

9

DERIVATIVE ANALYSIS AND VALUATION

Question 1

The equity share of VCC Ltd. is quoted at ₹ 210. A 3-month call option is available at a premium of ₹ 6 per share and a 3-month put option is available at a premium of ₹ 5 per share. Calculate the net payoffs to the option holder of a call option and a put option.

- the strike price in both cases is ₹ 220; and
- the share price on the exercise day is ₹ 200, 210, 220, 230, 240.

Also recommend the price range at which the call and the put options may be gainfully exercised.

(MTP 7 Marks Oct '19, Old & New SM)

(Same concept different figures PYP 8 Marks Nov'18)

Answer:

Net payoff for the holder of the call option

	(₹)				
Share price on exercise day	200	210	220	230	240
Option exercise	No	No	No	Yes	Yes
Outflow (Strike price)	Nil	Nil	Nil	220	220
Out flow (Premium)	6	6	6	6	6
Total Outflow	6	6	6	226	226
Less inflow (Sales proceeds)	-	-	-	230	240
Net payoff	-6	-6	-6	4	14

Net payoff for the holder of the put option

	(₹)				
Share price on exercise day	200	210	220	230	240
Option exercise	Yes	Yes	No	No	No
Inflow (strike price)	220	220	Nil	Nil	Nil
Less outflow (purchase price)	200	210	-	-	-
Less outflow (premium)	5	5	5	5	5
Net Payoff	15	5	-5	-5	-5

The call option can be exercised gainfully for any price above ₹ 226 (₹ 220 + ₹ 6) and put option for any price below ₹ 215 (₹ 220 - ₹ 5)

Question 2

A company is long on 10 MT of copper @ ₹ 534 per kg (spot) and intends to remain so for the ensuing quarter. The variance of change in its spot and future prices are 16% and 36% respectively, having correlation coefficient of 0.75. The contract size of one contract is 1,000 kgs.

Required:

- Calculate the Optimal Hedge Ratio for perfect hedging in Future Market.
- Advice the position to be taken in Future Market for perfect hedging.
- Determine the number and the amount of the copper futures to achieve a perfect hedge.

(MTP 6 Marks Oct 20, RTP Nov '21)

Answer:

The optional hedge ratio to minimize the variance of Hedger's position is given by:

$$H = \rho \frac{\sigma_S}{\sigma_F}$$

σ_S = Standard deviation of ΔS (change in Spot Prices) σ_F = Standard deviation of ΔF (Change in Future Prices) ρ = coefficient of correlation between ΔS and ΔF

H = Hedge Ratio

ΔS = change in Spot price

ΔF = change in Future price

Accordingly

Standard deviation of $\Delta S = \sqrt{16\%} = 4\%$ and

Standard deviation of $\Delta F = \sqrt{36\%} = 6\%$ and

$$H = 0.75 \times \frac{0.04}{0.06} = 0.5$$

- Since the company is long position in Spot (Cash) Market it shall take Short Position in Future Market.

- Since contract size of one contract is 1,000 Kg, the

$$\begin{aligned} \text{No. of Contract to be short} &= \frac{10,000 \text{ Kgs}}{1,000 \text{ Kgs}} \times 0.50 \\ &= 5 \text{ Contracts} \end{aligned}$$

$$\begin{aligned} \text{Amount} &= 5000 \times ₹ 534 \\ &= ₹ 26,70,000 \end{aligned}$$

Question 3

Mr. Dayal is interested in purchasing equity shares of ABC Ltd. which are currently selling at ₹ 600 each. He expects that price of share may go upto ₹ 780 or may go down to ₹ 480 in three months. The chances of occurring such variations are 60% and 40% respectively. A call option on the shares of ABC Ltd. can be exercised at the end of three months with a strike price of ₹ 630.

- (i) Advise what combination of share and option should Mr. Dayal select if he wants a perfect hedge?
- (ii) Evaluate the value of option today (the risk free rate is 10% p.a.)?
- (ii) Interpret the expected rate of return on the option?

(MTP 8 Marks Apr' 21, Mar'18, Oct' 22, RTP Nov'22) (Old & New SM)

Answer:

- (i) To compute perfect hedge we shall compute Hedge Ratio (Δ) as follows:

$$= \Delta = \frac{C_1 - C_2}{S_1 - S_2} = \frac{150 - 0}{780 - 480} = \frac{150}{300} = 0.5$$

Mr. Dayal should purchase 0.50 share for every 1 call option.

- (ii) Value of Option today

If price of share comes out to be ₹ 780 then value of purchased share will be:

Sales Proceeds of Investment ($0.50 \times ₹ 780$)	₹ 390
Loss on account of Short Position ($₹ 780 - ₹ 630$)	₹ 150
	<u>₹ 240</u>

If price of share comes out to be ₹ 480 then value of purchased share will be:

Sales Proceeds of Investment ($0.50 \times ₹ 480$)	₹ 240
--	-------

Accordingly, Premium say P shall be computed as follows:

$$(₹ 300 - P) 1.025 = ₹ 240$$

$$P = ₹ 65.85$$

Expected Return on the Option

- (iii) Expected Option Value = $(₹ 780 - ₹ 630) \times 0.60 + ₹ 0 \times 0.40$
= ₹ 90

$$\text{Expected Rate of Return} = \frac{90 - 65.85}{65.85} \times 100 = 36.67\%$$

Question 4

Ram holding shares of Reliance Industries Ltd, which is currently selling at ₹ 1000. He is expecting that this price will further fall due to lower than expected level of profits to be announced after one month. As on following option contract are available in Reliance Share.

Strike Price	Option	Premium (₹)
1030	Call	40
1010	Call	35
1000	Call	30
990	Put	35
970	Put	20
950	Put	8
930	Put	5

Ram is interested in selling his stock holding as he cannot afford to lose more than 5% of its value. Recommend a hedging strategy with option and show how his position will be protected.

(MTP 6 Marks Nov'21 & Apr' 23, RTP Nov'18)

Answer:

Instead of selling the stock of Reliance Ltd., Ram must cover his Risk buying or long position in Put Option with appropriate strike price. Since Ram's risk appetite is 5%, the most suitable strike price in

Put Option shall be ₹ 950 ($₹ 1000 - 5\% \text{ of } ₹ 1000$).

If Ram does so, assuming that the spot price after 1 month is ₹ 942* then overall position will be as follows:

Spot Price after 1 month	Stock Value	Put Payoff	Initial Cash Flow	Total
$S < 950$	S	$950 - S$	-8	$942 - S$
$S > 950$	S	-	-8	$S - 8$

Thus, from the above, it can be seen that the value of holding of Ram shall never be less than ₹ 942 as Put Option will compensate for loss below spot price of ₹ 950. However, this strategy will involve a cost of ₹ 8.

*Students can assume any price other than ₹ 942 and could answer accordingly.

Question 5

Mr. A established the following strategy on the stock of D Ltd. which is currently trading at ₹ 1000 per share:

- (1) Purchased one 3-month call option with a premium of ₹ 60 at an exercise price of ₹ 1100 per share.
- (2) Purchased one 3-month put option with a premium of ₹ 10 at an exercise price of ₹ 900 per share.

