Stockholm University
Department of Economics

Course name:	Financial Economics
Course code:	EC2206
Type of exam:	Retake exam
Examiner:	Roine Vestman
Number of credits:	7.5
Date of exam:	2019-12-03
Examination time:	4 hours (9:00-13:00)
Aids:	Pocket calculator (not programmable)

Write your identification number on each answer sheet (the number stated in the upper right hand corner on your exam cover).

Start each new question on a new answer sheet.

Explain notions/concepts and symbols. If you think that a question is vaguely formulated, specify the conditions used for solving it. Only legible exams will be marked.

There are 100 points in total, including the credit question. The credit question is meant for students who did not hand in the problem set and for students who received less than 10 points and wish to improve. For students who handed in the problem set, the credit question only counts if it improves the total score. For the grade E a total of 45 points are required, for D 50 points, C 60 points, B 75 points and A 85 points.

Your results will be made available on your Ladok account (www.student.ladok.se) within 15 working days from the date of the examination.

Good luck!

Exam December 3, 2019 (Financial Economics, EC2206)

See formula sheet at the back. A pocket calculator is allowed as long as it is not connected to the internet or is programmable. Upon request, the memory of the calculator should be erased.

Question 1: Smaller questions (25 points)

These questions (a. to e.) can be answered independently.

a. Suppose that you have returns at monthly frequency on a portfolio and compute the portfolio's Sharpe ratio to 0.100 when using these returns. Assume that monthly returns are identically and independently distributed (i.i.d.). Compute the Sharpe ratio at quarterly frequency. (5 points)

b. We watched a discussion between Eugene Fama and Richard Thaler. Fama mentions that one particular risk factor (among Small-Minus-Big, High-Minus-Low, and Momentum) is particularly hard to reconcile with market efficiency. Which factor and why? (5 points)

c. In empirical sciences it is common to test a null hypothesis such as $H_0 : \alpha = 0$ where α can be, among other things, the effect of some medical treatment or the effect of some action.

   i. In this kind of hypothesis testing, what does a "false positive result" mean? (2 points)

   ii. Suppose that a researcher tests the null hypothesis multiple times, that is, $H_0 : \alpha_1 = 0$, $H_0 : \alpha_2 = 0$,...,$H_0 : \alpha_N = 0$. How does this affect the likelihood of obtaining a false positive result? You may find it helpful to draw analogies to the "lucky event issue" or to other empirical sciences. (2 points)

   iii. What kind of bearing does the insight from part (ii.) have on evaluations of actively managed mutual funds? (1 points)

d. Suppose that you have found an optimal portfolio P of risky assets which will have a stochastic return r_p. It has an expected return denoted by $E[r_p]$ and a volatility denoted by σ_p. You form your complete portfolio C by deciding on the portfolio weight y invested into P and the weight $1 - y$ invested into the risk-free asset which has a deterministic return r_f.

   i. Write down an expression for the return on the complete portfolio, r_c. (1 point)

   ii. Suppose you have preferences given by $U(y) = E[r_c] - \frac{1}{2}A\sigma_c^2$ where A is a parameter that determines risk aversion, $E[r_c]$ is the expected return on the complete portfolio and σ_c^2 is the variance of the complete portfolio. Solve for the optimal weight in P as a function of $E[r_p]$, r_f,A, and σ_p. (4 points)

e. Describe the advantages and disadvantages of optimizing a risky portfolio using the single-index model instead of the Markowitz model. Please list the required estimates in each model, and how many they are, provided that there are N securities. (5 points)

Question 2: Bond pricing (25 points)

Consider a 3-period bond with the following characteristics. The bond was issued at $t = 0$ with face value $FV = 100$ in $t = 3$. In periods $t = 1$, $t = 2$, and $t = 3$ coupons of 5 are paid out ($c = 5$). We are in $t = 0$ and no coupon has been paid. The price of the bond is $P_0 = 102.775$.

