CONTENTS

SECTION 01

What Is This Tool?

The **TVM Calculator** is a browser-based financial calculator that solves the fundamental equation of finance: the relationship between money today and money in the future. It implements the five-variable Time Value of Money (TVM) framework used by every financial calculator, from the HP 12C to the BA II Plus, and directly applicable to every discounted cash flow analysis, loan amortisation, and investment appraisal you will encounter in an MBA programme or finance career.

The core principle is that **a rupee today is worth more than a rupee tomorrow** — because today's rupee can be invested and earn a return. The TVM equation quantifies exactly how much more, given a rate of return, a time horizon, and a schedule of payments. The calculator solves for any one of the five TVM variables when the other four are known, presenting results instantly on an LCD-style display and in a results grid.

Who should use this tool?

Finance students working through TVM problem sets, MBA candidates preparing for quantitative exams, financial analysts evaluating loans and investments, and any professional who needs quick, accurate discounted cash flow calculations without switching to a spreadsheet. The physical keypad interface mirrors a real financial calculator, making the tool familiar and tactile.

What the tool does NOT do

The TVM Calculator handles single-amount and level-annuity (equal periodic payment) cash flows only. It does not handle uneven cash flows — for NPV and IRR on irregular cash flow streams, use the Capital Budgeting tool. It also has no backend: all calculations run entirely in your browser, and there is no save, load, or PDF export functionality. Every result is available on-screen in the results grid immediately after solving.

SECTION 02

Quick Start

You can solve any standard TVM problem in under twenty seconds.

1 ENTER THE KNOWN VALUES

Click any of the amber function keys at the top of the keypad (PV, FV, I/Y, N, PMT) to select a field, then type the value using the digit keys. Repeat for each known variable. Leave the variable you want to solve for blank — or clear it with CE. Use the +/− key for negative values (cash outflows).

2 SELECT THE APPROPRIATE MODE

Use the mode tabs in the right panel to choose Single Sum, Annuity, Loan, or Savings depending on the nature of your problem. The formula strip updates to show the relevant equation. For annuity problems, also select End or Begin timing (ordinary annuity or annuity due).

3 PRESS THE TEAL SOLVE BUTTON

Press the teal solve button for the variable you want to calculate — for example, →PMT to find the periodic payment, or →PV to find the present value. The result appears instantly on the LCD display, in the results grid, and the status box flashes green with the solved value.

4 READ THE RESULTS GRID

After solving, all five TVM variables are shown simultaneously in the results grid in the right panel. This gives you a complete picture of the cash flow scenario — useful for verifying your work or presenting the full set of values in an analysis.

> **Rate is always per period, not per year.** For monthly loan payments enter the annual rate divided by 12. For quarterly compounding divide by 4. The calculator does not convert rates automatically — you must enter the per-period rate.

SECTION 03

The Five TVM Variables

Every TVM problem is defined by five variables. Given any four, the calculator solves for the fifth. Understanding what each variable represents — and especially the sign convention — is essential to getting correct answers.

PV — PRESENT VALUE

The value of money today — at time zero. In a loan context, PV is the amount borrowed (positive, cash received). In an investment context, PV is the amount invested today (negative, cash paid out). In a discounting problem, PV is what a future sum is worth right now.

Examples: loan principal of ₹10,00,000; initial investment of $50,000; current price of a bond.

FV — FUTURE VALUE

The value of money at the end of the last period. In a savings problem, FV is the target balance

you want to reach. In a single-sum investment, FV is what a lump sum grows to at maturity. In a loan, FV is typically zero (fully repaid) or the balloon payment remaining at the end.

Examples: savings goal of ₹50 lakhs; maturity value of a fixed deposit; balloon payment on a structured loan.

RATE % — PERIOD RATE

The interest or discount rate per compounding period, entered as a percentage. This is NOT the annual rate unless compounding is annual. Divide the annual rate by the number of periods per year before entering. For a 12% annual rate with monthly compounding, enter 1 (= 12 ÷ 12).

```
Period Rate = Annual Rate % ÷ Periods per Year
```

Valid range: any positive value. For Newton-Raphson solver (when solving for Rate), the calculator tries multiple starting guesses to find a stable root.

