

FINANCIAL ENGINEERING

SURPRISE TEST

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2K18/MC/008

1. $S(0) = 110$

$$u = 0.4$$

$$d = 0.1$$

$$q = 0.2$$

$$X = 120$$

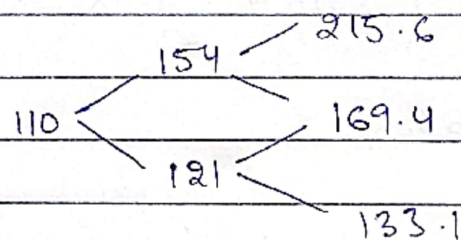
$$S^u = S(0) * (1+u) = 110 * 1.4 = 154$$

$$S^d = S(0) * (1+d) = 110 * 1.1 = 121$$

$$S^{uu} = S(0) * (1+u) * (1+u) = 215.6$$

$$S^{ud} = S(0) * (1+u) * (1+d) = 169.4$$

$$S^{dd} = S(0) * (1+d) * (1+d) = 133.1$$



$$p^* = \frac{q-d}{u-d} = \frac{0.2-0.1}{0.4-0.1} = \frac{0.1}{0.3} = \frac{1}{3}$$

$$1 - p^* = \frac{2}{3}$$

$$C_{uu} = [S_{uu} - K]^+ = 215.6 - 120 = 95.6$$

$$C_{ud} = [S_{ud} - K]^+ = 169.4 - 120 = 49.4$$

$$C_{dd} = [S_{dd} - K]^+ = 133.1 - 120 = 13.1$$

$$C^d = \frac{1}{1+r} [p^* \cdot C_{dd} + (1-p^*) \cdot C_{ud}]$$

$$= \frac{1}{1.2} \left[\frac{1}{3} \cdot 13.1 + \frac{2}{3} \cdot 49.4 \right]$$

$$= 31.083$$

$$C^u = \frac{1}{1.2} \left[\frac{1}{3} \cdot 95.6 + \frac{2}{3} \cdot 49.4 \right]$$

$$= 54$$

$$C(0) = \frac{1}{1+r} [p^* \cdot C^u + (1-p^*) \cdot C^d]$$

$$= \frac{1}{1.2} \left[\frac{1}{3} \cdot 54 + \frac{2}{3} \cdot 31.083 \right]$$

$$= 32.268$$

Number of Stocks in portfolio

$$= \frac{C_u - C_d}{S_u - S_d} = \frac{54 - 31.083}{110 - 100}$$

$$= \frac{22.917}{10} = 2.2917$$

$$= 0.6944$$

$$2. \quad \begin{aligned} A(0) &= \$90 \\ A(1) &= \$99 \\ S(0) &= \$75 \end{aligned}$$

$$S(1) = \begin{cases} \$90 & 0.8 \text{ prob} \\ \$70 & 0.2 \text{ prob} \end{cases}$$

$$x = 60, y = 40$$

$$\begin{aligned} V(0) &= x * S(0) + y * A(0) \\ &= 60 \times 75 + 40 \times 90 \\ &= 8100 \end{aligned}$$

$$V(1) = x * S(1) + y * A(1)$$

$$= \begin{cases} 60 \times 90 + 40 \times 99 & 0.8 \\ 60 \times 70 + 40 \times 99 & 0.2 \end{cases}$$

$$= \begin{cases} 9360 & 0.8 \\ 8160 & 0.2 \end{cases}$$

$$K = \frac{V(1) - V(0)}{V(0)}$$

$$= \begin{cases} 0.156 & 0.8 \\ 0.007 & 0.2 \end{cases}$$

$$\begin{aligned} E(K) &= 0.8 \times 0.156 + 0.2 \times 0.007 \\ &= 0.1262 \end{aligned}$$

$$\text{Risk} = \sqrt{[(0.156 - 0.126)^2 \times 0.8 + (0.007 - 0.126)^2 \times 0.2]}$$

$$= \sqrt{\frac{0.0009 \times 0.8 + 0.01416 \times 0.2}{0.8}}$$

$$= \cancel{0.1227} \quad 0.045$$