Question

Buycoins Inc is listed on the LSE with a stock price of £12.75 - the company is not known to pay dividends. We need to price a put option with a strike of $10 maturing in 6 months. The continuously-compounded risk-free rate is 2.75%/year, the mean return on the stock is 6%/year, and the standard deviation of the stock return is 20%/year. What is the Black-Scholes put price?

Solution:

To calculate the Black-Scholes put price

$$P = Ke^{-rt} * N(-d_2) - S_o N(-d_1)$$

$$d_1 = \frac{ln\left(\frac{S_O}{K}\right)+\left(r+\frac{\sigma^2}{2}\right)t}{\sigma\sqrt{t}} \quad , \quad d_2 = d_1 - \sigma\sqrt{t}$$

Where:

C_o = Current stock price

K = Strike stock price

σ = represents the underlying volatility

r = risk-free interest rate

t = duration in years

$N(d_1)$ and $N(d_2)$ are cumulative distribution functions for a standard normal distribution

Given:

S_o = £12.75, K = £10, r= 2.75%, σ = 20%, T = 6months(1/2 years)

Calculating the d_1 and d_2

$$d_1 = \frac{ln\left(\frac{S_O}{K}\right)+\left(r+\frac{\sigma^2}{2}\right)t}{\sigma\sqrt{t}}$$

$$= \frac{ln\left(\frac{12.75}{10}\right)+\left(0.0275+\frac{0.2^2}{2}\right)0.5}{0.4\sqrt{0.5}}$$

$$= \frac{0.2429+0.02375}{0.1414} = 1.8858$$

$$d_2 = d_1 - \sigma\sqrt{t}$$

$$= 1.8858 - 0.2\sqrt{0.5}$$

$$= 1.7414$$

Checking the normal distribution table for $N(-d_1)$ and $N(-d_2)$

$N(d_1) = 0.97062$, $N(d_2) = 0.95907$

$N(-d_1) = 1 - N(d_1)$

$= 1 - 0.97062$

$= 0.02938$

$N(-d_2) = 1 - N(d_2)$

$= 1 - 0.95907$

$= 0.04093$

Calculating the put price

$$P = Ke^{-rt} * N(-d_2) - S_o N(-d_1)$$

$$= 10e^{-0.0275*0.5}(0.04093) - 12.75(0.02938)$$

$$= 0.4037 - 0.3746$$

$$= 0.0291$$

The Put Price is **£ 0.0291**