2025

MATHEMATICS — GENERAL

Paper : DSE-B-2

(Mathematical Finance)

Full Marks : 65

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Group - A

(Marks : 10)

1. Choose the correct alternative : 1×10

(a) If the amount P is borrowed for t years at a nominal interest rate of r per cent per year compounded continuously, then the amount owed at time t is

(i) $P(1+r)^t$ (ii) Pe^{rt}

(iii) Pe^{2rt} (iv) None of these.

(b) In portfolio analysis which curves play an important role?

(i) Circle (ii) Ellipse

(iii) Parabola (iv) Hyperbola.

(c) If the co-variance between stock A and market returns is 15 and the standard deviation of market return is 3 then what is the value of beta?

(i) 1.66 (ii) 1.67

(iii) 5.0 (iv) None of these.

(d) What is the real rate of interest if nominal rate is 10% and inflation rate is 4%?

(i) 5.7% (ii) 5.8%

(iii) 5.6% (iv) 3.8%.

(e) The net present value at a discount rate of 12% is ₹ 2,000 and at 11% it is ₹ 2,808. Which one of the following statements about the Internal Rate of Return (IRR) is correct?

(i) The IRR must be between 11% and 12%

(ii) The IRR mut be 11%

(iii) The IRR must be 12%

(iv) None of the above.

(f) The accumulated series of deposits as future sum of money is classified as

(i) Marginal fund (ii) Nominal fund

(iii) Sinking fund (iv) None of these funds.

(g) The money an investor receives for taking as a risk is called

(i) Risk premium (ii) Risk-free rate

(iii) Option value (iv) Arbitrage.

(h) X is a random variable with only two spectra defined by $P(X=-1)=p$ and $P(X=1)=1-p$, where $0<p<1$. The mean of X is

(i) p (ii) $(1-p)$

(iii) $(1-2p)$ (iv) 0.

(i) A four year zero-coupon bond has 6% yield. What is its duration in years?

(i) 4 (ii) 6

(iii) 7 (iv) 5.

(j) The price of a stock is ₹ 1,000, and there are 40% chances that it would be ₹ 950 and 60% chances that it would be ₹ 1,150 the next year. What is the percentage expected return?

(i) 7.5% (ii) 7%

(iii) 8% (iv) 10%.

Group - B

(Marks : 15)

Answer ***any three*** questions.

2. What do you mean by expected return and standard deviation? Give a suitable example to explain them. What is the difference between them? 2+1+2

3. An investor's portfolio consists of the following shares along with the value of investments and respective betas :

Share	Value Invested	Beta
A	45,000	0.8
B	29,000	0.6
C	68,000	1.3
D	12,000	1.8

Calculate portfolio's beta. 5

4. Define the terms :

(a) Efficient portfolio

(b) Minimum Variance point. 3+2

5. Many credit card companies charge interest at a yearly rate of 18% compounded monthly. If the amount M has been taken credit at the beginning of a year, how much has to pay at the end of the year if no previous payments have been made? 5

6. Find the pay-off from a bear spread created using put options. Also draw the profit diagram corresponding to this trading strategy. 3+2

Group - C

(Marks : 40)

Answer ***any four*** questions.

7. Prove that the curve in on $\bar{\pi} - \sigma$ diagram defined by non-negative mixtures of two assets 1 and 2 lies within the triangular region defined by the two original assests and the point on the vertical axis of height

$$A = \frac{\bar{\pi}_1\sigma_2 + \bar{\pi}_2\sigma_1}{\sigma_1 + \sigma_2}$$ 10

8. State Markowitz mean-variance problem. To solve this problem set the Lagrangian function. Give an outline to optimize this function. 3+2+5

9. An individual who plans to retire in 20 years has decided to put an amount A in the bank at the beginning of each of the next 240 months, after which she will withdraw ₹ 10,000 at the beginning of each of the following 360 months. Assuming a nominal yearly interest rate of 6% compounded monthly, how large does the amount A need to be? 10

10. Suppose that a portfolio manager purchase ₹ 10,00,000 of per value of an eight year bond that has a coupon rate of 7% and pays interest once per year. The first annual coupon payment will be made one year from now. How much will the portfolio manager have if

    (a) he holds the bond untill it matures eight year from now, and

    (b) can reinvest all the annual interest payments at an interest rate of 6.2%? 4+6

11. Name the six factors that affect stock option prices. Explain any four of them. 10

12. (a) Find the correlation coefficient between X, Y where $2X - 3Y + 1 = 0$.

    (b) An investor with capital x can invest any amount between 0 and x; if y is invested then y is either won or lost, with respective probabilities p and $1 - p$. If $p > \frac{1}{2}$, how much should be invested by an investor having a long utility function? 4+6

13. (a) Describe the method of bisection to find an approximate value of a real root of the equation $f(x) = 0$.

    (b) An investor who pays CF_0 to buy a bond that will pay coupon interest CF_1 after one year and CF_2 (coupon interest plus face value) after two years. The investor wants to find the internal rate of return or yield to maturity that solves the equation $CF_0 = \frac{CF_1}{1+IRR} + \frac{CF_2}{(1+IRR)^2}$. Find the internal rate of return by taking $CF_0 = 90$, $CF_1 = 10$, $CF_2 = 100$. 5+5
