33. You own one share of a nondividend-paying stock. Because you worry that its price may drop over the next year, you decide to employ a *rolling insurance strategy*, which entails obtaining one 3-month European put option on the stock every three months, with the first one being bought immediately.

You are given:

(i) The continuously compounded risk-free interest rate is 8%.

(ii) The stock's volatility is 30%.

(iii) The current stock price is 45.

(iv) The strike price for each option is 90% of the then-current stock price.

Your broker will sell you the four options but will charge you for their total cost now.

Under the Black-Scholes framework, how much do you now pay your broker?

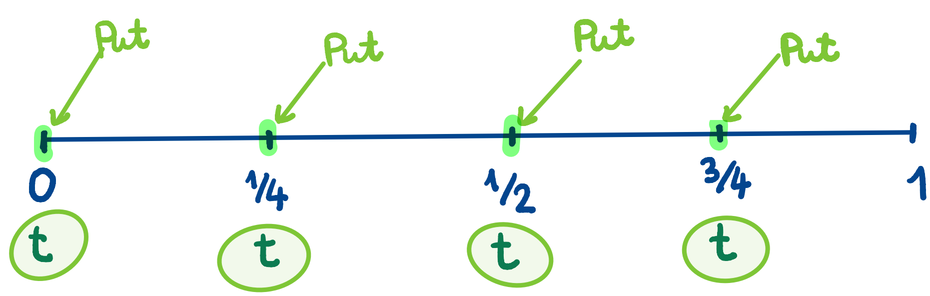
(A) 1.59

(B) 2.24

(C) 2.86

(D) .48

(E) 3.61



t… represents the valuation date

34-39. DELETED

For each of the four puts in the rolling insurance strategy:

- one quarter year to exercise
- $\boxed{K_t = 0.9 \cdot S(t)}$

For every t @ which a put option is received:

$$d_1(\cancel{t}) = \frac{1}{\sigma\sqrt{\frac{1}{4}}}\left[\ln\left(\frac{\cancel{S(t)}}{0.9\cdot \cancel{S(t)}}\right) + \left(r + \frac{\sigma^2}{2}\right)\left(\frac{1}{4}\right)\right]$$

$$d_1(\cancel{t}) = \frac{1}{0.3(\frac{1}{2})}\left[-\ln(0.9) + \left(0.08 + \frac{0.09}{2}\right)\left(\frac{1}{4}\right)\right] = 0.9107$$

$$d_2(\cancel{t}) = 0.7607$$

M339D: April 22nd, 2024.

In general,

$$V_p(t) = K e^{-r(T-t)} \cdot N(-d_2) - S(t) N(-d_1)$$

$$N(-0.9107) = 0.1812267$$

$$N(-0.7607) = 0.2234181$$

$$V_p(t) = 0.9 S(t) \cdot e^{-0.08(0.25)} \cdot 0.2234181 - S(t) \cdot 0.1812267$$

$$V_p(t) = S(t) \cdot 0.01586801$$

=> Note that for every "put delivery" date, i.e., $t = 0, 1/4, 1/2, 3/4$, the value of the put delivered @ that time is

$$\boxed{0.01586801 \cdot S(t)}$$

In order to perfectly replicate, we should buy 0.01586801 shares of stock today.
This costs:

$$0.01586801 \cdot \underbrace{S(0)}_{45}$$

Since there are 4 puts, each w/ the same cost of replicating today, the total cost of the rolling insurance policy is

$$4 \cdot 0.01586801 \cdot 45 = \underline{2.856242}$$

$\square$