Financial Market Uncovered – Article 1

Mastering Options: The Foundation of Derivatives Trading

Kilian Voillaume

March 3, 2025

Contents

1 What are options? 3

1.1 Understanding Call and Put options 3

Key components of an option contract 3

1.2 Visualisation of a call and put option's payoff 4

2 The mechanics of options trading 5

2.1 How do traders buy and sell options: Market Makers 5

2.2 Long vs short positions 5

2.3 Understanding Moneyness: ITM, ATM, and OTM 6

3 Practical use cases for options 7

3.1 Hedging: Using options to protect against losses 7

3.2 Speculation: Leveraging options for high-reward trades 7

4 Appendix 8

5 References 9

1 What are options?

Options are among the most powerful tools available to traders and investors. They can be used to hedge risks, speculate on price movements, but can also help in constructing complex strategies that stocks alone could not. However, they are often misunderstood due to their unique characteristics.

Options are financial contracts that give their holder the right—but not the obligation—to buy or sell an underlying asset at a set price, before or on a specific expiration date. This makes them quite different from other financial contracts such as futures contracts, where both parties are required to fulfil the agreement.

It costs a trader nothing to enter a forward or a future contract, whereas purchasing an option requires an up-front payment. Options are commonly used in stock, commodity, and forex markets.

1.1 Understanding Call and Put options

A *Call option* gives the holder the right to buy an asset by a certain date for a certain price. A *Put option* gives the holder the right to sell an asset by a certain date for a certain price.

There are primarily two types of options traded, *European* and *American*. *European options* can only be exercised on the expiration date itself, while *American options* can be exercised at any time up to the expiration date.

Key components of an option contract

1. Strike price (Exercise price)

The *strike price* is the predetermined price at which the option holder can buy (for a call) or sell (for a put) the underlying asset. The relationship between the strike price and the market price is what determines the option's value at expiration.

For a call option to be profitable, the market price of the underlying must be above the strike price. For a put option to be profitable, the market price must be below the strike price.

2. Expiration date (Maturity Date)

As options are time-sensitive financial contracts, they remain valid until their expiration date. Once an option expires, it either has value (if it is in-the-money) or becomes worthless (if it is out-of-the-money).

Short-term options can expire in a few weeks, while longer options—known as **LEAPS (Long-term Equity Anticipation Securities)**— can have a much longer expiration date.

3. Premium (Cost of an option)

The *premium* is the price that the holder must pay in order to hold the option. This cost fluctuates based on volatility, the underlying stock price, and the time until maturity.

The premium acts as a vertical offset in the option's payoff graph, shifting the profit and loss curve downward for calls and upwards for puts. This means that your breakeven point is determined by the strike price plus the premium (for a call), minus the premium (for a put).

1.2 Visualisation of a call and put option's payoff

We have the following formulas to represent a call and a put payoff and profit:

$Call\ option$:	$Put\ option$:
$Buyer's_{payoff} = \max(0, S_t - K) * n$	$Buyer's_{payoff} = \max(0, K - S_t) * n$
$Buyer's_{profit} = (\max(0, S_t - K) - C) * n$	$Buyer's_{profit} = (\max(0, K - S_t) - C) * n$
$Seller's_{payoff} = -\max(0, S_t - K) * n$	$Seller's_{payoff} = -\max(0, K - S_t) * n$
$Seller's_{profit} = (-\max(0, S_t - K) + C) * n$	$Seller's_{profit} = (-\max(0, K - S_t) + C) * n$