Appraise the position of Mr. A if after 3-months the price of D Ltd. stock:

- (i) remains at ₹ 1000,
 - (ii) falls at ₹ 700.
 - (iii) rises to ₹ 1300.
- (i) Assume the option size is 100 shares of D Ltd.

(MTP 4 marks March '24)

(MTP 6 Marks, April'22, MTP 8 Marks Oct'18, PYP 8 Marks May '19)

Answer:

Total premium paid on purchasing a Call and Put option

$$= (\text{₹ } 60 \text{ per share} \times 100) + (\text{₹ } 10 \text{ per share} \times 100).$$

$$= \text{₹ } 6,000 + \text{₹ } 1000$$

$$= \text{₹ } 7,000$$

- (i) In this case, Mr. A exercises neither the Call option nor the Put option as both will result in a loss for him.

$$\text{Accordingly, the Ending value} = \text{₹ } 7,000 + \text{zero gain}$$

$$= -\text{₹ } 7,000$$

$$\text{i.e Net loss} = \text{₹ } 7000$$

- (ii) Since the price of the stock is below the exercise price of the Call, the Call will not be exercised. Only Put is valuable and hence is exercised. Accordingly,

$$\text{Total Premium paid} = \text{₹ } 7,000$$

$$\text{Ending value} = -\text{₹ } 7000 + \text{₹ } [(900 - 700) \times 100]$$

$$= \text{₹ } 7000 + \text{₹ } 20,000$$

$$= \text{₹ } 13,000$$

$$\text{Net gain} = \text{₹ } 13,000$$

(iii) Since the price of stock rises above the exercise price of Put, the Put will not be exercised. Only Call is valuable and hence is exercised. Accordingly,

Total Premium paid = ₹ 7,000

Ending value = ₹ -7000 + ₹ [(1300-1100) × 100]

= -₹ 7000 + ₹ 20000

Net gain = ₹ 13,000

EXAMINERS' COMMENTS ON THE PERFORMANCE OF EXAMINEES:

Overall performance of the examinees was very good as it was well attempted by most of the examinees. Though some examinees calculated the profit / loss on Call / Put separately and ignored the fact that it is a combination.

Question 6

The current market price of an equity share of Eagle Ltd. is ₹ 950. Within a period of 3 months, the maximum and minimum price of it is expected to be ₹ 1000 and ₹ 900 respectively. If the risk free rate of interest be 8% p.a. COMPUTE the value of a 3 months Call option under the "Risk Neutral" method at the strike rate of ₹ 980.

Given $e^{0.02} = 1.0202$

(MTP 4 Marks Sep' 22, Old & New SM)

(Same concept but different figures MTP Oct'18 6 Marks)

Answer:

Let the probability of attaining the maximum price be p

$$(1000 - 950) \times p + (900 - 950) \times (1 - p) = 950 \times (e^{0.02} - 1)$$

$$\text{or, } 50p - 50(1 - p) = 950 \times 0.0202$$

$$\text{or, } 50p - 50 + 50p = 19.19 \text{ or, } 100p$$

$$= 69.19$$

$$p = 0.6919$$

$$\text{The value of Call Option in ₹} = \frac{0.6919(1000 - 980)}{1.0202}$$

$$= ₹ 13.56$$

Question 7

The share of X Ltd. is currently selling for ₹ 500. Risk free interest rate is 0.6% per month. A three-month futures contract is selling for ₹ 511.

DEVELOP an arbitrage strategy and show what your riskless profit will be 3 months hence assuming that X Ltd. will not pay any dividend in the next three months.

(MTP 4 Marks Sep' 22, Old & New SM)

Answer:

The appropriate value of the 3 months futures contract is - Of - ₹ 500 $(1.006)^3 = ₹509.05$

Since the futures price exceeds its appropriate value it pays to do the following:

Action	Initial cash flow	Cash flow at time T (3 months)
Borrow ₹500 now and repay with interest after 3 months	+ ₹500	-500 $(1.006)^3 = ₹509.05$
Buy a share	- ₹500	ST
Sell a futures contract (Fo = 511/-)	0	₹511 - ST
Total	₹0	₹1.95

Such an action would produce a risk less profit of ₹1.95.

Question 8

The shares of TIC Ltd. are currently priced at ₹ 415 and call option exercisable in three months' time has an exercise rate of ₹ 400. Risk free interest rate is 5% p.a. and standard deviation (volatility) of the share price is 22%. The TIC Ltd. is not going to declare any dividend over the next three months.

DECIDE whether the option worth buying for ₹25.

CALCULATE the value of aforesaid call option if the current price of share is considered as ₹380.

CALCULATE the value of aforesaid call option if present price of share is taken as ₹408 and a dividend of ₹10 is expected to be paid in the two months' time.

Given

$\ln(1.0375) = 0.03681$, $\ln(0.95) = -0.05129$ and $\ln(0.9952) = -0.00481$ $e^{0.0125} = 1.0126$ and $e^{0.00833} = 1.0084$

Cumulative Area of Number of S.D. from Mean (z)

Z	0.0150	0.1250	0.3933	0.5033	-0.2976	-0.4076
Area	0.5060	0.5497	0.6530	0.6926	0.3830	0.3418

(MTP 10 Marks Oct '22, Old & New SM)

Answer:

- (i) Current Price of share of TIC Ltd. = ₹ 415
 Exercise rate = ₹ 400
 Risk free interest rate is = 5% p.a.
 SD (Volatility) = 22%

Based on the above bit is calculated value of an option based on Black Scholes Model:

$$d_1 = \frac{\ln\left(\frac{415}{400}\right) + \left[0.55 + \frac{1}{2}(0.22)^2\right] 0.25}{0.22\sqrt{0.25}}$$

$$= \frac{0.03681 + 0.01855}{0.11} = 0.5033$$

$$d_2 = \frac{\ln\left(\frac{415}{400}\right) + \left[0.55 + \frac{1}{2}(0.22)^2\right] 0.25}{0.22\sqrt{0.25}}$$

$$= \frac{0.03681 + 0.00645}{0.11} = 0.3933$$

$$V_0 = V_s N(d_1) - \frac{E}{e^{rt}} N(d_2)$$

$$N(d_1) = N(0.5033) = 0.6926$$

$$N(d_2) = N(0.3933) = 0.6530$$

$$\text{Value of Option} = 415(0.6926) - \frac{400}{e^{(0.05)(0.25)}} (0.6530)$$

$$= 287.43 - \frac{400}{1.0126} (0.6530)$$

$$= 287.43 - 257.95 = ₹ 29.48$$

Since market price of ₹ 25 is less than ₹ 29.48 (Black Scholes Valuation model) indicate that option priced, hence worth buying.

