CA-Final AFM Test 3
Topics Covered: Derivatives
Max Marks: 35 Time: 1 Hour

Question 1(10 Marks): Details about portfolio of shares of an investor is as below:

Shares	No. of shares (Iakh)	Price per share	Beta
A Ltd.	10.00	Rs 400	1.50
B Ltd.	6.00	Rs 500	1.20
C Ltd.	5.00	Rs 600	1.80

The investor thinks that the risk of portfolio is very high and wants to reduce the portfolio beta to 1.125. He is considering two below mentioned alternative strategies:
(i) Dispose off a part of his existing portfolio to acquire risk free securities, or
(ii) Take appropriate position on Nifty Futures which are currently traded at 5000 and each Nifty points is worth Rs 500.
You are required to determine:
(1) portfolio beta,
(2) the value of risk free securities to be acquired,
(3) the number of shares of each company to be disposed off,
(4) the number of Nifty contracts to be bought/sold; and
(5) the value of portfolio beta for 4% rise in Nifty.

Question 2(5 Marks): Hari is holding 100 equity shares of VCC Ltd. which is being quoted at Rs210 per share. He is interested in hedging downside risk of his holding as he is going to sell them after 2 month. A 2-month Call option is available at a premium of Rs 6 per share and a 2- month put option is available at a premium of Rs 5 per share. The strike price in both cases is Rs 220.You are required to:
(i) Suggest the position Hari should take in the option market to hedge his holding in the VCC Ltd.
(ii) Calculate his final position after 2 months if after 2 months i.e. on the day of exercise the actual market price of per share of VCC Ltd. happens to be Rs 200, Rs 210, Rs 220, Rs 230 and Rs 240.

Question 3(5 Marks):

BSE Index	10000
Value of portfolio	Rs 12,00,000
Risk free interest rate	10% p.a.
Dividend yield on Index	5% p.a.
Beta of portfolio	1.70

We assume that a future contract on the BSE index with six months maturity is used to hedge the value of portfolio over next five months. One future contract is for delivery of 50 times the index.
Based on the above information CALCULATE:
(1) Price of future contract.
(2) The gain on short futures position if index turns out to be 8,500 in five months.

Question 4(5 Marks): You as an investor had purchased a 4 month call option on the equity shares of X Ltd. of Rs 10, of which the current market price is Rs 132 and the exercise price Rs 150. You expect the price to range between Rs 120 to Rs 190. The expected share price of X Ltd. and related probability is given below:

Expected Price (Rs)	120	140	160	180	190
Probability	0.05	0.20	0.50	0.10	0.15

COMPUTE:

(i) Expected Share price at the end of 4 months.
(ii) Value of Call Option at the end of 4 months, if the exercise price prevails.
(iii) In case the option is held to its maturity, what will be the expected value of the call option?

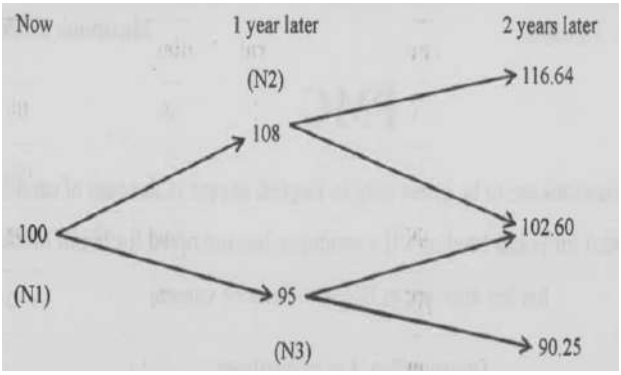
Question 5(5 Marks): The price of ACC stock on 31 December 2022 was Rs 220 and the Futures price on the same stock on the same date, i.e., 31 December 2022 for March 2023 was Rs 222. Other features of the Futures contract and related information are as follows:

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	-	Rs 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. Show Risk free income

Question 6(5 Marks):

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 Rs 98. The current price of the stock is Rs 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:

(i) The probability of price moving up and down;

(ii) Expected pay offs at each nodes i.e. N1, N2 and N3 (round off upto 2 decimal points).

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The investor thinks that the risk of portfolio is very high and wants to reduce the portfolio beta to 1.125. He is considering two below mentioned alternative strategies:

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(ii) Take appropriate position on Nifty Futures which are currently traded at 5000 and each Nifty points is worth Rs 500.