N — NUMBER OF PERIODS

The total number of compounding or payment periods. This must be consistent with the rate: if Rate is monthly, N is the number of months. A 5-year monthly loan has N = 60 (5 × 12). A 10-year annual bond has N = 10.

N must be positive. Non-integer values are accepted mathematically but represent fractional periods, which have limited real-world interpretability.

PMT — PAYMENT

The regular periodic payment amount — the same amount paid or received every period. In a loan, PMT is the EMI (Equated Monthly Instalment). In a savings plan, PMT is the regular deposit. PMT is zero for single-sum (lump-sum only) problems.

PMT follows the same sign convention as PV and FV: negative for outflows (paying), positive for inflows (receiving). In most loan problems, if PV is positive (loan received), PMT will be negative (payments made).

The solver always needs exactly four known values

Enter values in exactly four fields and press the solve button for the fifth. If you enter values in all five fields and then press a solve button, the calculator will overwrite the solved variable with the newly calculated value. Always clear the variable you intend to solve for using CE before pressing its solve button.

SECTION 04

The Four Modes

The mode selector in the right panel configures which formula the calculator applies. Selecting the right mode ensures the correct mathematical relationship is used. The formula strip below the mode tabs always shows the active equation.

Single

Single Sum — Lump-Sum Compounding

Used when there is **no periodic payment** — only a single amount invested or received at time zero (PV) that grows to a future value (FV) at a given rate over N periods. PMT is ignored

in this mode.

```
FV = PV × (1 + r)^N
```

- **Solve for FV:** What does ₹1,00,000 grow to at 8% p.a. over 10 years?
- **Solve for PV:** What is the present value of ₹5,00,000 received in 7 years at 10%?
- **Solve for Rate:** What return doubles your money in 9 years (Rule of 72)?
- **Solve for N:** How many years at 7% until ₹1 lakh becomes ₹2 lakhs?

Annuity

Annuity — Regular Equal Payments

Used when a **series of equal periodic payments** (PMT) is made or received over N periods, combined with an optional lump sum at start (PV) or end (FV). This is the general annuity mode covering both ordinary annuities (End) and annuities due (Begin).

```
FV = PV(1+r)^N + PMT × [(1+r)^N - 1] / r
```

For **annuity due** (Begin), the payment factor is multiplied by (1 + r) because each payment earns one extra period of interest.

- **Solve for PMT:** What monthly SIP achieves ₹1 crore in 20 years at 12% p.a.?
- **Solve for PV:** What is a pension stream of ₹50,000/month for 20 years worth today at 8%?
- **Solve for FV:** What does a ₹10,000/month SIP accumulate to in 15 years at 12%?

Loan

Loan — Amortising Debt

A focused mode for **loan and mortgage calculations**. Set PV to the loan amount (positive, cash received), and FV to zero (fully repaid) or the residual balloon. Solve for PMT to find the EMI, for Rate to find the effective interest rate on a known payment stream, or for N to find how many payments are needed.

```
PV = PMT × [1 - (1+r)^(-N)] / r
```

- **Solve for PMT:** EMI on a ₹40 lakh home loan at 8.5% p.a. for 20 years.
- **Solve for Rate:** Effective interest rate on a loan being offered at ₹22,000/month for 36 months for ₹7 lakhs.
- **Solve for N:** How quickly can you repay a ₹5 lakh loan at ₹15,000/month at 10% p.a.?

Savings

Savings — Goal-Based Accumulation

A focused mode for **savings and accumulation problems**. Set FV to the target amount. Solve for PMT to find the required periodic contribution, for PV to find the lump sum needed today, or for Rate to find the required return on an existing savings plan.

```
FV = PV(1+r)^N + PMT × [(1+r)^N - 1] / r
```

- **Solve for PMT:** Monthly SIP needed to accumulate ₹2 crore for retirement in 25 years at 10% p.a.
- **Solve for PV:** Lump sum to invest today to reach ₹50 lakhs in 15 years at 9% p.a.
- **Solve for Rate:** Required return to grow ₹5 lakhs to ₹30 lakhs in 10 years with ₹5,000/month contributions.

