Solution to (31) Answer: (B)

Assume that the bull spread is constructed by buying a 50-strike call and selling a 60-strike call. (You may also assume that the spread is constructed by buying a 50-strike put and selling a 60-strike put.)

Delta for the bull spread is equal to

(delta for the 50-strike call) – (delta for the 60-strike call).

(You get the same delta value, if put options are used instead of call options.)

Call option delta = $N(d_1)$, where $d_1 = \dfrac{\ln(S/K) + (r + \frac{1}{2}\sigma^2)T}{\sigma\sqrt{T}}$

50-strike call:

$$d_1 = \frac{\ln(50/50) + (0.05 + \frac{1}{2}\times 0.2^2)(3/12)}{0.2\sqrt{3/12}} = 0.175, \qquad N(0.175) = 0.56946$$

60-strike call:

$$d_1 = \frac{\ln(50/60) + (0.05 + \frac{1}{2}\times 0.2^2)(3/12)}{0.2\sqrt{3/12}} = -1.64822, \qquad N(-1.64882) = 0.04965$$

Delta of the bull spread = 0.56946 – 0.04965 = 0.51981.

After one month, 50-strike call:

$$d_1 = \frac{\ln(50/50) + (0.05 + \frac{1}{2}\times 0.2^2)(2/12)}{0.2\sqrt{2/12}} = 0.1428869 \qquad N(0.14289) = 0.55681$$

60-strike call:

$$d_1 = \frac{\ln(50/60) + (0.05 + \frac{1}{2}\times 0.2^2)(2/12)}{0.2\sqrt{2/12}} = -2.090087 \qquad N(-2.0901) = 0.01830$$

Delta of the bull spread after one month = 0.55681 – 0.01830 = 0.53851.

The change in delta = 0.53851 – 0.51981 = 0.0187 ≈ 0.02.