You are required to determine:

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(2) the value of risk free securities to be acquired,

(3) the number of shares of each company to be disposed off,

(4) the number of Nifty contracts to be bought/sold; and

(5) the value of portfolio beta for 4% rise in Nifty.

Answer:

Shares	**No. of shares (lakhs) (1)**	**Market Priceof Per Share(2)**	**× (2) (Rs lakhs)**	**% to total (w)**	**ß(x)**	**wx**
A Ltd.	10.00	400.00	4000.00	0.40	1.50	0.60
B Ltd.	6.00	500.00	3000.00	0.30	1.20	0.36
C Ltd.	5.00	600.00	3000.00	0.30	1.80	0.54
			10000.00	1.00		1.50

(1) Portfolio beta 1.50

(2) Required Beta 1.125

Let the proportion of risk free securities for target beta 1.125 = p 1.125 = 0 × p + 1.50 (1 – p)

p = 0.25 i.e. 25%

Shares to be disposed off to reduce beta (10000 × 25%) Rs2,500 lakh and Risk Free securities to be acquired.

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

Shares	% to total (w)	Proportionate Amount (Rs lakhs)	Market Price Per Share	No. of Shares (Lakh)
A Ltd.	0.40	1000.00	400.00	2.50
B Ltd.	0.30	750.00	500.00	1.50
C Ltd.	0.30	750.00	600.00	1.25

Alternatively, students can also compute above no. of shares by directly multiplying current holding with 25%.

(4) Number of Nifty Contract to be sold

$$\frac{(1.50-1.125) \times 10000\ lakh}{5{,}000 \times 500} = 150 \text{ contracts}$$

(5) 4% rises in Nifty is accompanied by 4% x 1.50 i.e. 6% rise for portfolio of shares

	Rs Lakh
Current Value of Portfolio of Shares	10000

Value of Portfolio after rise	10600
Mark-to-Market Margin paid on short position (5000 × 0.04 × 500 × 150)	150
Value of the portfolio after rise of Nifty	10450
% change in value of portfolio (10450 – 10000) / 10000	4.50%
% rise in the value of Nifty	4%
Beta	1.50

Question 2(5 Marks): Hari is holding 100 equity shares of VCC Ltd. which is being quoted at Rs210 per share. He is interested in hedging downside risk of his holding as he is going to sell them after 2 month. A 2-month Call option is available at a premium of Rs 6 per share and a 2- month put option is available at a premium of Rs 5 per share. The strike price in both cases is Rs 220.You are required to:
(i) Suggest the position Hari should take in the option market to hedge his holding in the VCC Ltd.
(ii) Calculate his final position after 2 months if after 2 months i.e. on the day of exercise the actual market price of per share of VCC Ltd. happens to be Rs 200, Rs 210, Rs 220, Rs 230 and Rs 240.

Answer:

(i) Since Hari holds 100 equity shares, he should buy equal no. of Put option i.e. 100 put options in the same stock to hedge his position.
Total Premium amount to be paid = 5 x 100 Put = Rs 500
(ii) Net Position after 2-months

(Rs)					
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
Inflow (in open market)	-	-	220	230	240
Less outflow (premium)	5	5	5	5	5
Position (per share) Total Position	215 21500	215 21500	215 21500	225 22500	235 23500

Thus, from above table it can be observed in any case the value of holding of Hari in VCC Ltd. shall not go below Rs 215 per share.

Question 3(5 Marks):

BSE Index	10000
Value of portfolio	Rs 12,00,000
Risk free interest rate	10% p.a.
Dividend yield on Index	5% p.a.
Beta of portfolio	1.70

We assume that a future contract on the BSE index with six months maturity is used to hedge the value of portfolio over next five months. One future contract is for delivery of 50 times the index.
Based on the above information CALCULATE:
(1) Price of future contract.
(2) The gain on short futures position if index turns out to be 8,500 in five months.

