Options Strategies

An option strategy involves combining an option with other assets, such as stocks and bonds, and/or other options together. The analysis that follows applies to European type options written on non-dividend paying stocks.

Even though all strategies could be implemented using American type options, the payoff diagrams we present below might be affected by the potential early exercise of such instruments.

Covered Call

A covered call consists of a long position in the stock and a short position in a European call option with strike K and maturity T. The figure below depicts the payoffs of the long stock, the short call, and the covered call.

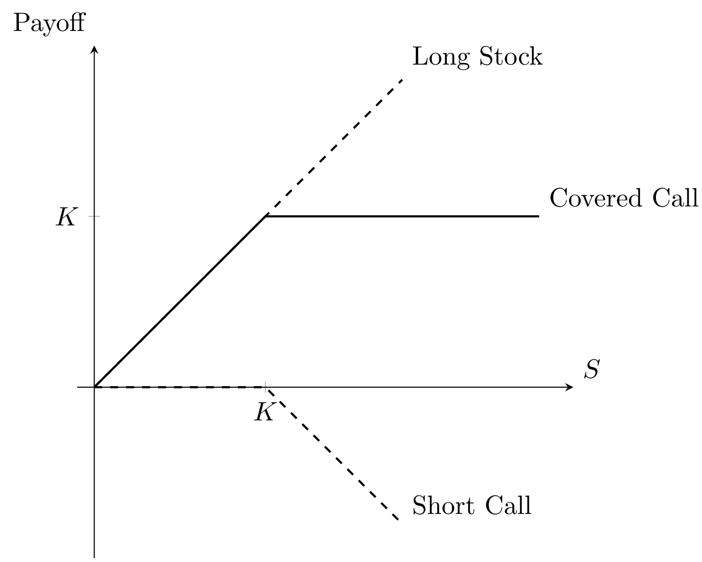


Figure 1: Payoff function of a covered call strategy.

As can be seen from the figure, only the long stock position pays off when the stock price is less than K. In that case the call is out-of-the-money and will not be exercised. Otherwise the short call becomes active, and for every additional dollar that the stock gains in value the short call loses the same amount. The resulting payoff is therefore flat at K for stock prices greater than the strike.

This might be an interesting strategy if you think that the stock has limited upside potential. Indeed, by selling the call you give up all the upside potential if the stock price is higher than the strike price, but you can purchase the stock for less. Also, if you are planning to hold the stock for a long time, by selling the call you can generate additional income if the stock does not appreciate too much in value during the life of the option.

Example 1. A non-dividend paying stock currently trades at $50. A call option with strike $60 and maturity 3 months sells for $3.45. A covered call with the same characteristics would then cost 50 - 3.45 = $46.55.

Below are some possible covered call payoffs and profits for different stock prices at maturity.

Stock Price	40	50	60	70	80
Payoff	40	50	60	60	60
Profit	-6.55	3.45	13.45	13.45	13.45

If the stock price is $40, then the call is OTM and pays nothing, leaving only the stock that pays $40. The profit is then $40 - 46.55 = -\$6.55$. If the stock price climbs to $80, then the call is ITM and the payoff of the short call is $-(80 - 60) = -\$20$. The payoff of the covered call is then $80 - 20 = \$60$, and its profit is $60 - 46.55 = \$13.45$.

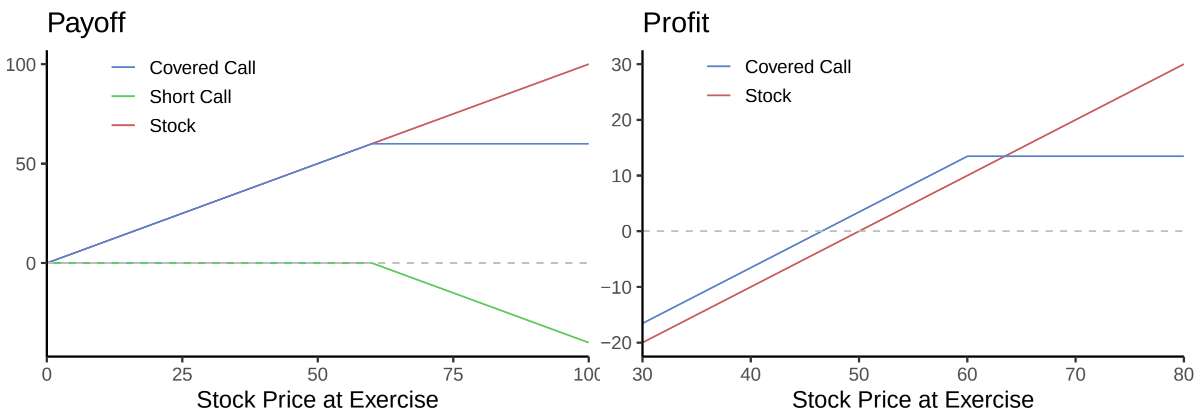
The payoff diagram reveals that the covered call payoff is the same as the long position in the stock if $S \leq 60$, and is capped at $60 otherwise.

