

Chapter-wise Question Workbook

Chapter 1

Question 1 (Year: 2024) - [2 marks]

Q. 1) As we move down the indifference curve from left to right, the slope of the indifference curve tends to which of the following?

- I. Unity
- II. Zero
- III. Decline
- IV. Rise [2]

Question 11 (Year: 2024) - [4 marks]

Q. 11) A Gambler wins 500 when a coin comes up heads and loses 750 when the coin comes up tails.

If p is the probability of the coin showing heads then which of the following is a submartingale?

- a. Gambler's fortune over time when $p = 0.45$
- b. Gambler's fortune over time when $p = 0.5$
- c. Gambler's fortune over time when $p = 0.6$
- d. Gambler's fortune over time when $p = 0.65$
- I. a & b
- II. c & d
- III. a, b & c
- IV. b, c & d [4]

Chapter 2

Question 2 (Year: 2024) - [2 marks]

Q. 2) Which of the following statement(s) is(are) correct.

- a. random variables are defined in respect of sample spaces.
- b. probabilities measures are associated with sample spaces.
- c. probabilities measures are associated with event spaces.
- d. event space is a set containing the subsets of sample space.
- I. a & b
- II. c & d
- III. Only c
- IV. a, b & d [2]

Question 8 (Year: 2024) - [2 marks]

Q. 8) Consider the following inequalities relating to the probability of ruin for a claims process operating in continuous time. Which of these inequalities are correct?

[Here, u , u_1 and u_2 represent initial surplus and t , t_1 and t_2 represent time.]

- A. $\text{Prob}(u, t_1) \leq \text{Prob}(u, t_2)$ if $0 \leq t_1 \leq t_2$
- B. $\text{Prob}(u_1, t) \leq \text{Prob}(u_2, t)$ if $0 \leq u_1 \leq u_2$
- C. $0 \leq \text{Prob}(u, t) \leq 1$
- I. A and B only
- II. A and C only

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- III. B only
- IV. A, B and C [2]

Question 9 (Year: 2024) - [2 marks]

Q. 9) Which of the following(s) factors are ignored in the specification of Modern Portfolio Theory?

- a. rationality of the investors
- b. risk aversion of investors
- c. skewness of the distribution of returns
- d. kurtosis of the distribution of returns
- I. a & b
- II. c & d
- III. Only c
- IV. a, b & d [2]

Question 10 (Year: 2024) - [2 marks]

Q. 10) Pick the correct statement what do these symbols denote: Δ , σ , δ ?

- I. Change in derivative price w.r.t interest rate, share price, dividend rate respectively
- II. Change in derivative price w.r.t interest rate, time, volatility respectively
- III. Change in derivative price w.r.t volatility, share price, dividend rate respectively
- IV. Change in derivative price w.r.t interest rate, time, dividend rate respectively [2]

Chapter 3

Question 15 (Year: 2024) - [2 marks]

Q. 15) Which of the following invalidates continuous log normal assumption in modelling investment returns?

- a. Mean reverting nature of returns
- b. Volatility is constant over time
- c. Momentum effect of returns
- d. Drift is constant over time

- I. a & b
- II. c & d
- III. a & c
- IV. a, b & d [2]

Question 20 (Year: 2024) - [11 marks]

Q. 20) An investor has Rs. 1,00,000 to invest, for a period of 1 year, and has identified two investment opportunities in which to invest.

The first is a direct investment in a stock index for a period of 1 year. The annual return, X , on the index follows a Normal distribution with mean $\mu = 7\%$ p.a. and standard deviation $\sigma = 5.5\%$ p.a.

i) Calculate the following in respect of the investment at the end of 1 year:

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- a) The shortfall probability below a value of Rs. 90,000. (2)
- b) The 99.5% value at risk. (3)

The second opportunity is a derivative that offers the following payoff in 1 years? time based on the performance of the index during the year.

