

Name of Course	: CBCS B.Sc. (H) Mathematics
Unique Paper Code	: 32357504
Name of Paper	: DSE-II Mathematical Finance
Semester	: V
Duration	: 3 hours
Maximum Marks	: 75 Marks

Attempt any four questions. All questions carry equal marks.

1. Consider a stream of cash flows $(-5, 2, 2, 2, 2, 2)$ received at time points $t = 0, 1, 2, 3, 4, 5$ where the time is measured in years. Let the rate of interest be 10% per annum compounding annually. Determine present and future values of the cash flow stream and verify the relationship between them. Also find the internal rate of return (up to two decimal places) of the cash flow stream.
2. Consider two 12-year bonds: one has 8% coupon, face value \$100 and yield 8% per annum compounded annually; the other has 10% coupon, face value \$100 and yield 9% per annum compounded annually. Find the price of these bonds assuming that the coupon is paid at the end of each year. Identify the bond which is more sensitive among the two and give reasons for your answer. Also find the price of a 12-year zero coupon bond.
3. Assume that there are three assets having mean rates of return $\bar{r}_1 = 8\%$, $\bar{r}_2 = 10\%$, $\bar{r}_3 = 6\%$, standard deviations $\sigma_1 = 1.5$, $\sigma_2 = 0.5$, $\sigma_3 = 1.2$ and correlations $\rho_{12} = 0.3$, $\rho_{23} = 0$, $\rho_{13} = -0.2$.
 - (a) Find the covariance matrix for these three assets.
 - (b) Find the mean rate of return and the standard deviation of portfolio P_1 consisting of the above three assets with respective weights $w_1 = 40\%$, $w_2 = -20\%$, $w_3 = 80\%$.
 - (c) Find the mean rate of return and the standard deviation of portfolio P_2 consisting of the above three assets with respective weights $w_1 = 30\%$, $w_2 = -10\%$, $w_3 = 80\%$.
 - (d) Find the mean rate of return and the standard deviation of portfolio P_3 consisting of the above three assets with respective weights $w_1 = 20\%$, $w_2 = 10\%$, $w_3 = 70\%$.
 - (e) Plot the points representing portfolios P_1 , P_2 , P_3 on the \bar{r} - σ diagram.
 - (f) Identify the least risky portfolio and the portfolio with maximum risk.
4. Assume that the risk-free rate of interest is 7%, the mean rate of return and the standard deviation of the market portfolio are 12% and 17% respectively. Assume that the market portfolio is efficient.
 - (a) Find the equation of the capital market line.
 - (b) If the standard deviation of the rate of return of a risky asset A is 30%, then find the mean rate of return predicted by the capital market line.
 - (c) How will you allocate \$2000 to achieve the mean rate of return obtained in part (b)?
 - (d) If you invest \$500 in the risk-free asset and \$1500 in the market portfolio, how much money do you expect to have at the end of the year.

5. A 1-year long forward contract on a non-dividend paying stock is entered into when the stock price is \$300 and the risk-free rate is 10% per annum compounding continuously. What are the forward price and initial value of a forward contract? Six months later the price of the stock is \$350 and the risk-free rate is still 10%. Obtain the forward price and the value of forward contract.
6. The current price of a non-dividend paying stock is \$29 and the price of a six-month European call option on the above stock with strike price \$30 is \$2. The risk-free rate of interest is 4% per annum compounding continuously. Find the price of a 6-month European put option written on the same stock with strike price \$30. If the above European put and call options are selling at \$3 and \$4 respectively, then identify an arbitrage opportunity if it exists.

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