

CHAPTER 11

Solutions

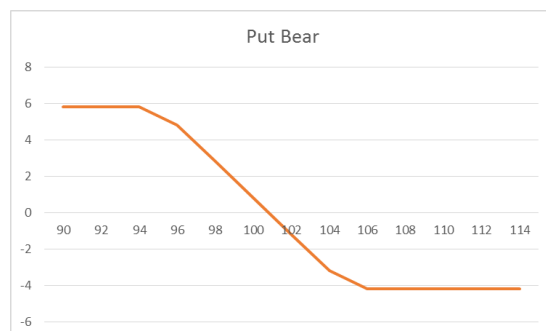
Exercise 1

Solution:

Initial cost of call bear spread = $[C(95) - C(105)] = 18.38 - 13.34 = 5.04$

Initial cost of put bear spread = $[P(95) - P(105)] = 6.08 - 10.26 = -4.28$

Net profit Diagram of both the positions:



Difference in the cost of call and put bear spread

$$[C(95) - C(105)] - [P(95) - P(105)] = 5.04 + 4.18 = 9.23$$

And from put call parity we have

$$C(K_1, t) - P(K_1, t) = S(t) - K_1 e^{-r(T-t)}$$

$$C(K_2, t) - P(K_2, t) = S(t) - K_2 e^{-r(T-t)}$$

$$[C(K_2, t) - C(K_1, t)] - [P(K_2, t) - P(K_1, t)] = (K_2 - K_1) e^{-r(T-t)}$$

$$(K_2 - K_1) e^{-r(T-t)} = (105 - 95) e^{-0.08 \cdot 1} = 10 e^{-0.08} = 9.23$$

Exercise 2

Solution: The actual volatility will be $(53 - 30) \% = 23\%$

This implies that we will be having the expected stock movement to be around

$$\sigma S_t \Delta = 0.23 * 1600 * \sqrt{\frac{3}{12}} = 184$$

This is approximately 5.75% movements towards either side of the initial stock price.

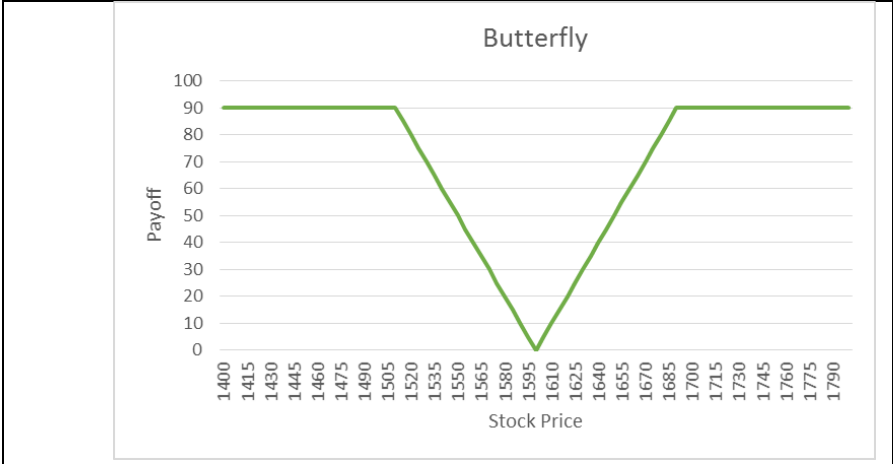
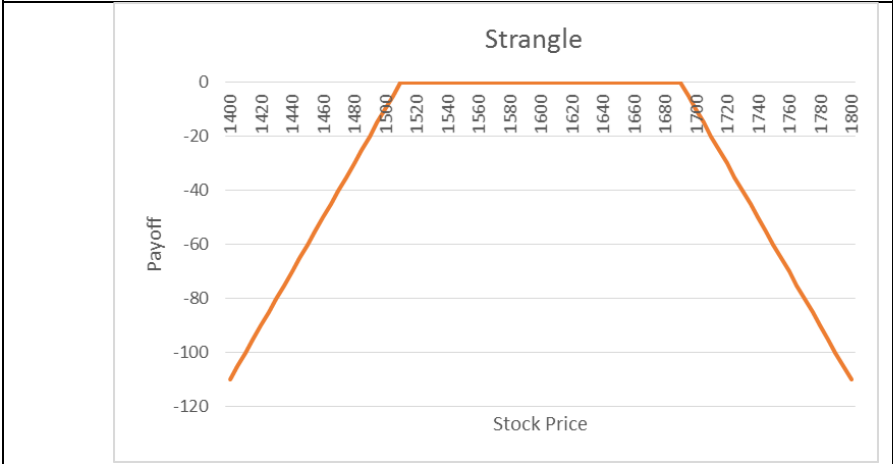
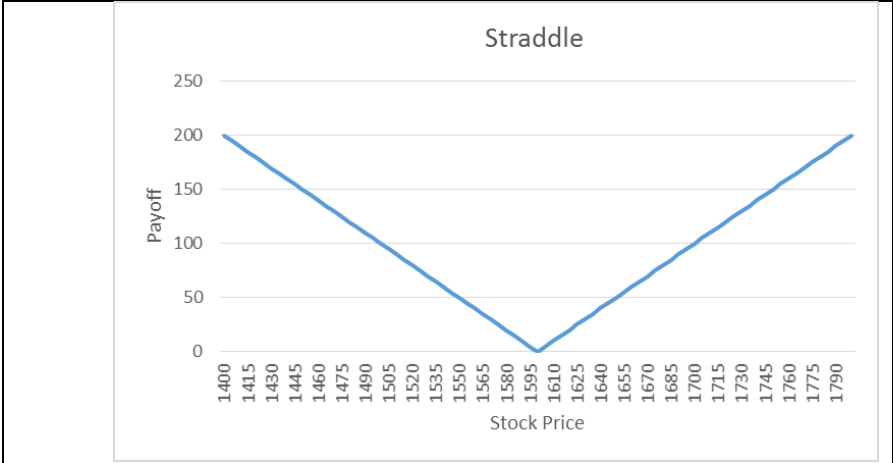
Accordingly to cover the cost of straddle he can short 5.75% out-of-money strangle.