- (ii) If the current price is taken as ₹ 380 the computations are as follows:

$$d_1 = \frac{\ln\left(\frac{380}{400}\right) + \left[0.05 + \frac{1}{2}(0.22)^2\right] 0.25}{0.22\sqrt{0.25}}$$

$$= \frac{-0.05129 + 0.01855}{0.11} = -0.2976$$

$$d_2 = \frac{\ln\left(\frac{380}{400}\right) + \left[0.05 + \frac{1}{2}(0.22)^2\right] 0.25}{0.22\sqrt{0.25}}$$

$$= \frac{-0.05129 + 0.00645}{0.11} = -0.4076$$

$$N(d_1) = N(-0.2976) = 0.3830$$

$$N(d_2) = N(-0.4076) = 0.3418$$

$$\text{Value of Option} = 380(0.3830) - \frac{400}{e^{(0.05)(0.25)}}(0.3418)$$

$$= 145.54 - \frac{400}{1.0126}(0.3418)$$

$$= 145.54 - 135.02 = ₹ 10.52$$

- (iii) Since dividend is expected to be paid in two months time we have to adjust the share price and then use Black Scholes model to value the option:

Present Value of Dividend (using continuous discounting)

$$= \text{Dividend} \times e^{-rt}$$

$$= ₹ 10 \times e^{-0.05 \times 0.16666}$$

$$= ₹ 10 \times e^{-0.008333}$$

$$= \frac{₹ 10}{1.0084} = ₹ 9.92$$

Adjusted price of shares is ₹ 408.00 – ₹ 9.92 = ₹ 398.08

This can be used in Black Scholes model

$$d_1 = \frac{\ln\left(\frac{398.08}{400}\right) + \left[0.05 + \frac{1}{2}(0.22)^2\right] 0.25}{0.22\sqrt{0.25}}$$

$$= \frac{-0.00481 + 0.01855}{0.11} = 0.1250$$

$$d_2 = \frac{\ln\left(\frac{398.08}{400}\right) + \left[0.05 + \frac{1}{2}(0.22)^2\right] 0.25}{0.22\sqrt{0.25}}$$

$$= \frac{-0.00481 + 0.00645}{0.11} = 0.0150$$

$$N(d_1) = N(0.1250) = 0.5497$$

$$N(d_2) = N(0.0150) = 0.5060$$

$$\text{Value of Option} = 398.08(0.5497) - \frac{400}{e^{(0.05)(0.25)}}(0.5060)$$

$$= 218.82 - \frac{400}{1.0126}(0.5060)$$

$$= 218.82 - 199.88 = ₹ 18.94$$

Question 9

A future contract is available on R Ltd. that pays an annual dividend of ₹ 4 and whose stock is currently priced at ₹ 125. Each future contract calls for delivery of 1,000 shares to stock in one year, daily marking to market. The corporate treasury bill rate is 8%.

Required:

- (i) Using the above information, calculate theoretical price of one future contract.
- (ii) Determine the price of one futures contract if the company stock price decreases by 6%.
- (iii) Determine the amount of gain or loss of an investor as a result of the company stock price decrease who has a long position in one futures contract of R Ltd.

(Ignore margin and taxation, if any)

(MTP 4 Marks Mar '21, PYP 6 Marks Nov '19)

Answer:

- (i) Future Price = Spot + Cost of Carry - Dividend
 $= ₹ 125 + (₹ 125 \times 0.08) - 4 = ₹ 131$

Price of one future contract = 1000 share $\times$ ₹ 131 = ₹ 1,31,000

- (ii) Price decrease by 6%

Market Price = $125 \times 94\% = 117.50$

Then, price of one future contract

$= ₹ 117.50 + (₹ 117.50 \times 0.08) - 4 = ₹ 122.90$

$= ₹ 122.90 \times 1000 = ₹ 1,22,900$

- (iii) If the investor has taken a long position, decrease in price will result in loss for the investor.

Amount of loss will be:

$= ₹ 1,31,000 - ₹ 1,22,900 = ₹ 8,100$

EXAMINERS' COMMENTS ON THE PERFORMANCE OF EXAMINEES:

Average performance was observed in this question due to lack of clarity about how to approach the question and committed mistakes in the calculations.

Question 10

The price of March Nifty Futures Contract on a particular day was 9170. The minimum trading lot on Nifty Futures is 50. The initial margin is 8% and the maintenance margin is 6%. The index closed at the following levels on next five days:

Day	1	2	3	4	5
Settlement Price (₹)	9380	9520	9100	8960	9140

You are required to calculate:

- (i) Mark to market cash flows and daily closing balances on account of
 - (a) An investor who has taken a long position at 9170
 - (b) An investor who has taken a short position at 9170
- (ii) Net profit / loss on each of the contracts

(8 Marks Mar'23, PYP 8 Marks Jan'21)

Answer:

- (i) Contract Size (₹ 9,170 × 50) = ₹ 4,58,500
 Initial Margin (8% of 4,58,500) = ₹ 36,680
 Maintenance Margin (6% of 4,58,500) = ₹ 27,510

(1) For investor taken Long position:

Day	Change in Future value(₹)	Margin A/c (₹)	Call Money (₹)
0	-----	36,680	
1	(₹ 9,380 – ₹ 9,170) × 50 = 10,500	47,180	
2	(₹ 9,520 – ₹ 9,380) × 50 = 7,000	54,180	
3	(₹ 9,100 – ₹ 9,520) × 50 = -21,000	33,180	
4	(₹ 8,960 – ₹ 9,100) × 50 = -7,000	36,680	
5	(₹ 9,140 – ₹ 8,960) × 50 = 9,000	45,680	10,500

For investor taken Short position:

Day	Change in Future value (₹)	Margin A/ (₹)	Call Money (₹)
0	-	36,680	
1	(₹ 9,170 – ₹ 9,380) × 50 = -10,500	36,680	10,500
2	(₹ 9,380 – ₹ 9,520) × 50 = -7,000	29,680	
3	(₹ 9,520 – ₹ 9,100) × 50 = 21,000	50,680	
4	(₹ 9,100 – ₹ 8,960) × 50 = 7,000	57,680	
5	(₹ 8,960 – ₹ 9,140) × 50 = -9,000	48,680	

(ii) Calculation of Net Profit/Loss
(1) Long Position

	(₹)
Ending margin	45,680
Less: Initial Margin	36,680
Profit	9,000
Less: Margin Call	10,500
Net Loss	1,500

OR, Loss $(9,140 - 9,170) \times 50 = (\text{₹ } 1,500)$

(2) Short Position

	(₹)
Ending margin	48,680
Less: Initial Margin	36,680
Profit	12,000
Less: Margin Call	10,500
Net Profit	1,500

OR, Profit $= (9,170 - 7,040) \times 50 = \text{₹ } 1,500$

Question 11

Mr. A is holding 1000 shares of face value of ₹ 100 each of M/s. ABC Ltd. He wants to hold these shares for long term and have no intention to sell.

On 1st January 2020, M/s XYZ Ltd. has made short sales of M/s. ABC Ltd.'s shares and approached Mr. A to lend his shares under Stock Lending Scheme with following terms:

- (i) Shares to be borrowed for 3 months from 01-01-2020 to 31-03-2020,
- (ii) Lending Charges/Fees of 1% to be paid every month on the closing price of the stock quoted in Stock Exchange and
- (iii) Bank Guarantee will be provided as collateral for the value as on 01-01-2020.

Other Information:

- (a) Cost of Bank Guarantee is 8% per annum,
- (b) On 29-02-2020 M/s ABC Ltd., declared dividend of 25%,
- (c) Closing price of M/s. ABC Ltd.'s share quoted in Stock Exchange on various dates are as follows:

Date	Share Price in Scenario -1 Bullish	Share Price in Scenario-2 Bullish
01-01-2020	1000	1000
31-01-2020	1020	980
29-02-2020	1040	960
31-03-2020	1050	940

You are required to find out:

- Earning of Mr. A through Stock Lending Scheme in both the scenarios,
- Total Earnings of Mr. A during 01-01-2020 to 31-03-2020 in both the scenarios,
- What is the Profit or loss to M/s. XYZ by shorting the shares using through Stock Lending Scheme in both the scenarios?