Where S_t: stock price, K: strike price, C: premium, and n: number of contracts

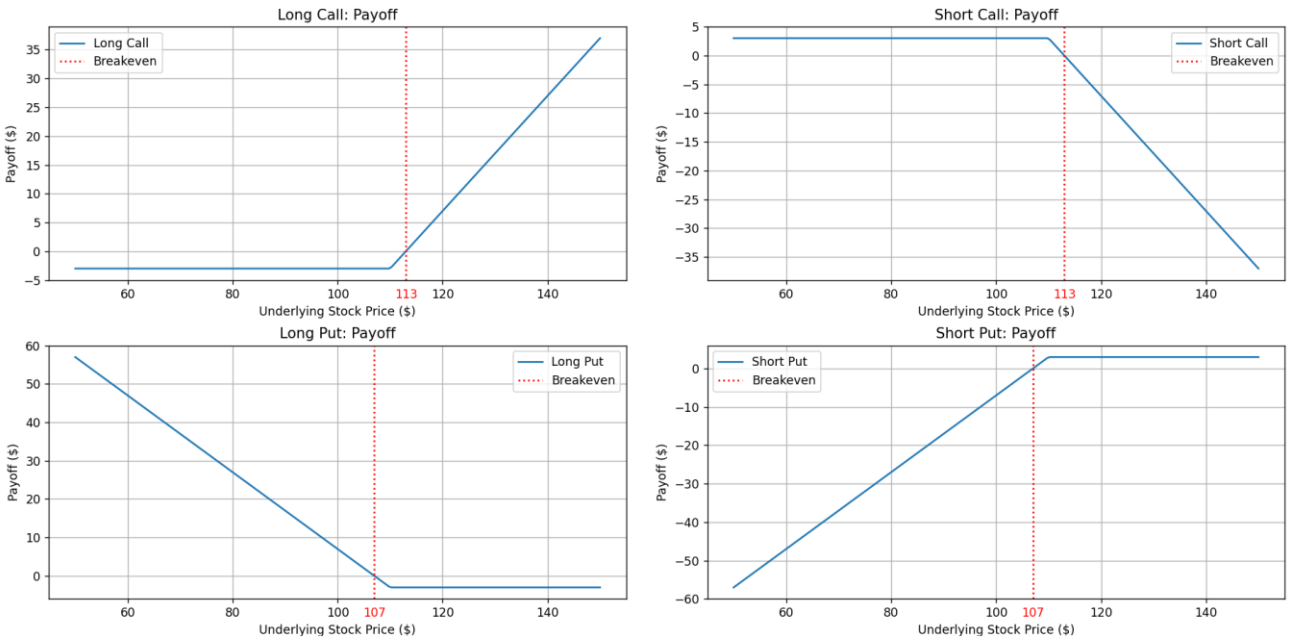

Figure 1: Options payoff diagrams for positions with Strike Price = 110 and Premium = 3

You can find the python code in the appendix.

2 The mechanics of options trading

2.1 How do traders buy and sell options: Market Makers

Options trading used to be conducted in open and large area where individuals would meet and trade options. Nowadays, most derivatives exchanges operate electronically, so traders don't have to meet physically. The trading takes place in regulated markets such as the *Chicago Board Options Exchange (CBOE),* and through brokerages that provide access to options contracts.

When you buy an option, you are not necessarily buying it from another retail trader. Instead, most options exchanges use *market makers* to facilitate trading. A market maker is an individual who, when asked, will quote both a bid and an offer price on the option.

The *bid* represents the price at which the market maker is willing to buy, while the *ask* is the price at which they are willing to sell. At the time the *bid* and *ask* prices are quoted, the *market maker* does not know whether the requesting trader wants to buy or sell the option. The *ask* is always higher than the *bid*, and the difference between them is called the *bid-ask spread*.

The existence of the *market maker* ensures that buy and sell orders can always be executed at a given price without any delays. *Market makers* thus contribute to market liquidity.

An investor who has purchased an option can close out their position simply by issuing an offsetting order to sell the same option. Similarly, they can close out their position in the case where they have written an option by issuing an offsetting order to buy the same option.

2.2 Long vs short positions

In options trading, you can either buy (go *long*) or sell (go *short*) an option contract. Each position has different risk-reward dynamics:

1. Long positions (buying options)

When traders take a *long position*, they buy an option, and therefore pay a premium for it. The maximum risk for a *long position* is limited to the premium paid. Potential profits are unlimited for a call option and significant for put options.

