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

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

1. Provide concise explanations for the following concepts:

   a) Forward contract. (1p)
   b) Synthetic option. (1p)
   c) Certainty equivalent. (1p)
   d) One fund theorem. (1p)
   e) Forward rate. (1p)
   f) Jensen's α index. (1p)

2. Are the following statements true or false? Justify your answer.

   (a) If the maturity of Bond A is longer than that of Bond B, then the duration of Bond A must inevitably be higher than that of Bond B. (1 p)

   (b) The security market line shows how the expected returns $\overline{r}$ of individual assets perform relative to the market portfolio as a function of their volatility σ. (1p)

   (c) In the standard capital budgeting problem, choosing projects in the order of decreasing benefit-cost ratios (i.e., project with the highest benefit-to ratio is selected first) always leads to the selection of the project portfolio which offers the highest possible total benefit for the available budget. (1p)

   (d) Bonds belong to the class of interest rate derivatives. (1p)

   (e) The price of a European call option goes down if the interest rates go up (assuming that there are no dividends). (1p)

   (f) If the expectations hypothesis of interest rates holds, the prices of futures and forward contracts are equal for the delivery of the same commodity at the same time and place. (1p)

3. A farmer will be harvesting 150 000 kg of barley in 3 months. He is worried about possible price changes and is therefore interested in hedging. There are no futures contracts available for barley, but there are futures contracts for wheat. The spot prices are currently 0.30€ for wheat and 0.40€ for barley, respectively. The standard deviations of both prices are 20% annually, and the correlation between them is 0.70. What is the minimum-variance hedge for this farmer? How effective is this hedge in comparison with no hedging?

4. Consider a stock which is currently valued at $S(0) = 100$€ and whose logarithmic price is expected to rise annually by $\nu = 12\%$ with volatility parameter $\sigma = 20\%$.

   (a) Determine suitable parameters for a binomial lattice which represents the price process of this stock with a basic period of 3 months. Draw the lattice for four periods (i.e., one year) and enter the node values representing stock prices. With what probabilities are the different final nodes of the lattice reached? (3p)

   (b) Consider an American put option that has been written on this stock so that the strike price is $K = 90$€ and the expiration date $T = 1$ is a year from now. If the yearly risk-free rate is 10%, what is the value of this option? (3p)

5. Assume that the expected rate of return on the market portfolio is 15% and the risk-free interest rate is 5%. The standard deviation of the market is 20%. Assume that the market portfolio is efficient.

   (a) What is the equation of the capital market line? (2p)

   (b) If an expected return of 40% is desired, what is the standard deviation of this position? If you have 1 000€ to invest, how should you allocate it to achieve the above position? (2p)

   (c) If you invest 300€ in the risk-free asset and 700€ in the market portfolio, how much money can you expect to have at the end of the year (2p)?