OVERVIEW, TRADING STRATEGIES

1. Trading strategies involving a single option on a stock and the stock itself:
   i) Covered call; ii) Protective put

2. Trading strategies involving taking a position in two or more options of the same type:
   i) Bull spreads; ii) Bear spreads; iii) Butterfly spreads

3. Combinations: Option trading strategies that involve taking a position in both calls and puts on the same stock:
   i) Straddles; ii) Strips; iii) Straps; iv) Strangles
COVERED CALL

Consider a portfolio that consists of a long position (buy) in a stock plus a short position (sell) in a call option.

The investment strategy represented by this portfolio is known as writing a covered call.

This is because the long stock position "covers" or protects the investor from the possibility of a sharp rise in the stock price.

lp on \( S_t \) and a sp on \( C \)

Profit (\( \Pi \)):

\[
\text{payoff} \left( S_T - \max( S_T - X, 0) \right) \text{cost } S_t + C
\]

\( S_T < X \): \( S_T - S_t + C \)

When \( S_T < X \) the profit is a positive function of \( S_T \) (slope +1)

When \( S_T = 0 \): \( \Pi = -S_t + C \) (maximum loss). From upper bound of a call this is negative: \( C \leq S_t \)
\[ S_T > X: \quad S_T - (S_T - X) - S_t + C = X - S_t + C \]

When \( S_T > X \) the profit is not affected by changes in \( S_T \) (slope 0)

When \( S_T = X \): \( \Pi = X - S_t + C \) (maximum gain). From lower bound of a call this is positive:

\[ C \geq S_t - X e^{-r(T-t)} \implies C + X e^{-r(T-t)} - S_t \geq 0 \implies C + X - S_t \geq 0 \]

Finally, the profit is zero when \( \Pi = S_T - S_t + C = 0 \) \( \implies S_T = S_t - C \)

An investor will invest in this strategy if he/she believes that \( S_T \geq S_t - C \)

See graph covered call
Covered call: Lp on $S_t$ and a sp on $C$

But from the put call parity we have:

$$C + X e^{-r(T-t)} = P + S_t \implies S_t - C = X e^{-r(T-t)} - P$$

That is why the profit of this strategy is similar to the one of selling a put

The reverse of writing a covered call is a short position (sell) in a stock combined with a long position (buy) in a call option

Profit ($\Pi$): $\begin{align*}
\text{payoff} & & \text{cost} \\
S_T < X: & & -(S_T - S_t + C) \\
S_T > X: & & -[S_T - (S_T - X, 0) - S_t + C] \\
& & = -(X - S_t + C)
\end{align*}$

See graph reverse covered call
PROTECTIVE PUT STRATEGY

An investment strategy that involves buying a put option on a stock and the stock itself is referred to as a protective put

lp on $S_t$ and lp on $P$

Profit ($\Pi$): $\overbrace{S_T + \max(X - S_T, 0)}^{\text{payoff}} - \overbrace{S_t - P}^{\text{cost}}$

$S_T < X$: $S_T + X - S_T - S_t - P = X - S_t - P$

When $S_T < X$ the profit is independent of changes in $S_T$ (slope 0): $X - S_t - P$

When $S_T = 0$: $\Pi = X - S_t - P$ (the maxim loss)

This must be negative otherwise this strategy will involve only gain

(regardless from the future price of the stock)
$S_T > X$: $S_T - S_t - P$

When $S_T > X$ the profit is a positive function of $S_T$ (slope +1): $S_T - S_t - P$

$\Pi = 0$ when $\Pi = S_T - S_t - P = 0 \Rightarrow S_T = S_t + P$

This strategy has no upper limit

An investor will invest in this strategy if she/he believes that $S_T > S_t + P$

See graph protective put
Recall that from the put call parity we have:

\[ C + X e^{-r(T-t)} = P + S_t \]

The above equation shows that a long position in a put combined with a long position in the stock is equivalent to a long call position plus an amount of cash: \( X e^{-r(T-t)} \)

This explain why the profit pattern for a protective put strategy is similar to the profit pattern from a long call position

The reverse of a protective put is a short position in a put option combined with a short position in the stock

\[
\text{Profit (}\Pi\text{): } -[S_T + \max(X - S_T, 0)] - (-S_t - P)
\]

\[ S_T < X: \quad -(S_T + X - S_T - S_t - P) = -(X - S_t - P) \]

\[ S_T > X: \quad -(S_T - S_t - P) \]

See graph selling a protective put
BULL SPREAD (CREATED FROM CALLS)

A bull spread can be created by buying a call on a stock with a certain strike price and selling a call on the same stock with a higher strike price.

