CHAPTER 10
Mechanics of Options Markets

Short Concept Questions

10.1 An American option can be exercised any time up to the expiration date. A European option can be exercised only on the expiration date.

10.2 Long call, short call, long put, and short put.

10.3 SPX, OEX, NDX, and DJX.

10.4 A flex option is a nonstandard option traded by the CBOE.

10.5 (a) and (b).

10.6 A position limit is a limit on the number of options an investor can hold on one side of the market. They are to prevent one investor exercising undue influence on the market.

10.7 There is more flexibility on strike price, maturity and option terms.

10.8 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.

10.9 (a) Options trade for April, May, August, and November maturity months. (b) Options trade for the June, July, August, and November maturity months.

10.10 Writing a put gives a payoff of $\min(S_T - K, 0)$. Buying a call gives a payoff of $\max(S_T - K, 0)$. In both cases, the potential payoff is $S_T - K$. The difference is that for a written put the counterparty chooses whether you get the payoff (and will allow you to get it only when it is negative to you). For a long call, you decide whether you get the payoff (and you choose to get it when it is positive to you.)

Practice Questions

10.11
The investor makes a profit if the price of the stock on the expiration date is less than \$37. In these circumstances, the gain from exercising the option is greater than \$3. The option will be exercised if the stock price is less than \$40 at the maturity of the option. The variation of the investor's profit with the stock price in Figure S10.1.

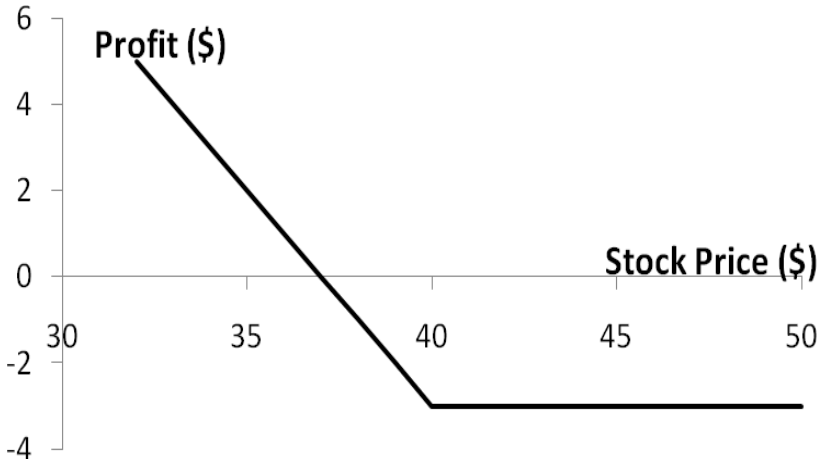

Figure S10.1: *Investor's profit in Problem 10.11*

10.12
The investor makes a profit if the price of the stock is below \$54 on the expiration date. If the stock price is below \$50, the option will not be exercised, and the investor makes a profit of \$4. If the stock price is between \$50 and \$54, the option is exercised and the investor makes a profit between \$0 and \$4. The variation of the investor's profit with the stock price is as shown in Figure S10.2.

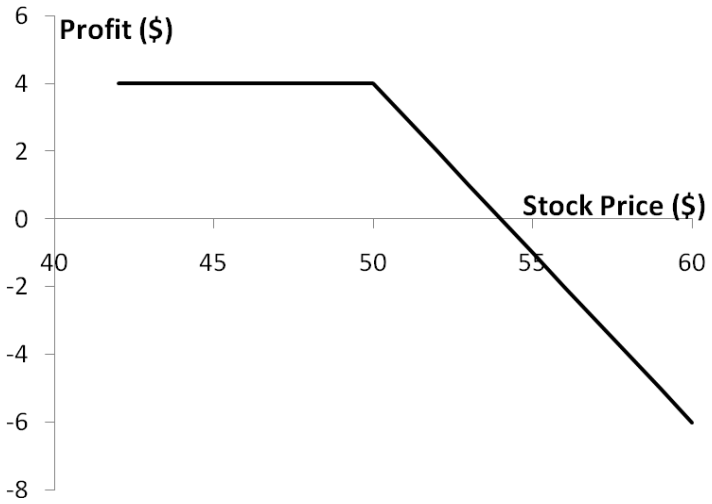

Figure S10.2: *Investor's profit in Problem 10.12*

10.13
The payoff to the investor is

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

This is $K - S_T$ in all circumstances. The investor's position is the same as a short position in a forward contract with delivery price K.