The final butterfly position which consist of straddle = (long 1600-strike call, long 1600-strike put) and out-of-money strangle = (short 1510-strike put and 1690-strike call)

Initial cost of butterfly position will be

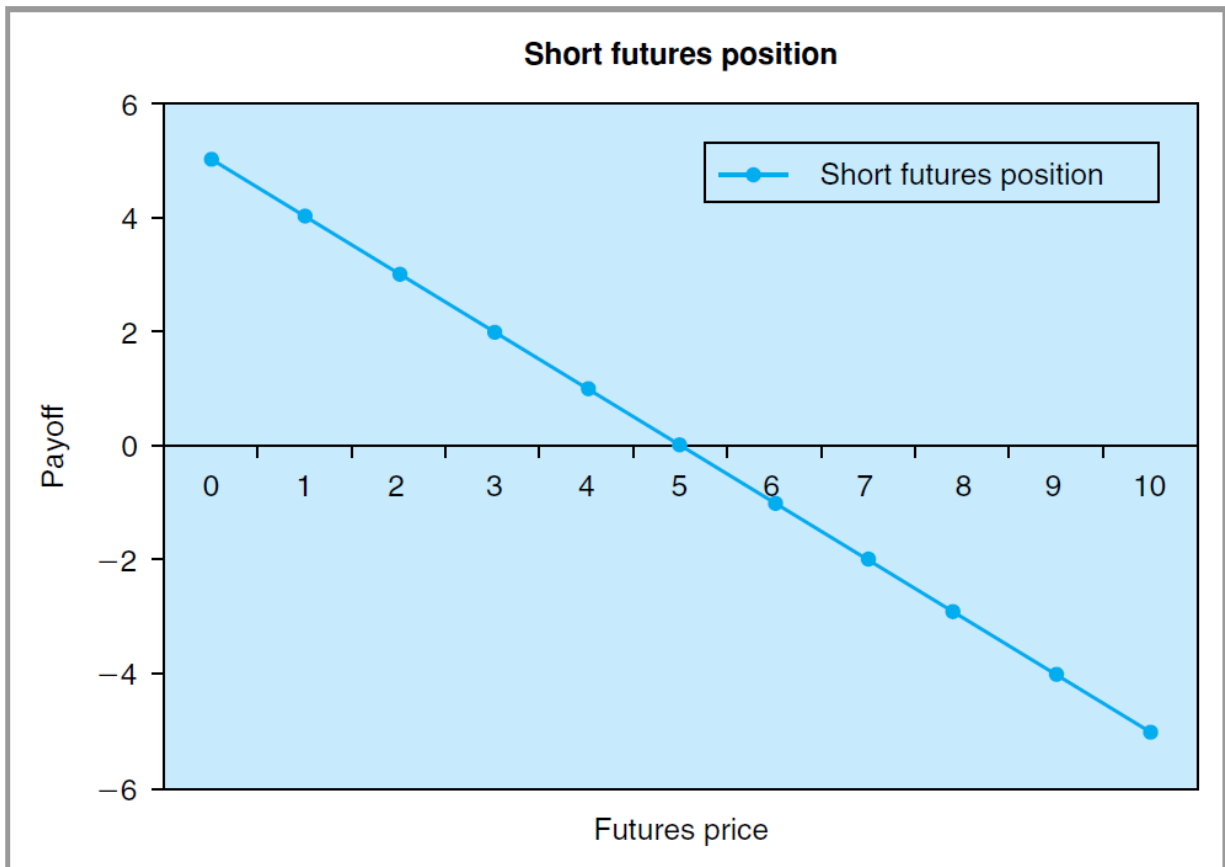
$$C(1600) + P(1600) - P(1510) - C(1690) = 366.66 + 288.63 - 241.85 - 331.41 = 82.03$$

