest in decimal,  R = rate of interest in %,  t = time in years</p>												
Amount (Simple interest)	$A = P + \text{S.I.} = P + \frac{P * r * t}{100} = P \left( 1 + \frac{r * t}{100} \right)$												
Amount (double, triple or n times) with simple interest	$R = \frac{n - 1}{t} \times 100$ <p style="text-align: center;">Where, n = number of times,  R = rate of interest  t = time in years</p>												
Find the r / t / S.I. if given two different amounts (calculated by S.I)	$r = \frac{A_2 - A_1}{A_1 t_2 - A_2 t_1} \quad t = \frac{A_2 - A_1}{A_1 t_2 - A_2 t_1}$ $\text{S.I} = \frac{\text{difference of amount}}{\text{difference of time}} = \frac{A_2 - A_1}{t_2 - t_1}$												
Conversion time/period	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 60%;">Description</th> <th style="width: 40%;">Number of conversion period in a year(m)</th> </tr> </thead> <tbody> <tr> <td>Compounded Annually</td> <td style="text-align: center;">1</td> </tr> <tr> <td>Compounded Semi-annually</td> <td style="text-align: center;">2</td> </tr> <tr> <td>Compounded Quarterly</td> <td style="text-align: center;">4</td> </tr> <tr> <td>Compounded Monthly</td> <td style="text-align: center;">12</td> </tr> <tr> <td>Compounded Daily</td> <td style="text-align: center;">365</td> </tr> </tbody> </table>	Description	Number of conversion period in a year(m)	Compounded Annually	1	Compounded Semi-annually	2	Compounded Quarterly	4	Compounded Monthly	12	Compounded Daily	365
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Compound interest	$\text{C.I} = A - P = P[(1 + i)^n - 1]$ $= P[(1 + i)^t - 1] = P \left[ \left( 1 + \frac{r}{m} \right)^{t * m} - 1 \right]$ <p style="text-align: center;">Where, P = principal value,  r = rate of interest p.a.,  i = rate of interest in decimal,  R = rate of interest in %,  n or t = time in years  m = conversion period</p>												
Calculator tricks for C.I.	$P + (r\% + r\% + \dots n \text{ times} - p)$												

Amount (Compound Interest)	$A = P(1 + i)^n = P \left(1 + \frac{r}{m}\right)^{t*m}$	
Calculator tricks for Amount (C.I)	$P + (r\% + r\% \dots \dots (n \text{ times}))$	
Find t / r of C.I.	If amount double	$t = \frac{69}{r} + 0.35$
	If amount triple	$t = \frac{111.444}{r} + 0.35$
Effective Interest Rate	$E = [(1 + i)^n - 1]$	
Depreciation	<b>Scrap value = Cost <math>\times (1 - d)^n</math></b> Where, d- depreciation rate	
Future value of single cashflow	<b>F.V. = C.F. <math>(1 + i)^n = P.V. (1 + i)^n</math></b> Where, C.F.- cashflow for which future value is to be calculated	
Future value (Regular / Ordinal Annuity)	$F.V. = R \left\{ \frac{(1 + i)^n - 1}{i} \right\}$ Where, R = regular payment(installment) n = no. of periods $FVAF(n, i) = \left\{ \frac{(1+i)^n - 1}{i} \right\}$	
Future value (Annuity Due)	$F.V. = R \left\{ \frac{(1 + i)^n - 1}{i} \right\} \times (1 + i)$	
Present value of single cashflow	$P.V. = \frac{F.V.}{(1 + i)^n}$	
Factors	Compounding Factor	$\times (1 + i)^n$
	Discounting Factor	$\times \frac{1}{(1 + i)^n}$
Present value (Regular / Ordinal Annuity)	$P.V. = R \left\{ \frac{1 - (1 + i)^{-n}}{i} \right\}$ $PVAF(n, i) = \left\{ \frac{1 - (1 + i)^{-n}}{i} \right\}$	
Present value (Annuity Due)	$P.V. = R \left\{ \frac{1 - (1 + i)^{-n}}{i} \right\} \times (1 + i)$	

Calculator tricks for PVRA	$(1 + i) \rightarrow \div \rightarrow = \rightarrow = \dots (n \text{ times}) \rightarrow GT$ $\rightarrow \text{sign change to } (-) \rightarrow +1 \rightarrow \div i$ $\rightarrow \times R$	
Perpetual Annuity (Perpetuity)	Regular Annuity	$P.V. = \frac{R}{i}$
	Annuity Due	$P.V. = \frac{R}{i} + R$
Growing Perpetuity	$P.V. = \frac{R}{i - g}$ Where, $i$ = discount rate $g$ = growth rate	
Net Present value(NPV)	<b>NPV = PV of cash Inflow</b> <b>– PV of cash Outflow</b>	
Decision base for NPV	If <b>NPV <math>\geq 0</math></b> , accept the proposal	
	If <b>NPV <math>&lt; 0</math></b> , reject the proposal	
Real Rate of Return(RRR)	<b>RRR = Nominal Rate of Return</b> <b>– Rate of Inflation</b>	
Compound Annual Growth Rate(CAGR)	$CAGR = \left( \frac{V(T_n)}{V(T_0)} \right)^{\frac{1}{T_n - T_0}} - 1$	
<b>Application of Mathematical Finance</b>		
Sinking Fund (Use formula FVRA/FVAD)	$F.V. = R \left\{ \frac{(1 + i)^n - 1}{i} \right\}$	
	$F.V. = R \left\{ \frac{(1 + i)^n - 1}{i} \right\} \times (1 + i)$	
Leasing Problems (Use formula PV annuity of rental amount/lease amount)	IF <b>Cost of asset <math>&gt;</math> rent(lease) benefit for Lessee(user)</b>	
	IF <b>Cost of asset <math>&lt;</math> rent(lease) benefit for Lessor(owner)</b>	
Capital Expenditure Decision	Find <b>PV of future benefits</b> and <b>compared with purchase value of asset</b> and then decide whether to <b>purchase or not</b>	
Bond Problems	1) Find <b>PVAR of interest income</b> received. Calculate interest value on <b>Face value/Par value</b>	
	2) Find <b>PV single cashflow Maturity value</b>	

	<b>1) + 2) PV of Total benefits</b>
	PV of Total Benefits Compare with issue price (Actual purchase value)
Decisions	<b>If Issue price &gt; PV of Total benefits, then don't Buy.</b>
	<b>If Issue price &lt; PV of Total benefits, then Buy.</b>