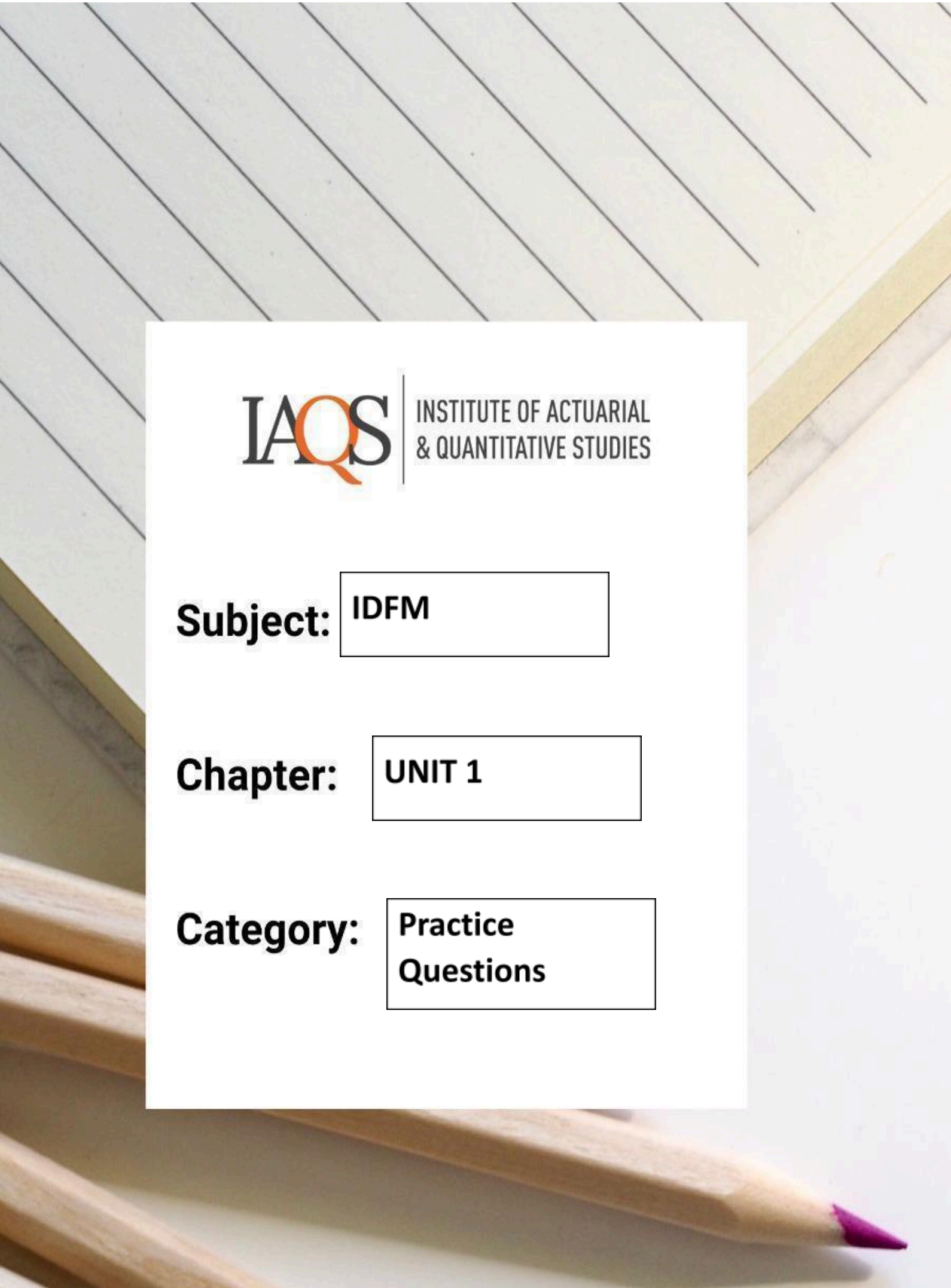


IAQS | INSTITUTE OF ACTUARIAL & QUANTITATIVE STUDIES

Subject: IDFM

Chapter: UNIT 1

Category: Practice Questions

Chapter 1: Introduction to Derivatives

1. What is the difference between a long forward position and a short forward position?

Ans –

When a trader enters into a long forward contract, she is agreeing to *buy* the underlying asset for a certain price at a certain time in the future. When a trader enters into a short forward contract, she is agreeing to *sell* the underlying asset for a certain price at a certain time in the future.

2. What is the difference between entering into a long forward contract when the forward price is $50 and taking a long position in a call option with a strike price of $50?

