Financial Mathematics

MATH 5870/6870[1]
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[1] Based on Robert L. McDonald's *Derivatives Markets*, 3rd Ed, Pearson, 2013.

Chapter 3. Insurance, Collars, and Other Strategies

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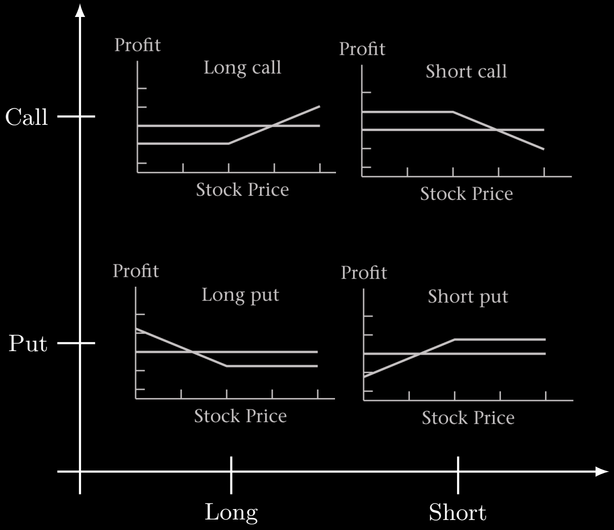
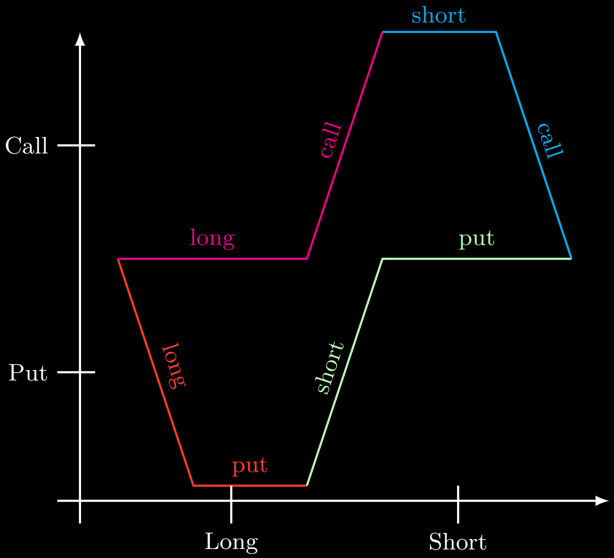
By combining two or more options, we find many well-known strategies.




short
Call
call
call
long
put
Put
long
short
put
Long
Short

An option spread is a position consisting of only calls or only puts, in which some options are purchased and some written.

- Bull and bear spreads
- Box spreads
- Ratio spreads
- Collars

Example for this section

Black-Scholes option prices

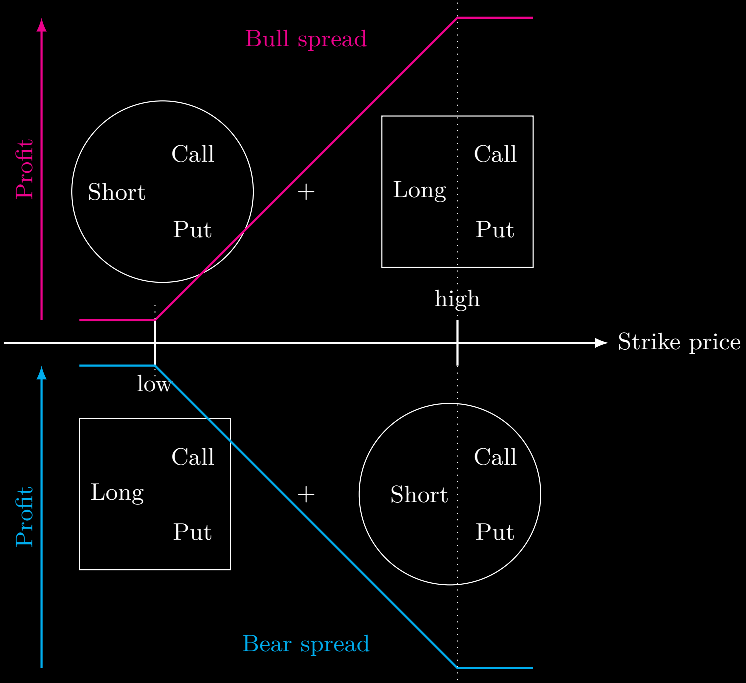
$$\begin{aligned} \text{Stock price} &= \$40 \\ \text{Volatility} &= 30\% \\ \text{Effective annual risk-free rate} &= 8.33\% \\ \text{Dividend yield} &= \$0 \\ \text{Expriation days} &= 91 \text{ days} \end{aligned}$$

