



IIT ROORKEE



NPTEL ONLINE
CERTIFICATION COURSE

QUANTITATIVE INVESTMENT MANAGEMENT

LECTURE 40

Option Trading Strategies – 1

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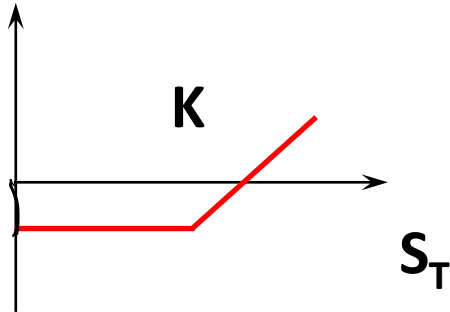
TRADING STRATEGIES WITH OPTIONS



PROFIT DIAGRAM OF LONG CALL

- We ignore time value of money on option premium for simplicity of exposition:
- Profit Diagram:

$\pi(S_T)$



$$\pi_{\text{long call}} = \begin{cases} -c & \text{if } S_T \leq K \\ (S_T - K) - c & \text{if } S_T \geq K \end{cases}$$

$$\pi_{\text{long call}}^{\max} = \infty$$

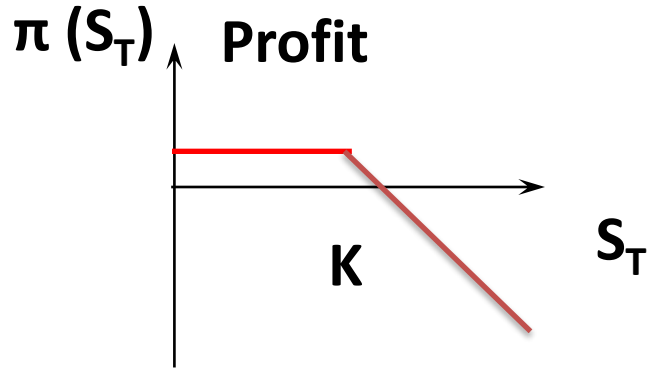
$$\pi_{\text{long call}}^{\min} = -c$$

$$S_T^{\text{bep}} = K + c$$

- Investor Perception???

PROFIT DIAGRAM OF SHORT CALL

- Profit Diagram:
- Mirror Image of Long Call:



$$\pi_{\text{short call}} = \begin{cases} +c & \text{if } S_T \leq K \\ (K - S_T) + c & \text{if } S_T \geq K \end{cases}$$

$$\pi_{\text{short call}}^{\max} = +c$$

$$\pi_{\text{short call}}^{\min} = -\infty$$

$$S_T^{\text{bep}} = K + c$$

- Investor Perception???

RELATION BETWEEN PREMIUM & STRIKE PRICE FOR CALLS & PUTS

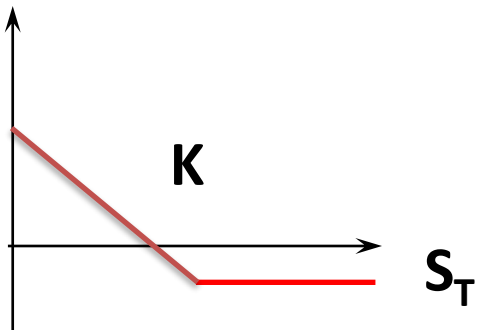
- A call gives the right to the holder to buy the asset at the exercise price.
- Clearly, lower the exercise price, the more valuable is the call and hence, higher its premium.
- Converse is the case with puts, where the premium is directly related to strike price.



PROFIT DIAGRAM OF LONG PUT

- Profit Diagram:

$\pi(S_T)$ Profit



$$\pi_{\text{long put}} = \begin{cases} (K - S_T) - p & \text{if } S_T \leq K \\ -p & \text{if } S_T \geq K \end{cases}$$

$$\pi_{\text{long put}}^{\max} = K - p$$

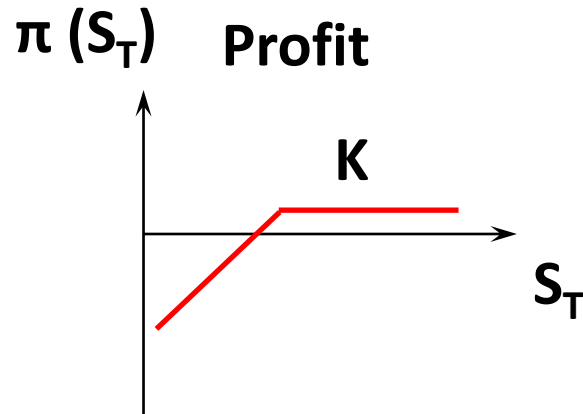
$$\pi_{\text{long put}}^{\min} = -p$$

$$S_T^{\text{bep}} = K - p$$

- Investor Perception???