Both options have the same expiration date.

\[ \text{lp in } C(X_1) \text{ and a sp in } C(X_2) \text{ where } X_2 > X_1 \]

\[
\Pi: \overbrace{\max(S_T - X_1, 0) - \max(S_T - X_2, 0)}^{\text{Revenue}} - \overbrace{C_1 + C_2}^{\text{Cost}}
\]

\[ S_T < X_1 < X_2: -C_1 + C_2 \]

That is, \( \Pi \) is fixed (does not depend on \( S_T \)). Further, we have: \( X_2 > X_1 \Rightarrow C_2 < C_1 \). Hence \( \Pi < 0 \)
\[ X_1 < S_T < X_2: \quad S_T - X_1 - C_1 + C_2 \]

In this case \( \Pi \) is a positive function \( S_T \). When \( \Pi = 0 \Rightarrow S_T = X_1 + C_1 - C_2 \)

\[ X_1 < X_2 < S_T: \quad S_T - X_1 - (S_T - X_2) - C_1 + C_2 = X_2 - X_1 - C_1 + C_2 \]

In this case \( \Pi \) is fixed (does not depend on \( S_T \)).

\( X_2 - X_1 > 0, \quad C_2 - C_2 < 0. \) Overall, \( X_2 - X_1 - C_1 + C_2 \) is positive. Otherwise \( \Pi \) will always be negative.

See graph Bull Spread (Created using Calls)
MAIN POINTS

- A bull spread, when created from calls, requires an initial investment

- An investor entering into a bull spread is hoping that the stock price will increase

- A bull spread strategy limits both the investor’s upside potential and his or her downside risk

- Symmetric strategy with respect to $S_T$: unlimited gain from lp in $C(X_1)$ and unlimited loss from sp in $C(X_2)$
BEAR SPREAD (CREATED USING CALLS). THE REVERSE OF BULL SPREAD

A bear spread can be created by selling a call on a stock with a certain strike price and buying a call on the same stock with a higher strike price.

Both options have the same expiration date.

sp in $C(X_1)$ and a lp in $C(X_2)$ where $X_2 > X_1$

\[
\Pi: -\left[\max(S_T - X_1, 0) - \max(S_T - X_2, 0)\right] - (-C_1 + C_2)
\]

$S_T < X_1 < X_2$: $-(-C_1 + C_2)$

That is, $\Pi$ is fixed (does not depend on $S_T$). Further, we have: $X_2 > X_1 \Rightarrow C_2 < C_1$. Hence $\Pi > 0$
\[X_1 < S_T < X_2: -(S_T - X_1 - C_1 + C_2)\]

In this case \(\Pi\) is a negative function \(S_T\). When \(\Pi = 0 \Rightarrow S_T = X_1 + C_1 - C_2\)

\[X_1 < X_2 < S_T: -[S_T - X_1 - (S_T - X_2) - C_1 + C_2] = -(X_2 - X_1 - C_1 + C_2)\]

In this case \(\Pi\) is fixed (does not depend on \(S_T\)).

\(X_2 - X_1 > 0, C_2 - C_2 < 0\). Overall, \(-(X_2 - X_1 - C_1 + C_2)\) is negative. Otherwise \(\Pi\) will always be positive.
MAIN POINTS

- A bear spread created from calls involves an initial cash inflow since the price of the call sold is greater than the price of the call purchased.

- An investor who enters into a bear spread is hoping that the stock price will be decline.

- Like bull spreads, bear spreads limit both the upside profit potential and the downside risk.

- It is a symmetric strategy with respect to $S_T$.

