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SECTION 01

What Is This Tool?

The **Options Pricer** is a professional-grade derivatives pricing engine that combines two foundational approaches to valuing European options: the analytical **Black-Scholes model** and **Monte Carlo simulation**. It goes well beyond a simple premium calculator — it provides a complete analytical workbench with seven tabs covering option Greeks, payoff diagrams, sensitivity matrices, simulated price paths, terminal-price distributions, a Black-Scholes vs. Monte Carlo comparison, and a multi-leg strategy builder.

All pricing updates live as you adjust any input — there is no Calculate button. Every number on screen, from the premium to the delta to the break-even, reflects the current parameter set in real time.

Who should use this tool?

Finance students learning derivatives for the first time, MBA candidates completing options assignments, investment analysts evaluating hedging strategies, traders stress-testing option positions, and any professional who needs a rigorous, visual understanding of how European options behave across a range of market conditions.

Two pricing engines, one tool

The **Black-Scholes model** (Fischer Black and Myron Scholes, 1973) produces a closed-form analytical price in microseconds. It is exact within its assumptions and is the industry-standard benchmark for European options. The **Monte Carlo engine** simulates thousands of independent random price paths for the underlying asset under geometric Brownian motion, then takes the average discounted payoff across all paths. Monte Carlo is slower but more general — it can in principle be adapted to any payoff structure, and its convergence toward the Black-Scholes price provides a powerful validation of both methods.

European options only

This tool prices **European options**, which can only be exercised at expiry — not before. American options (exercisable at any time) command an early-exercise premium that requires different techniques (binomial trees, finite-difference methods). For vanilla European equity options, dividends are handled via a continuous dividend yield adjustment (the Merton extension to Black-Scholes).

Seven analysis tabs at a glance

Greeks — sensitivity measures and a Delta vs. Spot chart · **Payoff** — expiry payoff and P&L diagram · **BS vs MC** — model comparison with confidence intervals · **Paths** — simulated GBM price paths · **Distribution** — terminal price histogram · **Sensitivity** — price and delta matrices across spot and vol · **Strategy** — six multi-leg strategy builder and payoff charts

SECTION 02

Quick Start

You can price your first option and explore all seven tabs in under two minutes.

1. SELECT CALL OR PUT

   Use the two toggle buttons at the top of the left panel to switch between a call option (right to buy) and a put option (right to sell). The stats bar, Greeks, payoff chart, and all calculations update instantly.

2. SET YOUR CONTRACT PARAMETERS

   Adjust Spot Price, Strike Price, Days to Expiry, Implied Volatility, Risk-free Rate, and Dividend Yield using the base inputs and sliders. Every change is live — no need to press any button. Watch the moneyness indicator bar update as you move spot relative to strike.

3. READ THE STATS BAR AND EXPLORE THE TABS

   The dark stats bar beneath the header shows the Black-Scholes premium, intrinsic value, time value, and break-even price. Click through the seven tabs — Greeks, Payoff, BS vs MC, Paths, Distribution, Sensitivity, Strategy — to explore different dimensions of the option.

4. RUN MONTE CARLO SIMULATION

   In the left panel beneath the contract parameters, choose the number of simulations (default 10,000) and time steps (default 50), then click Run Simulation. The progress bar tracks completion. Once done, the BS vs MC, Paths, and Distribution tabs populate with simulation results.

SECTION 03

Contract Parameters

The six contract parameters — and the Call/Put toggle — define the option contract completely. Every parameter updates the entire tool in real time. Most parameters have both a base input (for exact entry) and a slider (for exploratory adjustment around that base value).

CALL / PUT

Toggle between a call option (the right to buy the underlying at the strike) and a put option (the right to sell the underlying at the strike). This is the most fundamental parameter — it changes the pricing formula, all Greeks, the payoff diagram, and the break-even calculation.

A call profits when spot rises above the strike + premium. A put profits when spot falls below the strike - premium.

SPOT PRICE (S)

The current market price of the underlying asset — a stock price, index level, commodity price, or currency rate. In Black-Scholes, this is denoted S.

`Default: 100 · Slider range: ±50% of base`

Set the base to your actual asset price (e.g., 1,450 for a Nifty option), then use the slider to explore how the option price changes as spot moves. The moneyness indicator bar updates as you drag the slider.

STRIKE PRICE (K)

The exercise price agreed in the option contract — the price at which the holder may buy (call) or sell (put) the underlying at expiry. Denoted K in the formula.

`Default: 105 · Slider range: ±50% of base`

A call with S=100 and K=105 is out-of-the-money (OTM) by 5%. The same parameters for a put would be in-the-money (ITM). The moneyness bar reflects whichever contract type is active.

DAYS TO EXPIRY (T)

The number of calendar days remaining until the option expires. The tool converts this to years internally by dividing by 365 (denoted T in the formula). Supports direct text entry and a slider from 1 to 730 days.

`T (years) = Days / 365 · Default: 30 days`

Time value collapses to zero at expiry. Long-dated options (180+ days) have substantial time value; short-dated options (sub-7-days) behave increasingly like a binary bet and have very high gamma.

IMPLIED VOLATILITY (Σ)

The annualised standard deviation of returns — the single most important driver of option premium beyond intrinsic value. Expressed as a percentage. In practice, this is often the market-implied volatility backed out from traded option prices; here you supply it directly.

`Default: 20% · Slider range: ±50% of base`

At-the-money options are most sensitive to vol changes (highest Vega). Deep ITM or deep OTM options are less sensitive. Typical equity market vols: India 20-35%, US large-cap 15-25%, individual stocks 30-60%, crypto 60-120%.

