



Time Value of Money Formulas

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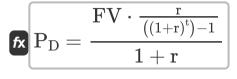




List of 43 Time Value of Money Formulas

Time Value of Money 🗗

1) Annuity Due Payment using Future Value



ex
$$3291.257 = rac{33000 \cdot rac{0.05}{\left((1+0.05)^8
ight)-1}}{1+0.05}$$

2) Doubling Time

$$extstyle extstyle ext$$

ex
$$15.7473 = \log 10 \frac{2}{\log 10} \left(1 + \frac{4.5}{100} \right)$$

3) Doubling Time (Continuous Compounding)

$$ext{DT}_{ ext{CC}} = rac{\ln(2)}{rac{\% ext{RoR}}{100}}$$

ex
$$15.40327$$
Year $=\frac{\ln(2)}{\frac{4.5}{100}}$

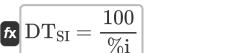


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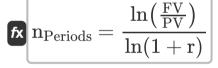
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4) Doubling Time (Simple Interest)



$$eta_{
m L} = eta_{
m UL} \cdot \left(1 + (1 - {
m T}_\%) \cdot {
m R}_{
m D/E}
ight)$$

6) Number of Periods



ex
$$118.8578 = \frac{\ln\left(\frac{33000}{100}\right)}{\ln(1+0.05)}$$

7) Perpetuity Payment 🗗

$$ag{PMT_{ ext{perpetuity}} = ext{PV} \cdot ext{r}}$$

$$\boxed{\texttt{ex} \ 5 = 100 \cdot 0.05}$$



8) Perpetuity Yield

 $\mathbf{f}\mathbf{x}igg|\mathbf{Y} = rac{\mathrm{PMT}_{\mathrm{perpetuity}}}{\mathrm{PV}}$

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 $\boxed{\textbf{ex}} 0.05 = \frac{5}{100}$

9) Rule of 69

 $DT = \frac{69}{i}$

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 $= 3.45 = \frac{69}{20}$

10) Rule of 72

Rule of $72 = \frac{72}{i}$

Open Calculator

 $3.6 = \frac{72}{20}$



Future value

11) Annuity Due for Future Value

extstyle ext

Open Calculator 🗗

 $\boxed{ 129.15 = 60 \cdot \frac{\left(1 + 0.05\right)^2 - 1}{0.05} \cdot \left(1 + 0.05\right) }$

12) Annuity Payment using Future Value

 $ag{PMT}_{ ext{Annuity}} = rac{ ext{FV}_{ ext{A}}}{\left(\left(1+ ext{r}
ight)^{ ext{n}} _ \left\{ ext{Periods}
ight\}
ight) - 1}$

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13) Future Value Factor

 $oldsymbol{\mathsf{F}}_{\mathrm{FV}} = (1+\mathrm{r})^{\mathrm{n}} \, _ \left\{ \mathrm{Periods}
ight\}$

Open Calculator 🗗

 $\begin{array}{|c|c|c|c|c|c|c|c|} \hline \textbf{ex} & 1.1025 = \left(1 + 0.05\right)^2 \end{array}$





14) Future Value of Annuity

fx

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$$\mathrm{FV_A} = \left(rac{\mathrm{p}}{\mathrm{IR} \cdot 0.01}
ight) \cdot \left(\left(1 + \left(\mathrm{IR} \cdot 0.01
ight)
ight)^\mathrm{n} - \left\{\mathrm{Periods}
ight\} - 1
ight)^\mathrm{n}$$

 $\boxed{ 57540 = \left(\frac{28000}{5.5 \cdot 0.01} \right) \cdot \left(\left(1 + \left(5.5 \cdot 0.01 \right) \right)^2 - 1 \right) }$

15) Future Value of Annuity with Continuous Compounding

 $\mathrm{FV}_{\mathrm{ACC}} = \mathrm{C}_{\mathrm{f}} \cdot \left(rac{e^{\mathrm{r} \cdot \mathrm{nPeriods}} - 1}{e^{\mathrm{r}} - 1}
ight)$

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ex $3076.907 = 1500 \cdot \left(\frac{e^{0.05 \cdot 2} - 1}{e^{0.05} - 1}\right)$