(MTP 8 Marks Apr 23)

Answer:

Earnings of Mr. A through stock lending scheme

	Scenario 1	Scenario 2
(i) Lending fee		
31-01-20 1020 × 1% and 980 × 1%	10.20	9.80
29-02-20 1040 × 1% and 960 × 1%	10.40	9.60
31-03-20 1050 × 1% and 940 × 1%	10.50	9.40
Earnings from lending per Share (A)	31.10	28.80
Total No. of Shares	1000	1000
Total Earning from Lending	31,100	28,800
(ii) Dividend income per Share (B)	25.00	25.00
Total earnings per share (A) + (B)	56.10	53.80
Total No. of Shares	1000	1000
Total Earning	56,100	53,800
(iii) Gain on shortening the shares		
(1,050-1,000) and (1,000-940)	(50.00)	60.00
Lending fees paid	(31.10)	(28.80)
Bank guarantee charges @ 8% p.a.	(20.00)	(20.00)
Gain Per Share	(101.10)	11.20
Total No. of Shares	1000	1000
Total Gain on shortening the shares	(1,01,100)	11,200

Question 12

Calculate the justified price of 3 months ABC futures, if share of ABC (FV ₹ 10) quotes at ₹ 450 on NSE and the one month borrowing rate is given as 12 percent per annum and the expected annual dividend is 20 percent, payable before expiry. Also demonstrate is there any arbitrage opportunities if the three months Futures Price quotes at ₹ 470.

(MTP 8 Marks Sep'23)

Answer:

(i) Future Price = Spot + cost of carry – Dividend

$$F = 450 + 450 \times (0.12 \times 0.25)^{\dagger} - 0.20^{**} \times 10 = 461.50$$

**Entire 20% dividend is payable before expiry, which is ₹ 2.

† Alternatively monthly compounding can also be used.

Thus, we can see that justified futures price is ₹ 461.50 which is quoted at ₹ 470 in the exchange.

(ii) **Analysis of Arbitrage Opportunities:**

Since, Fair value of Futures is less than Actual Futures Price it is advised to sell it and buying stock in the cash market.

Step I

Arbitrageur will buy ABC Stock at ₹ 450 by borrowing at 12% for 3 months. Therefore, his outflows will be:

Cost of Stock	450.00
Add: Interest @ 12% for 3 months ie. 0.25 years ($450 \times 0.12 \times 0.25$)	13.50
Total Outflows (A)	463.50

Step II

Arbitrageur will settle futures at ₹ 470. Meanwhile he would receive dividend for his stock.

Hence his inflows are

Sale proceeds of futures	470.00
Dividend	2.00
Total inflows (B)	472.00
Inflow-Outflow Profit earned by Arbitrageur = ₹ 472.00 – ₹ 463.50 = ₹ 8.50	

Question 13

The market received rumour about ABC Corporation's tie-up with a multinational company. This has induced the market price to move up. If the rumour is false, the ABC corporation stock price will probably fall dramatically. To protect from this an investor has bought the call and put options.

He purchased one 3 months call with a striking price of ₹ 42 for ₹ 2 premium, and paid Re.1 per share premium for a 3 months put with a striking price of ₹ 40.

- (i) Determine the Investor's position if the tie up offer bids the price of ABC Corporation's stock up to ₹ 43 in 3 months.
- (ii) Determine the Investor's ending position, if the tie up programme fails and the price of the stocks falls to ₹ 36 in 3 months.

(RTP May 19, Old & New SM)

Answer:**Cost of Call and Put Options**

$$= (\text{₹ } 2 \text{ per share}) \times (100 \text{ share call}) + (\text{₹ } 1 \text{ per share}) \times (100 \text{ share put})$$

$$= \text{₹ } 2 \times 100 + 1 \times 100$$

$$= \text{₹ } 300$$

- (i) Price increases to ₹ 43. Since the market price is higher than the strike price of the call, the investor will exercise it.

$$\text{Ending position} = (- \text{₹ } 300 \text{ cost of 2 option}) + (\text{₹ } 1 \text{ per share gain on call}) \times 100$$

$$= - \text{₹ } 300 + 100$$

$$\text{Net Loss} = - \text{₹ } 200$$

- (ii) The price of the stock falls to ₹ 36. Since the market price is lower than the strike price, the investor may not exercise the call option.

$$\text{Ending Position} = (- \text{₹ } 300 \text{ cost of 2 options}) + (\text{₹ } 4 \text{ per stock gain on put}) \times 100$$

$$= \text{₹ } 300 + 400$$

$$\text{Gain} = \text{₹ } 100$$

Question 14

Sensex futures are traded at a multiple of 50. Consider the following quotations of Sensex futures in the 10 trading days during February, 2009:

Day	High	Low	Closing
4-2-09	3306.4	3290.00	3296.50
5-2-09	3298.00	3262.50	3294.40
6-2-09	3256.20	3227.00	3230.40
7-2-09	3233.00	3201.50	3212.30
10-2-09	3281.50	3256.00	3267.50
11-2-09	3283.50	3260.00	3263.80
12-2-09	3315.00	3286.30	3292.00
14-2-09	3315.00	3257.10	3309.30
17-2-09	3278.00	3249.50	3257.80
18-2-09	3118.00	3091.40	3102.60

Abhishek bought one Sensex futures contract on February, 04. The average daily absolute change in the value of contract is ₹ 10,000 and standard deviation of these changes is ₹ 2,000. The maintenance margin is 75% of initial margin.

You are required to determine the daily balances in the margin account and payment on margin calls, if any. (RTP Nov '19, Old & New SM)

Answer:

Initial Margin = $\mu + 3\sigma$

Where μ = Daily Absolute Change

σ = Standard Deviation Accordingly:

Initial Margin = ₹ 10,000 + ₹ 6,000 = ₹ 16,000

Maintenance margin = ₹ 16,000 × 0.75 = ₹ 12,000

Day	Changes in future Values (₹)	Margin A/c (₹)	Call Money (₹)
4/2/09	-	16000	-
5/2/09	50 × (3294.40 - 3296.50) = -105	15895	-
6/2/09	50 × (3230.40 - 3294.40) = -3200	12695	-
7/2/09	50 × (3212.30 - 3230.40) = -905	16000	4210
10/2/09	50 × (3267.50 - 3212.30) = 2760	18760	-
11/2/09	50 × (3263.80 - 3267.50) = -185	18575	-
12/2/09	50 × (3292 - 3263.80) = 1410	19985	-
14/2/09	50 × (3309.30 - 3292) = 865	20850	-
17/2/09	50 × (3257.80 - 3309.30) = -2575	18275	-
18/2/09	50 × (3102.60 - 3257.80) = -7760	16000	5483

Question 15

A Rice Trader has planned to sell 22000 kg of Rice after 3 months from now. The spot price of the Rice is ₹ 60 per kg and 3 months Future on the same is trading at ₹ 59 per kg. Size of the contract is 1000 kg. The price is expected to fall as low as ₹ 56 per kg, 3 months hence.

