

INSTITUTE OF ACTUARIES OF INDIA

EXAMINATIONS

May 2026

CM2B - Economic Modelling

Time allowed: 1 Hours 45 Minutes

Total Marks: 100

Q.1) CHOAM inc. is a company that offers various investment products to its customers. One of its products “Caladan Plus” claims to offer higher return than the market. You have been provided a sheet with the simulated returns for 100 scenarios over a 10-year period.

- i) Using this data, calculate the final fund value of an initial investment of INR 100,000 at the end of the 10 years under all scenarios. Also calculate the expected fund value at the end of the 10 years. [5]

- ii) Mr. Shaddam, the CEO of the company suggests that they offer a 3% p.a. guaranteed return on the product. This guarantee is applicable only to the fund value at the end of the 10th year and not the fund values until year 9.

You are now requested to calculate the probability of the final fund value being lower than the guaranteed fund value at the end of the 10 years. [7]

- iii) Mr. Duncan, the CFO of the company wants to assess the financial impact of offering this guarantee.

In this regard, please calculate the cost of offering this guarantee. You may assume a risk-free rate of 2% p.a. to discount the values back to present day. [8]

- iv) Mr. Duncan suggests that the company charge a percentage fee to the customers at the end of every year. This fee will be charged by deducting the said fee percentage from the annual return. You may assume that this fee is deducted even when the return for the year is negative.

Please calculate the highest fee percentage that the company can charge such that the probability of the final fund value being lower than the guaranteed fund value at the end of 10 years is not more than 20%. [8]

- v) The company decides to change its investment strategy by investing 50% of the initial fund value in a debt instrument which gives a fixed return of 3.5% p.a. and the rest as per its existing investment strategy. The company has decided to waive off the percentage fee.

Recalculate the probability of the final fund value being lower than the guaranteed fund value at the end of the 10 years as well as the expected fund value. [10]

- vi) Comment on the differences from (i) and (ii). [2]
[40 marks]

Q.2) Mr. Camus owns a car and is interested in insuring it. The repair cost (R) is given by the formula : $R = 100,000 * (x)$.

- i) The simulated values of x over a 100 scenarios have been provided in the workbook.

Calculate the expected repair cost for Mr. Camus' Car. Also calculate the probability that the repair cost is higher than the expected repair cost. [8]

- ii) Mr. Camus has initial wealth of INR 100,000 and his utility function given by :

$$U(w) = \sqrt{w} \text{ for } w > 0 ;$$

$$U(w) = 0 \text{ for } w \leq 0$$

Calculate the utility for Mr. Camus across all simulations as well as the expected utility. [6]

iii) Plot the utility function of Mr. Camus against wealth for values of wealth from 0 to 100,000 with a step of 5,000. Also, comment on the shape of the graph as well as Mr. Camus' risk appetite. [6]

iv) Kafka Inc. is an insurance company which specialises in Motor Insurance. It has a product which offers to insure all car repair losses upto a maximum of INR 100,000.

Mr. Camus expects the insurance premium to be anywhere from INR 500 to INR 15,000. Calculate the maximum premium (rounded up to the nearest 500) Mr. Camus will be willing to pay for this insurance.

(Hint: The utility after purchasing insurance should be greater than without purchasing insurance) [10]

[30 marks]

Q.3) Mr. Marcus is an investor who has a portfolio of shares of a company called Commodus Inc. He is looking at various investment strategies involving European Call and Put options. The current share price is INR 100 and the estimated volatility for the share is 15%. The risk-free force of interest is 6% p.a. There are no dividends paid during this time.

i) Calculate the price of the following options:

1. A call option expiring in one year with a strike price of INR 90
2. A put option expiring in one year with a strike price of INR 100

[8]

ii) Calculate the delta of the call and put option and comment on the difference between the two. [5]

iii) War has commenced in the country of Carthage. The revised estimate of the volatility of the share is now 25%.

Calculate the revised price of the options and comment on the difference in price from (i). [4]

iv) Mr. Marcus currently owns 1,000 shares of the company. He is looking to buy put options as above to hedge his downward risk.

Calculate the no. of put options (rounded up to 0 decimal) Mr. Marcus should buy such that the portfolio is completely delta neutral at time 0. Also calculate the value of the portfolio at that time. [6]

v) Mr. Nero, another investor claims that by holding a combination of a single call option and some cash, he will be replicate the payoff from a portfolio consisting of a single put option and a share. The call option will have the same strike price as Mr. Marcus' put option. You may assume the share price is 100 and the share volatility is 25%.

Calculate the amount of cash Mr. Nero needs to hold to create this replicating portfolio.
The cash holding can also be negative.

[7]

[30 marks]