10.14
The strike price is reduced to $30, and the option gives the holder the right to purchase twice as many shares.

10.15
The exercise of employee stock options usually leads to new shares being issued by the company and sold to the employee. This changes the amount of equity in the capital structure. When a regular exchange-traded option is exercised, no new shares are issued and the company's capital structure is not affected.

10.16
\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 S10.3.

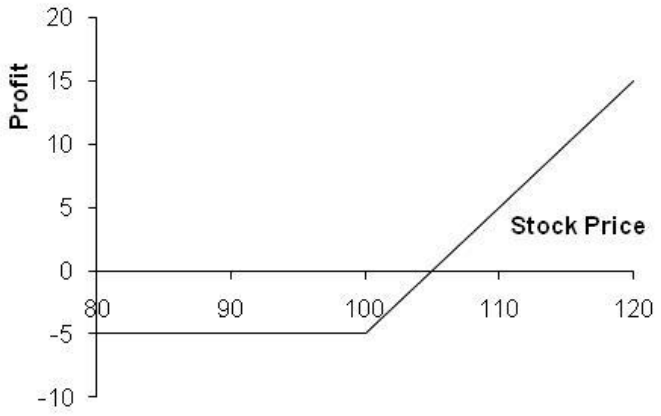

Figure S10.3: *Profit from long position in Problem 10.16*

10.17
Ignoring the time value of money, the seller of the option will make a profit if the stock price at maturity is greater than $52.00. This is because the cost to the seller of the option is in these circumstances less than the price received for the option. The option will be exercised if the stock price at maturity is less than $60.00. Note that if the stock price is between $52.00 and $60.00, the seller of the option makes a profit even though the option is exercised. The profit from the short position is as shown in Figure S10.4.

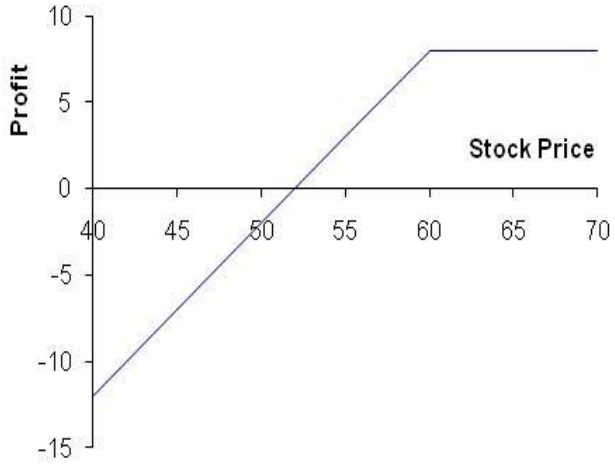

Figure S10.4: *Profit from short position in Problem 10.17*

10.18

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 forward price of the asset at the time the portfolio is set up. (The delivery price in the forward contract is also F_0.)

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 an exercise price equal to F_0. This result is illustrated in Figure S10.5.

