LM01 Options Strategies

Version 1.0

1. Introduction

A derivative is a financial instrument that derives its value from the economic performance of the underlying (stocks, interest rate, etc.). Options are contingent-claim derivatives. The two main types of options are call options and put options.

- A call option gives the holder a right but not the obligation to buy the underlying asset at a particular price.
- Similarly, a put option gives the holder a right but not the obligation to sell the underlying asset at a particular price.

Section 2 of this reading covers position equivalencies – how two or more securities can be combined to create another security. Sections 3 -6 cover the two most widely used options strategies – covered calls and protective puts. Sections 7 and 8 cover other popular options strategies – spreads and combinations. Section 9 discusses implied volatility embedded in option prices and volatility skew. Section 10 discusses how to select an appropriate option strategy to achieve a particular investment objective. Sections 11 and 12 cover the uses of options in portfolio management.

2. Position Equivalencies

In this section, we will outline how certain combinations of derivatives are equivalent to other assets/portfolios. At earlier levels, we covered two important position equivalence relationships:

- **Put-call parity**: A fiduciary call is equivalent to a protective put.
  i.e. $S_0 + p_0 = c_0 + X/(1 + r)^T$
- **Put-call-forward parity**: Here we replace S_0 with a forward contract to buy the underlying. The forward price is given by $F_0(T) = S_0(1 + r)^T$, therefore the put-call parity formula changes to:
  $F_0(T)/(1 + r)^T + p_0 = c_0 + X/(1 + r)^T$

Synthetic Forward Position

Synthetic Long Forward Position

Buying a call and writing a put on the same underlying with the same strike price and expiration creates a synthetic long position (or, a synthetic long forward position). This can be demonstrated by looking at the payoffs of the three alternatives:

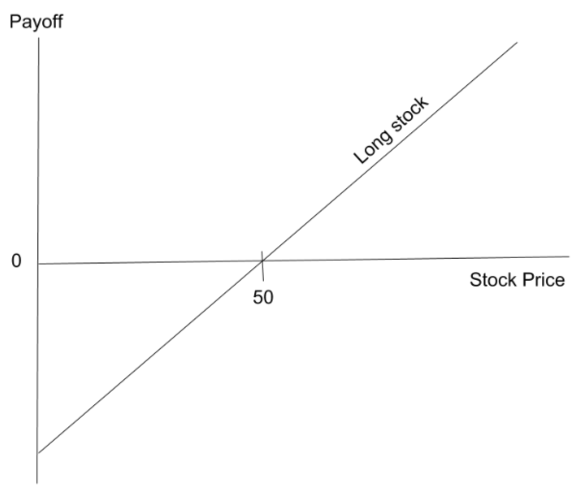
1) Buy a call and write a put. Both options have the same expiration date and the same exercise price of $50.
2) Buy a stock for $50.
3) Buy forward/futures at 50.

Stock price at expiration:	**40**	**50**	**60**
Alternative 1: Long call, short put			
Long call payoff	0	0	10
Short put payoff	–10	0	0
Alternative 1 payoff	**–10**	**0**	**10**
Alternative 2: Long stock at 50			
Alternative 2 payoff	**–10**	**0**	**10**
Alternative 3: Long forward/futures at 50			
Alternative 3 value	**–10**	**0**	**10**

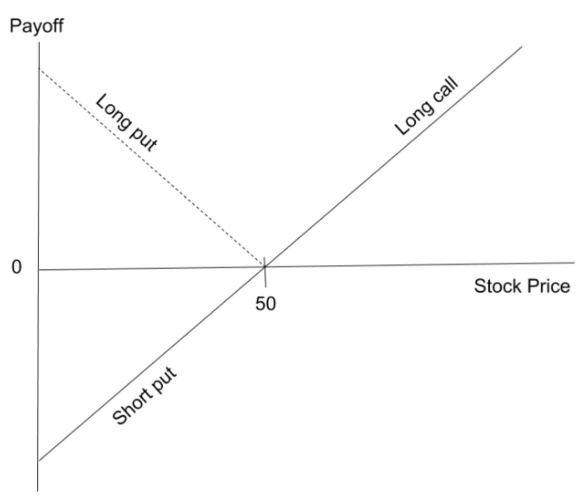
The table above shows that all three alternatives have the same payoff (value). Hence, we can conclude that: **Long call + Short put = Long stock = Long forward/futures**

Another method to evaluate the alternatives is to draw their payoff diagrams.

Payoff of a Long stock (or Long forward/futures)



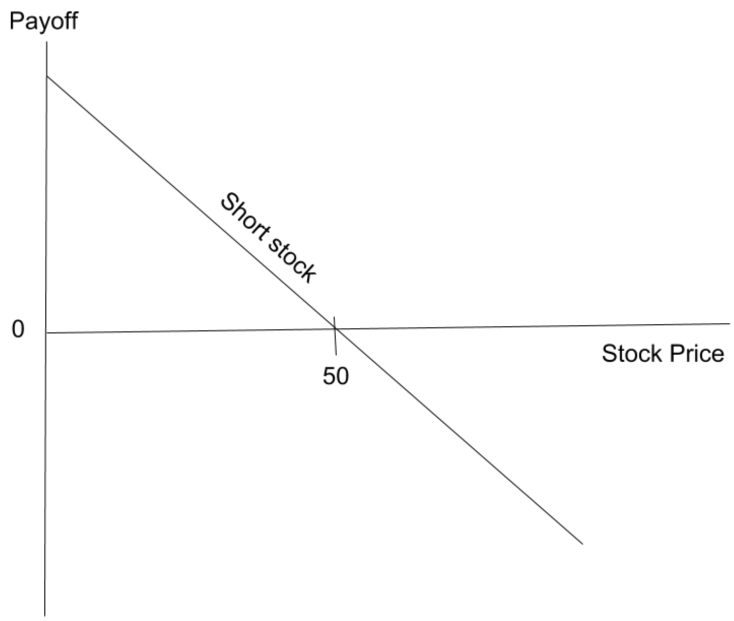
Payoff of a Long call + Short put



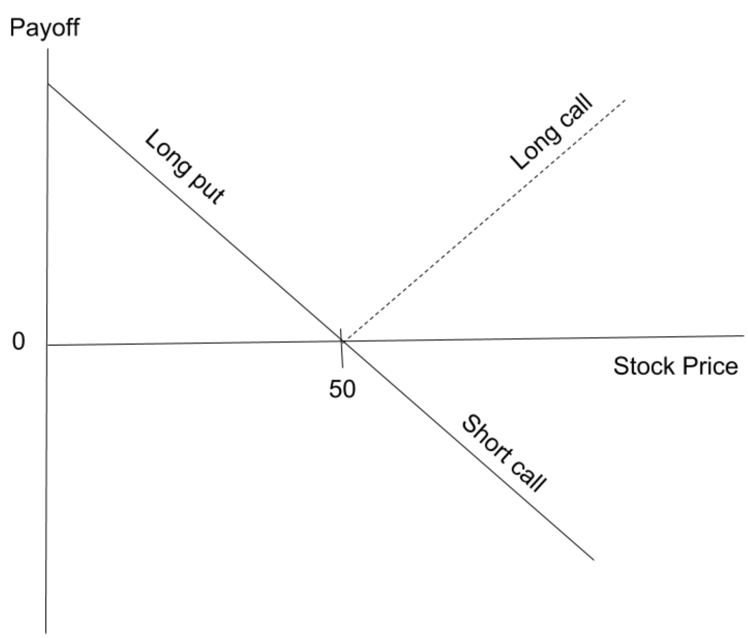
Synthetic Short Forward Position

Selling a call and buying a put on the same underlying with the same strike price and expiration creates a synthetic short position. This can be demonstrated by looking at the payoff diagrams of the alternatives:

Payoff of a short stock (or short forward/futures)



Payoff of Long put + Short call



Hence, we can conclude that: **Long put + Short call = Short stock = Short forward/futures**

Synthetic positions are used:

1. To exploit arbitrage opportunities, when the actual forward contract is over or undervalued as compared to the implied synthetic contract.
2. When it is difficult to buy an actual forward contract.

Example: Synthetic Long Forward Position vs. Long Forward/Futures
(*This is Example 1 from the curriculum.*)

A market maker has sold a three-month forward contract on Vodafone that allows the client (counterparty) to buy 10,000 shares at 200.35 pence (100p = £1) at expiration. The current stock price (S0) is 200p, and the stock does not pay dividends until after the contract matures. The annualized interest rate is 0.70%. The cost (i.e., premium) of puts and calls on Vodafone is identical.

1. Discuss (a) how the market maker can hedge her short forward position upon the sale of the forward contract and (b) the market maker's position upon expiration of the forward contract.
2. Discuss how the market maker can hedge her short forward contract position using a synthetic long forward position and explain what happens at expiry if the Vodafone share price is above or below 200.35p.

Solution 1:

a. To offset the short forward contract position, the market maker can borrow £20,000 (= 10,000 × S0/100) and buy 10,000 Vodafone shares at 200p. There is no upfront cost because the stock purchase is 100% financed.
b. At the expiry of the forward contract, the market maker delivers the 10,000 Vodafone shares she owns to the client that is long the forward, and then the market maker repays her loan. The net outflow for the market maker is zero because the following two transactions offset each other:

Amount received for the delivery of shares: 10,000 × 200.35p = £20,035

Repayment of loan: 10,000 × 200p [1 + 0.700% × (90/360)] = £20,035

Solution 2:

To hedge her short forward position, the market maker creates a synthetic long forward position. She purchases a call and sells a put, both with a strike price of 200.35p and expiring in three months.

At the expiry of the forward contract, if the stock price is above 200.35p, the market maker exercises her call, pays £20,035 (=10,000 × 200.35p), and receives 10,000 Vodafone shares. She then delivers these shares to the client and receives £20,035.

At the expiry of the forward contract, if the stock price is below 200.35p, the owner of the long put will exercise his option, and the market maker receives the 10,000 Vodafone shares for £20,035. She then delivers these shares to the client and receives £20,035.

