

DERIVATIVES

Financial instrument which deliver its value from some other underlying asset.

(a) Financial derivatives: forwards, futures, options, swaps (b) commodity derivative

OPTIONS - contract giving right to buy or sell (VA) - at specific price & date.

Call: RIGHT to buy **PUT:** RIGHT TO SELL

Holder: right holder (holder) **Writer:** obligation holder (writer)

BUY = LONG **SELL = SHORT**

BULL = ↑ MP (call is exercised) **BEAR = ↓ MP** (put is exercised)

	Holder	Writer
CALL	Right to BUY	Obl to SELL
PUT	Right to SELL	Obl to BUY

OPTION STRATEGIES

Simple strategy

- 1) long call - holder: RTB.
- 2) long Put - holder: RTS
- 3) Short call - writer: OTS
- 4) Short Put - writer: OTB.

Complex strategy

- 1) straddle & strangle HH (CIC - IP)
- 2) skip & strap HH (CIP)
- 3) Spreads - horizontal, vertical (Bull & Bear), diagonal
- 4) Butterfly spread H+W of call or put.
- 5) Covered call
- 6) Protective Put.

Simple strategies

Buy March 500 call @ 50
- holder E period premium
- long call [premium - expense (holder)]
- short - premium income - income (writer)
draw table and then graph.

Table format

MP	EP = (Benefit)	Premium	Net
↑			
0			
↓			

for opn: exercised or lapse
see from holder's point of view

Pay off matrix

find equilibrium point (net = 0) + comment

limited/unlimited P/L

Call holder	In the money profit	out of m loss	at the money equilib
Call	$MP > EP$	$MP < EP$	$MP = EP$
Put	$MP < EP$	$MP > EP$	$MP = EP$

Straddle & Strangle

Straddle (1:1) CIP **Strangle** diff EP

same EP period same 2 opn

long strad
H of IC
H of IP] same EP

Short
WIC
WIP] same

mbts ↑ volatile
(50% Pi ↑ ↓)

long strangle
HIC
HIP] diff EP

Short
WIC
WIP] diff

Pi MP ↑ or ↓ equal

either holder or writer x both (C+P)

STRIP & STRAP [2:1] [C:P]

same EP and same period

STRIP

2P + 1C

long
H 2P + H 1C

STRAP [call]

2C + 1P

H 2C + H 1P

either holder or writer

Pi MP ↓ is high
∴ 2P

MP ↑ is high
∴ 2C

Butterfly spread (2:2) (1H1W) only call or only put

long: Buy @ 2 diff price (high & low)
2 CH @ high & low
2 CW @ middle

short: sell @ 2 diff
2 CH @ middle
2 CW @ high & low

★ 2 calls or puts

MP	1C	1P	2P	Premium
	10x2	10x2	x2	x2

as net 2 will be common

SPREADS (only call or only put) CH+W)

Vertical: diff E-price
Horizontal: diff ex-period
diagonal: both diff

Bull vertical
Bull call
Bull Put

$E \cdot P(\text{op}^n \text{ w}) > EP(\text{held})$
as mbs ↑

Bear vertical
Bear call
Bear Put (covered put)

$EP(\text{held}) > EP(\text{written})$
mbs ↓

THEORETICAL VALUE

min premium to be charged from ~~writer~~ holder & writer

Call: $CMP - PV(EP)$

Put: $PV(EP) - CMP$

$[P_{\text{put}} - PV(\text{CF})] [C_{\text{call}} - CMP \text{ 1st}]$

continuous: loge: eg: 200Rs 5% for 6 mths.

discounting (PV)

compounding (FV)

$$200 \times \frac{1}{e^{rt}} = \frac{200}{1.025} = 195$$

$$200 \times e^{rt} = 200 \times 1.025 = 205$$

r = rate of int (CF) in %

t = time in years

$$e^{rt} = e^{0.05 \times 6/12} = e^{0.025}$$

use log & antilog.

