

UNIVERSITY OF TEXAS AT AUSTIN

HW Assignment 12The Delta.

Please, provide your **complete solutions** to the following problems. Final answers only, even if correct will earn zero points for those problems.

Problem 12.1. (2 points) The Black-Scholes delta of a European call option is always between 0 and 1. *True or false? Why?*

Problem 12.2. (2 points) The Black-Scholes delta of a European put option is always between -1 and 0 . *True or false? Why?*

Problem 12.3. (10 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?

Problem 12.4. (4 points) An investor wants to delta-hedge a portfolio consisting of a long K_1 -strike call option and an otherwise identical K_2 -strike call option with $K_1 < K_2$. Then, she should short-sell shares of the underlying asset. *True or false? Why?*

Problem 12.5. (2 points) A market-maker writes a call option on a stock. To decrease the delta of this position, (s)he can **write** a call on the underlying stock. *True or false? Why?*

Problem 12.6. (6 points) Consider an option whose payoff function is given by $v(s, T) = \min(s, 50)$. If a market-maker **writes** this option, they need to short sell shares of stock to create a delta-neutral portfolio. *True or false? Why?*

Problem 12.7. (14 points) Assume the Black-Scholes framework.

Let $K_P < K_C$. A (K_P, K_C) -strangle consists of a long K_P -strike put and an otherwise identical long K_C -strike call.

The goal is to delta-hedge a written one-year, $(40, 60)$ -strangle on a non-dividend-paying stock whose current price is \$50. The stock's volatility is 0.20.

The continuously compounded, risk-free interest rate is 0.10.

What is the cost of delta-hedging the strangle using shares of the underlying stock?

Problem 12.8. (10 points) Assume the Black-Scholes model. Let the current stock price be equal to \$90 per share. Its volatility is 0.20.

The continuously compounded, risk-free interest rate is 0.01.

Consider a one-year European call option on the above stock. The delta of this call option is 0.50. What is the strike price of the call?