Synthetic Put and Call

Synthetic Put

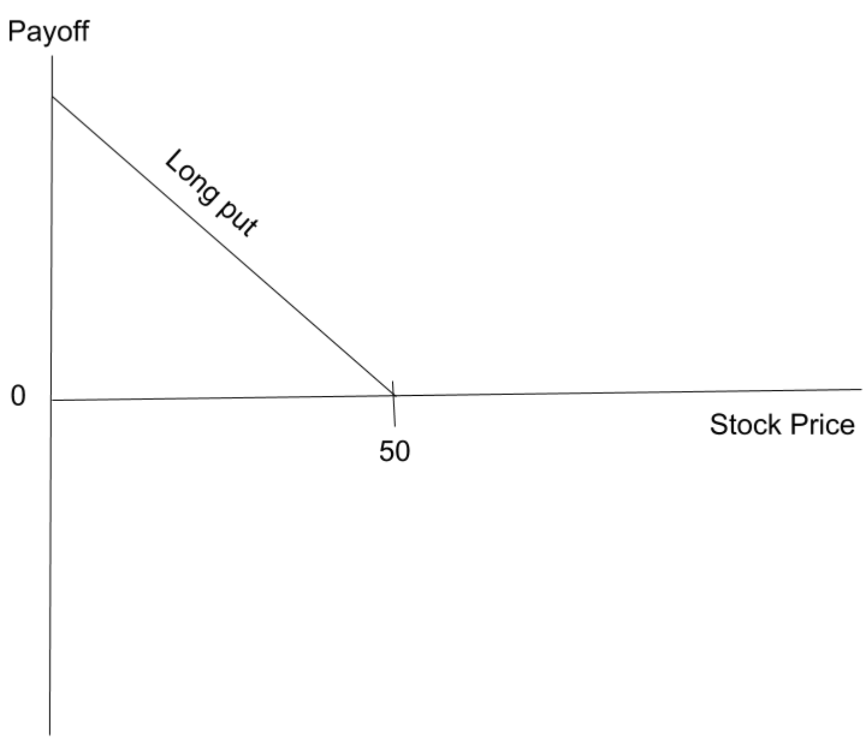
A synthetic long put position consists of a short stock and long call position in which the call strike price equals the price at which the stock is shorted.

This can be demonstrated by looking at the payoff associated with the two alternatives.

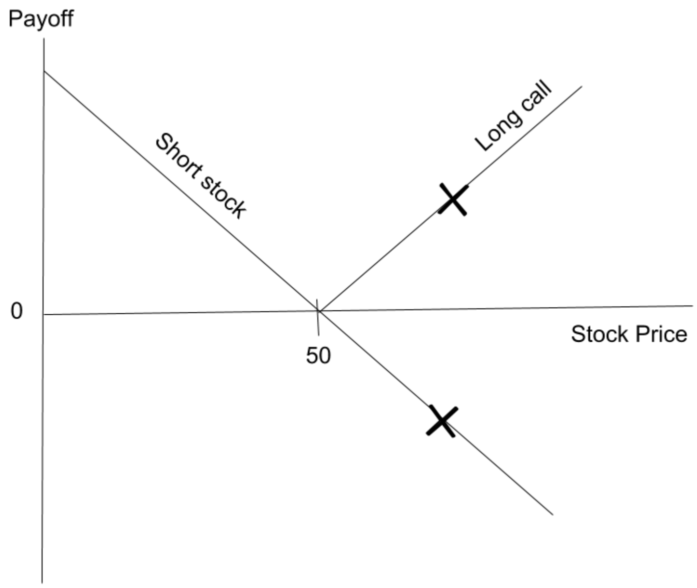
Stock price at expiration:	**40**	**50**	**60**
Alternative 1: Short stock at 50 and Long 50-strike call			
Short stock payoff	10	0	-10
Long call payoff	0	0	10
Alternative 1 payoff	**10**	**0**	**0**
Alternative 2: Long 50-strike put			
Alternative 2 payoff	**10**	**0**	**0**

We can also look at the payoff diagrams of the two alternatives.

Payoff of Long put



Payoff of Short stock + Long call



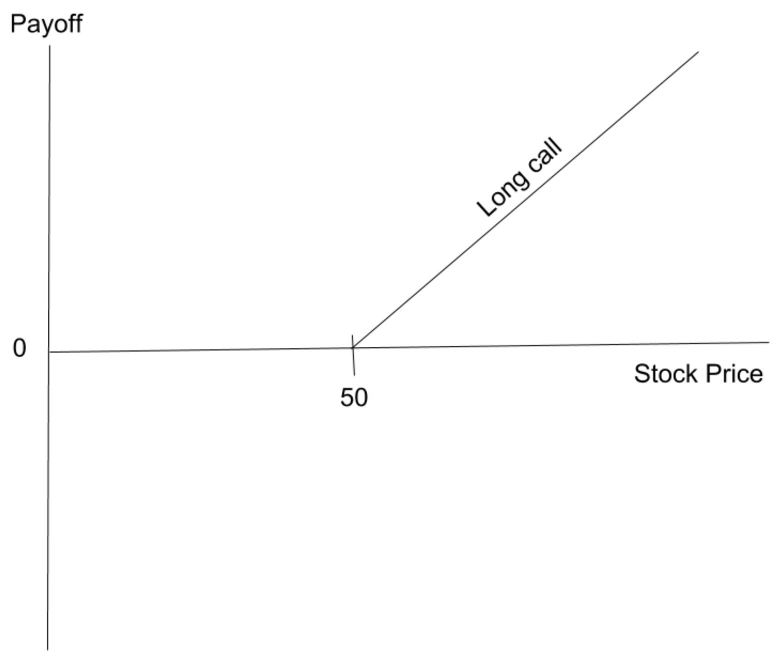
Hence, we can conclude that: **Long put = Short stock + Long call**

Synthetic Call

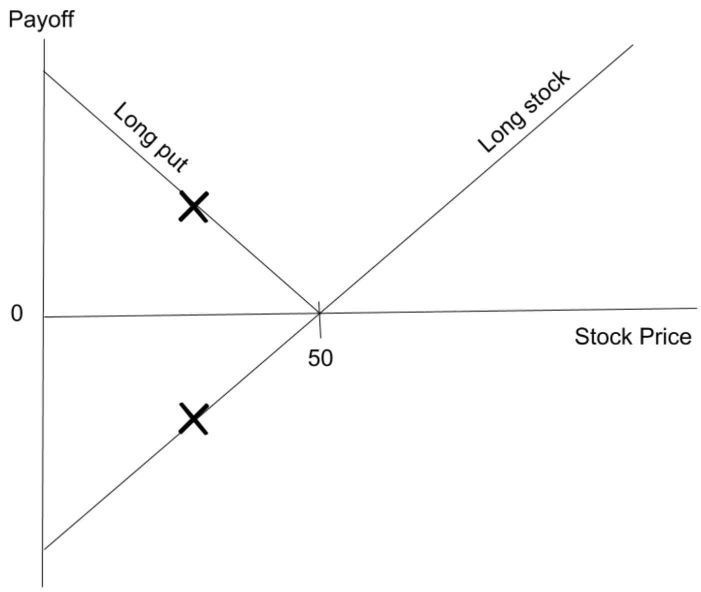
A synthetic long call position consists of a long stock and long put position in which the put strike price equals the price at which the stock is purchased.

This can be demonstrated by looking at their payoff diagrams.

Payoff of Long call



Payoff of Long stock + Long put



Hence, we can conclude that: **Long call = Long stock + Long put**

Example: Synthetic Long Put
(*This is Example 2 from the curriculum.*)

Three months ago, Wing Tan, a hedge fund manager, entered into a short forward contract that requires him to deliver 50,000 Generali shares, which the fund does not currently own, at €18/share in one month from now. The stock price is currently €16/share. The hedge fund's research analyst, Gisele Rossi, has a non-consensus expectation that the company will report an earnings "beat" next month. The stock does not pay dividends.

1. Under the assumption that Tan maintains the payoff profile of his current short forward position, discuss the conditions for profit or loss at contract expiration.
2. After discussing with Rossi her earnings outlook, Tan remains bearish on Generali. He decides to hedge his risk, however, in case the stock does report a positive earnings surprise. Discuss how Tan can modify his existing position to produce an asymmetrical, risk-reducing payoff.

Solution 1:

If Tan decides to keep the current payoff profile of his position, at the expiry date, given a stock price of S_T, the profit or loss on the short forward will be 50,000 × (€18 – S_T). The position will be profitable only if S_T is below €18; otherwise the manager will incur in a loss.

Solution 2:

Tan decides to modify the payoff profile on his short forward position so that, at expiration, it will benefit from any stock price decrease below €16 while avoiding losses if the stock rises above that price. He purchases a call option with a strike price €16 and one month to maturity at a cost (premium) of €0.50. At expiration, the payoffs are as follows:

- On the short forward contract: 50,000 × (€18 – S_T)
- On the long call: 50,000 × {Max[0,(S_T – €16)] – €0.50}
- On the combined position: 50,000 × {(€18 – S_T) + [Max[0,(S_T – €16)] – €0.50]}

If $S_T \leq$ €16, the call will expire worthless and the profit will amount to 50,000 × (€18 − S_T + 0 – €0.50).

If $S_T >$ €16, the call is exercised, and the Generali shares delivered for a maximum profit of 50,000 × (€18 – €16 – €0.50) = €75,000.

3. Covered Calls and Protective Puts

Option Greeks:

- **Delta** is the change in an option's price for a given small change in the value of the underlying instrument, all else equal. Delta for long calls is always positive and delta for long puts is always negative.
- **Gamma** is the change in an option's delta for a given small change in the value of the underlying instrument, all else equal. Gamma for long calls and long puts is always positive.
- **Vega** is the change in an option's price for a given small change in volatility of the underlying, all else equal. Vega for long calls and long puts is always positive.
- **Theta** is the daily change in an option's price, holding all else constant. Theta for long calls and long puts is generally negative.

Consider Exhibit A showing the premium for options on IFT stock which currently sells for $16.

Exhibit A: IFT Option Premiums: Current IFT stock price = 16.00

Calls			**Exercise Price**	**Puts**		
SEP	**OCT**	**NOV**		**SEP**	**OCT**	**NOV**
1.64	3.00	3.44	15	0.65	1.00	1.46
0.94	2.00	2.90	16	1.14	1.50	1.96
0.51	1.00	1.44	18	1.76	2.00	2.59

With respect to terminology, when we say 'IFT October **15** call sells for 3.00', the expiration is October, the exercise price is 15, the option is a call, and the call premium is 3.00.

Investment Objectives of Covered Calls

A covered call is an option strategy in which an investor who owns a stock, sells a call option on that stock. It is known as a covered call because the short call position is 'covered' by owning the underlying stock. Hence: Covered Call = Long Stock + Short Call.

The investment objectives of covered calls are:

- Yield enhancement
- Reducing position at a favorable price
- Target price realization

Yield Enhancement

The most common reason for writing covered calls is that it provides an additional source of income in the form of the option premium. However, this income comes at a cost. If the stock price rises above the exercise price at expiry the call writer needs to deliver shares and gives up capital gains of (S – X) to the call buyer.

