

Problem Set 3

Instructions: This problem set is due on 2/17 at 11:59 pm CST and is an individual assignment. All problems must be handwritten. Scan your work and submit a PDF file.

Problem 1. Suppose that the price of a non-dividend-paying stock is \$32, its volatility is 30%, and the risk-free rate for all maturities is 5% per year. You have the following information on European call options written on the stock for different strikes and maturities:

Strike	25	30	35
Expiration 6 months	7.90	4.18	1.85
Expiration 1 year	8.92	5.60	3.28

Calculate the cost of setting up the following positions. In each case provide a diagram showing the relationship between payoff and profit with respect to final stock price. Use put-call parity to compute the price of the corresponding European put options. In your diagrams, indicate the cutoff prices that lead to a gain/loss.

- A bull spread using European call options with strike prices of \$25 and \$30 and a maturity of six months.
- A bear spread using European put options with strike prices of \$25 and \$30 and a maturity of six months.
- A butterfly spread using European call options with strike prices of \$25, \$30, and \$35 and a maturity of one year.
- A butterfly spread using European put options with strike prices of \$25, \$30, and \$35 and a maturity of one year.
- A straddle using options with a strike price of \$30 and a six-month maturity.
- A strangle using options with strike prices of \$30 and \$35 and a six-month maturity.

Problem 2. A 4-month European put option on a non-dividend-paying stock is currently selling for \$1.80. The stock price is \$96, the strike price is \$100, and the risk-free interest rate is 6% per year. What opportunities could an arbitrageur exploit? Think of synthesizing a negative price call.

Problem 3. A 6-month European call option on a non-dividend-paying stock is currently selling for \$6.70. The stock price is \$104, the strike price is \$100, and the risk-free interest rate is 6% per year. What opportunities could an arbitrageur exploit? Think of synthesizing a negative price put.

Problem 4. A non-dividend paying stock trades for \$200. The risk-free rate is 5% per year with continuous compounding. European call and put options with strike \$200 and maturity 9 months trade for \$15 and \$8 per share, respectively. Is there an arbitrage opportunity? If so, how an arbitrageur would make a profit?

Problem 5. A non-dividend paying stock trades for \$100. The risk-free rate is 6% per year with continuous compounding. European call and put options with strike \$100 and maturity 6 months trade for \$15 and \$13 per share, respectively. Is there an arbitrage opportunity? If so, how an arbitrageur would make a profit?

Problem 6. The price of a non-dividend paying stock is \$250. The risk-free rate is 5% per year with continuous compounding. Consider a European put option with strike price \$280 and maturity 1 year. What should be the price of the put if the volatility of the stock returns is zero?

Problem 7. What should be the price of a six-month European call option written on a non-dividend-paying stock when the stock price is \$160, the strike price is \$150, the risk-free rate is 10% per year, and the volatility of the stock returns is zero?

Problem 8. Consider a non-dividend paying asset. There are American and European call and put options written on this asset and available for trade. The risk-free rate is positive for all maturities. Please say whether the following statements are true or false, and briefly explain why.

- a. It might be optimal to exercise early an American call option written on this asset.
- b. It might be optimal to exercise early an American put option written on this asset.
- c. The time-value of a European call written on this asset might be negative for stock prices that are high enough.
- d. The time-value of a European put written on this asset might be negative for stock prices that are low enough.