Examination: 1904 – Securities Analysis **Summer Term 2008**

Examiner: Prof. Dr. Peter Reichling

You are welcome to use non-programmable pocket calculators as well as English-language dictionaries without any markings. This examination comprises five problems (on five pages). All of the problems are to be solved. If you are not able to compute any values which are to be used in the following parts of a problem just assume some plausible (!) ones. We will then use your assumed values in correcting your exam. Always show your way of computation (except for the multiple choice part). There will be no points given for the pure result without any calculations. **Good luck!**

Examination Questions (Total Number of Points: 120)

Problem 1 (Duration and Convexity – 30 Points)

Assume a flat term structure is given at 4.5% p.a. Furthermore, there is a coupon bond at the bond market with a maturity of five years, a coupon rate of 7.5% (annual payment), and a face value of 100€.

(a) Compute the price of the coupon bond. (2 points)

(b) Compute the duration (D) and the modified duration (MD) of the coupon bond. (6 points)

(c) By using (b), determine approximately the price of the bond if the term structure shifts downward by 150 bps. (2 points)

(d) A more accurate pricing of the bond after a shift of the term structure is possible when using the convexity of a bond as an additional measure. Write down the general formula of the convexity of a coupon bond (hint: convexity is defined as $Conv = \frac{1}{P} \cdot \frac{\partial^2 P}{\partial r^2}$, where P is the price of the bond) and compute the convexity of the given coupon bond. Use the so called duration-with-convexity rule to compute the price of the given bond if the term structure shifts downward by 150 bps. (hint: use the formula $\frac{\Delta P}{P} = -MD \cdot \Delta r + \frac{1}{2} \cdot Conv \cdot (\Delta r)^2$) (11 points)

(e) What is the duration of

(i) a zero bond, (1 point)

(ii) a floating rate note, and (1 point)

(iii) a (level) perpetuity (just the formula). (1 point)

(f) Complete the following sentences:

(i) Holding maturity constant, a bond's duration is higher when the coupon rate is... (1 point)

(ii) Holding the coupon rate constant, a bond's duration for bonds selling at par increases, when maturity... (1 point)

(iii) Holding other factors constant, the duration of a coupon bond is higher when the bond's yield to maturity is... (1 point)

(g) Give three interpretations of the duration. (3 points)

Problem 2 (Term Structure of Interest Rates, Forward Rates – 15 Points)

Suppose there are four zero-coupon bonds (ZB) on the market with the following characteristics:

ZB	Maturity (in years)	Par Value	Price
ZB1	1	100	93.90
ZB2	2	100	89.34
ZB3	3	100	86.14
ZB4	4	100	83.54

(a) Compute the term structure of interest rates (spot rates). What kind of term structure is given? (5 points)

(b) Compute the corresponding forward rates. (4 points)

(c) Compute the price of a coupon bond with a maturity of two years, a coupon of 4%, paid annually, and a face value of 100€. What is its yield to maturity? (3 points)

(d) Compute the values of the forward rates $f_{1,3}$, $f_{1,4}$, and $f_{2,4}$, i.e., the interest rate p.a. (fixed today) for an investment with maturity 2 and 3 years, respectively, that starts in one year and two years, respectively. (3 points)

Problem 3 (Risk, Certainty Equivalent – 21 Points)

Suppose you have the following two prospects: prospect 1 is a risky prospect that generates a payment (after one year) of 200,000€ with a probability of 0.55, a payment of 120,000€ with a probability of 0.20, and a payment of 60,000€ with a probability of 0.25. Prospect 2 offers a return of 4.5% p.a. with certainty.

(a) What is the expected return of prospect 1? (1 point)

(b) Compute the value of prospect 1 if you demand a risk premium of 7%. (4 points)

(c) Compute the standard deviation of prospect 1 in terms of rate of return. (3 points)

(d) Assume your utility function is given as $u(x) = \sqrt{x} \cdot \frac{1}{10}$. Compute your certainty equivalent and explain if you are risk averse, risk neutral or risk seeking. (4 points)

(e) Decide and explain which prospect of the above given ones you prefer. (3 points)

(f) Suppose another investor demands a risk premium of 14%. Compute his fair value of prospect 1. (2 points)

(g) Use your results from (a) and (f) to draw a diagram (with all possible intercepts!) which shows the relationship between (nonnegative) risk premia and the value of prospect 1, where the risk premium is the independent variable. (4 points)

Problem 4 (Optimal Risky Portfolios – 22 Points)

Suppose you are managing a risky portfolio with a volatility of 25% and your portfolio offers a risk premium of 9%. The risk-free interest rate is assumed to be 6%.