Scenario: Suppose a stock is trading at $16. An investor who owns this stock believes that the stock will remain stable over a certain time period. He does not want to sell the stock, but he wants to generate additional cash. He writes a SEP 18 call and collects the premium of $0.51. This represents an income for the investor. If the stock price increases from $16 to $18 the investor benefits. However, any stock appreciation above the strike price of $18 does not benefit the investor. The gain in stock price is canceled out by what the investor owes on the short call position.

Reducing Position at Favorable Price

If an investor has decided to sell a stock, he can use a covered call to effectively receive more than the current market price of the stock.

Scenario: Using the data in Exhibit A, the IFT stock is at $16.00 and OCT 15 calls sell for 3.00. An investor who has decided to sell IFT can sell OCT 15 call options. He will receive $3 when he writes the option and $15 when the option is exercised. Overall, he'll effectively receive $3 + $15 = $18 for the stock which is better than the market price of $16. However, the risk with this strategy is that if the stock price falls below $15, the options will expire out of the money and the investor may have to sell the stock at a lower price than originally anticipated.

Target Price Realization

A third popular use of covered calls is a hybrid of the first two objectives. Here investors write calls with an exercise price near the target price for the stock.

Scenario: Suppose the IFT stock is trading at $15.80 but its target price is $16.00. An investor might choose to write SEP 16 calls and receive a premium of 0.94 (from Exhibit A). If the stock rises above 16 in a month, the stock will be sold at its target price. Through this strategy, the investor sells the stock at the target price and pockets the premium.

The disadvantages of this strategy are as follows:

- there is a risk that the stock price may fall, resulting in an opportunity loss relative to the outright sale of the stock.

- an opportunity loss also occurs if the stock rises sharply above the exercise price and is sold at a lower-than-market price.

Profit and Loss at Expiration

The formulas in this subsection use the following terminology:

- S_0 = Stock price when option position opened
- S_T = Stock price at option expiration
- X = Option exercise price
- c_0 = Call premium received or paid

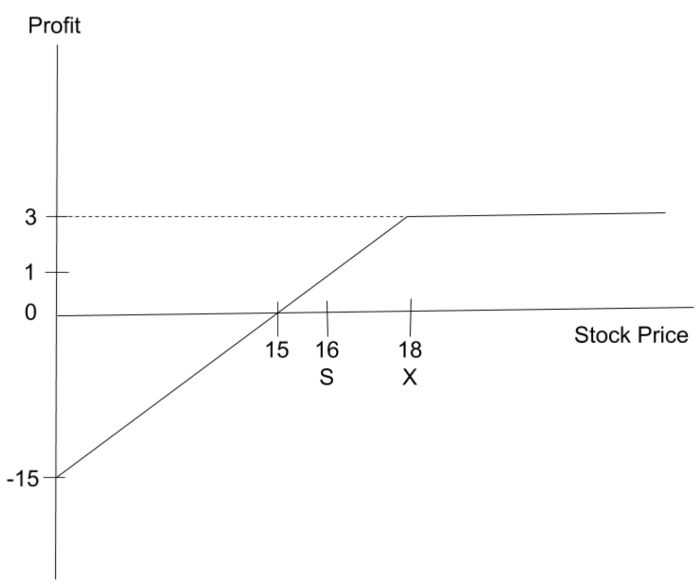
The profit and loss relationships for a covered call strategy can be expressed as:

- Maximum gain = $(X - S_0) + c_0$
- Maximum loss = $S_0 - c_0$
- Breakeven point = $S_0 - c_0$
- Expiration value = $S_T - \text{Max}\,[(S_T - X),0]$
- Profit at expiration = $S_T - \text{Max}\,[(S_T - X),0] + c_0 - S_0$

Taking numbers from Exhibit A, currently S_0 = 16.00, writing the IFT OCT 18 call for 1.00, X= 18.00, c_0 = 1.00. If S_T = 16.00 then:

- Max gain = $18 - 16 + 1 = 3$
- Max loss = $16 - 1 = 15$
- Breakeven point = $16 - 1 = 15$
- Profit at expiration = $16 - 0 + 1 - 16 = 1$ if S_T = 16.00

Profit/loss diagram for the covered call



Example: Characteristics of Covered Calls

(*This is Example 3 from the curriculum.*)

S_0 = Stock price when option position opened = 25.00
X = Option exercise price = 30.00
S_T = Stock price at option expiration = 31.33
c_0 = Call premium received = 1.55

1. Which of the following correctly calculates the maximum gain from writing a covered call?
A. $(S_T - X) + c_0 = 31.33 - 30.00 + 1.55 = 2.88$
B. $(S_T - S_0) - c_0 = 31.33 - 25.00 - 1.55 = 4.78$
C. $(X - S_0) + c_0 = 30.00 - 25.00 + 1.55 = 6.55$

2. Which of the following correctly calculates the breakeven stock price from writing a covered call?
A. $S_0 - c_0 = 25.00 - 1.55 = 23.45$
B. $S_T - c_0 = 31.33 - 1.55 = 29.78$
C. $X + c_0 = 30.00 + 1.55 = 31.55$

3. Which of the following correctly calculates the maximum loss from writing a covered call?
A. $S_0 - c_0 = 25.00 - 1.55 = 23.45$
B. $S_T - c_0 = 31.33 - 1.55 = 29.78$
C. $S_T - X + c_0 = 31.33 - 30.00 + 1.55 = 2.88$

Solution to 1:

C is correct. The covered call writer participates in gains up to the exercise price, after which further appreciation is lost to the call buyer. That is, $X - S_0 = 30.00 - 25.00 = 5.00$. The call writer also keeps c_0, the option premium, which is 1.55. So, the total maximum gain is 5.00 + 1.55 = 6.55.

Solution to 2:

A is correct. The call premium of 1.55 offsets a decline in the stock price by the amount of the premium received: 25.00 – 1.55 = 23.45.

Solution to 3:

A is correct. The stock price can fall to zero, causing a loss of the entire investment, but the option writer still keeps the option premium received: 25.00 – 1.55 = 23.45

4. Investment Objectives of Protective Puts

A protective put is a long position in a stock and a long position in a put option on that stock. It is known as a protective put because the put provides protection against loss in value of the underlying stock. Hence: Protective Put = Long Stock + Long Put.

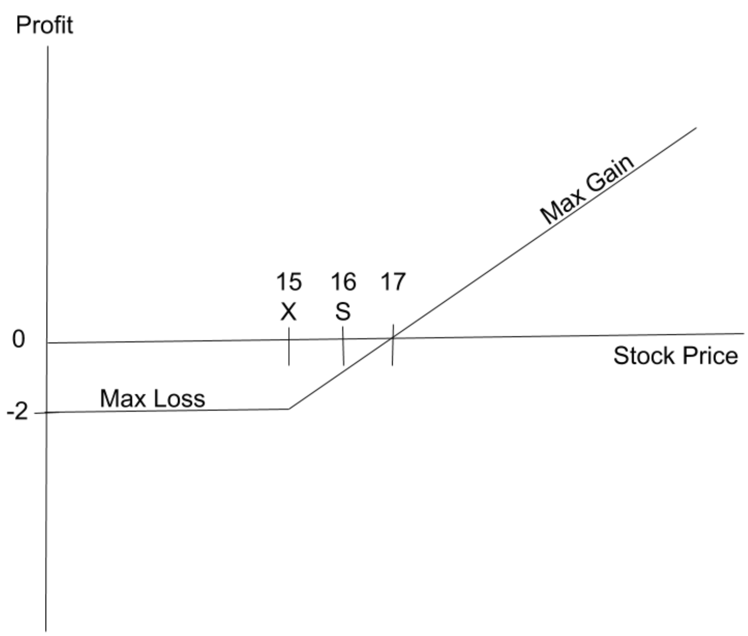
Buying a put option is like buying insurance. The put premium is similar to insurance premium. The exercise price of the put is similar to the coverage amount for an insurance policy. Like traditional insurance, this insurance coverage also expires after a certain period of time.

The investment objectives of protective puts are:

- **Loss protection**: Consider an investor who owns an IFT stock currently trading at 16. His research suggests that there may be a negative shock to the stock price in the next few weeks. To protect himself against a price decline the investor can purchase IFT OCT 15 puts for $1.00. Thus, a protective put strategy will protect against losses below 15 as long as the put does not expire before the occurrence of the expected price shock.
- **Upside preservation**: Unlike a covered call strategy, a protective put strategy does not limit the upside potential of the stock. If the stock price rises, the position fully benefits from the appreciation, and the maximum gain is unlimited.

An important point to remember is that in a protective put, the put options provide coverage for a certain period. After expiry, the investor has to purchase new put options for continued coverage. If the investor continuously buys put options for protection, the amount spent on the put premiums can significantly impact the return generated from the position. Therefore, put options should be purchased selectively, only when an investor has a bearish outlook for a short period.

Profit/loss diagram for protective put



Profit and Loss at Expiration

The profit and loss relationships of the protective put are given below:

- Maximum profit = $S_T - S_0 - p_0$ = Unlimited
- Maximum loss = $S_0 - X + p_0$

- Breakeven point = $S_0 + p_0$
- Expiration value = $Max(S_T, X)$
- Profit at expiration = $Max(S_T, X) - S_0 - p_0$

Example: Characteristics of Protective Puts
(*This is Example 4 from the curriculum.*)

S_0 = Stock price when option position opened = 25.00
X = Option exercise price = 20.00
S_T = Stock price at option expiration = 31.33
p_0 = Put premium paid = 1.15

1. Which of the following correctly calculates the gain with the protective put?

A. $S_T - S_0 - p_0 = 31.33 - 25.00 - 1.15 = 5.18$
B. $S_T - S_0 + p_0 = 31.33 - 25.00 + 1.15 = 7.48$
C. $S_T - X - p_0 = 31.33 - 20.00 - 1.15 = 10.18$

2. Which of the following correctly calculates the breakeven stock price with the protective put?

A. $S_0 - p_0 = 25.00 - 1.15 = 23.85$
B. $S_0 + p_0 = 25.00 + 1.15 = 26.15$
C. $S_T + p_0 = 31.33 + 1.15 = 32.48$

3. Which of the following correctly calculates the maximum loss with the protective put?

A. $S_0 - X + p_0 = 25.00 - 20.00 + 1.15 = 6.15$
B. $S_T - X - p_0 = 31.33 - 20.00 - 1.15 = 10.18$
C. $S_0 - p_0 = 25.00 - 1.15 = 23.85$

Solution to 1:

A is correct. If the stock price is above the put exercise price at expiration, the put will expire worthless. The profit is the gain on the stock (ST – S0) minus the cost of the put. Note that the maximum profit with a protective put is theoretically unlimited, because the stock can rise to any level and the entire profit is earned by the stockholder.

Solution to 2:

B is correct. Because the option buyer pays the put premium, she does not begin to make money until the stock rises by enough to recover the premium paid.