Long Call: Profits when the underlying asset rises above the strike price.

Long Put: Profits when the underlying asset falls below the strike price.

2. Short positions (selling options)

When traders take a *short position*, they sell an option. They do not pay any premium but rather collect it from the buyer. Selling options can be highly risky because potential losses can be unlimited for short calls.

Short Call: Loses money when the underlying asset rises above the strike price.

Short Put: Loses money when the underlying asset falls below the strike price.

Position	Max Profit	Max Loss	Best Outcome	Worst Outcome
Long Call	Unlimited	Premium Paid	Stock price rises significantly	Stock stays below strike price
Long Put	Strike Price – Premium	Premium Paid	Stock price falls significantly	Stock stays above strike price
Short Call	Premium Received	Unlimited	Stock stays below strike price	Stock skyrockets
Short Put	Premium Received	Strike Price – Premium	Stock stays above strike price	Stock crashes

2.3 Understanding Moneyness: ITM, ATM, and OTM

Moneyness refers to the relationship between the current stock price and the option strike price. It determines whether an option has intrinsic value or is purely speculative.

1. In-The-Money (ITM)

For Calls: The stock price is above the strike price

For Puts: The stock price is below the strike price

ITM options have intrinsic values and are more expensive, with higher premiums.

2. At-The-Money (ATM)

An option is considered ATM when the stock price matches the strike price. ATM options have no intrinsic value but still carry extrinsic value (time).

3. Out-Of-The-Money (OTM)

For Calls: The stock price is below the strike price.

For Puts: The stock price is above the strike price.

OTM options are mostly speculative. They are cheaper but carry a higher risk of expiring worthless.

3 Practical use cases for options

3.1 Hedging: Using options to protect against losses

Hedging is a strategy to limit investing risks. Investors hedge an investment by making a trade in another asset that is likely to move in the opposite direction. It limits downside losses while still allowing for potential upside gains.

Protecting a stock portfolio with puts (protective put strategy)

Suppose an investor owns 100 shares of Microsoft (MSFT) at $400 but is worried about a potential market downturn. The investor can buy a put option on MSFT, with a strike price of $380, expiring in one month.

- If Microsoft's stock drops to $350, the put option allows the investor to sell at $380, limiting losses
- If Microsoft's stock rises to $450, the put option expires worthless, but the investor still benefits from selling the stock.

3.2 Speculation: Leveraging options for high-reward trades

Options are also popular for speculation, as they allow traders to bet on short-term price movements with leveraged positions. They allow traders to control a large position with a small upfront investment, creating a high-risk, high-reward opportunity.

Bullish speculation: Buying call options

Suppose a trader believes that Microsoft's share price will rise from $400 to $450 within the next month. Instead of buying 100 shares at $40,000, the trader could buy an MSFT $420 call option for $10 per share (making the total cost for the premium $1,000).

- If MSFT rises to $450, the call option gains value, $30 per share ($4,500 total value).
- If MSFT stays below $420, the call option expires worthless, the trader only loses the $1,000 premium, rather than facing large stock losses.

Bearish speculation: Buying put options

Using the same example. Let's suppose a trader expects MSFT's stock price to decline from $400 to $350, they could buy a $380 put option for $10 per share ($1,000 total cost, for 100 shares).

- If MSFT drops to $350, the put option gains $30 per share ($3,000 total value).
- If MSFT remains above $380, the maximum loss is limited to the initial $1,000.

