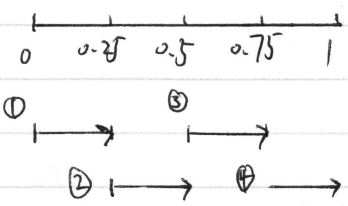
33. Given: Rolling Insurance strategy = Forward Start option.

$S_0 = 45$ $\sigma = 0.3$

$K = 0.9S$

$r = 0.08$

$\delta = 0$



① Put option at time 0, 0.25, 0.5, 0.75

$$P(S,K,T-t) = 0.9S\,N(-d_2)e^{-r(T-t)} - S\,N(-d_1)$$

$$d_1 = \frac{\ln(S/K) + (r-\delta+0.5\sigma^2)(T-t)}{\sigma\sqrt{T-t}}$$

$$= \frac{\ln(S/0.9S) + (r+0.5\sigma^2)(T-t)}{\sigma\sqrt{T-t}}$$

$$= \frac{-\ln 0.9 + (0.8+0.5\cdot 0.3^2)0.25}{0.3\cdot\sqrt{0.25}}$$

$$= 0.91073677$$

$$d_2 = d_1 - \sigma\sqrt{t} = 0.76074$$

$N(-d_1) = 0.18122$ $N(-d_2) = 0.22341$

$$P = 0.9S\,N(d_2)e^{-r(T-t)} - S\,N(-d_1)$$
$$= 0.9S\cdot 0.22341\cdot e^{-0.08\cdot 0.25} - S\cdot 0.18122$$
$$= 0.015868S$$

0 0.25 0.5 0.75

$0.015868S(0)$

$0.015868S(0.25)$

$0.015868S(0.5)$

$0.015868S(0.75)$

Prepaid forward $F^P_{0,T}(S(t)) = S(0)$

Strategy cost $= 0.015868S(0)\cdot 4 = 0.015868\cdot 45\cdot 4 = 2.85624 \approx 2.86$ C