$$\log e^{0.025} = 0.025 \log e$$

$$= 0.025 \times 0.4343 = 0.0109$$

$$\log e = 0.4343$$

$$\text{now Antilog}(0.0109) = 1.025$$

A-put = ASAP.
A-call = always on EP

American opⁿ: any day (can be before expⁿ) (payable)

European opⁿ: only on expⁿ period (ASAP)

Valuation: factors & their relationship

Factors

Call (holder's pov) Put

1) CMP

direct

inv

2) EP

inv

direct

3) IR

direct

indirect

4) Time

direct

inv

5) volatility of asset price

direct

direct

6) div/inc from asset

inv

direct

others all

fundamental princ:

Pay as late

receive as soon

Call: delivery settlement

Covered call writer

call w buys asset b4

MP ↑ call exercise

sell asset already had

MP ↓

lapse - call
sell asset in mkt

naked/uncovered call w

writes call X asset

Buy from mkt and give

X premium inc

Protective Put/Covered Put: hold put option

at EP ↑ than cost (both opⁿ profit)

MP ↑ (put lapse - sell asset mkt) MP ↓ sell to w of P at THP

Arbitraging: price ≠ theoretical value

only possible when underpriced

Call: actual price < T.P

Buy cheap sell exp [opp mkt] [asset & opⁿ]

Buy call opⁿ

Short sell asset

(pay now delivery later)

0 CIF of sale X

COF premium on call X

Net CIF X

FV of CIF after/on EP = X

on EP

MP ↑

call - exercise
buy asset from L/O
and deliver to
short buyer

COF (EP)

COF PV of net CIF (X)

profit

MP =

same as MP ↑

MP ↓

call lapse
buy from mkt (shorter EP)
deliver

COF (MP)

COF X

profit

Profit in all 3 opⁿ same (win-win)

For Put opⁿ $AP < TP$

Buy put option & Buy asset
holder (right to sell)

0 year: COF (asset buy + premium) = find FV on EP

MP ↑

opⁿ lapse
sell in mkt

MP ≠

same as MP ↓

MP ↓

exercise put
CIF = EP
COF (FV)
XX

same profit in all 3 cases

Risk neutralization
Risk neutral

Binomial
model

Black Scholes
model

(i) RISK NEUTRAL MODEL

Value = PV of Future benefits of opⁿ passed to holder.

assume: Inv even R_f

benefits = probable future find P_i

$$= \sum (\text{future benefit} \times P_i)$$

MP(EP)	EP	Benefit	P_i	$MP \times P_i$
a	c	a-c	x	ax
b	c	b-c	1-x	

Pi of mp

EMP

$$\begin{aligned} EMP &= CMP + R_f \\ &= CMP \times e^{rt} \end{aligned}$$

find P_i (x and 1-x)

To find PV of FB

FB	P_i	$FB \times P_i$
a-c	x	1×2
b-c	1-x	

$$\sum (A)$$

$$\text{find PV(A)} = A \times \frac{1}{e^{rt}}$$

$$\therefore \text{Value} = \frac{A}{e^{rt}}$$

if more than 1 year

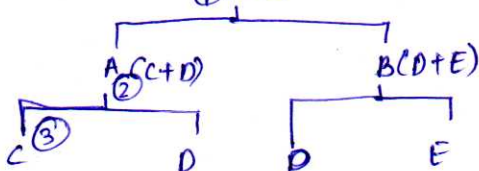
(P_i in all years = same)

use joint P_i method.

case	like	Benefit- P_i	$V_b \times P_i$
		$1 \times 2 \times 3$	$\downarrow$ PV

step wise neutral model.

① A+B



(ii) BINOMIAL MODEL

$$V_c = \underbrace{COF}_{\text{(Buy shares)}} - \underbrace{PV \text{ of } CIF}_{\text{(riskless hedge)}}$$

- covered call strategy.
- buys shares as per delta and writes a call on same shares.

$$V_p = \underbrace{PV \text{ of } CIF}_{\text{(hedge)}} - \underbrace{COF}_{\text{(hedge) Buy shares}}$$

- protective put.
- Buy shares and hold put option.

