QUESTION:

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:

$$C = P_a N(\theta_1) - P_e N(\theta_2) e^{-rt}$$

Where:

C = black-scholes call price = ?
P_a = Current stock price = 40
P_e = Excise or strike price = 45
r = risk-free rate of return = 0.03 or 30%
t = time of maturity (in years) = 4/12
S = standard deviation (volatility rate) = 0.4 or 40%
N = Normal distribution = ?

$$\theta_1 = \frac{ln(\frac{P_a}{P_e}) + (r + 0.5s^2)t}{s\sqrt{t}}$$

$$= \frac{ln(\frac{40}{45}) + (0.03 + 0.5(0.4)^2) * 0.333}{0.4\sqrt{0.333}}$$

$$= -0.35$$

$$\theta_2 = \theta_1 - s\sqrt{t}$$

$$= (-0.35) - 0.4\sqrt{0.333}$$

$$= -0.5808$$

... Checking for the normal distribution (from the standard statistical table)

$$N(\theta_1) = N(-0.35) = 0.3617$$

$$N(\theta_2) = N(-0.58) = 0.28096$$

... Black-Scholes call price

$$C = P_a N(\theta_1) - P_e N(\theta_2) e^{-rt}$$
$$= (40 * 0.3617) - (45 * 0.28096) e^{-(0.03*0.333)}$$
$$= 1.9505$$
$$C \simeq 2$$