UNIVERSITY OF TEXAS AT AUSTIN

HW Assignment 3

Option Greeks. Focus on the delta.

Provide your final answer only to the following problem(s):

Problem 3.1. (2 points) *Rho* measures the sensitivity of a portfolio to the changes in the applicable risk-free interest rate. *True or false?*

Problem 3.2. Consider a European call and an otherwise identical put. Then, the call rho is greater than the put rho. *True or false?*

Problem 3.3. (2 points) In the Black-Scholes model, Ψ is the first-order sensitivity with respect to the volatility parameter. *True or false?*

Problem 3.4. (2 points) In the Black-Scholes model, *volga* is the first-order sensitivity with respect to the volatility parameter. *True or false?*

Problem 3.5. (2 points) In the Black-Scholes model, the put theta is **always** positive. *True or false?*

Problem 3.6. (5 pts) Which of the following gives the correct values for the delta and gamma of a single share of non-dividend-paying stock?

(a) $\Delta = 1, \Gamma = 1$
(b) $\Delta = 1, \Gamma = 0$
(c) $\Delta = 0, \Gamma = 1$
(d) $\Delta = 0, \Gamma = 0$
(e) None of the above.

Problem 3.7. (5 points) Assume the Black-Scholes framework as model for the price of a non-dividend-paying stock. What is the difference between the delta of a European call option and the delta of the otherwise identical put option?

(a) 0
(b) 1
(c) $S(0)$
(d) Not enough information is given to answer this question.
(e) None of the above.

Problem 3.8. Assume the Black-Scholes framework. For an at-the-money, $T-$year European call option on a non-dividend-paying stock you are given that its delta equals 0.5832. What is the delta of an otherwise identical option with exercise date at time $2T$?

(a) 0.62
(b) 0.66
(c) 0.70
(d) 0.74
(e) None of the above.

Problem 3.9. (5 points) Assume the Black-Scholes framework. The current stock price is \$50 per share. Its dividend yield is 0.01 and its volatility is 0.25.

The continuously compounded, risk-free interest rate is 0.05.

Consider a one-year, \$55-strike European put option on the above stock. What is the volatility of the put option?

(a) 1.013
(b) -0.534
(c) 6.6
(d) 0.978
(e) None of the above.

Problem 3.10. (5 points) *Source: Sample MFE Problem #8.*

Consider a non-dividend-paying stock whose price $\mathbf{S} = \{S(t), t \geq 0\}$ is modeled using the Black-Scholes model. Suppose that the current stock price equals \$40 and that its volatility is given to be 0.30.

Consider a three-month, \$41.5-strike European call option on the above stock. You learn that the current call delta equals 0.5.

What is the Black-Scholes price of this call option?

(a) 2.19
(b) 2.65
(c) 3.51
(d) 3.65
(e) None of the above.

Problem 3.11. Consider the following portfolio:

- 5 long options of type I,
- 4 long options of type II,
- 1 written option of type III.

The prices of the three options are 0.75, 1.00, and 1.50, respectively, while the option elasticities are 10, 7, and 2, respectively. What is the elasticity of the above portoflio?

(a) 5
(b) 7
(c) 10
(d) 12
(e) None of the above.

Problem 3.12. (5 points) Assume the Black-Scholes framework. The current price of a certain stock is \$50 per share. Its dividend yield is 0.04 and its volatility is 0.14.

The continuously compounded, risk-free interest rate is 0.02.

What is the current delta of a European, \$43.75-strike, six-year put on the above stock?

(a) -0.13
(b) -0.23
(c) -0.33
(d) -0.45
(e) None of the above.

Problem 3.13. (5 points) Assume that the stock price of a certain non-dividend-paying stock is modeled using the lognormal distribution, i.e., the Black-Scholes framework.

The time-0 delta of an at-the-money, time$-T$ European call option is 0.5557. What is the time-0 delta of an otherwise identical call option with exercise date $4T$?

(a) 0.3011

(b) 0.4145

(c) 0.5255

(d) 0.6103

(e) None of the above.