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b) $S_T \approx \log \text{Normal}(\mu = 0, \sigma^2 = \sigma_{10}^2)$

$$f_{S_T}(s) = \frac{1}{s \cdot \sigma_{10}\sqrt{2\pi}} e^{\frac{-\log(s/s_0)^2}{2\sigma_{10}^2}}$$

$$E[\max(S_T - K, 0)] = \int_K^\infty (s-K) f_{S_T}(s)\, ds$$

Q3a) $E[X] = \int_{-c}^{c} |x| \frac{1}{2c}\, dx = 2\int_0^c x \cdot \frac{1}{2c}\, dx = \frac{c}{2} = 1$

$c = 2$

support $= (-2, 2]$

2 A

a)

$$S_T = 100 + 2x - 10 > 105$$

$$2x > 15$$

$$x \geq 8$$

$$P(\text{in the money}) = P(x=8) + P(x=9) + P(x=10)$$

$$= \frac{{}^{10}C_8}{1024} + \frac{{}^{10}C_9}{1024} + \frac{{}^{10}C_{10}}{1024}$$

$$= \frac{56}{1024}$$

$$\approx 5.47\ \%$$

b)

$$E[\text{payoff}] = \sum_{x=8}^{10} P(X=x) \cdot \max(\underbrace{S_T}_{2x+90} - \overset{105}{K}, 0)$$

$$E[\text{payoff}] = 1 \cdot \frac{{}^{10}C_8}{1024} + 3 \cdot \frac{{}^{10}C_9}{1024} + 5 \cdot \frac{1}{1024}$$

$$= 0.0781$$

c) $FV = 0.0781$ (no discounting)

B

a) $E[|R|] = \underbrace{\sigma\sqrt{\frac{2}{\pi}}}_{\text{integral of pos quadrant}} = 1$

$$\sigma = \sqrt{\frac{\pi}{2}}$$