Solution to 3:

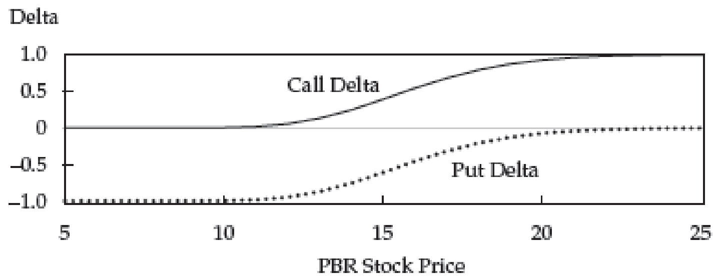
A is correct. Once the stock falls to the put exercise price, further losses are eliminated. The investor paid the option premium, so the total loss is the “deductible” plus the cost of the insurance.

5. Equivalence to Long Asset/Short Forward Position

Delta measures the sensitivity of an option’s price to the underlying.

- Call deltas vary from 0 to 1. Delta of at-the-money call option ≈ 0.5.
- Put deltas vary from -1 to 0. Delta of at-the-money put option ≈ -0.5.

This is illustrated in Exhibit 12 of the curriculum.



By definition, the delta for a stock is 1 and the delta for a long position in a forward contract is also 1.

The portfolio delta depends upon its constituents. For example,

- A portfolio comprising 100 shares will have a portfolio delta of 100 x 1 = 100.
- A portfolio comprising 100 shares and 100 at-the-money long call options on the same stock will have a portfolio delta of 100 x 1 + 100 x 0.5 = 150

Covered call delta: If we construct a covered call portfolio with 100 shares and short 100 at-the-money call options, then the portfolio delta will be equal to 100 – 0.5 x 100 = 50

Protective put delta: Similarly, if we construct a protective put portfolio with 100 shares + long 100 at-the-money put options, then the portfolio delta will be equal to 100 – 0.5 x 100 = 50

Long stock/short forward delta: If we construct a portfolio with 100 shares + short forward position on 50 shares, then the portfolio delta will be equal to 100 – 50 x 1 = 50

These examples show three different positions: an ATM covered call, an ATM protective put, and a long stock/short forward position that all have the same delta. For small changes in the price of the underlying, these positions will provide similar payoffs.

Writing Puts

When someone writes a put option, he has an obligation to buy the underlying stock at the exercise price.

A **cash-secured put** is when an investor sells a put option and deposits an amount of money equal to the exercise price into a designated account. The cash in a cash-secured put is similar to a stock in a covered call strategy. The cash-secured put strategy is appropriate when an investor is bullish on a stock or wants to acquire shares at a particular price.

Scenario: IFT stock is currently at 16.00. An investor wants to purchase the stock for 15.00. To do so, the investor writes the SEP 15 put for 0.65 (Exhibit A). If the stock is above 15 at expiration the put option will expire worthless and the investor pockets the put premium. If the stock is below 15 at expiration, the put will be exercised and the option writer will purchase shares at an effective purchase price (= exercise price – put premium = 15 – 0.65) of 14.35.

6. Risk Reduction Using Covered Calls and Protective Puts

Covered calls and protective puts are both risk-reducing strategies.

Covered calls: Say an investor purchases a stock at 25. If the price goes down to 20, the investor will incur a loss of 5. To hedge this risk the investor sells a call option with a strike price of 25. Assume that the premium received from selling this option is 3. Now, if the stock price goes down to 25, the call premium will help offset some of the loss and the investor will incur a net loss of 2. Therefore, a covered call strategy provides some downside cushion. But this cushion comes at a price, the call writer has to give up the potential upside of the stock.

The delta for a long stock position is 1. However, the delta for a covered call position, i.e. long stock + short call = 1 – 0.5 = 0.5. A lower delta indicates reduced sensitivity to changes in stock price and therefore lower risk.

Protective puts: With a protective put, the put option provides downside protection. But this protection is at a cost because the put buyer must pay the option premium. Say an investor owns a stock currently at 25, and he buys an at-the-money put option for 2. If the stock price goes down to 20, the investor will receive a gain of 5 from the put option and his net loss will be 2 (the put premium). However, continually buying puts in anticipation of a stock price decline will wipe out long-term gains on the stock.

The delta for a long stock position is 1. However, the delta for a protective put position, i.e. long stock + long put = 1 – 0.5 = 0.5. The lower delta indicates lower risk.

Buying calls on a short position: If an investor goes short on a stock, he is exposed to the risk that the stock price may go up. To hedge this risk the investor can purchase a call option. If the stock price goes up, the loss from the short position will be offset by the gains on the long call.

Writing puts on a short position: The risk in a short position can also be hedged by writing put options. If the stock price goes up, the put will expire worthless but the put premium that the investor received will help cushion some of the loss of the short stock position.

Example: Risk-Reduction Strategies
(*This is Example 5 from the curriculum.*)

Janet Reiter is a US-based investor who holds a limited partnership investment in a French private equity firm. She has received notice from the firm's general partner of an upcoming capital call. Reiter plans to purchase €1,000,000 in three months to meet the capital call due at that time. The current exchange rate is US$1.20/€1, but Reiter is concerned the euro will strengthen against the US dollar. She considers the following instruments to reduce the risk of the planned purchase:

- A three-month USD/EUR call option (to buy euros) with a strike rate X = US$1.25/€1 and costing US$0.02/€1
- A three-month EUR/USD put option (to sell dollars) with a strike rate X = €0.8080/US$1 priced at €0.0134/US$1
- A three-month USD/EUR futures contract (to buy euros) with f_0 = US$1.2052/€1

1. Discuss the position required in each instrument to reduce the risk of the planned purchase.
2. Reiter purchases call options for US$20,000, and the exchange rate increases to US$1.29/€1 (EUR currency strengthens) over the next three months. The effective price Reiter pays for her 1,000,000 EUR purchase is closest to:

A. US$1,270,000.
B. US$1,290,000.
C. US$1,310,000.

3. Calculate the price Reiter will pay for the EUR using the three instruments if the exchange rate in three months falls to US$1.10/€1 (EUR currency weakens).

Solution to 1:

Reiter could purchase a €1,000,000 call option struck at US$1.25/€1 for US$20,000. If the EUR price were to increase above US$1.25, she would exercise her right to buy EUR for US$1.25. She would also benefit from being able to purchase EUR at a cheaper price should the exchange rate weaken. A call on the euro is like a put on the US dollar. So, a put to sell dollars struck at an exchange rate of X = €0.8000/US$1 can be viewed as a call to buy Euro at an exchange rate of US$1/€0.8000 = US$1.25/€1. Reiter could also buy a put option on USD struck at X = €0.8080/US$1 which would allow her to sell US$1,237,624 (= €1,000,000/[€0.8080/$1]) to receive the €1,000,000 should the dollar weaken below that level. This would cost her €0.0134/US$1 × US$1,237,624 = €16,584 or US$19,901 upfront. If USD appreciated against the EUR, Reiter would still be able to benefit from the lower cost to purchase the EUR. She could instead enter a long position in a three-month futures contract at US$1.2052. Reiter would have the obligation to purchase €1,000,000 at US$1.2052 regardless of the exchange rate in three months. The futures position requires a margin deposit, but no premium is paid.

Solution to 2:

A is correct. At an exchange rate of US$1.29/€1, the call with strike of X = US$1.25/€1 will be exercised. Including the call premium (US$0.02/€1), the price effectively paid for the euros is US$1.27/€1 × €1,000,000 = US$1,270,000.

Solution to 3:

Both the call and the put options will expire unexercised and Reiter benefits from the lower rate by purchasing €1,000,000 for US$1,100,000. However, she will lose the premiums she paid for the options. For the futures contract, she pays US$1.2052/€1 or US$1,205,200 for €1,000,000 regardless of the more favorable rate.

7. Spreads and Combinations

An **option spread** is a strategy that involves two options of the same type which differ by exercise price only. The term *spread* means the payoff is based on the difference, or spread, between option exercise prices. For a bull or bear spread, the investor buys a call and writes another call with a different exercise price or buys a put and writes another put with a different exercise price. An **option combination** uses both types of options, for example, an investor buys a call option and sells a put option.

Bull Spreads and Bear Spreads

Bull and bear spreads represent cost-effective bets on the direction of the underlying. A bull spread increases in value when the underlying rises. A bear spread increases in value when the underlying falls.

If a cash payment is required to establish a spread, then it is a debit spread. If a cash payment is received as a result of the spread, then the spread is called a credit spread.

Spreads can be established with call options or with put options. For simplicity purposes, we will use call options to construct bull spreads and put options for bear spreads.

Bull Spread

Investment objective: To benefit from an increase in price of the underlying while keeping costs low.

Structure: Buy one call option with a lower exercise price and sell another with a higher exercise price.

Scenario**:** Say the IFT stock is trading at $16 in August. If an investor believes that the stock will not rise above $18 in two months, he can use an OCT 16/18 bull call spread strategy. It will involve the following:

- buy the OCT 16 call option for 2.00
- sell the OCT 18 call option for 1.00

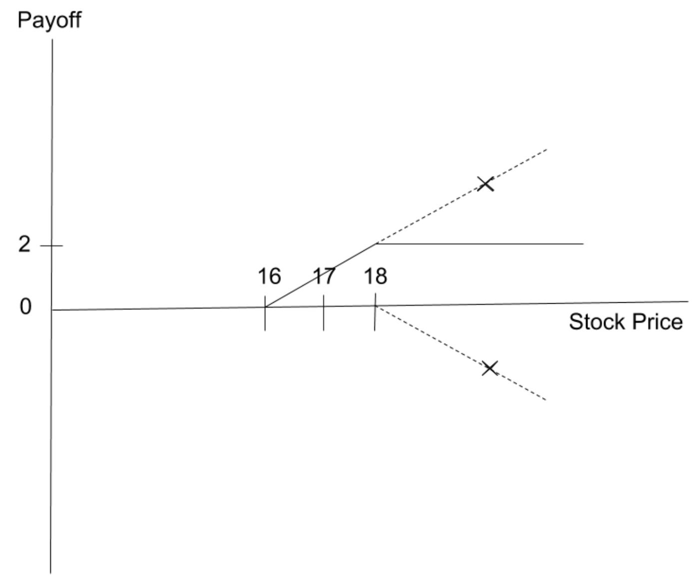
The cost, breakeven stock price, and the maximum profit for bull spread are given by:

- Cost = $c_L - c_H$
- Maximum profit = $X_H - X_L$ – cost
- Breakeven price for a call bull spread = X_L + cost

