1. The payout for a call is \( \max(S - K, 0) \) and for a put it is \( \max(K - S, 0) \).

(a) Call payout is 10.

(b) Put payout is 0.

(c) The call is in-the-money and the put is out-of-the-money.

2. (a) The possible values of \( S(1) \) are 120 with probability \( \frac{1}{2} \) and 80 with probability \( \frac{1}{2} \).

(b) \( E[S(1)] = .5 \times 120 + .5 \times 80 = 100 \).

\[ Var[S(1)] = E[(S(1) - E[S(1)])^2] = .5 \times (20)^2 + .5 \times (-20)^2 = 400. \]

(c) The possible values of \( S(2) \) are \( u^2 100 = 144 \) with probability \( p^2 = \frac{1}{4} \), \( du100 = 96 \) with probability \( 2pq = \frac{1}{2} \), and \( d^2 100 = 64 \) with probability \( q^2 = \frac{1}{4} \).

3. The mean and variance for this are

\[ 1 = E[S(1)/S(0)] = pu + qd = .5(u + d) \]

\[ 1/4 = Var[S(1)/S(0)] = p(u - 1)^2 + q(d - 1)^2 = .5(u^2 + d^2 - 2(u + d) + 2 = .5(u^2 + d^2) - 2) \]

from which it follows that

\[ u + d = 2 \]

\[ u^2 + d^2 = 5/2 \]

The solution is \( u = 3/2 \) and \( d = 1/2 \).

4. The utility of the two investments is

\[ U(x_1) = .5\sqrt{4} + .5\sqrt{36} = .5(2 + 6) = 4 \]

\[ U(x_2) = (1/3)\sqrt{16} + (2/3)\sqrt{25} = 4/3 + 20/3 = 4/3 > 4 \]

This shows that the second investment is preferable.

5. The utilities are

\[ U_1(x_1) = \log(1.1) \]

\[ U_1(x_2) = .5(\log(2) + \log(1/2)) = .5(\log(2) - \log(2)) = 0 < U_1(x_1) \]

\[ U_2(x_1) = 1.1 \]

\[ U_2(x_2) = .5(2 + 1/2) = 5/4 > U_2(x_1) \]
This shows that the first investor favors investment 1 and the second investor favors investment 2.

6. The value of the portfolio $x(1)$ and the proportion of risky investment at time 1 are

$$x(1) = (1 + r)(x(0) - \delta(0)S(0)) + S(1) = 2(2 - 1) = 2 + S(1)$$

$$\frac{.5}{= \Pi = \delta(1)S(1)/x(1) = \delta(1)S(1)/(2 + S(1))}$$

(a) If $S(1) = 3$, then $\delta(1) = 5/6$.

(b) If $S(1) = 1$, $\delta(1) = 3/2$.

(c) Case (a) involves selling and case (b) involves buying the equity.