Hedge ratio of option

Delta

no. of shares for riskless hedge.

$$\text{delta} = \frac{\Delta \text{ opt}^n \text{ value}}{\Delta \text{ price of UA}}$$

(sensitivity of value to Δ price of UA)

Value = benefit.

alternate presentation of hedge.

int (loan taken) + fund by premium income.

$$II \text{ of shares} = \text{delta} \times \text{CMP}$$

loan

premium

Such loan that

$$P + I = \frac{P \times 1}{e^{rt}} \quad \text{ED} = \text{Net CIF of hedge.}$$

$$\text{premium} = VC / VP$$

Put Call Parity

$$V_c + PV(EP) = V_p + CMP$$

(call)

$$V_{CEP} = V_{pmp}$$

(iii) Black Scholes model

$$V_c = \text{CMP} \frac{N(d_1)}{P_i} - PV(EP) \frac{N(d_2)}{N(d_2)}$$

$$V_p = PV(EP) \frac{N(-d_2)}{N(-d_2)} - \text{CMP} \frac{N(-d_1)}{N(-d_1)}$$

$$d_1 = \frac{N \cdot \log \left[\frac{\text{CMP}}{EP} \right] + \left[\text{int} + 0.5 \right] \frac{(\sigma)^2}{2}}{\sigma \sqrt{t}}$$

$$\sigma \sqrt{t}$$

t = time in years

σ = volatility

$$d_2 = d_1 - \sigma \sqrt{t}$$

$$\begin{aligned} N \left[\log \frac{\text{CMP}}{EP} \right] &= \log \text{CMP} - \log EP \\ &= x \times \frac{1}{\log e} \end{aligned}$$

(base move log)

find P_i using $N(d)$ table.

when $d_1 = -ve$

$$P_i = 1 - (d_1 + P_i)$$

for put

$$N(-d_1) = d_1 \text{ if } d_1 -ve$$

$$N(d_1) =$$

Dividend paying stocks

$$\text{CMP} = (\text{replaced by}) \text{ Adj mp}$$

$$\text{Adj mp} = \text{CMP} - \frac{PV \text{ of div}}{e^{rt}}$$

(in main form + d) (d x $\frac{1}{e^{rt}}$)

Time for div can be diff from E.P (be careful)

$$\sigma = \frac{\text{high price} - \text{low price}}{\text{avg price}}$$

ARBITRAGING: Put call parity

$$V_C + PV(CEP) = V_P + CMP$$

(i) $V_C + PV(CEP) > V_P + CMP$
 Sell. Buy
 writer of call holder of put
 [Obl to sell] [right to sell]

∴ Buy asset.

(ii) $V_C + PV(CEP) < V_P + CMP$
 Buy Sell
 H-C W-P
 right to buy Obl to buy
 ∴ short sell asset.

exercise again & again in spec'd interval premium = % of principal

Cap:
 (max pay by borrower)
 max int. is decided.
 if actual int = cap rate
 ↑ = cap exercise
 diff int rec'd from writer by borrower
 ↓ = cap lapse.

Floor:
 min accept by bank.
 min bank must receive
 actual
 ↑ = floor lapse
 ↓ = floor exercise.
 Bank = receive mkt int from party + diff of int from writer.

cash pay off (writer → holder) = diff x principal x time

Forward/Future contracts

given

Formula (FV)

- (i) R. $CMP \times e^{rt}$
 (ii) IR & CC in % carrying cost $CMP \times e^{(r+c)t}$
 (iii) IR + CC + div yield % $CMP \times e^{(r+c-y)t}$
 (iv) IR + CCes $Adj CMP \times e^{rt}$
 $\downarrow$
 $CMP + PV \text{ of CC}$
 (v) $IR + \frac{CC + div}{R_s}$ $Adj CMP \times e^{rt}$
 $\downarrow$
 $CMP + PV \text{ of CC} - PV \text{ of div}$

* be careful for 't' of dividend.

Arbitraging

FV = should be price.

Opn

(fair value)

FV < actual

B.

FV > actual

future: overprice

underprice

Buy

A

future

Sell

short sell future

B.

Cash & carry

Reverse Cash & carry

profit = SP - PV of CP