Time Value of Money – FV, PV & application

Past Trends

Attempt	SI & CI	FV PV and Other	Total
May 2018	3	3	6
Nov 2018	11	3	14
Jun 2019	7	3	10
Nov 2019	10	3	10
Nov 2020	7	7	14
Jan 2021	10	4	14
Jul 2021	6	7	13
Dec 2021	4	3	7
Jun 2022	2	8	10
Dec 2022	8	6	14

Types of Cashflows

Single Cashflow	If single amount is paid or received initially and then direct finally at the end
Annuity	Annuity can be defined as a sequence of **constant periodic** payments (or receipts) regularly over a specified period.
Types of Annuities	Annuity Regular: First payment/receipt at the end of the period Annuity Due: First payment/receipt at the beginning of the period

Future Value

Future Value – Single Cashflow	▪ Future value is the **cash value** of an **investment** at some time in the future. ▪ It is **tomorrow's value** of today's money **compounded** at the rate of interest.
Formula for FV of Single Cashflow	$$FV = CF(1+i)^n$$ where, CF = Single Cashflow for which FV is to be calculated, i = adjusted interest rate, n = no. of periods
FV of Annuity Regular	▪ To calculate **final maturity value** of an investment like RD where sum is invested in the annuity pattern starting at the end of each period. ▪ To calculate the final value of Sinking Fund or Savings amount to achieve the **target maturity value.**
Formula for Future Value - Annuity Regular	$$FVAR = A_i \times FVAF(n,i)$$ $$FVAR = A_i \times \left\{\frac{[(1+i)^n - 1]}{i}\right\}$$ where, **FVAR** = Future Value of Annuity Regular, $\mathbf{A_i}$ = Annuity Value (Installment), **FVAF** = Future Value Annuity Factor, **i** = adjusted interest rate, **n** = no. of periods

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FV of Annuity Due	▪ To calculate final maturity value of an investment like RD where sum is invested in the annuity pattern **at the beginning of each period** ▪ To calculate final maturity value of an investment like RD where sum is invested in the annuity pattern at the beginning of each period
Formula for Future Value - Annuity Due	$$FVAD = A_i \times FVAF(n,i) \times (1+i)$$ $$FVAD = A_i \times \left\{ \frac{[(1+i)^n - 1]}{i} \right\} \times (1+i)$$ **where, FVAD**= Future Value of Annuity Due, **A_i** = Annuity Value (Installment), **FVAF** = Future Value Annuity Factor, **i** = adjusted interest rate, **n** = no. of periods
Sinking Fund	▪ It is the **fund credited** for a specified purpose by way of **sequence of periodic payments** over a **time-period** at a specified interest rate. ▪ Interest is compounded at the **end of every period**. ▪ Size of the sinking fund deposit is same as Future Value of Annuity
Compounding and Discounting	Compounding (Adding the interest): $\times(1+i)^n$ Discounting (Removing the interest): $\times \frac{1}{(1+i)^n}$

Present Value

Present Value of Single Cashflow	▪ Present value is **today's value** of tomorrow's money **discounted** at the interest rate
Formula for PV of Single Cashflow	$$PV = \frac{CF}{(1+i)^n}$$ where, CF = Single Cashflow for which PV is to be calculated, i = adjusted interest rate, n = no. of periods
Present Value – Annuity Regular	**Use:** To calculate **loan amount** when periodic installments value are given and vice-versa. **Application:** Leasing, Capital Expenditure etc.
Formula for PV of Annuity Regular	$$PVAR = A_i \times PVAF(n,i)$$ $$PVAR = A_i \times \left[\frac{1}{i} \times \left\{ 1 - \frac{1}{(1+i)^n} \right\} \right]$$ **where, PVAR** = Present Value of Annuity Regular, **A_i** = Annuity Value (Installment), **PVAF** = Present Value Annuity Factor, **i** = adjusted interest rate, **n** = no. of periods
Calculator Trick for PVAF	$1+i$ [÷] [=] [=] ...n − times [GT]
Formula for Present Value of Annuity Due	$$PVAD = \left[A_i \times PVAF\{(n-1), i\} \right] + A_i$$