Comparing the profit diagram of the covered call and a long position in the stock, we see that the covered call profit is higher than the stock alone whenever $S < 63.45$. This is because the cost of the covered call, compared to the stock alone, is cheaper. For example, if you only buy the stock and the price at maturity is $60, then your profit would be $10 instead of $13.45. The covered call is then a good strategy when the stock price finishes close to the call strike. Indeed, if the stock goes up to $80, then the covered call profit is still the same, whereas a pure stock position would yield a profit of $30.

□

We can recover the payoff function of the covered call by analyzing the payoff of the long position in the stock and the short position in the call. The payoff of the long stock is always S whereas the payoff of the short call is $K - S$ whenever $S > K$ and zero otherwise. [1]

[1] Remember that the buyer of the call receives $S - K$ from the seller whenever $S > K$. Therefore, the cash flow of the short call position is $K - S$.



	$S \leq K$	$S > K$
Long Stock	S	S
Short Call	0	$K - S$
Covered Call	S	K

The table confirms the payoff function pictured previously. The covered call pays like the stock if $S \leq K$ and caps the payoff at K otherwise. The analysis also suggests that the payoff of a covered call for a given value of S is the *smallest* value between S and K, i.e.

$$\text{Covered Call Payoff} = \min(S, K)$$

There is nothing deep about the above expression, but it might come handy if you want to plot the payoff function using Microsoft Excel or Python.

Protective Put

A protective put consists of a long position in the stock and a long position in a European put option with strike K and maturity T. The figure below depicts the payoffs of the long stock, the long put and the protective put.

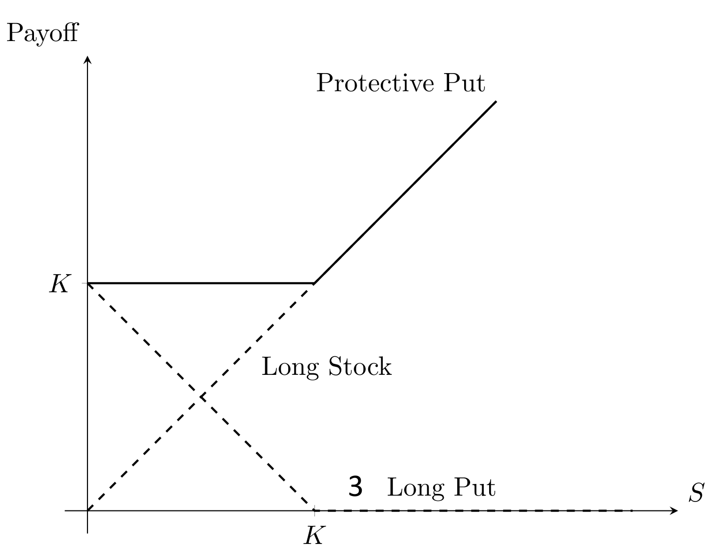


Figure 2: Payoff function of a protective put strategy.

As the figure shows, the objective of the long put is to *protect* the stock by keeping it from falling below K. This might be an interesting strategy if you want to hedge your portfolio from

For example, you might be concerned that over the next three-months your stocks might fall significantly because of current global conditions. You could then buy 3-month puts to protect your portfolio from heavy loses. Buying puts in this case amounts to buying portfolio insurance.