Answer:

BSE Index
(1) Current future price of the index = 10000 + 10000 (0.10-0.05)6/12 = 10000 + 250 = 10,250
Price of the future contract = Rs 50 x 10250 = Rs 5,12,500
(2) Hedge ratio = 12,00,000 *1.70 / 5,12,500 = 3.98 or 4 contracts
Index after three months turns out to be 8500
Future price will be = 8500 + 8500 (0.10-0.05) × 1/12 = 8535.42
Therefore, Gain from the short futures position is = 4 x (10250 – 8535.42) x 50 = Rs 3,42,916

Question 4(5 Marks): You as an investor had purchased a 4 month call option on the equity shares of X Ltd. of Rs 10, of which the current market price is Rs 132 and the exercise price Rs 150. You expect the price to range between Rs 120 to Rs 190. The expected share price of X Ltd. and related probability is given below:

Expected Price (Rs)	120	140	160	180	190
Probability	0.05	0.20	0.50	0.10	0.15

COMPUTE:

(i) Expected Share price at the end of 4 months.

(ii) Value of Call Option at the end of 4 months, if the exercise price prevails.

(iii) In case the option is held to its maturity, what will be the expected value of the call option?

Answer:

(i) Computation of Expected Share Price

= Rs120 X 0.05 + Rs140 X 0.20 + Rs160 X 0.50 + Rs180 X 0.10 + Rs 190 X 0.15

= Rs6 + Rs28 + Rs80 + Rs18 + Rs28.50 = Rs160.50

(ii) Computation of Value of Call Option = Rs150 - Rs150 = Nil

(iii) Computation of expected Value of Call Option if the option is held till maturity:

Expected price (X)	Value of call (C)	Probability (P)	CP
Rs 120	0	0.05	0
Rs 140	0	0.20	0
Rs 160	Rs 10	0.50	Rs 5
Rs 180	Rs 30	0.10	Rs 3
Rs 190	Rs 40	0.15	Rs 6
Total			Rs 14

Question 5(5 Marks): The price of ACC stock on 31 December 2022 was Rs 220 and the Futures price on the same stock on the same date, i.e., 31 December 2022 for March 2023 was Rs 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 - Rs 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. Show Risk free income

Answer:

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

Spot price + Interest Portion – Dividend

= 220 + (220 x 0.15 x 0.25) – (0.25 x 10) = 225.75

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

Advise to the Arbitrager.

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

After 3 months

1. Take money out of the Bank.
2. Take delivery by paying Rs 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. Total Inflow = 220 + (220 x 0.15 x 0.25) = Rs 228.25
Total Outflow = 222 + 2.50 = Rs 224.50
Net Gain to the Arbitrager = Total Inflow – Total Outflow
= Rs 228.25 - Rs 224.50
= Rs 3.75
Thus, the arbitrager earns Rs 3.75 per share without involving any risk.

Question 6(5 Marks):
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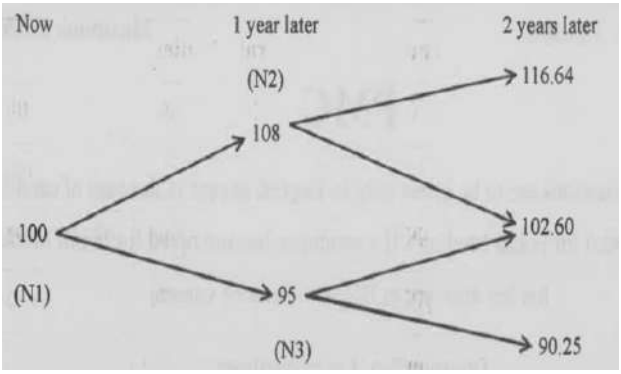

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Assume two time periods of one year each. Using the Binomial Model, calculate:
(i) The probability of price moving up and down;
(ii) Expected pay offs at each nodes i.e. N1, N2 and N3 (round off upto 2 decimal points).
Answer:
(i) Using the single period model, the probability of price moving up is
P = R-d/u-d = 1.05127-0.95/1.08-0.95 = 78%
Therefore, the probability of price moving down = 1 - 0.78 = 0.22 i.e. 22%
(ii)
Expected pay-off at Node N2
=0.78 ×18.64 + 0.22 × 4.60 / 1.05127 = Rs.14.79
Node N3
= 0.78 ×4.60 + 0.22 × 0/ 1.05127 = Rs.3.41
Node N1
= 0.78 × 14.79 + 0.22 × 3.41/ 1.05127 = Rs.11.69