

UNIVERSITY OF TEXAS AT AUSTIN

HW Assignment 6

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

Problem 6.1. (2 points) Consider a one-year, \$55-strike European call option and a one-year, \$45-strike European put option on the same underlying asset.

You observe that the time-0 stock price equals \$40 while the time-1 stock price equals \$50. Then, both of the options are out-of-the-money at expiration.

Problem 6.2. (15 points) You produce cupcakes. You plan to sell 1,000 festive cupcakes in a month. Your (unhedged) payoff will be $\$25,000 - S(1)$, where $S(1)$ denotes the price of the 1,000 fondant reindeer required to decorate the 1,000 cakes.

Assume that the continuously compounded annual risk-free interest rate equals 6%.

Your hedge consists of the following two components:

- (1) one **long** one-month, \$10,000-strike call option on the fondant reindeer you need; its premium is $V_C(0) = \$70.00$,
- (2) one **written** one-month, \$9,000-strike put option on the fondant reindeer you need; its premium is $V_P(0) = \$150.00$.

Calculate the maximum and the minimum of the profit for the (overall) **hedged** portfolio.

Problem 6.3. (15 points) The future value in one year of the total aggregate costs of manufacturing a widget is \$100. You will sell a widget in one year at its market price of $S(1)$.

Assume that the continuously compounded, risk-free interest rate equals 5%.

You purchase a one-year, \$120-strike put on one widget for a premium of \$7. You sell some of the potential gain by writing a one-year, \$150-strike call on one widget for a \$3 premium.

What is the **range** of the profit of your total hedged portfolio?

Floors. The portfolio consisting of

- the **long** risky asset, and
- a **long** put on that asset

is commonly referred to as the *floor*. It arises naturally when the producer of a commodity or an owner of a risky asset (shares of stock, e.g.) uses puts to hedge his/her exposure to risk.

Provide your final answer only for the following problem.

Problem 6.4. (5 points) Sample FM(DM) #13.

Suppose that you short one share of a stock index for 50, and that you also buy a 60-strike European call option that expires in 2 years for 10. Assume the effective annual interest rate is 3%. If the stock index increases to 75 after 2 years, what is the profit on your combined position, and what is an alternative name for the call in this context?

- | Profit | Name |
|-----------|------------------------|
| A. -22.64 | Floor |
| B. -17.56 | Floor |
| C. -22.64 | Cap |
| D. -17.56 | Cap |
| E. -22.64 | “Written” Covered Call |

Covered puts. The writer of a put option might want to hedge his/her exposure to risk by shorting the underlying asset. The position consisting of

- the **short** risky asset, and
- a **written** put on that asset

is commonly referred to as the *covered put*.

Problem 6.5. (2 points) Which one of the following constructs a *covered put*?

- (a) Write a one-year, \$100-strike call and buy the underlying.
- (b) Write a one-year, \$100-strike put and short the underlying.
- (c) Write a one-year, \$100-strike put and buy the underlying.
- (d) Write a one-year, \$100-strike put and write a one-year, \$100-strike call.
- (e) None of the above.

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 appraised 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 6.6. (2 points) *Source: Sample FM(DM) Problem #27.*

The position consisting of *one long homeowner's insurance contract* benefits from falling prices in the underlying asset. *True or false?*

Problem 6.7. (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 6.8. (7 points) Draw the profit diagram for the homeowner's **complete** position consisting of both the property and the insurance policy.