Payoff Diagram of the long straddle, short strangle and final long butterfly are as follows:



Exercise 3

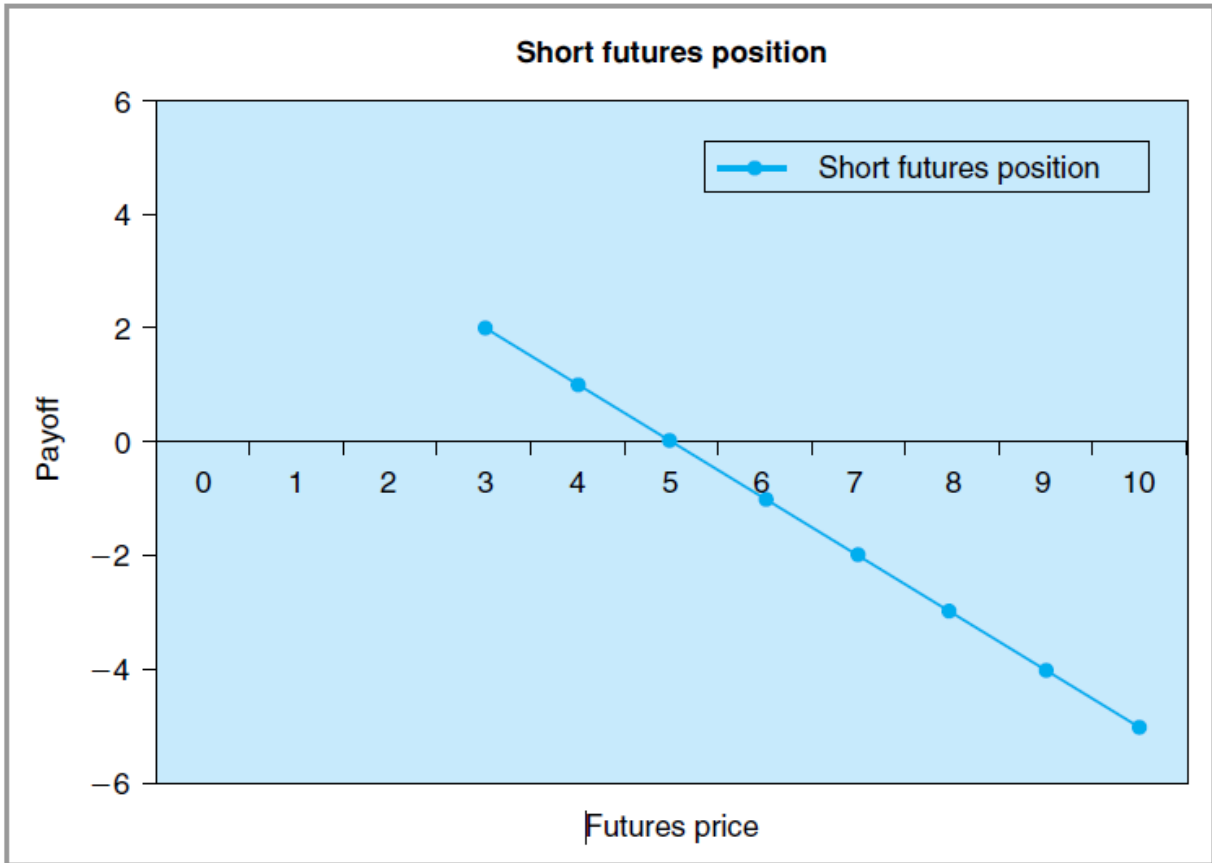
The pay off diagram for short futures position is given in in the figure below:



