

## Q1-B

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September 21, 2020

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 the 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 on the stock return is 40%/year What is the Black-Scholes call price?

Answer -

The Black-Scholes Call Option pricing model is given by the formula

$$C = S_t N(d_1) - K e^{rt} N(d_2)$$

where

$$d_1 = \frac{\ln \frac{S_t}{K} + \left( r + \frac{\sigma^2}{2} \right) t}{\sigma \sqrt{t}}$$

and

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

Equation terms

- $S_t = 40$
- $K = 45$
- $r = 0.03$
- $t = 4/12 = 0.3333$
- $\sigma = 0.4$
- $N = \text{CDF of Normal distribution} = \frac{1}{2} \left[ 1 + \text{erf} \left( \frac{x}{\sqrt{2}} \right) \right]$

Calculating the term  $d_1$

$$d_1 = \frac{\ln \frac{40}{45} + \left( 0.03 + \frac{0.4^2}{2} \right) * 0.333}{0.4 * \sqrt{0.333}} = -0.35124$$

Calculating the term  $d_2$

$$d_2 = -0.35124 - (0.4 * \sqrt{0.333}) = -0.58218$$

finally, calculating  $C$

$$C = 40 \cdot N(-0.35124) - 45 \cdot e^{0.03 * 0.333} \cdot N(-0.58218) = \underline{\underline{\$2.03}}$$