Introduction to Vanilla Options

1 Introduction

Vanilla options are financial derivative instruments that grant their holder the right, but not the obligation, to buy (call option) or sell (put option) an underlying asset at a predetermined price (strike price) on a specified date (maturity). This article explains the basic concepts of vanilla options, focusing on long (buy) and short (sell) positions for call and put options and their payoff profiles.

2 Definitions and Key Concepts

A vanilla option is characterized by:

- **Strike Price (K)**: The price at which the underlying asset can be bought (call) or sold (put).
- **Underlying Asset Price (S_T)**: The value of the asset at maturity.
- **Premium (P)**: The cost paid to acquire the option.
- **Maturity**: The date on which the option can be exercised (for European options).

The payoffs of vanilla options at maturity are defined as follows:

- **Call Option**: Gives the holder the right, but not the obligation, to buy an asset at a specified strike price before or at maturity.

$$\text{Payoff}_{\text{Call}} = \max(S_T - K, 0) - P^1$$

- **Put Option**: Gives the holder the right, but not the obligation, to sell an asset at a specified strike price before or at maturity.

$$\text{Payoff}_{\text{Put}} = \max(K - S_T, 0) - P^2$$

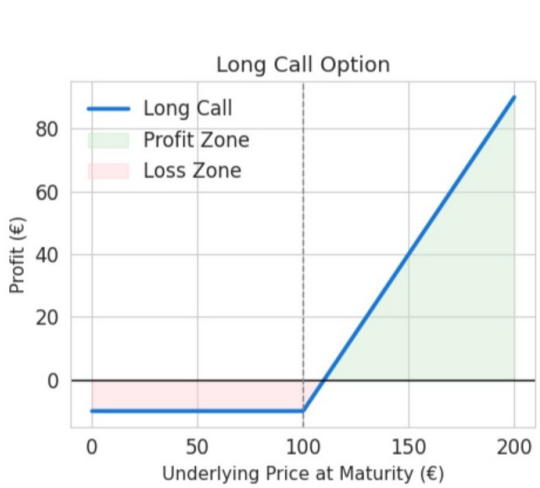
3 Payoff Plots

The following plots illustrate the payoff profiles for long and short positions of call and put options, with a strike price $K = 100$ € and a premium $P = 10$ €. Profit zones (in green) and loss zones (in red) are highlighted.

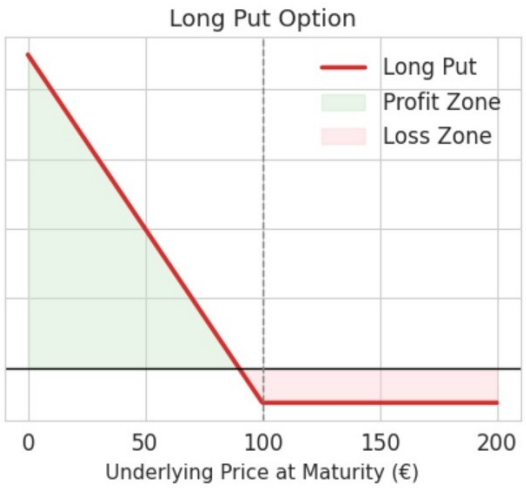
In Figure 1a, the payoff of a *long call* position shows a loss limited to the premium (-10 €) if $S_T < K$, and a potentially unlimited profit if $S_T > K + P$. In Figure 1b, the payoff of a *long put* position shows a loss limited to the premium (-10 €) if $S_T > K$, and a maximum profit of $K - P$ if $S_T = 0$.

In Figure 2a, the payoff of a *short call* position shows a profit limited to the premium ($+10$ €) if $S_T < K$, but a potentially unlimited loss if $S_T > K + P$. In Figure 2b, the payoff of a *short put* position shows a profit limited to the premium ($+10$ €) if $S_T > K$, but a maximum loss of $K - P$ if $S_T = 0$.

[1] S_T: Underlying asset price at maturity; K: Strike price; P: Premium.
[2] S_T: Underlying asset price at maturity; K: Strike price; P: Premium.

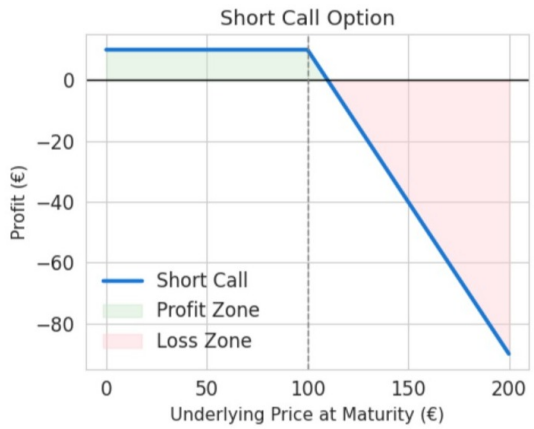


(a) Long Call Option

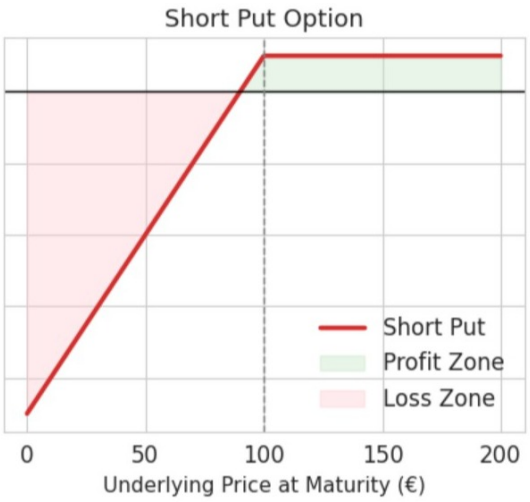


(b) Long Put Option

Figure 1: Long Call/Put Payoff Profiles



(a) Short Call Option



(b) Short Put Option

Figure 2: Short Call/Put Payoff Profiles

4 Explanation of Positions

- **Long Call**: The buyer of a call option bets on a rise in the underlying asset's price. The risk is limited to the premium paid, while the profit is theoretically unlimited.
- **Long Put**: The buyer of a put option bets on a decline in the underlying asset's price. The risk is limited to the premium, with a maximum profit if the asset's value drops to zero.
- **Short Call**: The seller of a call option receives the premium but faces an unlimited loss if the asset's price rises significantly.
- **Short Put**: The seller of a put option receives the premium but risks a significant loss if the asset's price falls sharply.

5 Conclusion

Vanilla options provide straightforward opportunities for risk management and speculation, with distinct payoff profiles for long and short positions in call and put options. The generated plots clearly illustrate the profit and loss zones, aiding in understanding the risks and rewards associated with each position.