Ans –

In the first case the trader is obligated to buy the asset for $50. (The trader does not have a choice.) In the second case the trader has an option to buy the asset for $50. (The trader does not have to exercise the option.)

3. A trader enters into a short cotton futures contract when the futures price is 50 cents per pound. The contract is for the delivery of 50,000 pounds. How much does the trader gain or lose if the cotton price at the end of the contract is (a) 48.20 cents per pound and (b) 51.30 cents per pound?

Ans –

(a) The trader sells for 50 cents per pound something that is worth 48.20 cents per pound.
Gain $=(\$0.5000 - \$0.4820) \times 50{,}000 = \$900$.

(b) The trader sells for 50 cents per pound something that is worth 51.30 cents per pound.
Loss $=(\$0.5130 - \$0.5000) \times 50{,}000 = \$650$.

4. Explain carefully the difference between selling a call option and buying a put option.

Ans –

Selling a call option involves giving someone else the right to buy an asset from you. It gives you a payoff of

$$-\max(S_T - K, 0) = \min(K - S_T, 0)$$

Buying a put option involves buying an option from someone else. It gives a payoff of

$$\max(K - S_T, 0)$$

In both cases the potential payoff is $K - S_T$. When you write a call option, the payoff is negative or zero. (This is because the counterparty chooses whether to exercise.) When you buy a put option, the payoff is zero or positive. (This is because you choose whether to exercise.)

5. Suppose that you write a put contract with a strike price of $40 and an expiration date in 3 months. The current stock price is $41 and the contract is on 100 shares. What have you committed yourself to? How much could you gain or lose?

Ans –

You have sold a put option. You have agreed to buy 100 shares for $40 per share if the party on the other side of the contract chooses to exercise the right to sell for this price. The option will be exercised only when the price of stock is below $40. Suppose, for example, that the option is exercised when the price is $30. You have to buy at $40 shares that are worth $30; you lose $10 per share, or $1,000 in total. If the option is exercised when the price is $20, you lose $20 per share, or $2,000 in total. The worst that can happen is that the price of the stock declines to almost zero during the three-month period. This highly unlikely event would cost you $4,000. In return for the possible future losses, you receive the price of the option from the purchaser.

6. You would like to speculate on a rise in the price of a certain stock. The current stock price is $29 and a 3-month call with a strike price of $30 costs $2.90. You have $5,800 to invest. Identify two alternative investment strategies, one in the stock and the other in an option on the stock. What are the potential gains and losses from each?

Ans –

One strategy would be to buy 200 shares. Another would be to buy 2,000 options. If the share price does well the second strategy will give rise to greater gains. For example, if the share price goes up to \$40 you gain $[2,000 \times (\$40 - \$30)] - \$5,800 = \$14,200$ from the second strategy and only $200 \times (\$40 - \$29) = \$2,200$ from the first strategy. However, if the share price does badly, the second strategy gives greater losses. For example, if the share price goes down to \$25, the first strategy leads to a loss of $200 \times (\$29 - \$25) = \$800$, whereas the second strategy leads to a loss of the whole \$5,800 investment. This example shows that options contain built in leverage.

7. Suppose that you own 5,000 shares worth \$25 each. How can put options be used to provide you with insurance against a decline in the value of your holding over the next 4 months?

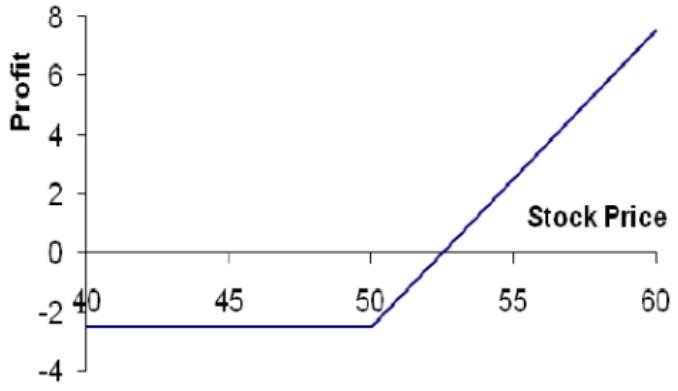
Ans –

You could buy 50 put option contracts (each on 100 shares) with a strike price of \$25 and an expiration date in four months. If at the end of four months the stock price proves to be less than \$25, you can exercise the options and sell the shares for \$25 each.