Payoff (Rs) Scenario

92,000 when $X \leq -7.1\%$

95,000 when $-7.1\% < X \leq 7\%$

1,20,000 when $X > 7\%$

ii) Calculate the expected payoff from the derivative at the end of the year. (4)

iii) Calculate the following in respect of the payoff from the derivative:

- a) The shortfall probability below a value of Rs. 90,000. (1)
- b) The 99.5% value at risk. (1)

[11]

Chapter 4

Question 3 (Year: 2024) - [2 marks]

Q. 3) If a market is inefficient and as a new information is received about a security then

- I. nothing will happen.
- II. the stock price will fall at first and then later rise.
- III. there will be a lag in the adjustment of the stock price.
- IV. there will be negative demand for the stock. [2]

Question 7 (Year: 2024) - [2 marks]

Q. 7) A company declares a cash dividend unexpectedly, what would be immediate effect on the value of call option and put option price on the company's share.

- a. The value of Call option will increase.
- b. The value of Put option will increase.
- c. The value of Call option will remain unchanged.

- d. The value of Call option will decrease.
- I. both a and b
- II. only c
- III. both b and d
- IV. only d [2]

Question 14 (Year: 2024) - [4 marks]

Q. 14) An analyst uses a two state continuous time model to study the credit risk of zero coupon bonds issued by different companies.

Company A has issued 10 year zero coupon bonds. The risk neutral transition intensity function for company A is as follows:

$$\lambda_A(s) = 0.05s, \quad 0 \leq s \leq 10$$

The risk-neutral probability that the bond will not default between times 5 and 10, given that it hasn't defaulted till time 5, is:

- I. 0.1362
- II. 0.1534
- III. 0.8466
- IV. 0.8825 [4]

Question 16 (Year: 2024) - [2 marks]

Q. 16) Claims occur on a portfolio of insurance policies according to a Poisson process at a Rate λ . All claims are for a fixed amount d , and premiums are received continuously. The insurer's initial surplus is U ($< d$) and the annual premium income is $1.5 \lambda d$. Pick the probability that ruin occurs at the first claim is:

- I. $1 - e^{(-1/1.5 (1-U/d))}$
- II. $1 - e^{(-1/1.5 (1-U/d\lambda))}$
- III. $1 - e^{(-1/1.5 \lambda (1-U/d))}$
- IV. $1 - e^{(-1/1.5 d (1-U/d))}$ [2]

Question 19 (Year: 2024) - [8 marks]

Q. 19) An investor makes decisions using the utility function $U(w) = \ln(w)$ where $w > 0$. The investor is going to invest INR 1000 now for a period of 1 year, and has identified the following two assets to invest in:

• Asset A is risk-free and will not change in value over the year.

• Asset B will increase in value by 50% over the year with probability 0.6 or decrease in value by 50% over the year with probability 0.4.

The investor does not make any allowance for discounting when making investment decisions. They are going to invest a proportion, x , of their wealth in Asset A and the remaining proportion, $(1 - x)$, in Asset B.

i) Construct a formula, in terms of x , for their expected utility at the end of the year. (3)

ii) Determine, using your result from part (i), the amount that the investor should invest in each asset to maximise their expected utility. (5)

[8]

Chapter 5

Question 6 (Year: 2024) - [2 marks]

Q. 6) Weak form of efficient markets hypothesis is represented by which of following statements:

- A. It should not be possible to consistently profit by selling winners and hanging onto losers.
 - B. It should not be possible to consistently profit by trading on any public information, such as that found on the Internet or in the financial newspaper.
 - C. It should not be possible to consistently profit by trading on private information, such as that obtained from a thorough analysis of the company and its industry.
 - D. It should not be possible to consistently profit by trading on inside information.
- I. Only A
II. Both A and B
III. Only D
IV. None [2]

Question 17 (Year: 2024) - [2 marks]

Q. 17) Which of the following statements is incorrect for Bornhuetter-Ferguson method:

- I. That whatever claims have already developed in relation to a given origin year, the future development pattern will follow that experienced for other origin years.
- II. It combines the estimated loss ratio with a projection method such as Chain ladder method.
- III. it could be applied to the development of paid claims, using either an accident year or policy year cohort.
- IV. It assumes that first accident year is not fully run off. [2]

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Chapter 7

Question 21 (Year: 2024) - [10 marks]

Q. 21)

i) Write down the general form of a statistical model for a claims run-off triangle, defining all terms used. (4)

The table below shows the cumulative incurred claims on a portfolio of insurance policies.

Development Year

Accident Year 1 2 3

2021 1300 1800 1900

2022 1400 1850

2023 1500

The company decides to apply the Bornhuetter-Ferguson method to calculate the reserves, with the assumption that the Ultimate Loss Ratio is 80%. Claims are assumed to be fully

run off by development year 3.