Required:

- (i) to interpret the position of trader in the Cash Market.
- (ii) to advise the trader the trader should take in Future Market to mitigate its risk of reduced profit.
- (iii) to demonstrate effective realized price for its sale if he decides to make use of future market and after 3 months, spot price is ₹ 57 per kg and future contract price for closing the contract is ₹ 58 per kg.

(RTP Nov '20)

Answer:

- (i) Since trader has planner to sell after 3 months now it implies, he is in Long Position in Cash or Spot Market.
- (ii) Since the trader is in Long Position in Cash Market, he can mitigate its risk of reduced profit by hedging his position by selling Rice Futures i.e. Short Position in Future Market.

- (iii) The gain on futures contract

$$= (\text{₹ } 59 - \text{₹ } 58) \times 22,000 \text{ kg.}$$

$$= \text{₹ } 22,000$$

Revenue from the sale of Rice

$$= 22,000 \times \text{₹ } 57$$

$$= \text{₹ } 12,54,000$$

Total Cash Flow = ₹ 12,54,000 + ₹ 22,000

$$= \text{₹ } 12,76,000$$

Cash Flow Per Kg of Rice =
$$\frac{\text{₹ } 12,76,000}{22,000}$$

$$= \text{₹ } 58$$

Question 16

The Following data relate to A Ltd.'s Portfolio:

Shares	X Ltd.	Y Ltd.	Z Ltd.
No. of Shares (lakh)	6	8	4
Price per share (₹)	1000	1500	500
Beta	1.50	1.30	1.70

The CEO is of opinion that the portfolio is carrying a very high risk as compared to the market risk and hence interested to reduce the portfolio's systematic risk to 0.95. Treasury Manager has suggested two below mentioned alternative strategies:

- Dispose off a part of his existing portfolio to acquire risk free securities, or
- Take appropriate position on Nifty Futures, currently trading at 8250 and each Nifty points multiplier is ₹ 210.

You are required to:

- Interpret the opinion of CEO, whether it is correct or not.
- Calculate the existing systematic risk of the portfolio,
- Advise the value of risk-free securities to be acquired,
- Advise the number of shares of each company to be disposed off,
- Advise the position to be taken in Nifty Futures and determine the number of Nifty contracts to be bought/sold; and
- Calculate the new systematic risk of portfolio if the company has taken position in Nifty Futures and there is 2% rise in Nifty..

Note: Make calculations in ₹lakh and up to 2 decimal points.

(RTP May '21)

Answer:

- Yes**, the apprehension of CEO is correct as the current portfolio is more riskier than market as the beta (Systematic Risk) of market portfolio is as computed as follows:

Shares	No. of shares (lakhs) (1)	Market Price of Per Share (2) (₹)	(1) × (2) (₹ lakhs)	% to total (w)	B(x)	Wx
X Ltd.	6.00	1000.00	6000.00	0.30	1.50	0.45
Y Ltd.	8.00	1500.00	12000.00	0.60	1.30	0.78
Z Ltd.	4.00	500.00	2000.00	0.10	1.70	0.17
			20000.00	1.00		1.40

(b) Since the Beta of existing portfolio is 1.40, the systematic risk of the current portfolio is 1.40.

(c) Required Beta 0.95

Let the proportion of risk-free securities for target beta $0.95 = p$

$$0.95 = 0 \times p + 1.40 (1 - p)$$

$$p = 0.32 \text{ ie. } 32\%$$

Shares to be disposed off to reduce beta $(20000 \times 32\%) ₹ 6,400$ lakh and Risk Free securities to be acquired for the same amount.

(d) Number of shares of each company to be disposed off

Shares	% to total (w)	Proportionate Amount (₹ lakhs)	Market Price Per Share (₹)	No. of Shares (Lakh)
X Ltd.	0.30	1920.00	1000.00	1.92
Y Ltd.	0.50	3840.00	1500.00	2.56
Z Ltd.	0.10	640.00	500.00	1.28

(e) Since, the company is in long position in cash market it shall take short position in Future Market.

Number of Nifty Contract to be sold $\frac{(1.40 - 0.95) \times 20000 \text{ lakh}}{0.250 \times 210} = 519 \text{ contracts}$

(f) If there is 2% rises in Nifty there will be 2.80% $(2\% \times 1.40)$ rise for portfolio of shares

	₹ Lakh
Current Value of Portfolio of Shares	20000
Value of Portfolio after rise	20560
Mark-to-Market Margin paid $(8250 \times 0.020 \times ₹210 \times 519)$	179.83
Value of the portfolio after rise of Nifty	20380.17
% change in value of portfolio $\frac{(20380.17 - 20000)}{20000}$	1.90%
% rise in the value of Nifty	2%
New Systematic Risk (Beta)	0.95

Question 17

Mr. P established the following spread on the Coastal Corporation's stock:

- (i) Purchased one 3-month call option with a premium of ₹ 6.5 and an Exercise price of ₹ 110.
- (ii) Purchased one 3-month put option with a premium of ₹ 10 and an Exercise price of ₹ 90.

Coastal Corporation's stock is currently selling at ₹ 100. Determine profit or loss, if the price of Coastal Corporation's stock:

- (i) Remains at ₹ 100 after 3 months.
- (ii) Falls at ₹ 70 after 3 months.
- (iii) Rises to ₹ 138 after 3 months.
- (iv) Assume the size of option is 1,000 shares of Coastal Corporation.

(RTP May'22)

Answer:

- (i) Total premium paid on purchasing a call and put option

$$= (\text{₹ } 6.50 \text{ per share} \times 1000) + (\text{₹ } 10 \text{ per share} \times 1000).$$

$$= \text{₹ } 6,500 + \text{₹ } 10,000 = \text{₹ } 16,500$$

In this case, Mr. P exercises neither the call option nor the put option as both will result in a loss for him.

$$\text{Ending value} = -\text{₹ } 16,500 + \text{zero gain} = -\text{₹ } 16,500$$

$$\text{i.e. Net loss} = \text{₹ } 16,500$$

- (ii) Since the price of the stock is below the exercise price of the call, the call will not be exercised. Only put is valuable and is exercised.

$$\text{Total premium paid} = \text{₹ } 16,500$$

$$\text{Ending value} = -\text{₹ } 16,500 + \text{₹ } [(90 - 70) \times 1000]$$

$$= -\text{₹ } 16,500 + \text{₹ } 20,000 = \text{₹ } 3,500$$

$$\therefore \text{Net gain} = \text{₹ } 3,500$$

- (iii) In this situation, the put is worthless, since the price of the stock exceeds the put's exercise price. Only call option is valuable and is exercised. Total premium paid =