a. What is the yield to maturity on the bond? Consider the following answers: 3%, 4%, and 5%. (10 points)

b. We are now in t=1. Suppose that all market interest rates increased by 1 percentage points.

   i. What is the price of the bond now (i.e., P_1)? (5 points)

   ii. What is the holding period return between $t = 0$ and $t = 1$? (5 points)

   iii. Consider a 2-period bond with the same characteristics that also was issued at $t = 0$. Would the holding period return between $t = 0$ and $t = 1$ have been greater or smaller than in (ii.)? Please provide motivating calculations. (5 points)

Question 3: The single-index model (18 points)

You are evaluating an equity index fund and get the following information from the fund prospectus:

Weight in market portfolio	0.98
Weight in cash	0.02
Management fee	F% per year

Your task is to show that we can expect that the fund has a market beta (β_i) of 0.95 and a risk-adjusted return (α_i) of $-F$%.

a. Write down an expression for the index fund's gross realized returns,
$r_i = A_1 \cdot r_f + A_2 \cdot r_M - A_3 \cdot F + A_4 \cdot \varepsilon_i$, where you need to determine A_1, A_2, A_3, and A_4. (5 points)
Hint 1: Assume that cash earns the return of the risk-free rate (r_f).
Hint 2: Assume that the fund's tracking error is neglictible. To be precise,
$std(r_i - 0.98 \cdot r_M) = 0$.

b. Subtract the risk-free rate (r_f) to obtain an expression for the index fund's excess realized returns, $R_i = r_i - r_f = ...$ (3 points)

c. Compute the fund's market beta (β_i) by proceeding in two steps:

i. Compute the fund's covariance with the market portfolio, $cov(R_i, R_M)$. (2 points)

ii. Use the formula for the slope coefficient in a bivariate regression: $\beta_i = \frac{cov(R_i,R_M)}{var(R_M)}$. (2 points)

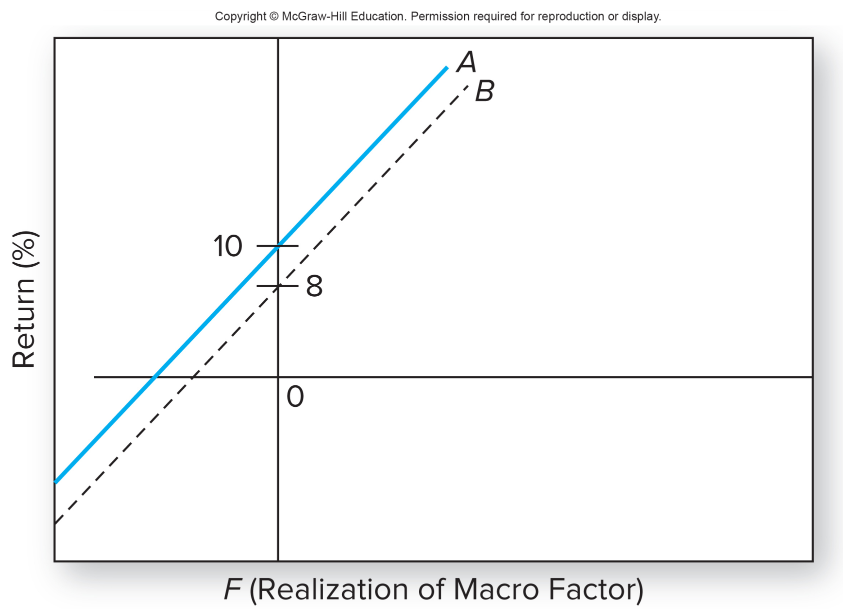
d. Compute the fund's alpha (α_i) by proceeding in two steps:

i. Express the fund's expected excess return, $E[R_i]$, as function of the fee and the expected market excess return. (2 points)

ii. To solve for the fund's alpha, use the formula for the intercept coefficient in a bivariate regression: $\alpha_i = E[R_i] - \beta_i E[R_M]$. (2 points)

e. Draw a graph with the expected return-beta relationship and position the index fund relative to the axes and to the security market line (SML). (2 points)

