

# Understanding and Pricing Spread Options

## 1 Introduction

Spread options involve the purchase of one option and the sale of another. In a call spread, a call option with a lower strike price is bought, and a call option with a higher strike price is sold. This strategy limits both the maximum gain and loss, creating a profit and loss profile with a "spread" between two strikes.

## 2 Pricing Spread Options

The value of a spread option can be calculated by taking the difference in prices of two vanilla options with different strike prices. For a call spread, the formula for the spread option price is:

$$\text{Spread Price} = \text{VanillaCall}(S, K1, T, r, \sigma) - \text{VanillaCall}(S, K2, T, r, \sigma) \quad (1)$$

where *VanillaCall* represents the Black-Scholes price of a vanilla call option,  $S$  is the current price of the underlying,  $K1$  and  $K2$  are the strike prices of the long and short call options respectively,  $T$  is the time to expiration,  $r$  is the risk-free interest rate, and  $\sigma$  is the volatility of the underlying asset.

## 3 Numerical Example

Given the following parameters for a call spread:

- Current price of the underlying asset,  $S = 100$
- Lower strike price,  $K1 = 90$
- Upper strike price,  $K2 = 110$
- Time to maturity,  $T = 1$  year
- Annual risk-free interest rate,  $r = 0.05$  (5%)
- Volatility of the underlying asset,  $\sigma = 0.4$  (40%)

Using the provided Python code, the spread option price is calculated to be \$8.98, with an intrinsic value at the current price of the underlying asset of \$10.00 and a time value of -\$1.02.

Below is a graphical representation of the payoff and current value of the spread option:

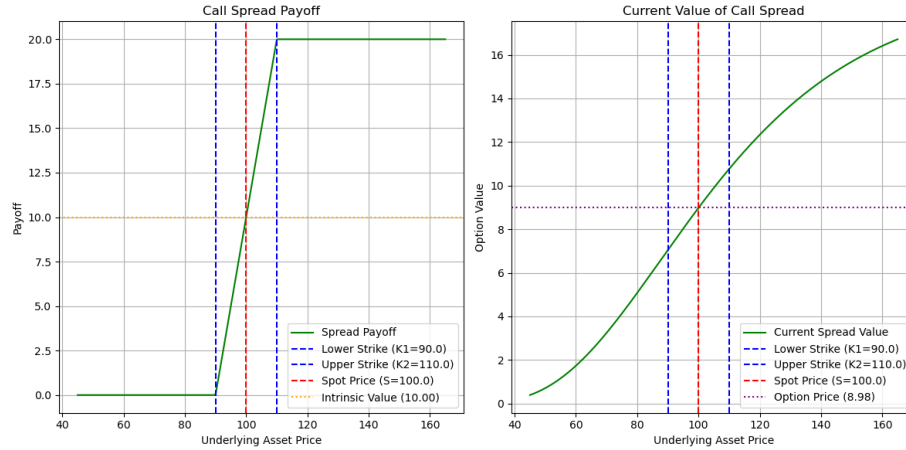


Figure 1: Call spread example

## 4 Conclusion

Spread options are a versatile tool in an investor's arsenal, allowing for tailored risk profiles. By understanding how to price these options, investors can make informed decisions based on their market outlook and risk tolerance.