<u>Question:</u>

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?

<u>Solution:</u>

To calculate the Black-Scholes call price

$$C_o = SoN(d1) - Ke^{(rt)}N(d2)$$

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

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 = $40,   K = $45,   r= 3%, σ = 40%,   T= 4 months (1/3 years)

$d_1 \quad = \dfrac{\ln\left(\frac{So}{K}\right)+\left(r+\frac{\sigma^2}{2}\right)T}{\sigma\sqrt{T}}$

$\quad = \dfrac{\ln\left(\frac{40}{45}\right)+\left(0.03+\frac{0.4^2}{2}\right)0.33}{0.4\sqrt{0.33}}$

$\quad = -0.35$

$d_2 \quad = d_1 - \sigma\sqrt{(T)}$

$\quad = -0.35 - (0.4\sqrt{0.33}\,)$

$\quad = -0.58$

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

$N(d_1)$ = 0.3617, $N(d_2)$ = 0.28096

Calculating the call price now

Call price (C$_o$) $= SoN(d1) - Ke^{(rt)}N(d2)$

$= 40N(d1) - 45e^{(0.03*0.333)}N(d2)$

$= (40 * 0.3617) - (45e^{(0.03*0.333)} * 0.28096)$

$= 2.009$

The call price is 2.009