PROFIT DIAGRAM OF SHORT PUT

- Profit Diagram:



$$\pi_{\text{short put}} = \begin{cases} -(K - S_T) + p & \text{if } S_T \leq K \\ +p & \text{if } S_T \geq K \end{cases}$$

$$\pi_{\text{short put}}^{\max} = p$$

$$\pi_{\text{short put}}^{\min} = -(K - p)$$

$$S_T^{\text{bep}} = K - p$$

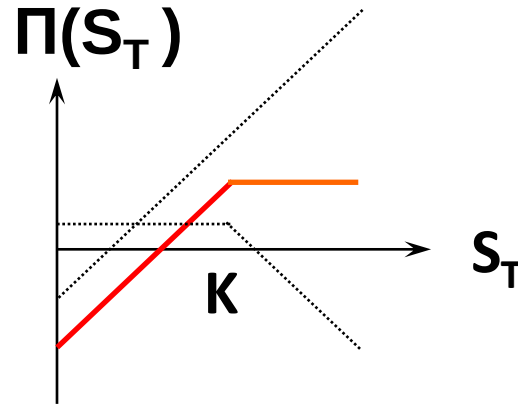
COMPLEX OPTION TRADING STRATEGIES

- The covered call strategy
- The protective put strategy
- Straddles & Strangles
- Strips & Straps
- Spread strategies



COVERED CALL STRATEGY

- BUY THE UNDERLYING ASSET
- WRITE A EUROPEAN CALL ON THE ASSET
- Why called
- Covered Call?



COVERED CALL STRATEGY

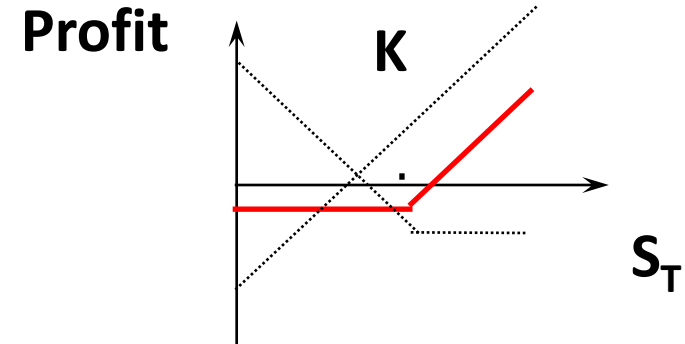
	t=0	t=T	
		$S_T < K$	$S_T > K$
BUY STOCK	$-S_0$	S_T	S_T
WRITE CALL	$+c$	0	$-(S_T - K)$
TOTAL	$c - S_0$	S_T	K
	$c - S_0$	$-(K - S_T) + K$	$0 + K$

Payoff of covered call is parallel to payoff of short put.

$$\begin{aligned}
\pi_{\text{Covered Call}} &= \pi_{\text{Long Stock}} + \pi_{\text{Short Call}} \\
&= \begin{cases} (S_T - S_0) + c & \text{if } S_T < K \\ (S_T - S_0) - (S_T - K) + c & \text{if } S_T \geq K \end{cases} \\
&= \begin{cases} (K - S_0) - (K - S_T) + c & \text{if } S_T < K \\ (K - S_0) + c & \text{if } S_T \geq K \end{cases} \\
&= (c - S_0) + K + \begin{cases} -(K - S_T) & \text{if } S_T < K \\ 0 & \text{if } S_T \geq K \end{cases} \\
&= (c - S_0) + K + \Pi_{\text{Short Put}}
\end{aligned}$$

PROTECTIVE PUT: PROFIT PROFILE

- BUY THE UNDERLYING ASSET
- BUY A EUROPEAN PUT ON THE ASSET
- **Why Protective Put?**