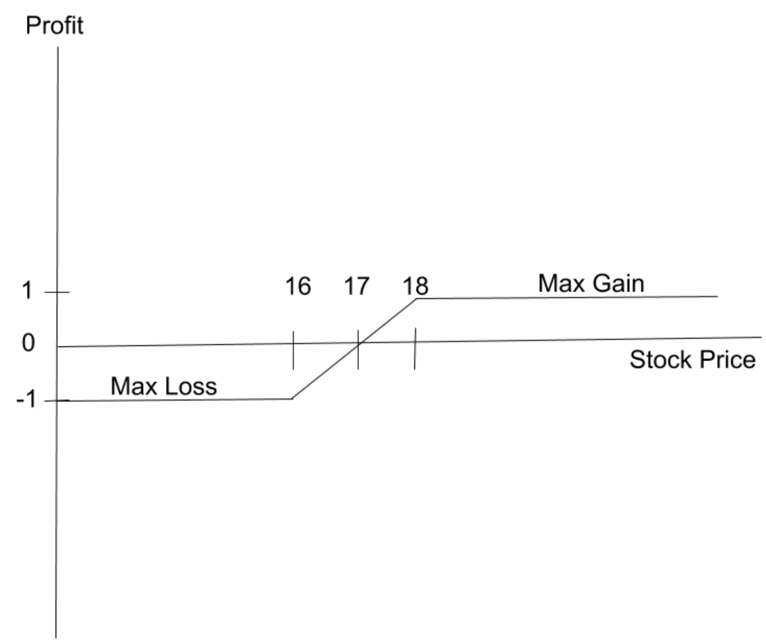
where:
X_L = the lower exercise price, X_H = the higher exercise price
c_L = call with the lower-strike price, c_H = call with the higher-strike price

Using the data given above, the net cost is 2.00 – 1.00 = 1.00
Breakeven price = 16 + 1 = 17.
Maximum profit = 18 – 16 – 1 = 1.

The payoff diagram for this strategy is:



The profit diagram for this strategy can be constructed by shifting the payoff diagram down by 1 which is the cost of the strategy.



The maximum profit occurs at or above the exercise price of 18.

Notice that by buying the OCT 16 call option the investor benefits if his bullish outlook is correct and the stock price increases. The bull spread strategy is cost-effective because the cost of the OCT 16 is partially offset by selling the OCT 18 option.

The risk of this strategy is that the investor will make a loss if the stock price stays below 17. Also, gains above 18 are given up in exchange for a lower cost of this position.

Bear Spread

Investment objective: To benefit from a decrease in price of the underlying while keeping cost low.

Structure: Buy one put option with a higher exercise price and sell another with a lower exercise price.

Scenario: Say the IFT stock is trading at $16 in August. If an investor believes that the stock will decline to 14 by October, he can establish an OCT 14/16 bear spread to benefit from this outlook. To do this, he can:

- buy the IFT OCT 16 put for 2.00
- sell the IFT OCT 14 put for 1.00

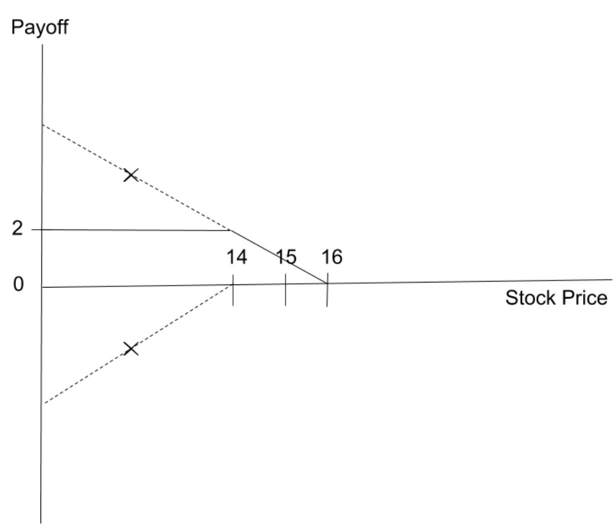
The cost, breakeven stock price, and the maximum profit for bear spread are given by:

- Cost = $p_H - p_L$
- Maximum profit = $X_H - X_L$ – cost
- Breakeven price for a put bear spread = X_H - cost

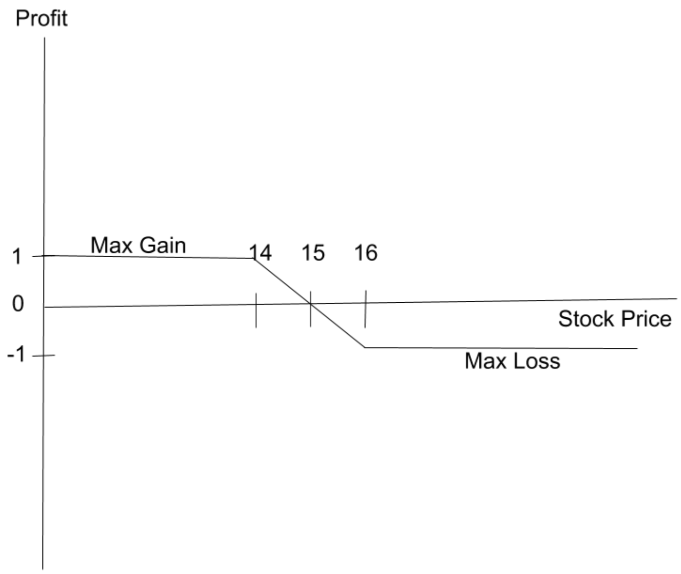
where,
X_L = the lower exercise price, X_H = the higher exercise price
p_L = the lower-strike price put, p_H = the higher-strike price put

Using the data given above, the net cost of the spread = 2.00 - 1.00 = 1.00
Breakeven price = 16 – 1 = 15.
Maximum profit = 16 – 14 – 1 = 1.

The payoff diagram for this strategy is:



The profit diagram for this strategy can be constructed by shifting the payoff diagram down by 1 which is the cost of the strategy.



The maximum profit occurs at or below the exercise price of 14.

Notice that the investor benefits by establishing the OCT 14/16 bear spread if his bearish outlook is correct and the stock price declines. The bear spread strategy is cost-effective because the cost of the OCT 16 put is partially offset by selling the OCT 14 put.

The risk of the strategy is that the investor will make a loss if the stock price stays above 15. Gains below the stock price of 14 are given up for reducing the cost of this position.

Example: Spreads
(*This is Example 6 from the curriculum.*)

Use the following information to answer questions 1 to 3 on spreads.

S_0 = 44.50

OCT 45 call = 2.55, OCT 45 put = 2.92

OCT 50 call = 1.45, OCT 50 put = 6.80

1. What is the maximum gain with an OCT 45/50 bull call spread?
A. 1.10
B. 3.05
C. 3.90

2. What is the maximum loss with an OCT 45/50 bear put spread?
A. 1.12
B. 3.88
C. 4.38

3. What is the breakeven price with an OCT 45/50 bull call spread?
A. 46.10
B. 47.50
C. 48.88

Solution to 1:

C is correct. With a bull spread, the maximum gain occurs at the high exercise price. At an underlying price of 50 or higher, the spread is worth the difference in the strike prices, or 50 – 45 = 5. The cost of establishing the spread is the price paid for the lower-strike option minus the price received for the higher-strike option: 2.55 – 1.45 = 1.10. The maximum gain is 5.00 – 1.10 = 3.90.

Solution to 2:

B is correct. With a bear spread, an investor buys the higher exercise price and writes the lower exercise price. When this strategy is done with puts, the higher exercise price option costs more than the lower exercise price option. Thus, the investor has a debit spread with an initial cash outlay, which is the most he can lose. The initial cash outlay is the cost of the OCT 50 put minus the premium received from writing the OCT 45 put: 6.80 – 2.92 = 3.88.

Solution to 3:

A is correct. An investor buys the OCT 45 call for 2.55 and sells the OCT 50 call for 1.45, for a net cost of 1.10. She breaks even when the position is worth the price she paid. The long call is worth 1.10 at a stock price of 46.10, and the OCT 50 call will expire out of the money and thus be worthless. The breakeven price is the lower exercise price of 45 plus the 1.10 cost of the spread, or 46.10.

Refining spreads: It is not necessary that both legs of the spread be established at the same time or maintained for the same period. Based on market conditions, spreads can be adjusted to capitalize on price movement and increase profits.

8. Straddle

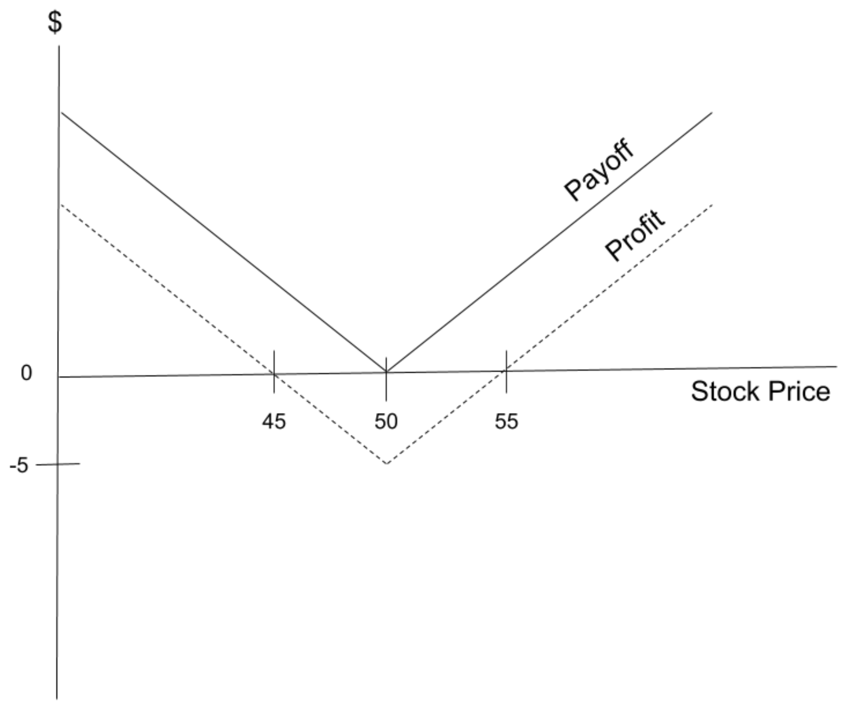
Investment objective: To take advantage of an (a) increase (decrease) in volatility.

Structure: A long straddle is created by buying a call and a put. The call and put should be on the same underlying asset. The exercise price of the call and put should be the same. The party that writes (sells) the call and put options takes a short straddle position.

A straddle is a directional play on the volatility of the underlying. A long straddle has a positive payoff if the true (actual) volatility of the underlying is higher than the expected volatility (predicted by the market participants). A short straddle has a positive payoff if the actual volatility of the underlying is less than the expected volatility.

