Derivatives

Valuation of Patent - Real Option

Q.39) $S_0 = 16.7\,m$ $\quad \sigma^2 = 0.268$ $\quad n = 15$ years

$K = 12.5\,m$ $\quad r = 0.078$

In Real Options, consider $y = \frac{1}{n} = \frac{1}{15} = 0.067$

Given

ln(1.336) = 0.2897

$e^{-1.0005} = 0.3677$ and $e^{-1.17} = 0.3104$

$$\text{Adj. } S_0 = \frac{S_0}{e^{yn}} = \frac{16.7m}{e^{0.067 \times 15}}$$

$$= \frac{16.7m}{e^{1.0005}}$$

$$= 16.7m \times 0.3677$$

$$= 6.14m$$

$$C_0 = \text{Adj. } S_0 \times N(D_1) - \frac{K}{e^{rn}} \times N(D_2)$$

$$= 6.14m \times N(D_1) - \frac{12.5m}{e^{0.078 \times 15}} \times N(D_2)$$

$$= 6.14m \times N(D_1) - \frac{12.5m}{e^{1.17}} \times N(D_2)$$

$$= 6.14m \times N(D_1) - 3.88\,m \times N(D_2)$$

$$D_1 = \frac{\ln\left[\frac{S_0}{K}\right] + \left[r - y + \frac{\sigma^2}{2}\right]t}{\sigma\sqrt{t}}$$

$$= \frac{\ln\left[\frac{16.7m}{12.5m}\right] + \left[0.078 - 0.0667 + \frac{0.268}{2}\right]15}{\sqrt{0.268} \times \sqrt{15}}$$

$$= \frac{\ln[1.336] + 2.1795}{2.005}$$

$$= \frac{0.2897 + 2.1795}{2.005}$$

$$= 1.2315$$

$$D_2 = D_1 - \sigma\sqrt{t}$$
$$= 1.2315 - 2.005$$
$$= -0.7735$$

Cal. of $N(D_1)$

$P[1.23] = 0.3907$
$P[1.24] = 0.3923$

$P[1.2315]$ [on Interpolation]
$= 0.39097$

$\therefore N(D_1) = 0.5 + 0.39097$
$= 0.89097$

Cal. of $N(D_2)$

$P[0.77] = 0.2794$
$P[0.78] = 0.2823$
$P[0.7735]$ [on Interpolation]
$= 0.280415$

$\therefore N(D_2) = 0.5 - 0.280415 = 0.219585$

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$C_0 = 6.14m \times N(D_1) - 3.88m \times N(D_2)$

$= 6.14m \times 0.8910 - 3.88m \times 0.2196$

$= 4.619m \longrightarrow$ Value of Patent