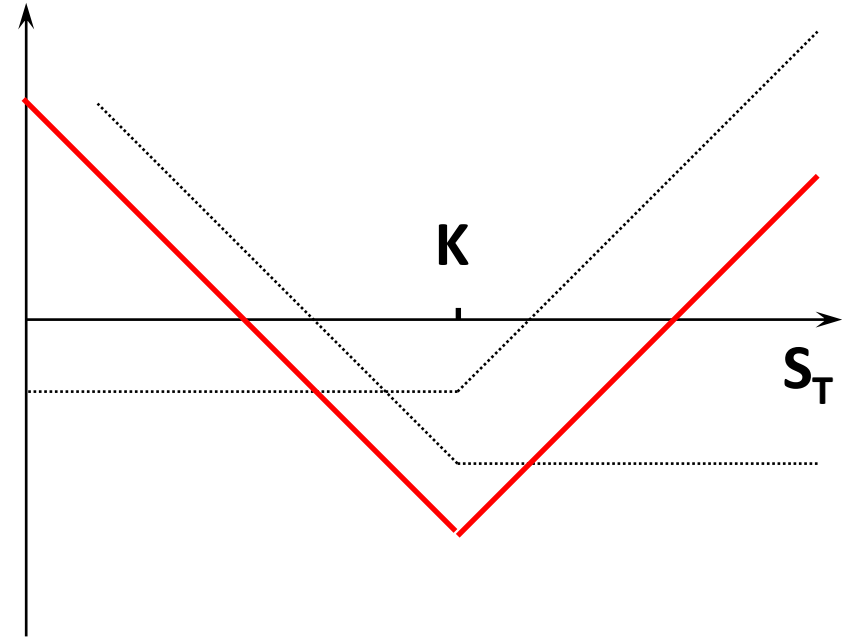


$$\begin{aligned}
\pi_{\text{Protective Put}} &= \pi_{\text{Long Stock}} + \pi_{\text{Long Put}} \\
&= \begin{cases} (S_T - S_0) + (K - S_T) - p & \text{if } S_T < K \\ (S_T - S_0) - p & \text{if } S_T \geq K \end{cases} \\
&= \begin{cases} (K - S_0) - p & \text{if } S_T < K \\ (K - S_0) + (S_T - K) - p & \text{if } S_T \geq K \end{cases} \\
&= -(p + S_0) + K + \begin{cases} 0 & \text{if } S_T < K \\ (S_T - K) & \text{if } S_T \geq K \end{cases} \\
&= -(p + S_0) + K + \Pi_{\text{Long Call}} \quad \text{or} \\
\pi_{\text{Protective Put}} &= -(p + S_0)e^{rT} + K + \Pi_{\text{Long Call}}
\end{aligned}$$

STRADDLE

Profit

- BUY CALL A (K, T, c)
- BUY PUT B (K, T, p)
- BOTH EUROPEAN
- SAME UNDERLYING
- SAME MATURITY
- SAME EXERCISE PRICE



STRADDLE STRATEGY

	$t=0$	$t=T$	
		$S_T < K$	$S_T > K$
LONG CALL	$-c$	0	$S_T - K$
LONG PUT	$-p$	$K - S_T$	0
TOTAL	$-(c+p)$	$K - S_T$	$S_T - K$

$$\pi_{\text{Straddle}} = \pi_{\text{Long Call A}} + \pi_{\text{Long Put B}}$$

$$= \begin{cases} (\mathbf{K} - \mathbf{S}_T) - (\mathbf{p} + \mathbf{c}) & \text{if } \mathbf{S}_T < \mathbf{K} \\ (\mathbf{S}_T - \mathbf{K}) - (\mathbf{p} + \mathbf{c}) & \text{if } \mathbf{K} < \mathbf{S}_T \end{cases}$$

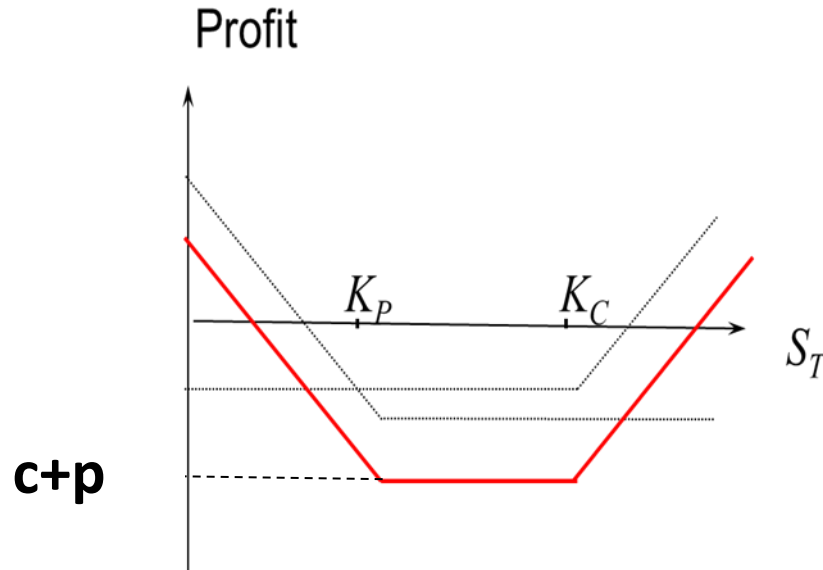
$$\pi_{\text{STRADDLE}}^{\text{MAX}} = \infty; \quad \pi_{\text{STRADDLE}}^{\text{MIN}} = -(\mathbf{p} + \mathbf{c})$$

$$\mathbf{S}_T^{\text{BEP}} = \mathbf{K} - (\mathbf{p} + \mathbf{c}), \quad \mathbf{K} + (\mathbf{p} + \mathbf{c})$$