8. Suppose that a March call option to buy a share for \$50 costs \$2.50 and is held until March. Under what circumstances will the holder of the option make a profit? Under what circumstances will the option be exercised? Draw a diagram illustrating how the profit from a long position in the option depends on the stock price at maturity of the option.

Ans –

The holder of the option will gain if the price of the stock is above \$52.50 in March. (This ignores the time value of money.) The option will be exercised if the price of the stock is above \$50.00 in March. The profit as a function of the stock price is shown in Figure S1.1.



PRACTICE QUESTIONS

UNIT 1

9. It is May and a trader writes a September call option with a strike price of $20. The stock price is $18 and the option price is $2. Describe the trader's cash flows if the option is held until September and the stock price is $25 at that time

Ans –

The trader has an inflow of $2 in May and an outflow of $5 in September. The $2 is the cash received from the sale of the option. The $5 is the result of the option being exercised. The trader has to buy the stock for $25 in September and sell it to the purchaser of the option for $20.

10. A company knows that it is due to receive a certain amount of a foreign currency in 4 months. What type of option contract is appropriate for hedging?

Ans –

A long position in a four-month put option on the foreign currency can provide insurance against the exchange rate falling below the strike price. It ensures that the foreign currency can be sold for at least the strike price.

11. A U.S. company expects to have to pay 1 million Canadian dollars in 6 months. Explain how the exchange rate risk can be hedged using (a) a forward contract and (b) an option.

Ans –

The company could enter into a long forward contract to buy 1 million Canadian dollars in six months. This would have the effect of locking in an exchange rate equal to the current forward exchange rate. Alternatively the company could buy a call option giving it the right (but not the obligation) to purchase 1 million Canadian dollars at a certain exchange rate in six months. This would provide insurance against a strong Canadian dollar in six months while still allowing the company to benefit from a weak Canadian dollar at that time.

12. Describe the profit from the following portfolio: a long forward contract on an asset and a long European put option on the asset with the same maturity as the forward contract and a strike price that is equal to the forward price of the asset at the time the portfolio is set up.

Ans –

The terminal value of the long forward contract is:

$$S_T - F_0$$

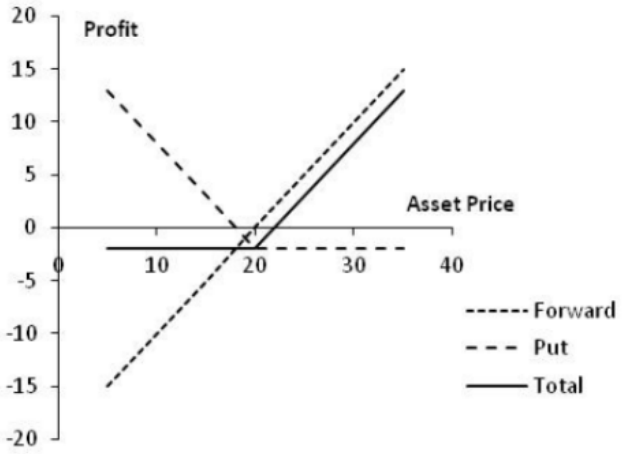
where S_T is the price of the asset at maturity and F_0 is the delivery price, which is the same as the forward price of the asset at the time the portfolio is set up). The terminal value of the put option is:

$$\max(F_0 - S_T, 0)$$

The terminal value of the portfolio is therefore

$$S_T - F_0 + \max(F_0 - S_T, 0)$$
$$= \max(0, S_T - F_0)$$

This is the same as the terminal value of a European call option with the same maturity as the forward contract and a strike price equal to F_0 . This result is illustrated in the Figure S1.3.
The profit equals the terminal value of the call option less the amount paid for the put option. (It does not cost anything to enter into the forward contract.



13. On July 1, 2017, a company enters into a forward contract to buy 10 million Japanese yen on January 1, 2018. On September 1, 2017, it enters into a forward contract to sell 10 million Japanese yen on January 1, 2018. Describe the payoff from this strategy.

Ans –

Suppose that the forward price for the contract entered into on July 1, 2017 is F_1 and that the forward price for the contract entered into on September 1, 2017 is F_2 with both F_1 and F_2 being measured as dollars per yen. If the value of one Japanese yen (measured in US dollars) is S_T on January 1, 2018, then the value of the first contract (in millions of dollars) at that time is

$$10(S_T - F_1)$$

while the value of the second contract at that time is:

$$10(F_2 - S_T)$$

The total payoff from the two contracts is therefore

$$10(S_T - F_1) + 10(F_2 - S_T) = 10(F_2 - F_1)$$

Thus if the forward price for delivery on January 1, 2018 increased between July 1, 2017 and September 1, 2017 the company will make a profit. (Note that the yen/USD exchange rate is usually expressed as the number of yen per USD not as the number of USD per yen)

14. A trader sells a put option with a strike price of $40 for $5. What is the trader's maximum gain and maximum loss? How does your answer change if it is a call option?