The earned premium for 2023 is 3000 and the paid claims for 2023 are 1000.

ii) Calculate the reserve in respect of the accident year 2023. (6)

[10]

Chapter 8

Question 12 (Year: 2024) - [2 marks]

Q. 12) The adjustment coefficient α in Lundberg's inequality is negative. Then which of the following is true:

- I. The statement is incorrect as α is only positive.
- II. The statement is incorrect as α is unique and positive.
- III. The statement is incorrect as α is unique and negative.
- IV. The statement is correct as α is always a root of Lundberg's inequality. [2]

Question 22 (Year: 2024) - [6 marks]

Q. 22) In a Black-Scholes market, the stock price is given by:

$$S_t = S \exp(0.2B_t + 0.2t)$$

0

where B_t is a standard Brownian motion under the real-world probability measure.

A derivative security written on the stock in the same market at time t has price:

$$D_t = 2 \exp(0.6(\beta + ct) + 0.39t)$$

t

where β is a standard Brownian motion under the equivalent martingale measure.

t

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Determine the value of c such that $B + ct$ is a standard Brownian motion under the

t

equivalent martingale measure. [6]

Chapter 9

Question 5 (Year: 2024) - [4 marks]

Q. 5) For a 3-month European call option of a non-dividend paying share the current share price is $\$1040$ and strike price is $\$1000$. If the risk-free interest rate is 12% per annum and volatility is 30% per annum then find the price of call option.

- a. The price of this call option is 101.1.
- b. If the strike price and current share price is halved then the price of call option will be

half of the price calculated in (a).

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c. If the strike price and current share price is halved then the price of call option will be double of the price calculated in (a).

d. Given information not sufficient to calculate the price of call option.

Which of the statement is correct?

I. Only d is correct

II. both a and b is correct

III. both a and c is correct

IV. only a is correct [4]

Question 23 (Year: 2024) - [6 marks]

Q. 23) An investor has the choice of the following assets that earn rates of return as follows in each of the four possible states of the world:

State Probability Asset 1 Asset 2 Asset 3

1 0.2 4% 5% 6%

2 0.3 4% 12% 5%

3 0.1 4% 2% 3%

4 0.4 4% 1% 7%

Market Capitalisation 20,000 20,000 80,000

Determine the market price of risk assuming CAPM holds. Define all terms used. [6]

Chapter 10

Question 18 (Year: 2024) - [19 marks]

Q. 18) Let S_t be a stock price process which follows a geometric Brownian motion according to the following stochastic differential equation (SDE):

$$dS_t = (\mu + \frac{1}{2} \sigma^2) S_t dt + \sigma S_t dW_t$$

where μ and σ are constants, and W_t is a standard Brownian motion.

Let B_t be a risk-free bond whose price grows deterministically at the risk-free rate r , continuously compounded, according to the formula $B_t = e^{rt}$

i) Derive the SDE for the discounted stock price process $D = \frac{S_t}{B_t}$. (7)

$t \geq t$

Let $X = f(S_T)$ be a path-independent claim on S_T for some horizon T .

ii) Describe what is meant by a self-financing and replicating strategy for X . (3)

iii) Explain the steps needed to construct a replicating strategy for X that enables the claim to be valued. (9)

[19]

Chapter 11

Question 4 (Year: 2024) - [2 marks]

Q. 4) Consider an American put option on a non dividend paying share. Which of the following statement(s) is/are correct.

- a. Increase in the share price will decrease the value of put option.
- b. Increase in the exercise price will decrease the value of put option
- c. Increase in the time to expiry will decrease the value of put option
- d. Increase in the risk free interest rate will decrease the value of put option

I. only a

II. Only a & b

III. Only a & d

IV. None of the above [2]

Chapter 12

Question 13 (Year: 2024) - [2 marks]

Q. 13) Which of the following behaviours of insured policyholders is Adverse selection?

A. A person with co-morbid conditions availing a group term insurance through the employer

B. A vehicle owner parking the car below a tree during windy rainy season

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C. A biker riding the bike carelessly after buying additional accidental cover

I. Only A

II. Both A and B

III. Both B and C

IV. All of the above [2]