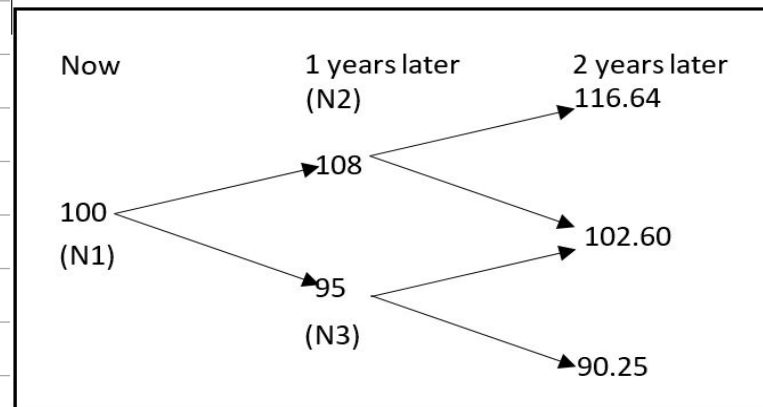
$$\text{₹ } 16,500$$

$$\text{Ending value} = -\text{₹ } 16,500 + \text{₹ } [(138 - 110) \times 1000]$$

$$\therefore \text{Net Gain} = -\text{₹ } 16,500 + \text{₹ } 28,000 = \text{₹ } 11,500$$

Question 18

A two year tree for a share of stock in ABC Ltd., is as follows:



Consider a two years American call option on the stock of ABC Ltd., with a strike price of ₹ 98. The current price of the stock is ₹ 100. Risk free return is 5 per cent per annum with a continuous compounding and $e^{0.05} = 1.05127$.

Assume two time periods of one year each. Using the Binomial Model, calculate:

- The probability of price moving up and down;
- Expected pay offs at each nodes i.e. N1, N2 and N3 (round off upto 2 decimal points).

(RTP May'23, PYP 8 Marks Nov'20)

Answer:

Using the single period model, the probability of price moving up is

$$P = \frac{R-d}{u-d} = \frac{1.05127 - \frac{95}{100}}{\frac{108}{100} - \frac{95}{100}} = \frac{0.10127}{0.13} = 0.779 \text{ say } 0.78 \text{ i.e. } 78\%$$

Therefore, the probability of price moving down = $1 - 0.78 = 0.22$ i.e. 22%

Expected pay-off at

Node N2

$$\frac{0.78 \times 18.64 + 0.22 \times 4.60}{1.05127} = \frac{15.55}{1.05127} = ₹ 14.79$$

Node N3

$$\frac{0.78 \times 4.60 + 0.22 \times 0}{1.05127} = \frac{3.588}{1.05127} = ₹ 3.41$$

Node N1

$$\frac{0.78 \times 14.79 + 0.22 \times 3.41}{1.05127} = \frac{12.286}{1.05127} = ₹ 11.79$$

Question 19

AB Ltd.'s equity shares are presently selling at a price of ₹ 500 each. An investor is interested in purchasing AB Ltd.'s shares. The investor expects that there is a 70% chance that the price will go up to ₹ 650 or a 30% chance that it will go down to ₹ 450, three months from now. There is a call option on the shares of the firm that can be exercised only at the end of three months at an exercise price of ₹ 550.

Calculate the following:

- If the investor wants a perfect hedge, what combination of the share and option should he select ?
- Explain how the investor will be able to maintain identical position regardless of the share price.
- if the risk-free rate of return is 5% for the three months period, what is the value of the option at the beginning of the period ?
- What is the expected return on the option?

(MTP 8 Marks Nov'29)

Answer:

- To compute perfect hedge we shall compute Hedge Ratio (Δ) as follows:

$$\Delta = \frac{C_1 - C_2}{S_1 - S_2} = \frac{100 - 0}{650 - 450} = \frac{100}{200} = 0.50$$

The investor should purchase 0.50 share for every 1 call option Or, the investor should purchase 1 share for every 2 Call Option.

- How the investor will be able to maintain his position if he purchase 0.50 share for 1 call option written.

- If price of share goes upto ₹ 650 then value of purchased share will be

Sale Proceeds of Investment (0.50 x ₹ 650)	₹ 325
Loss on account of Short Position (₹ 650 - ₹ 550)	₹ 100
	₹ 225

- if price of share comes down to ₹ 450 then value of purchased share will be:

Sale Proceeds of Investment (0.50 x ₹ 450)	₹ 225
--	-------

(iii) The Value of Option, say, P at the beginning of the period shall be computed as follows:

$$(\text{₹ } 250 - P) 1.05 = \text{₹ } 225$$

$$\text{₹ } 262.50 - 1.05P = \text{₹ } 225$$

$$\text{₹ } 37.5 = 1.05P \quad P = \text{₹ } 35.71$$

(iv) Expected Return on the Option

$$\text{Expected Option Value } (\text{₹ } 650 - \text{₹ } 550) \times 0.70 + \text{₹ } 0 \times 0.30 = \text{₹ } 70$$

$$\text{Expected Rate of Return} = \frac{70 - 35.71}{35.71} \times 100 = 96.02\%$$

EXAMINERS COMMENTS ON THE PERFORMANCE OF EXAMINEES:

In this question overall performance was below average as majority of examinees could not arrive at the correct value of option and hence failed to calculate expected returns. However, most of them examinees have correctly arrived at the estimated option value.

Question 20

On 31/08/2021 Mr. R has taken a Long position of Two lots of Nifty Futures at 17300. One lot of Nifty future is 50 units. Initial Margin required is 10% of Contract Value. Maintenance Margin required is 80% of Initial Margin. The closing price of 5 days are given below-

Date	Closing Price of Nifty Future
01/09/2021	17340
02/09/2021	17180
03/09/2021	16990
06/09/2021	16900
07/09/2021	17120

You are required to-

- Prepare a statement showing the daily balances in the margin account & payment on margin calls, if any.
- Compute the Gain or Loss of Mr. R, if contract squared off on 07/09/2021.
- What would be the Gain or Loss if Mr. R, had taken the short position?

(PYP 8 Marks Dec'21)

Answer:

$$\text{Contract Size } (\text{₹ } 17,300 \times 50 \times 2) = \text{₹ } 17,30,000$$

$$\text{Initial Margin (10\% of 17,30,000)} = \text{₹ } 1,73,000$$

$$\text{Maintenance Margin (80\% of 1,73,000)} = \text{₹ } 1,38,400$$

Statement showing the daily balances in Margin A/c and margin call if any.

Day	Change in Future value (₹)	Margin A/c (₹)	Call Money (₹)
31/08/21	---	1,73,000	---
01/09/21	(₹ 17,340 - ₹ 17,300) × 50 × 2 = 4,000	1,77,000	---
02/09/21	(₹ 17,180 - ₹ 17,340) × 50 × 2 = -16,000	1,61,000	---
03/09/21	(₹ 16,990 - ₹ 17,180) × 50 × 2 = -19,000	1,42,000	---
06/09/21	(₹ 16,900 - ₹ 16,990) × 50 × 2 = -9,000	1,73,000	40,000
07/09/21	(₹ 17,120 - ₹ 16,900) × 50 × 2 = 22,000	1,95,000	---

(ii) Gain or Loss of Mr. R squared off position on 07/09/21

	(₹)
Ending margin	1,95,000
Less: Initial Margin	1,73,000
Profit	22,000
Less: Margin Call	40,000
Net Loss	(18,000)

(iii) Gain/Loss if Mr. R has taken Short Position

Day	Change in Future value (₹)	Margin A/c (₹)	Call Money (₹)
31/08/21	---	1,73,000	---
01/09/21	(₹ 17,300 - ₹ 17,340) × 50 × 2 = 4,000	1,69,000	---
02/09/21	(₹ 17,340 - ₹ 17,180) × 50 × 2 = 16,000	1,85,000	---
03/09/21	(₹ 17,180 - ₹ 16,990) × 50 × 2 = 19,000	2,04,000	---
06/09/21	(₹ 16,990 - ₹ 16,900) × 50 × 2 = 9,000	2,13,000	---
07/09/21	(₹ 16,900 - ₹ 17,120) × 50 × 2 = -22,000	1,91,000	---

Profit or Loss on short position

	(₹)
Ending margin	1,91,000
Less: Initial Margin	1,73,000
Profit	18,000

EXAMINERS' COMMENTS ON THE PERFORMANCE OF EXAMINEES:

While above average performance has been observed in this question an Index Futures but only some students could compute call money correctly. Even some students could not show calculation of Margin Call properly. Further some student even ignored existence two lots in their calculation.

