UNIVERSITY OF TEXAS AT AUSTIN

HW Assignment 3

CONTENTS

3.1. **Parallels between put options and classical insurance.** Consider *homeowner's insurance.* An insurance policy is there to compensate the homeowner in case there is a financial loss due to physical damage to the home (fire, e.g.). At the time the insurance policy is issued the home is apraised and its **initial value** becomes part of the insurance policy. If the property is damaged, the insurance company is liable to make a benefit payment to the policyholder in the amount needed to bring the home back to its original state. In order for this to happen, however, the policyholder needs to initiate a claim. The homeowner is not required to file a claim, but should the claim be filed, the insurance company is required to proceed according to the contract and make the benefit payment.

So far, we have discussed the use of derivative securities (forward contracts, call options and put options) for hedging. If we draw parallels between classical insurance and use of options, we get the following correspondence:

Classical homeowner's insurance	**Hedging with derivative securities**
Home	Risky asset
Value of home	Market price of the risky asset
Insurance company	Option writer
Policyholder	Option buyer
Benefit payment	Payoff

If we specify the features of the insurance policy, we can see even more precise connections. Most insurance policies include a type of cost-sharing between the insurer and the insured. Most commonly, homeowner's insurance includes a *deductible.* The deductible d is the monetary amount up to which the policyholder pays for the damages. Once the loss exceeds d, the insurer pays for the excess of the loss over the deductible. So, if we denote the loss amount by the random variable X, the amount paid by the insurer and received by the policyholder is $(X - d)_+$.

The loss X can be understood as the reduction in the home's value due to physical damage. If we denote the home's value at time t by $S(t)$, we see that $X = S(0) - S(T)$ with T denoting the end of the insurance period, say. Having observed this, we see that the amount received by the policyholder is

$$(X - d)_+ = (S(0) - S(T) - d)_+ = ((S(0) - d) - S(T))_+$$

The expression above is exactly the payoff of a put option with strike price $S(0) - d$. With this observation, our analogy is complete.

Please, provide the **final solution only** to the following problem(s):

Problem 3.1. (2 points) The owner of a house worth $180,000 purchases an insurance policy at the beginning of the year for a price of $1,000. The deductible on the policy is $5,000.
If after 6 months the homeowner experiences a casualty loss valued at $50,000, what is the homeowner's net loss? Assume that the continuously compounded interest rate equals 4.0%.

(a) $6,020
(b) $11,020
(c) $50,000
(d) $51,020
(e) None of the above.

Problem 3.2. (8 points) Draw the profit diagram for the homeowner's **complete** position consisting of both the property and the insurance policy.

3.2. **Put-call parity.** Provide your **final solution only** to the following problem(s).

Problem 3.3. (5 points) A company forecasts to pay dividends of $\$0.90, \$1.20$ and $\$1.45$ in $3, 6$ and 9 months from now, respectively. Given that the interest rate is $r = 5.5\%$, how much dollar impact will dividends have on prices of 9−month options? More precisely, what is the present value of the projected dividend payments?

(a) \$3.45
(b) \$3.90
(c) \$4.22
(d) \$4.50
(e) None of the above.

Problem 3.4. (5 points) A certain common stock is priced at \$42.00 per share. Assume that the continuously compounded interest rate is $r = 10.00\%$ per annum. Consider a \$50−strike European call, maturing in 3 years which currently sells for \$10.80. What is the price of the corresponding 3−year, \$50−strike European put option?

(a) \$5.20
(b) \$5.69
(c) \$5.04
(d) \$5.84
(e) None of the above.

Problem 3.5. (5 points) A certain common stock is priced at \$99.00 per share and pays a continuous dividend yield of 2% per annum. Consider a \$100−strike European call and put, maturing in 9 months which currently sell for \$11.71 and \$5.31. Let the continuously compounded risk-free interest rate be denoted by r. Then,

(a) $0 \leq r < 0.05$
(b) $0.05 \leq r < 0.10$
(c) $0.10 \leq r < 0.15$
(d) $0.15 \leq r < 0.20$
(e) None of the above.

Problem 3.6. (5 points)

The initial price of a non-dividend-paying stock is \$55 per share. A 6−month, at-the-money call option is trading for \$1.89. Let the interest rate be $r = 0.065$. Find the price of the European put with the same strike, expiration and the underlying asset.

(a) \$0.05
(b) \$0.13
(c) \$0.56
(d) \$0.88
(e) None of the above

Problem 3.7. (5 points) A stock currently sells for \$32.00. A 6-month European call option with a strike of \$30.00 has a premium of \$4.29, and the otherwise identical put has a premium of \$2.64. Assume a 4% continuously compounded, risk-free rate. What the net present value of the dividends payable over the next 6 months?

(a) \$0.05
(b) \$0.13
(c) \$0.52
(d) \$0.94
(e) None of the above

Problem 3.8. (5 points) *Source: Problem #2 from the Sample IFM (Derivatives: Introductory) questions.* You are given the following information:

(1) The current price to buy one share of XYZ stock is 500.
(2) The stock does not pay dividends.
(3) The risk-free interest rate, compounded continuously, is 6%.
(4) A European call option on one share of XYZ stock with a strike price of K that expires in one year costs \$66.59.
(5) A European put option on one share of XYZ stock with a strike price of K that expires in one year costs \$18.64.

Determine the strike price K.

(a) \$449
(b) \$452
(c) \$480
(d) \$559
(e) None of the above.

Problem 3.9. (5 points) Consider a European call option and a European put option on a non-dividend-paying stock. Assume:

(1) The current price of the stock is \$55.
(2) The call option currently sells for \$0.15 more than the put option.
(3) Both options expire in 4 years.
(4) Both options have a strike price of \$70.

Calculate the continuously compounded risk-free interest rate r.

(a) \$0.044
(b) \$0.052
(c) \$0.06
(d) \$0.065
(e) None of the above.

3.3. **Chooser options.** Provide your **final answer** only for the following problems.

Problem 3.10. (2 points) The initial price of a chooser option is greater than or equal to the price of a regular European call on the same asset with the same strike and exercise date. *True or false?*

Problem 3.11. (5 points) Consider a chooser option on a stock S whose current price is \$100 per share. Assume that we are using our usual notation, i.e., let

$$V_{CH}(0, t^*, T, K)$$

denote the time-0 price of a chooser option with choice date t^*, exercise date T and strike price K. Also, let $V_C(0, T, K)$ denote the time-0 price of a European call option with strike K and exercise date T. Likewise, let $V_P(0, T, K)$ denote the time-0 price of a European put option with strike K and exercise date T. Then, the following inequality holds:

(a) $V_{CH}(0, t^*, T, K) \leq V_P(0, T, K)$
(b) $V_{CH}(0, t^*, T, K) \leq V_C(0, T, K)$
(c) $\max(V_P(0, T, K), V_C(0, T, K)) \leq V_{CH}(0, t^*, T, K)$
(d) $V_{CH}(0, t^*, T, K) < \max(V_P(0, T, K), V_C(0, T, K))$
(e) None of the above