Derivatives

MS : Put Call Parity Theorem [PCPT]

$$C_0 + PV\ of\ K = P_0 + S_0$$

- C_0 → Value of Call today
- K → Strike Price
- P_0 → Value of Put today
- S_0 → Share Price today

(I) Lower Boundary of a Call [LBC]

$$C_0 \geq S_0 - PV\ of\ K$$

Eg:

$S_0 = 500$

$K = 470$

$r = 10\%$

$n = 1\ year$

Cal. of LBC

$$C_0 \geq S_0 - PV\ of\ K$$

$$\geq 500 - \frac{470}{(1.1)^1}$$

$$\geq 500 - 427.27$$

$$C_0 \geq 72.73$$

Case 1 : If Actual $C_0 < 72.73$
Let's say $C_0 = 60$

This gives rise to an Arbitrage Opportunity.

∵ C_0 is underpriced, Strategy for Arbitrage:

BUY Call

&

SELL Share

Cal. of Net ₹ Inflow today:

Step 1:	Buy Call	(60)
Step 2:	Sell Share	500
	Net ₹ Inflow	440

Step 3: Invest ₹ 440 today @ 10% for 1 year.

$MV = 440(1.1)^1$
$= 484$

Cal. of CF on DD:

Particulars	$S_1 > K$	$S_1 < K$
	Call : ITM	Call : OTM
	$S_1 = 600$	$S_1 = 300$
Step 4: Realise MP of Investment	484	484
Step 5: Buy share @ S_1	(600)	(300)
Step 6: GP on Call	130 [$S_1 - K$]	0 [–]
Arbitrage Gain	14	184

This Strategy will provide Gain [Min. 14 or Higher], irrespective of S_1; ∴, Arbitrage!

Due to this arbitrage opportunity, Demand for 'Buy Call & Sell Share' strategy will increase. Due to this, demand for Call will increase thereby pushing C_0 above ₹60. Once it touches ₹ 72.73, Arbitrage opp. ceases to exist. This is why, C_0 cant hang around below 72.73. ∴, ₹72.73 is LBC.

<u>Case 2</u> : If Actual $C_0 > 72.73$
Let's say $C_0 = 90$

This gives rise to an 'Arbitrage Opportunity'.

∵ C_0 is over priced, Strategy for Arbitrage:

SELL Call

&

BUY Share

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Cal. of Net ₹ Outflow today :

Step 1 :	Sell Call	90
Step 2 :	Buy Share	(500)
	Net ₹ Outflow	(410)

Step 3 : Borrow ₹ 410 today @ 10% for 1 year.

$MV = 410 (1.1)^1$
$= 451$

Cal. of CF on DD :

Particulars	$S_1 > K$ Call : ITM $S_1 = 600$	$S_1 < K$ Call : OTM $S_1 = 300$
Step 4 : Pay MV of Borrowing	(451)	(451)
Step 5 : Sell shares S_1	600	300
Step 6 : GP on Call	(130) $[K - S_1]$	0 [–]
~~Arbitrage~~ Gain	19	(151)

∴, this strategy gives Gain only if $S_1 > K$.
∴, Such Strategy Can't be Called as Arbitrage.

Alternate understanding

Consider foll. 2 Portfolios :

P(A) = 1 Call + Cash Equivalent to PV of K

P(B) = 1 share

Cal. of V(P) on DD :

Particulars	$S_1 > K$ [Call : ITM]	$S_1 < K$ [Call : OTM]
P(A)	$[S_1 - K] + K$ $= S_1$	$0 + K$ $= K$
P(B)	S_1	S_1

If $S_1 > K$, P(A) = P(B)

If $S_1 < K$, P(A) > P(B)

∴, Irrespective of S_1,

$$P(A) \geq P(B)$$

$$C_0 + PV\ of\ K \geq S_0$$

$$\therefore C_0 \geq S_0 - PV\ of\ K$$

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Q.427 (i) Cal. of Th. Min. Price of a Call [LBC]

$C_0 \geq S_0 - PV\ of\ K$

$\geq 200 - \frac{180}{(1.1)^1}$

$\geq 200 - 163.64$

$C_0 \geq 36.36$

(ii) If $C_0 = 30$

$\because$ C_0 is underpriced, Strategy for Arbitrage:

Buy Call
&
Sell Share

Cal. of Net ₹ Inflow today:

Step1:	Buy Call	(30)
Step2:	Sell Share	200
	Net ₹ Inflow	170

Step3: Invest ₹ 170 today @ 10% for 1 year.

MV = 170 (1.1)^1

= 187

Cal. of CF on DD:

Particulars	$S_1 > K$ Call: ITM	$S_1 < K$ Call: OTM
let's say	$S_1 = 250$	$S_1 = 150$
Step4: Realise MP of Invt	187	187
Step5: Buy Share @ S_1	(250)	(150)
Step6: GP on Call	70 i.e. 250 − 180	0
Arbitrage Gain	7	37

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