See Graph Bear Spread (Created using Calls)
BULL SPREAD (CREATED USING PUTS)

A bull spread can be created by buying a put on a stock with a certain strike price and selling a put on the same stock with a higher strike price.

Both options have the same expiration date.

lp in \( P(X_1) \) and a sp in \( P(X_2) \) where \( X_2 > X_1 \)

\[
\Pi: \frac{\text{Revenue}}{\text{Cost}} = \max(X_1 - S_T, 0) - \max(X_2 - S_T, 0) - P_1 + P_2
\]

\( S_T < X_1 < X_2: X_1 - S_T - (X_2 - S_T) - P_1 + P_2 = X_1 - X_2 - P_1 + P_2 \)

That is, \( \Pi \) is fixed (does not depend on \( S_T \)). Further, we have: \( X_2 > X_1 \Rightarrow P_2 > P_1 \).

Overall \( X_1 - X_2 - P_1 + P_2 \) is negative. Otherwise \( \Pi \) will always be positive.
\[ X_1 < S_T < X_2: -(X_2 - S_T) - P_1 + P_2 = S_T - X_2 - P_1 + P_2 \]

In this case \( \Pi \) is a positive function of \( S_T \). When \( \Pi = 0 \) \( \Rightarrow S_T = X_2 + P_1 - P_2 < X_2 \)

\[ X_1 < X_2 < S_T: -P_1 + P_2 > 0 \]

In this case \( \Pi \) is fixed (does not depend on \( S_T \)).

The profit pattern for this strategy is similar to the profit pattern from a Bull spread created using calls.

See Graph Bull Spread (Created using Puts)
BULL SPREAD (CREATED USING PUTS). THE REVERSE OF A BULL SPREAD

A bull spread can be created by selling a put on a stock with a certain strike price and buying a put on the same stock with a higher strike price.

Both options have the same expiration date.

sp in $P(X_1)$ and a lp in $P(X_2)$ where $X_2 > X_1$

$$\Pi: \frac{-\left[\max(X_1 - S_T, 0) - \max(X_2 - S_T, 0)\right]}{-(-P_1 + P_2)}$$

$S_T < X_1 < X_2: -[X_1 - S_T - (X_2 - S_T) - P_1 + P_2] = -(X_1 - X_2 - P_1 + P_2)$

That is, $\Pi$ is fixed (does not depend on $S_T$). Further, we have: $X_2 > X_1 \Rightarrow P_2 > P_1$.

Overall $-(X_1 - X_2 - P_1 + P_2)$ is positive. Otherwise $\Pi$ will always be negative.
\[ X_1 < S_T < X_2: -[-(X_2 - S_T) - P_1 + P_2] = -(S_T - X_2 - P_1 + P_2) \]

In this case \( \Pi \) is a negative function of \( S_T \). When \( \Pi = 0 \) \( \Rightarrow S_T = X_2 + P_1 - P_2 < X_2 \)

\[ X_1 < X_2 < S_T: -(-P_1 + P_2) < 0 \]

In this case \( \Pi \) is fixed (does not depend on \( S_T \)).

The profit pattern for this strategy is similar to the profit pattern from a Bear spread created using calls.

See Graph Bear Spread (Created using Puts)
BUTTERFLY SPREAD (CREATED USING CALLS)

A butterfly spread can be created by buying a call option with a relatively low strike price, $X_1$, buying a call option with a relatively high strike price, $X_3$, and selling two call options with a strike price, $X_2$, halfway between $X_1$ and $X_2$: $X_2 = (X_1 + X_3)/2$

lp in $C(X_1)$, sp in $2C(X_2)$, and lp in $C(X_3)$

\[
\Pi: \frac{\text{Revenue}}{-\text{Cost}} = \max(S_T-X_1, 0) - 2 \max(S_T-X_2, 0) + \max(S_T-X_3, 0)
\]

\[
- C_1 + 2C_2 - C_3
\]

$S_T < X_1, X_2, X_3$: $-C_1 + 2C_2 - C_3 = C^*$

In this case the profit is equal to the cost (it can be shown that $C^* < 0$)
\[ X_1 < S_T < X_2, X_3 : S_T - X_1 + C^* \]

