P1.T4. Valuation & Risk Models

Chapter 16. Option Sensitivity Measures: The "Greeks"

Bionic Turtle FRM Practice Questions

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Chapter 16. Option Sensitivity Measures: The “Greeks”

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P1.T4.817. Option delta

Learning objectives: Describe and assess the risks associated with naked and covered option positions. Explain how naked and covered option positions generate a stop loss trading strategy. Compute the delta of an option.

817.1. As a market maker, Toughgreen Financial has written (aka, taken a short position in) a single contract for 100 call options on a non-dividend-paying stock whose volatility is 36.0% per annum when the riskless rate is 3.0%. Their strike price is $100.00 but the options are underwater because the current stock price is $90.00. The option term is six months. At the current stock price, each option has a value of $5.88 and each option's percentage delta, Δ = +0.410. From Toughgreen's perspective, if the stock price increases by +$3.00 to $93.00, which is **nearest** to the impact on the position's value?

a) A loss of few dollars less than $8.00; ie, 100 * [$5.88 * ($3.00/$90.00) * 0.410] minus (-) gamma adjustment
b) A loss of few dollars more than $8.00; ie, 100 * [$5.88 * ($3.00/$90.00) * 0.410] plus (+) gamma adjustment
c) A loss of few dollars less than $123.00; ie, 100 * ($3.00 * 0.410) minus (-) gamma adjustment
d) A loss of few dollars more than $123.00; ie, 100 * ($3.00 * 0.410) plus (+) gamma adjustment

817.2. A non-dividend-paying stock has a volatility, σ, equal to 35.0% and a current price of $60.00 while the riskfree rate is 4.0%. Which is **nearest** to the percentage delta, Δ(p), of a six-month put option with an exercise price of $75.00?

a) -2.2127
b) -0.7580
c) -0.2420
d) +0.2429

817.3. Greendex Financial LLC is a market maker who, at the request of its client, has written out-of-the-money (OTM) call options on the stock of Industrial Automation, Inc. Greendex wrote 100 contracts, and the size of each contract is 100 options with nine month maturities. Because S(0) = $20.00, K = $25.00, σ = 40.0%, Rf = 4.0% and T = 0.75 years, the percentage delta Δ(c) of each call option is +0.350.

Greendex immediately seeks to neutralize its delta exposure (i.e., achieve a position delta equal to zero) by trading put options on the same underlying stock, Industrial Automation, Inc. Compared to the call options, these put options will have an identical strike price and maturity. Which of the following trades is advisable to neutralize its delta, and after having neutralized delta, what is the nature of Greendex's retained gamma exposure?

a) Write about 54 put option contracts (100 put options per contract) but Acme is exposed to wild movements in the stock price
b) Write about 54 put option contracts (100 put options per contract) but Acme is exposed to a virtually constant stock price
c) Write about 185 put option contracts (100 put options per contract) but Acme is exposed to wild movements in the stock price
d) Write about 185 put option contracts (100 put options per contract) but Acme is exposed to a virtually constant stock price

Answers:

817.1. D. True: A loss of few dollars more than $123.00; ie, 100 * ($3.00 * 0.410) plus (+) gamma adjustment.

As a partial first derivative, delta is the rate of change of the option price with respect to the price of the underlying asset (stock, in this case): $\Delta = \partial c / \partial S$. A percentage delta of 0.410 signifies the expectation of a linear change of $0.410 in the call option value for each $1.00 change in the stock price. However, this excludes the gamma adjustment: the actual price increase in the call option is GREATER than the change estimated by the linear approximation. Consequently, the short position (who writes the call) is exposed to a greater price drop.

Specifically, in this example (although the problem does NOT require calculating gamma!), the percentage gamma is about 0.0170 such that the loss due to a +$3.00 stock price change is $3.00*0.410 + 0.5*0.0170*$3.00^2 = $1.3065. Indeed, the actual option price increases from $5.882 to $7.188, for an exact difference of $1.3060. In this way, the actual loss on the position (of 100 options) is $130.60 while the delta-gamma estimate is $130.65

817.2. B. True, Δ(p) = -0.7580. The exact N(d1) is 0.24288 while lookup-based N(-0.70) is 0.2420 such that Δ(p) = N(d1) - 1 = 0.2420 - 1 = -0.7580, or exactly -0.75712. However, this question can be answered without any calculations given that we should know the percentage delta of a put is negative and lies between -1.0 and zero. Further, this put option is in-the-money (ie., S < K) such that we expect the delta to be nearer to -1.0 than zero.

817.3. A. True: Write about 54 contracts (100 put options per contract) but Acme is exposed to wild movements in the stock price

The initial position delta = (-100*100)*0.350 = -3,500 such that 3,500/(0.35 - 1.0) = 5,384.62 put options will neutralize delta, or about 54 contracts. To neutralize the negative position delta, the puts must contribute positive position delta which requires they short put positions.

After neutralizing delta, Greendex has a short gamma position because Greendex has written calls and written puts. Consequently, Greendex is exposed to volatility. Specifically, the exposure is to realized volatility that exceeds the implied volatility at the time of writing the options; i.e., the price of the written options "embeds" the stock's implied volatility, by definition.

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