Loan vs Annuity: what is the difference?

Mathematically, Loan and Annuity use identical formulas. The distinction is a workflow convenience: Loan mode sets sensible defaults (FV = 0, PMT negative relative to PV) and pre-focuses fields for debt analysis, while Annuity mode is the general-purpose setting. Savings mode similarly pre-focuses on FV as the target. Use whichever mode matches the framing of your

problem.

SECTION 05

Using the Keypad

The physical keypad replicates the layout of a financial calculator. Every key has a specific function. The LCD display at the top always shows the active field and the current value being entered.

Function Keys (Amber row — field selectors)

PV
Focuses the Present Value field. After pressing, digit entry goes to PV. The display shows "PV" as the active field label.

FV
Focuses the Future Value field. After pressing, digit entry goes to FV.

I/Y
Focuses the Interest / Yield (Rate %) field. Enter the per-period rate as a percentage number — e.g., type 1 for 1% per period, not 0.01.

N
Focuses the Number of Periods field.

PMT
Focuses the Payment field. Enter the per-period payment amount, positive for inflow, negative for outflow.

Digit Entry

0 - 9
Appends a digit to the currently active field's value on the display. Digits accumulate left-to-right as you type.

. (DECIMAL)
Inserts a decimal point. Only one decimal point per value is allowed — pressing again has no effect.

+/-
Toggles the sign of the value in the active field. Pressing once makes a positive number negative (prepends a minus sign); pressing again removes it. Use this for cash outflows.

⌫ (BACKSPACE)
Deletes the last digit entered in the active field. Useful for correcting a mis-typed digit without clearing the entire field.

Clear Keys

CE
Clear Entry — clears the value in the currently active field only. Use this to erase one variable before solving for it, without disturbing the other four inputs.

AC
All Clear — resets all five TVM fields to blank/zero and clears the results grid. Use this when starting a completely new problem.

Memory Keys

STO
Store — saves the current field's value into the calculator's single memory register. The MEM indicator on the LCD display confirms a value is stored.

RCL
Recall — retrieves the value stored in memory and pastes it into the currently active field. Useful for reusing a rate or payment across multiple calculations.

Solve Buttons (Teal row)

→PV
Solve for Present Value using the other four inputs. The result is written to the PV field and shown on the display.

→FV
Solve for Future Value.

→I/Y
Solve for the per-period Interest Rate. Uses Newton-Raphson iteration with multiple starting guesses to handle non-linear rate equations. May take a fraction of a second longer than other solves.

→N
Solve for the Number of Periods.

→PMT
Solve for the periodic Payment amount — the most common solve in loan and savings problems.

> The **status box** below the results grid confirms every solve with a green "Solved X = Y" flash, or shows an error in red if the inputs are inconsistent (e.g., solving for Rate with no sign change in cash flows, or N = 0). Read the status box if you get an unexpected result.

SECTION 06

Sign Convention & Timing

Sign convention is the single most common source of errors in TVM calculations. The calculator uses the standard **cash flow sign convention**: money flowing toward you (inflow) is **positive**; money flowing away from you (outflow) is **negative**. Think of yourself as the investor or borrower — not the bank.

The Golden Rule of TVM Sign Convention

In any TVM problem, **at least one value must be positive and at least one must be negative.** If all your inputs have the same sign, the solver will return an error because there is no consistent cash flow story — money cannot flow only in one direction indefinitely.

Practical examples

HOME LOAN (BORROWER)
PV = +40,00,000 (loan received, cash in)
PMT = −35,120 (EMI paid every month, cash out)
FV = 0 (fully repaid at end)
PV is positive because the bank gives you money. PMT is negative because you pay the bank.