16) Future Value of Growing Annuity

 $ag{FV}_{ ext{GA}} = ext{II} \cdot rac{\left(1+ ext{r}
ight)^{n_{ ext{Periods}}} - \left(1+ ext{g}
ight)^{n_{ ext{Periods}}}}{ ext{r}- ext{g}}$

Open Calculator

17) Future Value of Lumpsum

 $ag{FV}_{
m L} = {
m PV} \cdot (1 + {
m IR}_{
m P})^{
m n} \, _ \, \{{
m Periods}\}$

Open Calculator

ex $112.36 = 100 \cdot (1 + 0.06)^2$







18) Future Value of Ordinary Annuities and Sinking Funds

extstyle ext

Open Calculator

19) Future Value of Present Sum given Compounding Periods

 $ext{FV} = ext{PV} \cdot \left(1 + \left(rac{\% ext{RoR} \cdot 0.01}{ ext{C}_{n}}
ight)
ight)^{ ext{C}_{n} \cdot ext{n}_{ ext{Period}}}$

Open Calculator

 $oxed{ex} 109.3973 = 100 \cdot \left(1 + \left(rac{4.5 \cdot 0.01}{11}
ight)
ight)^{11 \cdot 2}$

20) Future Value of Present Sum given Number of Periods

 $ag{FV} = ext{PV} \cdot \exp(\% ext{RoR} \cdot ext{n}_{ ext{Periods}} \cdot 0.01)$

Open Calculator

 $\boxed{ 109.4174 = 100 \cdot \exp(4.5 \cdot 2 \cdot 0.01) }$

21) Future Value of Present Sum given Total Number of Periods

fx

Open Calculator

 $\overline{\mathrm{FV}} = \mathrm{PV} \cdot \left(1 + \left(\% \mathrm{RoR} \cdot 0.01\right)\right)^{\mathrm{n}} - \left\{\mathrm{Periods}\right\}$



22) Future Value with Continuous Compounding 🗗

 $ag{FV}_{
m CC} = {
m PV} \cdot \left(e^{\%{
m RoR} \cdot {
m n}_{
m cp} \cdot 0.01}
ight)$

Open Calculator

Open Calculator

23) Growing Annuity Payment using Future Value

 $ag{FV \cdot (r-g)} \ ext{PMT}_{ ext{initial}} = rac{ ext{FV} \cdot (r-g)}{((1+r)^{n_{ ext{Periods}}}) - ((1+g)^{n_{ ext{Periods}}})}$

 $extbf{ex} 15942.03 = rac{33000 \cdot (0.05 - 0.02)}{\left(\left(1 + 0.05
ight)^2
ight) - \left(\left(1 + 0.02
ight)^2
ight)}$

24) Number of Periods using Future Value

 $n_{
m Periods} = rac{ \ln \left(1 + \left(rac{{
m FV_A \cdot r}}{{
m C_f}}
ight)
ight)}{ \ln (1 + r)}$

ex $21.94906 = rac{\ln\left(1 + \left(rac{57540 \cdot 0.05}{1500}
ight)
ight)}{\ln(1 + 0.05)}$

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Present value 2

25) Annuity Due for Present Value

fx

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$$egin{aligned} ext{PV}_{ ext{AD}} = ext{PMT} \cdot \left(rac{1-\left(rac{1}{(1+ ext{r})^{n_{ ext{Periods}}}}
ight)}{ ext{r}}
ight) \cdot (1+ ext{r}) \end{aligned}$$

ex $117.1429 = 60 \cdot \left(rac{1-\left(rac{1}{(1+0.05)^2}
ight)}{0.05}
ight) \cdot (1+0.05)$

26) Growing Annuity Payment using Present Value 🗗

fx

Open Calculator

$$ext{PMT}_{ ext{initial}} = ext{PV} \cdot \left(rac{ ext{r} - ext{g}}{1 - \left(\left(rac{1 + ext{g}}{1 + ext{r}}
ight)^{ ext{n}} - \{ ext{Periods}\}
ight)}
ight)$$

ex
$$53.26087 = 100 \cdot \left(rac{0.05 - 0.02}{1 - \left(\left(rac{1 + 0.02}{1 + 0.05}
ight)^2
ight)}
ight)$$





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27) Number of Periods using Present Value of Annuity 🗗

