Understanding and Pricing Straddle Options

1 Introduction

A straddle is an options strategy involving the purchase of both a call and put option with the same strike price and expiration date. It is a bet on volatility; the trader is anticipating a significant move in the underlying asset's price, but the direction of the move is uncertain.

2 Pricing Straddle Options

The price of a straddle option can be calculated using the Black-Scholes model by summing the prices of a call and a put option with the same strike price and expiration date. The formula for the price of each option is:

$$C = S_0 N(d_1) - K e^{-rT} N(d_2) \tag{1}$$

$$P = K e^{-rT} N(-d_2) - S_0 N(-d_1) \tag{2}$$

Thus, the price of the straddle is $C + P$. The terms are as defined in the Black-Scholes model.

3 Numerical Example

Consider a straddle option with the following parameters:

- Current price of the underlying asset, $S = 100$
- Strike price, $K = 80$
- Time to maturity, $T = 1$ year
- Annual risk-free interest rate, $r = 0.05$ (5%)
- Volatility of the underlying asset, $\sigma = 0.4$ (40%)

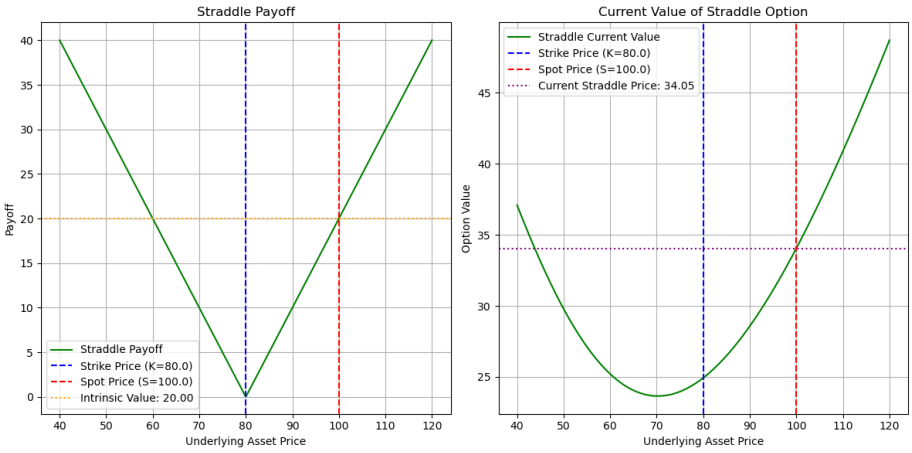

Figure 1: Straddle option example

Using the provided Python code, the straddle option price is computed to be \$34.05, with an intrinsic value of \$20.00 and a time value of \$14.05.

The following graphs represent the payoff and current value of the straddle option:

4 Conclusion

Straddle options are powerful tools in options trading that allow investors to profit from significant moves in the underlying asset's price, regardless of the direction. By understanding the pricing mechanisms, traders can make informed decisions based on their expectations of market volatility.