FIXED DEPOSIT (INVESTOR)
PV = −5,00,000 (deposited, cash out)
FV = +7,40,122 (maturity proceeds, cash in)
PMT = 0 (no periodic payments)
PV is negative because you give money to the bank. FV is positive because the bank returns it.

SIP / SAVINGS PLAN
PMT = −10,000 (monthly SIP deposit, cash out)
FV = +1,00,00,000 (target corpus, cash in)
PV = 0 (no lump sum today)
PMT is negative (you pay in). FV is positive (you receive the corpus).

BOND PRICING
PMT = +4,000 (coupon received, cash in)
FV = +1,00,000 (face value at maturity, cash in)
PV = −? (price to pay today, solve, will be negative)
Coupons and principal are inflows (positive). Price paid is outflow (negative).

Timing: End vs Begin

The timing toggle (End / Begin) controls when within each period the payment occurs. This setting appears in the right panel and only affects calculations when PMT is non-zero.

End — Ordinary Annuity

Payment occurs at the **end** of each period. This is the default and the most common assumption. Bank loans (EMIs), most bonds, and standard SIP calculations use End timing. The first payment is made at the end of period 1.

```
FV_factor = [(1+r)^N - 1] / r
```

Begin — Annuity Due

Payment occurs at the **beginning** of each period. Used for lease payments, rent payments, and insurance premiums — where payment is due at the start of each month. An annuity due is worth more than an ordinary annuity by a factor of (1 + r) because each payment earns one extra period of interest.

```
FV_factor = [(1+r)^N - 1] / r × (1+r)
```

> The difference between End and Begin can be significant. A ₹10,000/month SIP at 12% p.a. for 20

years accumulates to approximately ₹98.9 lakhs (End) versus ₹1,05 crore (Begin) — a difference of over ₹6 lakhs — simply because Begin payments each earn one extra month of compounding.

SECTION 07

Core Concepts

The following concepts underpin every calculation the tool performs. Understanding them transforms TVM from a formula-plugging exercise into genuine financial intuition.

Time Value of Money

The foundational principle that money available today is worth more than an identical amount available in the future, because today's money can be invested to earn a return. TVM quantifies this difference using a discount rate. Every discounted cash flow analysis — NPV, IRR, bond pricing, equity valuation — rests on this principle.

Compounding

The process by which interest earns interest over time. In compound interest, each period's interest is added to the principal, and the next period's interest is calculated on the new (larger) balance. More frequent compounding produces a higher effective annual rate (EAR) than the stated nominal rate. The TVM formula assumes compounding at the same frequency as the period rate.

```
FV = PV × (1 + r)^N
```

Discounting

The reverse of compounding: finding the present value of a future amount. If compounding asks "what will ₹1 lakh grow to?", discounting asks "what is ₹1 lakh in the future worth today?" The discount rate represents the opportunity cost — the return forgone by not investing the money in the best available alternative.

```
PV = FV / (1 + r)^N
```

Annuity

A series of equal cash flows occurring at regular intervals over a fixed period. Loans, SIPs, pensions, lease payments, and bond coupons are all annuities. The present value of an annuity is the sum of the discounted values of each individual payment — compressed into a single formula using the annuity factor. Perpetuities are annuities with an infinite term: PV = PMT / r.

Discount Rate

The rate used to convert future cash flows to present values. In corporate finance, the discount rate is typically the Weighted Average Cost of Capital (WACC) or the required rate of return. In personal finance, it is the expected investment return or the cost of debt. A higher discount rate makes future cash flows worth less today — the further out the cash flow, the more dramatically it is discounted.

Newton-Raphson Solver

Solving for Rate is the only non-algebraic TVM calculation — it requires iterative numerical methods because rate appears as an exponent. This calculator uses the Newton-Raphson algorithm,

which starts with an initial guess and progressively refines it until the TVM equation is satisfied within a very small tolerance. Multiple starting guesses are tried to avoid converging on a wrong root.