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Applications of TVOM & Other Concepts

<table>
<tr><td>Leasing</td><td>

Lessor: Owner of Asset, who gives asset on rent. Lease Rentals are income for Lessor
Lessee: User of the asset who has taken asset on rent. Lease Rentals are expense for Lessee
Use of TVOM: Present Value of Annuity (Lease Rentals) are compared with asset cash down price to decide if leasing is preferable or not.

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<tr><td>Capital Expenditure Decisions</td><td>

Present value of future benefits due to new asset are compared with purchase value of asset, to decide whether asset to purchase or not.

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<tr><td>Valuation of Bond</td><td>

Present value of interest income and maturity value is compared with the issue price of bond
Terms

<table>
<tr><td>Bond</td><td>It is a debt security. Type of loan taken by company from public. Like debentures</td></tr>
<tr><td>Face Value/ Par Value</td><td>Value written on the document of bond. This value is used to calculate Interest Amount</td></tr>
<tr><td>Issue Price</td><td>Actual payment made to purchase the bond</td></tr>
<tr><td>Maturity Value</td><td>Amount to be received on redemption or maturity of bond</td></tr>
</table>
</td></tr>
<tr><td>PV of Perpetuity</td><td>Perpetuity: An annuity that continues till infinite period of time is called as Perpetuity.
$$PVP = \frac{A_i}{i}$$
where,
PVP = Present Value of Perpetuity, A_i = Annuity Value (Installment), i = adjusted interest rate</td></tr>
<tr><td>PV Growing Perpetuity</td><td>A stream of cashflows that grows at constant rate forever is known as growing perpetuity.
$$PVGP = \frac{A_i}{i-g}$$
where,
PVGP = Present Value of Growing Perpetuity
A_i = Annuity Value (Installment)
i = adjusted interest rate
g = growth rate</td></tr>
<tr><td>Net Present Value</td><td>
<table>
<tr><td>Formula</td><td>NPV = Present Value of Cash Inflows – Present Value of Cash Outflows</td></tr>
<tr><td>Decision Base</td><td>If NPV ≥ 0, accept the proposal,
If NPV < 0, reject the proposal</td></tr>
</table>
</td></tr>
<tr><td>Real Rate of Return</td><td>Real Rate of Return = Nominal Rate of Return – Rate of Inflation</td></tr>
<tr><td>CAGR</td><td>Compounded Annual Growth rate used to show annual growth as per CI</td></tr>
</table>

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MCQs

Exercise

A person invests ₹ 500 at the end of each year with a bank which pays interest at 10% p.a. C.I. annually. The amount standing to his credit one year after he has made his yearly investment for the 12th time is.

a. 11,761.36 b. 10,692.34
c. 12,000 d. None

Ans: a

Exercise

A person bought a house paying ₹ 20,000 cash down and ₹ 4,000 at the end of each year for 25 yrs. at 5% p.a. C.I. The cash down price is

a. 75,000 b. 76,000 c. 76,375.5 d. None

Ans: c

Exercise

Johnson left ₹ 1,00,000 with the direction that it should be divided in such a way that his minor sons Tom, Dick and Harry aged 9, 12 and 15 years should each receive equally after attaining the age 25 years. The rate of interest being 3.5%, how much each son receives after getting 25 years old?

a. 50,000 b. 51,947 c. 52,000 d. None

Ans: b

Exercise

A sinking fund is created for redeeming debentures worth ₹ 5 lakhs at the end of 25 years. How much provision needs to be made from profits each year provided sinking fund investments can earn interest at 4% p.a.?

