Suggested Solution

Test-05

Mission 80+ for N/D24

Case Scenario-I		
(i)	(b)	₹38.78
(ii)	(a)	Overpriced (put option)
(iii)	(a)	Yes, by writing put option
(iv)	(b)	₹7.13

Hint:

(i) Using PCP,

C_0 (*Fair*) = (Spot price – PV of strike) + Put option (*Actual*)

$= \left(200 - \frac{180}{e^{0.1 \times 6/12}}\right) + 10 = \left(200 - \frac{100}{e^{.05}}\right) + 10$

$= \left(200 - \frac{180}{1.0513}\right) + 10 = 200 - 171.22 + 10$

= 38.78 (Fair Call Premium)

- As actual premium (i.e., 32) is lesser than fair premium (i.e., 38.40), we can say there is mispricing in call option (undervalued).

(ii) In this situation Put Option must be overvalued.

(iii) **Advantage from above mispricing (i.e., Arbitrage gain):**

Action:

(a) Buy Call Option @₹ 32 premium.

(b) Write Put Option @ ₹ 10 premium.

(c) Sale share of X Ltd. @ ₹200

Calculation of arbitrage:

As on today:

(a) Net inflow = (200 + 10) – 32 = 178

(b) Deposit ₹ 178 @ 10% for 6m

On Expiry:

(c) Withdraw Deposit:

Amount $= 178 \times e^{0.1 \times 6/12}$

$= 178 \times 1.0513 = 187.13$

(d) Buy share. Outflow should be Strike Price (i.e., 180)

(e) Arbitrage = 187.13 – 180 = 7.13

Case Scenario-II		
(i)	(c)	Hedge using forward contract
(ii)	(c)/(iii)	76.865

Hint:

- Inflow if unhedged = ₹1,000,000 × 76 = **₹76,000,000**
- Inflow under forward contract = ₹1000,000 × 77 = **₹77,000,000**
- **Net inflow under option contract:**

Payoff = 80-76 = 4

(-) FV of premium = 3.135

3× [1+ 0.18×90/360]

Net payoff per $ = 0.865

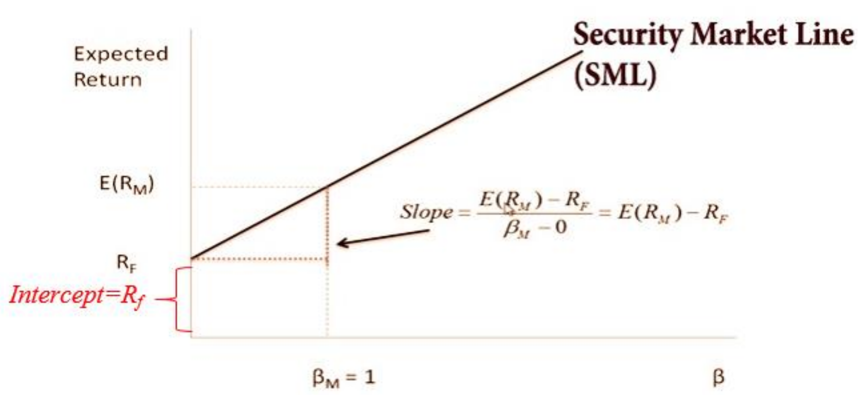
Total net payoff = 1,000,000 × 0.865 = ₹865, 000

Total Net Inflow = 76,000,000 + 86,500 = **₹76,865,000**

Inflow is maximum under Forward contract ₹77,000,000.

(b) break-even Spot Rate (Put) = strike price - FV of Premium

= 80 – 3.135 = 76.865

MCQ-3	
(a)	Intercept = Risk-free return; Slope = Risk premium
Hint:	
	The **Security Market Line (SML)** is a graphical representation of the capital asset pricing model (CAPM), which says; Expected Return = Risk Free Rate + Beta × (Risk Premium) Where, Risk premium = Market Return – Risk Free Rate

In SML, X-axis represents **beta** & Y-axis represents **expected return**.

Intercept:

Intercept is the point on Y-axis where x becomes zero;

when x (i.e. Beta) = 0,

then y (i.e., expected return) = Risk free Rate + 0 × Risk Premium

= Risk free Rate.

Hence, Intercept is risk free rate.

Slope:

Slope = $\frac{Rise}{Run} = \frac{\Delta y}{\Delta x}$

Slope = $\frac{(\text{value of y when x is 1}) - (\text{value of y when x is 0})}{1-0}$

We know,

when value of x (i.e., Beta) = 1, then expected return = market return

& when value of x (i.e., Beta) = 0, then expected return = Risk free rate

Hence, Slope = $\frac{Market\ Return - Risk\ free\ rate}{1-0}$

= market return – risk free rate

= Risk Premium

MCQ-4	
(c)	Risk free rate
Hint:	β = r σ_y/σ_m where r is correlation coefficient, σy is standard deviation of security and σ_m is the standard deviation of market. Hence beta is independent of risk-free rate.