Here, we assume that initial futures price is \$5.

1. A bear spread can be created by buying a call option with strike price of K_1 and by selling a call option with a strike K_2 , such that $K_1 < K_2$. (Note that because of put-call parity, a bear spread can be constructed using either put options or call options. If constructed using calls (puts), it is a bear call (put) spread.)

Now assume that the investor does not expect a future's price less than \$3. Under this new assumption expected pay off diagram of short future's position would look like:



2. Now we create a similar payoff by using a bear spread:

Here, the net payoff is from the bear spread. It is clear from the figure that, if investor does not expect that underlying price will go below some minimum (here this is assumed \$3), then bear spread provides the same payoff as a short future's position. Yet, it also puts a limit on potential losses in case underlying price does go up. How do we construct a bear spread in general? In other words, how do we choose two call options?

We short the call with a strike price K_1 such that

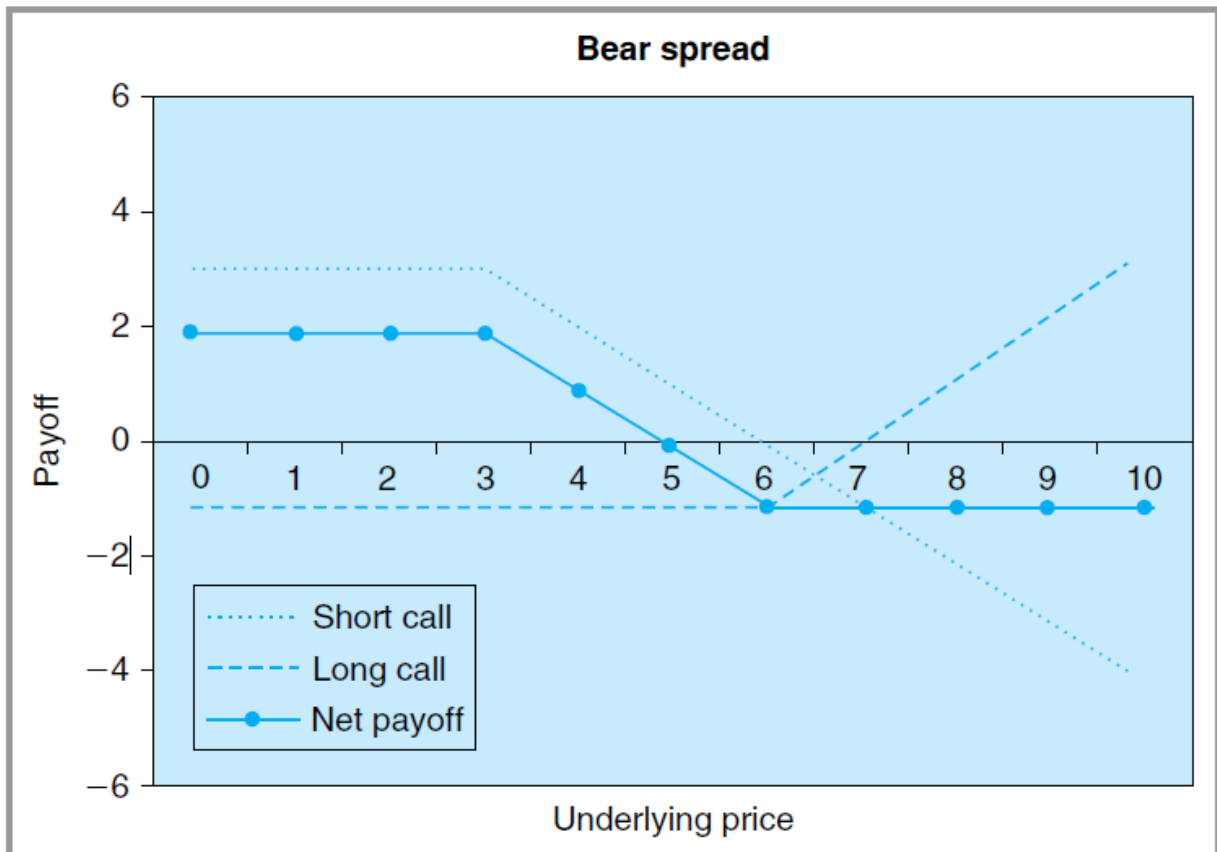
$$K_1 = X_{\min}.$$

The second call is chosen so that

$$C_1 - C_2 = \max\text{"expected" payoff}$$

where C_1 , C_2 are option premiums of short and long calls, respectively.

3. Actually we would pay something negative for this position because construction cost of the portfolio is negative. This means that, for the position we expect to be paid.