STRANGLE ($K_C > K_P$)

- BUY CALL A (K_C, T, c)
- BUY PUT B (K_P, T, p)
- SAME TYPE (EUROPEAN)
- SAME UNDERLYING
- SAME MATURITY
- DIFFERENT STRIKE PRICE
- CASE 1: $K_C > K_P$
- CASE 2: $K_C < K_P$



STRANGLE..... ($K_C > K_P$)

- WE CAN DIVIDE THE ENTIRE SPECTRUM OF STOCK PRICE INTO THREE SEGMENTS VIZ.
- $S_T < K_P < K_C$: PUT WILL BE EXERCISED, CALL WILL LAPSE
- $K_P < S_T < K_C$: BOTH WILL LAPSE
- $K_P < K_C < S_T$: CALL WILL BE EXERCISED, PUT WILL LAPSE



STRANGLE STRATEGY ($K_C > K_P$)

	$t=0$	$t=T$		
		$S_T < K_P$	$K_P < S_T < K_C$	$K_C < S_T$
LONG CALL	$-c$	0	0	$S_T - K_C$
LONG PUT	$-p$	$K_P - S_T$	0	0
TOTAL	$-(c+p)$	$K_P - S_T$	0	$S_T - K_C$

$$\pi_{\text{STRANGLE}}^{\text{MAX}} = \infty;$$

$$\pi_{\text{STRANGLE}}^{\text{MIN}} = -(\mathbf{p} + \mathbf{c})$$

$$\mathbf{S}_{\text{T}}^{\text{BEP}} = \mathbf{K}_{\text{P}} - (\mathbf{p} + \mathbf{c}),$$

$$\mathbf{K}_{\text{C}} + (\mathbf{p} + \mathbf{c})$$

STRANGLE..... ($K_C < K_P$)

- WE CAN DIVIDE THE ENTIRE SPECTRUM OF STOCK PRICE INTO THREE SEGMENTS VIZ.
- $S_T < K_C < K_P$: PUT WILL BE EXERCISED, CALL WILL LAPSE
- $K_C < S_T < K_P$: BOTH WILL BE EXERCISED
- $K_C < K_P < S_T$: CALL WILL BE EXERCISED, PUT WILL LAPSE



$$\pi_{\text{Strangle}} = \pi_{\text{Long Call A}} + \pi_{\text{Long Put B}}$$

$$= \begin{cases} (\mathbf{K_P} - \mathbf{S_T}) - (\mathbf{p} + \mathbf{c}) & \text{if } \mathbf{S_T} < \mathbf{K_C} \\ \left[(\mathbf{K_P} - \mathbf{S_T}) + (\mathbf{S_T} - \mathbf{K_C}) - (\mathbf{p} + \mathbf{c}) \right] & \text{if } \mathbf{K_C} < \mathbf{S_T} < \mathbf{K_P} \\ (\mathbf{K_P} - \mathbf{K_C}) - (\mathbf{p} + \mathbf{c}) \\ (\mathbf{S_T} - \mathbf{K_C}) - (\mathbf{p} + \mathbf{c}) & \text{if } \mathbf{K_P} < \mathbf{S_T} \end{cases}$$

$$\pi_{\text{STRANGLE}}^{\text{MAX}} = \infty; \pi_{\text{STRANGLE}}^{\text{MIN}} = (\mathbf{K_P} - \mathbf{K_C}) - (\mathbf{p} + \mathbf{c})$$

$$\mathbf{S_T}^{\text{BEP}} = \mathbf{K_P} - (\mathbf{p} + \mathbf{c}), \mathbf{K_C} + (\mathbf{p} + \mathbf{c})$$



$$\pi_{\text{STRANGLE}}^{\text{MIN}} = (\mathbf{K}_P - \mathbf{K}_C) - (\mathbf{p} + \mathbf{c})$$

From put - call parity ($\mathbf{K}_C < \mathbf{K}_P$)

$$\mathbf{c} + \mathbf{K}_C \mathbf{e}^{-rT} = \mathbf{p}_c + \mathbf{S}_0$$

$$\mathbf{c}_p + \mathbf{K}_P \mathbf{e}^{-rT} = \mathbf{p} + \mathbf{S}_0$$

$$(\mathbf{c} - \mathbf{c}_p) - (\mathbf{K}_P - \mathbf{K}_C) \mathbf{e}^{-rT} = \mathbf{p}_c - \mathbf{p}$$

$$(\mathbf{K}_P - \mathbf{K}_C) \mathbf{e}^{-rT} - (\mathbf{p} + \mathbf{c}) = -(\mathbf{c}_p + \mathbf{p}_c) < \mathbf{0}$$

