Call options on stocks

If you buy a call option (1 contract) on XYZ stock, you get the right (but not the obligation) to buy 100 shares of XYZ at a certain price (the strike price), quoted per share,

- on or before the expiration date (American call option)
- on the expiration date (European call option)

The price you pay is quoted per share, so if it is $0.85, you pay $85.00 for 1 contract.

The expiration date (on US exchanges) is the third Friday of each month, except for weekly options for which it is the Friday of that week (trading begins on Thursday of the preceding week).
Ch. 1. Introduction to derivatives

Def. A derivative is a financial instrument whose value is determined by the price of another quantity (the underlying asset), such as a stock, a stock index, or a commodity, interest rate, exchange rate.

Ex. Options, futures, swaps.

Trading of financial assets
- buyer and seller agree on a price
- the trade is cleared (obligations of each party are specified)
- the trade is settled (obligations are fulfilled)
- ownership records are updated

Ex. Exchanges use clearinghouses to clean trades.

Examples of exchanges: NYSE, Nasdaq, CBOE, ICE

CME Group, LIFFE

Trading can also be made through dealers (bonds) or over-the-counter (OTC)
Measures of market size and activity:
- Trading volume (e.g., number of shares, number of option contracts)
- Market value ("market cap", cap = capitalization)
- Notional value (e.g., if an option)
- Open interest (number of existing contracts, not of counterparties)

Uses of derivatives:
- Risk management (hedging, insurance)
- Speculation
- Reduced transaction costs (in special situations)
- Regulatory arbitrage (e.g., taxes)

Perspectives on derivatives:
- By the end-user (investors, risk managers, etc.)
- By the market-maker
- By the "economic observer"

Financial engineering (regarding derivatives):
- Construction of (combinations of) derivatives for prescribed purposes (of the client)
Aspects of buying and selling financial assets

- **transaction costs** (e.g. commissions, fees)
- **bid-ask spread** (can be large for options)
  - buy at ask price
  - sell at bid price

Ways to buy or sell

- **market order** (executed at current market price; commission may be lower)
- **limit order** (executed at the "limit price" that you specify, or better (for you))

- many other possibilities, such as stop-loss order

(************** Meaning of long/short positions **************)

Short-selling

Selling something (e.g., a stock) you do not have, so you have to buy it back later.

Uses

- speculation (hoping that the asset value goes down)
- financing (borrowing the proceeds of the sale)
- hedging (to offset the risk of another investment)

The short-seller must pay dividends (if any) until the short sale is closed. ("leaves rate")

May have to post collateral ("haircut") on which low interest is paid ("repo rate" (banks), "short rebate" (stocks)).
Ch. 2: Introduction to forwards and options

Def. A forward contract is an agreement to buy or sell a specific asset at a certain future time at a pre-set price. The contract specifics:
- the quantity and exact type of the asset or commodity the seller must deliver
- the time, date and place of delivery
- the price the buyer must pay at the time of delivery
- the obligation of the seller to sell and the buyer to buy, according to the above conditions.

Expiration date: the time of settlement
Underlying asset: the asset that is traded

There may be commissions and a bid-ask spread, but no initial payment (or premium).

Payoff (not profit) of a forward contract:
- long = short = spot price at expiration - forward price

Payoff of long

forward price

Spot price
payoff = cash value of position at a certain time (here the settlement time)

net payoff or profit = payoff minus future value of the investment in the position

To figure the future value assumptions must be made (e.g. about a risk-free interest rate)
By purchasing a call option on a stock, (1 contract), one obtains the right the buy 100 shares of the stock at the strike price (K) at the expiration date (T) (European) or also at any time before T (American). (During certain periods only, Bermudan-style option)

By selling a call, one accepts the obligation to sell the stock at K if the option buyer exercises the option.

**Notation:**
Stock price at time t: S_t

A call option is in the money at time t if $S_t > K$.

A put is out of the money if $S_t < K$. 

A put is in the money if $S_t > K$. 

A put is at the money if $S_t = K$. 

A put is out of the money if $S_t < K$. 

A call is in the money if $S_t > K$.
Payoff of

\[
\begin{align*}
\text{long call} & = \max \{ 0, S_T - K \} = (S_T - K)^+ \\
\text{short call} & = -(S_T - K)^+ \\
\text{long put} & = (K - S_T)^+ \\
\text{short put} & = -(K - S_T)^+
\end{align*}
\]

\[
\text{long call} \quad \text{short call} \quad \text{long put} \quad \text{short put}
\]

Profit on options depends also on initial price paid or received and assuming an interest rate.

If interest rate = 0% (almost true today) and premium = \( P \) then profit of

\[
\begin{align*}
\text{long call} & = (S_T - K)^+ - P \\
\text{short call} & = P - (S_T - K)^+ \\
\text{long put} & = (K - S_T)^+ - P \\
\text{short put} & = P - (K - S_T)^+
\end{align*}
\]
Profit if annual interest rate (risk-free) is \( r \) (e.g., 5% \( \rightarrow r = 0.05 \)) and interest is continuously compounded (other assumptions on compounding lead to slightly different formulas) if present time is 0 (\( t=8 \) now):

- long call \((S_T - K)^+ - Pe^{-rT}\)
- short call \(Pe^{-rT} - (S_T - K)^+\)
- long put \((K - S_T)^+ - Pe^{-rT}\)
- short put \(Pe^{-rT} - (K - S_T)^+\)
Delivery methods

E.g., for S&P 500 index

SPY shares
SPX cash settlement