Vrije Universiteit Amsterdam
Faculty of Economics and Business Administration

Program:	M.Sc. Finance
Exam:	Investments 4.1
Program:	M.Sc. Finance, period 4.1
Vakcode:	60412040
Date:	December 14, 2005
Tijd:	8:45 – 11:30
Duration:	2 hours, 45 minutes
Parts:	The exam has 4 questions. The first two questions (1 and 2) are for the part taught by prof. Frijns. The second two questions (3 and 4) relate to the part taught by prof. Lucas. Each question makes up 25% of your grade for this written exam. Perhaps redundantly: the written exam makes up 70% of your final grade. The remaining 30% is scored by the cases done during the lecture period.
Score:	Each of the four questions in the exam yields you a maximum of 10 points. Your total score cannot exceed 40 points. The grade for this written exam is obtained by dividing the points scored by 4.
Results:	Results will be made known as soon as possible, but at the latest January 2, 2006.
Inspection:	You can inspect your marked exam papers Wednesday, January 4, 9:00am. The room will be announced via the monitor system.
Remark:	Provide complete answers (including computations where appropriate). Always provide motivation/explanation of your answer, even if this is not mentioned explicitly in the question. A short 'yes' or 'no' will never do as an answer. Use your time efficiently.

Please answer Questions 1+2 on a separate sheet from Questions 3+4. This will speed up marking considerably.

Good luck!

This document has 7 pages.

QUESTION 1

A portfolio manager decides to switch from a traditional fundamental stock selection technique towards a more modern factor-approach. He uses a two-factor model using the market factor and a value factor, with the following (classical) notation:

$$R_i = r^f + \alpha_i + \beta_i(R_m - r^f) + \gamma_i(HML) + \varepsilon_i$$

Part a.
Write down the formulas for the expected return and the variance of R_i in terms of the underlying factors.

To estimate the characteristics of the value-factor HML, the portfolio manager ranks all the stocks on the base of their dividend-yield. He then forms 5 sub-portfolios with S1 the sub-portfolio with the highest dividend-yield and S5 the one with the lowest dividend-yield. The portfolio S1-S5 is the mimicking portfolio which he uses as a proxy for the value-factor. He finds the following results, based on a sample of 60 monthly observations:

Portfolio	β portfolio	mean return (annualized)	st-deviation (annualized)	residual risk
S1	1	0.12	0.23	0
S2	1	0.10	0.22	0
S3	1	0.10	0.20	0
S4	1	0.08	0.23	0
S5	1	0.07	0.24	0
S1-S5	0	0.05	0.10	0

Part b.
Explain why the β of the portfolio S1-S5 is zero and why the standard deviation of this portfolio is much lower than that of the underlying portfolios S1 and S5.

Part c.
What is the standard deviation of the value-factor (S1-S5) and give the risk decomposition of S2 if you know that the exposure γ_{S2} to the value-factor (S1-S5) is 0.5. Assume that all factors are uncorrelated.

The manager defines the active risk of his portfolio P as $STD(R_p - R_m)$. His portfolio has a market-beta of 0.9 and an exposure to the value factor (S1-S5) of 1.5. The residual risk is close to zero.

Part d.
Compute the active risk, assuming that the true standard-deviation of the market risk is 0.20.

After some thinking, the manager decides to market the mimicking portfolio S1-S5 as a long-short hedge fund.

Part e.
What is the active risk of this portfolio, and what is the total risk? Which risk measure is most appropriate for a hedge fund?

QUESTION 2 (CONCEPT CHECKS)

Part a.
A junior portfolio manager has to investigate whether an in-house analysis of Economic Value Added (EVA) can be used as a reliable alpha source. For all 500 stocks in his universe this manager computes EVAs and scales them in such a way that they are comparable. The rescaled EVA-variable for stock *i* is denoted g_i, the average of g_i over all stocks is 0. As a following step he wants to test the "forecasting" power of g_i. Explain how you would do that if the available dataset consists of the g_i and the return-data for these 500 stocks in respectively month (t-1) and month t. Can this be a successful strategy in terms of IR?

Part b.
The Grinold-Kahn formula for the stock return model is as follows:

$$R = X\, b + \varepsilon,$$

with $COV(b) = F$ and $Cov(\varepsilon) = \Delta$. The portfolio P is defined as $R_p = w' R$.
Write down the formula for the variance of R_p.

Part c.
Portfolio P is a long only, equally-weighted portfolio, invested in 100 stocks. Q is a long-short portfolio which is long in 100 stocks and short in another 100 stocks. The position in each individual stock is the same: equal *absolute* weights. The residual risk of each individual stock is $\sigma(\varepsilon) = 0.10$. Compute the residual risk of P and Q and explain the differences.