RISK-FREE RATE (R)

The annual continuously compounded risk-free interest rate, expressed as a percentage. This is the rate used to discount the expected future payoff back to present value and to compute the cost-of-carry for the underlying.

`Default: 5% · Direct input only`

Use the prevailing short-term government bond rate for the currency of the underlying. India: ~6.5–7% (RBI repo / 91-day T-Bill). US: ~4.5–5.5% (Fed Funds / 3-month T-Bill). The rate has a second-order effect on premium but materially affects Rho and the break-even for long-dated options.

DIVIDEND YIELD (Q)

The continuous annual dividend yield of the underlying asset, expressed as a percentage. The Merton (1973) extension to Black-Scholes accounts for dividends by discounting the spot price: the option is priced as if the underlying grows at (r − q) instead of r.

`Default: 0% · Direct input only`

For non-dividend-paying stocks, futures, or indices on a total return basis, leave at 0. For equity indices, use the dividend yield (e.g., Nifty 50 ~1.2%, S&P 500 ~1.3–1.5%). A higher dividend yield lowers call prices and raises put prices, because dividends reduce the expected spot price over time.

MONEYNESS INDICATOR

A visual bar beneath the parameters that shows the current moneyness status of the option with a colour-coded badge. ITM (In The Money) — call: S > K · put: S < K — intrinsic value is positive. ATM (At The Money) — S ≈ K — no intrinsic value; pure time value. OTM (Out of The Money) — call: S < K · put: S > K — option has only time value and may expire worthless.

The bar fills proportionally based on how far in- or out-of-the-money the option is relative to spot. Use it as a quick visual sanity check when comparing call vs. put or exploring the effect of moving the strike.

> **Base vs. Slider:** For Spot, Strike, and Volatility, enter the specific value you want in the base input field, then use the slider to explore ± deviations around that base. The slider range is always ±50% of whatever base value you type. This lets you precisely anchor one scenario and then stress-test it dynamically.

SECTION 04

The Stats Bar

The dark stats bar displays four key metrics for the current contract in real time. These are the headline numbers you would use in a client presentation or assignment — the core output of the Black-Scholes model summarised in four cells.

₹

Call / Put Premium

The theoretical fair value of the option as computed by the Black-Scholes formula. This is the price a buyer should be willing to pay (and a seller should demand) for the option contract assuming the model's assumptions hold. The label switches between "Call Premium" and "Put Premium" based on the active toggle.

For a call: `C = S·e^(-qT)·N(d1) − K·e^(-rT)·N(d2)`

For a put: `P = K·e^(-rT)·N(-d2) − S·e^(-qT)·N(-d1)`

IV

Intrinsic Value

The **immediate exercise value** of the option — the profit you would receive if you could exercise the option right now at the current spot price. Intrinsic value is always non-negative; it is zero for OTM and ATM options.

negative, it is zero for OTM and ATM options.

Call: `max(S − K, 0)` Put: `max(K − S, 0)`

TV

Time Value

The portion of the option premium attributable to the remaining time until expiry — the "hope value" that spot might move further into the money before expiration. Time value is always non-negative and decays to zero at expiry (theta decay).

`Time Value = Premium − Intrinsic Value`

ATM options have maximum time value. Deep ITM and deep OTM options have relatively little time value, but for different reasons: deep ITM options trade close to their intrinsic value (they are nearly certain to be exercised); deep OTM options have low probability of reaching the strike.

B/E

Break-even Price

The spot price at expiry at which the option holder neither profits nor loses (net of the premium paid). This is the hurdle the underlying must clear for the option buyer to be in profit.

Call: `Break-even = K + Premium`

Put: `Break-even = K − Premium`

For example, if a call has K=105 and costs ₹3.50 in premium, the underlying must exceed 108.50 at expiry for the buyer to profit. The break-even is a critical number for comparing option strategies and communicating cost-to-payoff to clients.

SECTION 05

The Greeks Tab

The Greeks measure how the option's value changes in response to changes in each underlying parameter. They are the primary risk management tools for options traders and are essential for understanding how a position behaves under different market conditions. All Greeks update in real time as you adjust inputs.

The Greeks Table

DELTA (Δ)

The rate of change of option price with respect to spot price. Delta tells you how much the option premium moves for a ₹1 (or $1) change in the underlying.

Call: `Δ = e^(-qT) · N(d1)` — ranges 0 to +1

Put: `Δ = -e^(-qT) · N(-d1)` — ranges -1 to 0

ATM options have |Δ| ≈ 0.5. Delta is also the risk-neutral probability that the option expires in the money (approximately). A delta of 0.65 means the option moves ₹0.65 for every ₹1 move in spot, and has roughly a 65% chance of being ITM at expiry. Delta is also the hedge ratio: to delta-hedge one long call with Δ=0.65, you sell 0.65 units of the underlying.

GAMMA (Γ)

The rate of change of Delta with respect to spot price — the second derivative of option price with respect to spot. Gamma measures the curvature of the option's price function.

$\Gamma = N'(d1) \cdot e^{-qT} / (S \cdot \sigma \cdot \sqrt{T})$ — same for call and put

Gamma is highest for ATM options near expiry. A high gamma means delta changes rapidly as spot moves — the option is highly non-linear and difficult to hedge. Long option positions have positive gamma (you benefit from large spot moves in either direction). Short option positions have negative gamma (you are hurt by large moves). Gamma risk increases dramatically in the last days before expiry for ATM options.

