Q. 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?

$C_0 = S_0N(d_1) - (X/e^{(rt)})N(d_2)$

where,
$d_1 = (\ln(S_0/X) + (r + 1/2\sigma^2)t)/\sigma\sqrt{t}$
$d_2 = d_1 - \sigma\sqrt{t}$
Stock price, S_0 = $40
Exercise price, X = $45
Interest rate, r = 0.03 (10% per year)
Time to expiration, t = 0.33 (3 months)
Standard deviation, σ = 0.40 (50% per year)
Nd = value of the cumulative standard normal distribution evaluated at d

Solution
$d_1 = (in(40/45) + (0.03+0.5(0.4)^2)0.33)/0.4\sqrt{0.33}$
$d_1 = -0.11778303565 + 0.0363/0.2299$
$d_1 = -0.3544$

$d_2 = -0.3544 - 0.2299$
$d_2 = -0.5843$

$Nd_1 = 0.3632$
$Nd_2 = 0.2810$

$C_0 = 40*0.3632 - (45/e^{(0.03*0.33)})*0.2810$
$C_0 = 14.528 - 12.52$
$C_0 = 2.008$