 $t = rac{\ln igg(ig(1-ig(rac{ ext{PVAnnuity}}{ ext{C}_{ ext{f}}}ig)ig)^{-1}igg)}{\ln (1+ ext{r})}$

ex $74.28425 = rac{\ln\left(\left(1-\left(rac{1460}{1500}
ight)
ight)^{-1}
ight)}{\ln(1+0.05)}$

28) Present Value Continuous Compounding Factor 🛂

fx $\left| \mathrm{F}_{\mathrm{PV}} = \left(e^{-\mathrm{r} \cdot \mathrm{t}}
ight)
ight|$

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 $0.67032 = (e^{-0.05 \cdot 8})$

29) Present Value Factor 💪

 $\mathbf{F}_{ ext{PVA}} = rac{1 - \left(\left(1 + \mathbf{r}
ight)^{- ext{np}_{ ext{eriods}}}
ight)}{r}$ $1.85941 = rac{1 - \left(\left(1 + 0.05
ight)^{-2}
ight)}{0.05}$

30) Present Value for Continuous Compounding

 $ho ext{PV}_{ ext{cc}} = rac{ ext{FV}}{e^{ ext{r}\cdot ext{n}_{ ext{Periods}}}}$

 $\left| \begin{array}{c} \mathbf{ex} \end{array} \right| 29859.63 = \frac{33000}{e^{0.05 \cdot 2}}$

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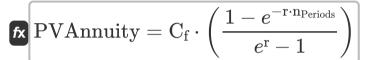
31) Present Value of Annuity

fx

Open Calculator

 $PVAnnuity = \left(\frac{p}{IR}\right) \cdot \left(1 - \left(\frac{1}{\left(1 + IR\right)^n} - \{Months\}\right)\right)$

32) Present Value of Annuity with Continuous Compounding 🗗



Open Calculator

ex
$$2784.1 = 1500 \cdot \left(\frac{1 - e^{-0.05 \cdot 2}}{e^{0.05} - 1} \right)$$

33) Present Value of Deferred Annuity

fx

Open Calculator

$$ext{PV}_{ ext{DA}} = ext{P}_{ ext{O}} \cdot rac{1 - \left(1 + \left(ext{IR} \cdot 0.01
ight)
ight)^{- ext{n}} - \left\{ ext{Periods}
ight\}}{\left(1 + \left(ext{IR} \cdot 0.01
ight)^{ ext{t}} - \left\{ ext{d}
ight\} \cdot \left(ext{IR} \cdot 0.01
ight)
ight)}$$



34) Present Value of Deferred Annuity based on Annuity Due

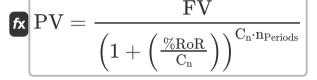
fx

Open Calculator

$$oxed{ ext{PV}_{ ext{DA}} = ext{P}_{ ext{D}} \cdot rac{1 - \left(1 + \left(ext{IR} \cdot 0.01
ight)
ight)^{- ext{n}} _ \left\{ ext{Periods}
ight\}}{\left(1 + \left(ext{IR} \cdot 0.01
ight)
ight)^{ ext{t}_{ ext{d}} - 1} \cdot \left(ext{IR} \cdot 0.01
ight)}}$$

$$oxed{egin{align*} egin{align*} egin{align*} egin{align*} egin{align*} egin{align*} egin{align*} 132.3366 = 110 \cdot rac{1 - \left(1 + (5.5 \cdot 0.01)
ight)^{2}}{\left(1 + (5.5 \cdot 0.01)
ight)^{9-1} \cdot (5.5 \cdot 0.01)} \end{aligned} }$$

35) Present Value of Future Sum given compounding periods



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ex
$$17.45242 = rac{33000}{\left(1 + \left(rac{4.5}{11}
ight)
ight)^{11\cdot 2}}$$

36) Present Value of Future Sum given Number of Periods

$$extstyle extstyle ext$$



37) Present Value of Future Sum given Total Number of Periods

 $PV = \frac{FV}{(1 + IR)^t}$

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 $= 2.010356 = \frac{33000}{(1+5.5)^8}$

38) Present Value of Growing Annuity

 $ext{PV}_{ ext{ga}} = \left(rac{ ext{II}}{ ext{r}- ext{g}}
ight) \cdot \left(1-\left(rac{1+ ext{g}}{1+ ext{r}}
ight)^{ ext{n}_{ ext{Periods}}}
ight)$