In this case \( \Pi \) is a positive function of \( S_T \). When \( \Pi = 0 \Rightarrow S_T = X_1 - C^* > X_1 \)

\[ X_1, X_2 < S_T < X_3 : S_T - X_1 - 2(S_T - X_2) + C^* = 2X_2 - X_1 - S_T + C^* = X_3 - S_T + C^* \]

In this case \( \Pi \) is a negative function of \( S_T \). When \( \Pi = 0 \Rightarrow S_T = X_3 + C^* < X_3 \)

\[ X_1, X_2, X_3 < S_T : S_T - X_1 - 2(S_T - X_2) + S_T - X_3 + C^* = 2X_2 - X_1 - X_3 + C^* = C^* \]

In this case the profit is equal to the cost (it can be shown that \( C^* < 0 \))

See Graph Butterfly Spread
A butterfly spread leads to a profit if the stock price stays close to $X_2 \left[ X_1 - C^* < S_T < X_3 + C^* \right]$

but gives rise to a small loss if there is a significant stock price move in either direction

It is therefore an appropriate strategy for an investor who feels that large stock price movements are unlikely

The strategy requires a small investment initially ($C^* < 0$)
THE REVERSE OF A BUTTERFLY SPREAD (CREATED USING CALLS)

A butterfly spread can be created by selling a call option with a relatively low strike price, $X_1$, selling a call option with a relatively high strike price, $X_3$, and buying two call options with a strike price, $X_2$, halfway between $X_1$ and $X_2$: $X_2 = (X_1 + X_3)/2$

sp in $C(X_1)$, lp in $2C(X_2)$, and sp in $C(X_3)$

\[
\Pi: - \left[ \max(S_T - X_1, 0) - 2 \max(S_T - X_2, 0) + \max(S_T - X_3, 0) \right] -(-C_1 + 2C_2 - C_3)
\]

$S_T < X_1, X_2, X_3$: $-(-C_1 + 2C_2 - C_3) = -C^*$

In this case the profit is equal to minus the cost (it can be shown that $-C^* > 0$)
$X_1 < S_T < X_2, X_3 : -(S_T - X_1 + C^*)$

In this case $\Pi$ is a negative function of $S_T$. When $\Pi = 0 \Rightarrow S_T = X_1 - C^* > X_1$

$X_1, X_2 < S_T < X_3 : -[S_T - X_1 - 2(S_T - X_2) + C^*] = -(2X_2 - X_1 - S_T + C^*) = -(X_3 - S_T + C^*)$

In this case $\Pi$ is a positive function of $S_T$. When $\Pi = 0 \Rightarrow S_T = X_3 + C^* < X_3$

$X_1, X_2, X_3 < S_T : -[S_T - X_1 - 2(S_T - X_2) + S_T - X_3 + C^*] = -(2X_2 - X_1 - X_3 + C^*) = -C^*$

In this case the profit is equal to minus the cost (it can be shown that $-C^* > 0$)

See Graph Reverse Butterfly Spread
The reverse of a butterfly spread leads to a loss if the stock price stays close to $X_2 \left[ X_1 - C^* < S_T < X_3 + C^* \right]$ but gives rise to a small profit if there is a significant stock price move in either direction.

It is therefore an appropriate strategy for an investor who feels that large stock price movements are likely.

The strategy gives rise to a small profit initially ($-C^* > 0$).

If $C^* > 0$ then a butterfly spread will always give rise to a profit.
BUTTERFLY SPREAD (CREATED USING PUTS)

A butterfly spread can be created by buying a put option with a relatively low strike price, $X_1$, buying a put option with a relatively high strike price, $X_3$, and selling two put options with a strike price, $X_2$, halfway between $X_1$ and $X_2$: $X_2 = (X_1 + X_3)/2$

$\text{lp in } P(X_1), \text{ sp in } 2P(X_2), \text{ and lp in } P(X_3)$

\[
\Pi: \underbrace{\text{Revenue}}_{\max(X_1 - S_T, 0)} - 2\underbrace{\text{Revenue}}_{\max(X_2 - S_T, 0)} = \underbrace{\text{cost}}_{-P_1 + 2P_2 - P_3}
\]

