

- (Please show your workings). 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?

NOTE: I used the stock return as a discount rate to find the present value of the strike price. My justification is that the discount rate is usually the rate that denotes the returns forgone if the investment had not been taken, if they didn't give the stock return i would have used the risk free rate.

The black scholes formula is given by

$$C_0 = S_0 N(d_1) - Xe^{-rt} N(d_2)$$

$$\text{Where } d_1 = \frac{\ln(S_0/X) + (r + \sigma^2/2) / \sigma \sqrt{T}}$$

$$\text{Where } d_2 = \frac{\ln(S_0/X) + (r - \sigma^2/2) / \sigma \sqrt{T}}$$

According to the question above the parameters are:

$$S_0=40 \quad X=45 \quad \sigma=0.4 \quad r=0.07 \quad r_f=0.03 \text{ (risk free rate)} \quad t=4/12 \text{ (0.333)}$$

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THEN

$$C_0 = 40 N(d_1) - 45 e^{-0.07(0.333)} N(d_2)$$

$$C_0 = 40 N(d_1) - 45 e^{-0.0233} N(d_2)$$

$$C_0 = 40 N(d_1) - 45(0.977) N(d_2)$$

$$C_0 = 40 N(d_1) - 43.962 N(d_2)$$

SOLVE FOR D1 & D2

$D_1$  and  $D_2$  are calculated below

Hence

$$d_1 = \ln \frac{40}{45} + (0.03 + \frac{1}{2}(0.4^2))0.333$$
$$0.4\sqrt{0.333}$$
$$= \frac{-0.1178 + (0.03 + 0.08)0.333}{0.231}$$
$$= \frac{-0.1178 + 0.0110}{0.231}$$
$$= \frac{-0.081}{0.231}$$
$$d_1 = -0.351$$

Solve for  $d_2$

$$d_2 = d_1 - \sigma\sqrt{t}$$
$$= -0.351 - (0.4\sqrt{0.333})$$
$$= -0.351 - 0.231$$
$$= -0.582$$

Therefore

$$N(d_1) = 1 - N(-0.351) = 1 - 0.638 = 0.3632$$

$$N(d_2) = 1 - N(-0.582) = 1 - 0.7190 = 0.281$$

HENCE

$$C_0 = 40(0.3632) - 43.962(0.281)$$

$$= 14.528 - 12.353$$

**CALL PRICE = \$2.175**

