UNIVERSITY OF OSLO
DEPARTMENT OF ECONOMICS

Exam: **ECON4510 – Finance Theory**

Date of exam: Tuesday, June 5, 2018   **Grades are given:**   June 19, 2018

Time for exam: 09.00 – 12.00

The problem set covers 4 pages (incl. cover sheet)

Resources allowed:
*   No written or printed resources – or calculator - is allowed (except if you have been granted use of a dictionary from the Faculty of Social Sciences)

The grades given: A-F, with A as the best and E as the weakest passing grade. F is fail.

YOU MAY ANSWER IN ENGLISH OR NORWEGIAN.

Some advice: Start by reading through the whole exam, and make sure that you allocate time to answering questions you find easy. You can get a good grade even if there are parts of problems that you do not have time to solve. It is better to try to do something on each question than to get bogged down with one question. If you find you are spending too much time on one question, stop working on it and plan to get back to it if you have time at the end. Make sure you state any assumptions you make.

1. **Asset pricing [60%]:** Consider an economy where all households have linear-quadratic preferences $U_i(c) = \xi_i c - \phi_i c^2$ (but not necessarily the same preference coefficients ξ_i and ϕ_i). Each household i has some wealth to invest and has no other income. Moreover, assume that the households do not face any liquidity constraint (i.e., no binding borrowing constraint).

   (a) Suppose the household is offered two assets – a safe asset with return r_f and a risky asset with return $\tilde{r}$. Explain why the household will have a positive amount of the risky asset if and only if $E\{\tilde{r}\} > r_f$.

   (b) Suppose the households can choose a portfolio comprising many risky assets (which are imperfectly correlated). Show that the household cares only about the expected return μ and the standard deviation σ of the portfolio.

   (c) Assume that one of the available assets is a risk free asset with return r_f.

      i. Illustrate the set of optimal portfolio choices for the households.
      ii. Show that all households will choose a combination of only two portfolios.

   (d) Let $\tilde{r}_M$ denote the return on the market portfolio and let the covariance between the return on asset j and $\tilde{r}_M$ be given by $cov(\tilde{r}_M, \tilde{r}_j)$. Derive an expression for the expected return $E\{\tilde{r}_j\}$ in equilibrium. Provide an interpretation of the results.

   (e) Suppose that households derive consumption from the return on the portfolio plus some labor income. Namely, each household works in one of the firms whose stocks are traded. Moreover, assume that the household's wage is positively correlated with the return on the stock of the firm they work for.

      i. Will the result in 1.c.ii (that all households invest in two portfolios) survive? Substantiate your answer.
      ii. What is the optimal portfolio now?

(f) Assume that the return on the market portfolio has $E\{\tilde{r}_M\} = 6\%$ and $std(\tilde{r}_M) = 10\%$ and that the risk free rate is $r_f = 1\%$. Consider now the return on a particular stock, say Yara. Assume that covariance between the return on the Yara stock, $\tilde{r}_Y$, and $\tilde{r}_M$ is given by $cov(\tilde{r}_Y, \tilde{r}_M) = 0.012$. Calculate the expected return on the Yara stock.

(g) Suppose we learn that Yara has undertaken an investment (in a hotel in China, say) and that this investment will add new risks to the return $\tilde{r}_Y$. Namely, the new return on the Yara stock, $\tilde{R}_Y$,

$$\tilde{R}_Y = \tilde{r}_Y + \tilde{x},$$

where $\tilde{x}$ reflects the added risk associated with the hotel investment, so that the volatility of the return increases;. Moreover, suppose $corr(\tilde{x}, \tilde{r}_M) < 0$. How will the news influence the price of the Yara stock? Substantiate your answer.

(h) Suppose there is no safe asset. How does the optimal portfolios change? Is it possible that each household holds a different portfolio and that no individual household holds the market portfolio?

2. **Portfolio manager evaluation and empirical testing [25%]:**

   (a) Suppose the household asks a portfolio manager to invest the funds. The household is interested in evaluating the portfolio manager, i.e., to determine if the manager is doing a good or a bad job.

      i. Explain why the household needs an asset pricing theory in order to evaluate a portfolio manger
      ii. Suppose the household believes that CAPM is true. How should the portfolio manager be evaluated?
      iii. The portfolio manager claims that he/she can "beat the market" since the expected return on his/her portfolio is higher than $E\{\tilde{r}_M\}$. Explain why the portfolio manager's argument is misleading.

   (b) The portfolio manager proposes to pursue a well-known trading strategy (i.e., a portfolio P) of going long in stocks which pay large dividends (relative to the price of the stock) and short in stocks paying little dividends. Suppose you observe that over time the expected return on this portfolio strategy is $E\{\tilde{r}_P\} = 11\%$ while the covariance with $\tilde{r}_M$ is $cov(\tilde{r}_P, \tilde{r}_M) = 0.018$.

      i. Based on this observation, what would you conclude about the asset pricing formula in (1.d) and the theory associated with it? Is this a valid empirical test?

   (c) Given the insight in 2.b, how would you design a plan for evaluating the portfolio manager?

3. **Options [15%]**

    (a) Show that one can construct the payoffs of a put option by making a portfolio combining three assets: a call option, riskfree debt, and the underlying asset.

    (b) An "American" option can be executed any day until the expiration date. Explain why it can never be optional to execute a put option before the expiration date. Why does this not necessarily hold for call options?

    (c) Suppose the price of a Yara stock is NOK 200. Moreover there exists a call option on Yara with strike price 250 (with strike date in one month). Moreover, assume that there are no dividends over the next month and that the risk free interest is zero. What would be the price of a put option on Yara with strike price 250 in one month?

    (d) Consider a stock with current price $S = 100$. One month from now the stock can either increase by 48% with some probability p or decline by 13.4% with probability $1 - p$. Suppose there exists a call option on the stock with strike price $K = 105$ and strike date one month from now. Moreover, suppose risk free debt has a (compounded) interest rate 1% per month and assume the stock will not have any dividends over the next month.

        i. Show that by using a portfolio comprising the bond and the stock it is possible to mimic the payoff of the option.

       ii. What weights does one need to mimic the option?

      iii. What is the price of the option?