Assume a stock sells for 50, and the straddle buyer invests in 30-day options with an exercise price of 50. The call price is 3 and the put price is 2, for a total cost of 5. For the straddle to be profitable, one of these two options must be profitable enough to recover the costs of both the put and call.

The payoff and profit diagram of this long straddle strategy is:



The profit diagram is obtained by shifting the payoff down by 5 which is the cost of the strategy.

The cost, max profit, breakeven and max loss of a long straddle are given by:

- Cost = $c_0 + p_0$
- Max profit = unlimited
- Breakeven = X + cost, X – cost (As can be seen in the profit diagram, a straddle has two breakeven points)
- Max loss = cost

The risk of a long straddle is limited to the amount paid for the two option positions. The movement in stock price, therefore, needs to be higher than the combined cost of the two options for the position to be profitable. If an investor believes that the stock price movement will not be significant to recover the cost of the combined option premiums, he or she may write the options instead and take a short straddle position.

The Greeks for a straddle are shown in Exhibit 22.

	Call	Put	Long Straddle = Call + Put	Short Straddle = –Call + –Put
Cost	2.29	2.28	4.570	–4.570
Delta	0.534	–0.465	0.069	–0.069
Gamma	0.072	0.067	0.139	–0.139
Vega	0.057	0.057	0.114	–0.114
Theta	–0.039	–0.036	–0.075	0.075
Implied Volatility	38%	41%	–	–

The long straddle initially has a very low delta (+0.069 for this example) with a high gamma (0.139). The portfolio is not very sensitive to initial small changes in the stock price, but this sensitivity increases quickly once the stock starts moving in a particular direction.
The vega for the long straddle is +0.114, meaning the portfolio will profit by approximately 0.114 from increased volatility of 1% in the underlying.

Collars

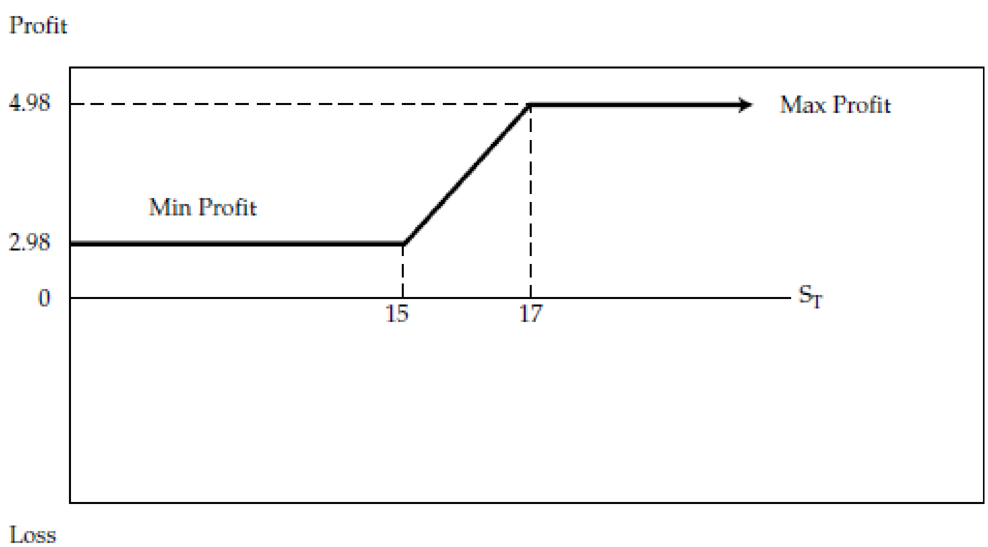
Investment objective: To limit downside risk at a low cost

Structure: A collar involves long shares of stock, a long put with an exercise price below the current stock price, and a short call with an exercise price above the current stock price.

Collars:

- provide downside protection through a put
- reduce the cash outlay by writing a call

Scenario: An investor previously bought a stock of XYZ company at $12. He now buys the NOV 15 put for 1.46 and simultaneously writes the NOV 17 call for 1.44. Exhibit 24 shows the profit and loss diagram for this collar.



As shown in the diagram, the position has a minimum gain of at least 2.98. This is because the stock price had appreciated before establishing the collar. Investors typically establish a collar on a position that is already outstanding.

The cost, max profit, and min profit of the strategy are given by:

- Cost = $S_0 + p_0 - c_0$
- Max profit = X_2 – cost
- Min profit = X_1 – cost

A collar forgoes the positive part of the return distribution in exchange for the removal of the adverse portion. The investor sells the right side of the return distribution by writing a call but receives protection against the left side of the distribution and losses by buying a put. The investment outcomes narrow, which is risk reducing, in exchange for limited return.

Calendar Spread

Investment objective: To take advantage of time decay.

There are two types of calendar spreads:

- **Short calendar spread** requires selling a longer-dated call and buying a near-term call. This strategy is profitable when greater price movements are expected in the near-term relative to price movements in the future.
- **Long calendar spread** requires selling a near-dated call and buying a long-dated call. This strategy is profitable when investment outlook is flat in the near-term, but greater price movements are expected in the future.

Instructor's Note:
Calendar spreads can also be constructed using put options.

Scenario: Suppose XYZ stock is trading at 45 in August. A trader believes that the stock will be stable at the current level for the year but will rise by early next year. He has access to options shown below (taken from the curriculum):

Calendar Spread Call Option Prices (August)

Exercise Price	SEP	OCT	JAN
40	5.15	5.47	6.63
45	1.55	2.19	3.81
50	0.22	0.62	1.99

Based on his outlook on the stock, the trader executes a long calendar spread strategy. He buys XYZ JAN 45 call for 3.81 and sells XYZ SEP 45 call for 1.55. The net cost is 3.81 – 1.55 = 2.26.

Assume that when the SEP 45 option expires, XYZ stock is at 45 and when the JAN 45 option expires the stock is at 50. In this case, the SEP 45 call is worthless, but the JAN 45 option is in the money.

In this example, the long calendar spread trader takes advantage of time decay. Time decay is more pronounced for a short-term option than for a long-term one. The long calendar spread trader exploits this by purchasing a longer-term option and writing a shorter-term option.

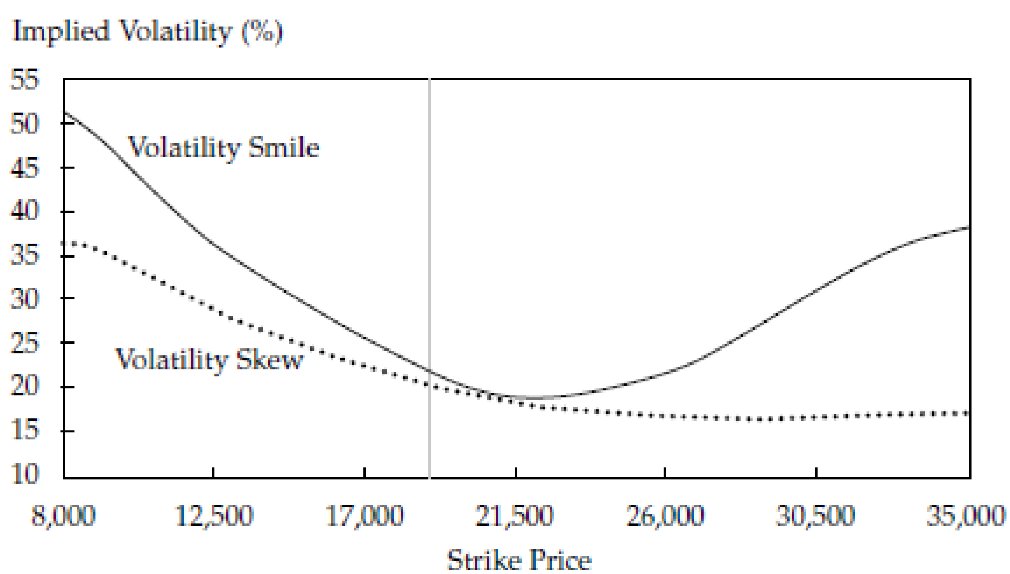
9. Implied Volatility and Volatility Skew

Implied volatility: Implied volatility can be derived from the Black-Scholes-Merton (BSM) option pricing model. The inputs to the BSM model are the option's strike price, the price of the underlying, the time to option expiration, the risk-free interest rate, and volatility of the underlying. All inputs expect volatility are observable. The output is the option price. Implied volatility is a value that equates the model price of an option to its market price. All else equal, a higher option market price implies higher volatility and vice versa.

Realized volatility: Realized volatility is the actual historical volatility of the underlying over a given time period. For example, for a given stock we can calculate the daily returns over the last one month. This data can be used to calculate the monthly standard deviation σ_M. The monthly standard deviation can be annualized by using the following formula:

$$\sigma_A = \sigma_M \times \sqrt{12}$$

Volatility smile and skew: The implied volatility is a function of the strike price. Exhibit 28 from the curriculum plots implied volatility (y-axis) against strike price (x-axis) for options on the same underlying with the same expiration.



- The underlying is trading at 19,000. Options with a strike price of 19.000 are ATM options. Call options with strike prices higher than 19,000 are OTM. Similarly, put options with strike prices lower than 19,000 are OTM.
- If the implied volatilities of both OTM puts and OTM calls are higher than the implied volatilities of ATM options, the curve is U-shaped and is called a **volatility smile** (since it resembles the shape of a smile.)
- However, the more common shape of the implied volatility curve is a **volatility skew** where the implied volatility increases for OTM puts and decreases for OTM calls, as the strike price moves away from the current price.

The extent of the skew depends on the following factors:

- Supply/demand: When investors are looking to hedge the underlying asset, the demand for put options exceeds that for call options. The excess demand for put options relative to the demand for call options, increases the put prices and their implied volatilities. This demand/supply imbalance will increase the degree of the skew.
- Investor sentiment: If investor sentiment becomes bearish, the demand for put options will go up raising their implied volatilities and therefore the skew will increase.

Measuring volatility skew: Exhibit 29 from the curriculum shows the levels of implied volatility at different degrees of moneyness for options on a few equity indexes. The 90% moneyness option is a put with strike (X) equal to 90% of the current underlying price (S); thus X/S = 90%. Similarly, the 110% moneyness option is a call option with strike (X), where X/S = 110%. The skew is calculated as the difference between the implied volatilities of the 90% put and the 110% call.