This is because,

$$K_1 < K_2 \Leftrightarrow C_1 > C_2$$

4. Maximum gain = $C_1 - C_2$

$$\text{Maximum loss} = -C_2.$$

5. See the figure above

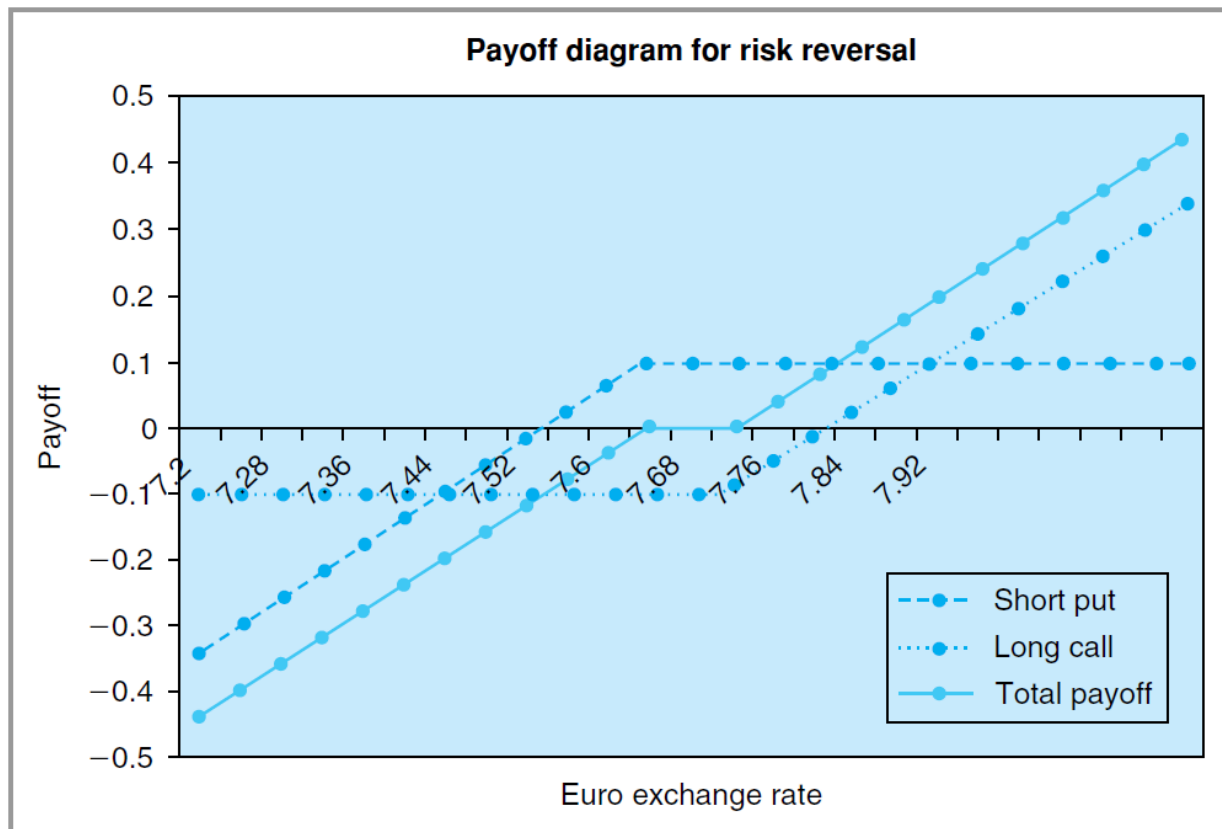
Exercise 4

1. See the diagram below:

2. The quotations are in favor of euro calls which means that market is expecting the value of euro to be higher which also makes euro calls more valuable compared to euro puts.

3. It is clear that implied volatility for euro puts is less than the implied volatility for euro calls

(See the text).



4. These are the volatilities which must be plugged in (Black-Scholes) pricing formula to find the market price of options.

5. ATM volatility is the implied volatility which makes the market price of an ATM option equal to price obtained from Black- Scholes formula. Yes there are OTM vols as well. These may be different from the ATM vols, due to the presence of smiles or skews.

Exercise 5

1. See the Figure 10.20 in the text.
2. It is clear from this figure that this may be quite useful when a trader is betting on volatility movements. For example, if volatility has been unusually high for a certain period of time, and an investor may think that it may return to its “normal” level. Range binaries enable the investor to take positions on volatility. For a detailed explanation see the text.
3. This may be the case if volatility is believed to be mean reverting, and if the current volatility is higher than its mean or alternatively during the holiday seasons.
4. Unexpected spikes in volatility can cause losses.

Exercise 6

1. See the Figure 11.19 in the text for range binaries. See also Figure 11.12 for similarity between range binaries and short strangle positions.
2. When volatility is expected to be low, or when the underlying price is expected to move in a certain range.
3. For butterfly structures see Figure 11.15 in the text. It is used to hedge losses against unexpected spikes in volatility.