THETA (Θ)

The rate of change of option price with respect to the passage of time — time decay. Expressed as the price change per calendar day. Always negative for long option positions (options lose value as time passes, all else equal).

The full Theta formula accounts for both the d1 and d2 normal distribution terms, the dividend yield, and the risk-free rate.

ATM options have the largest absolute Theta. Time decay accelerates non-linearly as expiry approaches — the last 30 days of an ATM option's life see the fastest decay. Theta and Gamma are inversely related: high-gamma positions (which benefit from large spot moves) pay for that benefit via high theta (rapid time decay when spot stays still).

VEGA (ν)

The rate of change of option price with respect to a 1% change in implied volatility. Vega measures the option's sensitivity to the volatility input.

$\nu = S \cdot e^{-qT} \cdot N'(d1) \cdot \sqrt{T} / 100$

Vega is highest for ATM options with long time to expiry. A Vega of 0.18 means the option price changes by ₹0.18 for a 1% rise or fall in implied volatility. Long option positions have positive Vega — they benefit from rising volatility. This is why buying options before earnings or major events (when vol is expected to spike) is a common strategy, while selling options in high-vol environments to collect premium is another.

RHO (Ρ)

The rate of change of option price with respect to a 1% change in the risk-free rate. Rho measures interest rate sensitivity.

Call: $\rho = K \cdot T \cdot e^{-rT} \cdot N(d2) / 100$

Put: $\rho = -K \cdot T \cdot e^{-rT} \cdot N(-d2) / 100$

Calls have positive Rho; puts have negative Rho. Higher interest rates increase call prices (higher cost-of-carry increases the forward price) and decrease put prices. Rho is typically the least important Greek for short-dated options, but becomes significant for long-dated options (LEAPS) where a 1% rate change over two years meaningfully affects the discount.

PROB ITM

The risk-neutral probability that the option expires in the money — the probability under the risk-neutral measure (not the real-world measure) that the option will be exercised profitably at expiry.

Call: Prob ITM = $N(d2)$

Put: Prob ITM = $N(-d2)$

This is a model-implied probability, not a historical frequency. It uses N(d2), not N(d1). Delta ≈ N(d1) is a slightly different probability (it accounts for the magnitude of payoff, not just occurrence). Prob ITM of 0.32 means a 32% chance the option expires ITM under the risk-neutral measure.

Delta vs. Spot Chart

Below the Greeks table, a chart plots Delta as a function of Spot Price across a range of ±50% around the current spot. The **teal line** shows the call delta curve; the **red line** shows the put delta curve. This chart illustrates the S-shaped delta profile:

- Deep OTM: delta approaches 0 (call) or -1 → 0 (put) — option barely moves with spot
- ATM: delta ≈ ±0.5 — option moves one-for-two with the underlying
- Deep ITM: delta approaches +1 (call) or -1 (put) — option moves almost one-for-one with spot

The inflection point of the S-curve shifts left or right as you change time to expiry or volatility — longer time and higher vol flatten and widen the curve; shorter time and lower vol steepen it around the current strike.

Put-Call parity check

The Greeks are consistent with put-call parity. The call Delta minus put Delta always equals e^(-qT) (approximately 1 for zero dividends and short tenors). Call Theta and Put Theta differ by the carry on the position, and put Rho is always negative while call Rho is positive by the same relationship.

SECTION 06

The Payoff Tab

The Payoff tab displays the option's cash flows at expiry as a function of the underlying's terminal spot price. This is the canonical diagram every options textbook uses — and it is the clearest way to visualise the risk/reward profile of a position.

Chart anatomy

Teal Line — Payoff at Expiry (Gross)

The gross payoff received from exercising the option at expiry, before subtracting the premium paid. For a call: max(S_T - K, 0). For a put: max(K - S_T, 0). This is the "hockey stick" shape — flat at zero for OTM outcomes, linearly increasing for ITM outcomes. The kink occurs exactly at the strike price K.

Gold Line — Net P&L (After Premium)

The net profit or loss from the option position, accounting for the premium paid upfront. The gold line is the teal line shifted downward by the premium amount. P&L = Payoff - Premium. The gold line crosses zero at the break-even price (call: K + premium; put: K - premium). Below break-even, the position is at a loss (capped at the premium paid). Above break-even, the position profits.

Payoff metrics

Max Loss

For a long option (call or put), the maximum loss is always limited to the **premium paid**. This is one of the defining advantages of buying options: the buyer's downside is strictly bounded, regardless of how far the underlying moves against them. Max loss = option premium.

Break-even Spot

The terminal spot price at which the net P&L is exactly zero. Call: K + Premium. Put: K − Premium. The underlying must move beyond the break-even for the buyer to profit. The greater the premium, the further spot must travel, which is why high-vol options are expensive — the required move is larger.

Max Gain (Call)

For a call, **theoretically unlimited** — the option profits without bound as spot rises above the strike. In practice, the gain is bounded by whatever price the underlying reaches at expiry. The maximum gain grows linearly above the strike at a rate of 1:1 (ignoring premium) once deeply ITM.

Max Gain (Put)

For a put, maximum gain is **K − Premium** (occurs when spot falls to zero). A put cannot profit more than the strike minus what you paid, because spot cannot fall below zero. Deep OTM puts that cost almost nothing can still return many multiples if spot collapses — this is the "lottery ticket" profile of cheap puts.

> Use the payoff diagram to explain asymmetric risk to clients or colleagues: the buyer's loss is capped at the premium but the gain is uncapped (call) or very large (put). The seller's position is the mirror image — capped gain (the premium received) but uncapped loss — which is why option sellers demand adequate premium.