Question 21

On 1st July 2021 Mr. P has made the following investment:

Name of Company	No. of Equity Share	Beta Value	Purchase Price per Equity Share
ML Ltd	1000	1.25	₹ 700

He wants to hold the investment till end of September 2021 with an expectation of huge dividends to be announced in the AGM. On the date of investment, September Nifty Futures are quoting at 175000 and tradeable with lot size of 50 for each contract.

You are the Investment advisor to Mr. P,

- (i) Please advise Mr. P how to hedge his market exposure using the available data.
- (ii) Calculate the profit or loss of Mr. P during the expiry of September 2021 futures in following situation.
 - (a) Nifty Future rise by 10%
 - (b) ML Ltd. falls by 5%
- (iii) Is it possible stock as well as nifty to raise or fall at the same percentage? Please state the reason.

(PYP 8 Marks Dec'21)

Answer:

- (i) To hedge his market exposure Mr. P should take short position in the Nifty Futures.
 No. of Contract of Nifty Future to be Short = $1.25 \times ₹ 700 \times 1,000 / 17,500 \times 50 = 1$

- (ii) a. Profit or loss of Mr. P during the expiry of September 2021 Futures:

Particulars	If Nifty rises by 10%
Loss on Nifty Futures (17,500 × 50 × 0.10)	₹ 87,500
Gain on Stock of ML Ltd. (1.25 × 0.10 × ₹ 7,00,000)	₹ 87,500
Net Gain/(Loss)	Nil

- b. Profit or loss of Mr. P during the expiry of September 2021 Futures:

Particulars	If ML Ltd. falls by 5%
Gain on Nifty Futures (17,500 × 50 × 0.05)/1.25	₹ 35,000
Gain on Stock of ML Ltd. (0.05 × ₹ 7,00,000)	₹ 35,000
Net Gain/(Loss)	Nil

- (iii) Normally it is not possible that Nifty to rise or fall by same percentage because of systematic risk i.e. Beta may not be the same as of market.

EXAMINERS' COMMENTS ON THE PERFORMANCE OF EXAMINEES:

Average performance has been observed in this question on Derivatives as most of the students have committed error in computing final part of the answer.

Question 22

You had purchased a 3 month call option on the Equity shares of Satya Ltd for a premium of ₹ 30 each, the current market price of the share is ₹ 560 and the exercise price is ₹ 590.

You expect the price range between ₹ 540 to ₹ 640.

The expected share price of Satya Ltd and related probability is given below:

Expected price (₹)	540	560	580	600	620	640
Probability	0.10	0.15	0.05	0.35	0.20	0.15

Compute the followings:

- Expected share price at the end of 3 months,
- Value of call option at the end of 3 months, if the exercise price prevails,
- In case the option is held to its maturity, what will be the expected value of the call option?
- Find out the price of the shares quoted at the stock exchange to get the value of the call option as computed in (iii) above.

(PYP 8 Marks May'22)

Answer:

- (i) **Expected Share Price**

$$\begin{aligned}
 &= ₹ 540 \times 0.10 + ₹ 560 \times 0.15 + ₹ 580 \times 0.05 + ₹ 600 \times 0.35 + ₹ 620 \times 0.20 + ₹ 640 \times 0.15 \\
 &= ₹ 54 + ₹ 84 + ₹ 29 + ₹ 210 + ₹ 124 + ₹ 96 \\
 &= ₹ 597
 \end{aligned}$$

- (ii) **Value of Call Option**

$$= ₹ 590 - ₹ 590 = \text{Nil}$$

- (iii) **If the option is held till maturity the expected Value of Call Option**

Expected price (X)	Value of call (C)	Probability (P)	Expected Value of Option
₹ 540	0	0.10	0
₹ 560	0	0.15	0
₹ 580	0	0.05	0
₹ 600	₹ 10	0.35	₹ 3.50
₹ 620	₹ 30	0.20	₹ 6.00
₹ 640	₹ 50	0.15	₹ 7.50
Total			₹ 17.00

Alternatively, it can also be calculated as follows:

Expected price (X)	Exercise Price (E)	Probability (P)	Expected Value of Option CP (X – E) X P
₹ 540	₹ 590	0.10	Not Exercised*
₹ 560	₹ 590	0.15	Not Exercised*
₹ 580	₹ 590	0.05	Not Exercised*
₹ 600	₹ 590	0.35	₹ 3.50
₹ 620	₹ 590	0.20	₹ 6.00
₹ 640	₹ 590	0.15	₹ 7.50
Total			₹ 17.00

* If the stock price goes below ₹ 590, option is not exercised at all.

(iv) Price to be quoted at the stock exchange to get the value of the call option

$$₹ 590 + ₹ 17 = ₹ 607$$

Question 23

Mr. V is a commodity trader and specialized himself in trading of rice.

He has 24,000 Kg. of rice. The following details are available as on date:

Spot price	₹ /Kg	70
3 month's future is trading at	₹ /Kg	68
Expected Lower price after 3 months	₹ /Kg.	64
Contract size	500 Kg./	Contract

You are required to advise to Mr. V:

- How to mitigate the risk of fall in price.
- How to use the futures market.
- What will be the effective realized price for his sales if, after 3 months, spot price is ₹ 69/ Kg. and the 3 months future contract price is
 - ₹ 72/Kg.
 - ₹ 67/Kg.

(PYP 8 Marks May'23)

Answer:

(i) in order to hedge its position Mr. V (trader) should use Future Contracts.

Particulars	
(a) Quantity of Rice to be hedged	24000 kg
(b) Contract Size	500 kg
(c) No. of Contracts (a/b)	48
(d) Future Price	₹ 68/kg.
(e) Exposure in the future market (a x d)	₹ 16,32,000

(ii) Mr. V should short 48 Future contracts at the price ₹ 68/kg and cancel its position after 3 months by buying Future contract at prevailing Future price.

(iii) After 3 months, trader would cancel its position in the future by buying a future contract of same quantity and will sell Rice in the spot market and position shall be as follows:

Particulars	₹	₹
(a) Price of Future Contract	72/kg	67/kg.
(b) Amount bought	17,28,000	16,08,000
(c) Exposure	16,32,000	16,32,000
(d) Gain/(Loss) on future position (b - c)	(96,000)	24,000
(e) Spot Price	69/kg	69/kg
(f) Amount realized by selling in the spot market	16,56,000	16,56,000
(g) Effective Selling Amount (f + d)	₹ 15,60,000	₹ 16,80,000
(g) Effective Selling Price	₹ 65/kg.	₹ 70/kg.