	Implied Volatility by Moneyness			90%–110%
Index	ATM	Put: 90%	Call: 110%	Volatility Skew
Nikkei 225	12.9	18.9	12.4	6.5
S&P 500	10.3	17.7	9.4	8.3
Euro Stoxx 50	12.3	17.8	9.3	8.5
DAX	14.5	20.0	11.0	9.0

Risk reversal strategy: If a trader believes that the current skew in the volatility curve is too high and expects the skew to reduce in the future, he can take a long position in a risk reversal strategy. He will buy OTM calls and sell the same expiration OTM puts. This options position is then delta-hedged by selling the underlying asset.

This strategy will be profitable if the implied volatility of OTM calls rises more relative to the implied volatility of OTM puts. In other words, if the investor view is correct the volatility skew decreases.

Term structure of volatility: Typically, for the same underlying and strike price, the implied volatilities of options with longer maturities are higher than the implied volatilities of options with shorter maturities. Therefore, the term structure of volatility is often in contango.

Implied volatility surface: It can be thought of as a 3D plot, for options on the same underlying asset, with days to expiration, option strike prices, and implied volatilities on the X, Y, and Z axis respectively. It simultaneously shows the volatility skew and the term structure of implied volatility.

10. Investment Objectives and Strategy Selection

The Necessity of Setting an Objective

Derivatives should be used to achieve a well-defined investment objective. Three high-level objectives include:

1. Hedging
2. Taking directional bets
3. Arbitrage

Factors to consider when setting objectives include:

- Actual portfolio – For example, when using derivatives for hedging, we need to consider the characteristics of the actual portfolio being hedged.
- Market outlook – This includes views on both direction and volatility.
- Timeframe – The time period required to execute the strategy.
- Benefits/limitations of derivatives – For example, close attention should be given to Greeks, as they provide insights on how option prices may change.

Criteria for Identifying Appropriate Option Strategies

Option strategies are often based on the outlook on direction and volatility of the underlying asset. Exhibit 32 of the curriculum outlines the appropriate strategy under different market conditions.

		Outlook on the Trend of Underlying Asset		
		Bearish	**Trading Range/ Neutral View**	**Bullish**
Expected Move in Implied Volatility	Decrease	Write calls	Write straddle	Write puts
	Remain Unchanged	Write calls and buy puts	Calendar spread	Buy calls and write puts
	Increase	Buy puts	Buy straddle	Buy calls

Few points to note:

- In general, if we expect volatility to decrease, we should write options. Whereas, if we expect volatility to increase, we should buy options.
- In general, if we expect the underlying price to go up, we should buy call options. Whereas, if we expect the underlying price to go down, then we should buy put options.

The following table provides a few sample scenarios and the appropriate strategies for these scenarios.

Objective/Outlook	**Strategy**
Buy stock only if price falls below target price	Sell puts with X = target price
Benefit from moderate increase in stock price	Bull spread
Implied volatility will rise in given timeframe	Long straddle
Long-term bearish and near-term neutral outlook	Long calendar spread

11. Uses of Options in Portfolio Management

This section includes mini cases that discuss ways in which different investors use derivatives to solve a particular situation. Only the most important facts from each case are presented here. To get a complete understanding of these cases please refer to the curriculum.

Covered Call Writing

Case facts: Carlos Rivera's client needs to raise $30,000 relatively quickly for the wedding expenses of her daughter. Client is "asset rich and cash poor." Revised investment policy statement permits all option activity except the writing of naked calls. Portfolio account has 5,000 shares of Manzana (MNZA) stock, which she is planning to sell in the near-term. Rivera has a bearish outlook on this stock. Exhibit 33 contains call and put price information for May MNZA options with strike prices close to the current market price of MNZA shares (S_0 = $169)

Call Premium	Call Delta	Exercise Price	Put Premium	Put Delta	Put or Call Vega
12.55	0.721	160	3.75	–0.289	0.199
9.10	0.620	165	5.30	–0.384	0.224
6.45	0.504	170	7.69	–0.494	0.234
4.03	0.381	175	10.58	–0.604	0.225
2.50	0.271	180	14.10	–0.702	0.199

Strategy: To generate cash, Rivera should use the covered call strategy. Call options with the 170-strike price should be sold. This will generate cash of 5,000 x 6.45 = 32,250, sufficient for the client's requirement.

The risks of this strategy are:

- The stock price increases above 170 and the options are exercised. Also, any upside potential above 170 is lost.
- If Rivera's bearish outlook is correct, the shares may drop in value resulting in a loss on the long stock position.

Put Writing

Case facts: Oscar Quintera wants to purchase 50,000 MNZA shares, but not at the current price of 169. Oscar wants to buy the shares at 165 or lower. He decides to write OTM puts on MNZA shares. The put premium is 5.30.

Discuss the outcome of this strategy for two scenarios:

- Scenario A: The stock price is 163 on the option expiration day.
- Scenario B: The stock price is 177 on the option expiration day.

Solution:

Scenario A: At 163 the put option will be exercised. Oscar will buy shares at 165 which is his objective. Also, the put premium will reduce his effective purchase price to 165 – 5.30 = 159.70, improving on the market price of 163.

Scenario B: At 177, the put option will expire worthless. Oscar will not buy the shares, but he will pocket the premium of 5.30 per share.

Long Straddle

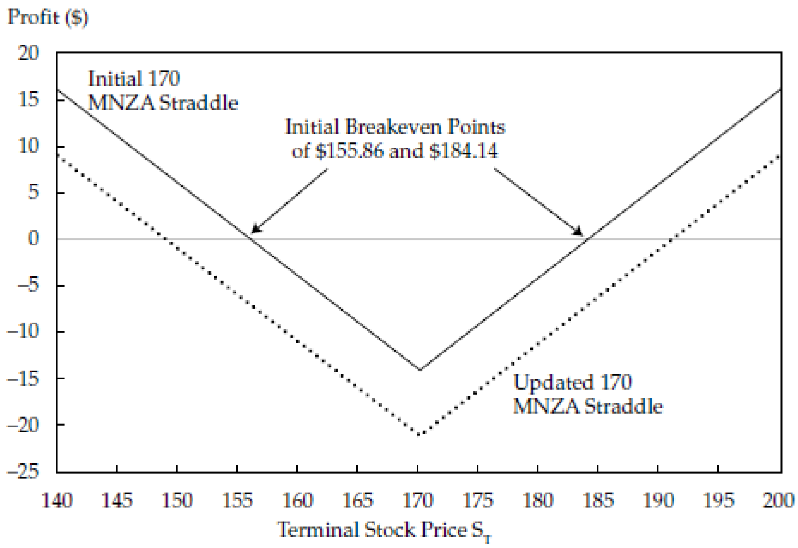
Case facts: Katrina Hamlet has been following Manzana stock for the past year. She anticipates the announcement of a major new product soon, but she is not sure how the critics will react to it. If the new product is praised, she believes the stock price will increase dramatically. If the product does not impress, she believes the share price will fall substantially. Hamlet has been considering trading around the event with a straddle. The stock is currently priced at $169.00, and she is focused on close-to-the-money (170) calls and puts selling for 6.45 and 7.69, respectively.

Hamlet expects that the stock will move at least 10% either way once the product announcement is made, making the straddle strategy potentially appropriate.

After the market close, Hamlet hears a news story indicating that the product will be unveiled at a trade show in two weeks. The following morning after the market opens, she goes to place her trade and finds that although the stock price remains at $169.00, the option prices have adjusted upward to $10.20 for the call and $10.89 for the put.

Discuss whether the new option premiums have any implications for Hamlet's intended straddle strategy.

Solution:



In her earlier planning, the break-even points were 155.86 and 184.14 which would have made the strategy profitable since she was expecting a change of 169 ± 10%. However, the new breakeven points require the stock to move by 12% to be profitable. Hence, she should not execute this straddle trade.

Example: Straddle Analytics
(*This is Example 7 from the curriculum.*)

Use the following information to answer Questions 1 to 3 on straddles.

XYZ stock price = 100.00

100-strike call premium = 8.00

100-strike put premium = 7.50

Options expire in three months

1. If Yelena Strelnikov, a portfolio manager, buys a straddle on XYZ stock, she is best described as expecting a:

A. higher volatility market.
B. lower volatility market.
C. stable volatility market.

2. This strategy will break even at expiration stock prices of:

A. 92.50 and 108.50.
B. 92.00 and 108.00.
C. 84.50 and 115.50.

3. Reaching an upside breakeven point implies an annualized rate of return on XYZ stock closest to:

A. 16%.
B. 31%.
C. 62%.

Solution to 1:

A is correct. A straddle is directionally neutral in terms of price; it is neither bullish nor bearish. The straddle buyer wants higher volatility and wants it quickly but does not care in which direction the price of the underlying moves. The worst outcome is for the underlying asset to remain stable.

Solution to 2:

C is correct. To break even, the stock price must move enough to recover the cost of both the put and the call. These premiums total to $15.50, so the stock must move up at least to $115.50 or down to $84.50.

Solution to 3:

C is correct. The price change to a breakeven point is 15.50 points, or 15.5% on a 100 stock. This is for three months. Ignoring compounding, this outcome is equivalent to an annualized rate of 62% on XYZ stock, found by multiplying by 12/3 (15.5% × 4 = 62%).

Collar

Case facts: Bernhard Steinbacher has a client with a holding of 100,000 shares in Tundra Corporation, currently trading for €14 per share. The client has owned the shares for many years and thus has a very low tax basis on this stock. Steinbacher wants to safeguard the position's value because the client does not want to sell the shares. He does not find exchange-traded options on the stock. Steinbacher wants to present a way in which the client could protect the investment portfolio from a decline in Tundra's stock price.

Discuss an option strategy that Steinbacher might recommend to his client.

Solution: In the over-the-counter market, Steinbacher might buy a put and then write an out-of-the money call. This strategy is a collar. The put provides downside protection below the put exercise price, and the call generates income to help offset the cost of the put.

Calendar Spread

Case facts: Ivanka Dubois is a professional advisor to high-net-worth investors. She expects little price movement in the Euro Stoxx 50 in the next three months but has a bearish long-term outlook. The consensus sentiment favoring a flat market shows no signs of changing over the next few months, and the Euro Stoxx 50 is currently trading at 3500. Exhibit 37 shows prices for two put options with a strike price of 3500 that are available on the index. Both options have the same implied volatility.

	Option A	Option B
Current Price	€119	€173
Time to Maturity	3 months	6 months

Discuss how can Dubois take advantage of her out-of-consensus view.

Solution: Dubois can implement a put calendar spread trade by selling the three-month put option (A) for €119 and buying the six-month same strike put option (B) at the price of €173. Therefore, the cost of establishing this strategy is a net debit of €54 per contact (given by €173 – €119).

12. Hedging an Expected Increase in Equity Market Volatility

Case facts: Jack Wu is a fund manager who oversees a stock portfolio valued at US$50 million that is benchmarked to the S&P 500. He expects an imminent significant correction in the US stock market and wants to profit from an anticipated jump in short-term volatility.