Part d.
Grinold and Kahn give in Chapter 14 both simple and advanced techniques for portfolio-construction. Explain the stratified technique and explain the quadratic optimization technique. Based on the alpha-potential and the relative risk aversion you have decided that the target tracking error (relative risk) should be not higher than 0.03 (=3%). Indicate how you can achieve that in the stratified technique and in the quadratic optimization technique.

Part e.
You are a start-up active manager and you have to decide on an appropriate active strategy. Describe at least three different strategies in terms of alpha-source and indicate per strategy whether you would manage the relative risk or the absolute risk and why.

START THE LAST TWO QUESTIONS ON A NEW ANSWER SHEET SUCH THAT THE ANSWER SHEETS CAN BE SPLIT BETWEEN PROF. FRIJNS AND PROF. LUCAS FOR FASTER MARKING.

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QUESTION 3

Assume the following returns,

$$\begin{pmatrix} r_1 \\ r_2 \\ r^L \end{pmatrix} \sim N\left(\begin{pmatrix} 8\% \\ 6\% \\ 2\% \end{pmatrix}, \begin{pmatrix} 9.33\% & -8.99\% & 0.17\% \\ -8.99\% & 8.69\% & -0.15\% \\ 0.17\% & -0.15\% & 0.01\% \end{pmatrix} \right)$$

where r^L is the liability return, r_1 and r_2 are the returns on asset 1 and 2 respectively. A well-funded pension fund has an assets to liability ratio (A/L) equal to 2.

Part a.
Compute the correlation between the liabilities and a portfolio consisting of 50% asset 1 and 50% asset 2 and show it is 100%.

Part b.
Construct the optimal asset allocation in asset 1 and 2 for this pension fund if it maximizes the expected surplus return minus 0.1 times the surplus variance.

Part c.
If the pension fund wishes to minimize its surplus volatility (irrespective of the value of the expected surplus return), and if there was also a riskfree asset around (earning 3%), what would be the optimal portfolio for this pension fund. Explain your answer and provide intuition.

You hold a portfolio of 40% in asset 1, and 60% in asset 2. The size of your portfolio is €1 million.

Part d.
Compute the 95% confidence level VaR of this portfolio.
(you can use the fact that the 5% quantile of a standard normal distribution is approximately -1.645.)

You hold a position in a one-year long call and a long put on an underlying security S. Your portfolio is currently worth €8. The strike of both the put and the call are equal to €100, and each put and call entitles you to sell/buy one unit of the underlying security. Assume that S (when the options expire) can only take one of the values
S=50,51,52,…,99,101,102,…,150 (note 100 is missing)
all with equal probability of 1/100.

Part e.
With a 90% confidence, what is the maximum one-year loss (or VaR) on your portfolio of options?

QUESTION 4

Assume a broadly diversified stock index return R that satisfies the following forecasting relationship:

$$R_{t+1} = a + b\,(E/P)_t + e_t, \qquad e_t \sim N(0,\sigma^2),$$

where a and b are coefficients, and (E/P) is the earnings-to-price ratio [in deviation from its expected value]. Dividends are approximately constant through time. You observe returns monthly. The risk free asset has a return of 0.5% per month. You have observed T=60 monthly returns.

Part a.

What is the one-month optimal portfolio if you optimize expected return (over period T+1) minus 5 times the return variance?

You have estimated the parameters (a,b) using ordinary least squares regression. As a result, you obtain the distribution of (a,b) conditional on the sample observations,

$$\begin{pmatrix} a \\ b \end{pmatrix} \Big| R_1, \ldots, R_T \sim N\left(\begin{pmatrix} a \\ b \end{pmatrix}, \frac{\sigma^2}{T} \begin{pmatrix} 1 & 0 \\ 0 & 1/s^2 \end{pmatrix} \right)$$

with T=60 denoting the number of observations, s^2 denoting the variance of the earnings-to-price ratio, and $\hat{a}$ and $\hat{b}$ denoting the least-squares estimates of the parameters.

Part b.

Derive the optimal allocation to the stock index using the same preferences as in part (a), but accounting for parameter uncertainty.

Part c.

If the your forecast of the E/P ratio over the coming period (T+1) increases, discuss in what way the effect of this increase may be different if we do or do not account for parameter uncertainty. Provide an explanation for the difference.

Assume the forecasting model above still holds, but you are no longer a mean-variance optimizer. Instead, you maximize expected utility. You have a power utility over final wealth, $U(W_T) = (1-\gamma)^{-1}(W_T)^{1-\gamma}$, with $\gamma>0$ being the risk aversion coefficient.

Part d.

Give and explain (give the reason why!) the differences in the size of your allocation to the risky security if you have a one-month, or a one-year horizon, and if you do or do not account for uncertainty in the parameters (4 cases).

Assume that instead of the power utility over final wealth, you maximize expected final wealth subject to a constraint that the VaR of final wealth should not exceed 10% of initial wealth. This is a stylized representation of the new regulatory framework for Dutch pension funds.

Part e.

Discuss how this change in preferences will affect your results and why?