SECTION 07

Monte Carlo Simulation

Monte Carlo simulation prices the option by generating a large number of independent random price paths for the underlying asset under geometric Brownian motion (GBM), then computing the average of the discounted payoffs across all paths. It is an entirely different approach to reaching the same answer as Black-Scholes — and verifying that both agree is one of the most instructive exercises in quantitative finance.

How to run the simulation

1 CHOOSE NUMBER OF SIMULATIONS

Select 1K, 5K, 10K (default), 50K, or 100K simulations. More simulations reduce the standard error of the MC price estimate: standard error ∝ 1/√N. Doubling simulations halves the standard error but quadruples run time. 10K is a good balance for quick analysis; 50K–100K for high-precision comparison.

2 CHOOSE TIME STEPS PER PATH

The slider controls how many discrete steps each path takes from today to expiry (range: 10–250, default 50). More steps produce smoother paths and reduce discretisation error. For

250, default 50). More steps produce smoother paths and reduce discretisation error. For most purposes, 50 steps is sufficient. Use 200+ steps if you need high-fidelity paths for the visualisation tab.

3 CLICK RUN SIMULATION

The progress bar tracks completion. The engine uses Box-Muller normal random number generation and geometric Brownian motion: $S_{t+dt} = S_t \cdot \exp[(r-q-\sigma^2/2)\cdot dt + \sigma\cdot\sqrt{dt}\cdot Z]$

where $Z \sim N(0,1)$. Each path ends at a terminal spot price S_T. The payoff is $\max(S_T - K, 0)$ for a call or $\max(K - S_T, 0)$ for a put, discounted at e^{-rT}.

What the simulation produces

MC Option Price

The average discounted payoff across all N simulated paths. This is the Monte Carlo estimate of the option's fair value. With 10,000 simulations, you can expect the MC price to be within approximately ±0.5% of the Black-Scholes price for typical parameters (standard error decreases with $\sqrt{N}$).

MC Prob ITM

The fraction of simulated paths that end in the money at expiry. This is the empirical (simulation-based) estimate of the probability that $S_T > K$ (call) or $S_T < K$ (put). As N grows, this converges to the Black-Scholes N(d2) probability.

Standard Error

The standard error of the MC price estimate: $SE = \sigma_{payoff} / \sqrt{N}$ where σ_{payoff} is the standard deviation of the simulated discounted payoffs. A 95% confidence interval for the true price is approximately [MC Price ± 1.96 · SE]. Use this to judge simulation precision — it shrinks with more simulations.

Simulated Paths

The Paths tab shows a sample of the generated GBM trajectories. Each path shows how the underlying price might evolve from today to expiry. The Distribution tab shows the histogram of terminal prices S_T — log-normally distributed, with right skew — which is the foundation of the Black-Scholes model.

Why Monte Carlo matters beyond pricing

Monte Carlo simulation is the industry standard for pricing exotic options, path-dependent options (Asian, barrier, lookback), and options on multiple underlyings where analytical formulas do not exist. Understanding how MC works — and how it converges to BS for European options — is the foundation for extending it to these more complex instruments. The paths and distribution tabs also make the log-normal price model visually concrete.

SECTION 08

BS vs MC Comparison

The BS vs MC tab provides a side-by-side comparison of the Black-Scholes analytical price and the Monte Carlo simulation estimate, along with confidence intervals and a chart showing both approaches across a range of volatilities. This is one of the most instructive views in the tool — it demonstrates both the power and the limitations of each method.

Comparison cards

Three comparison cards display the most important metrics side by side:

- **Option Price:** BS analytical price vs. MC estimated price with 95% confidence interval (MC Price ± 1.96 · SE). Both values should be very close with 10K+ simulations.
- **Prob ITM:** BS analytical N(d2) probability vs. the empirical fraction of paths ending ITM. These will agree asymptotically as $N \to \infty$.
- **Standard Error:** The MC price estimate's precision. A lower standard error means more reliable MC results. $SE = \sigma_{payoff} / \sqrt{N}$.

Price vs. Volatility chart

The chart plots option price against implied volatility across a range centered on the current volatility input. The **BS curve** is a smooth line showing how the analytical price varies with volatility. The **MC point** is plotted at the current volatility with error bars showing the 95% confidence interval. Together they show:

- How closely MC converges to BS at the current parameters (they should nearly overlap with 10K+ sims)
- How option price responds to a range of volatility assumptions — visually demonstrating Vega
- How the width of the MC confidence interval (the error bar) compares to the range of BS prices — a sanity check on simulation precision

When BS and MC agree or disagree

They agree (as expected)

For European options under geometric Brownian motion, Black-Scholes and Monte Carlo should produce identical prices in expectation. Any difference is purely simulation noise — it vanishes as N grows. If both agree closely, the simulation is working correctly and verifies the analytical formula.

Large divergence

A large and persistent gap between BS and MC (beyond what the standard error explains) usually means too few simulations. Try increasing to 50K or 100K. For near-expiry, ATM options, the payoff distribution is bimodal and convergence requires more paths — increase both simulations and time steps.

Convergence theorem

By the Law of Large Numbers, the average of N i.i.d. discounted payoffs converges to the true expected value (the Black-Scholes price) as $N \to \infty$. The Central Limit Theorem tells us the convergence rate: the MC error is $O(1/\sqrt{N})$. Doubling simulations halves the error; getting 10× more precision requires 100× more simulations. This is why variance reduction techniques (antithetic variates, control variates, importance sampling) are used in practice to speed up MC convergence.

