MTL-732: Practice Sheet 3

1. The Black-Scholes price for a certain European call option on stock is Rs 50. The stock is currently trading for Rs 1000 per share, and it is known that Rs 452 must be borrowed in the replicating portfolio for this option. Find the delta of the option.

2. Suppose that $\Gamma = 0.2$ and $\triangle = 0.5$ for a European call on a stock. What is the new value of $\triangle$ if the stock price increases by Rs 0.3?

3. A certain stock is currently trading for Rs 95 per share. The annual continuously compounded risk-free interest rate is 6%, and the stock pays dividends with an annual continuously compounded yield of 3%. The stock volatility relevant for the Black-Scholes formula is 32%. (a) Find the delta of a call option on the stock with strike price Rs 101 and time to expiration of 3 years. (b) Find the delta of a put option on the stock with strike price Rs 101 and time to expiration of 3 years.

4. A portfolio consists of 45 call options on Asset A (with $\triangle$A = 0.22), 14 put options on Asset B (with $\triangle$B = -0.82), 44 put options on Asset C (with $\triangle$C = -0.33), and 784 call options on Asset D (with $\triangle$D = 0.01). Find the delta of the entire portfolio.

5. A stock currently trades for Rs 50 per share. For which of these, otherwise same on all other parameter except strike prices K, is the gamma the highest? (a) Call, K = 65 (b) Put, K = 25 (c) Call, K = 45 (d) Put, K = 65.

6. Consider a bull spread where you buy a 40-strike put and sell a 45-strike put. Suppose S(0)= Rs 40, $\sigma = 30\%$, $r = 8\%$, $\delta = 0$, T = 6 months. What are delta and gamma?

7. You computed the delta for a 50-60 bull spread with the following information: continuously compounded $r = 5\%$, $\delta = 0$, $\sigma = 20\%$, T = 0.25, S(0) = 50. How much does the delta change after 1 month, if the stock price does not change?

8. A stock has a price of Rs 567 and a volatility of 0.45. A certain put option on the stock has a price of Rs 78 and a vega of 0.23. Suddenly, volatility increases to 0.51. Find the new put option price.

9. The stock pays dividends at an annual continuously compounded yield of 0.12. The annual continuously compounded risk-free interest rate is 0.34. Certain call options on the stock have time to expiration 99 days. The option currently trades for Rs 56. If theta of this call is -0.03 (per day), then find the price of the call option 65 days from expiration with all other things equal.

10. The current price of a stock is Rs 40 and the continuously compounded risk-free $r = 8\%$. You sold a 40-strike call with 3 months to expiration at a premium Rs 2.78 and at the same time you bought a 40-strike call with 1 year to expiration for a premium Rs 6.28. The theta for the long call is -0.0104 and that for the short call is -0.0173. Find the profit once the sold option has expired, if the stock price remains at Rs 40 and nothing else has changed.

11. A stock is currently trading for Rs 41 per share with a stock price volatility of 0.3. A European call option on the stock have a delta of 0.6911 and a price of Rs 6.961. Find the elasticity of such a call option. Use it to find call option price when stock goes up to Rs 41.41.

12. Prove that the elasticity of a call option decreases with the strike price decrease.

13. A European put option on a stock has K = 45, S(0) = 46, T = 0.25, annual continuously compounded $r = 0.08$, $\delta = 0.02$, prepaid forward price volatility = 0.35. Calculate the elasticity of such a put.

14. The expected return on a stock is 15% compounded continuously. The continuously compounded risk-free interest rate is 7% and the call elasticity on this stock is 4.5. Find the expected annual continuously compounded return on the call option.

15. Consider a portfolio that consists of buying a call option on a stock and selling a put option. The stock pays continuous dividends at the yield rate of 5%. The options have a strike of Rs 62 and expire in six months. The current stock price is Rs 60 and the continuously compounded risk-free interest rate is 10%. Find the elasticity of this portfolio.