

This examination consists of five problems graded on a scale from zero to six points.

Please justify your answers and write your name, student registration number, and degree programme clearly on each answer sheet.

Only a basic calculator is allowed as extra equipment.

1. Provide concise explanations for the following concepts:
 - (a) Forward contract (1p)
 - (b) Short rate (1p)
 - (c) Two-fund theorem (1p)
 - (d) Minimum variance hedge (1p)
 - (e) Minimum variance portfolio (1p)
 - (f) Margin call (1p)
2. Are the following statements true or false? Please provide detailed justifications for your answers.
 - (a) A bond is a risk-free asset. (1p)
 - (b) Systematic risk of stock portfolios can be removed by diversification. (1p)
 - (c) In the capital budgeting problem, selecting projects based on the decreasing order of their benefit-cost ratios guarantees that the optimal project portfolio will be selected. (1p)
 - (d) If the stock does not pay dividends, it is never optimal to exercise an American call option on this stock before the maturity date. (1p)
 - (e) The internal rate of return (IRR) is uniquely defined for all cash flow streams. (1p)
 - (f) If the interest rates rise, the price of a European call option goes up (other things being equal). (1p)

3. Consider a simple stock market in which there are only two stocks A and B whose parameters are in the table below. The correlation between the returns of the two stocks is $\rho_{AB} = 0.5$. Investors have access to unlimited borrowing at the risk-free rate r_f and the market is assumed to satisfy the assumptions of the Capital Asset Pricing Model.

Stock	Number of shares in the market	Price (\$)	Expected return	Standard deviation of returns
A	400	16.00	15%	27%
B	200	13.00	8%	14%

- (a) What are the expected return and the standard deviation of the market portfolio? (2p)
- (b) What are the β 's of stocks A and B? (3p)
- (c) What is the risk-free rate? (1p)
4. Consider the following bond and liability structure:

Item	Year 1	Year 2	Year 3	Year 4
Bond 1 cash flow	10	10	110	0
Bond 2 cash flow	5	5	5	105
Liability cash flow	2000	1500	1000	500
Spot rates	2.5%	2.9%	3.05%	3.2%

- (a) Determine the net present value (NPV) for both bonds and the liability cash flow. (2p)
- (b) Construct an immunizing investment portfolio consisting of bonds 1 and 2 in order to hedge against parallel shifts in the spot rates. (3p)
- (c) How much does the value of the immunizing portfolio and the liabilities change when the parallel shift in spot rates is 1%? (1p)
5. Consider a stock which is currently valued at $S(0) = 60 \text{ €}$ whose relative price changes are described by $u = 1.20$ and $d = 0.83$. The probability of the stock moving upwards is $p = 0.5$. The annual risk free rate is $r_f = 5\%$. What is the price of a European call option whose strike price K is 65 € and which expires in three months if the stock pays a dividend of 2 € at the end of the second month? (6p)