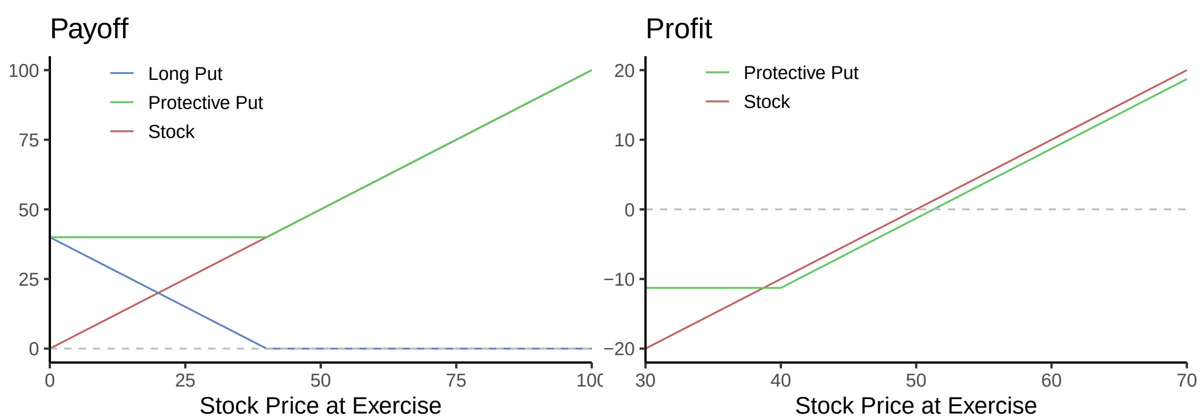
Example 2. A non-dividend paying stock currently trades at \$50. A put option with strike \$40 and maturity 3 months sells for \$1.28. A protective put with the same characteristics would then cost 50 + 1.28 = \$51.28. Below are some possible values for the payoff and profit of the protective put for different stock prices at maturity.

Stock Price	30	40	50	60	70
Payoff	40	40	50	60	70
Profit	-11.28	-11.28	-1.28	8.72	18.72

The top graph on the margin plots the payoff of the long stock, long put and the protective put. We can see that the payoff of the protective put is effectively capped at \$40.

The bottom graph on the right plots the profit diagram of the stock and the protective put. Comparing both profit diagrams, we see that the protective put profit is lower than the stock alone whenever $S < 38.72$. This is because the cost of the protective put, compared to the stock alone, is more expensive.

The protective put, though, caps the profit losses at 40 - 51.28 = -\$11.28 no matter how low is the stock price at maturity. This is an attractive feature if one fears that there is a non-zero probability of a massive crash in the stock price.



The payoff function of the protective put can be obtained explicitly by noting that the stock always pays S but the long put pays $K - S$ if $S \leq K$ and zero otherwise.

	$S \leq K$	$S > K$
Long Stock	S	S
Long Put	$K - S$	0
Protective Put	K	S

The table confirms the payoff function pictured previously. The protective put pays like the stock if $S > K$ and caps the payoff at K when the stock price falls below K. The table also shows that the payoff of a protective put for a given value of S is the *greatest* between S and K, i.e.

$$\text{Protective Put Payoff} = \max(K, S)$$

In contrast to the covered call payoff which is given by the minimum between S and K, the protective put payoff is determined by the maximum between the two. An immediate implication of this observation is that in the absence of arbitrage opportunities, the protective put can never cost less than an otherwise equivalent covered call.

Straddle

A straddle is a two-leg option strategy that consists in buying a call and a put with the same strike price K. The figure below depicts the payoffs of the long put, the long call and the straddle.

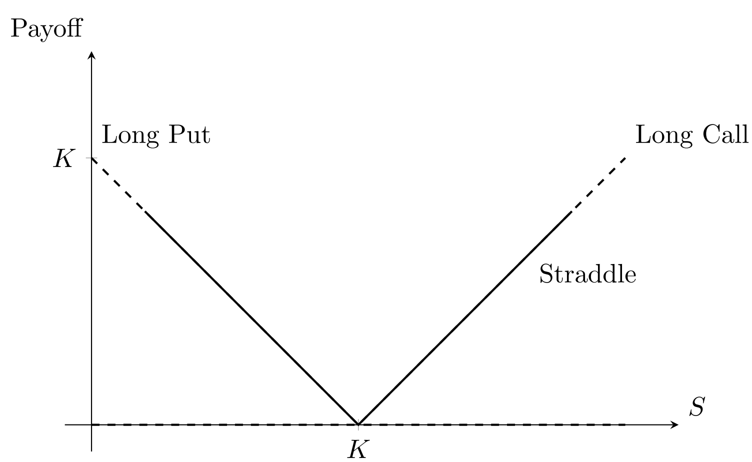


Figure 3: Payoff function of a straddle strategy.