MCQ-5	
(c)	Theta
Hint:	"theta" refers to the rate of decline in the value of an option due to the passage of time. It can also be referred to as the time decay of an option.

Part II (Descriptive Questions)

Question-1 Solution:

(i) SP = ₹ 1340

Strike = 1,300

R_f = 8% = 0.08

σ = 60%

T = 3/12 Year

Calculation of fair Call premium:

(a) d_1

$$= \frac{\text{Ln}\left(\frac{SP}{K}\right) + \left(R_f + \frac{\sigma^2}{2}\right) \times T}{\sigma \times \sqrt{T}}$$

$$= \frac{\text{Ln}\left(\frac{1340}{1300}\right) + \left(0.08 + \frac{(0.60)^2}{2}\right) \times 3/12}{0.60 \times \sqrt{3/12}}$$

$$= \frac{\text{Ln}\,(1.0308) + 0.065}{0.3}$$

$$= \frac{0.0303 + 0.065}{0.3} = 0.3177$$

In case value of Ln not given, calculate using calculator by following method:

Where,

Ln (1.0308) = ?

[ON] [2.71828] √ √ ------- 12 times

[-] [1] [M+]

[1.0308] √ √ ------- 12 times

[-] [1] [=] [÷] [MRC] [=] → 1.03033

(b) $d_2 = d_1 - \sigma \times \sqrt{T}$

$= 0.3177 - 0.6 \times \sqrt{3/12} = 0.0177$

(c) N (d1) = N (0.3177) = 0.6246,

(d) N (d2) = N (0.0177) = 0.5071

(e) Call Premium $= [SP \times N(d_1)] - [PV \text{ of Strike} \times N(d_2)]$

where,

PV of strike $= \frac{1300}{e^{rt}} = \frac{1300}{e^{.08 \times \frac{3}{12}}} = \frac{1300}{e^{0.02}}$

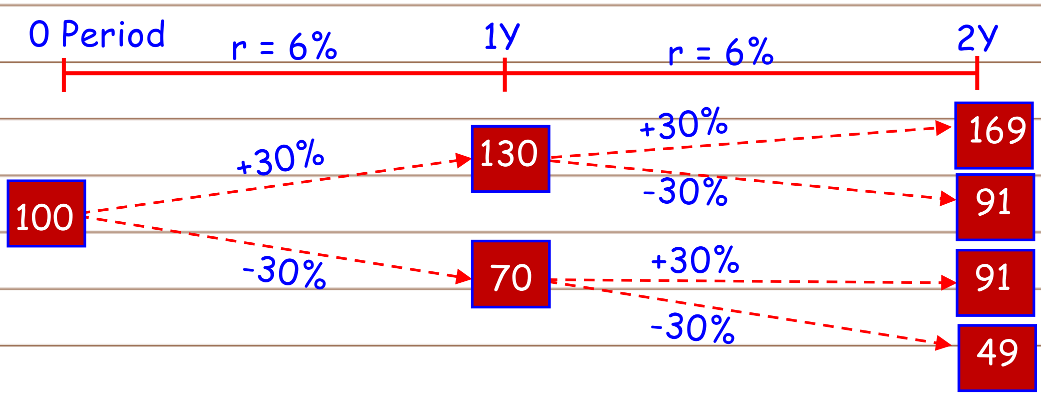
$= 1300 \times e^{-0.02} = 1{,}274.26$

= (1340 × 0.6246) – (1,274.26 × 0.5071)

= 836.96 – 646.18 = ₹190.78

Question –2 Solution:

(i) Two period Binomial tree for share price:



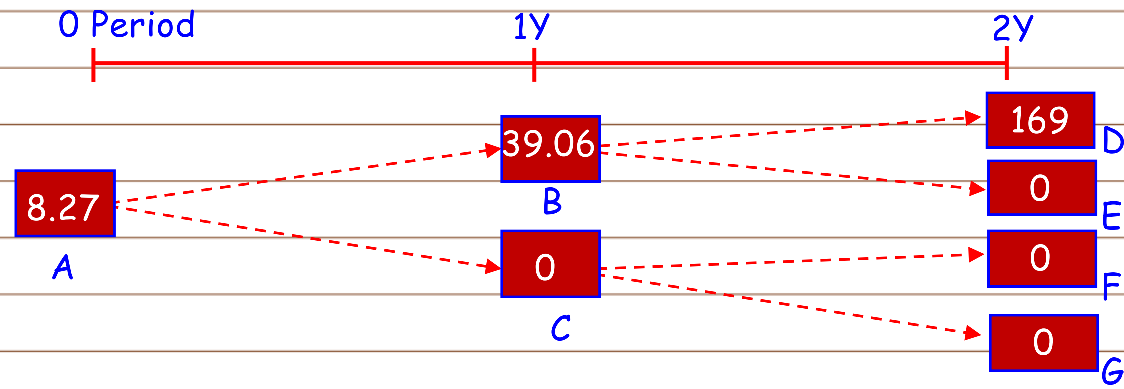
(ii) Probability of attaining HP (130,169,91):