Ans –

The trader's maximum gain from the put option is $5. The maximum loss is $35, corresponding to the situation where the option is exercised and the price of the underlying asset is zero. If the option were a call, the trader's maximum gain would still be $5, but there would be no bound to the loss as there is in theory no limit to how high the asset price could rise.

15. What is arbitrage? Explain the arbitrage opportunity when the price of a dually listed mining company stock is $50 (USD) on the New York Stock Exchange and $60 (CAD) on the Toronto Stock Exchange. Assume that the exchange rate is such that 1 U.S. dollar equals 1.21 Canadian dollars. Explain what is likely to happen to prices as traders take advantage of this opportunity.

Ans –

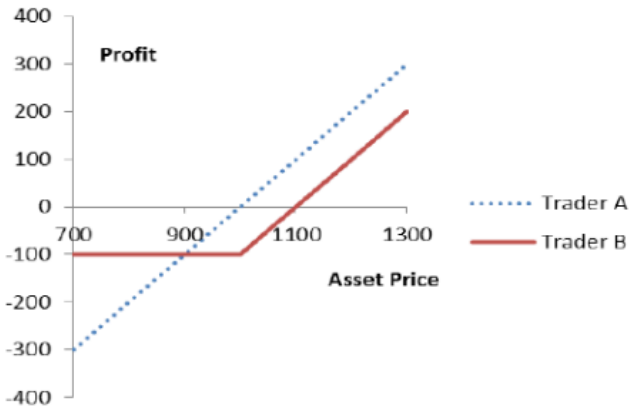
Arbitrage involves carrying out two or more different trades to lock in a profit. In this case, traders can buy shares on the TSX and sell them on the NYSE to lock in a USD profit of 50-60/1.21=0.41 per share. As they do this the NYSE price will fall and the TSX price will rise so that the arbitrage opportunity disappears

16. Trader A enters into a forward contract to buy an asset for $1,000 in one year. Trader B

buys a call option to buy the asset for $1,000 in one year. The cost of the option is $100. What is the difference between the positions of the traders? Show the profit as a function of the price of the asset in one year for the two traders.

Ans –

Trader A makes a profit of $S_T - 1000$ and Trader B makes a profit of max $(S_T - 1000, 0) - 100$ where S_T is the price of the asset in one year. Trader A does better if S_T is above $900 as indicated in Figure S1.4.



17. The price of gold is currently $1,200 per ounce. The forward price for delivery in 1 year is $1,300 per ounce. An arbitrageur can borrow money at 3% per annum. What should the arbitrageurs do? Assume that the cost of storing gold is zero and that gold provides no income.

Ans –

The arbitrageur should borrow money to buy a certain number of ounces of gold today and short forward contracts on the same number of ounces of gold for delivery in one year. This means that gold is purchased for $1,200 per ounce and sold for $1,300 per ounce. Interest on the borrowed funds will be $0.03 \times \$1,200$ or $36 per ounce. A profit of $64 per ounce will therefore be made.

18. A bond issued by Standard Oil some time ago worked as follows. The holder received no interest. At the bond's maturity the company promised to pay $1,000 plus an additional amount based on the price of oil at that time. The additional amount was equal to the product of 170 and the excess (if any) of the price of a barrel of oil at maturity over $25. The maximum additional amount paid was $2,550 (which corresponds to a price of $40 per barrel). Show that the bond is a combination of a regular bond, a long position in call options on oil with a strike price of $25, and a short position in call options on oil with a strike price of $40.

PRACTICE QUESTIONS

UNIT 1

Ans –

Suppose S_T is the price of oil at the bond's maturity. In addition to \$1000 the Standard Oil bond pays:

$$\begin{aligned} S_T < \$25 &: 0 \\ \$40 > S_T > \$25 &: 170(S_T - 25) \\ S_T > \$40 &: 2{,}550 \end{aligned}$$

This is the payoff from 170 call options on oil with a strike price of 25 less the payoff from 170 call options on oil with a strike price of 40. The bond is therefore equivalent to a regular bond plus a long position in 170 call options on oil with a strike price of \$25 plus a short position in 170 call options on oil with a strike price of \$40.