Nominal vs Effective Annual Rate (EAR)

The TVM calculator works with nominal per-period rates only — it does not convert between nominal and effective rates. If a bank quotes "12% p.a. compounded monthly," the effective annual rate is (1 + 0.01)^12 − 1 = 12.68%, not 12%. For monthly payment problems, enter 1 as Rate (= 12 ÷ 12) and 12 × years as N. Do not enter 12.68% as the monthly rate — that would double-count the compounding.

SECTION 08

Business Applications

The TVM framework is the most widely used quantitative tool in finance. Below are eight practical use cases that illustrate how to configure the calculator for real-world problems.

→ **Loan EMI calculation.** A borrower takes a ₹50 lakh home loan at 8.5% p.a. for 20 years. Set Mode = Loan, PV = 50,00,000, Rate = 0.708 (= 8.5/12), N = 240, FV = 0. Solve →PMT to get the monthly instalment. The result (approx. −₹43,391) is the cash outflow each month. A negative PMT confirms money flows away from the borrower.

→ **Retirement corpus planning.** An investor wants ₹3 crore in 25 years. She can invest a lump sum today and also contribute monthly. Set Mode = Savings, FV = 3,00,00,000, Rate = 0.9167 (= 11/12), N = 300. Enter any existing lump sum as a negative PV. Solve →PMT to find the required monthly SIP. This integrates both the lump sum and the annuity stream into a single solve.

→ **Bond pricing.** A bond pays a coupon of ₹5,000 semi-annually, has a face value of ₹1,00,000, matures in 6 years, and the market yield is 7% p.a. Set Mode = Annuity, PMT = 5,000, FV = 1,00,000, Rate = 3.5 (= 7/2), N = 12 (= 6 × 2). Solve →PV to get the fair price. A price above face value (premium bond) results when the coupon rate exceeds the yield.

→ **Implied interest rate (loan offer evaluation).** A dealer offers a ₹8 lakh car for "zero-cost EMI" of ₹24,000/month for 36 months — but the on-road price with the scheme is ₹8.5 lakhs. Set Mode = Loan, PV = 8,50,000, PMT = −24,000, N = 36, FV = 0. Solve →I/Y to find the true monthly interest rate, then multiply by 12 for the annual rate. This reveals the hidden cost embedded in the higher price.

→ **Lease vs buy analysis.** A company can buy an asset for ₹20 lakhs today or lease it for ₹45,000/month for 5 years. The company's cost of funds is 9% p.a. Set Mode = Annuity, PMT = −45,000, N = 60, Rate = 0.75, FV = 0. Solve →PV to find the present value of the lease stream. Compare this to the ₹20 lakh purchase price to identify which option is cheaper in present value terms.

→ **Break-even holding period.** An investor buys a property for ₹60 lakhs and expects it to sell for ₹1.2 crore. Set Mode = Single, PV = −60,00,000, FV = 1,20,00,000, Rate = 0.667 (= 8/12, the opportunity cost). Solve →N to find the number of months at which the property's doubling exactly matches the opportunity cost return. This is the break-even holding period.

→ Education fund accumulation. Parents want to accumulate ₹25 lakhs in 10 years for their child's university fees. They have ₹3 lakhs today to invest. Set Mode = Savings, FV = 25,00,000, PV = -3,00,000, N = 120, Rate = 0.9167 (= 11/12). Solve →PMT to find the additional monthly SIP required on top of the lump sum.

→ Perpetuity valuation. A preference share pays a fixed annual dividend of ₹12 per share indefinitely. At a required return of 8%, the fair value is PV = PMT / r = 12 / 0.08 = ₹150 per share. While the calculator does not have a direct perpetuity mode, set a very large N (e.g., 1000) and the PV solve will converge to the perpetuity value within a fraction of a rupee.

SECTION 09

Glossary of Terms

A quick-reference table of every technical term used in the tool and this guide.