4. Risk arises from a short position on range binaries if volatility is high or if price moves in a very wide range.
5. This requires obtaining market data and then evaluating mark to market losses.

Exercise 7

1. They are all volatility positions. It is clear from the text that all three structures have positive payoff if underlying price moves in a certain range. Assuming that the volatility is low.

2. This is a static position (see the article in the question).
3. In the dynamic hedge, position makes money as underlying price fluctuates around the initial price. And this payoff increases as prices fluctuations are more frequent. Similarly, payoff from (long) range accrual options increases as long as price moves in a certain range.
4. By using dynamic hedging, a structure similar to range accruals can be created.

Exercise 8

(For detailed calculation see also Excel file 'Exercise 11.8 Solution Excel Calculation' on book webpage.)

Calculation (For bear spread)

$$\text{Initial cost of call bear spread} = [C(95) - C(105)] = 18.38 - 13.34 = 5.04$$

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Difference in the cost of call and put bear spread

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$$[C(K_2, t) - C(K_1, t)] - [P(K_2, t) - P(K_1, t)] = (K_2 - K_1) e^{-r(T-t)}$$

$$(K_2 - K_1) e^{-r(T-t)} = (105 - 95) e^{-0.08 \cdot 1} = 10 e^{-0.08} = 9.23$$

Similar calculation for bull spread can be shown.

Exercise 9

(For detailed calculation see also Excel file ‘Exercise 11.9 Solution Excel Calculation’ on book webpage.)

Calculation

For long butterfly spread position

$$\text{Initial cost of straddle spread} = -[C(100) + P(100)] = -15.71 - 8.02 = -23.73$$

$$\text{Initial cost of strangle spread} = [P(90) + C(110)] = 4.45 + 11.25 = 15.7$$

Initial cost of butterfly spread

$$-[C(100) + P(100)] + [P(90) + C(110)] = -23.73 + 15.7 = -8.03$$

Exercise 10

(For detailed calculation see also Matlab file ‘Exercise 11.10 Solution Matlab Calculation’ on book webpage.)