(a) Your client chooses to invest 62.5% of his portfolio in your fund and the remaining part in the risk-free asset. Compute the expected return and standard deviation of the rate of return of your clients portfolio. (3 points)

(b) Suppose your risky portfolio consists of 4 stocks A, B, C, and D, where stock A has a proportion of 15%, stock B has a proportion of 41% and the proportion of stock C is three times the proportion of stock D. Compute the proportions of stock C and D, and compute all proportions in your client's overall portfolio (including the risk-free asset). (6 points)

(c) Compute the reward-to-variability ratio (Sharpe-ratio) of your and your client's portfolio. Proof that the Sharpe-ratio of any combination of the risky asset and the risk-free asset cannot be different from the Sharpe-ratio for the risky asset alone. (5 points)

(d) Suppose your client decides to invest a proportion ω in your risky portfolio so that his overall portfolio will generate an expected return of 19.5%.

   (i) Compute the proportion ω. (1.5 points)

   (ii) Write down the exact strategy (proportions in client's portfolio in €) you tell your client, if the investment amount is 100,000€. (4 points)

   (iii) Compute the standard deviation of the rate of return on your client's portfolio. (0.5 points)

(e) Suppose the standard deviation you just computed in (d) is too high for the client. Now your client wants to have a maximum standard deviation of 20%.

   (i) Compute the new proportions ω and $(1-\omega)$ that have to be invested in the risky and the risk-free asset so that the expected return on the client's portfolio is maximized under the given constraint. (1 point)

   (ii) Compute the expected return of the client's portfolio and the amount in € he or she receives when investing 100,000€ for one year. (1 point)

Problem 5 (Capital Asset Pricing Model (Multiple Choice) – 32 Points)

The following multiple choice part comprises eight questions. For each question, four answers are given, but only <u>one</u> answer is correct. You are allowed to (clearly) indicate your answers on this sheet. Every correct answer yields 4 points, every incorrect answer yields -2 points. If you do not answer a question, you will get 0 points. However, the total points for this problem cannot be negative.

(a) The security market line depicts:

   (i) A security's expected return as a function of its systematic risk.

   (ii) The market portfolio as the optimal portfolio of risky securities.

   (iii) The relationship between a security's return and the return on an index.

   (iv) The complete portfolio as a combination of the markte portfolio and the risk-free asset.

(b) Within the context of the capital asset pricing model (CAPM), assume that the expected return on the market is 15%, the risk-free rate is 8%, the expected rate of return on stock X is 17% and the beta coefficient of X is 1.25. Which one of the following statements is correct?

(i) X is overpriced.

(ii) X is fairly priced.

(iii) X's alpha is -0.25%.

(iv) X's alpha is 0.25%.

(c) What is the expected return of a zero-beta security?

(i) Market rate of return.

(ii) Zero rate of return.

(iii) Negative rate of return.

(iv) Risk-free rate of return.

(d) Capital asset pricing theory asserts that portfolio returns are best explained by:

(i) Economic factors.

(ii) Specific risk.

(iii) Systematic risk.

(iv) Diversification.

(e) According to the CAPM, the expected rate of return of a portfolio with a beta of 1.0 and an alpha of 0 is:

(i) Between the expected market rate of return, r_M, and the risk-free rate of return, r_f.

(ii) The risk-free rate of return, r_f.

(iii) $\beta(r_M - r_f)$.

(iv) The expected return on the market, r_M.

(f) Suppose the following data: Expected return on the market is 14%, the volatility of the market is 12%, and the beta is 1.0. Assume there is a portfolio Q with an expected return of 11%, a volatility of 10%, and a beta of 0.5. When plotting Q relative to the **security market line** (SML), portfolio Q lies:

(i) On the SML.

(ii) Below the SML.

(iii) Above the SML.

(iv) Insufficient data given.

(g) Suppose the following data: Expected return on the market is 14%, the volatility of the market is 12%, and the beta is 1.0. Assume there is a portfolio Q with an expected return of 11%, a volatility of 10%, and a beta of 0.5. When plotting Q relative to the **capital market line** (CML), portfolio Q lies:

(i) On the CML.

(ii) Below the CML.

(iii) Above the CML.

(iv) Insufficient data given.

(h) Assume a portfolio A has a beta of 1.0 and the specific risk for each individual security in the portfolio is high. Portfolio B has a beta of 1.0 as well, but the specific risk for each individual security in the portfolio is low. According to the CAPM, which portfolio has a higher expected rate of return?

(i) Return on A is higher than on B.

(ii) Return on A is equal to the return on B.

(iii) Return on A is lower than on B.

(iv) Insufficient data given.