$S_T < X_1, X_2, X_3$: $X_1 - S_T - 2(X_2 - S_T) + X_3 - S_T - P_1 + 2P_2 - P_3 = X_1 - 2X_2 + X_3 + P* = P*$

In this case the profit is equal to the cost (it can be shown that $P* < 0$)
\[ X_1 < S_T < X_2, \ X_3 : -2(X_2 - S_T) + X_3 - S_T - P_1 + 2P_2 - P_3 = S_T + X_3 - 2X_2 + P^* = S_T - X_1 + P^* \]

In this case the profit is a positive function of \( S_T \). When \( \Pi = 0 \Rightarrow S_T = X_1 - P^* > X_1 \)

\[ X_1, X_2 < S_T < X_3 : X_3 - S_T - P_1 + 2P_2 - P_3 = X_3 - S_T + P^* \]

In this case the profit is a negative function of \( S_T \). When \( \Pi = 0 \Rightarrow S_T = X_3 + P^* > X_3 \)

\[ X_1, X_2, X_3 < S_T : -P_1 + 2P_2 - P_3 = P^* \]

See Graph Butterfly Spread (Created Using Puts)
A butterfly spread leads to a profit if the stock price stays close to $X_2 \ [X_1 - P^* < S_T < X_3 + P^*]$

but gives rise to a small loss if there is a significant stock price move in either direction.

It is therefore an appropriate strategy for an investor who feels that large stock price movements are unlikely.

The strategy requires a small investment initially $(P^* < 0)$
THE REVERSE OF A BUTTERFLY SPREAD (CREATED USING PUTS)

sp in $P(X_1)$, lp in $2P(X_2)$, and sp in $P(X_3)$

\[
\Pi: -\left[\max(X_1 - S_T, 0) - 2 \max(X_2 - S_T, 0)\right]
+ \max(X_3 - S_T, 0)]
- (-P_1 + 2P_2 - P_3)
\]

$S_T < X_1 < X_2, X_3$: $-P^*$

$X_1 < S_T < X_2, X_3 : -\left(S_T - X_1 + P^*\right)$

In this case the profit is a negative function of $S_T$. When $\Pi = 0 \Rightarrow S_T = X_1 - P^* > X_1$

$X_1, X_2 < S_T < X_3 : -\left(X_3 - S_T + P^*\right)$

In this case the profit is a positive function of $S_T$. When $\Pi = 0 \Rightarrow S_T = X_3 + P^* > X_3$

$X_1, X_2, X_3 < S_T : -P^*$
COMBINATIONS

A combination is a strategy that involves taking a position in both calls and puts on the same stock. We will consider what are known as straddles, strips, straps, and strangles

STRADDLE

A straddle involves buying a call and a put with the same strike price and expiration date

lp \( C(X) \) and a lp \( P(X) \)

\[
\Pi: \max(S_T - X, 0) + \max(X - S_T, 0) - C - P
\]

\( S_T < X : X - S_T - C - P \)

When \( S_T = 0 \) : \( \Pi = X - C - P \) (Intercept with the vertical axis)

In this case the profit is a negative function of \( S_T \). When \( \Pi = 0 \) \( \Rightarrow S_T = X - C - P \)

It can be shown that \( X > C + P \)
\[ S_T > X : S_T - X - C - P \]

In this case the profit is a positive function of \( S_T \). When \( \Pi = 0 \) \( \Rightarrow S_T = X + C + P \)

If the stock price is close to the strike price at expiration of the options, the straddle leads to a loss \( (X - C - P < S_T < X + C + P) \)

A straddle is appropriate when an investor is expecting a large move in a stock price but does not know in which direction the move will be

The above straddle is sometimes referred to as a bottom straddle or a straddle purchase
TOP STRADDELE

A top straddle or a straddle write is the reverse position

It is created by selling a call and a put with the same exercise price and expiration date

sp $C(X)$ and a sp $P(X)$

\[
\Pi: -\left[\max(S_T - X, 0) + \max(X - S_T, 0)\right] - (-C - P)
\]

$S_T < X : -(X - S_T - C - P)$

When $S_T = 0 : \Pi = X - C - P$ (Intercept with the vertical axis)