SECTION 09

The Sensitivity Matrix

The Sensitivity tab displays two grids — a **Price matrix** and a **Delta matrix** — each covering a 9 × 7 range of spot prices and implied volatility levels. This is a stress-testing tool: it shows how the option price and delta respond simultaneously to movements in both the most important parameters.

How to read the grid

Both matrices are structured identically:

- **Rows (9 levels):** Spot prices ranging from -20% to +20% of the current spot in equal steps. Each row header shows the spot price level.
- **Columns (7 levels):** Implied volatility levels ranging from -20% to +20% of the current vol in equal steps. Each column header shows the vol level.
- **Each cell:** The Black-Scholes price (or delta) at that exact combination of spot and vol, with all other parameters held constant.

Colour coding

Gold outline — Current cell

The cell corresponding to the current spot and vol settings is highlighted with a gold outline border. This is your "base case" — the centre of the stress test. The price shown in this cell matches the premium in the stats bar.

Teal — In The Money

Cells where the option is in the money at that spot level are shaded teal. For a call: cells where the row's spot price exceeds the strike. For a put: cells where the row's spot is below the strike. ITM options have higher prices and deltas closer to ±1.

Gold fill — At The Money

Cells in the row where the spot price is closest to the strike (ATM row) are highlighted in gold. ATM options have the highest Vega and time value, and the highest sensitivity to all parameter changes.

Amber — Out of The Money

Cells where the option is out of the money are shaded amber. OTM options have lower prices and deltas closer to 0. As vol increases (moving right in the grid), even deeply OTM options gain significant value — the classic "vol smile" dynamic.

How to use the sensitivity matrix

Read the matrix like a scenario analysis table. Each row represents a different spot price scenario (e.g., what if the stock drops 10%?), and each column represents a different volatility regime (e.g., what if vol spikes to 30%?). This allows you to simultaneously stress-test both a directional move in the underlying and a change in implied volatility — the two key variables driving option P&L.

> The sensitivity matrix is especially useful for risk management of option portfolios. A portfolio

> The sensitivity matrix is especially useful for risk management of option portfolios. A portfolio manager can immediately see the option's dollar sensitivity to any combination of market movements, without recalculating manually. The Delta matrix complements this by showing how the hedge ratio changes across scenarios — critical for maintaining a delta-neutral book.

SECTION 10

Strategy Builder

The Strategy tab constructs six standard multi-leg option strategies using the current Black-Scholes parameters as the building blocks. For each strategy, the tool computes the legs (each with direction, type, strike, and BS-priced premium), calculates net cost, maximum gain, maximum loss, and break-even(s), and plots the combined net P&L at expiry. All strategies use European options priced with the current spot, vol, rate, and yield inputs.

The six strategies

Long Call

Structure: Buy one call at the current strike K. **View:** Bullish — you expect the underlying to rise significantly above K + Premium before expiry. **Max loss:** Premium paid. **Max gain:** Unlimited. **Break-even:** K + Premium.

When to use: When you have a strong directional view that spot will rise beyond the break-even, but want to limit downside to the premium. Cheaper than owning the underlying outright, with higher percentage returns if correct — but loses the entire premium if spot stays flat or falls.

Long Put

Structure: Buy one put at the current strike K. **View:** Bearish or defensive — you expect the underlying to fall below K - Premium, or you are hedging a long position in the underlying against downside. **Max loss:** Premium paid. **Max gain:** K - Premium (occurs at spot = 0). **Break-even:** K - Premium.

When to use: Outright bearish bets or portfolio insurance. A long put on an index (e.g., Nifty) is equivalent to buying insurance on the portfolio — it pays out if the market falls sharply. The premium is the cost of that insurance.

Bull Call Spread

Structure: Buy a call at K (the current strike) and sell a call at K2 (a higher strike, approximately K × 1.05). **View:** Moderately bullish — you expect spot to rise but not dramatically. By selling the higher strike call, you reduce the net premium paid at the cost of capping your upside. **Max loss:** Net premium paid (lower than a naked long call). **Max gain:** (K2 - K) - Net Premium. **Break-even:** K + Net Premium.

When to use: When you want to reduce the cost of a bullish bet and are comfortable capping the gain. The spread has a better break-even than a naked call because it costs less net premium — critical when vol is high and options are expensive.

Bear Put Spread

Structure: Buy a put at K and sell a put at K3 (a lower strike, approximately K × 0.95). **View:** Moderately bearish — you expect a moderate decline in spot and want to reduce the cost of a long put. **Max loss:** Net premium paid. **Max gain:** (K - K3) - Net Premium. **Break-even:** K - Net Premium.

Net Premium.

When to use: When you are bearish but not catastrophically so — you expect a defined downside move. The short put caps your maximum profit but significantly reduces the net cost of the position compared to a naked long put.

Long Straddle

Long Straddle

Structure: Buy one call and one put, both at the same strike K and same expiry. **View:** Long volatility / non-directional — you expect a large move in spot in either direction but are agnostic about which way. **Max loss:** Total premium (call + put), incurred if spot is exactly at K at expiry. **Max gain:** Unlimited (to the upside) / K − Total Premium (to the downside). **Break-even:** K + Total Premium (upper) and K − Total Premium (lower).

When to use: Before binary events — earnings announcements, central bank decisions, referendum results — where you expect a large price move but cannot predict the direction. The position benefits from any large move and from rising implied volatility (positive Vega).