$= \frac{R-d}{U-d} = \frac{(1+.06)-0.70}{1.30-.70} = 0.60$

Where, U = 1 + .30 = 1.30
d = 1 - .30 = 0.70

Probability of price moving down: = (1 - .60) = 0.40

(iii) Binomial tree for option value & payoff:



Payoff at 2 year end if option exercise at 2y end:

MP	Strike	Action	Payoff	Probability	Average
169	100	Exercise	69	0.60	41.40
91	100	Lapse	0	0.40	0
				TOTAL	41.40
91	100	Lapse	0	0.60	0
49	100	Lapse	0	0.40	0
				Total	0

Option value at node – B:

Higher of following two:

(i) Payoff at 1 Y when share price moves up to 120 and exercise option at same date: 120 – 100 = 20

(ii) Discounted value of expected Pay off at node D & E of option exercise at 2Year end = $\frac{41.40}{(1+.06)}$ = 39.06

Hence, option value = 39.06

Option value at node – C:

Higher of following two:

(i) Payoff at 1 Y if price of share moves down to 70.
Payoff = 0 (i.e., option lapse)

(ii) Discounted value = 0

Hence, option value = 0

Option value at node - A = $\frac{\text{Average of B \& C}}{(1+i)^n}$

$= \frac{(39.06 \times .60)+(0 \times .40)}{1+.06}$

= 22.11

QUESTION -3 Solution:

Amount payable = can $ 500,000 [After 1 m]

SR: Can$ 1 = $ 0.9284/0.9288

(i) Forward contract:

Can $ 1 = $0.9301

Can $ 500,000 = $(0.9301 × 50,000 0)

= $ 465,050

Hence, outflow under forward contract

= $465,050

(ii) option contract:

Strike = $0.94

Call premium = 1.02 cent [i.e. $ 0.0102]

Lot size = can $ 50,000

Requirement: Buy can $ 500,000

No of lot = $\frac{500,000}{50,000}$ = 10 contract.

premium to be paid = [$0.0102 x 50,000] x 10

= $ 5100

As interest rate is not given, ignore time value.

On expiry:
Assume price of can $ is higher than Strike price. Hence, option is beneficial to exercise.
It means, applicable rate to buy can$ is Strike price ($0.94).

Outflow to buy 10 contract of can$ (i.e 500,000).
= $(0.94 x 500,000)
= $ 470,000
Uncovered portion = NIL.

Hence, outflow under option contract
= $5100 + $470,000
= $ 475100

Advice: outflow under forward contract is lesser than option contract. Hence, it is beneficial to opt forward contract

QUESTION -4 Solution:

MF-A:

Expected Return (ER) = $\frac{10+8+12}{3} = 10\%$

S.D. = $\sqrt{\frac{(10-10)2+(8-10)2+(12-10)2}{3}}$

= 1.633%

MF-B:

ER = $\frac{5+10+8}{3} = 7.667\%$

S.D. = $\sqrt{\frac{(5-7.667)2+(10-7.667)2+(8-7.667)2}{3}}$

= 2.055

MF-C:

ER = $\frac{14+10+18}{3} = 14\%$

$$S.D. = \sqrt{\frac{(14-14)2+(10-14)2+(18-14)2}{3}}$$

$$= 3.266\ \%$$

Calculation of Beta

$$Beta(\beta) = \frac{S.D.of\ M.F.}{S.D.of\ Market} \times r_{(MF\ \&\ Market)}$$

$$MF\text{-}A = \frac{1.633}{\sqrt{9}} \times 0.45 = 0.245$$

$$MF\text{-}B = \frac{2.055}{3} \times 0.25 = 0.171$$

$$MF\text{-}C = \frac{3.266}{3} \times 0.65 = 0.708$$

Sharpe Ratio $= \frac{R_{MF}-R_F}{\sigma_{MF}}$

			Rank
MF-A	$\frac{10-7}{1.633}$	1.837	II
MF-B	$\frac{7.667-7}{2.055}$	0.325	III
MF-C	$\frac{14-7}{3.266}$	2.143	I

Treynor's Ratio $= \frac{R_{MF}-R_F}{\beta_{MF}}$

			Rank
MF-A	$\frac{10-7}{0.245}$	12.245	I
MF-B	$\frac{7.667-7}{0.171}$	3.900	III
MF-C	$\frac{14-7}{0.708}$	9.997	II