In this case the profit is a positive function of $S_T$. When \( \Pi = 0 \Rightarrow S_T = X - C - P \)

It can be shown that $X > C + P$
$S_T > X : -(S_T - X - C - P)$

In this case the profit is a negative function of $S_T$. When $\Pi = 0 \Rightarrow S_T = X + C + P$

If the stock price is close to the strike price at expiration of the options, the top straddle leads to a profit ($X - C - P < S_T < X + C + P$)

It is a highly risky strategy. The loss arising from a large stock movement in a positive direction is unlimited
STRIP

A strip consists of a long position in one call and two puts with the same strike price and expiration date.

\[ \text{lp in } C(X) \text{ and lp } 2P(X) \]

\[
\Pi: \begin{array}{c}
\text{Revenue} \\
\max(S_T - X, 0) + 2 \max(X - S_T, 0) \end{array} - \begin{array}{c}
\text{Cost} \\
C - 2P \end{array}
\]

\( S_T < X : 2(X - S_T) - C - 2P \)

When \( S_T = 0 : \Pi = 2X - C - 2P \) (Intercept with the vertical axis)

In this case the profit is a negative function of \( S_T \). When \( \Pi = 0 \Rightarrow S_T = X - C/2 - P \)

It can be shown that \( 2X > C + 2P \)
\[ S_T > X : S_T - X - C - 2P \]

In this case the profit is a positive function of \( S_T \). When \( \Pi = 0 \Rightarrow S_T = X + C + 2P \)

If the stock price is close to the strike price at expiration of the options, the straddle leads to a loss (\( X - C/2 - P < S_T < X + C + 2P \))

A strip is appropriate when an investor is expecting a large move in a stock price and considers a decrease in the stock price to be more likely than an increase.
STRAP

A strap consists of a long position in two calls and one put with the same strike price and expiration date.

\[ \text{lp in } 2C(X) \text{ and lp } P(X) \]

\[ \Pi: \frac{\text{Revenue}}{\text{Cost}} = 2 \max(S_T - X, 0) + \max(X - S_T, 0) - 2C - P \]

\( S_T < X : (X - S_T) - 2C - P \)

When \( S_T = 0 : \Pi = X - 2C - P \) (Intercept with the vertical axis)

In this case the profit is a negative function of \( S_T \). When \( \Pi = 0 \Rightarrow S_T = X - 2C - P \)

It can be shown that \( X > 2C + P \)
\[ S_T > X : 2(S_T - X) - 2C - P \]

In this case the profit is a positive function of \( S_T \). When \( \Pi = 0 \Rightarrow S_T = X + C + P/2 \)

If the stock price is close to the strike price at expiration of the options, the straddle leads to a loss \((X - 2C - P < S_T < X + C + P/2)\)

A strap is appropriate when an investor is expecting a large move in a stock price and considers a decrease in the stock price to be more likely than an decrease
STRANGLE

In a strangle, sometimes called a bottom vertical combination, an investor buys a put and a call with the same expiration date and different strike prices.

The call strike price, $X_2$, is higher than the put strike price, $X_1$

$\text{l}_p\ C(X_2)$ and a $\text{l}_p\ P(X_1)$

\[
\Pi : \frac{\text{Revenue}}{\text{Cost}} = \max(S_T - X_2, 0) + \max(X_1 - S_T, 0) - C - P
\]

$S_T < X_1 < X_2 : X_1 - S_T - C - P$

When $S_T = 0 : \Pi = X_1 - C - P$ (Intercept with the vertical axis)

In this case the profit is a negative function of $S_T$. When $\Pi = 0 \Rightarrow S_T = X_1 - C - P$

It can be shown that $X_1 > C + P$
\[ X_1 < S_T < X_2 : -C - P \]

In this case the profit is independent of changes in stock price

\[ X_1, X_2 < S_T : S_T - X_2 - C - P \]

In this case the profit is a positive function of \( S_T \). When \( \Pi = 0 \) \( \Rightarrow S_T = X_2 + C + P \)

A strangle is a similar strategy to a straddle. The investor is betting that there will be a large price move but is uncertain whether it will be an increase or a decrease