Long Strangle

Long Strangle

Structure: Buy an OTM call (at K2 > K) and an OTM put (at K3 < K). **View:** Long volatility / non-directional, like a straddle but cheaper and requiring a larger spot move to profit. **Max loss:** Total premium (less than a straddle because both legs are OTM). **Max gain:** Unlimited (upside) / K3 − Total Premium (downside). **Break-evens:** K2 + Total Premium (upper) and K3 − Total Premium (lower).

When to use: When you expect a very large move but want to pay less premium than a straddle. The tradeoff is that spot must move even further before you profit — both legs start OTM. A strangle is a cheaper, lower-probability version of a straddle.

Strategy payoff charts

Each strategy displays a net P&L at expiry chart showing how the combined position performs across the full range of terminal spot prices. The chart identifies the break-even point(s), the maximum profit zone (if bounded), and the maximum loss zone clearly. Use these charts to explain the risk/reward profile of each strategy to clients or in presentations. The metrics panel (Max Loss / Max Gain / Break-even / Net Cost) summarises the key numbers.

SECTION 11

Core Concepts Explained

The following concepts underpin the mathematics and intuition of the Options Pricer. A solid grasp of these ideas transforms the tool from a calculator into a decision-making framework.

Black-Scholes model and assumptions

The Black-Scholes model (1973) provides a closed-form formula for European option prices under the following assumptions:

- The underlying asset follows **geometric Brownian motion** (log-normal price distribution, constant drift and volatility)
- **No dividends** in the basic form; the Merton extension handles continuous dividends via yield q

- **Constant risk-free rate** r over the life of the option
- **No transaction costs, taxes, or restrictions** on short selling
- The option can only be exercised at expiry (**European**)
- Continuous trading is possible — the underlying can be delta-hedged continuously

Under these assumptions, arbitrage arguments (the "replicating portfolio" — a combination of the underlying and a risk-free bond that exactly replicates the option payoff) lead to the Black-Scholes PDE, whose solution is the famous pricing formula.

The d1 and d2 Terms

The two intermediate values in the Black-Scholes formula carry the probability structure of the model.

```
d1 = [ln(S/K) + (r-q+σ²/2)T] / (σ√T)
```

```
d2 = d1 - σ√T
```

N(d2) is the risk-neutral probability that the call ends ITM. N(d1) is the delta of the call — it weights the spot term because it accounts for the expected magnitude of the payoff, not just its probability.

Put-Call Parity

A fundamental no-arbitrage relationship between call and put prices with the same strike and expiry:

```
C - P = S·e^(-qT) - K·e^(-rT)
```

This means you can always derive the put price from the call price (and vice versa) without re-running the full formula. If this relationship is violated in the market, a risk-free arbitrage profit is available.

Risk-Neutral Pricing

Black-Scholes prices options as if investors were risk-neutral — indifferent between a certain return and a risky return with the same expected value. In this fictional world, all assets grow at the risk-free rate r. This is not a description of the real world; it is a mathematical device that gives the correct no-arbitrage price regardless of actual investor preferences.

Geometric Brownian Motion

The standard model for asset price dynamics:

```
dS = μS·dt + σS·dW
```

where μ is the drift, σ is volatility, and dW is a Wiener process (continuous random walk). GBM implies log-normally distributed prices — prices can never go negative, and log returns are normally distributed. The Monte Carlo engine discretises this SDE to generate random paths.

Intrinsic vs. Time Value

Option premium = Intrinsic Value + Time Value. Intrinsic value is what the option is worth if exercised immediately. Time value is the extra premium the market pays for the possibility that the option moves further ITM before expiry. Time value decays continuously (Theta) and reaches zero at expiry. ATM options have zero intrinsic value but maximum time value.

Implied Volatility

While historical volatility is computed from past returns, **implied volatility** is the value of σ that makes the Black-Scholes formula equal to the observed market price. It represents the market's forward-looking expectation of volatility — the price of uncertainty. The VIX (fear gauge) is derived from S&P 500 option IVs. Higher IV = more expensive options = the market expects larger moves.

Moneyness

The relationship between the current spot price S and the strike K. **ITM:** option has positive intrinsic value. **ATM:** S ≈ K, maximum time value, maximum Vega and Gamma. **OTM:** option has no intrinsic value; only time value. Deep OTM options have low probability of expiring ITM but provide the highest leverage if they do — the "lottery ticket" characteristic.

Volatility Smile / Skew

In real markets, the Black-Scholes model's assumption of constant volatility is violated — options at different strikes trade at different implied volatilities, creating a "volatility smile" or "skew." Equity markets typically show a leftward skew: OTM puts command higher IV than OTM calls (crash insurance premium). This tool assumes a flat vol surface but teaches the underlying mechanics.

The Greeks — systematic risk dimensions

The Greeks collectively describe how an option position is exposed to each dimension of market risk. A fully hedged (delta-neutral, gamma-neutral, vega-neutral) option portfolio is theoretically riskless — but achieving and maintaining such a hedge is costly and practically impossible. Understanding which Greeks dominate a position is the first step in professional options risk management.

Delta-Gamma-Theta triangle

The most important interrelationship among the Greeks: long options have positive Gamma (convexity — you benefit from large spot moves) and negative Theta (you pay for that convexity through time decay). Short options have the reverse. In a delta-hedged world, the Gamma and Theta of a position are in direct opposition — the daily time decay is approximately balanced by the gain from daily spot volatility. This is the core insight behind the Black-Scholes model: pricing an option means pricing this trade-off.