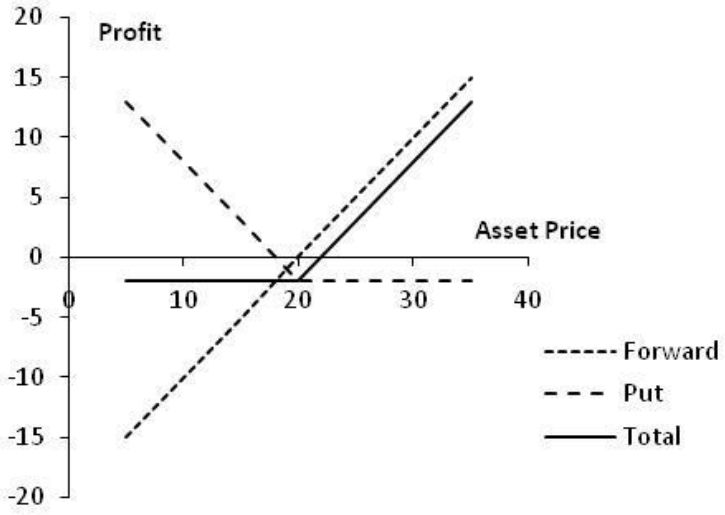

Figure S10.5: *Profit from portfolio in Problem 10.18*

We have shown that the forward contract plus the put is worth the same as a call with the same strike price and time to maturity as the put. The forward contract is worth zero at the time the portfolio is set up. It follows that the put is worth the same as the call at the time the portfolio is set up.

10.19

Figure S10.6 shows the variation of the trader's position with the asset price. We can divide the alternative asset prices into three ranges:

a) When the asset price less than \$40, the put option provides a payoff of $40-S_T$ and the call option provides no payoff. The options cost \$7 and so the total profit is $33-S_T$.

b) When the asset price is between \$40 and \$45, neither option provides a payoff. There is a net loss of \$7.

c) When the asset price greater than \$45, the call option provides a payoff of S_T-45 and the put option provides no payoff. Taking into account the \$7 cost of the options, the total profit is S_T-52.

The trader makes a profit (ignoring the time value of money) if the stock price is less than \$33 or greater than \$52. This type of trading strategy is known as a strangle and is discussed in Chapter 12.

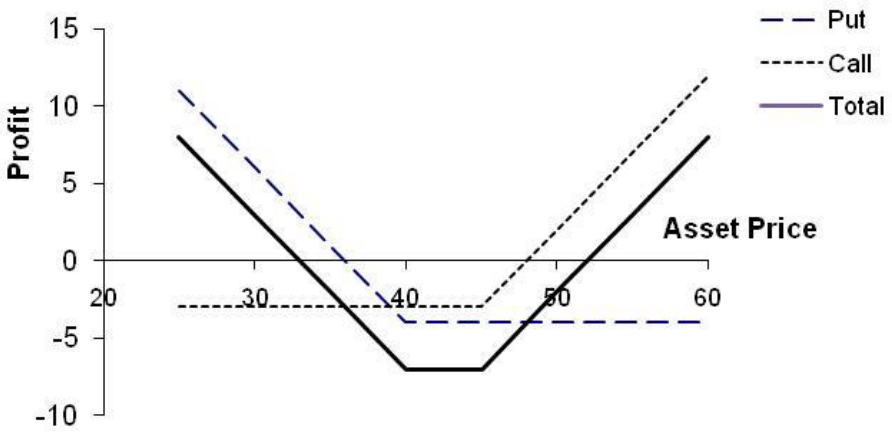

Figure S10.6: *Profit from trading strategy in Problem 10.19*

10.20
The holder of an American option has all the same rights as the holder of a European option and more. It must therefore be worth at least as much. If it were not, an arbitrageur could short the European option and take a long position in the American option.

10.21
The holder of an American option has the right to exercise it immediately. The American option must therefore be worth at least as much as its intrinsic value. If it were not, an arbitrageur could lock in a sure profit by buying the option and exercising it immediately.

10.22
Forward contracts lock in the exchange rate that will apply to a particular transaction in the future. Options provide insurance that the exchange rate will not be worse than some level. The advantage of a forward contract is that uncertainty is eliminated as far as possible. The disadvantage is that the outcome with hedging can be significantly worse than the outcome with no hedging. This disadvantage is not as marked with options. However, unlike forward contracts, options involve an up-front cost.

10.23
a) The option contract becomes one to buy $500\times 1.1 = 550$ shares with an exercise price $40/1.1 = 36.36$.
b) There is no effect. The terms of an options contract are not normally adjusted for cash dividends.
c) The option contract becomes one to buy $500\times 4 = 2,000$ shares with an exercise price of $40/4 = \$10$.

10.24
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.

10.25
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 in the value of a put option. (Note that the terms of an option are adjusted for cash dividends only in exceptional circumstances.)

10.26
a) March, April, June, and September
b) July, August, September, and December
c) August, September, December, and March.

Longer dated options may also trade.

