

BLACK-SCHOLES CALCULATION

Yara Inc is listed on the NYSE with a stock price of \$40 - the company is not known to pay dividends. We need to price a call option with a strike of \$45 maturing in 4 months. The continuously-compounded risk-free rate is 3%/year, the mean return on the stock is 7%/year, and the standard deviation of the stock return is 40%/year. What is the Black-Scholes call price?

Solution

Black-Scholes call price,

$$C = SN(d_1) - Ke^{-rt}N(d_2)$$

where:

S=Current stock price = \$40

K = Strike price = \$45

r = Risk-free interest rate = 3% = 0.03

T = Time to maturity = 4/12 = 1/3

N = A normal distribution

σ = standard deviation = 40% = 0.4

$$B = Ke^{-rt} = 45e^{-\left(0.03 \times \frac{1}{3}\right)} = 44.55224$$

$$C = SN(d_1) - BN(d_2)$$

$$d_1 = \frac{\ln(S/B)}{\sigma\sqrt{T}} + \frac{1}{2}\sigma\sqrt{T}$$

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

Solving for d1 and d2,

$$d_1 = \frac{\ln(40/44.55224)}{0.4 \times \sqrt{1/3}} + \frac{1}{2} \times 0.4 \times \sqrt{1/3}$$

$$d_1 = -0.351244$$

$$\text{recall, } d_2 = d_1 - \sigma\sqrt{T}$$

$$d_2 = -0.351244 - 0.4\sqrt{1/3}$$

$$d_2 = -0.582184$$

$$\text{recall, } C = SN(d_1) - BN(d_2)$$

$$C = 40 \times 0.3627026 - 44.55224 \times 0.2802213 = 2.023617$$

Therefore, the Black-Scholes call price, **C = 2.023617**