SECTION 12

Saving Models & Exporting PDFs

Two productivity features — **Save Model** and **Export PDF** — are available to Trial and Premium users. Free users can run the full pricing engine, explore all seven tabs, and run Monte Carlo simulations on-screen; saving and exporting require an account.

FEATURE	FREE	TRIAL	PREMIUM
Options Pricing (BS)	✓ Unlimited	✓ Unlimited	✓ Unlimited
All 7 Analysis Tabs	✓ Unlimited	✓ Unlimited	✓ Unlimited
Monte Carlo Simulation	✓ Unlimited	✓ Unlimited	✓ Unlimited

Export PDF	✗ Not available	✓ Unlimited	✓ Unlimited
Save Model	✗ Not available	Up to 3 models	✓ Unlimited
Load Saved Model	✗ Not available	✓ All saved models	✓ All saved models

Exporting a PDF Report

Click the ⬇ **Export PDF** button (in the left panel) after setting your contract parameters. The tool generates a formatted A4 landscape PDF entirely in your browser — no data is sent to a server — and downloads it immediately.

STATS BAR VALUES

The dark stats bar values — Call/Put Premium, Intrinsic Value, Time Value, and Break-even Price — are included in the PDF, providing the headline option pricing results at a glance.

BS PARAMETERS

All six contract parameters (Spot, Strike, Days to Expiry, Implied Volatility, Risk-free Rate, Dividend Yield) and the Call/Put selection are listed in the PDF, making the report fully reproducible — a reader can re-enter these parameters into the tool to get the same results.

CHART SNAPSHOT

A high-resolution snapshot of the active chart is embedded in the PDF. This captures whichever analysis is most relevant — Greeks chart, payoff diagram, or sensitivity matrix — depending on what is visible when you export.

GREEKS TABLE

The full Greeks table (Delta, Gamma, Theta, Vega, Rho, Prob ITM) for the current contract is included in the PDF, providing a complete risk profile of the option alongside the pricing.

Saving and Loading Models

A **model** is a named snapshot of all your current contract parameters. Saving a model lets you return to a specific option configuration in any future session with a single click — useful for tracking a specific option chain over multiple days or comparing multiple scenarios.

1 CLICK "SAVE MODEL"

The Save Model button appears in the left panel once you are logged in with a Trial or Premium account. Click it after setting the contract parameters you want to save.

2 ENTER A MODEL NAME (UP TO 10 CHARACTERS)

Choose a short, memorable name — for example NFTY-CE, AAPL-PUT, or STRADDLE1. The name identifies the model in the dropdown. Saving with an existing name prompts you to confirm overwrite.

3 LOAD IT ANY TIME FROM THE DROPDOWN

Select any saved model from the Load saved model dropdown. All parameters (spot, strike, days, vol, rate, yield, call/put) are restored instantly and all calculations update, so you can continue from exactly where you left off.

Trial — up to 3 saved models

During a Trial, you can save up to three distinct option configurations. Overwriting an existing model (saving under the same name) does not consume an additional slot. When the three-model limit is reached, overwrite an existing model or upgrade to Premium to save more.

Premium — unlimited saves

Premium users can save as many option models as needed. This is especially useful for analysing an entire option chain (saving each strike separately), tracking how a position's Greeks evolve day by day, or maintaining a library of strategy templates for client presentations.

What is stored in a saved model?

Call/Put selection · Spot Price (base) · Strike Price (base) · Days to Expiry · Implied Volatility (base) · Risk-free Rate · Dividend Yield · Project Title, Name, Roll Number, and Date. All values are stored as entered at the time of saving. Slider positions and Monte Carlo results are not stored — the simulation is re-run fresh each session.

SECTION 13

Glossary of Terms

A quick-reference table of every technical term used in the tool and this guide, from foundational option theory to Monte Carlo methods.

TERM	DEFINITION	IN THIS TOOL
European Option	An option contract that can only be exercised at expiry, not before. Black-Scholes prices European options exactly. Contrast with American options, which can be exercised any time before expiry and require different valuation methods.	The only type priced in this tool. Both call and put toggles price European contracts.
Call Option	The right (but not the obligation) to buy the underlying asset at the strike price at expiry. Pays off max(S_T − K, 0). Profitable when spot rises above the break-even (K + Premium).	Selected via the Call toggle button. All formulas, charts, and Greeks update accordingly.
Put Option	The right (but not the obligation) to sell the underlying asset at the strike price at expiry. Pays off max(K − S_T, 0). Profitable when spot falls below the break-even (K − Premium).	Selected via the Put toggle button.
Spot Price (S)	The current market price of the underlying asset. The most important driver of whether an option is in or out of the money.	Spot Price input. Default 100. Slider range ±50% of base.
Strike Price (K)	The price at which the option holder may buy (call) or sell (put) the underlying at expiry. Fixed at the time of purchase and does not change.	Strike Price input. Default 105. Slider range ±50% of base.
Time to Expiry (T)	The remaining life of the option, expressed in	Days to Expiry