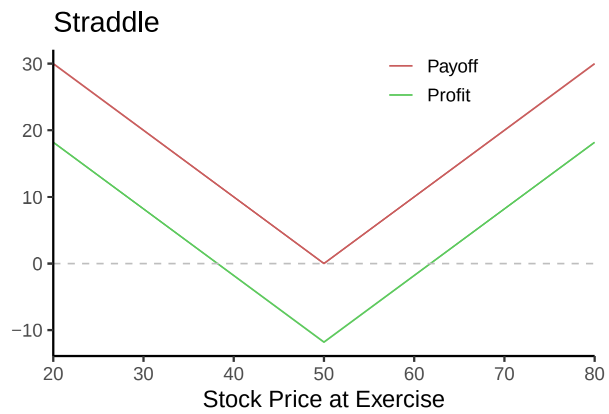
The payoff of the straddle is symmetric around the strike price, which suggests that the straddle can be used when we think that the stock price will move a lot over a relatively short time.

Holding the straddle for too long is costly, as the value of the straddle decays rapidly over time.

Example 3. A non-dividend paying stock currently trades at \$50. A put and a call with strike price \$50 cost \$4.68 and \$7.12, respectively. A straddle with the same strike then costs 4.68 + 7.12 = \$11.80. Below are some possible straddle payoffs and profits for different stock prices at maturity:

Stock Price	30	40	50	60	70
Payoff	20	10	0	10	20
Profit	8.20	-1.80	-11.80	-1.80	8.20

Therefore, the straddle makes a profit if the stock moves below \$38.20 or above \$61.80.



To analyze the payoff of the straddle in more detail, we could add the payoff of a long call and a long put.

	$S \leq K$	$K < S$
Long Put	$K - S$	0
Long Call	0	$S - K$
Straddle	$K - S$	$S - K$

The table shows that whenever the stock price is less than the strike the straddle pays like a put, whereas when the stock price is larger than the strike the straddle pays like a call. The cost of the straddle is therefore relatively high since it involves buying a call and a put together.

Strangle

A strangle is a two-leg option strategy that consists in a long call with strike K_2 and a long put with strike K_1 where $K_1 < K_2$. The figure below depicts the payoffs of the long put with strike K_1, the long call with strike K_2 and the resulting strangle.

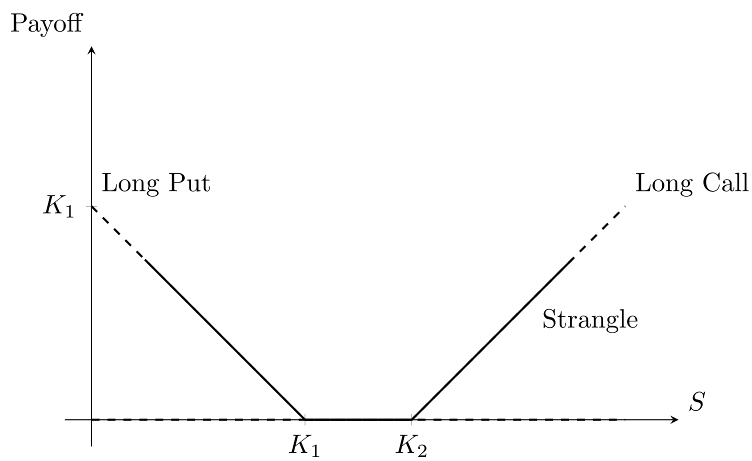


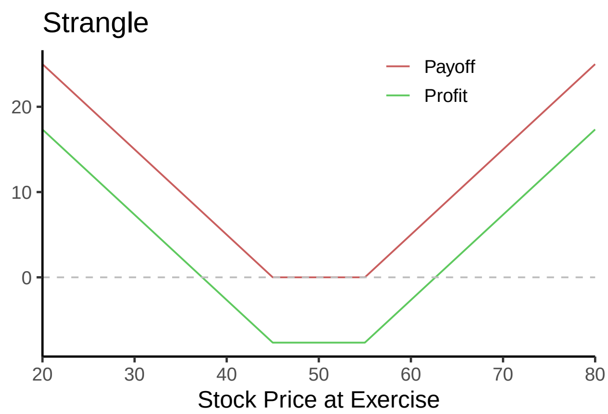
Figure 4: Payoff function of a strangle strategy.

A strangle with strikes $K_1 < K_2$ is a cheaper alternative to a straddle with strike $K = (K_1 + K_2)/2$ since both the call and the put will be more OTM. The payoff of the strangle, though, is zero for any stock price between K_1 and K_2, making the strangle less likely to pay the buyer a positive amount. Therefore, compared to the straddle, the strangle requires the stock price to move even more in order to make a profit.