Question 4: Arbitrage pricing theory (7 points)



a. Assume that arbitrage pricing theory works. The figure above is taken from Bodie et al., chapter 10. Describe a portfolio consisting of A and B such that an arbitrage is earned. (4 points)

b. Describe the Fama-French 3-factor model, including its factor structure (and the positions in each factor) and its pricing equation. (3 points)

Question 5: Financial Crises (15 points)

This is an essay question. Nevertheless, please be brief and to the point. **Your total answer should not exceed 2 pages.**

a. Describe how traditional securitization of mortgage backed securities worked in, say, the 1990s. (Who were the main players? What kind of mortgages were securitized? Illustrate with a value chain.) Then contrast to how securitization evolved in the early 2000s in the boom phase of the financial crisis. Describe the main differences and the appearing moral hazards. (5 points)

b. Why are central banks the natural lender of last resort? Under which three conditions can it lend to a financial entity? (5 points)

c. In chapter 20 of Mankiw's text book, six common features of a financial crisis are listed. Describe these features very briefly without necessarily making references to any specific crisis. (5 points)

Question 6: Questions for credit score (10 points)

Credit question. These questions should only be answered by students who either did not hand in the problem set or by students who received a score below 10 on the problem set and wish to try to improve. In the latter case, the best of the two scores will be counted.

a. Bond pricing. A stream of pay-outs c in the next T periods is called an annuity. Derive the following expression for its value: $\frac{c}{r}\left[1 - \frac{1}{(1+r)^T}\right]$ where r is the market interest rate. For a full score (5 points), start by deriving the value of a perpetuity. For a partial score (2 points), take the value of a perpetuity as a given from the formula sheet. (5 points)

b. Consider two random variables, x and y. Show that $var(x+y) =$ $var(x) + var(y) + 2 \cdot cov(x,y)$, starting from the definition of variance in the formula sheet. (5 points)

Formula sheet – Financial Economics (EC2206)

- The variance of a random variable x: $var(x) = E[(x - E[x])^2]$
- The covariance of two random variables x and y: $cov(x, y) = E[(x - E[x])(y - E[y])]$
- The variance of the sum of two random variables: $var(x + y) = var(x) + var(y) + 2 \cdot cov(x, y)$
- Covariances are additive: cov(x,z)+cov(y,z)=cov(x+y,z)
- The Sharpe ratio of a security: $\frac{E[r - r_f]}{std(r)}$
- For two risky assets with excess returns R_E and R_D, the optimal risky portfolio P is given by:

$$\begin{aligned} w_D &= \frac{E[R_D]\sigma_E^2 - E[R_E]cov(R_D, R_E)}{E[R_D]\sigma_E^2 + E[R_E]\sigma_D^2 - [E[R_D] + E[R_E]]cov(R_D, R_E)} \\ w_E &= 1 - w_D \end{aligned}$$

- The single-index model and the information ratio:
  - If $\beta_A = 1$ the weight in the active portfolio equals $w_A^0 = \frac{\alpha_A/\sigma_{e,A}^2}{E[R_M]/\sigma_M^2}$.
  - Otherwise $w_A^* = \frac{w_A^0}{1+(1-\beta_A)w_A^0}$.
  - The weight of each security in the active portfolio is $\frac{\alpha_i/\sigma_{e_i}^2}{\Sigma\alpha_i/\sigma_{e_i}^2}$.
  - The Sharpe ratio of the risky portfolio equals: $S_P = \sqrt{S_M^2 + [\frac{\alpha_A}{\sigma e,A}]^2}$.
- The equation $x^2 + px + q = 0$ has solutions $x = -\frac{p}{2} \pm \sqrt{(\frac{p}{2})^2 - q}$
- Bond pricing:
  - Given a market rate r, the value of a perpetuity that pays a coupon c forever is: $\frac{c}{r}$
  - The value of an annuity with coupons c and duration T is: $\frac{c}{r}\left[1 - \frac{1}{(1+r)^T}\right]$