Question 24

Mr. Shyam an investor is not sure about the expected price movement of the stock of Delta Corporation's share. His friend Adi advised him to go for option contracts if he wants to play in the market with limited risk. Adi advised him to follow below mentioned Strategy.

- Purchase one 3-month call option with a premium of ₹ 30 and an exercise price of ₹ 550.
- Purchase one 3-month put option with a premium of ₹ 5 and an exercise price of ₹ 450.

Delta Corporation's stock is currently selling at ₹ 500.

Demonstrate the net pay off position of Mr. Shyam at the expiry of option after 3-months if the price of Delta Corporation's stock happens to be:

- No change in price
- falls at ₹ 350
- rises to ₹ 600.

Assume the option lot size is 100.

(RTP May'24)

Answer:

Total premium paid on purchasing a call and put option

$$= (\text{₹ } 30 \text{ per share} \times 100) + (\text{₹ } 5 \text{ per share} \times 100)$$

$$= \text{₹ } 3,000 + \text{₹ } 500 = \text{₹ } 3,500$$

(i) Net Pay-off if there is no change in price

In this case, Mr. Shyam exercises neither the Call option nor the Put option as both will result in a loss for him,

Ending value = - ₹ 3,500 + Zero gain

$$= - \text{₹ } 3,500$$

i.e. Net loss is ₹ 3,500

(ii) Net Pay-off if price falls at ₹ 350

Since the price of the stock is below the exercise price of the Call, it will not be exercised. Only Put is valuable hence it is exercised.

Ending value = - ₹ 3,500 + ₹ [(450 - 350) × 100]

$$= - \text{₹ } 3,500 + \text{₹ } 10,000 = \text{₹ } 6,500$$

Net gain is ₹ 6,500

(iii) Net Pay-off if price rises to ₹ 600

In this situation, the put is worthless since the price of the stock exceeds the Put's exercise price. Only Call is valuable and hence it is exercised.

Ending value = - ₹ 3,500 + ₹ [(600 - 550) × 100]

$$= - \text{₹ } 3,500 + 5,000 = 1,500$$

Net Gain is ₹ 1,500

Question 25

The price of ACC stock on 31 December 2022 was ₹ 220 and the Futures price on the same stock on the same date, i.e., 31 December 2022 for March 2023 was ₹ 222. Other features of the Futures contract and related information are as follows:

Time to expiration	-	3 months (0.25 year)
Borrowing rate	-	15% p.a.
Annual Dividend on the stock	-	25% payable before 31.03. 2023
Face Value of the Stock	-	₹ 10

Advise the Investor the course of action to be followed by him so as to earn Risk free income if he can sell the stock short at spot price.

(RTP May'24)

Answer:

Based on the above information, the futures price for ACC stock on 31 December 2022 should be:

$$\begin{aligned} &\text{Spot price} + \text{Interest Portion} - \text{Dividend} \\ &= 220 + (220 \times 0.15 \times 0.25) - (0.25 \times 10) \\ &= 225.75 \end{aligned}$$

Thus, as per the 'cost of carry' criteria, the Futures price is ₹ 225.75, which is more than the actual price of ₹ 222 on 31 March 2023. This would give rise to earn riskless arbitrage opportunity of ₹ 3.75 i.e. (225.75 – 222)

Advise to the Arbitrager.

1. Short sell one unit of stock at spot price for ₹ 220
2. Deposit ₹ 220 at 15% p.a. for 3 months.
3. Buy a 3-month Futures contract for one unit of stock of ACC at ₹ 222.

After 3 months

1. Take money out of the Bank.
2. Take delivery by paying ₹ 222 and return the unit of stock to the party whom short sell was made along.
3. Pay the Dividend amount to the buyer whom short sell was made.

$$\begin{aligned} \text{Total Inflow} &= 220 + (220 \times 0.15 \times 0.25) \\ &= ₹ 228.25 \end{aligned}$$

$$\begin{aligned} \text{Total Outflow} &= 222 + 2.50 \\ &= ₹ 224.50 \end{aligned}$$

$$\begin{aligned} \text{Net Gain to the Arbitrager} &= \text{Total Inflow} - \text{Total Outflow} \\ &= ₹ 228.25 - ₹ 224.50 \\ &= ₹ 3.75 \end{aligned}$$

Thus, the arbitrager earns ₹ 3.75 per share without involving any risk.

Question 26

Following is the information available pertaining to shares of Omni Ltd.:

Current Market Price (₹)	₹ 420.00
Strike Price (₹)	₹ 450.00
Maximum Price (₹) expected in next 3 months' time	₹ 525.00
Minimum Price (₹) expected in next 3 months' time	₹ 378.00
Continuously Compounded Rate of Interest (p.a.) (%)	8.00%
e^{rt}	1.0202

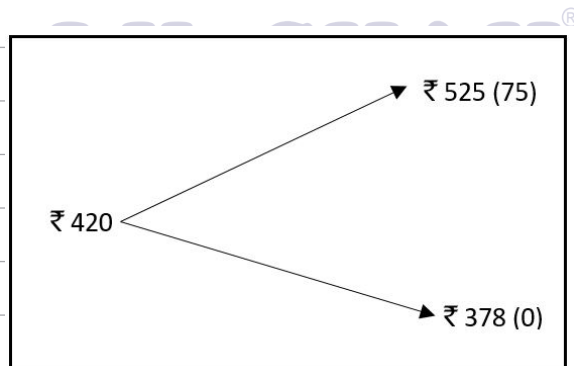
From the above:

- Calculate the 3 months call option by using Binomial Method and Risk Neutral Method. Are the calculated values under both the models are same?
- State also clearly the basis of Valuation of options under these models.

(PYP 8 Marks Nov'23)

Answer:

- (1) Call Option value using Binomial Model



a Veranda
Enterprise

$$\Delta = \frac{₹ 525 - ₹ 378}{₹ 75 - 0} = 0.51$$

$$\text{Initial Investment} = 0.51 \times 420 = 214.20$$

Value of Portfolio if Price goes down to ₹ 378 Value of holding $0.51 \times ₹ 378 = 192.78$

Accordingly Let 'P' be the option price, then

$$₹ 214.20 - P = ₹ 192.78/1.0202$$

$$= ₹ 188.96$$

$$P = ₹ 25.24$$

(2) Value of Call Option using Risk Neutral Method

Let "P" be the probability of Price increase, then $p \times 525 + (1 - p) \times 378 = 420(1.0202)$

$$147p = 50.48$$

$$p = 0.34$$

Probability of Price increase = 0.34 Probability of Price decrease = 0.66

$$\frac{0.34 \times 75 \times 0.66 \times 0}{1.0202} = ₹ 25.24$$

Yes, the value of option under both Models is same.

(ii) Basis of valuation of options:

- Binomial model uses an approach called "Risk less Hedge Approach" to find the price of the option, by creating a portfolio which will have same value at expiration irrespective of any price. Hedge means to create an equal and opposite position for protecting the value of portfolio.
- In Risk Neutral Model, valuation of options is based on arbitrage and is therefore independent of risk preferences; one should be able to value options assuming any set of risk preferences and get the same answer.