# M339D: April $18^{th}$, 2025.

**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 $\boxed{45.}$

(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?

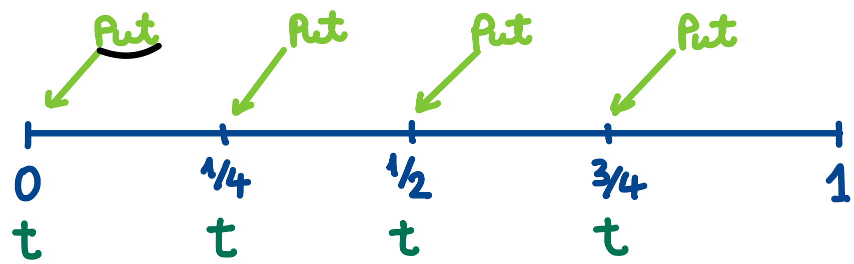
(A) 1.59

(B) 2.24

(C) 2.86

(D) .48

(E) 3.61




t... represents the valuation date

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

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

**34-39.** DELETED

For every t @ which a put option is received:

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

$$d_1(\cancel{t}) = \frac{1}{0.15}\left[-\ln(0.9) + \frac{0.25}{8}\right] = 0.9107 \approx 0.91$$

$$d_2(t) = 0.9107 - 0.15 = 0.7607 \approx 0.76$$

$$N(-0.91) = 0.1814, \qquad N(-0.76) = 0.2236$$

In general,

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

$$V_p(t) = 0.9\,S(t)\,e^{-0.08(1/4)} \cdot 0.2236 - S(t) \cdot 0.1814$$

$$V_p(t) = S(t) \cdot \underline{0.0159}$$

$\Rightarrow$ Note that EVERY put is worth $S(t) \cdot 0.0159$ on its delivery date $t = 0, 1/4, 1/2, 3/4$.

In order to perfectly replicate, we should buy 0.0159 shares of stock today for each put.

With 4 puts, the total cost is: $4 \cdot \overset{45}{\overbrace{S(0)}} \cdot 0.0159 =$

$= \underline{2.8562}$

$\square$