TERM	DEFINITION	IN THIS TOOL
Present Value (PV)	The current worth of a future sum or stream of cash flows, discounted at a given rate. Money received sooner is worth more than money received later because it can be reinvested.	PV field and →PV solve button on the keypad.
Future Value (FV)	The value of a current asset or cash flow at a specified future date, after applying compound interest. Answers the question "how much will this be worth then?"	FV field and →FV solve button on the keypad.
Period Rate (I/Y)	The interest or discount rate per compounding period. Must be consistent with the period used for N and PMT. Equal to annual rate ÷ periods per year.	I/Y field and →I/Y solve button. Entered as a percentage (e.g., 1 for 1%).
Number of Periods (N)	The total count of compounding or payment periods. If rate is monthly, N is months. If rate is annual, N is years. Must be consistent with the rate period.	N field and →N solve button on the keypad.
Payment (PMT)	A regular, equal periodic cash flow occurring each period for the duration of the annuity. Zero for single-sum problems. Positive for inflows (received), negative for outflows (paid).	PMT field and →PMT solve button. Most commonly solved variable in loan and savings problems.
Annuity	A series of equal cash flows at regular intervals over a fixed number of periods. Classified as ordinary (End) or due (Begin) based on payment timing. Loans, SIPs, pensions, and bond coupons are all annuities.	Annuity mode tab. Timing controlled by End/Begin toggle.

Ordinary Annuity	An annuity in which each payment occurs at the end of the period. The standard assumption for bank loans, bonds, and most SIP calculations. Also called an annuity-immediate.	End timing option in the right panel.
Annuity Due	An annuity in which each payment occurs at the beginning of the period. Used for rent, leases, and insurance premiums. Worth more than an ordinary annuity by factor (1 + r) because payments earn an extra period of interest.	Begin timing option in the right panel.
Discount Rate	The rate applied to reduce future cash flows to their present value. Represents the required rate of return or opportunity cost of capital. Higher discount rates assign lower present values to future cash flows.	Entered as the per-period Rate % (I/Y field).
Compounding	The process of earning interest on previously accumulated interest, causing exponential rather than linear growth. The frequency of compounding (annual, semi-annual, monthly, daily) determines the effective rate relative to the stated nominal rate.	Implicit in the (1 + r)^N term of every TVM formula. Tool assumes compounding matches the period rate frequency.
Net Present Value (NPV)	The sum of the present values of all cash inflows and outflows from a project or investment. A positive NPV means the project adds value; negative means it destroys value. TVM is the building block of NPV analysis.	Not directly calculated here — use the Capital Budgeting tool for multi-cash-flow NPV. TVM solves single-stream problems.
Newton-Raphson Method	An iterative numerical algorithm for finding the root of a nonlinear equation. Starts with an initial estimate and refines it using the derivative of the function until it converges. Used here to solve for Rate when the TVM equation cannot be rearranged algebraically.	Runs automatically when →I/Y is pressed. Invisible to the user; result appears immediately.
Sign Convention	The rule that cash inflows (money received) are entered as positive numbers, and cash outflows (money paid) are entered as negative numbers. Consistent sign convention is essential — at least one TVM value must be positive and one negative in any valid problem.	Applied via the +/− key on the keypad. Violations produce a solver error in the status box.
Effective Annual Rate (EAR)	The actual annual rate after accounting for intra-year compounding. EAR = (1 + r)^m − 1, where r is the period rate and m is periods per year. A 12% nominal rate compounded monthly has an EAR of 12.68%.	Not auto-converted. Enter per-period rates consistently with N to ensure correct results.
Perpetuity	An annuity with an infinite life — cash flows continue forever. PV of a perpetuity = PMT / r.	Approximate by setting N to a very large number

	Examples: preference shares with fixed dividends, consol bonds, endowment funds. As N approaches infinity, the annuity formula converges to this result.	(e.g., 1000) in Annuity mode.
Amortisation	The gradual repayment of a loan through periodic payments that cover both interest and principal. In early periods, most of the EMI is interest; in later periods, most is principal repayment. The loan balance declines to zero at the final payment.	Loan mode is designed for amortising debt. Solve →PMT for the EMI.

← BACK TO TVM CALCULATOR