Strike	Call	Put
35	6.13	0.44
40	2.78	1.99
45	0.97	5.08

Bull and bear spreads

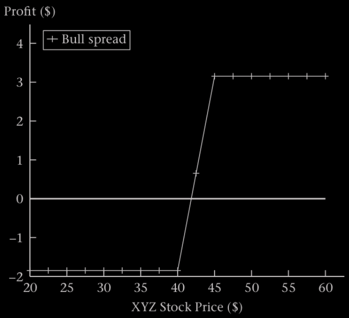
A position in which you buy a call and sell an otherwise identical call with a higher strike price is an example of a bull spread. Bull spreads can also be constructed using puts.

The opposite of a bull spread is a bear spread.


Bull spread
Profit
Call
Short
Put
+
Call
Long
Put
high
Strike price
low
Profit
Call
Long
Put
+
Call
Short
Put
Bear spread

Example 3.3-1 Draw profit diagram for a 40-45 bull spread, namely, buying a 40-strike call and selling a 45-strike call.

Solution.



□

Box spreads

A **box spread** is accomplished by using options to create a synthetic long forward at one price and a synthetic short forward at a different price.

This strategy guarantees a cash flow in the future.

Hence, it is an option spread that is purely a means of borrowing or lending money. It is costly but has no stock price risk.

Example 3.3-2 Suppose we simultaneously enter into the following two transactions:

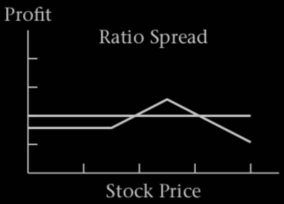
1. Buy a 40-strike call and sell a 40-strike put.
2. Sell a 45-strike call and buy a 45-strike put.

Explain why there is no free lunch. Draw the profit diagram.

Solution. Check book 74. □

Ratio spreads

A **ratio spread** is constructed by buying m options at one strike and selling n options at a different strike, with all options having the same type (call or put), same time to maturity, and same underlying asset.



Example 3.3-3 (Problem 3.15) Compute profit diagrams for the following ratio spreads:

a Buy 950-strike call, sell two 1050-strike calls.

b Buy two 950-strike calls, sell three 1050-strike calls.

c Consider buying n 950-strike calls and selling m 1050-strike calls so that the premium of the position is zero. Considering your analysis in (a) and (b), what can you say about n/m? What exact ratio gives you a zero premium?

Solution. Homework. □

Collars

A **collar** is the purchase of a put option and the sale of a call option with a higher strike price, with both options having the same underlying asset and having the same expiration date.

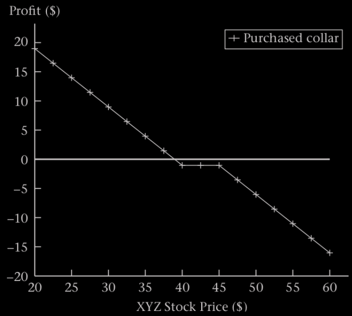
If the position is reversed, i.e., sale of a put and purchase of a call, the collar is written.

The **collar width** is the difference between the call and put strikes.

Example 3.3-4 Draw the profit diagram for a purchased collar:

selling a 45-strike call + buying a 40-strike put.

Solution.



□

It is possible to find strike prices for the put and call such that the two premiums exactly offset one another. This position is called a **zero-cost collar**.

Example 3.3-5 Consider XYZ:

Strike	Call	Put
35	6.13	0.44
40	2.78	1.99
41.72	1.99	—
45	0.97	5.08

Show that the following gives a zero-cost collar

buying XYZ at \$40 + buying a 40-strike put + selling a 41.72-strike call

Draw the profit diagram.

Solution. Check book p. 77. □