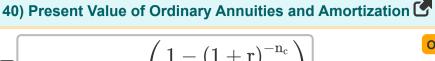
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39) Present Value of Lumpsum 🗗

 $ext{PV}_{ ext{L}} = rac{ ext{FV}}{(1+ ext{IR}_{ ext{P}})^{ ext{n}}} - \{ ext{Periods}\}$

Open Calculator 🗗





$$ext{PV} = ext{PMT} \cdot \left(rac{1 - (1 + ext{r})^{- ext{n}_{ ext{c}}}}{ ext{r}}
ight)$$

$$extbf{ex} \left[593.9185 = 60 \cdot \left(rac{1 - \left(1 + 0.05
ight)^{-14}}{0.05}
ight)
ight]$$

41) Present Value of Stock with Constant Growth

$$P = \frac{D1}{(\% RoR \cdot 0.01) - g}$$

ex
$$10 = \frac{0.25}{(4.5 \cdot 0.01) - 0.02}$$

42) Present Value of Stock with Zero Growth

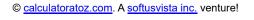
$$P = \frac{D}{\% RoR}$$

43) PV of Perpetuity

$$ext{PV}_{ ext{p}} = rac{ ext{D}}{ ext{DR}}$$

$$\boxed{\texttt{ex}} 291.6667 = \frac{35}{0.12}$$

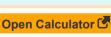






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Variables Used

- %i Annual Interest Rate
- %RoR Rate of Return
- Cf Cashflow per Period
- C_n Compounding Periods
- D Dividend
- D1 Estimated Dividends for Next Period
- DR Discount Rate
- DT Doubling Time
- DT_{CC} Doubling Time Continuous Compounding (Year)
- DT_{SI} Doubling Time Simple Interest (Year)
- F_{FV} Future Value Factor
- F_{PV} PV Continuous Compounding Factor
- F_{PVA} Annuity Present Value Factor
- FV Future Value
- FV_▲ Future Value of Annuity
- FV_{ACC} FV of Annuity with Continuous Compounding
- FV_{AD} Annuity Due Future Value
- FV_{CC} Future Value with Continuous Compounding
- FV_{GA} Future Value of Growing Annuity
- FV_I Future Value of Lumpsum
- FV_O Future Value of Ordinary Annuity
- g Growth Rate





- i Rate of Interest as Whole Number
- II Initial Investment
- IR Interest Rate
- IR_p Interest Rate per Period
- n_c Total Number of Times Compounded
- n_{cp} Number of Compounding Periods
- n_{Months} Number of Months
- nperiods Number of Periods
- p Monthly Payment
- P Price of Stock
- P_D Annuity Payment Due
- Po Ordinary Annuity Payment
- PMT Payment made in Each Period
- PMT_{Annuity} Annuity Payment
- PMT_{initial} Initial Payment
- PMT_{perpetuity} Perpetuity Payment
- PV Present Value
- PV_{AD} Annuity Due Present Value
- PV_{cc} Present Value with Continuous Compounding
- PV_{DA} Present Value of Deferred Annuity
- PV_{qa} Present Value of Growing Annuity
- PV_I Present Value of Lumpsum
- PV_p PV of Perpetuity
- PVAnnuity Present Value of Annuity



- r Rate per Period
- R_{D/E} Debt to Equity (D/E)
- Rule of 72 Rule of 72
- t Total Number of Periods
- T_% Tax Rate
- t_d Deferred Periods
- Y Perpetuity Yield
- β_L Leveraged Beta
- β_{UL} Unleveraged Beta





Constants, Functions, Measurements used

- Constant: e, 2.71828182845904523536028747135266249
 Napier's constant
- Function: exp, exp(Number)

 n an exponential function, the value of the function changes by a constant factor for every unit change in the independent variable.
- Function: In, In(Number)

 The natural logarithm, also known as the logarithm to the base e, is the inverse function of the natural exponential function.
- Function: log10, log10(Number)
 The common logarithm, also known as the base-10 logarithm or the decimal logarithm, is a mathematical function that is the inverse of the exponential function.
- Measurement: Time in Year (Year)
 Time Unit Conversion





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