a. 50,000 b. 51,994 c. 52,000 d. None

Ans: b

Exercise

The amount of an annuity certain of ₹ 150 for 12 years at 3.5% p.a C.I is

a. 2190.28 b. 1290.28 c. 2180.28 d. None

Ans: a

Exercise

A loan of ₹ 10,000 is to be paid back in 30 equal instalments. The amount of each installment to cover the principal and at 4% p.a CI is

a. 587.87 b. 587 c. 578.30 d. None

Ans: c

Exercise

Appu retires at 60 years receiving a pension of 14,400 a year paid in half-yearly installments for rest of his life after reckoning his life expectation to be 13 years and that interest at 4% p.a. is payable half-yearly. What single sum is equivalent to his pension?

a. 1,45,000 b. 1,44,900 c. 1,44,800 d. 1,44,700

Ans: b

PYQ June 19

A person wants to lease out a machine costing ₹5,00,000 for a 10-year period. It has fixed rental of ₹51,272 per annum payable annually starting from the end of the first year. Suppose rate of interest is 10% p.a. compounded annually. To whom this agreement is favorable?

a. Favor of Lessee b. Favor of Lessor
c. Not for both d. Can't be determined

Ans: b

PYQ June19

Determine the present value of perpetuity of ₹50,000 per month @ rate of interest 12% p.a. is _____

a. 45,00,000 b. 50,00,000 c. 55,00,000 d. 60,00,000

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Ans: b

PYQ Jul 21

If discount rate is 14% p.a., then how much a company has to pay to receive ₹280 growing at 9% annually forever?

a. 5,600 b. 2,800 c. 1,400 d. 4,200

Ans: a

PYQ Jul 21

If the nominal rate of growth is 17% and inflation is 19% for the five years. Let P be the GDP amount at the present year then the projected real GDP after 6 years is

a. 1.587P b. 1.921P c. 1.403P d. 2.51P

Ans: a

PYQ Jul 21

Let the operating profit of a manufacturer for five years is given as:

Years	1	2	3	4	5	6
Operating Profit	90	100	106.4	107.14	120.24	157.34

Find CAGR

a. 9% b. 12% c. 11% d. 13%

Ans: b

PYQ Jul 21

If the cost of capital is 12% p.a., then the NPV from the given cashflow is

Years	0	1	2	3
Cashflow	(100)	60	40	50

a. 31048 b. 34185 c. 21048 d. 24187

Ans: c

Example

An investor intends purchasing a three-year Rs. 1000 par value bond having nominal interest rate of 10%. At what price the bond may be purchased now if it matures at par and the investor requires a rate of return of 14%?

a. 907.125 b. 900.36 c. 916.66 d. 569.22

Ans: a

PYQ Jun 19

Let a person invest a fixed sum at the end of each month in an account paying interest 12% per year compounded monthly. If the future value of this annuity after the 12^{th} payment is ₹ 55,000 then the amount invested every month is?

a. ₹ 4,837 b. ₹ 4,637 c. ₹ 4,337 d. ₹ 3,337

Ans: c

PYQ Nov 20

A stock pays annually an amount of Rs. 10 from 6^{th} year onwards. What is the present value of the perpetuity if the rate of return is 20%?

a. 20.1 b. 19.1 c. 21.1 d. 22.1

Ans: a

PYQ Jan 21

The present value of an annuity immediate is the same as

a. Annuity regular for (n-1) year plus the initial receipt in the beginning
b. Annuity regular for (n-1) years
c. Annuity regular for (n+1) years
d. Annuity regular for (n+1) year plus the initial receipt in the beginning

Ans: a

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PYQ Dec 22

10 years ago the earning per share (EPS) of ABC Ltd. was ₹ 5 share. Its EPS for this year is ₹ 22. Compute at what rat, EPS of the company grow annually?

a. 15.97% b. 16.77% c. 18.64% d. 14.79%

Ans: a

PYQ Dec 22

Sinking fund factor is the reciprocal of:

a. Present value interest factor of a single cash flow
b. Present value interest factor of an annuity
c. Future value interest factor of an annuity
d. Future value interest factor of a single cash flow

Ans: c

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