Example 4. A non-dividend paying stock currently trades at \$50. A put with strike $K_1 = \$45$ trades for \$2.65 whereas a call with strike $K_2 = \$55$ costs \$5.01. A strangle with strikes K_1 and K_2 then costs 2.65 + 5.01 = \$7.66. Below are some possible strangle payoffs and profits for different stock prices at maturity:

Stock Price	35	40	45	50	55	60	65
Payoff	10	5	0	0	0	5	10
Profit	2.34	-2.66	-7.66	-7.66	-7.66	-2.66	2.34

The strangle makes a profit if the stock moves below \$37.34 or above \$62.66. It is interesting to note that the strangle in this example generates a positive profit for a range of prices very similar to the straddle in studied Example 3. This is because even though the strangle is cheaper than the straddle, the range of prices ofver which you receive a positive payoff is also wider.



It is not hard to derive the payoff table of the strangle by analyzing the payoffs of the long call and put.

	$S \leq K_1$	$K_1 < S \leq K_2$	$K_2 < S$
Long Put	$K_1 - S$	0	0
Long Call	0	0	$S - K_2$
Strangle	$K_1 - S$	0	$S - K_2$

There is now a range of prices, though, in which both the call and put are OTM and consequently the strangle pays zero.

Practice Problems

Solutions to all problems can be found at lorenzonaranjo.com/fin451.

Problem 1. Suppose you think FedEx stock is going to appreciate substantially in value in the next 6 months. Say the stock's current price is $100, and the call option expiring in 6 months has an exercise price of $100 and is selling at a price of $10. With $10,000 to invest, you are considering three alternatives:

- Invest all $10,000 in the stock, buying 100 shares.
- Invest all $10,000 in 1,000 options (10 contracts).
- Buy 100 options (one contract) for $1,000 and invest the remaining $9,000 in a money market fund paying 8% per year compounded semi-annually, i.e., 4% every six months.

a. Compute the total value of your portfolio in six months for each of the following stock prices.

Price of Stock	80	100	110	120
All stocks (100 shares)				
All options (1,000 options)				
Bills + 100 options				

b. Compute the percentage return of your portfolio in six months for each of the following stock prices.

Price of Stock	80	100	110	120
All stocks (100 shares)				
All options (1,000 options)				
Bills + 100 options				

Problem 2. Imagine that you are holding 5,000 shares of stock, currently selling at $40 per share. You are ready to sell the shares but would prefer to put off the sale until next year for tax reasons. If you continue to hold the shares until January, however, you face the risk that the stock will drop in value before year-end.

You decide to use a collar to limit downside risk without laying out a good deal of additional funds. January call options with a strike price of $45 are selling at $2, and January put options with a strike price of $35 are selling at $3. Assume that you hedge the entire 5,000 shares of stock.

Compute the value of your portfolio in January (net of the proceeds from the options) if the stock price ends up at $30, $40 and $50.

Problem 3. A call with a strike price of $60 costs $6. A put with the same strike price and expiration date costs $4. Construct a table that shows the profit from a straddle as a function of S when $S \leq 60$ and $S > 60$. For what range of stock prices would the straddle lead to a loss?

Problem 4. The price of a stock is $40. The price of a one-year European put option on the stock with a strike price of $30 is quoted as $7 and the price of a one-year European call option on the stock with a strike price of $50 is quoted as $5. Suppose that an investor buys

100 shares, shorts 100 call options, and buys 100 put options. Complete the following table for the strategy:

Stock Price	35	45	55	65
Payoff				
Profit				

Problem 5. Stock XYZ trades now for $75. You have the following information on different call and put options prices written on stock XYZ and expiring in 1 year:

Strike	Call	Put
$70	$10.76	$2.42
$80	$5.44	$6.22

Consider a strangle in which you purchase a put with strike $70 and purchase a call with strike $80. What is the profit of the strategy if the stock price at maturity is $60?

Problem 6. Suppose you think that there is a small possibility that XYZ stock might depreciate substantially in value in the next 3 months. Say the stock's current price is $200, and a put option expiring in 3 months has an exercise price of $180 and is selling at a premium of $5. With $10,000 to invest, you are considering investing $6,000 in the stock (30 shares) and $4,000 in puts (800 options). Compute the profit of your portfolio 3 months from now if the price of XYZ stock is $160.