19. A trader buys a European call option and sells a European put option. The options have the same underlying asset, strike price, and maturity. Describe the trader's position. Under what circumstances does the price of the call equal the price of the put?

Ans –

The trader has a long European call option with strike price K and a short European put option with strike price K. Suppose the price of the underlying asset at the maturity of the option is S_T. If $S_T > K$, the call option is exercised by the investor and the put option expires worthless. The payoff from the portfolio is then $S_T - K$. If $S_T < K$, the call option expires worthless and the put option is exercised against the investor. The cost to the investor is $K - S_T$. Alternatively we can say that the payoff to the investor in this case is $S_T - K$ (a negative amount). In all cases, the payoff is $S_T - K$, the same as the payoff from the forward contract. The trader's position is equivalent to a forward contract with delivery price K.

Suppose that F is the forward price. If $K = F$, the forward contract that is created has zero value. Because the forward contract is equivalent to a long call and a short put, this shows that the price of a call equals the price of a put when the strike price is F.

Chapter 2: Mechanics of Options Markets

20. Explain why margin accounts are required when clients write options but not when they buy options.

Ans –

When an investor buys an option, cash must be paid up front. There is no possibility of future liabilities and therefore no need for a margin account. When an investor sells an option, there are potential future liabilities. To protect against the risk of a default, margins are required.

21. A company declares a 2-for-1 stock split. Explain how the terms change for a call option with a strike price of $60 and lot size of 1000 shares.

Ans –

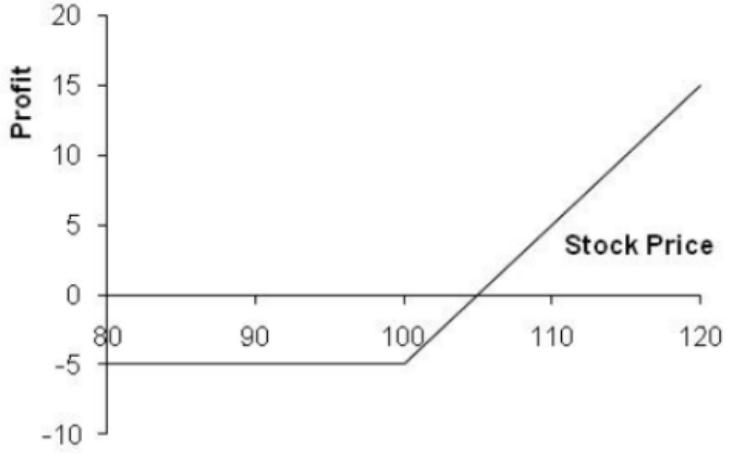
The strike price is reduced to $30, and the option gives the holder the right to purchase twice as many shares.

The lot size will now double to 2000 shares, resting everything being constant.

22. Suppose that a European call option to buy a share for $100.00 costs $5.00 and is held until maturity. Under what circumstances will the holder of the option make a profit? Under what circumstances will the option be exercised? Draw a diagram illustrating how the profit from a long position in the option depends on the stock price at maturity of the option.

Ans –

Ignoring the time value of money, the holder of the option will make a profit if the stock price at maturity of the option is greater than $105. This is because the payoff to the holder of the option is, in these circumstances, greater than the $5 paid for the option. The option will be exercised if the stock price at maturity is greater than $100. Note that if the stock price is between $100 and $105 the option is exercised, but the holder of the option takes a loss overall. The profit from a long position is as shown in Figure S9.3.



23. Explain why the market maker's bid–offer spread represents a real cost to options investors.

Ans –

A "fair" price for the option can reasonably be assumed to be half way between the bid and the offer price quoted by a market maker. An investor typically buys at the market maker's offer and sells at the market maker's bid. Each time he or she does this there is a hidden cost equal to half the bid-offer spread.

24. "If most of the call options on a stock are in the money, it is likely that the stock price has risen rapidly in the last few months." Discuss this statement.

Ans –

The exchange has certain rules governing when trading in a new option is initiated. These mean that the option is close-to-the-money when it is first traded. If all call options are in the money it is therefore likely that the stock price has increased since trading in the option began.

25. What is the effect of an unexpected cash dividend on (a) a call option price and (b) a put option price?

Ans –

An unexpected cash dividend would reduce the stock price on the ex-dividend date. This stock price reduction would not be anticipated by option holders. As a result there would be a reduction in the value of a call option and an increase the value of a put option. (Note that the terms of an option are adjusted for cash dividends only in exceptional circumstances.)

PRACTICE QUESTIONS

UNIT 1