	years. Converted from calendar days: T = Days / 365. As T → 0, time value collapses to zero and the option price approaches its intrinsic value.	input (1-730 days). Default 30 days. Synced slider and text input.
Implied Volatility (σ)	The market's expectation of future volatility, implied by the option's current market price. In this tool, you supply it directly. Higher IV means more expensive options. The single biggest driver of time value.	Implied Volatility input. Default 20%. Slider range ±50% of base.
Risk-free Rate (r)	The annual continuously compounded return on a riskless investment (short-term government bond). Used to discount future payoffs to present value and to compute the cost-of-carry on the underlying.	Risk-free Rate input. Default 5%. Direct input only.
Dividend Yield (q)	The continuous annual yield paid by the underlying asset. Reduces the effective forward price of the underlying, lowering call prices and raising put prices via the Merton adjustment.	Dividend Yield input. Default 0%. Direct input only.
Black-Scholes Formula	The closed-form solution for European option pricing derived by Fischer Black, Myron Scholes, and Robert Merton in 1973. Assumes log-normal price distribution, constant vol, and continuous hedging. The industry benchmark for European options.	The primary pricing engine. All stats bar values and Greeks are BS-derived.
Intrinsic Value	The immediate exercise value of the option: max(S-K,0) for a call, max(K-S,0) for a put. Always ≥ 0. An option's price is always at least its intrinsic value (otherwise arbitrage exists).	Second cell of the stats bar.
Time Value	The portion of the option premium above intrinsic value. Represents the probabilistic value of the option potentially moving further ITM before expiry. Decays to zero at expiry. Highest for ATM options.	Third cell of the stats bar. = Premium − Intrinsic Value.
Break-even	The terminal spot price at which the option buyer's net P&L is exactly zero. For a call: K + Premium. For a put: K − Premium. The underlying must move beyond the break-even for the buyer to profit.	Fourth cell of the stats bar. Also shown on the Payoff chart.
Delta (Δ)	Rate of change of option price with respect to spot price. Ranges 0 to +1 for calls, -1 to 0 for puts. Approximately equals the probability the option expires ITM. Also the hedge ratio for delta-hedging.	Greeks tab table. Also the Y-axis of the Delta vs. Spot chart.
Gamma (Γ)	Rate of change of Delta with respect to spot price. Second derivative of option price with respect to spot. Measures convexity. Highest for ATM options near expiry. Positive for long options, negative for short options.	Greeks tab table.

Theta (θ)	Rate of change of option price with respect to the passage of time (time decay). Always negative for long options. Expressed as daily price decay. Accelerates as expiry approaches for ATM options.	Greeks tab table. Shown as daily decay.
Vega (ν)	Rate of change of option price with respect to a 1% change in implied volatility. Always positive for long options. Highest for ATM options with long time to expiry. Vega and Gamma tend to move together.	Greeks tab table. Shown as price change per 1% vol change.
Rho (ρ)	Rate of change of option price with respect to a 1% change in the risk-free rate. Positive for calls, negative for puts. Generally the least important Greek for short-dated options. More significant for LEAPS (1-2 year options).	Greeks tab table. Shown as price change per 1% rate change.
Prob ITM	The risk-neutral probability that the option expires in the money: N(d2) for a call, N(-d2) for a put. Distinct from Delta, which is N(d1) — Delta accounts for the magnitude of the payoff, not just its occurrence.	Greeks tab table. Also in the BS vs MC comparison tab.
Geometric Brownian Motion	The standard stochastic process used to model asset prices: $dS = \mu S \cdot dt + \sigma S \cdot dW$. Implies log-normally distributed prices, which are always positive. The foundation of the Black-Scholes model and the Monte Carlo engine.	Used in the MC Paths tab to generate simulated price trajectories.
Monte Carlo Simulation	Pricing by simulating a large number of random price paths and averaging the discounted payoffs. Converges to the Black-Scholes price for European options as $N \to \infty$. The industry standard for pricing exotic and path-dependent options.	The secondary pricing engine. Controls in the left panel; results in BS vs MC, Paths, and Distribution tabs.
Standard Error (SE)	The statistical precision of the MC price estimate: $SE = \sigma_{payoff} / \sqrt{N}$. A 95% confidence interval is approximately MC Price ± 1.96 · SE. Halved by quadrupling the number of simulations.	Shown in the BS vs MC comparison tab. Also the width of the error bar on the Price vs. Volatility chart.
Put-Call Parity	No-arbitrage relationship: $C - P = S \cdot e^{-qT} - K \cdot e^{-rT}$. Holds exactly in frictionless markets. Means call and put prices are not independent — knowing one determines the other.	Implicitly enforced by the Black-Scholes formula. Visible by toggling call/put and observing premium changes.
Moneyness	The relationship of spot to strike. ITM (call: $S>K$; put: $S<K$), ATM ($S \approx K$), OTM (call: $S<K$; put: $S>K$). Determines the split between intrinsic and time value.	Shown as a colour-coded bar beneath the contract parameters.
Delta Hedging		The Delta value

	Buying or selling shares of the underlying to offset an option's delta exposure. A delta-neutral position has Δ = 0 and is insensitive to small spot moves. Because gamma is non-zero, the hedge must be rebalanced as spot moves — continuous rebalancing is the Black-Scholes model's core assumption.	in the Greeks tab is the hedge ratio: to delta-hedge 1 short call with Δ=0.6, buy 0.6 shares of the underlying.
Volatility Smile	The empirical pattern where options at different strikes command different implied volatilities, violating the Black-Scholes assumption of constant vol. Equity markets typically show a downward skew (higher IV for OTM puts) due to crash risk premiums.	Not modelled explicitly — the tool assumes a flat vol surface. Adjust the IV input to explore the effect of different vol assumptions manually.
Log-normal Distribution	A distribution where the logarithm of the variable is normally distributed. If returns are normally distributed, prices are log-normally distributed — they can never go below zero, and are right-skewed. The terminal price distribution visible in the Distribution tab.	Shown as the histogram in the Distribution tab after running Monte Carlo.

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