4 Appendix

```python
import numpy as np
import matplotlib.pyplot as plt

#++++++++++++++++++++++++++++
#+++++ OPTION PAYOFFS +++++++
#++++++++++++++++++++++++++++
def opayoff(S0, K, premium, otype, position):
    if otype == "call":
        payoff = np.maximum(S0 - K, 0) - premium
    elif otype == "put":
        payoff = np.maximum(K - S0, 0) - premium
    else:
        raise ValueError("Option type must be a 'call' or a 'put'")
    if position == 'long':
        return payoff
    else:    #If position is short
        return -payoff

#++++++++++++
# PARAMETERS #
#++++++++++++
S0 = np.linspace(50, 150, 200)  # Stock price range
K = 110  # Strike price
premium = 3  # Option premium
breakeven_call = K + premium
breakeven_put = K - premium

#++++++++++
# PAYOFFS #
#++++++++++
long_call = opayoff(S0, K, premium, "call", "long")
short_call = opayoff(S0, K, premium, "call", "short")
long_put = opayoff(S0, K, premium, "put", "long")
short_put = opayoff(S0, K, premium, "put", "short")

# Create subplots
fig, ax = plt.subplots(2, 2, figsize=(12, 8))

#+++++++++++++++++++++++++
#+++++ Visualization +++++
#+++++++++++++++++++++++++
ax[0, 0].plot(S0, long_call, label="Long Call")
ax[0, 0].axvline(breakeven_call, linestyle="dotted", color="red", label="Breakeven")
ax[0, 0].annotate(f'{breakeven_call}', xy=(breakeven_call, ax[0, 0].get_ylim()[0]), xytext=(0, -15),
                  textcoords='offset points', color='red', ha='center')
ax[0, 0].set_title("Long Call: Payoff")
ax[0, 0].set_xlabel("Underlying Stock Price ($)")
ax[0, 0].set_ylabel("Payoff ($)")
ax[0, 0].grid()
ax[0, 0].legend()

ax[0, 1].plot(S0, short_call, label="Short Call")
ax[0, 1].axvline(breakeven_call, linestyle="dotted", color="red", label="Breakeven")
ax[0, 1].annotate(f'{breakeven_call}', xy=(breakeven_call, ax[0, 1].get_ylim()[0]), xytext=(0, -15),
                  textcoords='offset points', color='red', ha='center')
ax[0, 1].set_title("Short Call: Payoff")
ax[0, 1].set_xlabel("Underlying Stock Price ($)")
ax[0, 1].set_ylabel("Payoff ($)")
ax[0, 1].grid()
ax[0, 1].legend()

ax[1, 0].plot(S0, long_put, label="Long Put")
ax[1, 0].axvline(breakeven_put, linestyle="dotted", color="red", label="Breakeven")
ax[1, 0].annotate(f'{breakeven_put}', xy=(breakeven_put, ax[1, 0].get_ylim()[0]), xytext=(0, -15),
                  textcoords='offset points', color='red', ha='center')
ax[1, 0].set_title("Long Put: Payoff")
ax[1, 0].set_xlabel("Underlying Stock Price ($)")
ax[1, 0].set_ylabel("Payoff ($)")
ax[1, 0].grid()
ax[1, 0].legend()

ax[1, 1].plot(S0, short_put, label="Short Put")
ax[1, 1].axvline(breakeven_put, linestyle="dotted", color="red", label="Breakeven")
ax[1, 1].annotate(f'{breakeven_put}', xy=(breakeven_put, ax[1, 1].get_ylim()[0]), xytext=(0, -15),
                  textcoords='offset points', color='red', ha='center')
ax[1, 1].set_title("Short Put: Payoff")
ax[1, 1].set_xlabel("Underlying Stock Price ($)")
ax[1, 1].set_ylabel("Payoff ($)")
ax[1, 1].grid()
ax[1, 1].legend()

plt.tight_layout()
plt.show()
```

Figure 2: Python Code for Options Visualization

5 References

[1] Hull, J. C. (2018). Options, Futures, and Other Derivatives (10th ed.). Pearson.

[2] Cox, J. C., Ross, S. A., & Rubinstein, M. (1979). Option pricing: A simplified approach. Journal of Financial Economics, 7(3), 229-263.

[3] Hull, J. C. (2001). Fundamentals of futures and options markets (4th ed.). Pearson.