What Exactly Is an Option?

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September 2026

1 An Intuitive First Look

Imagine a stock trading today at Rs. 1,000. An investor believes the underlying company might launch a successful new product over the next three months, but also recognizes that broader market headwinds could drag the stock price down significantly.

Instead of buying the stock outright for Rs. 1,000, taking on the full risk of a price decline, the investor pays an upfront fee of Rs. 50 to a counterparty for a contract. This contract grants the investor the right, but not the obligation, to buy one share of the stock at a fixed price of Rs. 1,000 exactly three months from today.

What happens at the end of the three months?

- **Scenario A (Stock rises to Rs. 1,200):** The investor exercises their right, purchasing the stock for Rs. 1,000 when its market value is Rs. 1,200. This yields a gross payoff of Rs. 200. Subtracting the initial Rs. 50 fee, the investor realizes a net profit of Rs. 150.
- **Scenario B (Stock falls to Rs. 800):** Paying Rs. 1,000 for an asset available on the open market for Rs. 800 would be irrational. The investor simply walks away. The contract expires unexercised, yielding a gross payoff of Rs. 0, and the investor's net loss is strictly capped at the upfront Rs. 50 fee.

By decoupling the right to execute a transaction from the obligation to do so, an option creates a distinctly nonlinear structure: the terminal payoff is bounded below by zero, while the buyer's maximum loss is limited to the premium paid.

2 Anatomy of an Option: Roles and Parameters

Every option agreement is defined by two counterparties in asymmetric positions:

- **The Holder (Buyer):** Pays an upfront cash price, known as the option premium, to acquire the right, but not the obligation, to execute the transaction.
- **The Writer (Seller):** Receives the upfront premium and assumes the obligation to fulfill the transaction if the holder chooses to exercise.

The contract is specified by three core parameters:

1. **Underlying Asset (S):** The security, commodity, or index upon which the option contract is written (for instance, a share of stock whose spot price at time t is denoted S_t).
2. **Strike Price (K):** The pre-agreed, fixed price at which the underlying asset will be bought or sold if the option is exercised (Rs. 1,000 in our opening example).
3. **Expiration Date (T):** The maturity date marking the end of the contract's life.

Options are categorized by the nature of the right granted:

- A **Call Option** grants the holder the right to buy the underlying asset at strike price K.

- A **Put Option** grants the holder the right to sell the underlying asset at strike price K.

While exercise styles can vary (American options permit exercise at any time prior to expiration), we focus here on European options, which can be exercised exclusively at the exact maturity date T.

To see how options serve real-world business needs beyond speculative trading, consider an airline hedging against jet fuel price volatility. Spikes in jet fuel prices threaten the airline's operating margins. To protect itself while retaining the benefit of lower prices, the airline purchases European call options on jet fuel with a strike price of \$2.50 per gallon, paying an upfront premium. If global fuel prices surge to \$3.50 per gallon at maturity, the airline exercises its options, acquiring fuel at \$2.50. If fuel prices drop to \$1.80 per gallon, the airline lets the options expire unexercised and purchases fuel on the spot market at \$1.80. The option functions as financial insurance: it shields against catastrophic price increases while preserving the benefit of lower market prices.

3 The Geometry of Payoffs and Profits

Consider a European call option maturing at time T with strike price K. At expiration, the holder compares the prevailing stock price S_T to the strike price K. If $S_T > K$, exercising yields $S_T - K$. If $S_T \leq K$, the option expires worthless, yielding 0.

Mathematically, the terminal payoff of a European call option C_T is:

$$C_T = \max(S_T - K,\, 0) = (S_T - K)^+. \tag{1}$$

Here, $\max(S_T - K, 0)$ represents the maximum of the two quantities, and the superscript $+$ denotes taking the positive part.

Conversely, for a European put option, the holder exercises when $S_T < K$, selling the stock for K when its market price is lower. The terminal payoff P_T is:

$$P_T = \max(K - S_T,\, 0) = (K - S_T)^+. \tag{2}$$

It is essential for students to distinguish between an option's gross payoff and its net profit:

$$\text{Net Profit} = \text{Terminal Payoff} - \text{Initial Premium Paid}. \tag{3}$$

For a call option buyer who pays an initial premium C_0 at time $t = 0$, the net profit at expiration Π_T is:

$$\Pi_T = (S_T - K)^+ - C_0. \tag{4}$$

While the terminal payoff $(S_T - K)^+$ is strictly non-negative, the net profit Π_T can be negative if the terminal payoff is less than the initial premium C_0. However, the buyer's worst-case net loss is strictly capped at $-C_0$, occurring whenever $S_T \leq K$.

4 Intrinsic Value, Time Value, and Volatility

Prior to expiration ($t < T$), an option possesses value long before its final payoff is realized. At any time $t < T$, the total market price of an option can be decomposed into two components:

$$\text{Option Price} = \text{Intrinsic Value} + \text{Time Value}. \tag{5}$$

Intrinsic Value represents what the option would be worth if it were to expire right now. Mathematically, the intrinsic value at time t is:

$$\text{Call Intrinsic Value} = (S_t - K)^+, \qquad \text{Put Intrinsic Value} = (K - S_t)^+. \tag{6}$$

Based on intrinsic value, options are categorized into three regimes:

- **In-the-Money (ITM):** Positive intrinsic value ($S_t > K$ for a call; $S_t < K$ for a put).
- **At-the-Money (ATM):** Underlying price equals the strike price ($S_t = K$).
- **Out-of-the-Money (OTM):** Zero intrinsic value ($S_t < K$ for a call; $S_t > K$ for a put).

Time Value (or extrinsic value) is the additional value the market commands above intrinsic value due to the remaining uncertainty before expiration. Even if a call option is currently out-of-the-money ($S_t < K$), there remains a non-zero probability that the stock price will rise above K by time T. Because the holder faces no downside payoff below zero, this upside potential gives the contract positive market value today.

For standard vanilla calls and puts, greater volatility generally increases option value, all else equal. In traditional asset holding, price volatility increases risk. For an option holder, however, unfavorable outcomes do not produce a negative payoff for the holder, while favorable price movements can create larger payoffs.

5 Payoff versus Price: The Central Question

A critical distinction in quantitative finance is the difference between an option's terminal payoff C_T at expiration and its market price C_t today ($t < T$).

At maturity T, once S_T is known, the option's payoff is determined by the payoff formula $(S_T - K)^+$.

Prior to maturity, however, today's price C_t depends on several interacting factors: the current stock price S_t, the strike price K, the time remaining to maturity $T - t$, the volatility of the underlying asset, and prevailing interest rates.

For any unexpired call, $C_t > (S_t - K)^+$ whenever $S_t \leq K$, reflecting the positive time value of future uncertainty.

Understanding what an option contract gives its holder, a one-sided right built on conditional choices, is the necessary first step.

The central question that drives all of derivative theory is:

If we know what an option may pay in the future, how do we determine what that uncertain right is worth today?