As \( X_2 \uparrow \rightarrow C \downarrow \); As \( X_1 \downarrow \rightarrow P \downarrow \);

The further the strike prices are apart, the less the downside risk and the further the stock price has to move for a profit to be realized
SALE OF A STRANGLE

In a sale of a strangle an investor sells a put and a call with the same expiration date and different strike prices

The call strike price, $X_2$, is higher than the put strike price, $X_1$

sp $C(X_2)$ and a sp $P(X_1)$

\[
\Pi: -\left[ \max(S_T - X_2, 0) + \max(X_1 - S_T, 0) \right] - (-C - P)
\]

$S_T < X_1 < X_2 : -(X_1 - S_T - C - P)$

When $S_T = 0 : \Pi = -(X_1 - C - P)$ (Intercept with the vertical axis)

In this case the profit is a negative function of $S_T$. When $\Pi = 0 \Rightarrow S_T = X_1 - C - P$
\[ X_1 < S_T < X_2 : -(-C - P) \]

In this case the profit is independent of changes in stock price.

\[ X_1, X_2 < S_T : -(S_T - X_2 - C - P) \]

In this case the profit is a negative function of \( S_T \). When \( \Pi = 0 \Rightarrow S_T = X_2 + C + P \)

The sale of a strangle is sometimes referred to as a top vertical combination.

It can be appropriate for an investor who feels that large stock price movements are unlikely. However, like the sale of a straddle, it is a risky strategy since the investor’s potential loss is unlimited.
SUMMARY

Trading strategies:

A. Involving a single option on a stock and the stock itself:

i) Covered call: \( \text{lp } S_t, \text{sp } C(X) \); Protective put: \( \text{lp } S_t, \text{lp } P(X) \)

B. Spreads: Involve a position in two or more options of the same type:

i) Bull spread: \( \text{lp } C(X_1), \text{sp } C(X_2), X_2 > X_1 \); \( \text{lp } P(X_1), \text{sp } P(X_2), X_2 > X_1 \)

ii) Bear Spread: \( \text{sp } C(X_1), \text{lp } C(X_2), X_2 > X_1 \); \( \text{sp } P(X_1), \text{lp } P(X_2), X_2 > X_1 \)
iii) Butterfly Spread: \( lp \ C(X_1), \ sp \ 2C(X_2), \ lp \ C(X_3); \ X_2 = (X_1 + X_3)/2 \)

\( lp \ P(X_1), \ sp \ 2P(X_2), \ lp \ P(X_3); \ X_2 = (X_1 + X_3)/2 \)

C. Combinations: Involves taking a position in both calls and puts on the same stock:

i) Straddle: \( lp \ C(X), \ lp \ P(X) \); ii) Strip: \( lp \ C(X), \ lp \ 2P(X) \); iii) Straps: \( lp \ 2C(X), \ lp \ P(X) \)

iv) Strangle: \( lp \ C(X_2), \ lp \ P(X_1), \ X_2 > X_1 \)
METHODOLOGY

Steps:

1. Write down the profit in a general form

Recall that payoffs for calls and puts

<table>
<thead>
<tr>
<th></th>
<th>Call</th>
<th>Put</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buy</td>
<td>$\max(S_T - X, 0)$</td>
<td>$\max(X - S_T, 0)$</td>
</tr>
<tr>
<td>Sell</td>
<td>$-\max(S_T - X, 0)$</td>
<td>$-\max(X - S_T, 0)$</td>
</tr>
</tbody>
</table>

2. Write down the profit for special case:

If $S_t < X$, then $\max(S_T - X, 0) = 0$ and $\max(X - S_T, 0) = S_T$

If $S_t > X$, then $\max(S_T - X, 0) = S_T$ and $\max(X - S_T, 0) = 0$
3. Draw the graph for the profit. Important points in the graph:

i) Intercept with the vertical axis: $S_T = 0 \rightarrow \Pi = ?$

ii) Intercept(s) with horizontal axis: $\Pi = 0 \rightarrow S_T = ?$

iii) maximum profit; iv) maximum loss

4. Comment on the properties of the profit