

- **Option** is a contract that gives the holder a right, without any obligation, to buy or sell an underlying asset at a given exercise (or strike) price on or before a specified expiration period. The underlying asset (i.e., asset on which right is written) could be a share or any other asset.
- **Call Option** is a right to buy an asset. A buyer of a call option on a share will exercise his right when the actual share price at expiration (S_t) is higher than the exercise price (E), otherwise, he will forgo his right.
- **Put Option** is a right to sell an asset. The buyer of a put option will exercise his right if the exercise price is higher than the share price; he will not exercise his option if the share price is equal to or greater than the exercise price.
- **American Option** can be exercised at expiration or any time before expiration while European options can be exercised only at expiration.

➤ **In/Out/At the Money**

<i>Call option</i>		<i>Put option</i>
Exercise if $S_t > E$	in-the-money	Exercise if $E > S_t$
Do not exercise if $S_t < E$	out-of-the-money	Do not exercise if $E < S_t$
Do not exercise if $S_t = E$	at-the-money	Do not exercise if $S_t = E$

- **Value of a Share Option** There are five factors that affect the value of a share option: (1) the share price, (2) the exercise price, (3) the volatility (standard deviation) of the share return, (4) the risk-free rate of interest, and (5) the option's time to expiration.

- **Value of a Call** At expiration the maximum value of a call option is:

$$\text{Value of call option at expiration} = \text{Max} [(S_t - E), 0]$$

Call Option's Value will increase with increase in the share price, the rate of interest, volatility and time to expiration. It will decline with increase in the exercise price.

- **Value of Put Option** at expiration is:

$$\text{Value of put option at expiration} = \text{Max} [(E - S_t), 0]$$

Put Option's Value will increase with increase in the exercise price, volatility and time to expiration. It will decrease with increase in the share price, and the rate of interest.

- **Several Trading Strategies (Hedged Position)** An investor can create a hedged position by combining a long position in the share with a long position in a protective put—a put that is purchased at-the-money (exercise and current share prices being the same).
- **Straddle** The investor can also create a portfolio of a call and a put with the same exercise price. This is called a straddle.
- **Spread** If call and put with different exercise price are combined, it is called a spread.
- **Value of Call and Put in case of Dividend Paying Shares** The value of call decreases and the value of put increases in the case of dividend paying shares.

- **Black and Scholes (B–S) Model** to value a European call option:

$$C_0 = SN(d_1) - Ee^{-r_ft}N(d_2)$$

where C_0 = the value of an option, S = the current market value of the share, E = the exercise price, $e = 2.7183$, the exponential constant, r_f = the risk-free rate on interest, t = the time to expiration (in years), σ = the standard deviation of the continuously compounded annual return on the share and $N(d_1)$, $N(d_2)$ = the cumulative normal probability density function. d_1 and d_2 can be calculated as follows:

$$d_1 = \frac{\ln(S/E) + [r_f + \sigma^2/2]t}{\sigma\sqrt{t}}$$

$$d_2 = d_1 - \sigma\sqrt{t}$$

$\ln$ = the natural logarithm

The term $N(d_1)$ in the B–S model is interpreted as a hedge ratio, or the call option's delta. The option delta indicates the number of units of a share to be bought for each call sold.

- **Put-Call Parity** There is a fixed relationship between put and call on the same share with similar exercise price and maturity period. This relationship, called put-call parity, is given as follows:

$$\text{Value of put} + \text{value of share} = \text{value of call} + \text{PV of exercise price}$$

- **Option in Case of an Ordinary Share** There is a hidden option in the case of an ordinary share that arises because of the limited liability of the shareholders. Shareholders have a call option on the firm with an exercise price equal to the required payment for debt. Shareholders will exercise their option to keep the firm (by making required payment to debt-holders) if the value of the firm is higher than the debt payment.