VIX is a measure of expected future volatility. The VIX Index is currently at 14.87 and Exhibit 40 shows quotes for options on VIX.

	Call Option	Put Option
Option Strike	15.60	14.75
Option Price	2.00	1.55

Discuss a strategy that Wu can implement.

Solution: Wu can purchase the 15.60 call on the VIX and, to partially finance the purchase, he can sell an equal number of the 14.75 VIX puts. The total cost of the options strategy is 0.45 (= 2.00 – 1.55) per contract.

At expiry, the strategy will be profitable if volatility spikes up (as anticipated) and the VIX futures increase above 16.05. This is calculated as the call strike of 15.60 plus the net cost of the options (15.60 + 0.45). Above this level, the strategy will gain proportionally. In contrast, Wu's option strategy will lose proportionally to its exposure to the short puts if the VIX futures' settlement price is below 14.75 (put strike).

Establishing or Modifying Equity Risk Exposure

Long Call

Case facts: Armando Sanchez is a private wealth advisor working in London. He expects the shares of Markle Co. Ltd. will move from the current price of £60 a share to £70 a share over the next three months. He wants to use call options to benefit from this view. Prices for three-month call options on the stock are shown in Exhibit 42. Determine which option will be the most profitable.

	Option A	Option B	Option C
Strike	£58.00	£60.00	£70.00
Price	£4.00	£3.00	£0.40
Delta	0.6295	0.5227	0.1184
Gamma	0.0304	0.0322	0.0160

Solution: Option C is not appropriate, because it has a strike price of 70. If the stock reaches 70, there will be no payoff from the option.

The expected payoff from option B is 70 – 60 = 10. The profit is 10 – 3 = 7. The profitability is 7/3 = 2.3

The expected payoff from option A is 70 – 58 = 12. The profit is 12 – 4 = 8. The profitability is 8/4 = 2

Therefore, Option B is the most profitable.

Protective Put Position

Case facts: Eliot McLaire manages a Glasgow-based hedge fund that holds 100,000 shares of Relais Corporation, currently trading at €42.00. He is concerned that the stock price will go down by 10% to 37.80. Exhibit 43 provides information on options prices for Relais Corporation.

	Option A	Option B	Option C
Strike	€40.00	€42.50	€45.00
Price	€1.45	€1.72	€3.46
Delta	−0.4838	−0.5385	−0.7762
Gamma	0.0462	0.0460	0.0346

Determine which option will be the most profitable.

Solution:

The expected payoff from Option A is 40 – 37.80 = 2.2. The profit is 2.2 – 1.45 = 0.75. The profitability is 0.75/1.45 = 0.5

The expected payoff from Option B is 42.50 – 37.80 = 4.7. The profit is 4.7 – 1.72 = 2.98. The profitability is 2.98/1.72 = 1.7

The expected payoff from Option C is 45 – 37.80 = 7.2. The profit is 7.2 – 3.46 = 3.74. The profitability is 3.74 / 3.46 = 1.1

Therefore, Option B is the most profitable.

Summary

LO: Demonstrate how an asset's returns may be replicated by using options.

Buying a call and writing a put on the same underlying with the same strike price and expiration creates a synthetic long position (or, a synthetic long forward position).

Selling a call and buying a put on the same underlying with the same strike price and expiration creates a synthetic short position.

A synthetic long put position consists of a short stock and long call position in which the call strike price equals the price at which the stock is shorted.

A synthetic long call position consists of a long stock and long put position in which the put strike price equals the price at which the stock is purchased.

LO: Discuss the investment objective(s), structure, payoff, risk(s), value at expiration, profit, maximum profit, maximum loss, and breakeven underlying price at expiration of a covered call position.

Covered Call = Long Stock + Short Call.

The investment objectives of covered calls are:

- Yield enhancement
- Reducing position at a favorable price
- Target price realization

The profit and loss relationships for a covered call strategy can be expressed as:

- Maximum gain = $(X - S_0) + c_0$
- Maximum loss = $S_0 - c_0$
- Breakeven point = $S_0 - c_0$
- Expiration value = $S_T - \text{Max}[(S_T - X),0]$
- Profit at expiration = $S_T - \text{Max}[(S_T - X),0] + c_0 - S_0$

LO: Discuss the investment objective(s), structure, payoff, risk(s), value at expiration, profit, maximum profit, maximum loss, and breakeven underlying price at expiration of a protective put position.

Protective Put = Long Stock + Long Put

The investment objectives of protective puts are:

- Loss protection
- Upside preservation

The profit and loss relationships of the protective put are given below:

- Maximum profit = $S_T - S_0 - p_0$ = Unlimited
- Maximum loss = $S_0 - X + p_0$
- Breakeven point = $S_0 + p_0$

- Expiration value = Max(S_T,X)
- Profit at expiration = Max(S_T,X) – S_0 – p_0

LO: Compare the delta of covered call and protective put positions with the position of being long an asset and short a forward on the underlying asset.

Covered call delta: If we construct a covered call portfolio with 100 shares – 100 at-the-money call options, then the delta of this portfolio will be equal to 100 – 0.5 x 100 = 50

Protective put delta: Similarly, if we construct a protective put portfolio with 100 shares + long 100 at-the-money put options, then the delta of this portfolio will be equal to 100 – 0.5 x 100 = 50

Long stock/short forward delta: If we construct a portfolio with 100 shares + short forward position on 50 shares, then the portfolio delta will be equal to 100 – 50 x 1 = 50

These examples show three different positions: an ATM covered call, an ATM protective put, and a long stock/short forward position have the same delta. For small changes in the price of the underlying, these positions will provide similar payoffs.

LO: Compare the effect of buying a call on a short underlying position with the effect of selling a put on a short underlying position.

Buying calls on a short position: If an investor goes short on a stock, he is exposed to the risk that the stock price may go up. To hedge this risk the investor can purchase a call option. If the stock price goes up, the loss from the short position will be offset by the gains on the long call.

Writing puts on a short position: The risk in a short position can also be hedged by writing put options. If the stock price goes up, the put will expire worthless but the put premium that the investor received will help cushion some of the loss.

LO: Discuss the investment objective(s), structure, payoffs, risk(s), value at expiration, profit, maximum profit, maximum loss, and breakeven underlying price at expiration of the following option strategies: bull spread, bear spread, straddle, and collar.

Bull Spread

Investment objective: To benefit from an increase in price of the underlying while keeping costs low.

Structure: Buy a call option with a low exercise price and sell a call option with a high exercise price.

The cost, breakeven stock price, and the maximum profit for bull spread are given by:

- Cost = c_L – c_H
- Maximum profit = X_H – X_L – cost
- Breakeven price for a call bull spread = X_L + cost

Bear Spread

Investment objective: To benefit from a decrease in price of the underlying while keeping cost low.

Structure: Buy a put option with a high exercise price and sell a put option with a low exercise price.

The cost, breakeven stock price, and the maximum profit for bear spread are given by:

- Cost = $p_H - p_L$
- Maximum profit = $X_H - X_L$ – cost
- Breakeven price for a put bear spread = X_H - cost

Straddle

Investment objective: To take advantage of volatility.

Structure: A long straddle is created by buying a call and buying a put. The call and put should be on the same underlying asset. The exercise price of the call and put should be the same.

The cost, max profit, breakeven and max loss of a long straddle are given by:

- Cost = $c_0 + p_0$
- Max profit = unlimited
- Breakeven = X + cost, X – cost (As seen in the profit diagram, a straddle has two breakeven points)
- Max loss = cost

Collars

Investment objective: To limit downside risk at a low cost

Structure: A collar consists of long shares of stock, a long put with an exercise price below the current stock price, and short call with an exercise price above the current stock price.

The cost, max profit, and min profit of the strategy are given by:

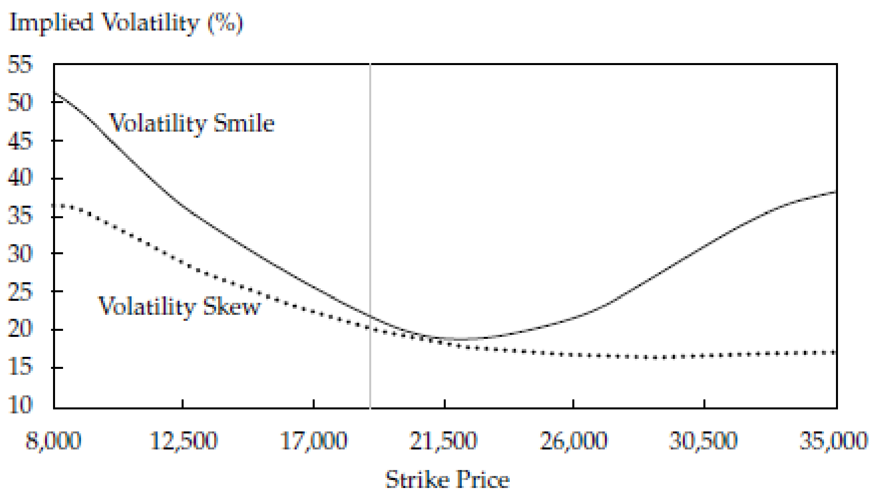
- Cost = $S_0 + p_0 - c_0$
- Max profit = X_2 – cost
- Min profit = X_1 – cost

LO: Describe uses of calendar spreads.

Calendar spreads are used to take advantage of time decay when volatility is expected to change.
There are two types of calendar spreads:

- Short calendar spread: selling a longer-dated call, buying a near-term option. This strategy is profitable when greater price movements are expected in the near-term relative to price movements expected in the future.
- Long calendar spread: selling a near-dated call, buying a long-dated call. This strategy is profitable when investment outlook is flat in the near term, but greater price movements are expected in the future.

LO: Discuss volatility skew and smile.



- If the implied volatilities of both OTM puts and OTM calls are higher than the implied volatilities of ATM options, the curve is U-shaped and is called a **volatility smile** (since it resembles the shape of a smile.)
- However, the more common shape of a volatility curve is a **volatility skew** where the implied volatility increases for OTM puts and decreases for OTM calls, as the strike price moves away from the current price.

LO: Identify and evaluate appropriate option strategies consistent with given investment objectives.

		Outlook on the Trend of Underlying Asset		
		Bearish	**Trading Range/ Neutral View**	**Bullish**
Expected Move in Implied Volatility	Decrease	Write calls	Write straddle	Write puts
	Remain Unchanged	Write calls and buy puts	Calendar spread	Buy calls and write puts
	Increase	Buy puts	Buy straddle	Buy calls

LO: Demonstrate the use of options to achieve targeted equity risk exposures.

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