10.27
A "fair" price for the option can reasonably be assumed to be half way between the bid and the ask price quoted by a market maker. An investor typically buys at the market maker's ask 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-ask spread.

10.28
The two calculations are necessary to determine the initial margin. The first gives

$$500\times(3.5+0.2\times57-3)=5,950$$

The second gives

$$500\times(3.5+0.1\times57)=4,600$$

The initial margin is the greater of these, or \$5,950. Part of this can be provided by the initial amount of $500\times3.5=\$1,750$ received for the options.

10.29
For strike prices of 290, 300, 310, 320, 330, and 340, the intrinsic values of call options are 26, 16, 6, 0, 0, and 0. The mid-market values of the options are 39.875, 33.20, 26.80, 21.075, 16.05, and 11.675. The time values of the options are given by what is left from the mid-market value after the intrinsic value has been subtracted. They are 13.875, 17.20, 20.80, 21.075, 16.05, and 11.675, respectively.
For strike prices of 290, 300, 310, 320, 330, and 340, the intrinsic values of put options are 0, 0, 0, 4, 14, and 24. The mid-market values of the options are 13.175, 16.35, 20.125, 24.425, 29.30, and 35.05. The time values of the options are given by what is left from the mid-market value after the intrinsic value has been subtracted. They are 13.175, 16.35, 20.125, 15.30, and 11.05, respectively.
Note that for both puts and calls, the time value is greatest when the option is close to being at-the-money.

10.30
(a) The margin requirement is the greater of 500×(10 + 0.2×58) = 10,800 and 500×(10+0.1×64) = 8,200. It is \$10,800.
(b) The margin requirement is the greater of 500×(10+0.15×58) = 9,350 and 500×(10+0.1×64) = 8,200. It is \$9,350.
(c) The margin requirement is the greater of 500×(10+0.2×70-6) = 9,000 and 500×(10+0.1×64) = 8,200. It is \$9,000.

(d) No margin is required if the trader is buying.

10.31

Executive stock option plans account for a high percentage of the total remuneration received by executives. When the market is rising fast, many corporate executives do very well out of their stock option plans—even when their company does worse than its competitors. Large institutional investors have argued that executive stock options should be structured so that the payoff depends on how the company has performed relative to an appropriate industry index. In a regular executive stock option, the strike price is the stock price at the time the option is issued. In the type of relative-performance stock option favored by institutional investors, the strike price at time t is $S_0 I_t / I_0$ where S_0 is the company's stock price at the time the option is issued, I_0 is the value of an equity index for the industry in which the company operates at the time the option is issued, and I_t is the value of the index at time t. If the company's performance equals the performance of the industry, the options are always at-the-money. If the company outperforms the industry, the options become in the money. If the company underperforms the industry, the options become out of the money. Note that a relative performance stock option can provide a payoff when both the market and the company's stock price decline.

Relative performance stock options clearly provide a better way of rewarding senior management for superior performance. Some companies have argued that, if they introduce relative performance options when their competitors do not, they will lose some of their top management talent.

10.32

Suppose that the closing stock price is \$28 and an employee has 1,000 options with a strike price of \$24. Microsoft's adjustment involves changing the strike price to $24 \times 25/28 = 21.4286$ and changing the number of options to 1,000×28/25 = 1,120. The system used by exchanges would involve keeping the number of options the same and reducing the strike price by \$3 to \$21.

The Microsoft adjustment is more complicated than that used by the exchange because it requires a knowledge of the Microsoft's stock price immediately before the stock goes ex-dividend. However, arguably it is a better adjustment than the one used by the exchange. Before the adjustment, the employee has the right to pay \$24,000 for Microsoft stock that is worth \$28,000. After the adjustment, the employee also has the option to pay \$24,000 for Microsoft stock worth \$28,000. Under the adjustment rule used by exchanges, the employee would have the right to buy stock worth \$25,000 for \$21,000. If the volatility of Microsoft remains the same, this is a less valuable option.

One complication here is that Microsoft's volatility does not remain the same. It can be expected to go up because some cash (a zero risk asset) has been transferred to shareholders. The employees therefore have the same basic option as before but the volatility of Microsoft can be expected to increase. The employees are slightly better off because the value of an option increases with volatility.