BLACK-SCHOLES CALL PRICE

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>

Stock Price (P_0) = $ 40

NO DIVIDEND

Strike Price (X) = $ 45

Time (t) = (4/12) months

Risk _ free rate = 3% / year (0.03)

Mean = 7 % / year

Volatility (S.D) = 40% / year

$$V_c = P_0 N_{d_1} - \frac{X}{e^{K_{RF}t}} N_{d_2}$$

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

$$d_1 = \frac{[In\left(\frac{P_0}{X}\right) + (K_{RF} + .5\sigma^2)t]}{\sigma\sqrt{t}}$$

$$d_1 = \frac{[In\left(\frac{40}{45}\right) + (0.03 + .5 * 0.4^2)\frac{4}{12}]}{0.4\sqrt{\frac{4}{12}}}$$

$$d_1 = \frac{[In\,(0.889) + (0.03 + 0.08)0.33]}{0.4 * 0.58}$$

$$d_1 = \frac{[-0.118 + (0.03 + 0.08)0.333]}{0.4 * 0.577}$$

$$d_1 = \frac{[-0.118 + (0.11)0.333]}{0.231}$$

$$d_1 \quad = \frac{[-0.081]}{0.231}$$

$$d_1 \quad = -0.352$$

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

$$d_2 \ = \ -0.352 - \ 0.4\sqrt{\frac{4}{12}}$$

$$d_2 \ = -0.352 - 0.4(0.58)$$

$$d_2 \ = -0.352 - 0.228$$

$$d_2 \ = -0.582$$

Upon looking up the values on a standard dev table;

$$N_{(-0.352)} \ = 0.3632$$

$$N_{(-0.582)} \ = 0.2810$$

$$V_c = P_0 N_{d_1} - \frac{X}{e^{K_{RF}t}} N_{d_2}$$

Substituting into the expression for the call price and computing further gives;

$$V_c = (40)(0.3632) - \left[\frac{45}{e^{0.03*\left(\frac{4}{12}\right)}}\right](0.2810)$$

$$V_c = \$\,2.01$$